Brain drain and development: an overview

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1. INTRODUCTION

Introduction

- Brain drain = international mobility of people with higher (tertiary) education – an elite in developing countries (about 5% of the workforce)
- Numbers: by 2000 there were 180 million migrants worldwide, half of them residing in OECD countries. Of these 90 million migrants, 60 million were aged 25 or more and can be split across education levels (primary, secondary, tertiary).
- Skilled migrants in OECD countries come from Africa (7%), Asia (35%), Latin America (18%), Eastern Europe (8%) and from other OECD countries (32%).

Introduction

The stock of skilled immigrants in the OECD increased by 70 percent over the 1990s

What are the causes of this increased brain drain?

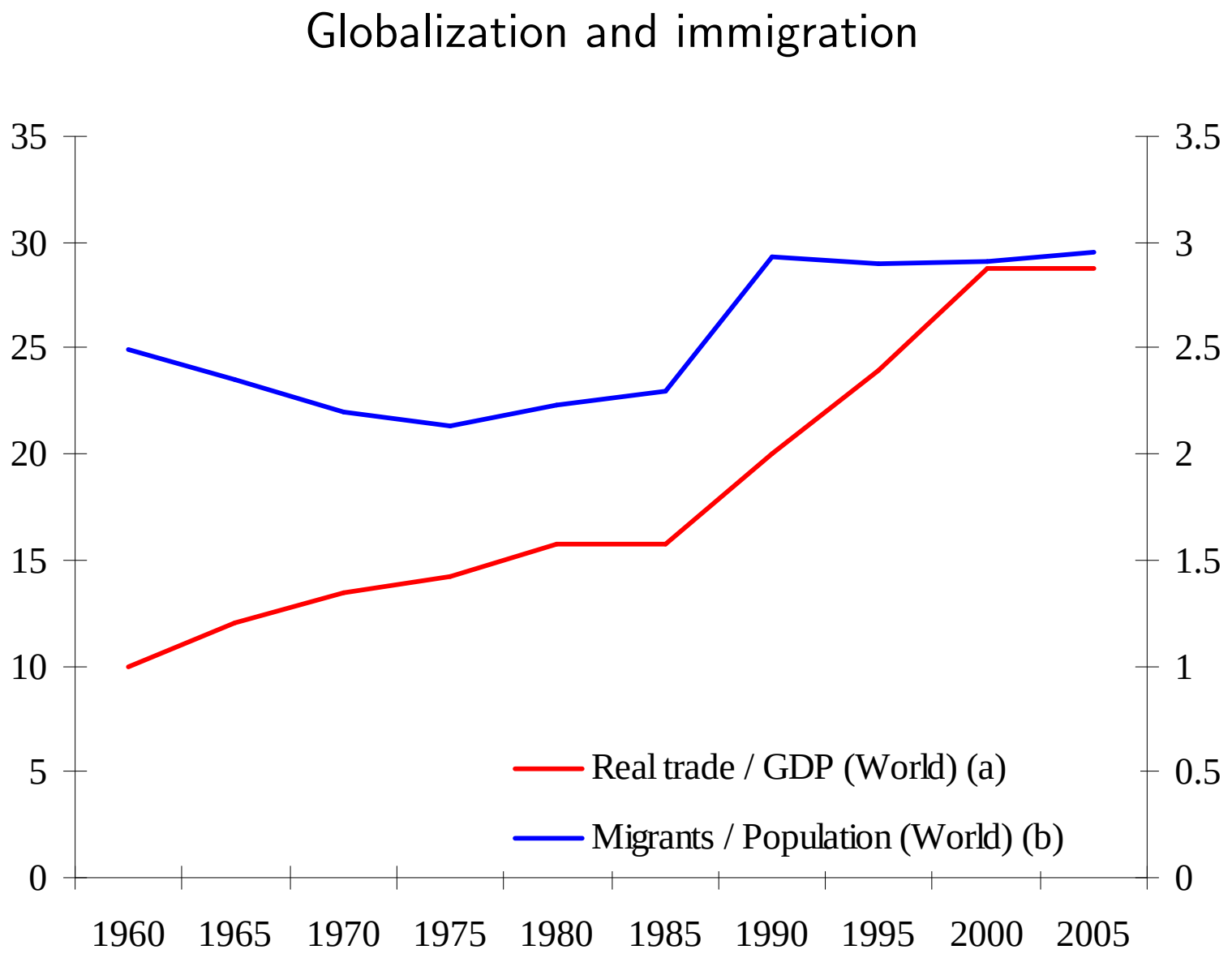
- General rise in educational attainments in developing countries
- Globalization tends to increase positive self-selection (skilled people agglomerate where human capital is already abundant, rising skill premium in some countries – especially the US); however migration networks are a counter-acting force
- Selective immigration policies since the 1980s: point-systems in Australia, Canada and now in the UK, H1-B Visas in the US, German Green Card, European Blue Card, French "immigration choisie".

Introduction

Did globalization really matter?

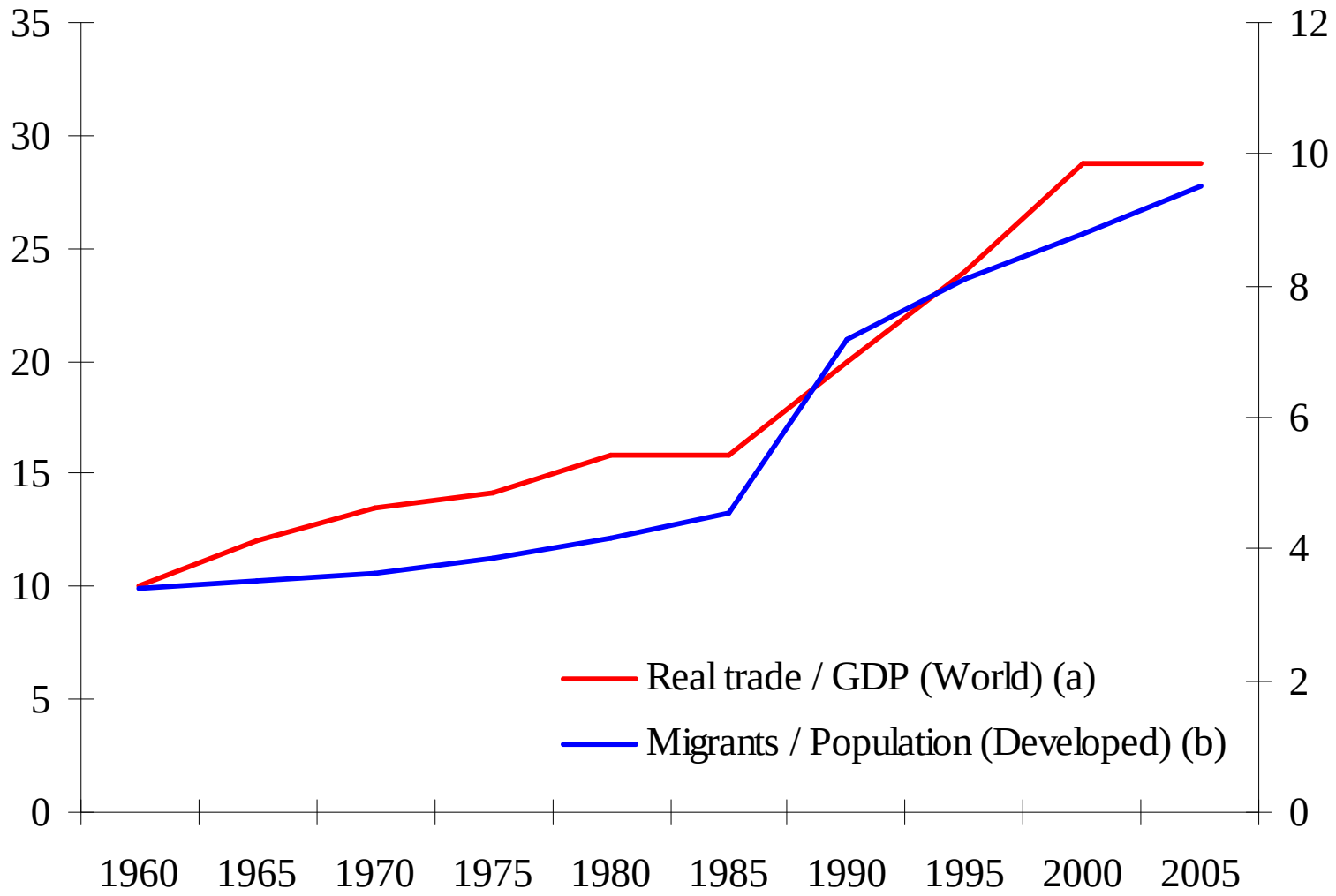
- World trade/GDP: from 10 to 30 percent between 1960 and 2000
- World migration: from 2.5 to 2.9 percent of the population (UN data)
- Migration to developed countries: tripled since 1960 ; doubled since 1985 (UN data)

Introduction



Introduction

Globalization and immigration in the more developed countries



Introduction

- South-North migration is a component of the globalization process
- Over the 1990s: +70% of skilled immigrants against +13% of unskilled immigrants in the OECD area. South-North skilled migration is a much more important component.
- Given the rise in educational attainments in developing countries (induces a mechanical rise even if migration propensities are constant across education levels), brain drain rates were relatively stable
- Nevertheless, brain drain rates remain very high for some developing countries

Should we (they) worry?

Introduction

Since the 1970s, the answer has long been "YES": the welfare loss for source countries goes well beyond the marginal product of the migrant due to fiscal, technological and Lucas-type externalities (= **traditional view**).

Illustration: *"The irony of international migration today is that many of the people who migrate legally from poor to richer lands are the very ones that Third World countries can least afford to lose: the highly educated and skilled. Since the great majority of these migrants move on a permanent basis, this perverse brain drain not only represents a loss of valuable human resources but could prove to be a serious constraint on the future economic progress of Third World nations"* (Todaro, 1996: 119).

Introduction

Recent, more optimistic view:

- New theoretical arguments: remittances; migration prospects raise the expected return to education and thus foster investment in education; skilled migration induces many positive externalities.
- New data: Docquier and Marfouk (World Bank, 2005), Beine, Docquier and Rapoport (WBER, 2007), Dumont and Lemaître (OECD WP), Defoort (Population, 2008): first comparative data sets on emigration rates by education levels
- New evidence: the first cross-country studies found evidence of positive effects for some channels (FDI, technology adoption, human capital formation).
- Important to assess how positive and negative effects balance out
- The brain drain impact is likely to be ambiguous (winners and losers).

Structure of the talk

1. Introduction
2. **How big is the brain drain?**
3. The traditional view
4. Brain drain and human capital formation
5. Other feedback effects
6. Conclusions and policy insights

How big is the brain drain?

Source: Docquier, Lowell and Marfouk (World Bank, 2005): use immigration data from all OECD countries to compute emigration rates by education level for 195 countries in 1990 and 2000.

Results for selected countries in 2000:

- Main exporters of brains: UK (1.441 million), Philippines (1.126), India (1.037), Mexico (0.923), Germany (0.848), China (0.816).
- Skilled emigration rates: 80% in Caribbean and Central American countries such as Guyana, Jamaica or Haiti, and 50% in many African countries.
- Lowest skilled emigration rates: Turkmenistan (0.2%), Tadjikistan (0.4%), Saudi Arabia (0.5%), Bhutan (0.6%) and... the United States (0.5%).

How big is the brain drain?

Determinants of the BD:

- Country geographical and historical characteristics.
- Population sizes. Emigration rates decrease with country size, are 7 times higher in small states countries.
- Income levels. Middle-income countries have the highest total rates, but the selection is highest in poor countries.
- Socio-political environment (political stability, ethnic diversity)

How big is the brain drain?

Correction for age of entry (Beine, Docquier and Rapoport, WBER 2007)

- Used data on immigrants' age of entry (as a proxy for where education was acquired) for 75% of skilled migrants and estimated the age of entry structure of the remaining 25% using a gravity model.
- Their results show that controlling for age of entry has a strong incidence for certain countries, mainly in Central America.
- However, the rankings based on corrected rates are roughly similar to the previous ones – suggesting cross-country comparisons results are robust to the use of corrected data.
- Examples (+0/+22): Haïti 84/74, Ghana 47/42, Cuba 29/17, Afghanistan 23/11, Mexico 15/10, Poland 13/12

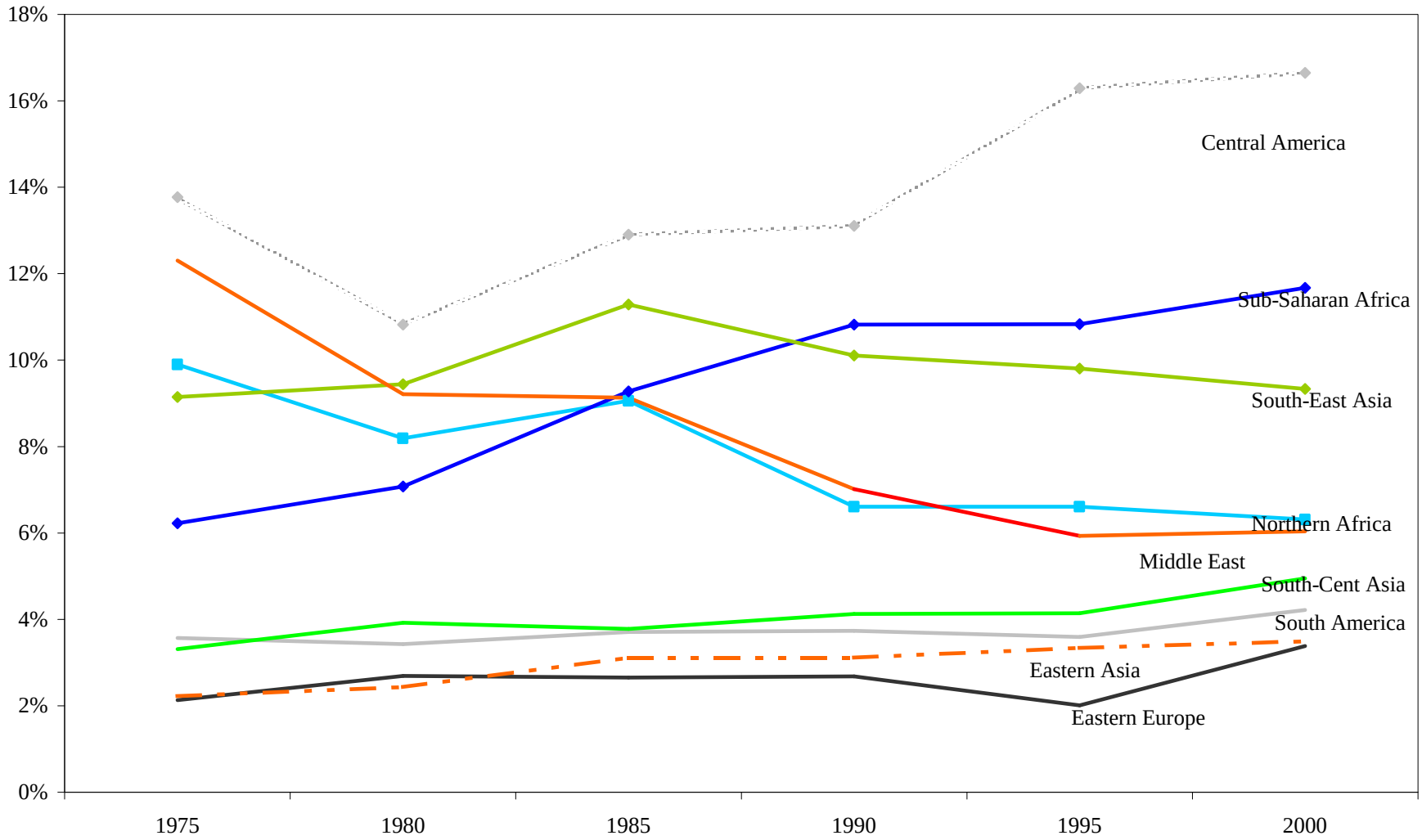
How big is the brain drain?

Panel data (Defoort, Population 2008).

- Skilled emigration rates slightly increased (resp. decreased) in the 1990s at the world level (resp. in developing countries). Is it true on a longer time-horizon?
- Panel data based on the six main immigration countries, 1975-2000 (one observation every five years).
- Global stability in brain drain intensities as the rise in educational attainments has pushed selection biases downwards.
- Increases in Central America, Eastern Europe, Sub-Saharan Africa, and decreases in the Caribbean and North Africa.
- Increases in countries such as Brazil, India, Mexico, or South Africa.

How big is the brain drain?

Long-run trends in skilled emigration, 1975–2000



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Traditional view

Construction of a stylized model to formalize the mechanisms at work:

- Production function
- Productivity growth
- Human capital investments

Traditional view

Theoretical framework - **Production**

- GDP: $Y_t = A_t K_t^{\alpha} H_t^{1-\alpha}$; GDP per worker: $y_t = A_t k_t^{\alpha} h_t^{1-\alpha}$

Traditional view

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- International mobility of capital with risk premium $(\Psi_t - 1)$:

$$R_t^* \Psi_t = \alpha A_t k_t^{\alpha-1} h_t^{1-\alpha}$$

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- GDP per capita as percent of the leading economy:

$$\frac{\overline{y}_t}{\overline{y}_t^*} = \left[\frac{A_t}{A_t^*}\right]^{1/(1-\alpha)} \times \left[\frac{\Psi_t}{\Psi_t^*}\right]^{-\alpha/(1-\alpha)} \times \left[\frac{h_t}{h_t^*}\right] \times \left[\frac{d_t}{d_t^*}\right]^{-1}$$

Traditional view

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- Adoption $g_t = g(h_t, X_t^{g})$ with $g_1^{'} \succ 0$ and $g_{11}^{''} \leqslant 0$

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- In the leading economy: $A_{t+1}^* = A_t^*.(1+\gamma_t^*)$
- Distance to the frontier: $a_{t+1} \equiv \frac{A_{t+1}}{A_{t+1}^*} = \frac{g_t}{1+\gamma_t^*} + \frac{1+\gamma_t-g_t}{1+\gamma_t^*}.a_t$

Traditional view

Theoretical framework - Long-run distance to the frontier

- Long-run TFP gap:

$$\lim_{t\to\infty} a_t = a_{ss} = \frac{g(h_{ss}, X_{ss}^{g})}{\gamma(h_{ss}^{*}, X_{ss}^{\gamma *}) - \gamma(h_{ss}, X_{ss}^{\gamma}) + g(h_{sst}, X_{ss}^{g})} = \phi(h_{ss}, h_{ss}^{*}, X)$$

Traditional view

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- Long-run ratio of GDP per capita and wages (per eff unit)

$$\frac{\overline{y}_{ss}}{\overline{y}^*_{ss}} = [\phi(h_{ss}, h^*_{ss}, X)]^{1/(1-\alpha)} \times \left[\frac{\Psi_{ss}}{\Psi^*_{ss}}\right]^{-\alpha/(1-\alpha)} \times \left[\frac{h_{ss}}{h^*_{ss}}\right] \times \left[\frac{d_{ss}}{d^*_{ss}}\right]^{-1}$$

$$\frac{w_{ss}}{w^*_{ss}} = [\phi(h_{ss}, h^*_{ss}, X)]^{1/(1-\alpha)} \times \left[\frac{\Psi_{ss}}{\Psi^*_{ss}}\right]^{-\alpha/(1-\alpha)}$$

Traditional view

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- Utility depends on education choice (E_t) and saving (s_{t+1}):

$$\begin{aligned} U(E_t, s_{t+1}) &= \ln\left[w_t - \widehat{\mu}_t - E_t(1-\sigma)cw_t\right] \\ &\quad +(1-\lambda)\ln\left[w_{t+1}(1+E_t\theta) - s_{t+1}\right] \\ &\quad +\lambda \ln\left[s_{t+1}R^*_{t+2}\right] \end{aligned}$$

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- Maximizing $U(E_t, s_{t+1})$ with respect to s_{t+1} gives

$$\begin{aligned} V(E_t) &= \ln\left[w_t - \widehat{\mu}_t - E_t(1-\sigma)cw_t\right] \\ &\quad +\ln\left[w_{t+1}(1+E_t\theta)\right] + \lambda \ln\left[R^*_{t+2}\right] + F \end{aligned}$$

Traditional view

- Education if $V(1) \succ V(0)$, i.e.

$$c \prec \frac{1}{1-\sigma} \times \frac{w_t - \widehat{\mu}_t}{w_t} \times \frac{\theta}{1+\theta} \equiv \widehat{c}_t$$

- **Without migration**, the proportion educated adults would be equal to $\pi_t = \widehat{c}_{t-1}$
- If each adult has m children, we would have $d_t = 1 + \frac{1}{m(1+m)}$
- The average level of human capital would be given

$$h_t = 1 + \frac{\pi_t \theta}{1+m}$$

Traditional view

Writing $\widehat{\mu}_t = \mu w_t^*$, our predictions are:

$$\begin{aligned}
\frac{w_{ss}}{w_{ss}^*} &= \left[\phi(h_{ss}, h_{ss}^*, X)\right]^{1/(1-\alpha)} \times \left[\frac{\Psi_{ss}}{\Psi_{ss}^*}\right]^{-\alpha/(1-\alpha)} \\
h_{ss} &= 1 + \frac{\theta}{1+m} \times \frac{1}{1-\sigma} \times \left[1 - \mu \frac{w_{ss}^*}{w_{ss}}\right] \times \frac{\theta}{1+\theta}
\end{aligned}$$

- Model compatible with multiple equilibria (i.e., poverty traps with low levels of human capital and large distance to the frontier, and a high-income equilibrium with high levels of human capital and low distance to the frontier) or slow convergence for poor countries
- It also allows for domestic and foreign policies (education subsidies, R&D policies, quality of governance) to affect steady-state outcomes.

Traditional view

The "pessimistic" models of the 1970s were based on a number of critical assumptions (Bhagwati and Hamada 1974, 1975, McCullock and Yellen 1975, 1977, generalized by Miyagiwa, 1991, Haque and Kim, 1995). The two main ones are:

- Human capital ex-ante is exogenous
- Complete disconnection after emigration.

In such conditions, skilled emigration can only have a negative impact on human capital accumulation at home.

Traditional view

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- Assuming that emigration does not modify education choices ($\widehat{c}_{ss}$ is exogenous), we have:

$$\begin{aligned} \pi_{ss} &= \frac{(1-p)\widehat{c}_{ss}}{1-p\widehat{c}_{ss}} \Rightarrow \frac{\partial \pi_{ss}}{\partial p} = \frac{-(1-\widehat{c}_{ss})\widehat{c}_{ss}}{(1-p\widehat{c}_{ss})^2} \prec 0 \\ d_{ss} &= 1 + \frac{1}{m(1+m)(1-p\widehat{c}_{ss})} \Rightarrow \frac{\partial d_{ss}}{\partial p} \succ 0 \end{aligned}$$

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- Indirect effect - a_{ss} decreases: less adoption (and eventually less innovation). The technological ratio $\phi(h_{ss}, h^*_{ss}, X)$ and thus wages decrease (higher distance to the frontier)
- Demographic impact - d_{ss} increases as skilled workers are working-aged agents.

Traditional view

Other pernicious mechanisms:

a) Complementarities skilled-unskilled
b) Fiscal cost of the brain drain: less tax-payers (lower σ or w_{ss})
c) Bhagwati and Hamada (1974): more unemployment

- Higher integration of the skilled labor market
- Elites bargain for higher wages ("our Joneses keeping up with their Joneses") and educate more
- Unskilled workers adjust their wage requirements ("our Joneses keeping up with our Joneses")
- Higher public education subsidies and taxes; higher wages and unemployment.

Traditional view

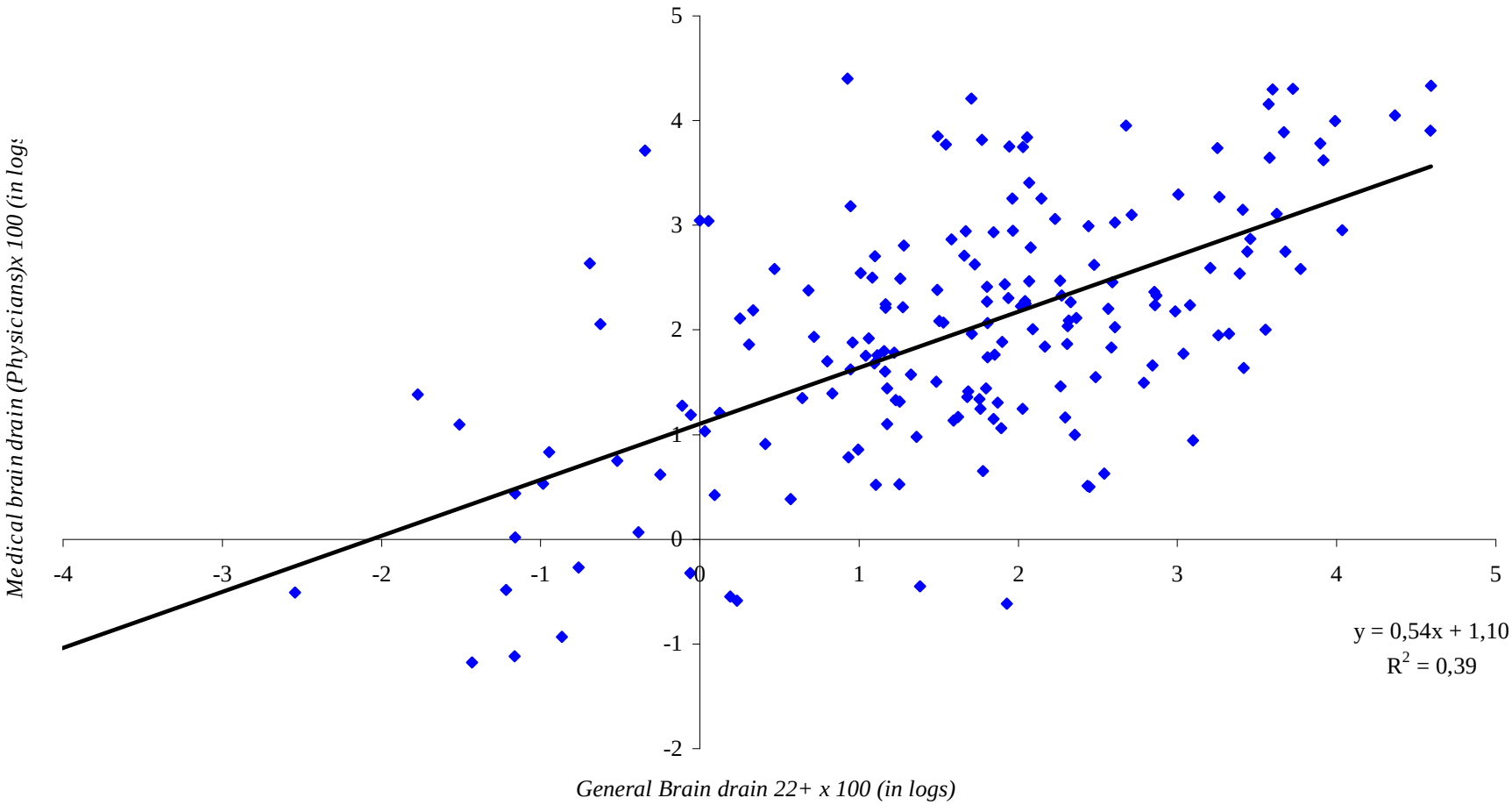
Other pernicious mechanisms:

d) Specific shortages harmful for developing countries: "O-ring theory"

- Example of medical brain drain, potentially very harmful for developing countries (rate of emigration of physicians by country of training)
- Governments have fewer incentives to provide internationally applicable education (Poutvaara, 2004)
- Ex ante, too few engineers, economists and nurses and doctors, and too many lawyers.

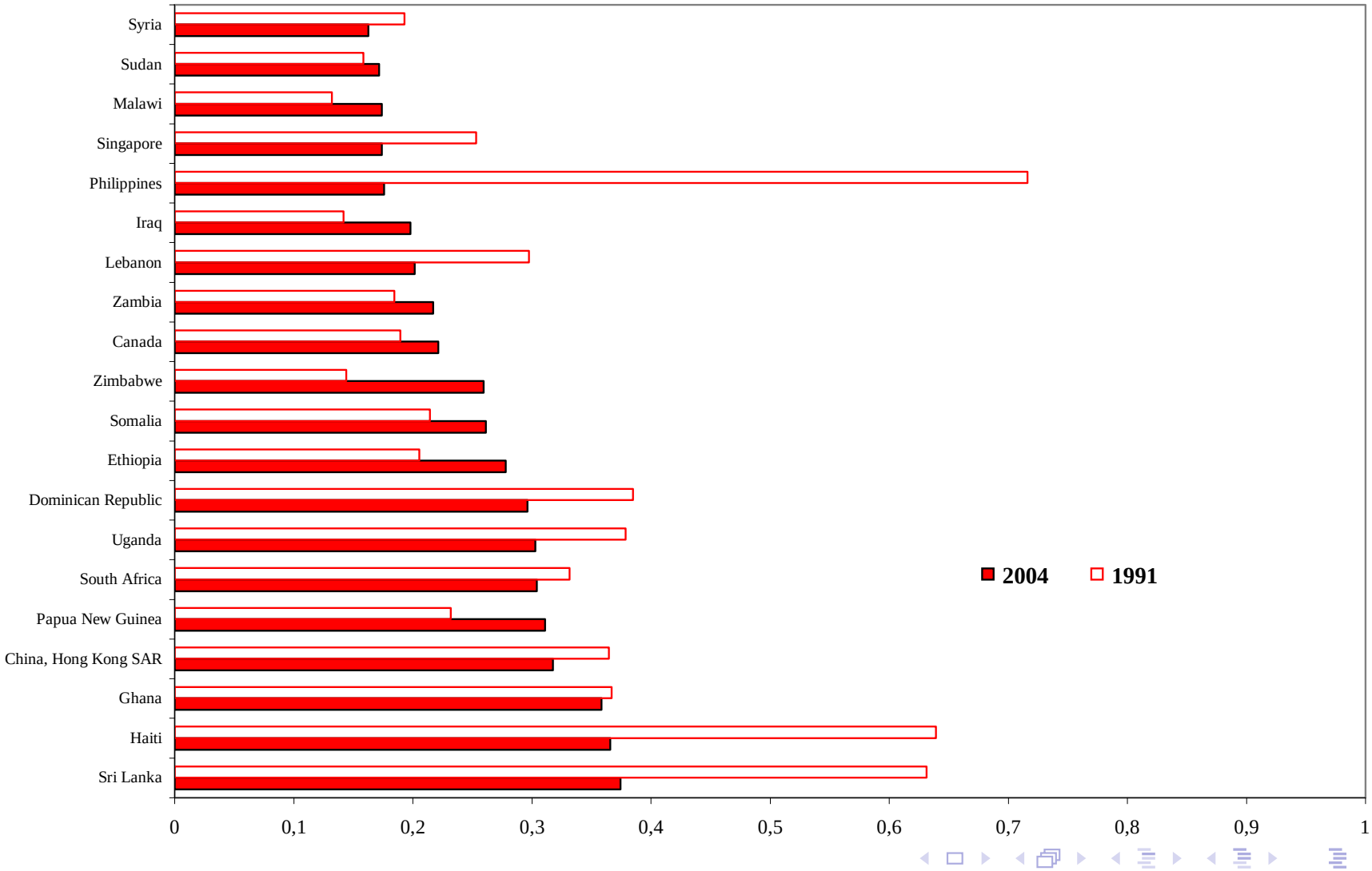
Traditional view

Medical and general brain drain rates (2000)



Traditional view

Most affected countries (1991-2004)



Traditional view

Waving the two main assumptions of the traditional view allows for potentially beneficial effects to kick-in:

- The education decision is endogenous and can be affected by future migration possibilities
- Skilled migrants are not totally disconnected:
  - They may return after a while
  - They may send remittances
  - They may take part in business and other types of networks that indirectly benefit the source country.

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Brain drain and human capital

- Does the brain drain reduce human capital accumulation?
- Starting point: migration is in essence probabilistic (with internal and external sources of uncertainty): education may be a necessary but not sufficient condition to immigration.
- Migration prospects raise the expected return to education and may thus foster domestic gross (pre-migration) human capital formation.
- If this incentive effect is strong enough to dominate the brain drain, then there can be a net brain gain for the source country (Mountford, 1997, Stark et al., 1998, Vidal, 1998, Beine et al., 2001).
- This mechanism can be introduced in our framework

Brain drain and human capital

- Skilled migrate with probability p; unskilled do not migrate
- The quasi-indirect utility function must now be changed to incorporate skilled migration prospects ; V(1) becomes

$$\begin{aligned} V(1) &= \ln\left[w_t - \widehat{\mu}_t - (1-\sigma)cw_t\right] + p\ln\left[w^*_{t+1}(1+\theta)\right] \\ &\quad + (1-p)\ln\left[w_{t+1}(1+\theta)\right] + \lambda\ln\left[R^*_{t+2}\right] + F \end{aligned}$$

- Education if $V(1) \succ V(0)$, i.e.

$$c \prec \widehat{c}_t = \frac{1}{1-\sigma} \times \left[1 - \mu\frac{w^*_t}{w_t}\right] \times \frac{(1+\theta)\left(\frac{w^*_{t+1}}{w_{t+1}}\right)^p - 1}{(1+\theta)\left(\frac{w^*_{t+1}}{w_{t+1}}\right)^p}$$

Brain drain and human capital

- As $\left(\frac{w^*_{t+1}}{w_{t+1}}\right) \succ 1$, the ex-ante proportion of educated among natives increases in p, i.e. $\widehat{c}_t$ is endogenous
- At the steady state we have

$$\frac{\partial \pi_{ss}}{\partial p} = \frac{\partial \pi_{ss}}{\partial \widehat{c}_{ss}} \frac{\partial \widehat{c}_{ss}}{\partial p} + \frac{\partial \pi_{ss}}{\partial p} = \frac{(1-p)\frac{\partial \widehat{c}_{ss}}{\partial p} - (1-\widehat{c}_{ss})\widehat{c}_{ss}}{(1-p\widehat{c}_{ss})^2}$$

- A possibility of beneficial brain drain can be obtained if the numerator of this derivative is positive. Obviously, when p is close to one, this can never be the case. However, a necessary condition for a brain gain to be possible is that this derivative must be positive for $p = 0$. This requires:

$$\ln\left(\frac{w^*_{ss}}{w_{ss}}\right) \succ \theta\left[1 - \frac{1}{1-\sigma} \times \left(1 - \mu\frac{w^*_{ss}}{w_{ss}}\right) \times \frac{\theta}{1+\theta}\right]$$

Brain drain and human capital

Micro-level evidence:

- Kangasniemi et al. (SSM, 2007): 30% of Indian MDs in the UK say emigration prospects affected their education decisions, respondents say 40% current medical students in India contemplate emigration.
- Lucas (2004), Philippines: "It is difficult to believe that these high, privately financed enrolment rates are not induced by the possibility of emigration. There are signs that the choice of major field of study ... responds to shifts in international demands. Higher education is almost certainly induced to a significant extent by the potential for emigration".
- Clemens (2005): dramatic rise in enrollment in nursing schools in South Africa following recent UK recognition of foreign education for nurses.
- Batista et al. (2007) for Cape Verde. Gibson, McKenzie & Stillman (2008) for Tonga.

Brain drain and human capital

Macro-level evidence (Beine, Docquier and Rapoport, EJ2008)

- Cross-section of 127 developing countries, using Docquier and Marfouk (2005).
- First step: testing for the brain gain hypothesis (i.e., the gross, or ex-ante effect).
- We run a regression of the type

$$\Delta ln(Ha, 90-00) = a0 + a1.ln(Ha, 90) + a2.ln(ps90) + ... + \varepsilon$$

- We find a positive effect of migration on gross (pre-migration) human capital formation, with an elasticity of about 5% (very stable across specifications and methods – OLS and IV).
- Ongoing work shows findings are robust to the use of other brain drain and HC measures, and to alternative functional forms

Brain drain and human capital

Second step: net effect (beneficial/detrimental BD)

- What is important is not "how many invest in education?" but "how many remain in the home country?"
- To compute net effects for each country, we do the following simulation exercise:

$$Hcf2000 = Ha2000 - a2.ln(ps90/pu90),$$

where $Hcf2000$ is the counterfactual ex-post HC stock of the country in 2000, $Ha2000$ is the observed ex-ante HC stock (all natives), and $ps90/pu90$ is the ratio of skilled to unskilled migration propensities in 1990.

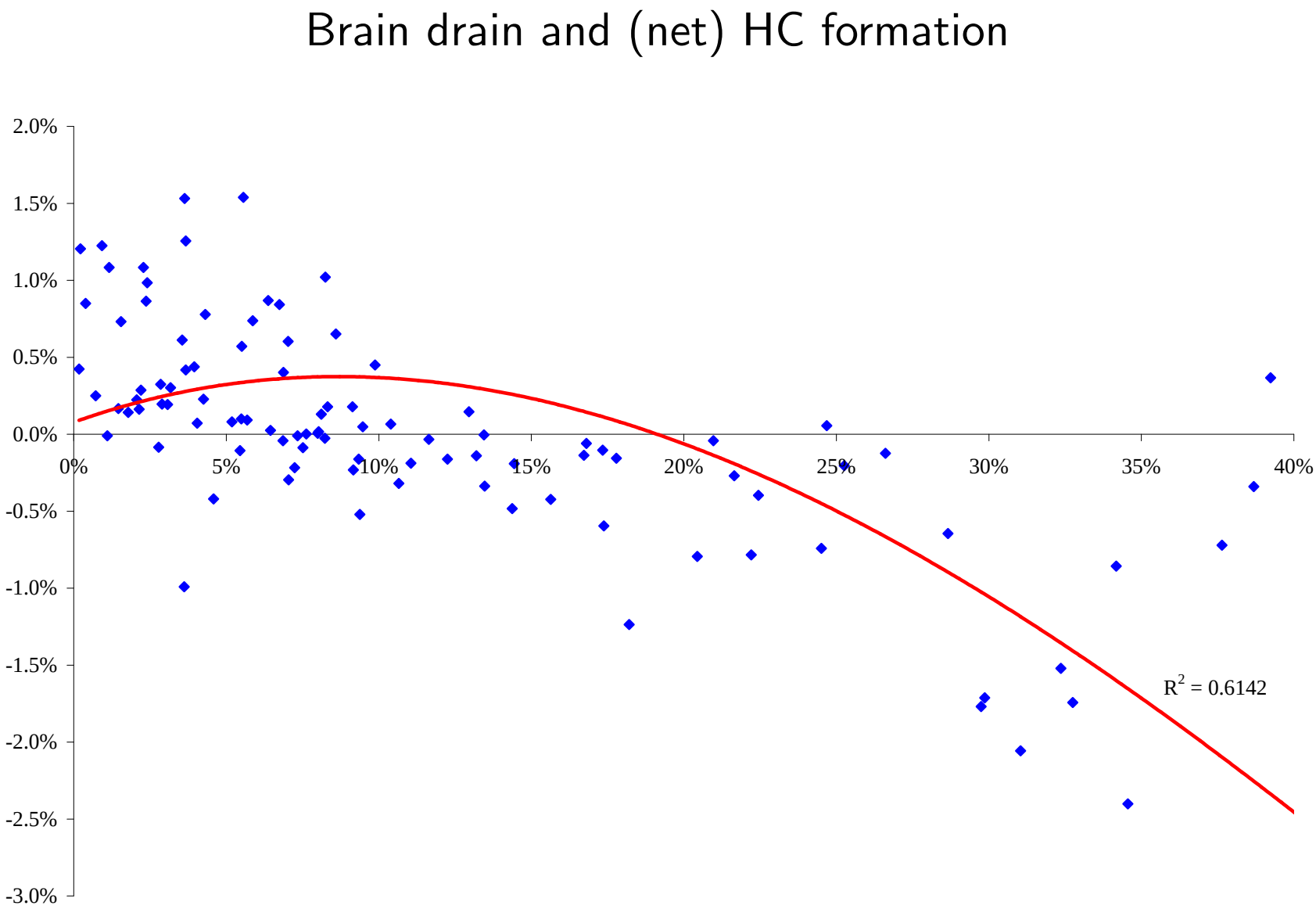
- Hence, $Hcf2000$ is the net of migration human capital stock the country would have if skilled workers were constrained to emigrate with the same probability as unskilled workers.

Brain drain and human capital

Once we do this simulation for all the countries in our sample, we find that:

- the losers are characterized by high migration rates ($\succ$20%) and/or high human capital stocks
- more losers, which tend to lose relatively more, but winners represent 80% of the sample population (include China, India, Indonesia) – hence the overall absolute net gain for developing countries.
- two conclusions: the BD contributes to increase the number of skilled worldwide and in the developing world but affects the World Distribution of Income.

Brain drain and human capital



Brain drain and human capital

- Beine, Defoort and Docquier (2007) use Defoort's panel data.
- Estimate a β-convergence equation for gross human capital formation, with country and time fixed effects + interactions between emigration rates and income group dummies
- Results: fixed effects, β (negative), and interaction between emigration and low-income status (positive) highly significant
- Interpretation: the incentive effect is stronger for poor countries, suggesting credit constraints are not such a serious issue for higher education.

Structure of the talk

1. Introduction
2. How big is the brain drain?
3. The traditional view
4. Brain drain and human capital formation
5. **Other feedback effects**
6. Conclusions and policy insights

Structure of the talk

5. OTHER FEEDBACK EFFECTS

5.1. Remittances
5.2. Return migration
5.3. Network externalities

5.1. Remittances

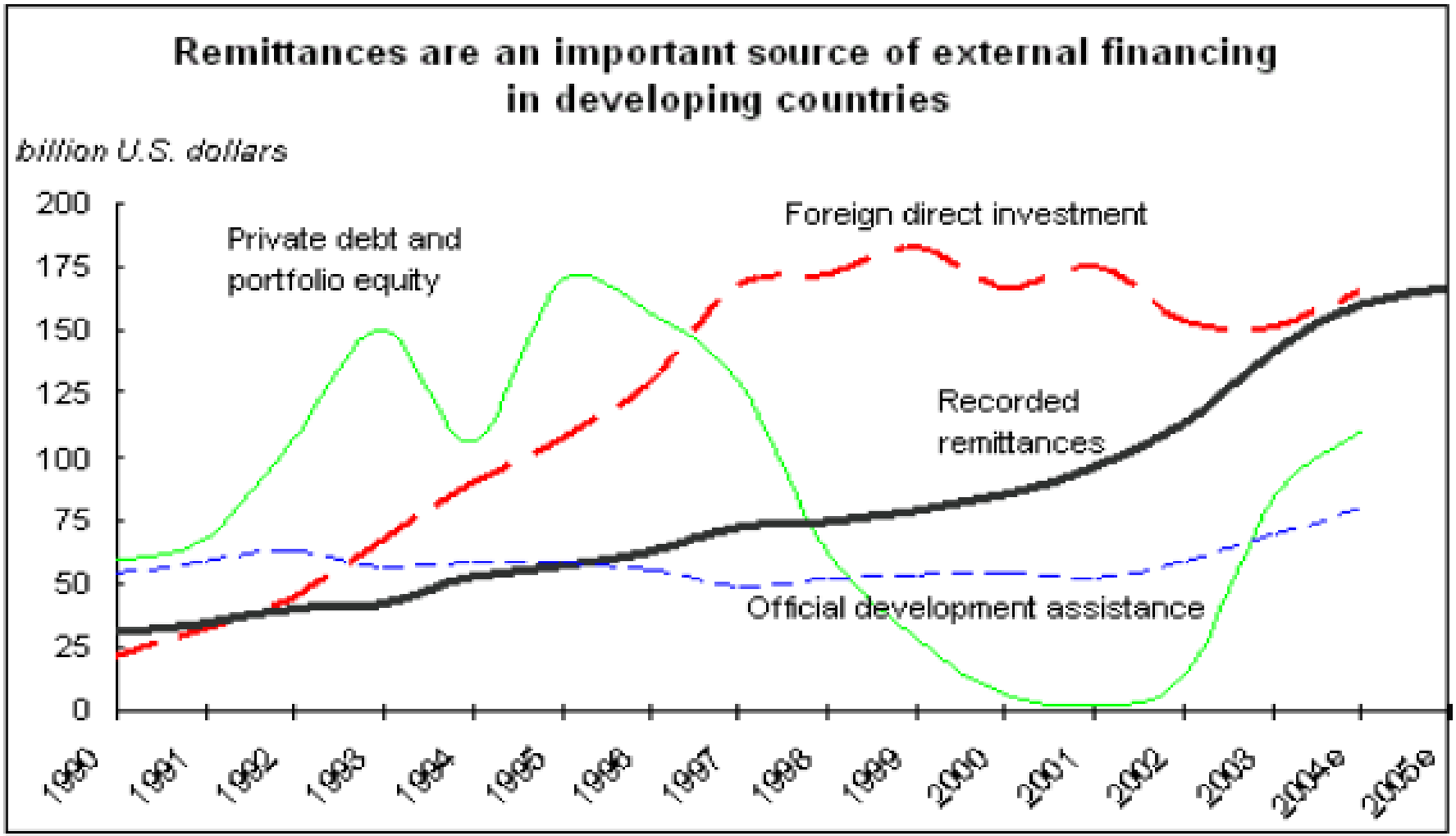
Feedback effects - Remittances

- "First welfare theorem": under certain conditions, when (skilled or unskilled) individuals take decisions that are good for them, an efficient allocation of resources is obtained. It is likely that the brain drain increases the world output.
- Caveat 1: the set of conditions do not necessarily reflect the workings of real economies (transaction costs, externalities)
- Caveat 2: the economic criterion of efficiency is not the only thing that a society might care about (what about equity?)

Feedback effects - Remittances

- "Second welfare theorem": with approporiate lump-sum transfers, we can improve the situation of all the parties concerned.
- There is no system of official assistance linked to the brain drain. However, migration induces remittances (private transfers) of important size

Feedback effects - Remittances



Feedback effects - Remittances

Remittances = major source of disposable income and can relax credit constraints on human and physical capital investments. In our framework:

- Remittances can be invested in education. Suppose individuals receive r_t when young, they educated if $V(1) \succ V(0)$, i.e.

$$c \prec \widehat{c}_t \equiv \frac{1}{1-\sigma} \times \frac{w_t - \widehat{\mu}_t + r_t}{w_t} \times \frac{(1+\theta)\left(\frac{w^*_{t+1}}{w_{t+1}}\right)^p - 1}{(1+\theta)\left(\frac{w^*_{t+1}}{w_{t+1}}\right)^p}$$

- Even if not invested, remittances increase GNI per capita (GNI = GDP + Net transfers in)

Feedback effects - Remittances

- The transfer must be high enough to compensate the possible losses of human capital and/or ensure a larger access to education. Is this likely to happen?
- From the literature we know that the two main motivations to remit are (familial) altruism and exchange (generally for preparing one's return).
- It is therefore a priori unclear whether the educated remit more: higher income, but move with family, on a more permanent basis.

Feedback effects - Remittances

Evidence on remittances

- Macro data: Faini (WBER2007) shows that remittances decrease with the proportion of skilled migrants. Confirmed after instrumenting by Nimii, Ozden and Schiff (2008).
- Micro data: Kangasniemi et al. (2007): nearly half of Indian medical doctors in the UK send remittances (16% of income on average). McCormick and Wahba (2001): skill-acquisition more important for educated migrants than savings to access to self-employment.

5.2. Return and temporary migration

Feedback effects - Return migration

- Temporary migration can boost human capital investments
- Suppose skilled individuals can spend a fraction q of adulthood abroad (no uncertainty).
- Same effect on human capital investments than p. The utility level V(1) becomes

$$\begin{aligned} V(1) &= \ln\left[w_t - \widehat{\mu}_t - (1-\sigma)cw_t\right] + \ln\left[qw^*_{t+1} + (1-q)w_{t+1}\right] \\ &\quad + \ln\left[1+\theta\right] + \lambda \ln\left[R^*_{t+2}\right] + F \end{aligned}$$

Feedback effects - Return migration

- The critical level of ability becomes:

$$c \prec \widehat{c}_t \equiv \frac{1}{1-\sigma} \times \frac{w_t - \widehat{\mu}_t}{w_t} \times \frac{(1+\theta)\left[1+q(\frac{w^*_{t+1}}{w_{t+1}}-1)\right]-1}{(1+\theta)\left[1+q(\frac{w^*_{t+1}}{w_{t+1}}-1)\right]}$$

- Possibility of a brain gain if q is not too large
- What if returnees improve their human capital by $1+\tau$ abroad:

$$h_{ss} = 1 + \frac{\theta}{1+m}\frac{(1-q)\widehat{c}_{ss} + q\widehat{c}_{ss}\tau}{1-q\widehat{c}_{ss}}$$

Feedback effects - Return migration

Other potential benefits linked to return migration:

- Returnees contribute to diffuse the advanced technology learned abroad (Dos Santos and Postel-Vinay, 2003). In our framework, adoption is determined by $g_t = g(h_t, X_t^g)$. Time spent abroad q can be included in X_t^g. It increases $a_{ss} = \phi(h_{ss}, h_{ss}^*, X)$.
- Negative selection in return migration that still embodies a brain gain (Stark et al., 1997)
- Savings, managerial skills, entrepreneurship (McCormick & Wahba, 2001, Dustmann & Kirchkamp, 2002, etc.).

Feedback effects - Return migration

Evidence on temporary/return skilled migration

- Although selective immigration programs are often intended for temporary migrants, return decision can be voluntary and endogenous: if $q \approx 1$, no brain gain.
- In general, return migrants are negatively self-selected; return skilled migration is more a consequence than a trigger of growth.
- Example: proportion of PhDs in Science and Engineering who return to Taiwan, Korea, China, India in the 1970s/1990s.
- Mixed results from case-studies (e.g., Indian IT workers: few returnees among engineers in Saxeenian (2001), more in Commander et al. (2004). Agrawal, Kapur and McHale (2008): few returnees among Indian inventors, and perform poorly
- No comparative evidence except for Rosenzweig (2008): more returnees to countries with high skill prices.

5.3. The role of networks

Feedback effects - Networks

- The diapora abroad may reduce transaction costs between the host and home countries, which can favor bilateral trade and FDI inflows (business networks), facilitate the diffusion of knowledge and adoption (scientific networks), or allow for the diffusion of democratic values and norms of public behavior, which can lead to better institutions (political networks)
- Each type of network effect may potentially compensate the source country for any potential loss of skills.

Feedback effects - Networks

Evidence on trade:

- Bilateral trade: Gould (1994) for the U.S., Head and Rees (1998) for Canada: demand for ethnic goods + networks
- Combes et al. (2005) for intra-regional trade in France: business/social networks
- Role of ethnic Chinese networks in international trade (Rauch and Trindade, 2002, Rauch and Casella, 2003) – solve information problems with trade in differentiated products differentiated goods.

Feedback effects - Networks

Evidence on FDI:

- Kugler and Rapoport (2007), US bilateral data: complementarity between skilled and services, substitutability between unskilled and manufacturing FDI
- Confirmed by Javorcik et al. (2007) using IV.
- Kugler and Rapoport (ongoing), bilateral data for all pairs of countries: same qualitative results after correction for selection.
- Docquier and Lodigiani (2006): cross-country comparisons using aggregate emigration by skill level; positive effect, stronger for democratic countries and intermediate corruption levels
- In our framework, the skilled diaspora MS_t may reduce the magnitude of informational costs: $\Psi_t = \Psi(MS_t)$ with $\Psi' \leq 0$. The stock of capital per worker increases.

Feedback effects - Networks

Evidence on scientific networks

- Meyer (2001) provides lots of anecdotal evidence on knowledge diffusion and brain circulation
- Agrawal, Kapur & McHale (2008), use patent citation data for Indian inventors: co-location effect larger on average than diaspora effect, implying a net loss. However the latter is much stronger for the most cited patents, which are likely to have the highest value
- Kerr (2008): similar findings for more diasporas (e.g., Chinese) in more countries
- Lodigiani (2008): skilled diaspora stimulates productivity growth iff far from the frontier (through adoption). In our framework, the skilled diaspora may increase the capacity to adopt: $MS_t \in X_t^g$. It increases $a_{ss} = \phi(h_{ss}, h_{ss}^*, X)$.

Feedback effects - Networks

Theory on political networks

DR (2003) - Political economy of endogenous ethnic discrimination

- Unlimited exit options (full mobility case) reduces discrimination. Equilibrium discrimination rate is such that no migration outflow is observed at equilibrium.
- Restrictive quotas increase the level of discrimination and induce emigration

Mariani (2006)

- Brain drain prospects reduce the number of rent-seekers
- When education and self-protection investments are substitutes, it is possible that the intensity of corruption increases with the migration rate

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Conclusion

- Micro and macro evidence suggest positive impact of skilled emigration through business and diaspora networks and some brain gain.
- This is starting to change the way people think about the brain drain in academic and policy forums
- At a policy level, the fact that the brain drain has redistributive effects has implications for:
  - immigration policy in receiving countries: should be differentiated across origin countries without distorting the system too much (legal, moral issues)
  - education policy in sending countries : is it still optimal to subsidize education if people emigrate? Migration and subsidies can be substitutes
  - taxation policy in both: think afresh about the Bhagwati tax (surplus sharing rather than compensation, feasibility issues).