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Among the best guys overseas: who will return and who will not?

Economic Growth, Risk Aversion and Brain Circulation

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Introduction

- This paper studies the behavior of the Brain Circulation, or the return of skilled workers to their home country after sometime migrating to a more advanced country to work.
- The first section deals with basic concepts to be used in the paper, and then discusses the stylized facts of the Brain Circulation phenomenon. The second section reviews the theoretical development of the literature dealing with this issue. Section 3 presents my basic model of the Brain Circulation. Section 4 discusses possible further steps to extend the model. The last section concludes.

Basic Concepts and Stylized Facts

- ***International Migration***
- ***Return Migration***
- ***Brain Drain***
- ***Brain Circulation***

Some facts about International Migration (1)

Table 1: World Population and Migrant Stocks by Continent, 2000

	Total Population (millions)	Migrant Stocks (millions)	Percent of population (%)
Asia	3672.3	49.7	1.4
Africa	793.6	16.2	2.1
Europe	727.3	56.1	7.7
Latin America/Caribean	518.8	5.9	2.1
North America	313.1	40.8	13.0
Oceania Pacific	30.5	5.8	1.1
Global	**6056.7**	**174.7**	**2.9**

Source: IOM (2003), p. 304

Some facts about International Migration (2)

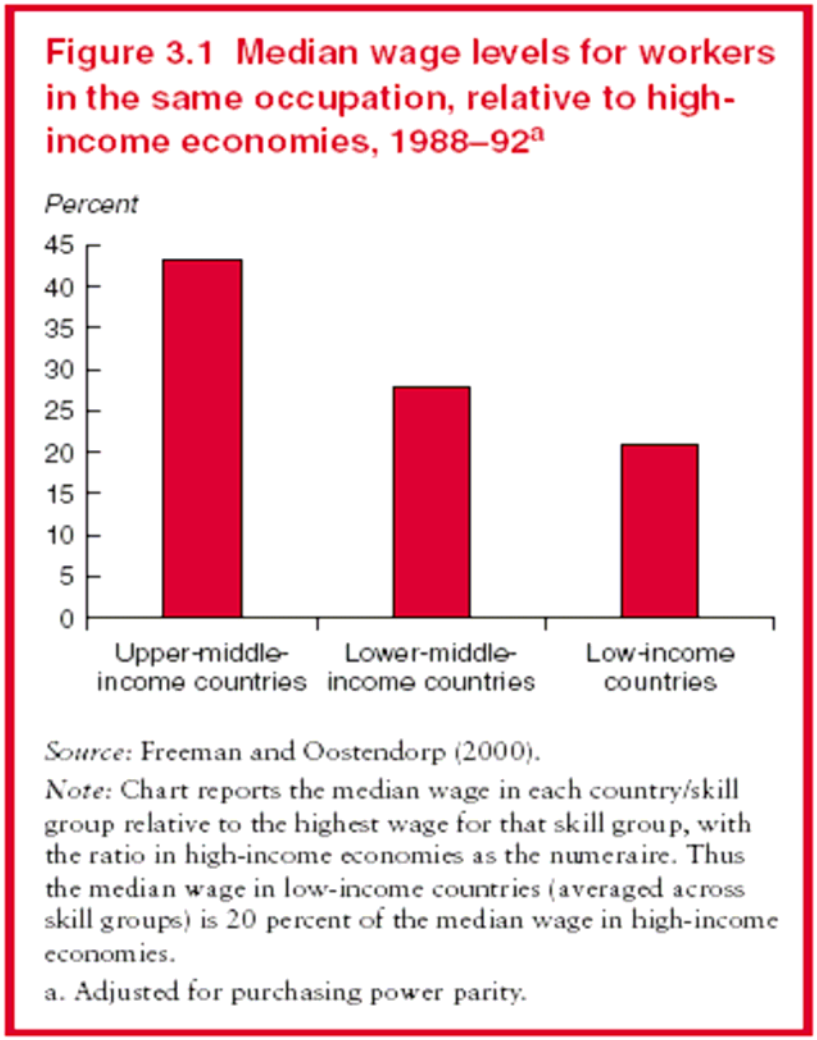
Table 2: Top 10 Countries of Immigration and Emigration, 1970-1995

Countries of Immigration		Countries of Emigration	
Country	Net number of Immigrants (mil)	Country	Net number of Emigrants (mil)
United States	16.7	Mexico	-6.0
Russian Federation	4.1	Bangladesh	-4.1
Saudi Arabia	3.4	Afghanistan	-4.1
India	3.3	Philippines	-2.9
Canada	3.3	Kazakhstan	-2.6
Germany	2.7	Vietnam	-2.0
France	1.4	Rwanda	-1.7
Australia	1.4	Sri Lanka	-1.5
Turkey	1.3	Columbia	-1.3
United Arab Emirates	1.3	Bosnia & Herzegovina	-1.2

Source: IOM (2003), p. 305

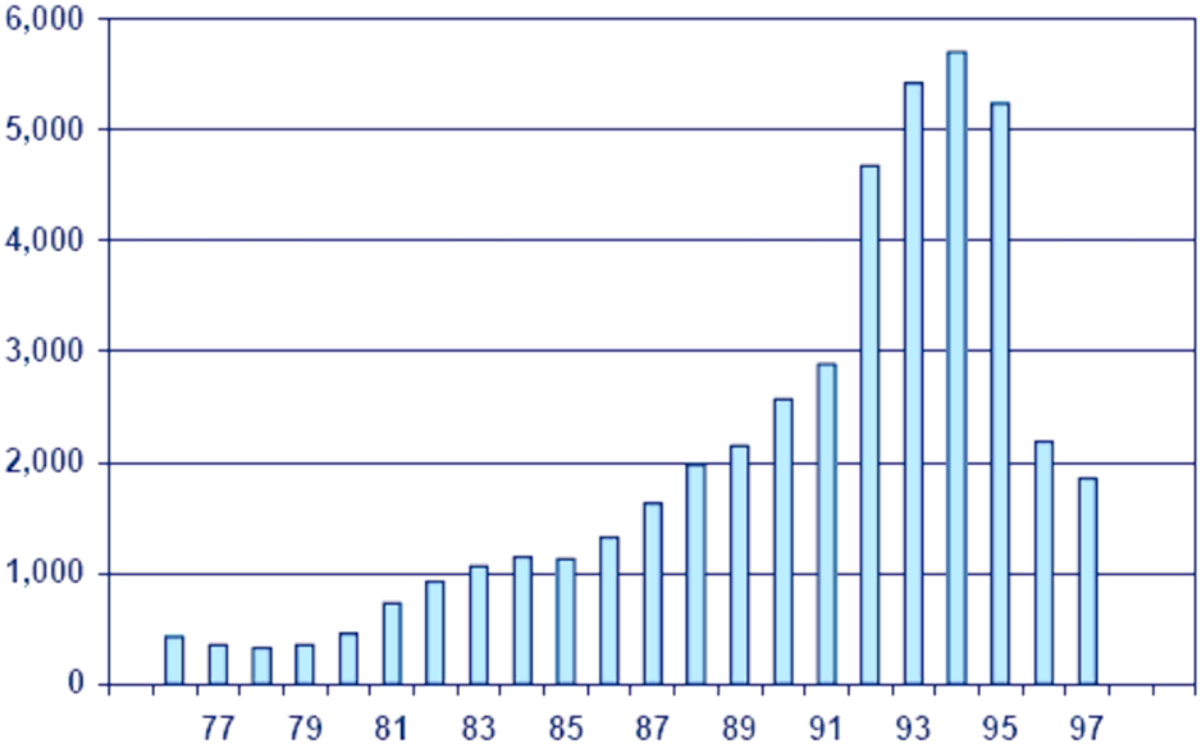
Wage Differentials as a Major Cause of Migration

Figure 1: Median wage levels for workers in the same occupation, relative to high-income economies, 1988-92 (adjusted for PPP)



Facts abour Return Migration (1)

Figure 2: Returnees from the US to Taiwan, 1976-96



Facts abour Return Migration (2)

Table 3: Intended and Realized Return Migration from (West) Germany 1984 -1993

	Frequency	Percentage
Return intended, realized	140	11.5
Return intended, not realized	667	54.6
Return not intended, returned	41	3.4
Return not intended, not returned	372	30.5
Total	1220	100

Note: Western Germany. Return intention is measured in 1984. An intention is realized if the individual is returned until 1993. *Source*: German Socio-economic Panel, 1984-1993.

Figure 3: Sills' Typology of Return Migration

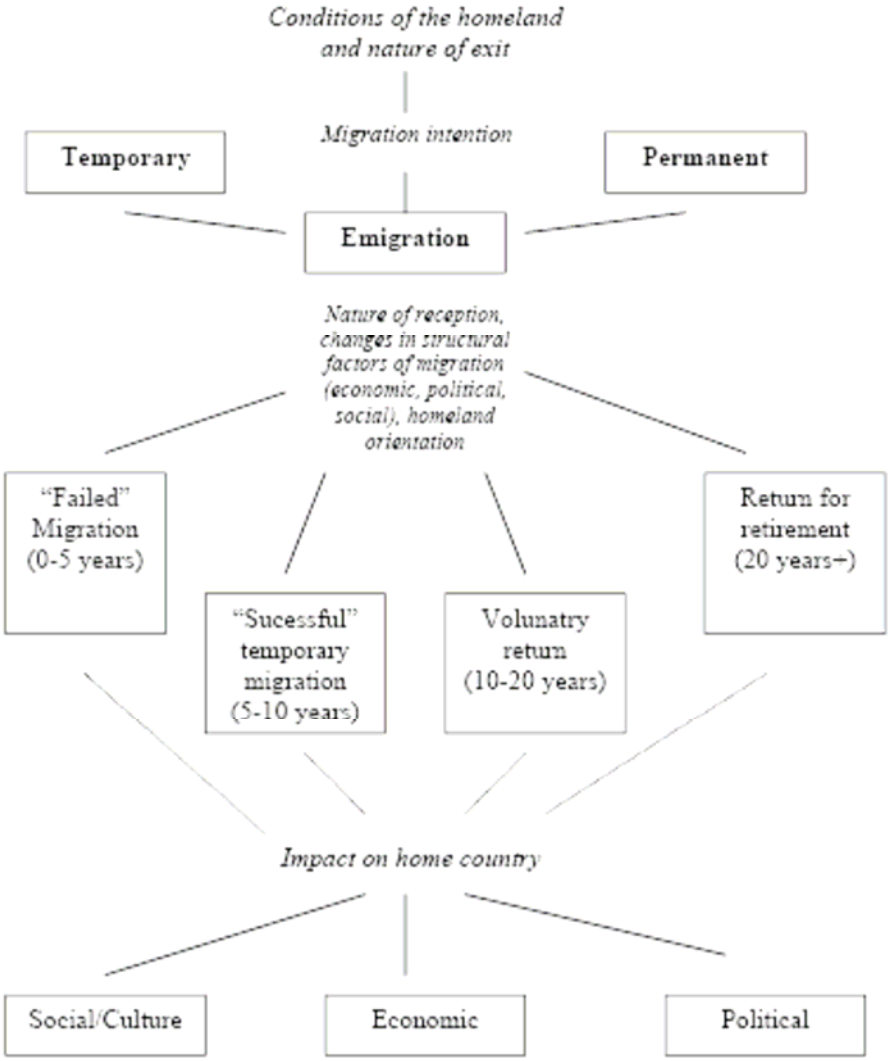


Table 4: Data on Students Studying Abroad, China 1978-97

Aggregate Number of Chinese Students Studying Abroad (in 10 thousand)	29.2
Of which: sent by the government	9.15
sent by units	15.34
self-supporting	9.85
Number of countries & regions involved	103
Aggregate number of returnees	9.85
Rate of return from abroad (%)	33.7

Source: China Education and Research Network, 2001, Table 8: Data on Study Abroad in the period 1978-1997, available at: http://www.cernet.edu.cn/zhong_guo_jiao_yu/shu_zi/tubiao/005.php

Table 5: Government Approved Overseas Students and Return Migrants by Host Country, China 1978-1999

Destination	Number arriving	Number returning	Return rate (%)
U. S. A.	213,200	30,021	14.1
Japan	66,800	25,016	37.4
Canada	26,800	10,036	37.4
Germany	26,800	10,036	37.4
UK	21,200	9,924	46.8
France	14,800	7,050	47.6
Australia	13,200	5,932	44.9
Others	17,000	1,984	11.5
Total	400,000	100,000	33.3

Table 6: Stay rate of foreign students earning S&E doctorates in U.S Universities

Regions	Total S&E Ph.D. degrees to foreign students	Number with plans to stay in U.S.	Percent	Number with firm plans to stay in U.S.	Percent
Total 1/	55,444	34,917	63.0	21,779	39.3
Asia	43,171	28,280	65.5	16,964	39.3
Europe	8,760	4,898	55.9	3,521	40.2
North America	3,513	1,739	49.5	1,294	36.8

1/ Foreign doctoral recipients from selected countries of Asia, Europe and North America. Asia includes China, India, Japan, South Korea and Taiwan. Europe includes all Scandanavian, Western and Eastern European countries. North America includes Canada and Mexico. Foreign students from these countries represent 74 percent of all U.S. foreign doctoral recipients in fields of science and engineering.

NOTE: Temporary and permanent visas.

SOURCE: National Science Foundation, Division of Science Resources Studies, Survey of Earned Doctorates, special tabulations.

Table 7: Percentage of 1990-91 foreign S&E doctoral recipients from U.S universities who were working in the U.S. in 1995, by country of origin

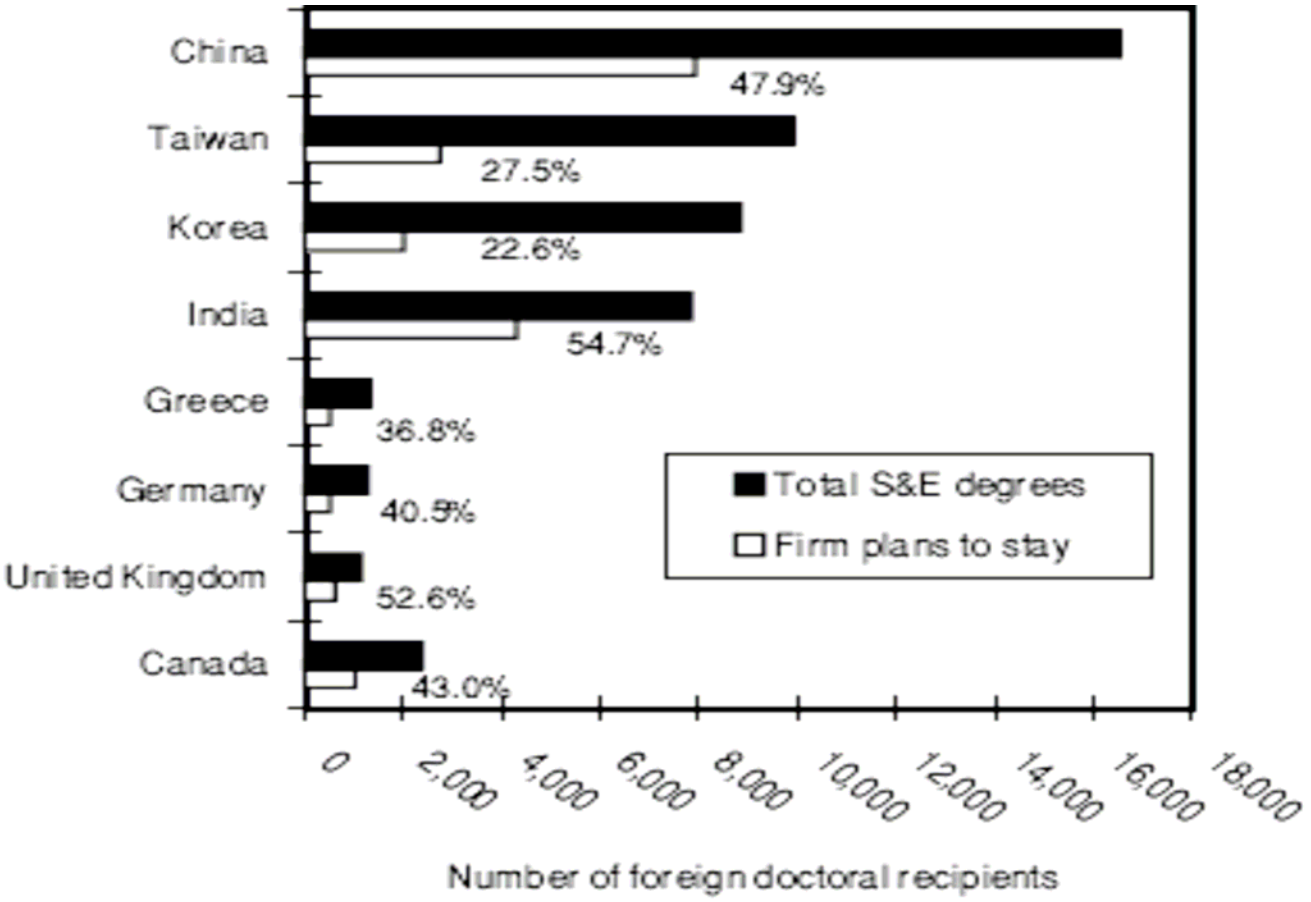
Country	Foreign S&E doctorates	Percent working in the United States
Total	**13,878**	**47**
China 1/	2,779	88
India	1,235	79
Japan	227	13
South Korea	1,912	11
Taiwan	1,824	42
England	142	59
Germany	177	35
Greece	240	41
Canada	417	46
Mexico	194	30

1/ The high stay rate of Chinese students is attributable to a one-time granting of permanent residence status in the United States (Chinese Students Protection Act) following China's response to student demonstrations.

NOTE: Includes foreign doctoral recipients with temporary visa status at the time of receipt of degrees in 1990-1991 (not permanent residents).

SOURCE: Finn, Michael G., *Stay Rates of Foreign Doctorate Recipients from U.S. Universities* , 1995 (Oak Ridge, TN: Oak Ridge Institute for Science and Education, 1997).

Figure 4: Foreign S&E doctoral recipients with firm plans to stay in U.S., 1988-96, by country of origin



SOURCE: National Science Foundation, Division of Science Resources Studies, Survey of Earned Doctorates, special tabulations.

Some stylized facts of the Brain Circulation

- **1. The smaller income gap between the home and receiving countries, the higher possibility of return** (for example, compare the case of China and South Korea)
- **2. The more stable or developed the (political/economic/business) environment in home country, the higher possibility of return** (say, China after the 1989 student crackdown, it seems that highly-skilled want to stay in the US after graduation)
- **3. The bigger the difference between cultures of the two countries, the higher possibility of return** (take UK, Germany and Taiwan as examples, see Figure 1 of NSF paper above)

A Brief Literature Review

- - *Return Migration Literature:* quite vast, both theoretical and empirical (Dustmann (2000), Dustmann (2003), Bellemare (2004), Kirdar (2004), Brucker & Schroder (2005), etc.)
- Determinants of return:
- classic reason: income → as the home country's economy becomes successful → may attract people back.
- Borjas & Brasberg(1996): imperfect information → wrong information → not as expected → then return
- Dustmann → return as a way of maximizing life utility if consumption preferences are different in the two countries.
- - *Brain Circulation Literature:* not many but seem emerging (Schmitt & Soubeyran (2005)) → talent distributions
- somehow overlapped with the return migration literature, but distinctive in terms of highly-skilled professionals or the most talented or productive people.

My Basic Model (*Assumptions)*

- At time *t =0* the person is in a foreign country. He thinks of a retire plan at time *T* fixed, for example 65 years old.
- He decides whether to turn back to his home country in some optimal point of time *t** in the future. If *0<t*<1*, he will actually come back (brain circulation), otherwise he will not turn back or turn back immediately .
- His income abroad is: $y_1 \sim N(\mu_1, \sigma_1)$
- His income in home country is $y_2 \sim N(\mu_2(1+\gamma t), \sigma_2)$

to show the impact of economic growth on real wage.

- He is a life-income maximizer, who maximizes the present value of his life-income at time *t=0* under uncertain conditions.

Or his problem is: $\max_t J = E[V(t) - 0.5R\,\mathrm{var}(V(t))]$

My Basic Model (*solutions*)

$$E[V(t)] = \int_0^t e^{-\rho\tau} y_1(\tau) d\tau + \int_t^T e^{-\rho\tau} y_2(\tau) d\tau = \int_0^t e^{-\rho\tau} \mu_1 d\tau + \int_t^T e^{-\rho\tau} (\mu_2(1+\gamma\tau)) d\tau$$

$$\text{var}(V(t)) = \int_0^t \sigma_1^2 e^{-2\rho\tau} d\tau + \int_t^T \sigma_2^2 e^{-2\rho\tau} d\tau$$

$$J = \int_0^t e^{-\rho\tau} \mu_1 d\tau + \int_t^T e^{-\rho\tau} (\mu_2(1+\gamma\tau)) d\tau - 0.5R\left(\int_0^t \sigma_1^2 e^{-2\rho\tau} d\tau + \int_t^T \sigma_2^2 e^{-2\rho\tau} d\tau \right)$$

$$J = \int_0^t e^{-\rho\tau} (\mu_1 - 0.5R\sigma_1^2 e^{-\rho\tau}) d\tau + \int_t^T e^{-\rho\tau} (\mu_2(1+\gamma\tau) - 0.5R\sigma_2^2 e^{-\rho\tau}) d\tau$$

FOC:

$$\frac{\partial J}{\partial t} = (\mu_1 - 0.5R\sigma_1^2 e^{-\rho t}) e^{-\rho t} - (\mu_2(1+\gamma t) - 0.5R\sigma_2^2 e^{-\rho t}) e^{-\rho t}$$

$$\frac{\partial J}{\partial t} = e^{-\rho t} \left\{ \left[\mu_1 - (\mu_2(1+\gamma t)) \right] - 0.5R(\sigma_1^2 - \sigma_2^2) e^{-\rho t} \right\}$$

My Basic Model (*solutions, cont.*)

If $(\sigma_1^2 - \sigma_2^2) \leq 0$ (working abroad less risky than or equal to domestic)

$\frac{\partial J}{\partial t} > 0 \forall t$ → J increasing in t → **Never returns.**

If $(\sigma_1^2 - \sigma_2^2) > 0$ (working abroad riskier than domestic)

Consider:

$$f(t) = \left[\mu_1 - \mu_2(1+\gamma t)\right] - 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho t}$$

$$f'(t) = -\gamma\mu_2 + 0.5R(\sigma_1^2 - \sigma_2^2)\rho e^{-\rho t}$$

$$f''(t) = -0.5R(\sigma_1^2 - \sigma_2^2)\rho^2 e^{-\rho t} < 0 \forall t$$

$f(t)$ is monotonic decreasing $\forall t$ and approach $-\gamma t$ as t becomes infinitive. Therefore, we consider the following two cases:

My Basic Model (*solutions, cont.*)

(1) If $f'(T) = 0.5R(\sigma_1^2 - \sigma_2^2)\rho e^{-\rho T} - \gamma\mu_2 \geq 0$ or $0.5R(\sigma_1^2 - \sigma_2^2)\rho e^{-\rho T} \geq \gamma\mu_2$

Then: $f'(t) > 0 \ \forall t < T \rightarrow J'' > 0 \ \forall t < T \rightarrow$ only corner solutions because there is no maximum of J (stay permanently or leave immediately) .

(2) If $f'(T) = 0.5R(\sigma_1^2 - \sigma_2^2)\rho e^{-\rho T} - \gamma\mu_2 < 0$ or $0.5R(\sigma_1^2 - \sigma_2^2)\rho < \mu_2\gamma e^{\rho T}$

(2.1) If $f'(0) = 0.5R(\sigma_1^2 - \sigma_2^2)\rho - \gamma\mu_2 < 0 \Leftrightarrow 0.5R(\sigma_1^2 - \sigma_2^2)\rho\mu_2^{-1} < \gamma \Rightarrow f'(t) < 0 \forall t \in [0,T]$

=> $f(t)$ is monotonic decreasing in $[0,T]$.

My Basic Model (*solutions, cont.*)

Condition for the existence of t^* to maximize $J(t)$ is that:

$$\begin{cases} f(0) = [\mu_1 - \mu_2] - 0.5R(\sigma_1^2 - \sigma_2^2) & > 0 \\ f(T) = [\mu_1 - \mu_2(1+\gamma T)] - 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho T} & < 0 \end{cases}$$

Then, all conditions are:

$$0.5R(\sigma_1^2 - \sigma_2^2)\rho\mu_2^{-1} < \gamma$$

$$0.5R(\sigma_1^2 - \sigma_2^2) < (\mu_1 - \mu_2) < \mu_2\gamma T + 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho T}$$

And $f(t^*) = [\mu_1 - \mu_2(1+\gamma t^*)] - 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho t^*} = 0$

My Basic Model (*solutions, cont.*)

(2.2.) If $f'(0) = 0.5R(\sigma_1^2 - \sigma_2^2)\rho - \gamma\mu_2 > 0 \Leftrightarrow 0.5R(\sigma_1^2 - \sigma_2^2)\rho\mu_2^{-1} > \gamma$

=> $\exists t^\circ \in (0,T) : f'(t^\circ) = 0$ and $f(t^\circ)$ maximizes *f(t)*

$$t^\circ = \rho^{-1} \ln\left[0.5R(\sigma_1^2 - \sigma_2^2)\rho(\gamma\mu_2)^{-1}\right]$$

$$f(t^\circ) = \left[\mu_1 - \mu_2(1+\gamma t^\circ)\right] - 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho t^\circ} = \left[\mu_1 - \mu_2(1+\gamma t^\circ)\right] - \frac{\gamma}{\rho}\mu_2$$

$$= \left[\mu_1 - \mu_2\left(1+\frac{\gamma}{\rho}\right)\right] - \mu_2\gamma t^\circ$$

If $f(t^\circ) \le 0$ → $f(t) \le 0 \forall t$ → *J* is decreasing in t → **returns immediately**.

$$\Leftrightarrow \mu_1 - \mu_2 \le \frac{\gamma}{\rho}\left(1 - \ln\left[0.5R(\sigma_1^2 - \sigma_2^2)\rho\gamma^{-1}\right]\right)$$

If $f(t^\circ) > 0$ → necessary condition is that:

$$f(T) = \left[\mu_1 - \mu_2 - \gamma T\right] - 0.5R(\sigma_1^2 - \sigma_2^2)e^{-\rho T} < 0$$

$\Rightarrow \exists t^* \in (t^\circ, T)$ to maximize *J*.

My Basic Model (*solutions, cont.*)

Then, all conditions are:

$$0.5R(\sigma_1^2-\sigma_2^2)\rho\mu_2^{-1}e^{-\rho T}<\gamma$$

$$0.5R(\sigma_1^2-\sigma_2^2)\rho\mu_2^{-1}>\gamma$$

$$\left[\mu_1-(\mu_2+\gamma t^\circ)\right]-\frac{\gamma}{\rho}>0 \text{ with } t^\circ=\rho^{-1}\ln\left[0.5R(\sigma_1^2-\sigma_2^2)\rho\gamma^{-1}\right]$$

$$\left[\mu_1-\mu_2-\gamma T\right]-0.5R(\sigma_1^2-\sigma_2^2)e^{-\rho T}<0$$

Or:

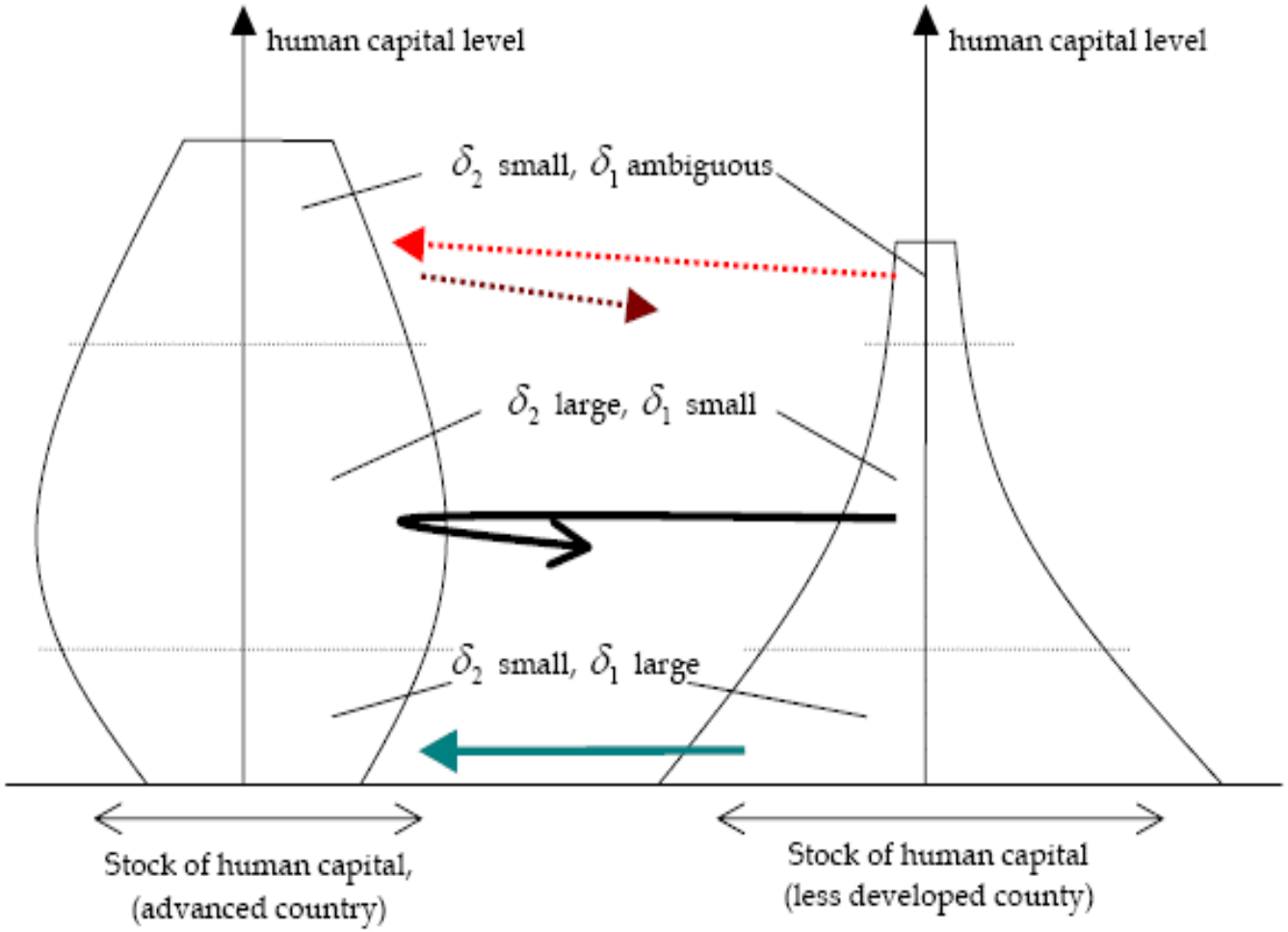
$$\gamma<0.5R(\sigma_1^2-\sigma_2^2)\rho\mu_2^{-1}<\gamma e^{\rho T}$$

$$\frac{\gamma}{\rho}\left\{1+\ln\left[0.5R(\sigma_1^2-\sigma_2^2)\rho\gamma^{-1}\right]\right\}<(\mu_1-\mu_2)<\gamma T+0.5R(\sigma_1^2-\sigma_2^2)e^{-\rho T}$$

If $f(T)=\left[\mu_1-\mu_2-\gamma T\right]-0.5R(\sigma_1^2-\sigma_2^2)e^{-\rho T}\geq 0$

→ $f(t)>0\forall t\in(t^\circ,T)$ → J is monotonic increasing → never returns.

Figure 5: The possible directions of migration with heterogeneous human capital



Further Developments

Introduction of Assimilation Costs

His income abroad is $y_1 \sim N(\mu_1 - ce^{-\beta t}, \sigma_1)$ to show the assimilation costs.

Introduction of the Transferablity of Skills

And more… (?)

Concluding Remarks (and a Final Thought)

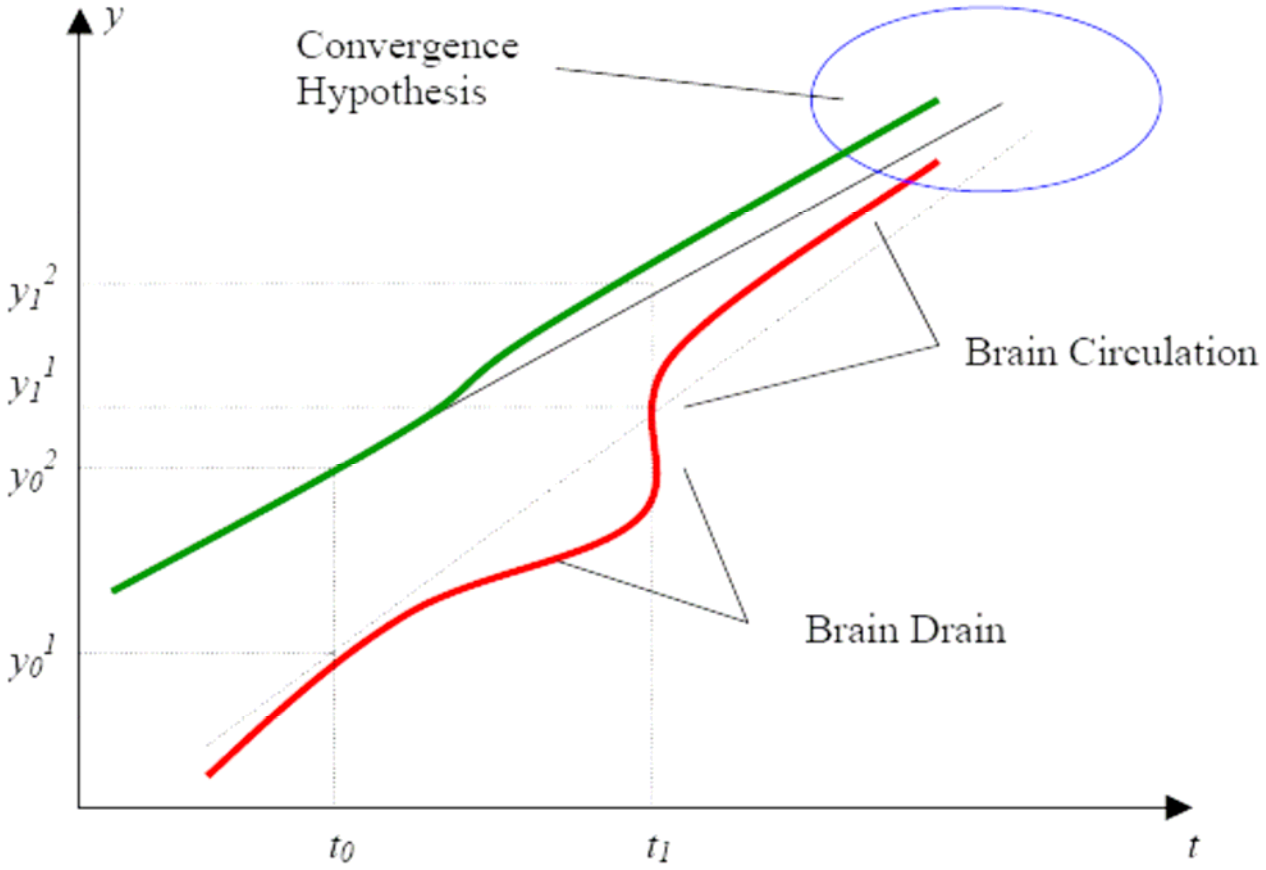


Figure 6: A Model of Economic Convergence with International Human Capital Flows

THE END

THANK YOU VERY MUCH