"*International students, university training, and multinationals in the flow of technology to China and India: Implications for growth and trade*"

I: Context: World Demography and Financial Meltdown
II: Globalization of Higher Education and Knowledge
III: Implications and Opportunities

Richard B. Freeman, Harvard and NBER, CEP LSE

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"Boosting growth and productivity in an open Europe:
The role of international flows of goods, services, capital and labour"
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Main theme

- International flows of students and highly educated immigrants and of knowledge are more important part of globalization than traditional economic focus on goods, capital, and services recognizes.
- Flow of technology moves us from H-O world or Ricardo world to single knowledge before developing countries have similar earnings and institutions to those in advanced countries.
- **Think trade and productivity, think students and immigrants and knowledge.**
- **Think growth and productivity policy, think student and university and immigration policy**

I. Context

1) Demography keeps diminishing the role of Europe in the world

	1900	1950	2005	2050
World	**1651**	**2519**	**6465**	**9076**
Africa	8.1	8.9	14.0	21.3
Asia	57.4	55.4	60.4	57.5
Europe	**24.7**	**21.7**	**11.3**	**7.2**
LA&Carr	4.5	6.6	8.7	8.6
NA	5.0	6.8	5.1	4.8
Oceania	0.4	0.5	0.5	0.5

Relative to US as well as to developing countries: population 15-59 in hundreds of thousands

	1975	2000	2025	2050
West Europe	99	113	100	86
US	132	176	196	217
Japan	71	79	65	49
India	335	594	809	939
China	497	829	913	787
West Europe/US	**0.75**	**0.64**	**0.51**	**0.40**

2. Long run Global Challenges

Globalization + development →

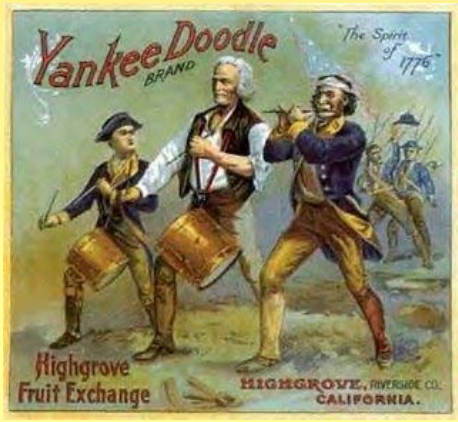
- Climate change and energy crisis
- Risk of pandemic
- Natural resource limits
- Terrorism/national security

For which Science, Engineering, and Technology is potentially critical source of positive modes of response and where EU can play a huge role

3. End of American Finance-Dominated Market-Driven Model

In “War of the Models” US model of limited regulation, high inequality, low taxes/social support, high debt, reliance on foreign-born brains, weak unions/social dialogue did well.

Collapse of this model→ Return of Public opens space for EU-style economies with greater emphasis on institutions working with and regulating market forces



II. Globalization of Higher Education and Knowledge

“Big Facts” about Education

1. The advanced country share of world higher education enrollments and degrees, particularly in science and engineering, is falling at undergraduate and graduate level due to “human resource leapfrogging” in highly populous developing countries.

2. EU has greatly improved position in higher education in quantities and in some research areas; US has stagnated

3. Women have become the majority of university students throughout the advanced world, and thus an increasingly important source of highly educated workers worldwide.

4. International students are an increasing share of world students and MAJOR source of immigration of science and engineering talent.

Fact 1a: Huge increase in DC Share of Enrollments in Higher Education (millions including < 4 year) 1970-2006

	1970	1980	1990	2006
World	29.4	55.3	67.6	141.5
US	8.5 (29%)	12.1 (22%)	13.7 (20%)	17.5 (12%)
Other advanced countries	4.9 (17%)	8.2(15%)	12.9 (19%)	21.5(15%)
Developing	16.0	35.0	41.0	102.5
China	<0.1	1.7	3.8	23.4
India	2.5	3.5	5.0	12.9

Source: UNESCO, Institute for Statistics, on line files

1b: Ratio of S&E PhDs from Foreign Universities to US Universities and US share of World S&E PhDs, 1975-2010

	1975	1989	2001	2004	2010
Asia major nations [a]	0.22	0.48	0.96	1.23	
China	na	0.05	0.32	0.57	1.26
Japan	0.11	0.16	0.29	0.29	
EU major (Fr, Germ, UK)	0.64	0.84	1.07	1.02	
All Advanced EU [b]	0.93	1.22	1.54	1.78	1.92
Chinese 'diaspora'/ US [c]			0.72		
US Share of World S&E PhDs			22.3%	17.6%	

Sources: Science & Engineering Indicators – 2008 , table 2-40; 2002, table 2-36; Weigo & Zhaohui National Research Center for S&T Development (China) – private communication; [a] China, Japan, India, Korea ; [b] Includes Norway, Switzerland, excludes new EU entrants, extrapolation to 2010; [c]diaspora' includes estimates of Chinese doctoral graduates from UK, Japan, and US (with temporary visas). US natives = citizens and permanent residents

1c) Human Resource Leapfrogging in China

Investment in higher ed:

4.1 million bachelors' graduates in 2005;

462,798 engineering graduates in 2004

Government programs to develop at least 10 world class universities

Not Just China: Universities in Bangladesh and Chile, 2004

Bangladesh Universities	
Name	Year Founded
Bangabandhu Medical	1965(1998)
Bangabandhu Medical Agric	1983(1998)
Bangladesh Agricultural Univ	1961(1972)
Bangladesh Open Univ	1992
BUET	1947(1992)
Chittagong	1964(1966)
Dhaka	1921
HMDSTU	1976(2002)
Islamic	1979(2000)
Jahangirnagar	1970(1972)
Khulna	1991
National University	1992
Rajshahi	1953
Shahjalal	1987
American International	1994
Ahsanullah	1995
AUB	1996
DIU	1989
Dhaka	1995(2000)
EWU	1996
Gono Bishwabidyalay	1998
IUB	1993
IUBAT	1992
Islamic University of Techl	1981
North South Univ	1992
People's University	1996
Queens	1997
Asia Pacific	1996
Univ Sci & Tech, Chittagnong	1992

Chilean Universitites	
Name	Year Founded
arturo prat	1984
metropolitan of education	1986
metropolitan of tech	
antofagasta	1981
atacama	1857
bio bio	1988
chile	1738
magallanes	1961(1981)
santiago chile	1849(1981)
talca	1981
tarapaca	1982
valparaiso	1911(1981)
Adolfo Ibanez	1953(1989)
Alberto Hurtado	1997
Andres Bello	1988
Autonomous Univ Christian	1975(1988)
Autonomous Univ of South	1989
Bernardo O'Higgins	1990
Bolivariana	1988
Catholic-Cardinal Henriquez	1990(1993)
Catholic	1888(1930)
Catholic Univ of Holy Concept	1991
Catholic Univ of Maule	1991
Catholic Univ of North	1956(1969)
Catholic Univ of Temuco	1991
Catholic Univ of Valparaiso	1928(1961)
Central	1982(1993)
Chile Adventist	1965(1990)
Diego Portales	1982(1993)

Fact 2: EU Countries have caught up with/surpassed US in Propensity for University Training, 1992-2005

Graduation Data from OECD/NSF

	1992	2005
"Tertiary A" graduation rates (OECD)	2 of 15	13 of 20
Bachelor's Degrees/24 yr old (NSF)*	2 of 21	14 of 23
Nat Science & Engineering/24 yr old (NSF)	3 of 21	19 of 23
Phd or equivalent graduation rates (OECD)	---	9 of 20
All Science Grads/ 25-34 yr olds (OECD)	---	12 of 20

Enrollment data from OECD

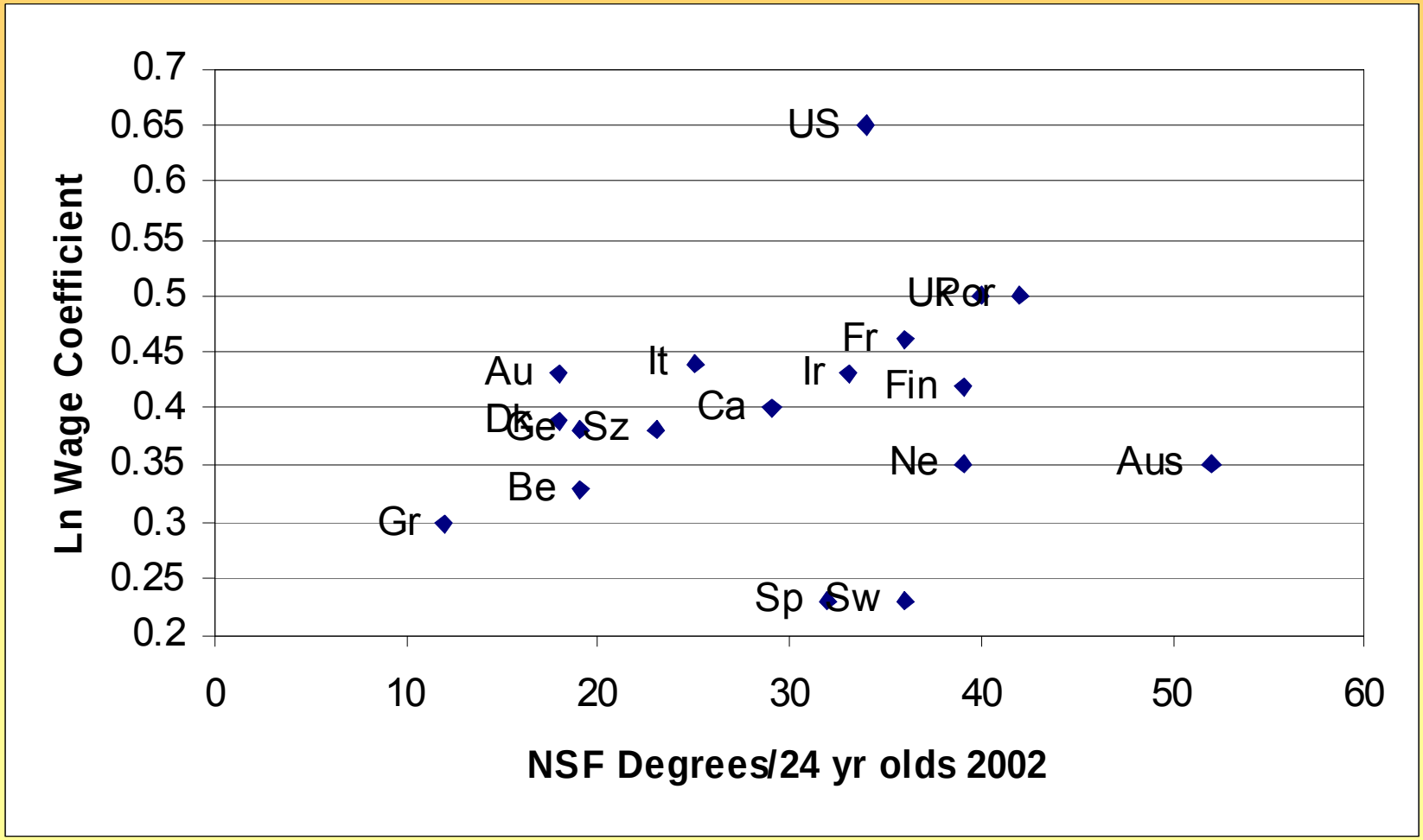
	1995	2005
first time entry as % of age group	2 of 15	7 of 20
Enrollment % of 20-29 yr olds	9 of 20	12 of 20

Survival Rates from OECD for advanced countries

Graduation/new entrants for type A 2004 17tie out of 18

OECD, Education at a Glance, NSF, Science and Engineering Indicators

EU has done this with lower wage differentials than US: OECD Estimated Ln Wage Coefficient and Proportion of 24 yr olds Getting Bachelor's Degree (r=0.19)



In part, returns in US are reduced by high costs

Fact 3: Cherchez la Femme: Ratio of Female to Male Tertiary enrollment rates

Group/Country	1988	2005
WORLD	64	105
Advanced	106	121
US	116	140
Netherlands	81	108
All developing	54	91
Chile	82	96
Malaysia	87	131
Most populous developing countries		
India	47	70
China	55	95
Indonesia	--	79
Brazil	106	132
Pakistan	46	88
Bangladesh	25	53
Nigeria	--	55
Mexico	66	99
Philippines	--	123
Vietnam	--	71

Enrollment Ratios of Women/Men in higher education, by age group, advanced countries, 2004

	OECD	UN		OECD	UN
Norway	1.54	1.38	Belgium	1.21	1.06
Iceland	1.78	1.82	Austria	1.19	1.24
Australia	1.23	1.14	Denmark	1.42	1.58
Ireland	1.28	1.28	France	1.28	1.47*
Sweden	1.55	1.47	Italy	1.34	1.27
Canada	1.36	--	UK	1.37	1.17 *
US	**1.39**	**1.27**	Spain	1.22	1.41
Netherlands	1.08	1.17	NZ	1.41	1.41
Finland	1.20	1.26	Israel	1.33	--
Luxembourg	1.18	--	Greece	1.17	1.23
Portugal	1.32	--			
Germany	..	0.97			
Japan	0.89	0.73			
Switzerland	0.80	0.97			
Korea,	0.61	0.87			

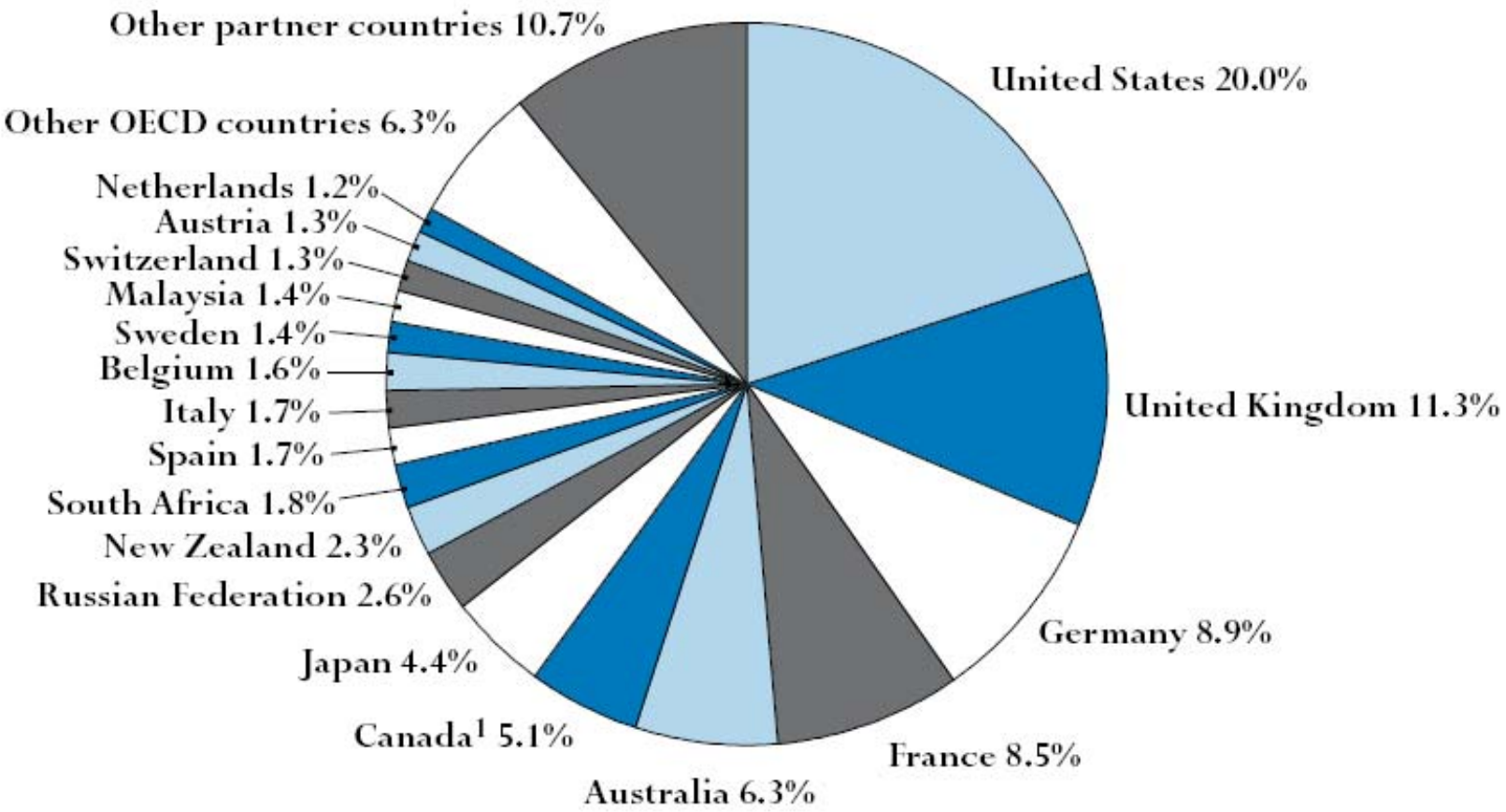
Fact 4: International Students Worldwide,

Year	Millions of International Students
1975	0.6
1980	0.8
1985	0.9
1990	1.2
1995	1.3
2000	1.9
2005	2.7
2006 OECD	2.9

- Source: OECD, Education at a Glance, 2008 p 352 and IIE, International Students and Mobility http://exchanges.state.gov/universitysummit/mobility_report.pdf
- NB: Project Atlas reports somewhat smaller numbers: “In 2006, UNESCO estimated that over 2.5 million students were being educated at the tertiary level in countries other than their homes, up from an estimated 1.7 million in 2000” (http://www.atlas.iienetwork.org/?p=46572)

Chart C3.2. Distribution of foreign students in tertiary education, by country of destination (2006)

Percentage of foreign tertiary students reported to the OECD who are enrolled in each country of destination



EU+ Switz, 38.9%

China and India, 2004

Percent Tertiary Students Abroad:

China **1.8%** **India** 1.2%

Top Host Destinations (2004)

	China	India
United States:	**87,943**	**79,736**
Japan:	**76,130**	
United Kingdom:	**47,738**	**14,625**
Australia:	**28,309**	**15,472**
Germany:	**25,284**	**4,237**

International Students are Critical Source of US Immigrants in SE workforce, 2005

	Proportion of Natural S &E Workers who are Foreign-Born	Proportion of Foreign-Born With Highest Degree in US
Bachelor's	5.2%	64%
Master's	38.6%	69%
Doctorate	50.9%	54%

Implication: International Students are major source of highly educated immigrant specialists.

Source: Degrees, NSF, Science and Engineering Indicators, 2008, chapter 2, Tables 2-28. 2-30, 2-31; Post-docs, Enrolments, grad, table 2-22.

The Great US SE Machine without foreign-born students and immigrants

Multinationals Invest Where the Educated Workers Are and Where Science is Being Producted.

Over 750 Multinationals have RD facilities in China;

China competes in nano-tech, other leading edge sectors;

Huge jump in Ga Tech index of sci-tech competence

Increased share of scientific papers

Rising China share of high tech exports

Falling EU share of high tech production

III. Implications and Opportunities

Tech transfer → all countries closer to technology frontier. By "North-South"model in which wage diff between advanced and developing depends on rate of innov vs rate of transfer, international wage and income differences should diminish

More SE workers and exchange should lead to faster production of ideas (ie recent China work on super-conductivity) and thus faster growth of knowledge. → faster productivity growth → lower priced goods.

Expansion of SE workers in developing country should reduce their price and cost of goods/ideas produced by SE workers

GREAT FOR WORLD

Example of Benefits of Foreign-Born To US economic development

Tech and Engineering companies founded from 1995-2005:

- 25.3% nationwide had an immigrant as a key founder
- 52.4% of Silicon Valley startups founded by immigrants
- 2005 revenue -- $52 billion. Employed 450,000
- Indians founded 26% of these

WIPO Patents from US:

- 25.6% had foreign national authors in 2006. This increased from 7.6% in 1998
- 16.8% had a Chinese-name and 13.7% had and Indian-name authors in 2006. This increased from 11.2% and 9.5% in 1998

But Change in Comparative Advantage:The N/S Model is No More

Traditional model:

We do high-tech, R&D and get good jobs;

Low income do old mfg at low wages;

We benefit from monopoly of advanced tech; only competition in high tech is from other advanced

But now populous low income have enough S&E workers to compete in high tech; can takeover most advanced

- Numbers matter, not relative numbers
- Able to commercialize despite weak infra-structure
- Lower cost R&D personnel, adjusted for quality
- Lower wage labor, adjusted for quality

Implications for Labor Market

- Highly elastic supply of foreign graduates for work in advanced countries means competition for home-grown talent.
- International students are major form of immigration policy
- Expect to see higher share of foreign-born and foreign-trained graduates in multinationals
- Expansion of modern technology/globalization will eventually create new job chances overseas for advanced country graduates but biggest gain for the present are for Developing country graduates

Universities become competitive source of comparative advantage

Branching overseas? Make immigrant status easier for overseas students? Raise quality? Teach in English?

US and EU exploit quality "brand"

Potential advantages of graduates in key positions in other countries: Trade networks; Idea networks

Possible danger to national security from spread of knowledge: In US, some agencies hire citizen S&E talent; to extent that immigration lowers returns and discourages US nationals from SE careers, these agencies fear increasing difficulty maintaining top flight work forces. (Why not quick citizenship? No evidence that non-citizens are less trustworthy than citizens.

Conclusion

Advanced countries cannot compete in quantity. So must find quality niches.

We thought we had better institutions but current financial crisis calls that into some question;

We have first mover edge. Tradition of openness to accept and build on foreign-created knowledge.

Key Policy Issue: Is it better to offshore work to low wage highly populous countries or to attract students and immigrants?

2: Millions of First University Degrees, Natural S&E Degrees, 24 year olds, ~2004

	European Union	US	World	EU/World	US/World
First Degree	1.636	1.407	10.926	15.0%	12.9%
Nat Sci &Eng	0.432	0.219	2.395	18.0%	8.5%
24 yr old	4.770	3.851	79.363	6.0%	4.9%
First/24 yr old	34.3%	36.5%	13.8%	2.49	2.64
Nat S&E/24 yr old	9.1%	6.1%	3.5%	2.60	1.74

Source: NSF 2008, appendix table 2-37 and 2006 table 2-37 for 24 year olds; NSF 1998 for 1995; * 1995-2004 for US/(Asia+Europe+ North America)