SESSION D

NATIONAL WORKFORCE DEVELOPMENT AND GLOBALIZATION

This session addressed the challenges and opportunities faced by nations in developing a skilled workforce through education and training, and in making the workforce available to a global market. It looked at the implications of “brain-gain/brain-drain” phenomena within different economies, and the actions taken by governments, businesses, and universities in recruiting S&T workers and students.

China's Competitive S&T Workforce: Unprecedented Expansion of Higher Education at the Turn of the Centuries

Yugui Guo, Ph.D.
Consultant, Community of Science, Inc.
E-mail: gillguo@msn.com

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Main Indexes:

1. **During the period of 25 years between 1978 and 2003, the China's GDP has grown at an annual average rate of 9.4%, increased by 9.5 times, from US$147.3 billion in 1978 to US$1.4 trillion in 2003;**
2. **In 2003 the China's total value of imports and exports took fourth place in the world, reached US$851.2 billion;**
3. **In 2003 China became the sixth largest economy in the world;**
4. **In 2003 China's foreign exchange reserve reached US$403.3 billion, 2,415 times as much as that in 1978;**

Main Indexes:

5. **In 2003 China's GDP per capita reached US$1,000, becoming lower-middle income country;**
6. **In 2003 China had the fifth largest share of worldwide outputs of S&T publications;**
7. **In 2003 China utilized foreign capital of US$53.5 billion, more than any other countries did;**
8. **In 2003 China began to run the largest higher educational system in the world: the higher educational institutions of various kinds enrolled 19 million students, the gross enrollment rate reached 17% of the age cohort.**

China's New Ambitious Goal:

- **The 16th National Congress of the Communist Party of China (CPC) held in November 2002 outlined the objectives of building a well-off society in an all-round way in China, one of which is to "quadruple the GDP of the year 2000 by 2020 and markedly enhance China's overall national strength and international competitiveness".**
- **Figures provided by the National Statistics Bureau show that China's GDP for the year 2000 was about US$1.08 trillion. In order to fulfill the above-said objective, China's GDP should reach about US$4.32 trillion by the year 2020 according to the current exchange rate. Then, China's GDP per capita will reach US$3,000, becoming upper-middle-income country.**

Two Fundamental Strategic Policies Adopted to Fulfill the Objective:

- **"Rejuvenate China through Science and Education" (Put forward at the National Science Convention held in May 1995)**

- **"Develop China through Talent" (Put forward at the National Summit Grand Convention on Talent held jointly by the Central Committee of the CPC and the State Council in December 2003. This Summit, for the first in history, focused specifically on talent. (Similar to the US National Education Summit in 1989, 1996, 1999, and 2001).**

Two Measures Taken to Ensure the Strategic Policies

- **To Train High-Level Talents on the Self Strength**

- **To Attract Overseas Chinese Students and Scholars through International Brain Circulation**

Unprecedented Expansion of Higher Education since 1998

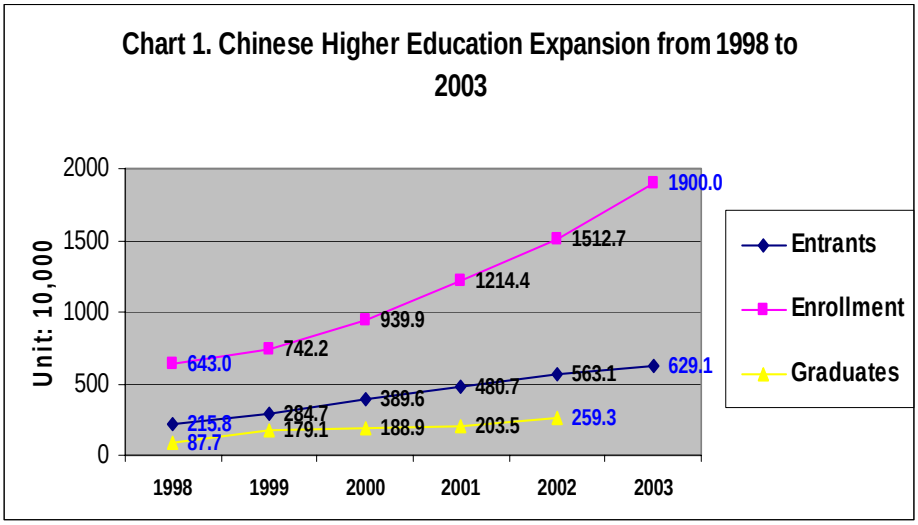
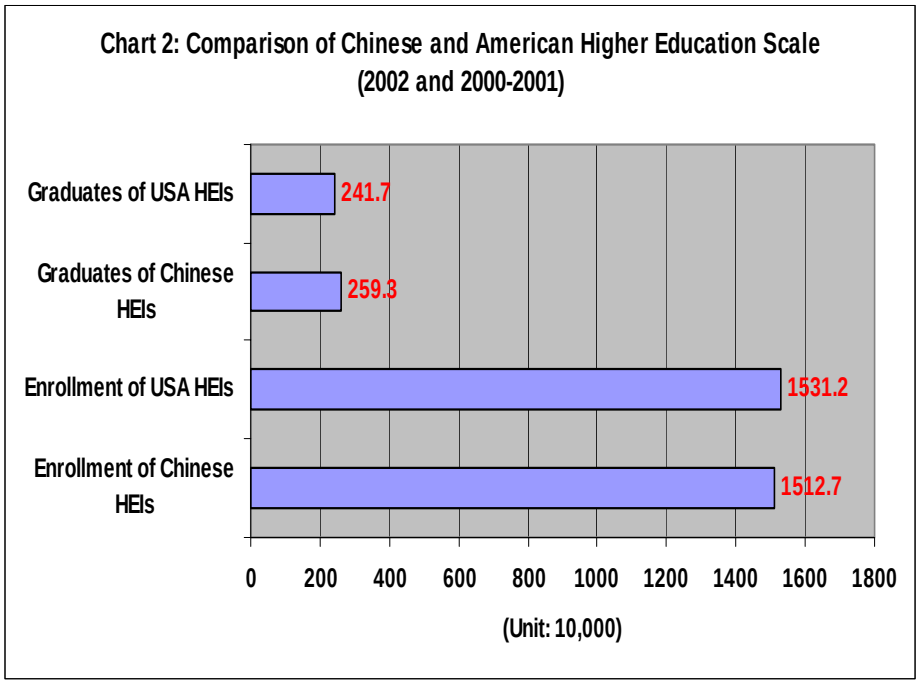


Table 1: Chinese Higher Education Expansion since 1998 (unit: 10,000)						
Regular HEIs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	108.4		340.9		83.0	
1999	159.7	47.3	413.4	21.3	84.8	2.2
2000	220.6	38.1	556.1	34.5	95.0	12
2001	268.3	21.6	719.1	29.3	103.6	9.1
2002	320.5	19.5	903.4	25.6	133.7	29.1
2003	382.2	19.3	1108.6	22.7	187.8	40.5
2004	410.0*	7.7*				
Adult HEIs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	100.14		282.22			
1999	115.8	15.6	305.5	8.3	88.8	
2000	156.2	34.9	353.6	15.8	88.0	-0.9
2001	195.9	25.5	456.0	28.9	93.1	5.8
2002	222.3	13.5	559.2	22.6	117.5	26.2
2003	220.0*		726.3*	29.9*		
2004	220.0**					
Graduate Programs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	7.3		19.9		4.7	
1999	9.2	26.0	23.4	17.6	5.5	17
2000	12.8	39.1	30.1	28.6	5.9	7.3
2001	16.5	28.9	39.3	30.6	6.8	15.3
2002	20.3	23.0	50.1	27.5	8.1	19.1
2003	26.9	32.5	65.1	29.9	11.1	37
2004	33.0**	22.7**				
Grand Total						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	215.8		643.0		87.7	
1999	284.7	31.9	742.2	13.9	179.1	
2000	389.6	36.9	939.9	26.6	188.9	5.5
2001	480.7	23.4	1214.4	29.2	203.5	7.7
2002	563.1	17.1	1512.7	24.6	259.3	27.4
2003	629.1	11.7	1900.0	25.6		
2004	750.0**	19.2**				



Chinese long-term goal:

- **To have 25 million students, and 23-25 percent of the age cohort, enrolled in higher education by 2010;**
- **To have 42 million students and 40 percent of the age cohort in gross enrollment by 2020;**
- **And to reach 50 percent in gross enrollment of the college age cohort by 2030-2035, thereby making Chinese higher education universalized.**

Projections of Graduate Education Expansion:

- **Though the capacity of the U.S.'s higher education system may be surpassed by that of China's education system, by breakdown, America currently leads in the conferring of graduate degrees. In 2003 China awarded 111,000 graduate degrees while America awarded 593,087 in the 2000-2001 academic year, 5.3 times as many. China has a long way to go to catch up with America. The detailed comparison can be seen in Table 2.**

Table 2: Breakdown of Higher Education Enrollments and Degree Conferred by Level in China and America (2002 and 2000-2001) (unit: 10,000)

	Total Enrollment	Undergraduate Enrollment		Graduate Enrollment		Total Degree Conferred	Undergraduate Degree Conferred		Graduate Degree Conferred	
	No.	No.	%	No.	%	No.	No.	%	No.	%
China	1512.7	1462.6	96.7	50.1	3.3	259.3	251.2	96.9	8.1	3.1
America	1531.2	1315.5	85.9	215.7	14.1	241.7	182.3	75.5	59.3	24.5

Trends of Graduate Expansion: 1995-2020

- Graduate enrollment is mainly affected by the growth rate of both the national economy and the relevant age cohort. But, in China, to a great extent it is affected by public policy—by whether enrollment quotas are set to restrict growth, or whether enrollment is left to be driven by demand. My projection here is mainly based on the first two factors: the growth rate of the economy and of the relevant age group.

The Population of Possible Graduate Students in China: the 25-to-29 age cohort

Table 3: Average Age of Recipients of Doctoral and Master's Degrees Awarded for Full-Time Studies, 1991-1994 (Number in person)

	Doctoral Degree		Master's Degree	
Year	Total	Average Age	Total	Average Age
1991	2519	31	29112	27
1992	2503	31	23572	27
1993	2082	31	23029	28
1994	3523	32	24780	28

Expansion Trends for GDP and Graduate Education, 1995-2020

Table 4: Expansion Trends for Graduate Education, 1995-2020 (In Constant 1994 Yuan)

	1994	2000	2010	2020
GDP Per Capita in Yuan				
Slow Growth (r=7%)	3,800	5,400	9,900	18,300
Medium Growth (r=8%)	3,800	5,700	11,500	23,300
Fast Growth (r=9%)	3,800	6,000	13,300	29,600
In Dollars (8.5 Yuan=$1)				
Slow Growth (r=7%)	447	630	1,200	2,200
Medium Growth (r=8%)	447	670	1,300	2,700
Fast Growth (r=9%)	447	710	1,600	3,500
Country Income Level	Low	Becoming Lower-Middle	Lower-Middle	Becoming Upper-Middle

Expansion Trends for GDP and Graduate Education, 1995-2020

Table 4: Expansion Trends for Graduate Education, 1995-2020 (In Constant 1994 Yuan) (Cont'd)

	1994	2000	2010	2020
Economy Income Level	**Low**	**Becoming Lower-Middle**	**Lower-Middle**	**Becoming Upper-Middle**
Enrollment Ratio (%)				
r=7.6%	**0.11**	**0.15**	**0.43**	**0.81**
r=9.8%	**0.11**	**0.19**	**0.64**	**1.47**
Enrollment (Thousand Students)				
r=7.6%	**128**	**186**	**387**	**805**
r=9.8%	**128**	**224**	**571**	**1,455**

The above predictions, formulated in 1998, are rather conservative. In 1999, the Chinese government decided to vigorously expand its graduate education. Table 5 shows that in the period from 1999 to 2003, the enrollment growth rate has been much higher than the fast growth rate of 9.8 percent predicted in 1998. The average annual growth rate reached as high as 26.8 percent. Graduate enrollment in China had already reached 651,000 in 2003. The MOE has planned to raise the graduate enrollment up to one million by 2005.

Table 5. Chinese Graduate Education Expansion since 1998 (Unit: 10,000)

Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	7.3		19.9		4.7	
1999	9.2	26.0	23.4	17.6	5.5	17
2000	12.8	39.1	30.1	28.6	5.9	7.3
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2002	20.3	23.0	50.1	27.5	8.1	19.1
2003	26.9	32.5	65.1	29.9	11.1	37
2004	33.0**	22.7**				

In 2000, the number of G-S enrolled in America was 2,156,625 in contrast with the figure of 501,000 G-S enrolled in Chinese universities in 2002 (four times as many). Based on these numbers, people might doubt the correctness of my prediction that China will catch up with America within about 15 years in producing the same number of graduate degrees. I would like to support my prediction by giving two more points:

First, since the majority of G-S in China study on the full-time basis, it is possible for them to complete their studies within the prescribed time span.

Secondly, it is important to consider the recent expansion momentum in graduate degrees production in China, as indicated in Table 5. Starting from 2005 when the Chinese graduate enrollment reach one million as projected, if graduate enrollment grows at the annual average rate of 7.5 percent over the next 10 years (up to 2015), the Chinese graduate enrollment will double the figure of 2005 and reach over 2 million. If 1/3 of these students graduate annually, the graduate degrees awarded annually would be about 700,000. On the contrary, according to the statistics of the US DOE, only about 623,000 graduate degrees are projected to be conferred in the 2010-2011 academic year. I am convinced China will also realize its goal within fewer than 15 years.

To Attract Overseas Chinese Students through International Brain Circulation

Leading Home Country of International Students in a Number of Countries:

In the past two decades from 1978 to 2003, over 600,000 Chinese students went to more than 103 countries and regions for overseas study, with the largest number traveling to the United States, according to a number of reports. China is now the leading sender of international students to a number of nations, including the U.S.A., Japan, Korea, Australia, Thailand, Malaysia, and Germany. America is the leading host country of Chinese international students.

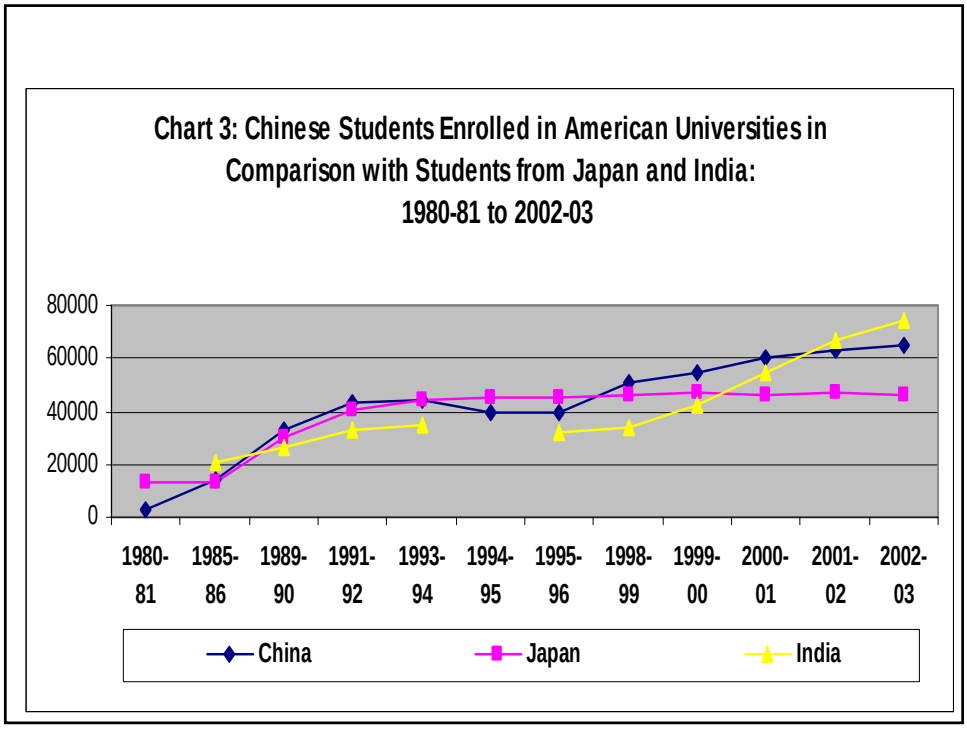


Table 6. Chinese Students Enrolled in American Universities in Comparison with Students from Japan and India: 1980-81 to 2002-03

	1980-81		1985-86		1989-90		1991-92		1993-94		1994-95	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	311880	100	343780	100	386850	100	419590	100	449704	100	452635	100
China	2770	0.9	13980	4.1	33390	8.6	42940	10	44381	9.9	39403	8.7
Japan	13500	4.3	13360	3.9	29840	7.7	40700	9.7	43770	9.7	45276	10
India			21010*	6.1	26240	7.3	32530	7.8	34796	7.7		
	1995-96		1998-99		1999-00		2000-01		2001-02		2002-03	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	453787	100	490933	100	514723	100	547867	100	582996	100	586323	100
China	39613	8.7	51001	10	54466	10.6	59939	10.9	63211	10.8	64757	11
Japan	45531	10	46406	9.9	46872	9.1	46497	8.5	46810	8	45960	7.8
India	31743	7	33818**	6.9	42337	8.2	54664	10	66836	11.5	74603	12.7

Table 7. Chinese Ph.D. Recipients from U.S. Universities Who Plan to Stay in the U.S.A. (1990-96)

1990					1991					1992					1993				
Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.	
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%		No	%	No.	%
All fields																			
1,225	725	59	502	41	1,919	1,523	79	920	48	2,238	1,980	89	1,080	48	2,416	2,134	88	1,077	45

1994					1995					1996				
Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.	
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%
All fields														
2,772	2,548	92	1,223	44	2,979	2,744	92	1,341	45	3,201	2,896	91	1,788	56

How to Turn Brain Drain into Brain Gain?

Asian students earning S&E Ph.D. in 1992-1993 who were working in US in 1997

Country of Origin	Foreign doctoral Recipients	Percent working in U.S. in 1997
S&E fields, total	16,391	53%
Chinese Taipei	2,149	36%
Korea	2,056	9%
China (PRC)	4,010	92%
Japan	214	21%
India	1,549	83%

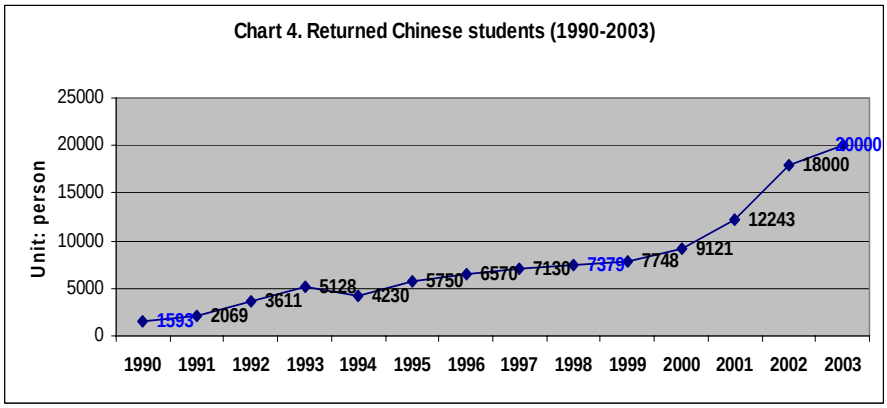
How to turn Brain Drain into Brain Gain? China Case

Encouraging Progress

Of the 1,045 Chinese students questioned in the USA in 1999:

- **Plan to return within 5 years: 21.2%**
- **Plan to return within 5-10 years: 36.5%**
- **Plan to return after 10 years: 22.9%**
- **Plan to remain: 19.4%**

Reverse Flow:



Trends of Reverse Flow:

- **Currently, China has a per capita GNP of about US$1,000, but numbers of overseas Chinese students returned home;**
- **Official report: From 1990 to 2003, the returnees increased by 13 percent each year, from 1,593 in 1990 to 20,000 in 2003;**
- **Considering the special circumstances of China: vast land, rich resources, large population as well as uneven development level from region to region, it seems likely that, when China has a per capita GNP of about US$1,500-2,000, China will turn brain drain into brain gain;**
- **To turn this possibility into reality should be accompanied with the enhancement of the political environment and improvement of the legal system.**

To Attract Overseas Chinese Students through International Brain Circulation

- **Reform in Overseas Study Policies**
- **New Policies on Absorbing Talents**
- **Acceptance of Foreign Students for Study in China**
- **Importation of Foreign Talents and Exportation Home Talents**
- **Mushroom Growth of Favored Programs for Talents Absorption and Nurturing**
- **In and Out China's Education Market**
- **Jointly-run Institutions**
- **Flow Back Through the Global Economy**

Global Development of Human Resources in Science and Technology and International mobility: Trends and Policy Issues

Mario Cervantes, OECD Science and Technology Policy Division

Outline

1) Context for HRST

2) Trends in S&T Graduates

3) Trends in S&T Enrolments

4) Demand for S&T grads and researchers

5) International mobility of students/researchers

6) HRST Policy measures

7) Conclusions and Next steps

1. Context for HRST

Move to knowledge-based economy – skills biased technological change

•Evolution of Higher Education – autonomy, multiple missions, internationalization, long term financing issues, more industry involvement

•Evolution of Research Systems - change in funding/governance

•Changes in public and private demand for Researchers

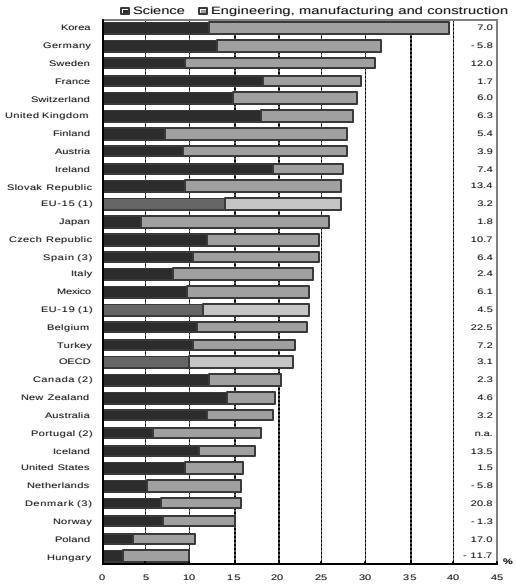
•Internationalization of higher education and research

•Triple concerns> Falling enrolments, ageing, competition for foreign talent.

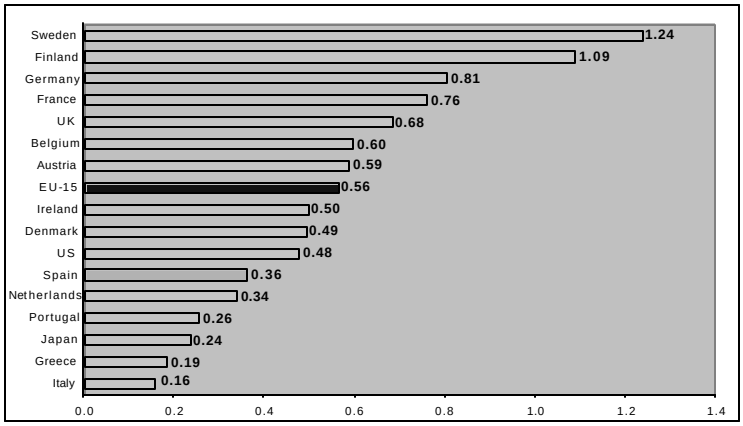
2. Recent trends in Supply of S&E grads

- Education attainment has increased across OECD
- EU and Japan have a greater share of tertiary graduates in science and engineering than the US
- The EU produces more science and engineering graduates at PhD level than the US and Japan.
- More women than men receive degrees in tertiary education in a number of countries but receive less degrees in S&T than men, especially at PhD level.
- Since 1998, the aggregate number of tertiary level graduates in science and engineering has increased in France, the United Kingdom, United States, Spain and Poland as well as the Nordic countries
- Germany, Hungary and the Netherlands record a decrease in science graduates
- Non-OECD countries produce a growing share of world supply of graduates, but also patents, and research papers

University graduates[1] in Science & Engineering[3], 1998-2001(*)



NEW SCIENCE AND TECHNOLOGY PhDs –per thousand population aged 25 to 34, 1999-2000



Source: OECD, Education and MSTI databases

2. The supply of S&T graduates in non-OECD countries is growing

- Non-OECD countries account for a growing share of the world's supply of university graduates.
- Number of university graduates in **China** in 2000 (739 000) was equivalent to 13% of the total number of graduates in the OECD area. More than half of Chinese university graduates receive degrees in science and engineering.
- The number of graduates from **India's** universities represented around 12% of the OECD total
- The number of **Russian** university graduates is equivalent to 11% the OECD total.
- China, Brazil, India, Russia, and Thailand collectively produced 87 115 PhDs, equivalent to around 60% of the OECD total.

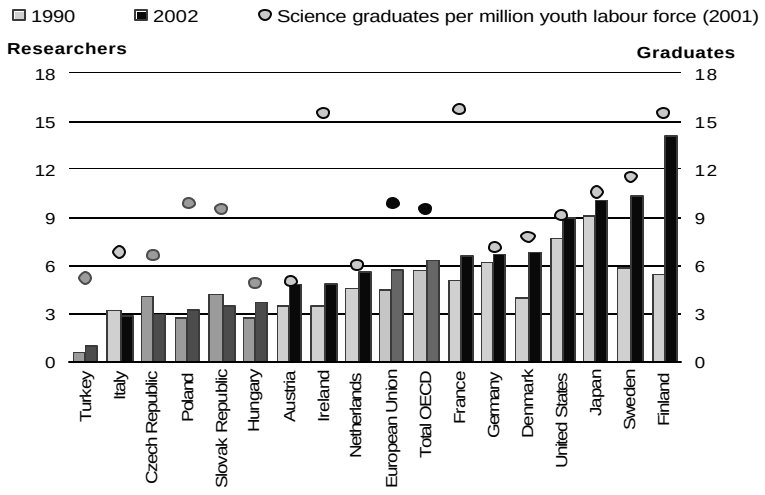
3. Recent trends in Enrolments in Some OECD Countries

- Uneven patterns by country, by level of education and by field of S&T study.
- Some countries have seen overall increases in enrolment
- Others register **a drop in enrolments at lower level tertiary education and in specific fields of science and engineering.** Still, some of these same countries have seen a rise in enrolment in science and engineering PhD programmes

4. Demand for S&T graduates and Researchers

- 20-35% of labour force has an S&T degree or works in an S&T occupation for which such qualifications are required.
- Researcher population in OECD countries increased sharply during 1990s
- Most women researchers work in the higher education and government sectors
- US has more researchers per labour force than EU
- But demand is coming more from the business and higher education sectors where R&D increases have been concentrated than from the government sector,
- Demand for foreign talent remains strong but responsive to business cycles and becoming more competitive
- R&D Targets and HRST implications

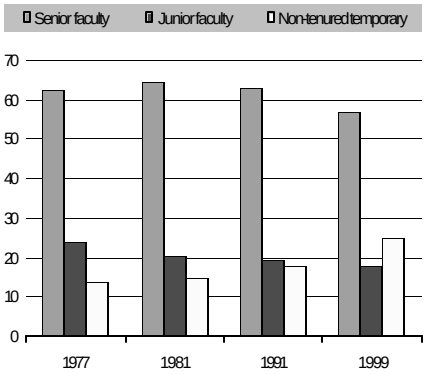
Growing employment of researchers



Source : OECD, Main Science and Technology Indicators, May 2003

But changing demand

Growth in temporary employment in the U.S.

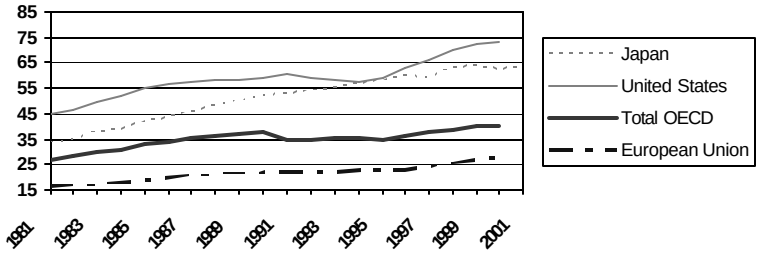


Trends

- Industry funding for research is increasing
- Greater industry support of academic positions
- Stress in public budgets limits hiring
- Temporary employment increasing (US, Japan, Italy)

and demand is coming more from the business sector

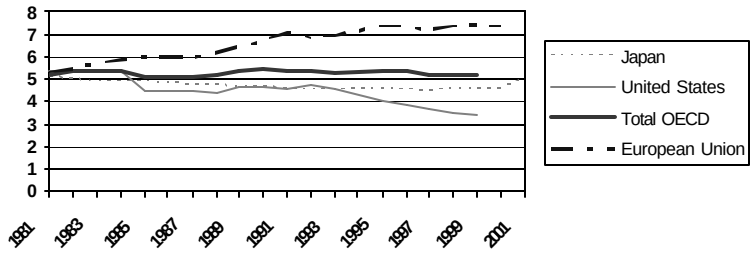
BE Researchers per 10 000 in the Labour Force (FTE)



Source : OECD, Main Science and Technology Indicators, May 2003

Overall Government demand is flat or falling in some countries

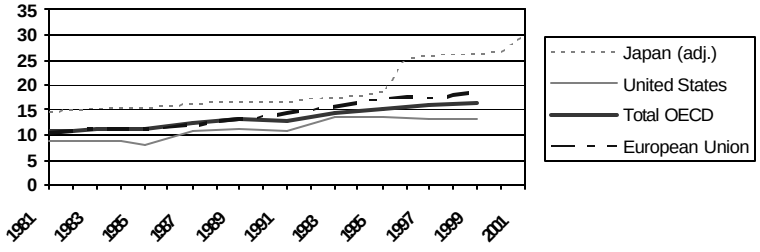
Gov Researchers per 10 000 in the Labour Force (FTE)



Source : OECD, Main Science and Technology Indicators, May 2003

Contrasts with upward demand for university researchers as universities increase share of public R&D

HE Researchers per 10 000 in the Labour Force (FTE)

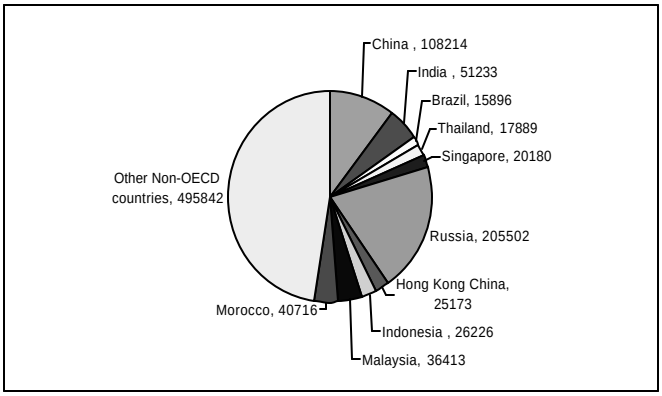


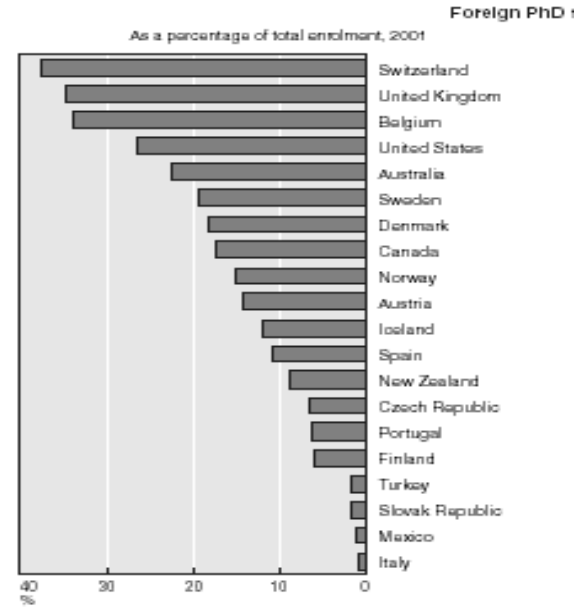
Source : OECD, Main Science and Technology Indicators, May 2003

5. Growing international mobility of S&T students and workers

- **1.5 million** foreign students in OECD countries.
- Foreign students account for **large share of S&T students/graduates**, including at PhD level, in several countries.
- **Growing complexity of flows** : south-north; north-north; temporary vs. permanent; return migration and brain circulation.
- **Multiple drivers of flows:** demand, globalization, but also policy actions (immigration, labour market access, etc.) and quality of national higher education and research systems

Foreign students enrolled in higher education studies in OECD countries, by country of citizenship, 2000

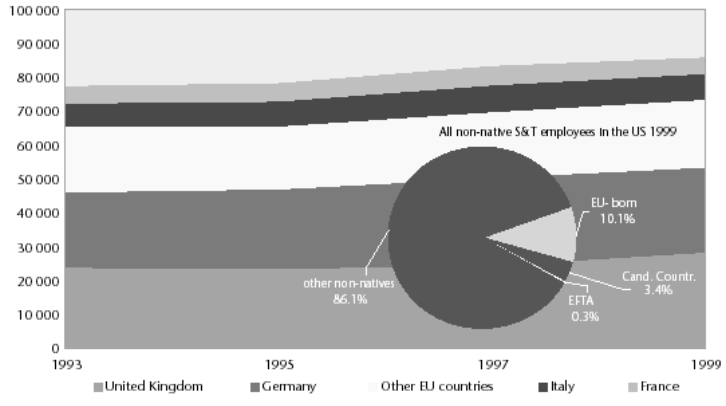




Source: OECD, Education database, November 2003.

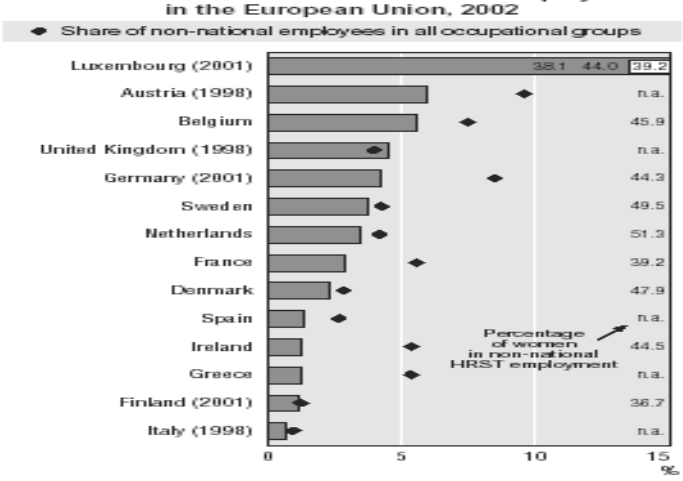
Foreign S&T employees in the US

Figure 4.4.3 Foreign born S&T employees in the US: total numbers 1993-1999, and shares of all non-nationals in % in 1999



Source NSF, treatment: DG Research
Data: NSF

Relative share of non-national HRST[1] employment in the European Union, 2002



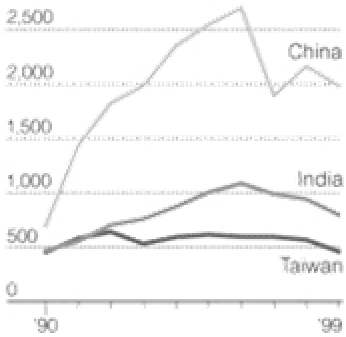
1. Human resources in science and technology defined according to occupational groups. HRST includes only ISCO-88 major groups 2 and 3 (professionals and associated professionals).

Source: OECD, based on data from the Eurostat Labour Force Survey, May 2003.

5. Complex patterns - Return Brain Gain? Or future brain circulation?

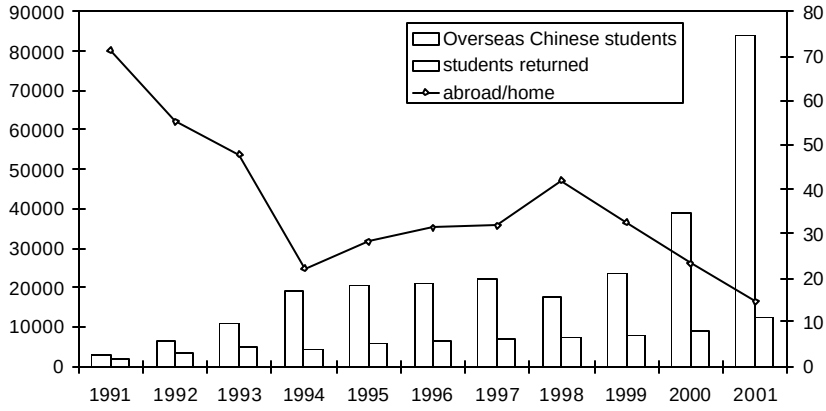
Graduates Planning to Stay

Science and engineering doctoral graduates from other countries who intend to remain in the U.S.



Sources: CHI Research, National Science Foundation

Chinese students studying abroad and returning (1991~ 2001)



Source: Gao Changlin, data from MOST(2002), China Science and Technology Indicators 2002

Globalisation of S&T Education and Workforce issues

Risk of Brain Drain remains for least developed countries;

Temporary migration dominates high skilled migration in OECD countries, but varies by country

Global trade in educational services increasing

- Driven by supply (capacity in OECD countries) and demand (from developing countries)
- Mobility of institutions complements mobility of students

Global benefits from international migration of the highly skilled but short-term adjustment costs

Limitations of accounting framework (i.e. costs versus benefits)

6. HRST Policy Measures

- Increase **participation** of young people in science studies
- **Reforms to curricula** to meet changing demand (e.g. multidisciplinary research)
- Enhance **teaching quality** at lower levels of education
- Reduce **gender gap** in science education/careers
- Fostering **mobility** -- through reforms & incentives
- Attracting **foreign talent** – and **return migration**
- Increasing **funding for PhDs and conditions of post-docs** and young researchers

7. Main Conclusions

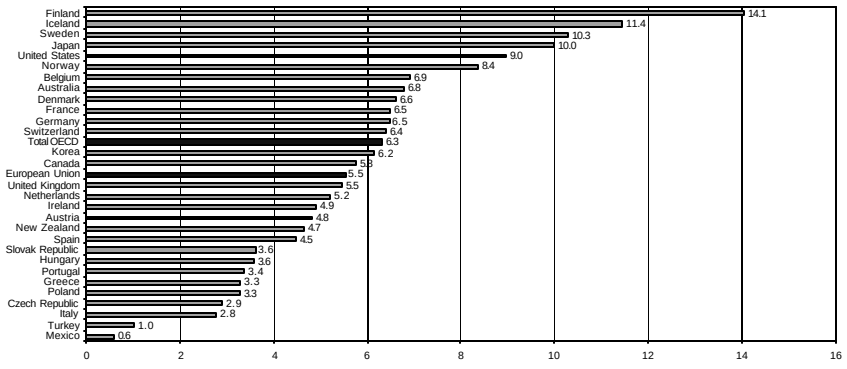
- Supply continues to increase, despite recent economic downturn
- Demand continues to expand and occupations projections show more employment will come from S&T occupations
- Globalisation of demand and supply
- Declines in enrolments/graduates all around but recent and limited to certain levels of tertiary education and specific fields of study (e.g. Chemistry/ Physics)

7. Ongoing work

- Further exploitation of data on enrolments at tertiary level by field/level of education.
- Fill gaps in demand data (census; labour force) by focusing on a few occupations
- Employment/unemployment data
- International mobility flows
- New International PhD Survey modelled on NSF

Research workforce continues to expand

Total Researchers per 1 000 in the Labour Force (FTE), 2001[1]

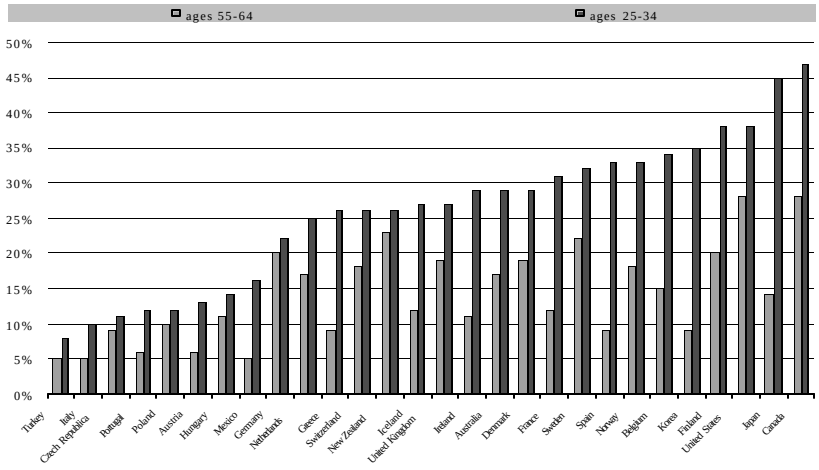


1. Or nearest available year.

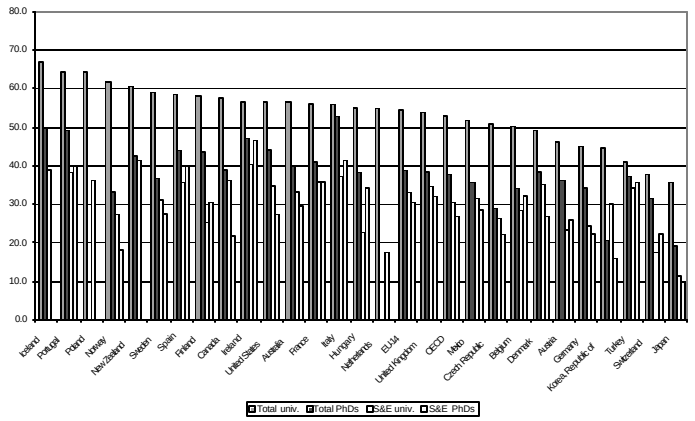
Source : OECD, Main Science and Technology Indicators, May 2003.

Educational attainment is improving

% of population with tertiary-level education



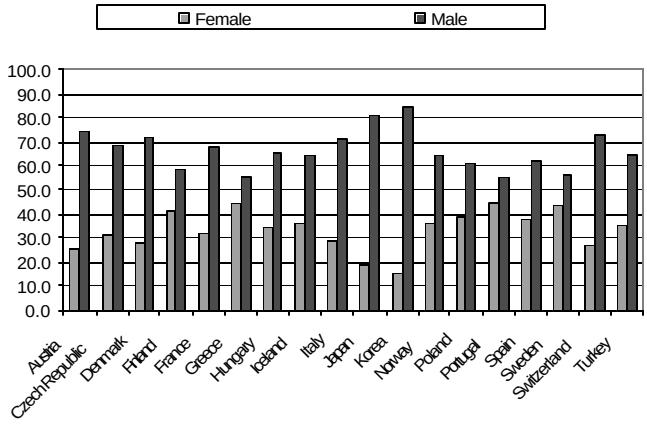
Gender gap in higher education is closing but less so in S&T and at higher degree levels



Source: OECD Education Database, November 2002.

Gender gap for researchers in higher education is still large

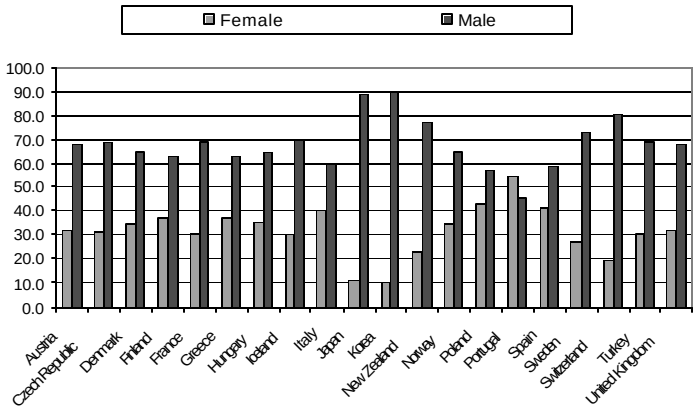
Researchers by gender, early 2000s
Higher Education



Source: OECD, MSTI, May 2003

Researchers by gender, early 2000s

Government

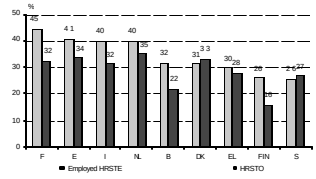


Source: OECD, MSTI, May 2003

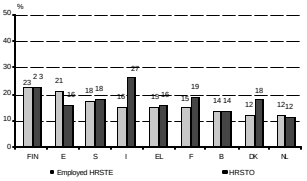
20-30% of people are classified as HRST across EU countries. Where is the demand?

HRSTO and employed HRSTE by selected field of study

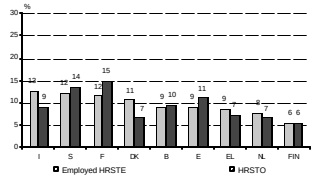
Social Sciences, Business and Law



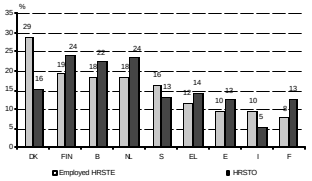
Engineering, Manufacturing and Construction



Science, Mathematics and Computing



Health and Welfare



Source: Eurostat, CLFS data.

TECHNOLOGY WORKFORCE

Education, Availability, and Globalization

A Study of the G7 Economies

Dr. Sujata S. Millick
U.S. Department of Commerce
sujata.millick@technology.gov

Objective and Themes

Objective

To determine ***policies*** and ***approaches*** adopted by countries in ***developing*** and ***sustaining*** their technology workforce base.

Themes

- Worker development - supply side
- Labor availability - demand side
- Globalization of workforce

Background

Previous Studies

- The Digital Work Force: Building Infotech Skills at the Speed of Innovation, June 1999.
- Education and Training for the Information Technology Workforce, June 2003.

Global Sourcing within the U.S.

- Foreign Students
- H-1B Visa issues

3

Country Focus

- Canada
- France
- Germany
- Italy
- Japan
- United Kingdom
- United States

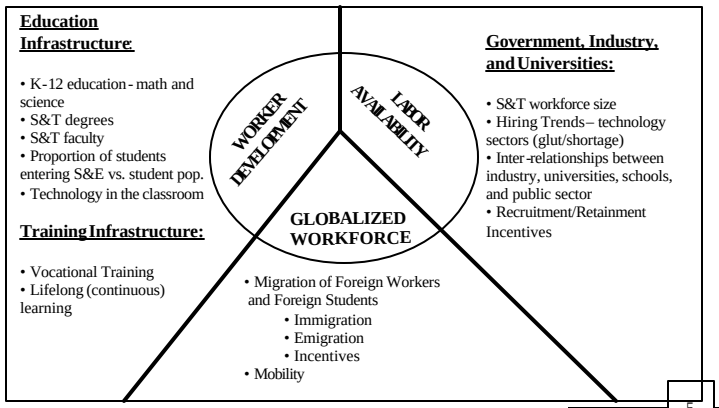
Countries: (1) History of investing in S&T

(2) History of investing in education

(3) History of data collection

4

Workforce Themes



Economic Snapshot

Country	Population	GDP ($B)	GDP/Capita	Labor Force	LF/Pop.
Canada	31M	700	22,572	16M	0.516
France	59M	1,306	22,169	27M	0.458
Germany	82M	1,846	22,054	40M	0.487
Italy	58M	1,089	18,783	24M	0.414
Japan	127M	4,144	32,554	67M	0.527
U.K.	59M	1,427	23,978	30M	0.508
U.S.	285M	10,206	35,835	143M	0.502

Source: IMD World Competitiveness Yearbook, 2002

R&D Snapshot

2001/2002/2003

Country	R&D Investment (million current PPP)	R&D Intensity	Government Share
Canada	$ 17,340	1.82	24%
France	$ 36,144	2.20	37%
Germany	$ 55,055	2.51	32%
Italy	$ 15,474	1.07	51%
Japan	$ 103,846	3.06	19%
U.K.	$ 29,353	1.89	30%
U.S.	$ 277,099	2.63	30%

Source: OECD

Education Snapshot

Country	Educ Expdt/GDP	Population aged 25-64 w/coll deg.	Enrollment Tertiary Educ. (00/01)	# of S&E Graduates (2000)
Canada	6.9%	41%	1.2M	53,307
France	6.2%	23%	2.0M	96,551
Germany	5.6%	23%	2.1M	65,163
Italy	4.8%	10%	1.8M	57,263
Japan	4.7%	34%	4.0M	359,019
U.K.	5.2%	26%	2.1M	95,179
U.S.	6.5%	37%	13.6M	398,622

Source: Col. 1,2– Statistics Canada & OECD, Col. 3 – UNESCO Institute for Statistics, Col.4 NSF

Foreign Students by Hosting Country and Continent of Origin (2000/2001)

	Total	North America	Asia	Europe
Canada	40,033	6,790	14,414	9,578
France	147,402	5,242	19,828	41,404
Germany	199,132	5,387	67,658	100,359
Italy	29,228	612	3,463	20,857
Japan	63,637	1,474	58,170	2,106
U.K.	225,722	18,564	74,400	109,454
U.S.	475,169	49,502	294,230	69,607
Total	1,180,323	87,571	532,163	353,365
		7%	45%	30%

Source: UNESCO, Global Education Digest 2003

Country Highlights

Canada – Highest percentage of population w/college degrees (41% of 25-64 population)

Germany – increasing flexibility in vocational education system for new technologies and new training, 6 yr degree program changing to 4yr system

U.S. – enrollment declines in physical sciences & engr, increases in computer science and life sciences

France – moving towards decentralization, broadening enrollment in grande ecoles

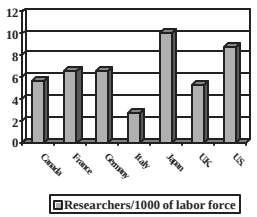
Italy – High dropout rate in university studies. 41% of secondary school graduates begin university with about 11% completing (= 5% of population that is college age).

U.K – Rise in biological and computer sciences and a reduction in physical sciences and engineering. University reform increasing fees.

Japan – The rigid structure of primary through tertiary education – needs to be balanced against creative/individualized learning

Workforce snapshot

Country	Labor Force	Unemplym Rate (2003)	Hourly Compensation	Researchers (FTE)
Canada	16M	6.9%	$16.02	90,810
France	27M	9.3%	$17.42	177,372
Germany	40M	9.3%	$25.08	264,384
Italy	24M	8.8%	$14.93	66,110
Japan	67M	5.3%	$18.83	675,898
U.K.	30M	5.0%	$17.47	157,662
U.S.	143M	6.0%	$21.33	1,261,227



Source: Col 1 - IMD World Competitiveness Yearbook, 2002; Col 2,3: BLS, Col 3,Col 4: OECD

Country Highlights

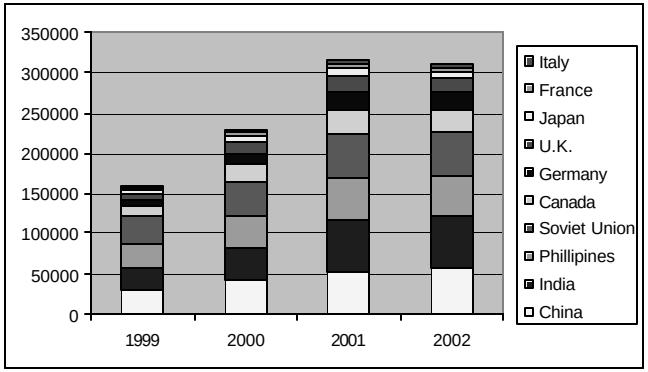
- Canada has a high youth unemployment rate (15% vs. 9% for overall) – questions regarding effectiveness of secondary/tertiary education. Limited population, decreasing fertility rate.
- France – Researcher issue over cancellation of new govt. research posts. Govt. research budget cuts and hiring of short-term researchers for govt. posts, 35 hr work-week.
- Germany – integration of dis-similar economies (east-west), unemployment higher in eastern region than western Germany
- Italy – Rigid labor rules, right to work. Highly industrialized central region, large informal economy (15%). Govt. has created incentives to encourage worker mobility between central and south.
- Japan – great need for "practice-based" education to meet industry's needs and "international skills" in technical workers.
- U.K. – S&E's moving to non-S&E sectors (financial, consulting) – salary rationale (+40%). Skills-matching between education and private sector needs.
- U.S. – concerns about manuf. and IT work, shifts of work to developing economies.

Foreign Population Snapshot

(in progress)

Country	Foreign Pop.	Foreign Labor	Labor growth	Immigration	Emigration
Canada	5.5M (2002)	3.2M (20%)	70%	199,560 (2003)	19,584 (2002)
France	3.3M (1999)	1.7M (1995) (6%)			
Germany	7m (1999)	2M (5%)			
Italy	1.2M (2000)			222,801	49,383
Japan	2.2M (2002)			351,000	1,680,300 (1997)
U.K.					
U.S.	32.5M (2002)	12.7M (9%)		1,063,732 (2002)	

U.S. Immigration



Source: USCIS, 2002 Yearbook of Immigration Statistics, October 2003

Recruitment of Foreign Skilled Workers

All countries have skilled worker entry-visa programs

• Canada – points system for skilled worker entry – immigration used to supplement labor force needs.

• France – 1998 law, ease of entry for scientists, and scholars, and some highly skilled professional categories.

• Japan – most restrictive immigration provisions, 5 year visas to meet short-term labor needs – IT especially.

• Germany – Universities have increased recruiting for foreign students, limited success of Green Card employment visa program.

• Italy – immigration reform for skilled and agricultural workers.

• U.K. – U.S. type temporary visa for high-skilled workers.

• U.S. – H-1B's, L-1's program – main source of skilled workers

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Education Challenges

- Declining size of entrant body
- Decline in S&T enrollments
- Education reform
  - Standardized system – 4 yr/GPA model
  - Incorporate IT
  - Market-based skills for entry jobs
  - Better connect univ. and industry research
  - Increase mobility for univ. researchers

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Labor challenges

- Shift from vocation/skill-based employment to knowledge-based employment (especially IT workers).
- Tertiary education needs to be responsive to market needs – skills and knowledge.
- Flexibility in worker skills and continuous worker training.
- Rigid labor rules restrict business transformations

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Migration Challenges

- Short-term (limited stay) approach
  - Japan, Germany
- Long-term (permanent stay) approach
  - Canada, U.K.
- Retention of native talent
  - France – Forum USA programs
  - Germany – Fellowships, Awards

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The Reasons to Stay

- Employment Availability
- Salary
- Stable/Increasing R&D Funding
- Career Mobility
- Social Factors:
  - Culture
  - Language
  - Integration ability

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Also the Reasons to Leave

- Employment Availability
- Salary
- Stable/Increasing R&D Funding
- Career Mobility
- Social Factors:
  - Culture
  - Language
  - Integration ability

Average Academic Salaries

Country	Average annual salary
Canada	58,289
United States	52,300
Finland	42,939
France	33,647
United Kingdom	31,210
Norway	30,511
Australia	28,654
Spain	23,365
Germany	23,005
Japan	15,481

Source: U.K., The Roberts Report, September 2002

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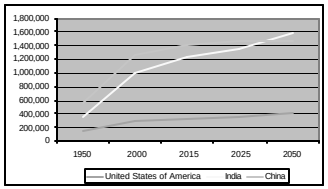
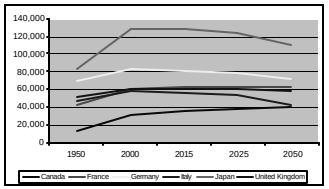
Ability to Scale the Workforce



Population



Implications for:

Benefits/Pension Systems
Labor Availability
Competitiveness

Affects:

Size of education infrastructure

Source: United Nations Population Fund, March 2001

India/China Factor

India has:
253 universities, 13,150 colleges
2.46 million graduates/2003
290k engineering grads/year

China has:
2.12M graduates/2003
450k engineering grads/year

IT Labor Pool

India: 290k engineering graduates
ITES labor pool of 2.1M

China: 50k annually
250k ITES labor pool

Russia: 20k IT professionals

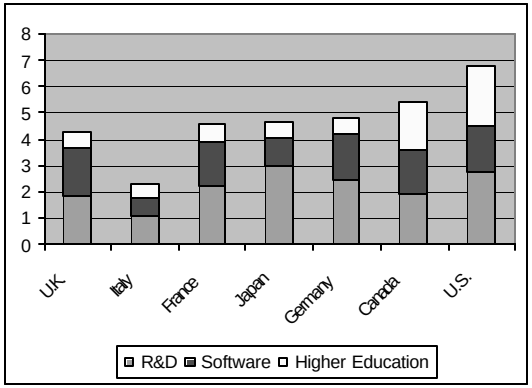
Philippines: 15k annually
380k ITES

Ireland: 4500 annually
U.S.:

Source: NASSCOM, Chinatoday.com

Continuing Investments

Investment in Knowledge (as a % of GDP)



Source: OECD, Science Technology and Industry Scoreboard 2003 – Towards a Knowledge-based economy

Industrialized Economies

Need to think Globally – Act Locally

- India and China – have become global labor sources.
- Education and National Priorities possibly more important than before.
- R&D investments – focused and stable

Thank You

Source: http://www.jklossner.com/TechToons/index.html