

The Human Resource Leapfrog Model and US Economic Leadership

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- CFR Roundtable
- Oct 31, 2005

Three Propositions

- I. US Share of S&E graduates falling; must continue to fall; Job market makes S&E careers less attractive to US than to foreign-born → reliance on foreign-born students & immigrants**

- III. Human Resource Leapfrog: Populous low income countries can compete in high-tech: China has become massive presence**

- III. Diminished comparative advantage in high-tech create adjustment problems for US**

Proposition 1

US share of World Population ... 6%

US share of college students

1970	30%
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2000	14%
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US share of S&E PhDs

1975	40%
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2010	15%
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Ratio of #S&E PhDs from Foreign Universities to # from US Universities

	1975	1989	2001	2003 ^a	2010 ^a
Asia major nations	0.22	0.48	0.96		
China	na	0.05	0.32	0.49	1.26
Japan	0.11	0.16	0.29		
EU major (Fr, Germ, UK)	0.64	0.84	1.07		
All EU	0.93	1.22	1.54	1.62 ^c	1.92 ^c
Chinese 'diaspora' vs. US 'stayers' (estimate)			0.72 ^b		

^a For 2003 & 2010, ratios calculated using US doctorates at 2001 production level.

^b 'diaspora' includes estimates of Chinese doctoral graduates from UK, Japan, and US (with temporary visas). US 'stayers' include US citizens and permanent residents

^c EU data extrapolated from earlier years.

China BS engineering degrees

Some confusion recently. Here are correct numbers

	Total Reported	4 year graduates
1989	---	108,729
2001	349,100	219,563
2002	459,820	252,024
2003	644,106	351,537
2004*	846,690	462,798

Younger Scientists Don't Get NIH Grants

Share of NIH Grants	1980	2002
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- | | | |
|-------|-----|-----|
| • <35 | 23% | 4% |
| • >45 | 22% | 60% |

Relative Odds of Getting an NIH, by age
(ratio of shares of NIH grants to shares of Ph.D.s)

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|-----------------|------|------|
| • <35 | 1.21 | 0.30 |
| • >45 | 0.52 | 1.07 |
| • Younger/Older | 2.33 | 0.28 |

Source: NIH for shares of grants by age and NSF for shares of PhDs by age,

Trend in Foreign-born Share of S&E Employment

	1990	2000
Bachelors	11%	17%
Masters	19%	29%
All PhD	24%	38%
PhDs < 45	27%	52%
Post-Doc	51%	60%

Source: all but post-docs from Census of Population; Post-Docs from NSF. Note:
FB % Post-Doc in 1987 was 45%

Proposition 2: HR Leapfrog

Traditional North/South model: we do high-tech, R&D 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

New “human resource leapfrog” model: populous low income has enough S&E to compete in high tech; can takeover most advanced because of lower cost; multinationals shift RD to populous low income

Key to Human Resource Leapfrog

- Numbers matter, not relative numbers
- Able to commercialize despite weak infrastructure
- Multinationals transfer skills/ use
- Lower cost R&D personnel, adjusted for quality
- Lower wage labor, adjusted for quality

Signs of lower comp advantage

shares of papers

Ga Tech technological index: rise of China

Off-shoring to India

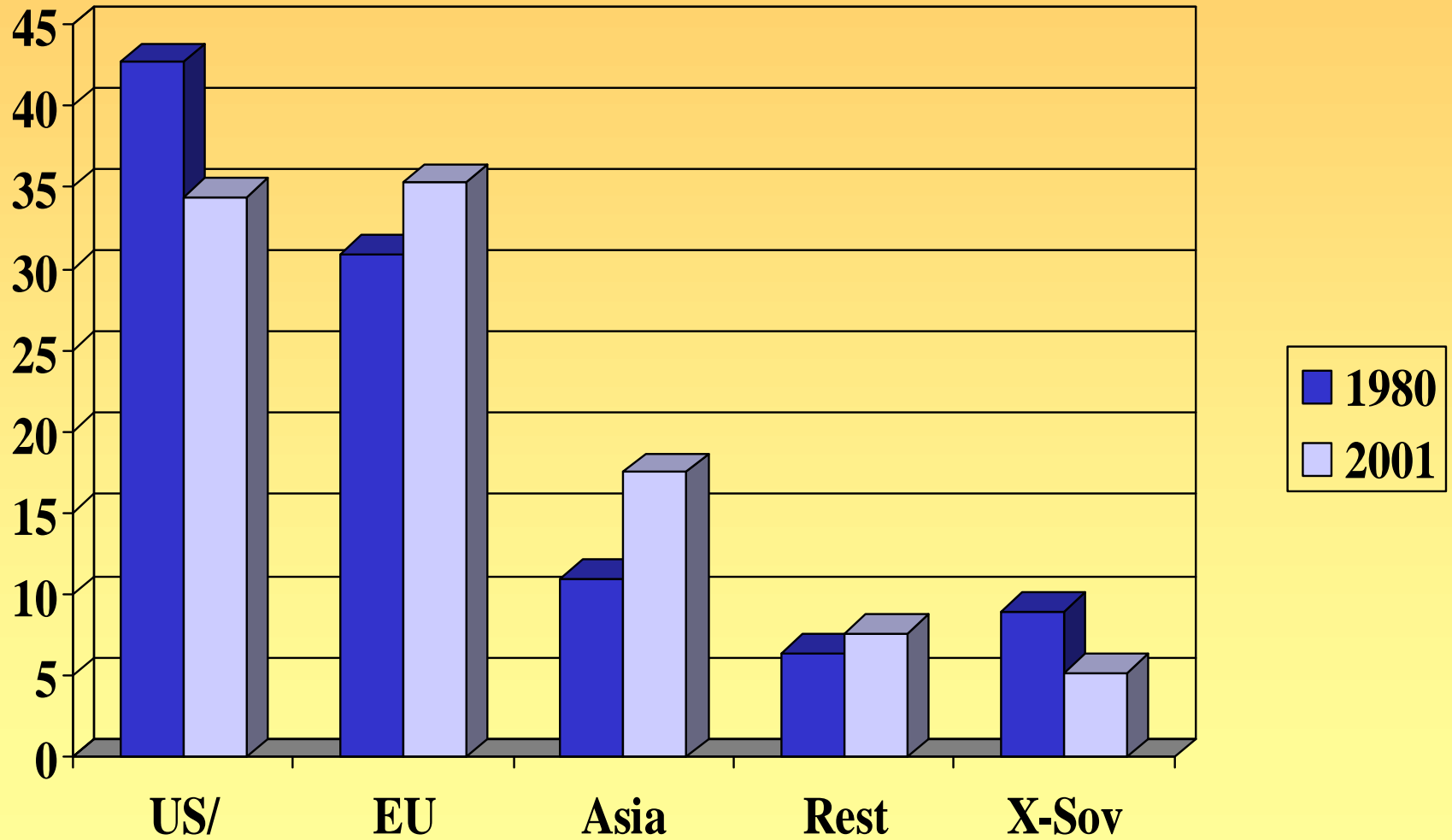
Multinational formation of R&D centers in China

Falling US share of high tech exports

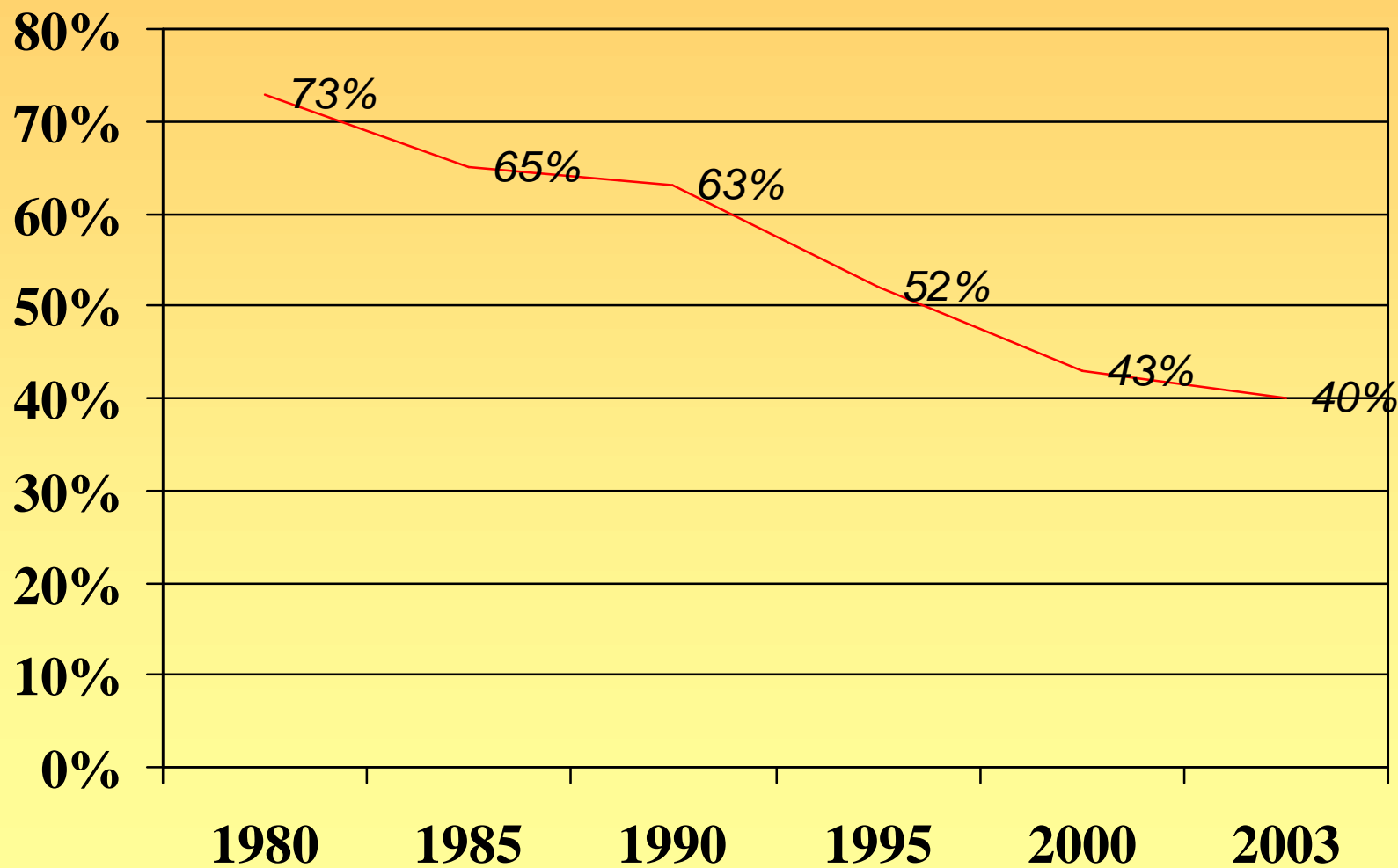
Rising China share of high tech exports

China as one of top four in nanotechnology

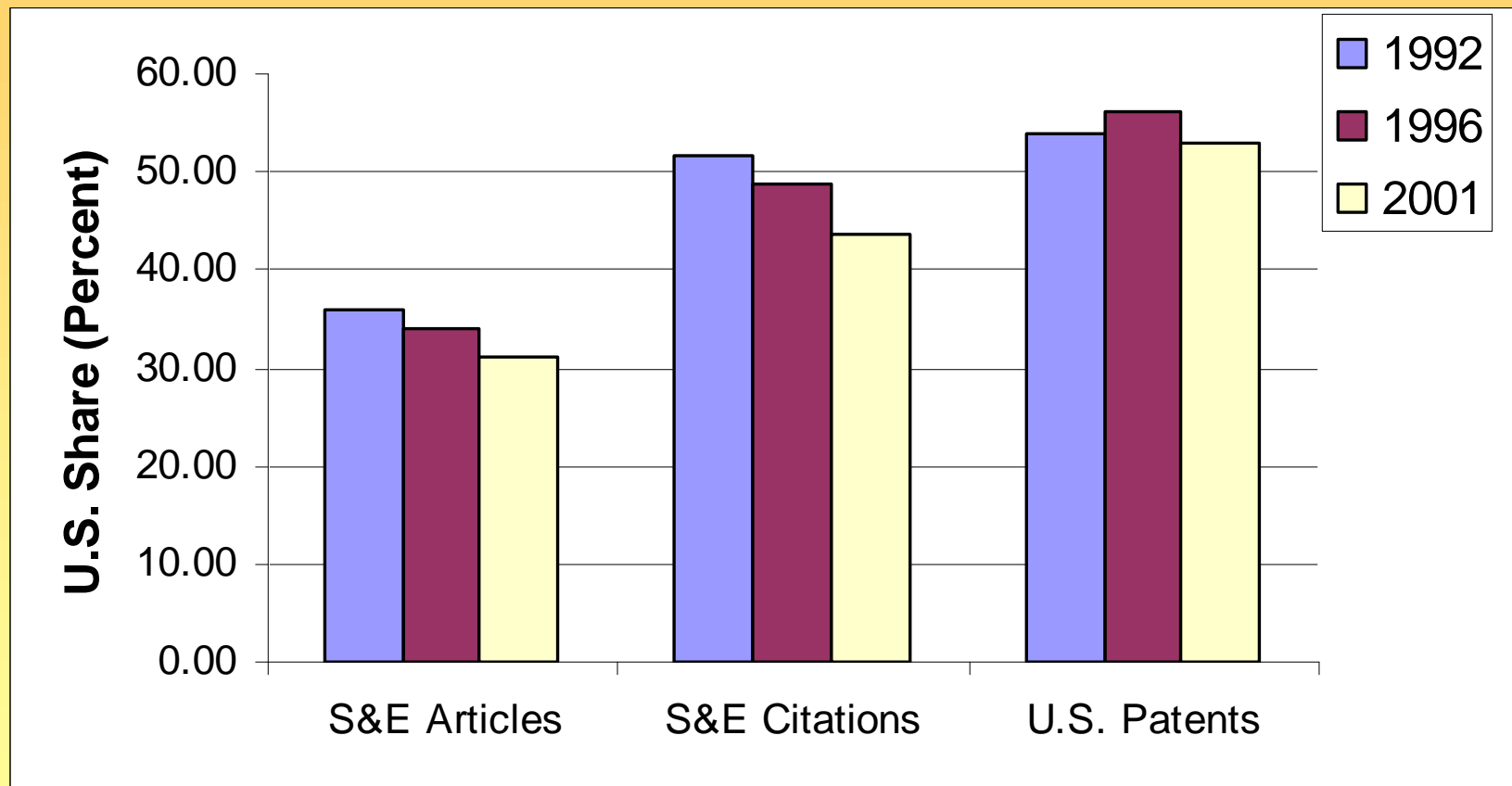
Share of Scientific Papers



US share of Papers Chemical Abstracts Service, 1980-2003



Trends in US shares of Scientific Papers, Citations, Patents



Sources: Science & Engineering Indicators – 2004 (NSF), and primary sources referenced therein.

Proposition 3: Adjustment

Standard argument is that competition lowers price of our exportables

Jones-Ruffin say, but if we lose sector completely and price falls a lot, we could be better off – analogous to immiserizing growth

More likely: loss of good jobs; loss of monopoly profits shared with workers

Cost of adjustment depends on size of sector, closest alternatives, magnitude of labor cost gap

Still, output and well-being should rise

- **Forces to raise well-being**

- More rapid technological change from more science and engineering RD

- Lower prices for high tech goods; for low tech goods

- Rising wages in developing countries

- **Forces to reduce well-being**

- Reduced price in US exportables

- Loss of dominance in good “retainable” industries

What Can US Do?

“Loss of dominance does not mean loss of excellence”

Slow transition by increasing SE work force
more/better stipends; fast citizenship

Concentrating resources on particular technologies;
danger of military absorbing too many resources

Exploit collaborations; network -- “When they
collab with us, who commercializes first?”

Partner with large populous to reduce competition?