

The US Engineering Workforce in the New Global Economy

- 1) Smaller US share of global science and engineering
--> Rising internationalization within US and through collaborations across country lines
- 2) Labor market issues and policies: demand not supply is the problem

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1. Globalization of Science and Engineering

Inevitable fall in US share of resources/activities

	US /World in % Units			
	1980	1990	2000	2011
1. R&D spending				
a) All countries, Indicators				32
b) Major R&D countries*	45	43	45	38
c) All countries, OECD	44	36	40	33
2. Researchers			22	20
3. S&E papers	37	37	31	26
4 S&E citations	53	50	43	
articles in upper 1% citation			57	46
5. S&E bachelor's				
a) Relative to select countries	23			
b) Relative to world			14	10
6. S&E PhDs				
a) Relative to select countries	52	41	34	
b) Relative to world			22	16

Foreign share in S&E Higher Education

Exhibit 2: Percentage Foreign-Born or with temporary visa of US S&E Graduate Enrollments and Degrees, 1970-2011/12

	1970	1980	1990	2000	2011/12
1. Graduate students, full-time, in science and engineering*		22.5%	33.9%	36.3%	36.3%
2. Bachelor's Degrees		3.5%	3.6%	3.8%	3.8%
3. Master's Degrees		16.4	22.6	25.8	26.0
4. Doctorate Degrees,	18.4	26.4	31.8	30.4	34.2
5. All Post-doctoral Workers		38.6	51.1	58.2	62.9
6. Post-doctoral in university jobs for US doctorates only	17.5	18.3	39.1	43.0	49.0

Foreign-born and Total Engineering Enrollees and Graduates in US, 2011

	Foreign-born	US total	Ratio of Foreign to Total
Undergraduate enrolled	33,150*	511,306	6.50%
Graduate Enrolled	66,580	143,390	46.4%
BS Graduates	5,251	78,099	6.7%
MS Graduates	17,387	41,282	42.1%
PhD Graduates	4,765	8,478	56.2%
Postdoctoral researchers in Academe	4,035	6,764	59.7%

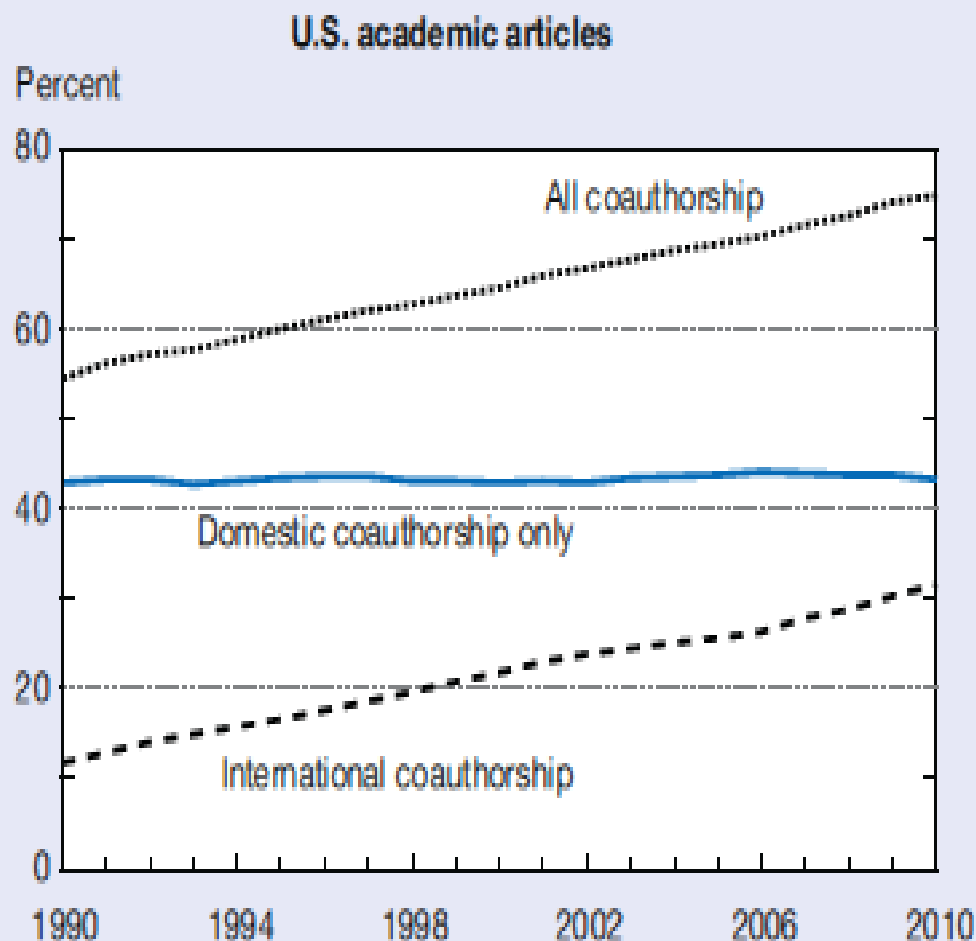
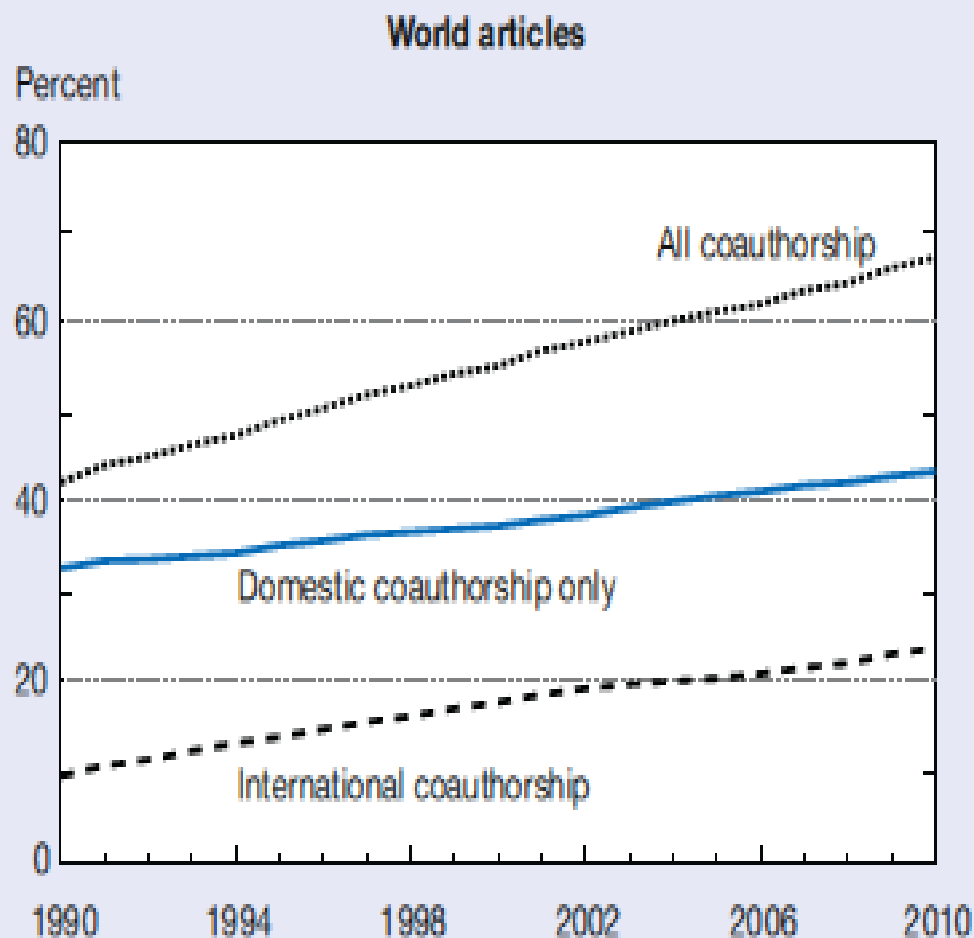
*42,220 in 2012

Source: Science and Engineering Indicators, 2014, appendix tables 2-23, 2-27, 2-28, 2-30, 2-31
Graduate Students and Postdoctorates in Science and Engineering: Fall 2011

Detailed Statistical Tables | NSF 13-331 | September 2013, table 38.

International Collaboration: Across countries

World and U.S. academic S&E articles coauthored domestically and internationally: 1990–2010



NOTES: Article counts from set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Articles classified by year they entered database, rather than year of publication, and assigned to country/economy on basis of institutional address(es) listed on article. Articles on whole-count basis, i.e., each collaborating institution or country credited one count. Internationally coauthored articles may also have multiple domestic coauthors.

Exhibit 4 Percent Foreign-Born in S&E Occupations, by education level, 1990-2011

Foreign-Born	1990	2000	2011
All College Graduates in S&E		22.4	26.2
Bachelor's	11.00%	16.5	19.0
Master's	19.00%	29.0	34.3
PhDs	24.00%	37.6	43.2

Source: Science and Engineering Indicators 2014, table 3-27.

International Students Critical in Immigration

Exhibit 5: Proportions of US Science and Engineering Workers that are Foreign-Born and the Proportion of the Foreign-Born that Have Highest Degree in the United States, 2005

	Foreign-Born Share of Workers	Share of Foreign-Born with Highest Degree in US
Bachelor's	15.2%	54.3%
Masters	27.2%	68.5%
Doctorates	34.6%	64.00%

EU studies show causal relation between programs to place students short term in another country and location in that country

2. Labor Problems and Policies

No Supply Side problem

shortage/disinterest of youth is “myth” – No evidence of lack of student response to jobs/pay nor of deterioration of interest or academic skills;

loss of some “best and brightest” to finance reflects market incentives

substantial response of foreign-born → elastic supply

Demand Side Problems

company collusion to lower job market competition in Silicon Valley

R&D exceptionally biomedical focused: In 2011 US spent 51.6% of RD on bio-med: EU spent 43.3%; Japan, 42% and China 26% .

US NIH spending due to doubling NIH budget; Senator Specter; ARRA spending; Senator Specter.

PERCENTAGE DISTRIBUTION OF GRADUATES BY TYPE OF HIGHER EDUCATION INSTITUTION, 2011
(Indicators 2014 Appendix table 2-1)

Panel A: Engineering

Type of Institution	Bachelor's	Master's	PhD
All institutions	100%	100%	100%
PhD – very high research	52.8%	54.8%	81.7%
PhD – high research	22.5%	25.6%	15.9%
PhD research	4.1%	3.8%	1.2%
Master's	14.5%	14.7%	0.0%
Baccalaureate	4.6%	0.0%	0.0%
All other	1.5%	1.1%	1.2%

Panel B: All S&E

Type of Institution	Bachelor's	Master's	PhD
All institutions	100%	100%	100%
PhD – very high research	38.0%	41.5%	74.2%
PhD – high research	14.9%	19.5%	15.8%
PhD research	5.6%	9.8%	4.9%
Master's	28.6%	24.9%	0.9%
Baccalaureate	11.7%	1.0%	0.0%
All other	1.2%	3.3%	4.2%

Apple, Google, Adobe and Intel settle Silicon Valley poaching case

By Howard Mintz hmintz@mercurynews.com San Jose Mercury News

Posted:

MercuryNews.com

In a case that exposed the dark side of hiring practices in the tech industry, Apple, Google, Intel and Adobe on Thursday opened their checkbooks to avoid an embarrassing trial by settling a major lawsuit that alleged they colluded for years to not poach each other's employees.

The settlement, disclosed in a letter to the federal judge handling the case, did not reveal the amount of the pact, but Reuters reported the figure was around \$324 million. The valley employees who sued over the "no poaching" agreements were expected to demand at least \$3 billion from a jury if the legal fight had moved to a late May trial.

More than 64,000 valley employees in the class action lawsuit, many of them in jobs such as software engineering that form the lifeblood of the local tech economy, stand to benefit from the deal. In addition to Thursday's settlement, Lucasfilm, Pixar and Intuit settled last year with the employees for about \$20 million.

Comment: Settlement of ~\$324M or \$5,000 per worker in class. True benefit to colluding firms? Almost certainly greater than \$5,000 for years scheme operated. True cost to economy?

A Banker Comments: Who Do These High-Tech companies think they are -- Wall Street Too-Big-to-Fail Banks!

Policy directions worth considering

- 1) Address localization of engineering in select schools; among declining male share of students; find ways to ease foreign-born grads into permanent resident/citizenship.
- 2) New fellowship for transformation of knowledge into US production.
- 3) Scientific study of national R&D budget to take account of long run effects of R&D on industrial structure and jobs
- 4) Require firms with govt R&D support to develop action plans for ways to produce innovative products in the US.