Immigration, Innovation and the Search for Talent

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What do Mark Zuckerberg and Bill Gates have in common? (aside from being insanely rich)

- Both want more H-1B visas for high-skilled workers
    - Tech industry is furiously lobbying the US Congress

- Supply of high-tech labor constrains growth of tech firms
    - Facebook, Google, IBM, Intel, Microsoft, Oracle, Qualcomm

- Would more H-1Bs change composition of immigrants?
    - Program criticized for attracting low-level outsourcers to US

Innovation and the Global Demand for Talent

The economic importance of highly skilled labor

- R&D talent sets pace of productivity growth
  - Around 50% of G-5 growth due to R&D intensity (Jones, 2003)

- Innovation requires STEM (science, tech, math, engineering)
  - STEM grads patent at much higher rates (Hunt, 2011)

- Immigration: high-skilled inflows raise productivity growth
  - Hunt & Gauthier-Loiselle (2010), Kerr & Lincoln (2010), Moretti (2012), Stuen Mobarak & Maskus (2012), Peri (2012)

Grow your own (Freeman, 2010)

- US universities remain highly ranked globally (ARWU.org)
  - All of top 10 universities in engineering
  - 7 of top 10 universities in natural sciences and math
  - 7 of top 10 universities in life and medical sciences

- But aptitude of US students in STEM is relatively weak
  - US PISA scores (2009): 31st in math, 23rd in science

Import from abroad (Bound Turner & Walsh, 2009)

- Immigration is a major source of STEM talent in US
  - Student/H-1B visas are key entry path for STEM labor

US Temporary Visa Programs: Alphabet soup

Visas for temporary immigrant workers (entries in 2010)

- E: Treaty Trader, Investor (384k)
- **H-1B: Specialty Occupation, Fashion Model (455k)**
- H-2: Temporary Agric., Non-agric. Worker (200k)
- L: Intracompany Transferee (700k)
- O: Individual with Extraordinary Ability or Achievement (70k)
- P: Athlete, Artist, Entertainer (97k)
- Q: Worker in Cultural Exchange (2k)
- R: Worker in Religious Occupation (21k)
- TN: NAFTA Professional Worker (674k)

H-1B Visa Program

Current procedures for H-1B visas

- Visas designated for workers in "specialty occupations"
  - Visa is for 3 years, renewable once (stepping stone to LPR)
  - Not limited to tech, just jobs requiring a BA degree
    - Tech's large share of H-1Bs is endogenous outcome
- Employers must file Labor Condition Application
  - Pay prevailing wage; must recruit, can't displace US workers
- Visa cap is 65k per year (additional 20k for US MAs, PhDs)
  - US Senate would increase cap to 110k (flexible up to 180k)
- Limited data on visa holders (gov't doesn't track H-1B exits)
  - Many leave before 3 years are complete (Clemens, 2011)

Common paths to legal permanent residence in US

Have US relative

- Apply for family-sponsored green card

Don't have US relative

- Apply for diversity visa (lottery) or refugee visa
- Apply to US university, obtain student visa
  - Upon graduating, obtain job and H-1B visa
  - Transition to employer-sponsored green card
- Apply to US employer, obtain job and H-1B visa
  - Transition to employer-sponsored green card

What I do in this paper

1. Document STEM presence in US high-skilled labor force

2. Document immigrant presence in STEM occupations

3. Speculate on entry channels of foreign-born STEM labor

4. Compare wage premia for foreign-born workers (relative to natives) in STEM, non-STEM occupations

Defining STEM

Categories in my definition

- Engineers
- Software developers, programmers, web developers
- Computer & information analysts
- Database administrators, network architects
- Life scientists, physical scientists
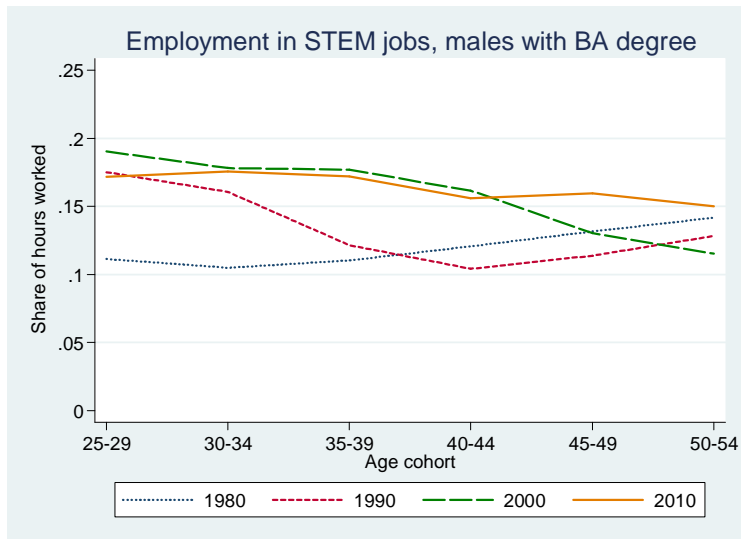- Mathematicians, computer scientists

Categories commonly included that I exclude

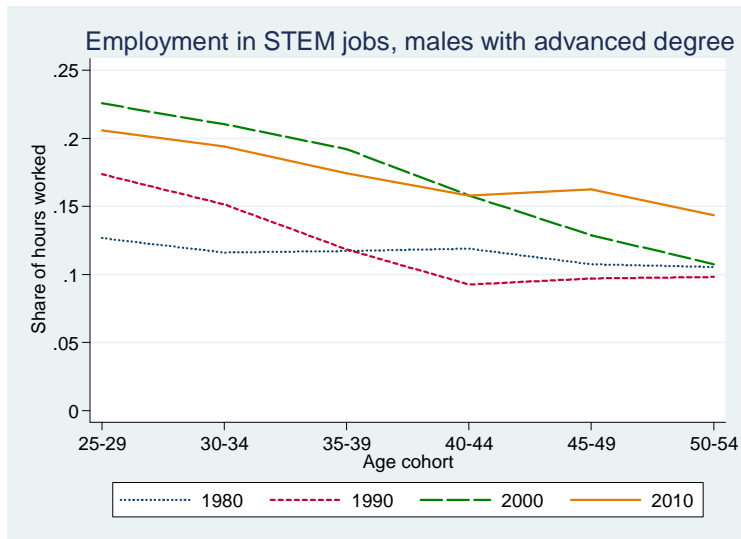- Drafters, technicians, computer support staff (all low skill)

US employment (hours worked) in STEM occupations

| STEM Occupation | Employment (2011) | Share of employment (%) | | Median salary (USD, 2011) |
		STEM jobs	All jobs	
Engineering Occupations	1,530,090	31.1	1.2	86,200
Software Developers, Programmers	1,397,780	28.4	1.1	87,100
Computer & Information Analysts	740,440	15.0	0.6	80,631
Database & Network Administrators	599,800	12.2	0.5	76,880
Life Scientists, Physical Scientists	534,640	10.9	0.4	71,898
Mathematicians, Computer Scientists	122,880	2.5	0.1	79,686
Total	4,925,630	100.0	3.9	

Employment in STEM jobs, males with BA degree

Employment in STEM jobs, males with advanced degree

Rise of STEM less pronounced among women
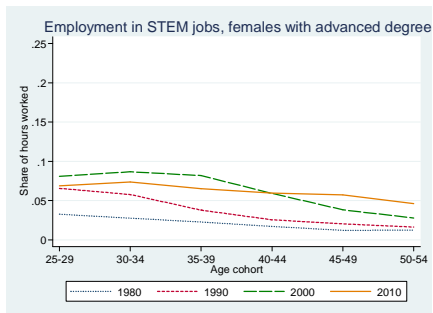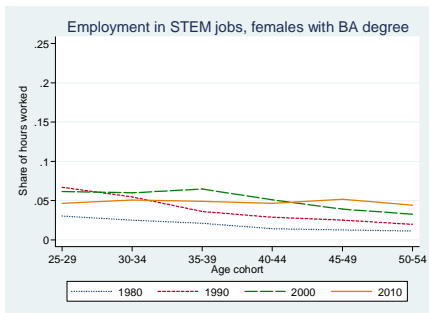
Immigrants are more common in STEM occupations...
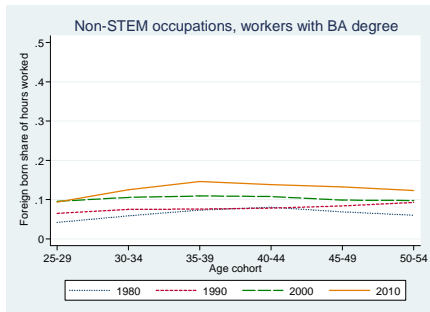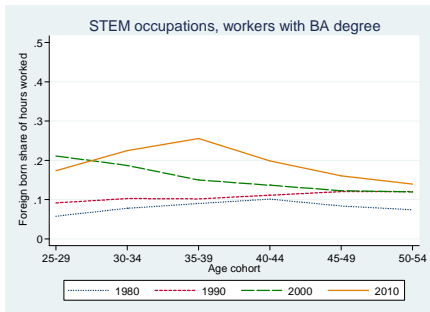
...especially among MAs and PhDs

Immigrant presence greatest in computer software, hardware

Most immigrants in STEM enter after age 21 (via H-1B?)

Share of foreign born workers arriving age 21+, 2010

Share of immigrant STEM employment by birth country

Foreign-born workers in STEM occupations with advanced degrees

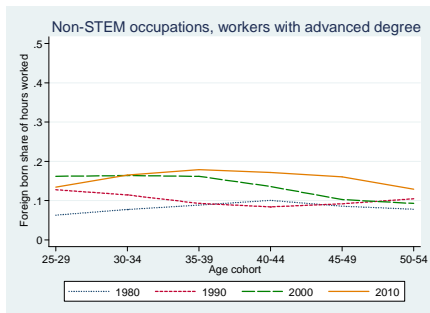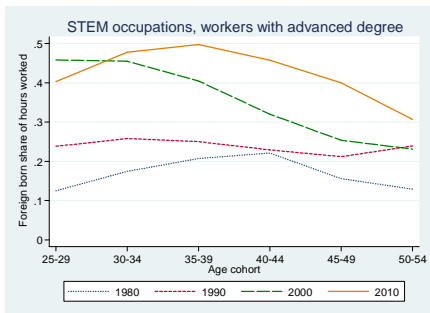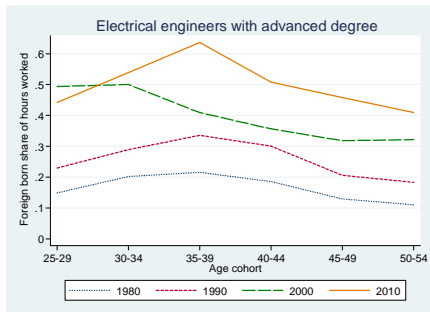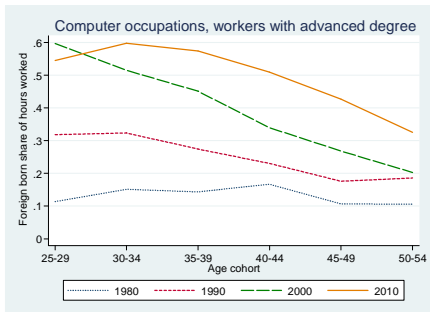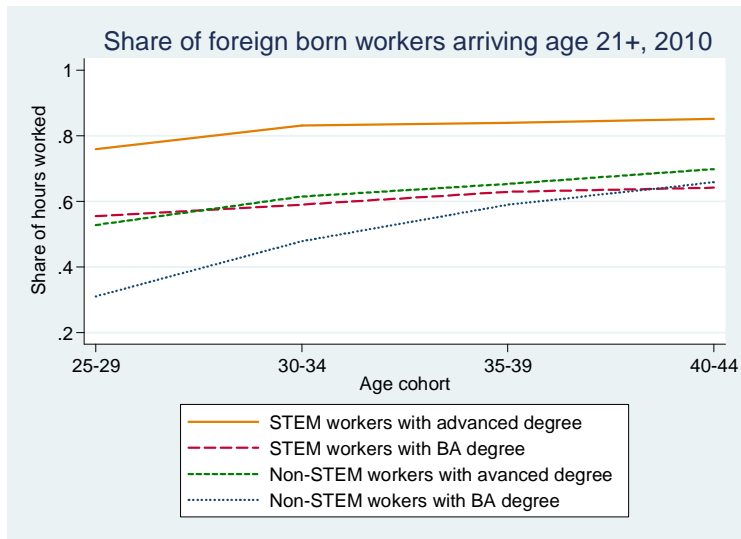|	1980		1990		2000		2010
India	**0.191**	**India**	**0.174**	**India**	**0.220**	**India**	**0.306**
China	**0.108**	Taiwan	0.142	**China**	**0.194**	**China**	**0.212**
Phil.	0.059	**China**	**0.087**	Taiwan	0.077	Taiwan	0.047
Taiwan	0.058	Iran	0.042	Russia	0.037	Korea	0.025
Germany	0.041	USSR	0.036	Canada	0.022	Russia	0.023

Foreign-born workers in STEM occupations with BA degree only

	1980		1990		2000		2010
Germany	0.070	Vietnam	0.090	**India**	**0.171**	**India**	**0.269**
China	**0.070**	Phil.	0.090	Vietnam	0.095	Vietnam	0.086
Phil.	0.066	**India**	**0.077**	Phil.	0.080	Phil.	0.073
India	**0.060**	**China**	**0.049**	**China**	**0.055**	**China**	**0.054**
UK	0.052	Iran	0.045	Canada	0.039	Korea	0.032

Foreign-born workers in non-STEM occupations with advanced degrees

	1980		1990		2000		2010
Phil.	0.109	**India**	**0.110**	**India**	**0.110**	**India**	**0.137**
India	**0.093**	Phil.	0.056	**China**	**0.056**	**China**	**0.080**
Germany	0.056	Canada	0.047	Mexico	0.054	Korea	0.045
Canada	0.051	**China**	**0.046**	Canada	0.045	Canada	0.042
Cuba	0.044	Taiwan	0.042	Phil.	0.041	Mexico	0.041

Foreign-born workers in non-STEM occupations with BA degree only

	1980		1990		2000		2010
Phil.	0.156	Phil.	0.188	Phil.	0.155	Phil.	0.138
Germany	0.063	**India**	**0.051**	Mexico	0.063	Mexico	0.085
Canada	0.055	Canada	0.044	**India**	**0.057**	**India**	**0.066**
Cuba	0.050	Mexico	0.039	Korea	0.043	Korea	0.050
Korea	0.046	Korea	0.038	Canada	0.040	Vietnam	0.037

Interpretation

High reward for skill makes US an attractive destination

- Many in high skilled global labor force seek entry to US
  - Demand for US visas likely to be greatest in STEM jobs

But US awards relatively few visas based on skill

- STEM applicants outcompete others for skill-based visas
  - Immigrants in STEM jobs tend to have skill-based visas
  - Immigrants in non-STEM jobs tend to have other visas

Implication:

- Holding constant selection of natives into STEM jobs:
  - Immigrant – native wage diff. in STEM v. non-STEM equals ability differential of immigrants on skill v. non-skill visas
  - Estimate: $\left[W_{STEM}^{Imm} - W_{STEM}^{Nat} \right] - \left[W_{nonSTEM}^{Imm} - W_{nonSTEM}^{Nat} \right]$

Data and sample

- 1990, 2000 US population census, 2009-2011 ACS
- Full-time, full-year workers with at least a BA degree
- Weight by hours worked times census pop. weight

Specification

- Hourly wages
  - Annual earnings/(weeks worked last yr*usual hours per wk)
  - Results for weekly, annual earnings are similar
- Controls
  - STEM dummy, foreign-born dummy
  - Gender, race, year, census region dummies
  - Five-year age cohort, educational degree interactions

Regressions for log hourly wage 1990-2011 (at least BA)

	(1)	(2)	(3)
STEM dummy	0.148***	0.188***	0.109***
	(0.001)	(0.001)	(0.001)
Foreign-born dummy	-0.081***	-0.104***	-0.127***
	(0.001)	(0.001)	(0.001)
STEM dummy * Foreign-born dummy	0.105***	0.094***	0.096***
	(0.003)	(0.002)	(0.002)
Sex, race, region, year controls	Y	Y	Y
Age, education controls	N	Y	Y
Sector controls	N	N	Y
Adjusted R squared	0.194	0.271	0.314
Observations	2,555,634	2,555,634	2,555,634

'Assimilation' of immigrants in non-STEM occupations: Wage regressions with arrival year cohort dummies

	1990	2000	2009-2011
0-5 years in US * foreign born	-0.289***	-0.244***	-0.255***
	(0.007)	(0.006)	(0.007)
6-10 years in US * foreign born	-0.222***	-0.222***	-0.201***
	(0.006)	(0.005)	(0.006)
11-15 years in US * foreign born	-0.104***	-0.172***	-0.101***
	(0.006)	(0.005)	(0.006)
15-20 years in US * foreign born	-0.034***	-0.086***	-0.060***
	(0.006)	(0.005)	(0.006)
20+ years in US * foreign born	0.018***	0.012***	0.000
	(0.004)	(0.004)	(0.004)
Sex, race, region, age, education controls	Y	Y	Y
Adjusted R Squared	0.165	0.135	0.182
Observations	692,417	897,896	658,237

'Assimilation' of immigrants in STEM occupations: Wage regressions with arrival year cohort dummies

	1990	2000	2009-2011
0-5 years in US * foreign born	-0.173***	0.007	-0.069***
	(0.012)	(0.007)	(0.008)
6-10 years in US * foreign born	-0.071***	0.043***	0.047***
	(0.008)	(0.007)	(0.007)
11-15 years in US * foreign born	0.000	0.045***	0.089***
	(0.007)	(0.008)	(0.006)
15-20 years in US * foreign born	0.035***	0.059***	0.056***
	(0.008)	(0.008)	(0.008)
20+ years in US * foreign born	0.031***	0.060***	0.034***
	(0.007)	(0.006)	(0.006)
Sex, race, region, age, education controls	Y	Y	Y
Adjusted R Squared	0.184	0.118	0.184
Observations	85,078	129,497	92,509

Wage regressions indicate that among BAs, MAs, PhDs:

- There is a STEM wage premium
  - STEM workers may be high ability, face high training costs

- There is a wage discount for foreign-born workers
  - But *not* for foreign-born workers in STEM jobs

- Convergence of foreign-born wages to native wages
  - Takes more than 20 years in non-STEM occupations
  - Takes less than 10 years in STEM occupations

Discussion

Suggestive evidence of differential selection by visa type

- Skill visas (H-1B) more likely to be awarded based on ability
  - Workers likely to be tied to high-reward (STEM) jobs

- Non-skill visas awarded based on family and other criteria
  - Workers likely to end up in assorted (non-STEM) jobs

But the potential confounds are many

- Older high-ability natives may tend to select into management
  - Native STEM comparison group may weaken as cohort ages

- Low-ability immigrants in STEM may tend to exit US
  - For immigrants, old-young wage diff. may be larger in STEM