PIIE

I Z A Institute of Labor Economics
Initiated by Deutsche Post Foundation

CReAM RFBerlin
Centre for Research & Analysis of Migration at RFBerlin

CEPR POLITICAL ECONOMY OF MIGRATION

International students and innovation: Evidence from restrictions on US-trained foreign STEM workers

Michael A. Clemens

PIIE Bridges & Borders Conference · Nov. 6, 2025

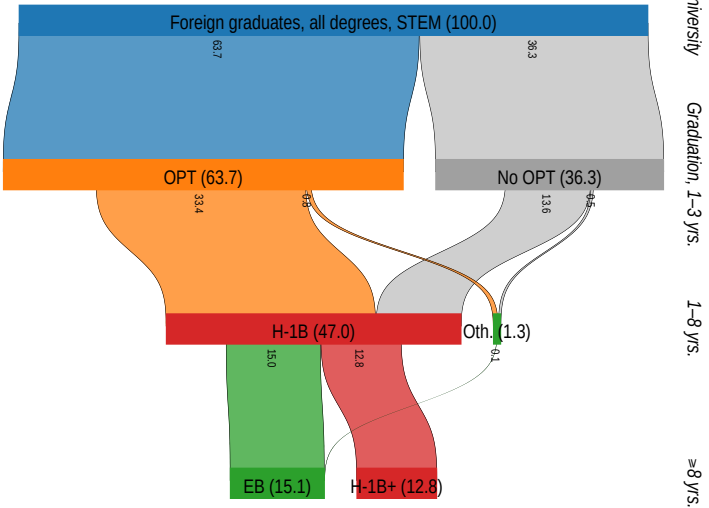
Optional Practical Training

12 months, 1992

(ii) *Optional practical training*—(A) *General.* An F–1 student may apply to the Service for authorization for temporary employment for practical training directly related to the student's major area of study. Temporary employment for practical training may be authorized:

(*4*) After completion of the course of study. A student must complete all practical training within a 14 month period following the completion of study.

Foreign STEM students ⟶ US workforce, 2018–2022



“I want …to remove the ability for employment authorizations for F-1 students beyond the time that they are in school.”

“We’ve got to do everything we can to really make it abundantly difficult—only in certain situations—for [foreign] students to think that they are just going to continue to live and work in the United States beyond the expiration of their [F-1 student] visa.”

—USCIS Director Joseph Edlow

Direct effects on patenting

Kiana Aran

(19) **United States**

(12) **Patent Application Publication**
Aran et al.

(10) **Pub. No.: US 2017/0246438 A1**
(43) **Pub. Date: Aug. 31, 2017**

(54) **ACTIVE AGENT DELIVERY DEVICES AND METHODS OF USING THE SAME**

(71) Applicant: **The Regents of the University of California**, Oakland, CA (US)

(72) Inventors: **Kiana Aran**, Berkeley, CA (US); **Jacobo Paredes**, Berkeley, CA (US); **Niren Murthy**, Berkeley, CA (US); **Dorian Liepmann**, Lafayette, CA (US); **Kunwoo Lee**, Albany, CA (US)

(21) Appl. No.: **15/513,110**

(22) PCT Filed: **Sep. 29, 2015**

(86) PCT No.: **PCT/US15/52901**
§ 371 (c)(1),
(2) Date: **Mar. 21, 2017**

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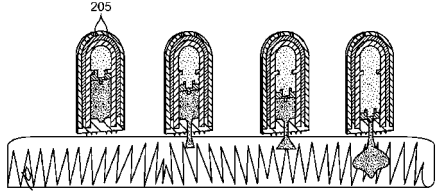
A61M 31/00 (2006.01)
A61K 9/0 (2006.01)
A61K 9/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61M 31/002*** (2013.01); ***A61K 9/006*** (2013.01); ***A61K 9/0085*** (2013.01); *A61K 2009/542* (2013.01); *A61M 2202/064* (2013.01); *A61M 2205/3324* (2013.01); *A61M 2205/3334* (2013.01); *A61M 2205/36* (2013.01)

(57) **ABSTRACT**

Provided are active agent delivery devices configured to deliver an active agent formulation into or through a mucosal layer in a subject. The active agent delivery devices include a power reservoir configured to eject the active agent formulation at a pressure sufficient to deliver the active agent formulation into or through a mucosal layer in a subject. Methods of using the subject active agent delivery devices are also provided.



Direct effects on patenting

Patenting by university-educated STEM workers:

- Native: 2 patents per 100 workers/year
- Foreign-born: 3 patents per 100 workers/year
- Foreign-born, US trained: 7 patents per 100 workers/year

Indirect mechanisms

1. Team, firm spillovers
2. Knowledge diffusion across firms
3. Complementary inputs
4. Demand-driven
5. Labor market crowd-in, crowd-out

Policy shock

FEDERAL REGISTER

The Daily Journal of the United States Government

Rule

You may be interested in this newer document that published on 06/03/2009 with action 'Interim final rule; correction.' View Document

Extending Period of Optional Practical Training by 17 Months for F-1 Nonimmigrant Students With STEM Degrees and Expanding Cap-Gap Relief for All F-1 Students With Pending H-1B Petitions

A Rule by the Homeland Security Department on 04/08/2008

PUBLISHED DOCUMENT: EB-7427 (73 FR 18944)

PDF

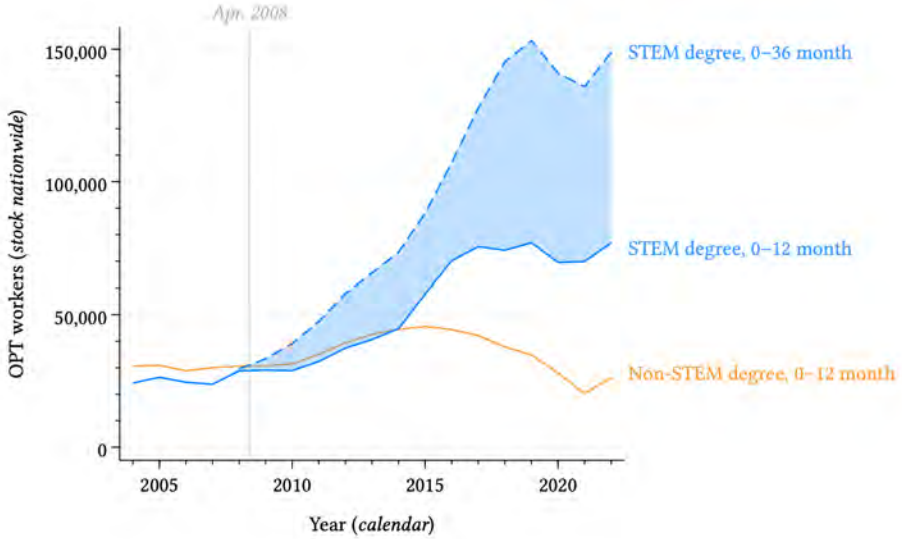
Document Details

Document Dates

DOCUMENT HEADINGS

Department of Homeland Security
8 CFR Parts 214 and 274a
[DHS No. ICEB-2008-0002; ICE No. 2124-08]
RIN 1653-AA56

US-trained foreign workers on OPT (*stock*)



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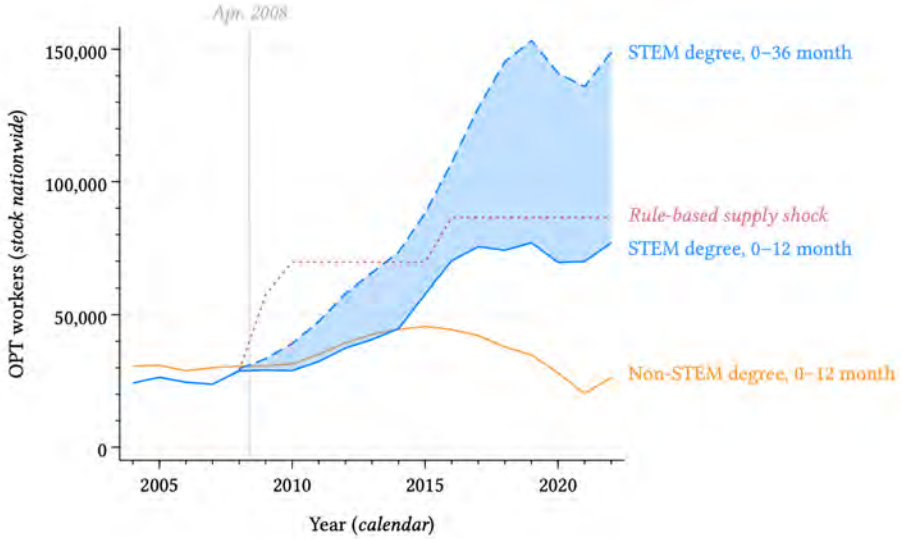
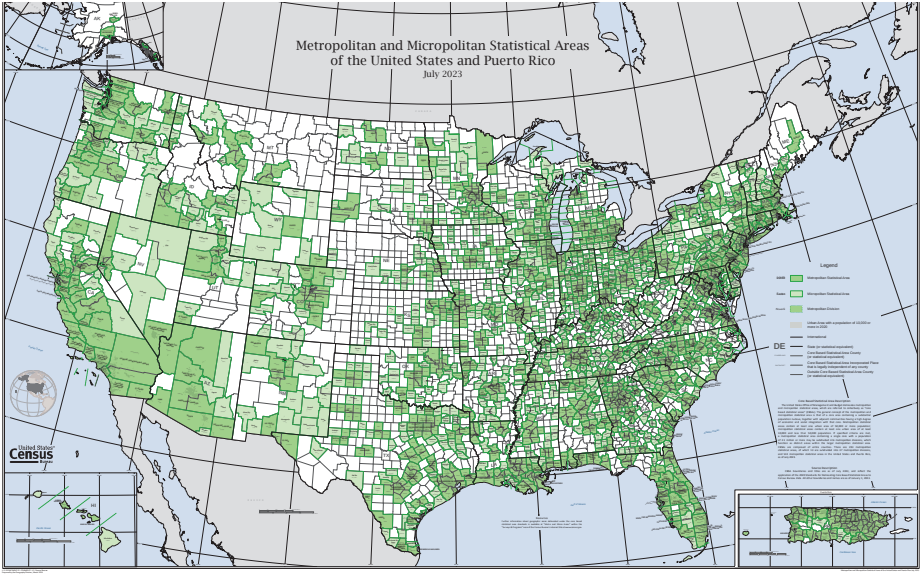


Shock magnitude

- ↑ ∼125,000 OPT STEM
- ↑ ∼187,500 high-skill STEM
- ↑ ∼5.6% in overall high-skill STEM

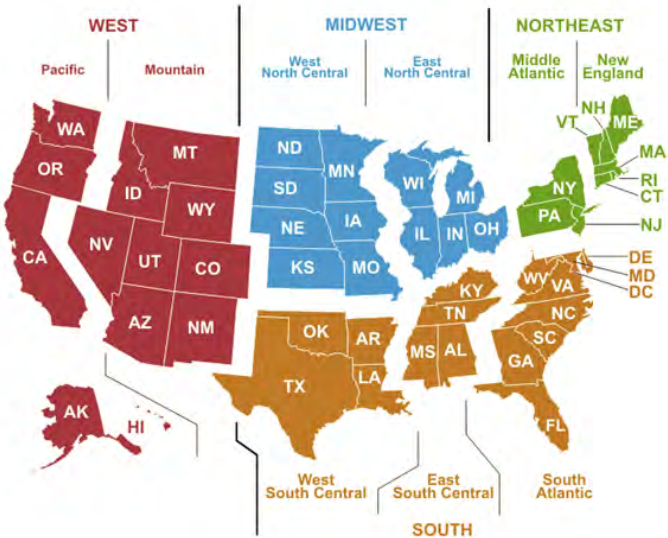
CBSAs (Metropolitan & Micropolitan Areas)



Core result

Dep. var:	*Patent applications per 100K workers*		
Estimator:	OLS		IV
OPT STEM per 100K workers	0.814	0.150	0.211
	(0.172)	(0.053)	(0.039)
Anderson-Rubin p-*val.*	—	—	*0.00593*
Observations	6793	6793	6793
Dep. var. mean	51.18	51.18	51.18
CBSA fixed effects	—	*Yes*	*Yes*
Year fixed effects	—	*Yes*	*Yes*

Census regions and divisions

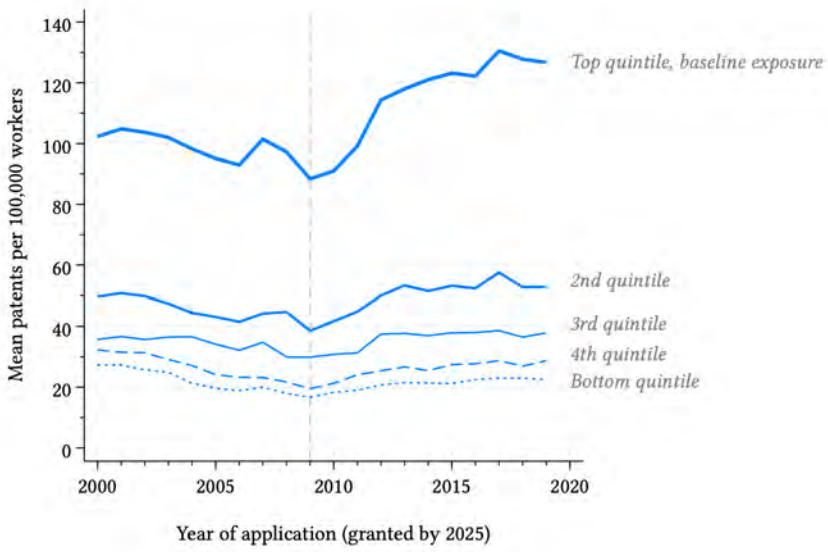


Influential shares

Adão et al., Borusyak et al.

Dep. var:	*Patent applications per 100K workers*		
Estimator:	IV		
Sample:	Full	Full	$\notin$ top 5
OPT STEM per 100K workers	0.211	0.199	0.201
	(0.039)	(0.040)	(0.057)
Anderson-Rubin p-*val.*	*0.00593*	*0.00807*	*0.00096*
Observations	6793	6793	6706
Dep. var. mean	51.18	51.18	28.89
CBSA fixed effects	Yes	*Yes*	*Yes*
Year fixed effects	Yes	*Yes*	*Yes*
Region $\times$ year fixed effects	—	*Yes*	—

Pre-trends by baseline exposure?



Placebo tests

Goldsmith-Pinkham et al.

Dep. var:	*Patent applications per 100K workers*				
Estimator:	IV				
Patent type:	All	All	Direct	Indirect	Low
OPT STEM per 100K workers	0.211	0.222	0.119	0.080	0.012
	(0.039)	(0.099)	(0.053)	(0.030)	(0.005)
OPT non-STEM per 100K workers		−0.189			
		(1.366)			
Observations	6793	6793	6793	6793	6793
Dep. var. mean	51.18	51.18	32.54	8.93	9.71
CBSA fixed effects	Yes	*Yes*	*Yes*	*Yes*	*Yes*
Year fixed effects	Yes	*Yes*	*Yes*	*Yes*	*Yes*

Effect magnitude

- *Caused by* each foreign STEM worker: 0.129

  → That is, $\frac{0.211 \text{ patents}}{\sim 1.63 \text{ workers}}$

- *Filed by* each US-trained high-skill foreign STEM worker: 0.07

- Multiplier $\sim$1.7

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  - → That is, $\frac{0.211 \text{ patents}}{\sim 1.63 \text{ workers}}$
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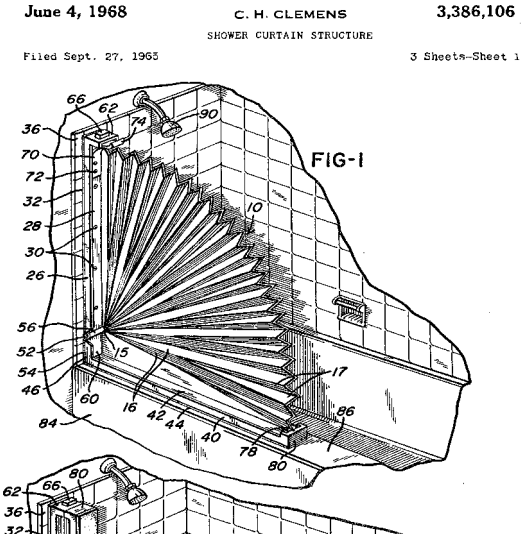
- Multiplier ~ 1.7

Economic value: Patents vs. innovation



June 4, 1968 C. H. CLEMENS 3,386,106

SHOWER CURTAIN STRUCTURE

Filed Sept. 27, 1965 3 Sheets-Sheet 1

FIG-1

Economic value: Patents vs. innovation

Dep. var:	*Patent applications per 100K workers*				
Estimator:	IV				
Weight:	—	Citations (All)	Citations (5 yr.)	Value (KPSS)	Backward sci. cit.
OPT STEM per 100K workers	0.211	0.233	0.245	0.254	0.239
	(0.039)	(0.036)	(0.038)	(0.034)	(0.060)
Observations	6793	6641	6503	5109	5714
CBSA fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Leonid Kogan et al. QJE 2017; Matt Marx & Aaron Fuegi "Reliance on science"

Bottom line

1. Evidence is consistent with OPT STEM extension causing a large increase in real innovation and productivity

2. Large indirect effects beyond individual inventors, within cities (nationwide omitted)

3. Consistent with imminent OPT termination causing substantial harm to US innovation and economic growth

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http://mclem.org

Direct Benefit CPC

A61	Medical/vet	C10	Petroleum/gas
B01	Phys/chem proc	C12	Biochemistry
B81	Microstructural	C23	Coating metal
B82	Nanotechnology	C25	Electrolytic
C01	Inorganic chem	C30	Crystal growth
C02	Water treatment	C40	Combinatorial
C07	Organic chem	G01	Measuring/Test
C08	Organic macro	G02	Optics
C09	Dyes/Paints	G05	Controlling
G06	Computing	G09	Crypto/Display
G11	Info storage	G16	ICT applications
G21	Nuclear physics	H01	Basic electric
H02	Electric power	H03	Electronic circ
H04	Communication	H05	Electric n.e.c.
H10	Semiconductors		

Indirect Benefit CPC

A01	Agri/Forestry	B64	Aircraft/Aviation
A23	Foods/stuffs	C03	Glass/Min wool
B03	Separation sol	C04	Cements/Concrete
B09	Solid waste	C21	Metallurgy iron
B29	Working plastics	C22	Metallurgy/Alloys
B32	Layered products	F01	Engines general
B33	Additive manuf	F02	Combustion eng
B60	Vehicles general	F03	Liquid engines
F15	Fluid actuators	F16	Engineering elem
F25	Refrigeration	F27	Furnaces/Kilns
F28	Heat exchange	G03	Photography
G04	Horology	G07	Checking-devices
G08	Signalling	G10	Musical instrum

Low Benefit CPC

A21	Baking/Doughs	B28	Work cement/clay	D99	Subject n.e.c.
A22	Butchering/Meat	B30	Presses	E01	Roads/railways
A24	Tobacco/Cigars	B31	Paper articles	E02	Hydraulic eng
A41	Wearing apparel	B41	Printing	E03	Water supply
A42	Headwear	B42	Bookbinding	E04	Building
A43	Footwear	B43	Writing impl	E05	Locks/Keys
A44	Haberdash/Jewel	B44	Decorative arts	E06	Doors/windows
A45	Hand/travel art	B61	Railways	E21	Earth drilling
A46	Brushware	B62	Land vehicles	E99	Subject n.e.c.
A47	Furniture/Dom	B63	Ships/vessels	F04	Pumps
A62	Life-saving/Fire	B65	Convey/Packing	F17	Storing gases
A63	Sports/Games	B66	Hoisting/Lifting	F21	Lighting
A99	Subject n.e.c.	B67	Opening bottles	F22	Steam generation
B02	Crushing/pulv	B68	Saddlery/Upholst	F23	Combustion app
B04	Centrifugal app	B99	Subject n.e.c.	F24	Heating/Vent
B05	Spraying/atom	C05	Fertilisers	F26	Drying
B06	Mech vibrations	C06	Explosives	F41	Weapons
B07	Separating sol	C11	Oils/fats	F42	Ammunition
B08	Cleaning	C13	Sugar industry	G12	Instrument det
B21	Metal-working	C14	Skins/Leather	Y02	Climate tech
B22	Casting/Powder	D01	Threads/fibres	Y04	ICT impact
B23	Machine tools	D02	Yarns/finishing	Y10	Former USPC
B24	Grinding/Polish	D03	Weaving		
B25	Hand/port tools	D04	Braiding/Knit		
B26	Hand cut tools	D05	Sewing/Embroid		
B27	Working wood	D06	Textile treatment		
		D07	Ropes/Cables		
		D21	Paper-making		