High-Skill Immigration, Innovation, and Creative Destruction

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Impact of Immigration on Product Reallocation

- Impact of immigration on innovation often looks at patenting and citations (Kerr and Lincoln 2010; Hunt and Gauthier-Loiselle 2010; Doran, Gelber and Isen 2018)
- A different kind of innovation is captured by the entry and exit of products (Aghion, Akcigit and Howitt 2014, Grossman and Helpman 1991)
- Product Reallocation: the entry and exit of products:
  - Is correlated with R&D expenditures
  - Drives revenue and TFP growth (Argente, Lee and Moreira 2018)
- What is the impact of high-skill immigration under the H-1B program, on firm-level product reallocation?

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Patents	Product Reallocation
What might they capture?	
Larger innovations	Incremental innovation
Ideas valuable to competitors	Includes firm-specific ideas
Measurement Issues	
Truncation issues; Propensities vary	Are slight changes really valuable?
Many innovations never patented	Some new products not "innovation"

What We Do In This Paper

- Combine data sources at the firm-by-year level:
  1. Labor Condition Applications for H1Bs (2001-15)
  2. I-129s for H1Bs (2012-14)
  3. Retail Scanner data on products (2006-15)
  4. Compustat data on firm characteristics (2001-15)
- Matched on firm name and location
- Study the impact of H1Bs on outcomes:
  1. Product entry and exit rates
  2. Reallocation (sum of entry and exit) rates
- Research Design: Future reallocation on current H-1B
  1. Conditional on fixed effects
  2. Distributed lead and lag to study timing
  3. Variation from lottery

Literature

1. High-skill immigration affects patenting, employment and profits
   - Shift-share approach Kerr and Lincoln (2010), Ghosh, Mayda and Ortega (2018)
   - Lottery variation: Doran, Gelber and Isen (2018), Peri, Shih and Sparber (2015)
2. Schumpeterian Growth and Product Reallocation
   - Aghion, Akcigit and Howitt (2014), Grossman and Helpman (1991), Aghion and Howitt (1992), Argente, Lee, Moreira (2018)

1. Data

The H1B Process

- Since 1991 – firms looking to hire workers in "specialty occupations" (R&D, tech)
- Workers must have college degree and be paid prevailing wage
- Firms file a Labor Condition Application (LCAs)
  - Data we have (2001-15)
- Visas are capped and cap changes via Congress
- As more LCAs than visas: hold a lottery
- Winners come to US and get a I-129
  - We have 2012, 2013, 2014; waiting for more years (2001-11)

H1B Data

- Labor Condition Application (LCA):
  - Employment start date: Years 2000-1 to 2016-17
  - Whether certified, withdrawn or denied, but not lottery winning
  - Name of firm and location: Possible to match to other data
  - Occupation, prevailing wage
- I-129s:
  - Employment start date: Years 2012,13,14
  - If granted H-1B (lottery winners in for-profit firms)
  - Name of firm and location: Possible to match to other data
  - Job title, wage, country of origin

Baseline product- and firm-level dataset

- Nielsen Retail Scanner Data (2006-2015)
  - 40,000 food, drug and mass merchandising stores (90 retail chains)
  - $220 billion of transactions/year
  - Weekly sales/volume for products generated by point-of-sales systems
- Products
  - Uniquely identified by 12-digit Universal Product Code
  - UPC: finest level of disaggregation
  - Approximately 200 thousand every quarter
  - Example: a 31-ounce bag of Tide Pods Detergent.
- Firm-product data
  - GS1 codes are part of the UPC code (first 6 or 10 digits of the code)
  - Combined dataset: can identify portfolio of products of each firm

GS1 Code: Example

Defining The Three Outcomes

1. Entry rates: $n_{it} = \frac{N_{it}}{T_{it}}$
   - N_{it} number of entering products
   - T_{it} total products

2. Exit rates: $x_{it} = \frac{X_{it}}{T_{it-1}}$
   - X_{it} number of exiting products

3. Reallocation rates: $r_{it} = n_{it} + x_{it}$

Compustat

- Financial and market information on global companies
- Variables from the fundamental annual database of North America:
    1. Number of employees
    2. R&D expenditure
    3. Total sales

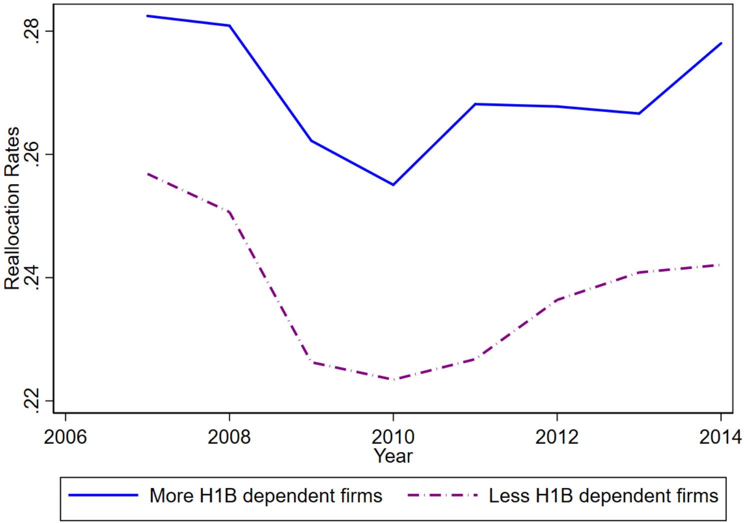
Matching Firms

1. Harmonize H1B data, 2001-2017
   - Name of employer inconsistent across years
2. Match firms
   - By firm name and location
   - Record linkage method, verified manually
3. We create three merged samples:

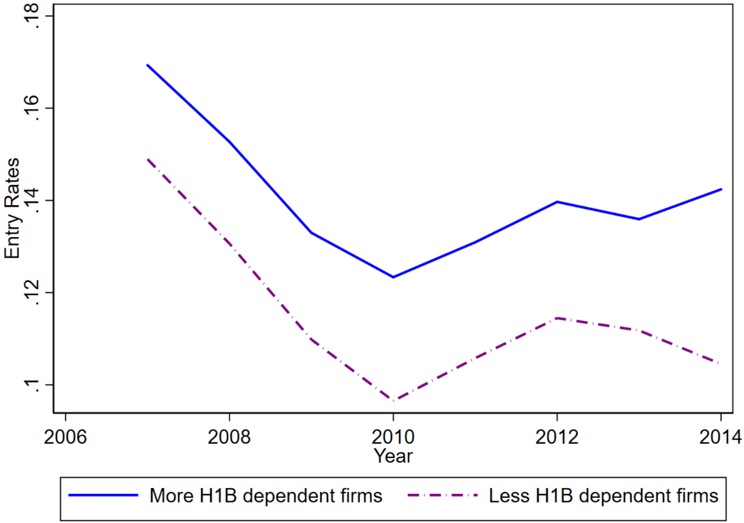
Merged Samples:	(1) LCA-Nielsen	(2) LCA-Nielsen-Compustat	(3) I129-LCA-Nielsen-Compustat
Number of Firms	36,218	482	482
Years	2006-2015	2006-2015	2012-2014
Variables from LCA/I129			
Avg # of Certified Workers	0.79	20.72	23.43
Avg # of I129 Workers	-	-	19.11
Variables from Nielsen			
# of Observations	235,522	4,022	1,201
Avg Firm Revenue (USD)	6.25 million	154 million	155 million
Avg Reallocation Rates (0-2)	0.1944	0.2585	0.2612
Variables from Compustat			
# of Observations	-	4,565	1,373
Avg # of Employees	-	43,841	45,158
Avg R&D to Sales	-	0.251	0.1715

2. Descriptive Evidence

Trends in Reallocation Rates by Baseline (2001) H1Bs



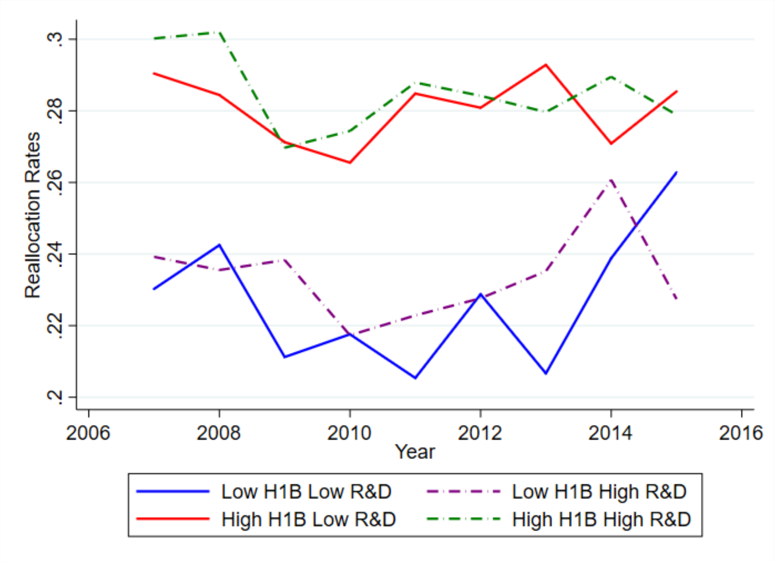
Trends in Entry Rates by Baseline (2001) H1Bs



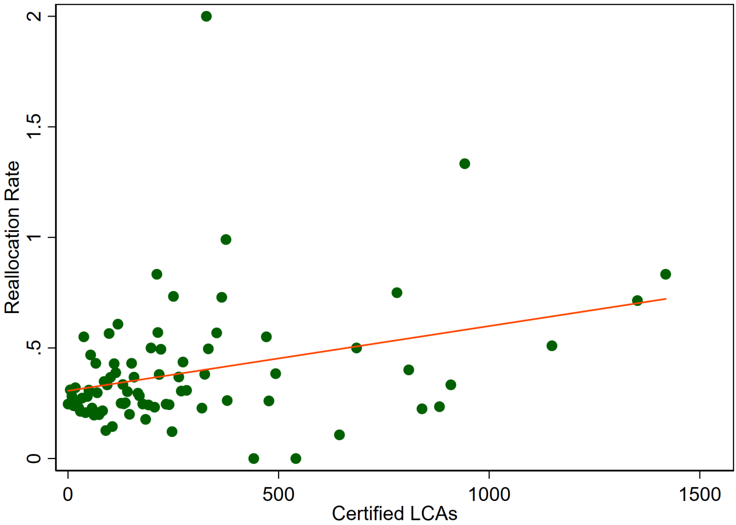
Reallocation Matters for Revenue Growth

$\Delta Log(Revenue)_{i,t+1}$	(1)	(2)	(3)
Reallocation Rate	0.432		
	(0.0235)***		
Product Entry Rate		1.240	
		(0.0210)***	
Product Exit Rate			0.355
			(0.0377)***
Observations	147,723	179,502	147,723
R-squared	0.013	0.063	0.009
Number of Firm	27,574	31,626	27,574
Fixed Effects	Year and Firm	Year and Firm	Year and Firm
Cluster	Firm	Firm	Firm

Reallocation Rates by Baseline (2001) H1Bs and R&D



Scatters by Certified LCAs: Reallocation



3. Effect of H-1Bs on Reallocation

1st Research Design

Firm i and year t

$$r_{i,t+1} = \alpha + \beta H1B_{i,t} + \mu_i + \tau_t + \epsilon_{i,t+1}$$

- Results for both current and future re-allocation rates $r_{i,t}$
- "Future" is preferred specification: (1) no contemporaneous shocks, (2) changes occur with lag (Argente, Lee, Moreira 2018)
- $H1B_{i,t}$ measures:
  1. Number of certified LCAs,
  2. Number of workers on certified LCAs
  3. Occupations
  4. Certified workers as share of employees

Magnitudes

- We find that:

    1. 1% pt increase in share of certified workers (more than doubling at the mean share) $=>$ 5% pt increase in reallocation (around 20% at mean)
    2. *Elasticity* $= 0.2$ at the mean

LCA Certification and CURRENT Reallocation Rates

Dep. var:	Reallocation Rate in year t		
	(1)	(2)	(3)
# of Applications	0.00217		
	(0.000413)***		
# of Certified Workers		0.00291	
		(0.000466)***	
By Occupations:			
Software			0.00217
			(0.000471)***
Science, Math and Engineer			0.0300
			(0.0446)
Manager			-0.00273
			(0.00976)
Finance, Analyst and Marketing			0.0359
			(0.0196)*
Observations	183,554	183,554	183,554
R-squared	0.003	0.003	0.003
Number of firm	31,876	31,876	31,876
Fixed Effects	Year and Firm	Year and Firm	Year and Firm
Cluster	Firm	Firm	Firm
Type	OLS	OLS	OLS

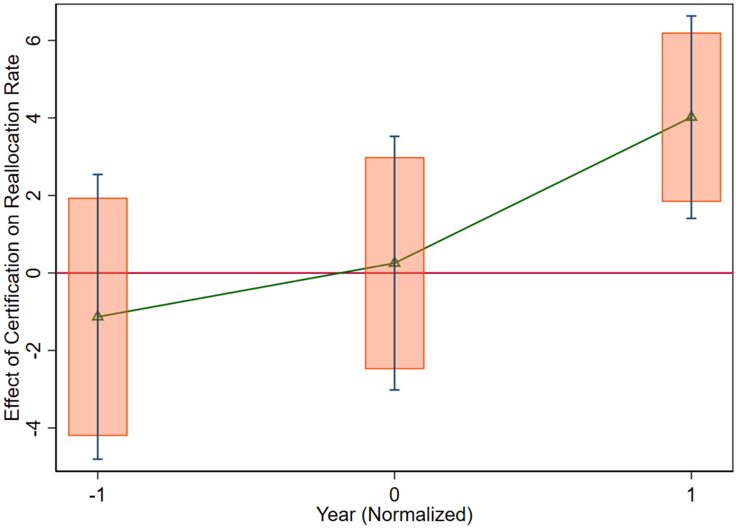
LCA Certification and FUTURE Reallocation Rates

Dep. var:	Reallocation Rate in year $t+1$		
	(4)	(5)	(6)
# of Applications	0.00118		
	(0.000615)*		
# of Certified Workers		0.00140	
		(0.000767)*	
By Occupations:			
Software			0.00166
			(0.000294)***
Science, Math and Engineer			0.0206
			(0.0274)
Manager			0.000558
			(0.0260)
Finance, Analyst and Marketing			-0.000832
			(0.0228)
Observations	181,451	181,451	181,451
R-squared	0.003	0.003	0.003
Number of firm	31,685	31,685	31,685
Fixed Effects	Year and Firm	Year and Firm	Year and Firm
Cluster	Firm	Firm	Firm
Type	OLS	OLS	OLS

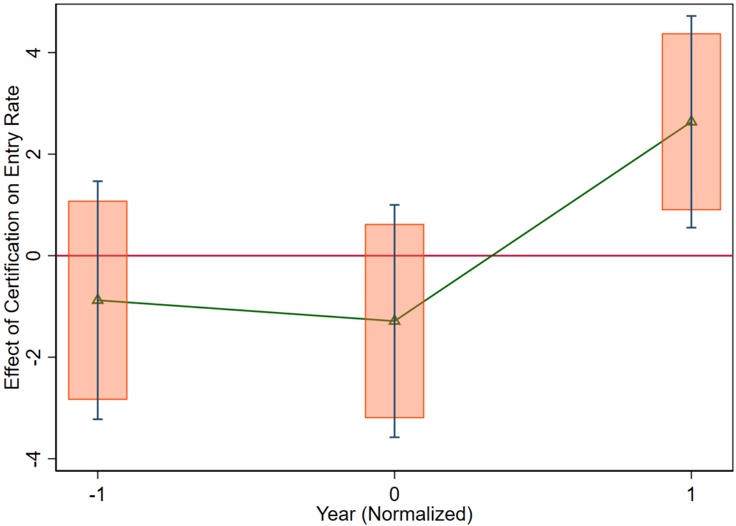
Certified Shares (with Compustat) of Total Employment

Dep. var:	Reallocation Rate in year $t+1$		
	(4)	(5)	(6)
Applications / Employees	5.077		
	(2.040)**		
Certified Workers / Employees		5.593	
		(2.034)***	
Occupations (per Employee):			
Software			9.344
			(0.732)***
Science, Math and Engineer			0.203
			(1.402)
Manager			5.854
			(4.384)
Finance, Analyst and Marketing			1.098
			(2.221)
Observations	2,800	2,800	2,800
R-squared	0.022	0.022	0.029
Number of firm	429	429	429
Fixed Effects	Year and Firm	Year and Firm	Year and Firm
Cluster	Firm	Firm	Firm
Type	OLS	OLS	OLS

Distributed Lead and Lag: Reallocation Rates



Distributed Lead and Lag: Entry Rates



4. I-129s

Research Design

Firm i and year t

$$r_{i,t+1} = \alpha + \beta H1B_{i,t} + \mu_i + \tau_t + \epsilon_{i,t+1}$$

- $H1B_{i,t} = I129s_{i,t} - LCA_{i,t}$
- 3 years of I-129s, we can include μ_i and τ_t

- Find: a 1% increase in supply shock at mean => 0.046% increase in reallocation rate at mean

H-1B Supply Shock and Reallocation: All Firms

Samples:	All firms			
Dep. var:	# of I-129s (1)	$r_{i,t+1}$ (2)	$n_{i,t+1}$ (3)	$x_{i,t+1}$ (4)
H-1B supply shock	0.656 (0.0268)***	0.136 (0.0753)*	0.0422 (0.0320)	0.0960 (0.0386)**
Observations	1,446	749	777	774
R-squared	0.674	0.013	0.033	0.026
Number of firm	482	392	406	405
Fixed Effects	Year and Firm			
Cluster	Firm			
Type	First Stage	Reduced Form		

H-1B Supply Shock and Reallocation: H-1B Firms

Samples:	Granted at least one certification			
Dep. var:	# of I-129s (5)	$r_{i,t+1}$ (6)	$n_{i,t+1}$ (7)	$x_{i,t+1}$ (8)
H-1B supply shock	0.658 (0.0270)***	0.138 (0.0759)*	0.0464 (0.0318)	0.0955 (0.0392)**
Observations	510	272	284	282
R-squared	0.677	0.046	0.033	0.061
Number of firm	220	166	173	172
Fixed Effects	Year and Firm			
Cluster	Firm			
Type	First Stage	Reduced Form		

Placebo Test for H-1B Supply Shock

Samples:	All firms			Granted at least one certification		
Dep. var:	$r_{i,t-1}$ (1)	$n_{i,t-1}$ (2)	$x_{i,t-1}$ (3)	$r_{i,t-1}$ (4)	$n_{i,t-1}$ (5)	$x_{i,t-1}$ (6)
H-1B supply shock	-0.0148	0.00283	-0.0160	-0.0134	0.00335	-0.0153
	(0.0258)	(0.00866)	(0.0195)	(0.0261)	(0.00892)	(0.0196)
Observations	755	780	779	272	283	284
R-squared	0.001	0.015	0.024	0.008	0.007	0.044
Number of firm	389	409	403	165	174	174
Fixed Effects	Year and Firm			Year and Firm		
Cluster	Firm			Firm		
Type	Reduced Form			Reduced Form		

5. Conclusions

Concluding Thoughts

- Hiring H-1Bs associated with higher product entry and exit
- Some patenting literature finds similar effects (Kerr and Lincoln 2010, Hunt and Gauthier-Loiselle 2010)
- Yet, other work finds little impact on patenting (Doran, Gelber and Isen 2018)
- We study alternative measure: Product reallocation
- Capturing incremental innovation
- May impact consumer welfare (Khanna and Lee 2018)