Early Career Choices of Superstar Entrepreneurs

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Careers of Superstar Entrepreneurs

- **Entry labor market conditions** affect early and long-run career outcomes(Oyer 2006, 2008; Schoar and Zuo 2017).

- New firms matter for job creation (Haltiwanger et al. 2013, Adelino et al., 2017); do early career choices affect likelihood of **transformative entrepreneurship**?

- **Unprecedented financial sector growth** since early 1990s led to dramatic increase in wages for skilled workers (Philippon and Reshef 2012; Boustanifer, et al., 2017; Celerier and Vallee 2018),

- Use financial sector growth as a **shock to labor demand** for highly skilled workers, and study effect on **early career choices,** and long-run **likelihood of entrepreneurial success**.

Today

Setup: Study effect of unprecedented growth in financial sector on the careers of engineers from the most selective schools (MIT, Stanford, Caltech, etc.) who graduate with honors, and have the potential to become transformative entrepreneurs.

Q1: **Does financial sector growth (causally) attract elite engineers from non-financial sector jobs?**

- (+) High wages should attract talented workers to finance (Bond and Glode 2014; Benabou and Tirole 2016; Baumol 1990; Murphy, et al. 1991).
- (-) Wages in finance may not be high enough to attract elite engineers due to high opportunity costs (Abowd et al., 1999, Haltiwanger, et al., 2009, Shu 2016).

Q2: **Do engineers who switch to finance create successful startups in the long-run?**

- (+) Preferential access to capital or accumulated wealth (Guiso, et al. 2004; Adelino, et al. 2015; Babina, et al. 2016).
- (-) Loss of skills (Oyer 2008), or increase in opportunity cost of entrepreneurship.

Preview of findings

- **Financial sector growth attracts engineers from higher ranked schools**, and those who received graduation **honors**, from non-financial sector jobs.
- Elite engineers **more likely to take a finance job** if they graduate from a state that undertook **financial deregulation**.
- Elite engineers who switch to finance due to finance growth are more likely to be employed in **finance-related occupations**.
- An elite engineer who **moves to finance because of the growth in industry** is less likely to create a firm that produces **patents**, **employs more workers**, receives **VC funding**, is **acquired**, or successfully completes an **IPO**.
- Engineers who **move to finance from low finance growth areas** are **more likely to create successful startups**.

Data

Data

- 12 Top Engineering Schools : MIT, Stanford, UC Berkeley, CalTech, Carnegie Mellon, Cornell, Northwestern, Illinois,Georgia Tech, UCLA, UW-Madison, and UT-Austin.

- Resume Data : From online business network, obtained **employment and education** data on all engineering graduates between 1998 and 2009. Final sample: ~70,000 engineers. **Coverage ranges from 93%-99% across schools** for each graduating cohort.

- Honors Data : Latin Honors from commencement programs for Stanford, Caltech, and Northwestern. For rest of sample, use data from resumes.

- Patent Data : Patents created by each firm founded by engineers in the sample from the USPTO.

- Funding Data : Funding data and exit outcome for each firm founded by the engineers in our data from Crunchbase.com.

Entrepreneurial engineers in sample

Examples of firms created by engineers in our sample:

Dropbox
Youtube
Instagram
Yelp
Quora
Change.org
Gofundme
Tinder
DoorDash
SurveyMonkey
Intuit
Square
Khan Academy
Fetch Robotics
Sienna Labs, Inc.

Relevant Facts from Summary Stats

- About 10% of engineers move to finance within 5 years of graduation.

- From higher ranked schools (Carnegie, Caltech, Cornell, MIT, Northwestern, Stanford), 8% of engineers move to finance upon graduation and another 6% move within 5 years, while for lower ranked schools, 3% move to finance upon graduation and 4% within 5 years.

- 12% of higher ranked school engineers tried an entrepreneurship endeavor; 2% have $>$ 1 patent, 3% received VC funding, 1% are acquired, and 3% employ 10 or more workers.

- 8% of lower ranked school engineers tried an entrepreneurship endeavor;$<$1% have 1 patent or more, 1% received VC funding, 0.4% are acquired, and 1% employ 10 or more workers.

Empirical Design

Two Empirical Designs

- Fixed Effects Design (ED1): Compare classmates and use geographic variation in financial sector growth in location of first job.

- Quasi-experimental Design (ED2): Use time-varying intensity of bank branch deregulation in state where engineers attend university, and study job choices at graduation.

Fixed Effects: Comparing Similar Engineers

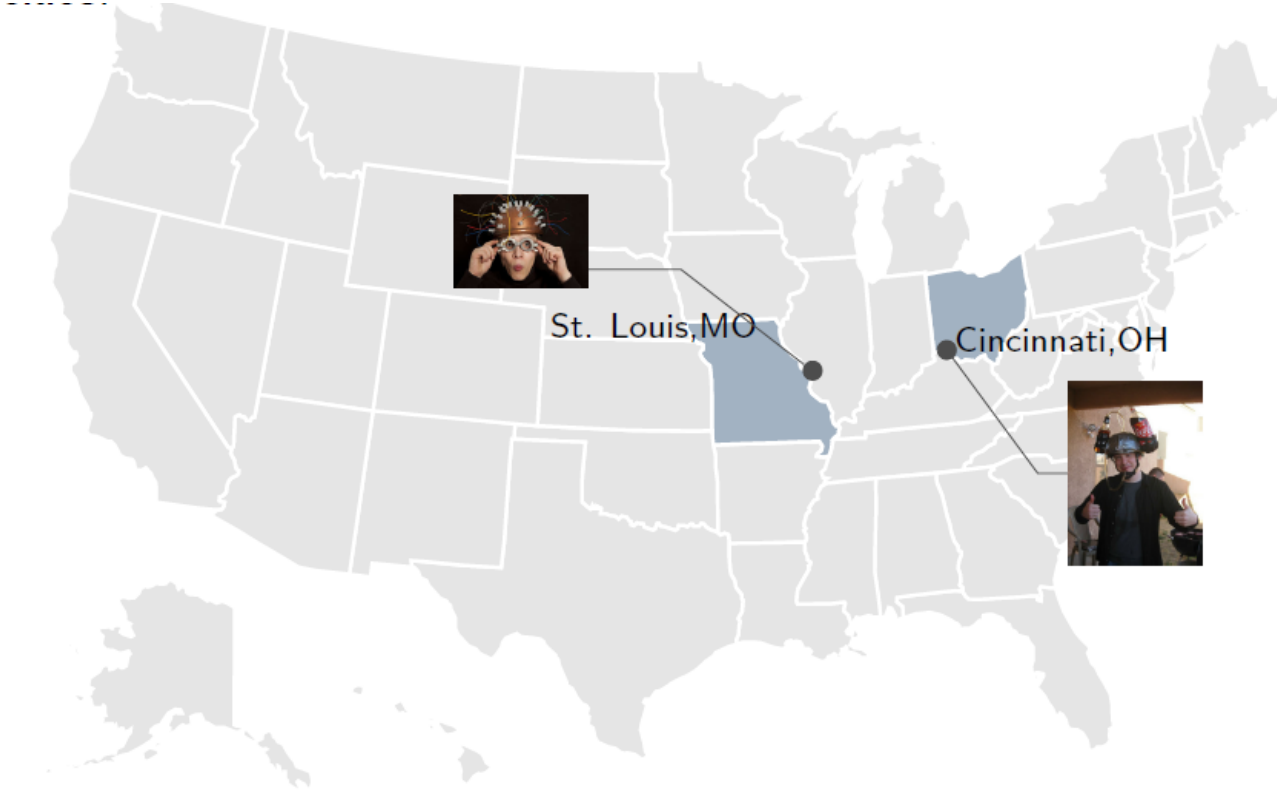
Consider two engineering graduates from the same top school, same major, same graduation year

Ada
MIT, Civil Eng
Class of **2002**

Paul
MIT, Civil Eng
Class of **2002**

ED1: Comparing Similar Engineers

Both Ada and Paul **take engineering jobs at graduation** (in early 2000s) in **similar sized firms** in the **same industry**, but in **different cities**.



ED1: Empirical Design

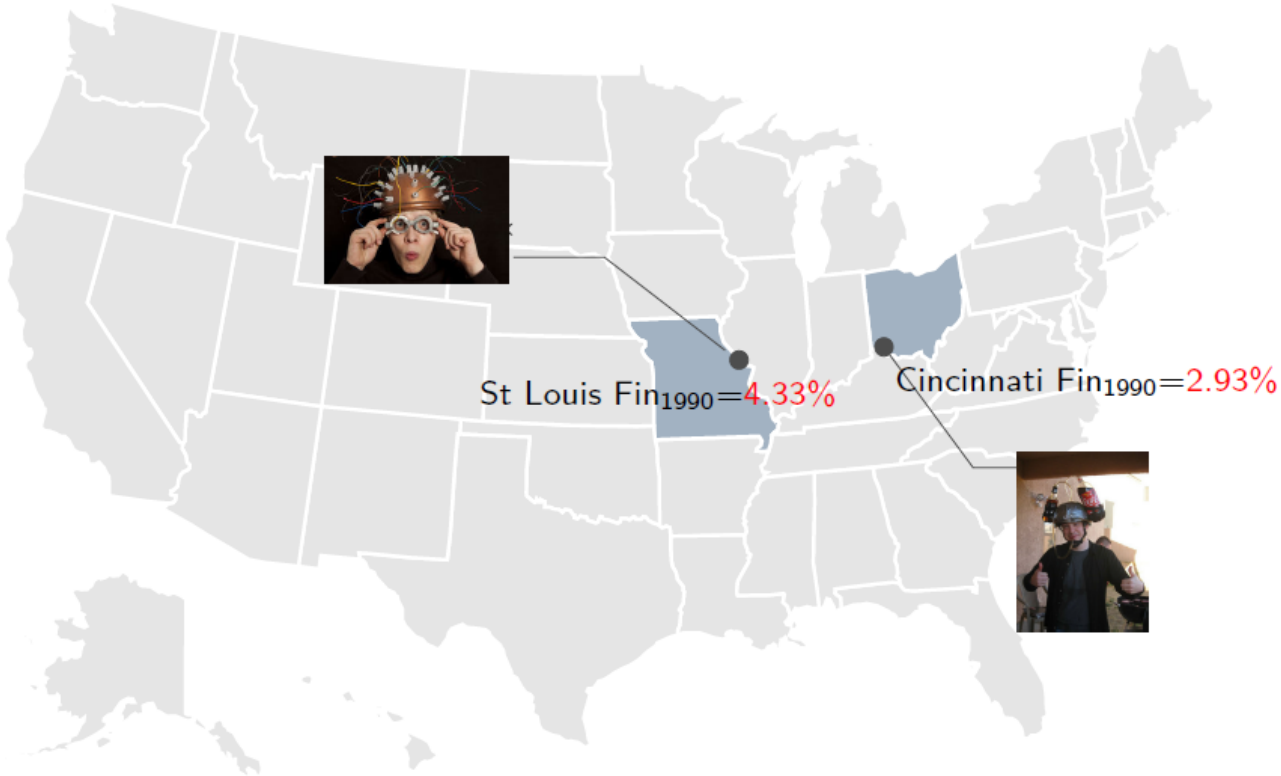
- Rely on **unprecedented growth at the national level in the finance industry** starting in the **mid 1990s**, as a shock to metro areas across the United States.

- Identify metro areas that are predisposed to be more affected by national growth in finance by estimating the **proportion of college-educated workers employed in finance in a metropolitan area in 1990**.

- Regions with **high pre-existing presence of financial sector employment more likely to be affected** by the national growth in finance, than regions with a low initial finance presence.

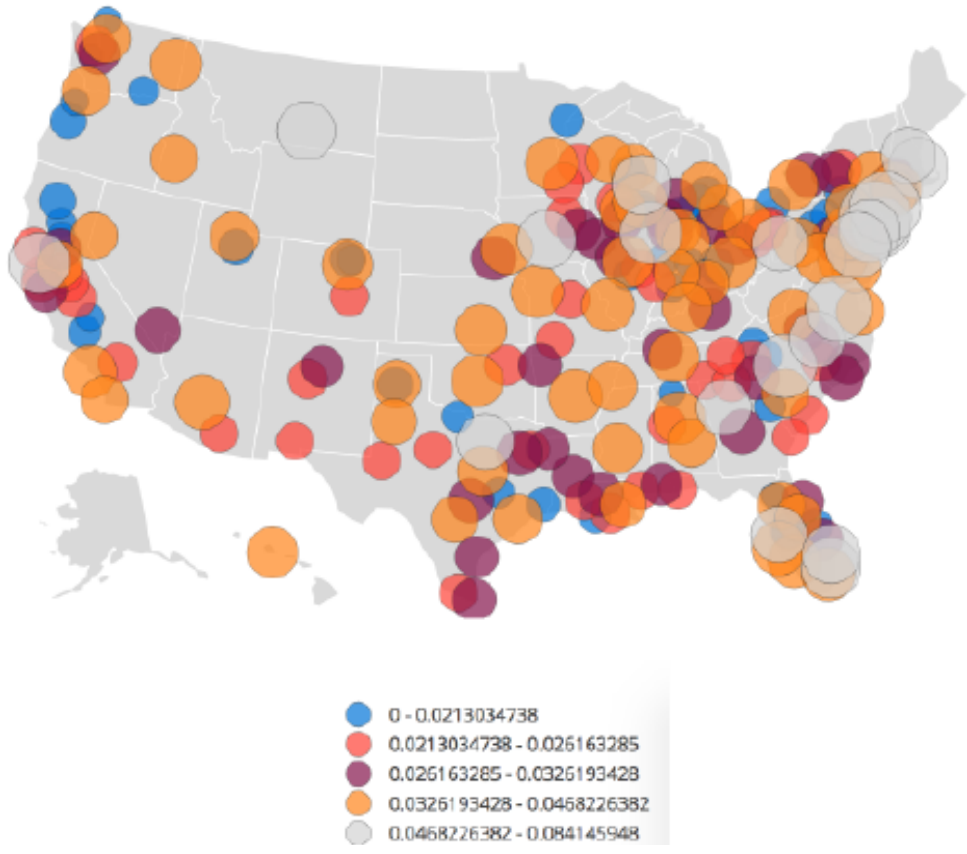
ED1: Comparing Similar Engineers

Is Ada, who is in St. Louis, more likely to move to finance than Peter, who is in Cincinnati, during the 2000s?



Financial sector presence is geographically dispersed

The mean MSA Finance Share in 1990 is 3.1%, the P25th is 2.3%, and the P75th is 3.9%.



ED1: MSA Finance in 1990 and Growth in 2000s

- MSA Finance Share 1990 is **positively correlated with change in finance employment share between** 2000-2006.

- MSA Finance Share 1990 **not correlated** with:
  - Change in employment in Manufacturing between 2000 to 2006.
  - Change in employment in Prof. & Serv. between 2000 to 2006.
  - Metro area employment growth between 2000 to 2006.
  - Share of engineers from higher-ranked schools.
  - Share of engineers who received honors.
  - Share of innovative entrepreneurs.

ED1: Regression Model

We estimate the following for subsamples based on talent measures, and test whether finance growth attracts more talented workers ($\beta_{TOP} > \beta_{NOT\ TOP}$):

$$\begin{aligned}
\text{Prob. Switch to Finance}_i^{00-08} &= \beta_1 \times \text{MSA Finance Share}_{i,1990} \\
&\quad + \theta_1 \times \text{MSA Emp Share in Eng}_i \\
&\quad + \theta_2 \times \text{MSA Size} \\
&\quad + \theta_3 \times \text{MSA Emp Growth} \\
&\quad + \text{School-Year-Major FE} \\
&+ \quad \text{Firm Size Class FE} \\
&+ \quad \text{Firm-Industry FE} + \varepsilon_i,
\end{aligned}$$

- Only consider engineers employed in a non-financial sector job after graduation to address preferences.
- Errors clustered at MSA level.
- For robustness:
  - Hometowns of engineers; Firm fixed effects; Exclude major financial centers; Time variation.
  - MSA share of employment in Finance in 1980; MSA share of employment in Securities, Credit Intermediation in 1990.

Empirical Design 2: Banking Deregulation

- US banking sector went through decades of regulatory changes affecting geographic expansion (Kroszner and Strahan, 2014), culminated in 1994 with Interstate Banking and Branching Efficiency Act (IBBEA).
- IBBEA authorized **free interstate banking** but granted **individual states discretion on rules** governing entry by out-of-state banks.
- Rice and Strahan (2010) compute index that records the **state-wise, time-varying** intensity of restrictions on interstate branching between 1994 and 2005.
- Since schools are located in different states, **exploit variation in deregulation across states at different times** to proxy for demand for skilled workers.
- Study job choices of engineers at graduation.
- Only consider career choices of **engineers who experienced banking deregulation while in school**.

ED2: Source of Variation

State **A**:

Time

Start School

Strong Dereg-ulation (4→0)

End School

State **B**:

Time

Start School

Soft Dereg-ulation (4→3)

End School

ED2: Source of Variation

State **A**:

End School

Start School

Deregulation

End School

Empirical Design 2: Banking Deregulation

We estimate the following for subsamples based on talent measures, and test whether finance growth attracts more talented workers ($\beta_{TOP} > \beta_{NOT\ TOP}$):

$$\text{Prob. Switch to Finance}_i^{Graduation} = \beta_1 \times \text{Deregulation Index}_i + \text{School FE} + \text{Year FE} + \text{Major FE}$$

- Errors are clustered at the state level.
- Δ*Deregulation Index* is the change in the value of the deregulation index while the engineer was at school. *Deregulation Index (binary)* is equal to 1 if the value of the deregulation index is equal to 3 or 4, indicating more deregulation, and zero otherwise.

1. Does Financial Sector Growth Attract Elite Engineers?

ED1: School Rank

- Higher-ranked schools are *Carnegie*, *Caltech*, *Cornell*, *MIT*, *Northwestern*, and *Stanford*.
- Lower-ranked schools are *UC Berkeley*, *UT Austin*, *UCLA*, *UIUC*, *U Madison*, and *Georgia Tech*.

	Higher-ranked Schools		Other Schools	
	(1)	(2)	(3)	(4)
MSA Finance Share 1990	1.203***	1.202***	0.443***	0.382***
	(4.50)	(4.69)	(4.78)	(3.17)
Log (Total Emp in MSA)	-0.005*	-0.007*	0.002**	-0.000
	(-1.78)	(-1.82)	(1.98)	(-0.04)
Share of Workers w/ College in MSA		-0.019		-0.041**
		(-0.48)		(-2.51)
Emp Growth in MSA		-0.022		-0.006
		(-0.59)		(-0.40)
MSA Share Emp in Industry of Eng *i*		0.056		-0.014
		(0.63)		(-0.16)
MSA Growth in Emp in Industry of Eng *i*		-0.015**		0.003
		(-2.31)		(0.71)
$\beta \times (X_{\text{p75th}} - X_{25\text{th}})$	2.9%	2.9%	1.07%	.92%
$\bar{Y}$	7.02%	7.02%	4.4%	4.4%
School FE	No	No	No	No
Graduation Year FE	No	No	No	No
Major FE	No	No	No	No
School-Year-Major FE	No	Yes	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes
Firm Size Class FE	No	Yes	No	Yes
#Engineers	11144	10758	21425	21012
R-squared	0.164	0.200	0.114	0.142

ED1: Honors Data

- Honors (S,N,C) → Honors from Stanford, Northwestern, and Caltech
- Honors (OBNS) → Honors from observed on resumes

	Honors (S,N,C)		No Honors (S,N,C)		Honors (OBNS)		No Honors (OBNS)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MSA Finance Share 1990	2.696***	3.029***	0.428	0.516	1.228***	1.384***	0.743***	0.634***
	(3.94)	(5.17)	(0.68)	(0.77)	(3.97)	(4.42)	(6.93)	(6.53)
Log (Total Emp in MSA)	-0.022**	-0.017	0.007	-0.000	-0.008**	-0.005	0.000	-0.002
	(-2.18)	(-1.59)	(0.86)	(-0.00)	(-2.36)	(-1.06)	(0.41)	(-1.31)
Share of Workers w/ College in MSA		0.066		-0.070		0.055		-0.045**
		(0.67)		(-1.25)		(1.12)		(-2.44)
Emp Growth in MSA		-0.101		-0.065		-0.021		-0.002
		(-0.87)		(-1.37)		(-0.30)		(-0.15)
MSA Share Emp in Industry of Eng *i*		-0.429		0.143		0.202		0.014
		(-0.78)		(1.00)		(0.82)		(0.21)
MSA Growth in Emp in Ind. of Eng *i*		-0.075**		-0.021		-0.015		-0.003
		(-2.37)		(-1.55)		(-0.66)		(-0.83)
$\beta \times (X_{p75th} - X_{25th})$	6.51%	7.31%	1.03%	1.24%	2.97%	3.34%	1.79%	1.53%
$\bar{Y}$	8.06%	8.06%	6.78%	6.78%	6.3%	6.3%	5.21%	5.21%
School FE	No	Yes	No	Yes	No	No	No	No
Graduation Year FE	No	Yes	No	Yes	No	No	No	No
Major FE	No	Yes	No	Yes	No	No	No	No
School-Year-Major FE	No	No	No	No	No	Yes	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	No	Yes	No	Yes	No	Yes	No	Yes
#Engineers	638	625	2794	2715	2672	2623	29894	29144
R-squared	0.294	0.334	0.121	0.158	0.152	0.305	0.136	0.170

ED2: Honors Data and Bank Deregulation

- Honors (S,N,C) $\rightarrow$ Honors from Stanford, Northwestern, and Caltech
- Honors (OBNS) $\rightarrow$ Honors from observed on resumes

	Prob. of Moving to Finance			
	(1) Honors	(2) Non-honors	(3) Honors	(4) Non-honors
Deregulation Index (0-4)	0.020***	0.006**		
	(3.37)	(2.50)		
Deregulation Index (binary)			0.034***	0.015***
			(8.72)	(4.06)
Constant	-0.020***	0.018***	-0.092	0.003
	(-3.37)	(7.34)	(-1.88)	(0.26)
Year FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
Major FE	Yes	Yes	Yes	Yes
#Engineers	2571	28714	1378	13487
R-squared	0.039	0.022	0.036	0.017

2. Do early career choices affect likelihood of entrepreneurship?

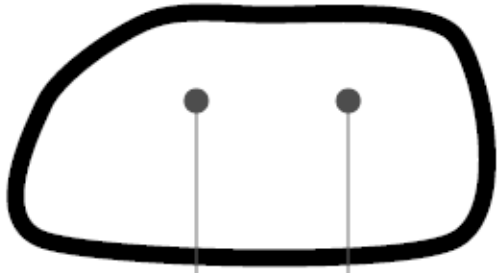
Finance and Migration and Innovation of Elite Engineers

Does an early career decision to switch to finance affect the likelihood of successful entrepreneurship by elite engineers?

- May have no effect if likelihood of entrepreneurship determined entirely by access to wealth, or innate ability (Lucas, 1978, Evans and Jovanovic, 1989)
- Or, working in finance can lead to better access to financing. Engineers who move to finance can co-found innovative firms with other engineers.
- Or, engineers may invest in finance-specific human capital rather than engineering-specific knowledge, which may reduce their ability to identify innovative ideas.

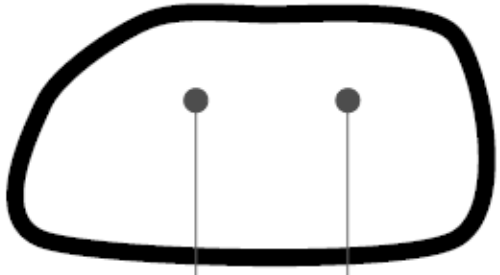
Financial sector growth and entrepreneurship

High-Finance Growth Metro Area



Eng Stays in Non-Fin ($\overline{y}^{high}_{stay}$) ← → Eng Moves to Fin ($\overline{y}^{high}_{move}$)

Low-Finance Growth Metro Area



Eng Stays in Non-Fin ($\overline{y}^{low}_{stay}$) ← → Eng Moves to Fin ($\overline{y}^{low}_{move}$)

$$\beta_1 = \underbrace{(\overline{y}^{high}_{move} - \overline{y}^{high}_{stay})}_{growth+selection} - \underbrace{(\overline{y}^{low}_{move} - \overline{y}^{low}_{stay})}_{selection}$$

ED1: Finance and Migration and Innovation of Elite Engineers

We then run the following regression:

$$
\begin{aligned}
\text{Innovative Firm} &= \beta_1 \times \text{Move to Finance}_{00-08} \times \text{MSA Emp Share in Finance}_{i,1990} \\
&= \beta_2 \times \text{Move to Finance}_{00-08} \\
&= \beta_3 \times \text{MSA Emp Share in Finance}_{i,1990} \\
&+ \theta_1 \times \text{MSA Emp Share in Engineering}_i \\
&+ \theta_2 \times \text{Size of MSA} \\
&+ \theta_3 \times \text{Employment Growth in MSA} \\
&+ \text{School-Year-Major FE} \\
&+ \text{Firm-Industry FE} \\
&+ \text{Firm-Size FE} \\
&+ \varepsilon_i
\end{aligned}
$$

ED1: Entrepreneurial Success of Elite Engineers

	Entrepreneurship		Innovative Entrepreneurship			
	(1) All	(2) All	(3) All	(4) All (Ent$\geq$2)	(5) Higher	(6) Others
Moved to Finance $\times$ MSA Finance Share 1990	-0.837***	-0.806***	-0.242***	-0.183**	-0.309**	-0.136
	(-2.85)	(-2.82)	(-2.97)	(-2.43)	(-2.00)	(-0.89)
MSA Finance Share 1990	0.241	0.197	-0.003	-0.006	-0.002	-0.005
	(1.12)	(0.99)	(-0.05)	(-0.10)	(-0.02)	(-0.07)
Moved to Finance	0.053***	0.049***	0.011**	0.008*	0.013	0.007
	(2.96)	(2.87)	(2.21)	(1.82)	(1.25)	(0.91)
MSA Controls	No	Yes	Yes	Yes	Yes	Yes
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	-2.02%	-1.95%	-.59%	-.44%	-.75%	-.33%
$\bar{Y}$	9.99%	9.99%	1.1%	1.03%	1.81%	.72%
School-Year-Major FE	Yes	Yes	Yes	Yes	Yes	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	Yes	Yes	Yes	Yes	Yes	Yes
#Engineers	32568	31769	31769	31643	10755	21014
R-squared	0.047	0.049	0.034	0.034	0.045	0.018

ED1: Entrepreneurial Success of Elite Engineers

	VC Funding		IPO or Acquired		Large Startup	
	(1) All	(2) Higher-Rank	(3) All	(4) Higher-Rank	(5) All	(6) Higher-Rank
Moved to Finance × MSA Fin. Share 1990	-0.287*	-0.191	-0.312***	-0.560***	-0.389*	-0.561***
	(-1.89)	(-0.76)	(-3.73)	(-3.14)	(-1.87)	(-2.67)
MSA Finance Share 1990	-0.016	-0.043	-0.048	-0.060	0.035	-0.048
	(-0.23)	(-0.37)	(-1.02)	(-0.77)	(0.49)	(-0.33)
Moved to Finance	0.019*	0.007	0.016***	0.032***	0.021*	0.028*
	(1.94)	(0.44)	(2.70)	(2.78)	(1.84)	(1.67)
MSA Controls	Yes	Yes	Yes	Yes	Yes	Yes
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	-.69%	-.46%	-.75%	-1.36%	-.94%	-1.36%
$\bar{Y}$	1.64%	2.79%	.75%	2.79%	2%	2.79%
School-Year-Major FE	Yes	Yes	Yes	Yes	Yes	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	Yes	Yes	Yes	Yes	Yes	Yes
#Engineers	31769	10756	31769	10756	31769	10756
R-squared	0.040	0.048	0.034	0.044	0.037	0.045

ED1: Entrepreneurial Success of Elite Engineers (Hometown)

	Entrepreneurship		Innovative Entrepreneurship	
	(1) (S,C)	(2) (S,C) (Ent≥2)	(3) (S,C)	(4) (S,C) (Ent≥2)
Moved to Finance × MSA Hometown Fin 1990	-4.492*	-4.689*	-2.377***	-2.260***
	(-1.90)	(-1.94)	(-2.80)	(-2.86)
MSA Hometown Fin 1990	-0.729	-0.706	0.641**	0.560**
	(-1.59)	(-1.64)	(2.21)	(2.31)
Moved to Finance	0.150	0.160	0.078*	0.077*
	(1.23)	(1.32)	(1.71)	(1.69)
Constant	0.130***	0.105**	-0.000	0.001
	(2.88)	(2.61)	(-0.01)	(0.04)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	-7.56%	-7.9%	-4%	-3.81%
$\bar{Y}$	18.01%	16.81%	3.07%	2.79%
School FE	No	No	No	No
Graduation Year FE	No	No	No	No
Major FE	No	No	No	No
School-Year-Major FE	Yes	Yes	Yes	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes
Firm Size Class FE	Yes	Yes	Yes	Yes
#Engineers	1387	1369	1387	1369
R-squared	0.133	0.135	0.080	0.079

ED1: Entrepreneurial Success of Elite Engineers (Hometown)

	VC Funding	IPO or Acquired	Large Startup
	(1)	(2)	(3)
Moved to Finance × MSA Hometown Fin 1990	-1.833**	-1.632***	-2.930*
	(-2.27)	(-3.31)	(-1.88)
fraction_fin_hometown_1990	0.446	0.162	0.191
	(1.05)	(0.74)	(0.51)
Moved to Finance	0.026	0.058	0.073
	(0.53)	(1.65)	(0.87)
Constant	-0.033	-0.021	0.011
	(-1.00)	(-0.97)	(0.31)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	-3.09%	-2.75%	-4.93%
$\bar{Y}$	4.88%	2.22%	5.04%
School-Year-Major FE	Yes	Yes	Yes
3-Digit NAICS FE	Yes	Yes	Yes
Firm Size Class FE	Yes	Yes	Yes
#Engineers	1391	1391	1391
R-squared	0.091	0.115	0.083

ED2: Entrepreneurial Success of Elite Engineers (Banking Deregulation)

$$\begin{aligned} \text{Innovative Firm} &= \beta_1 \times \text{Move to Finance}_{grad} \times \Delta \text{ Deregulation Index}_i \\ &+ \beta_2 \Delta \text{ Deregulation Index}_i \\ &+ \beta_3 \times \text{Move to Finance}_{grad} \\ &+ \varepsilon_i \end{aligned}$$

	Entrepreneur	Innovative	Funding	Acquired	Large Startup
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Dereg. Index (binary) × Move to Finance	-0.057**	-0.004	0.003	-0.026***	-0.030***
	(-2.24)	(-0.92)	(0.34)	(-5.43)	(-3.70)
Deregulation Index (binary)					0.009***
					(17.21)
Move to Finance	0.007	-0.004	0.013	0.009	0.003
	(0.29)	(-0.95)	(1.36)	(1.81)	(0.38)
Constant	0.106***	-0.001	0.008***	0.013***	0.006
	(12.76)	(-0.65)	(5.74)	(9.61)	(1.63)
Year FE	Yes	Yes	Yes	Yes	No
School FE	Yes	Yes	Yes	Yes	No
Major FE	Yes	Yes	Yes	Yes	No
#Engineers	8082	8082	8082	8082	8082
R-squared	0.015	0.003	0.005	0.006	0.004

Robustness I

- We use the **presence of finance in 1990 in the engineer's hometown** as explanatory variable. Link to Results
- We **exclude** the following MSAs: **NYC, Connecticut, New Jersey, and Chicago**. Link to Results
- Compare engineers in the same firm by using **firm fixed effects**. Smaller elasticity but still economically large and statistically significant. Link to Results
- Compare cohorts of 2004 and 2005 to cohorts of 1998 and 1999 and transitions over 3 years for **time variation**. Robust to **fixed industrial characteristics across MSAs** that affect engineer location. Link to Results

Robustness II

- Results **not driven by engineers moving from declining manufacturing sectors** or from professional services like management consulting. Link to Results
- Financial sector growth in a MSA **does not lead to moves to management consulting** (another high growth sector that demands talent); Link to Results results also not driven by **moves from management consulting** Link to Results.
- Moves to finance **decline post 2008, and then increase to pre-crisis levels** and higher. Link to Results
- Finance hires all engineering majors, not just CS, suggesting **high demand for talent and not specific engineering skills**. Link to Results

Concluding remarks

- Find that **financial sector growth attracts highly talented workers**, which suggests an explanation for the finance wage premium.

- Compared to classmates, engineers who switch to finance due to financial sector growth are **less likely to create startups that are innovative, receive VC funding, are acquired, and have high employment**.

- However, **engineers who move to finance in low finance growth areas, are more likely to create transformative enterprises**.

- Results show that **early career choices** driven by labor market factors **affect the long-run likelihood of transformative entrepreneurship** for individuals with potential to be superstar entrepreneurs.

ED1: Does Financial Sector Growth Attract Engineers?

	Prob. of Switching to Finance				
	(1)	(2)	(3)	(4)	(5)
MSA Finance Share 1990	0.761***	0.697***	0.688***		
	(9.66)	(7.61)	(7.55)		
MSA Finance Share 1990: Securities				1.053***	1.095***
				(4.23)	(4.07)
MSA Finance Share 1990: Credit Interme.				0.423**	0.374*
				(2.28)	(1.84)
Log (Total Emp in MSA)		-0.003	-0.003	-0.003	-0.003
		(-1.58)	(-1.51)	(-1.52)	(-1.49)
Share of Workers w/ College in MSA		-0.036*	-0.036*	-0.029	-0.030
		(-1.93)	(-1.91)	(-1.56)	(-1.49)
Emp Growth in MSA		-0.008	-0.008	-0.006	-0.005
		(-0.49)	(-0.47)	(-0.33)	(-0.28)
MSA Share Emp in Industry of Eng i		0.028	0.019	0.028	0.018
		(0.38)	(0.27)	(0.38)	(0.27)
MSA Growth in Emp in Industry of Eng i		-0.004	-0.003	-0.004	-0.003
		(-0.97)	(-0.90)	(-0.92)	(-0.83)
$\beta \times (X_{p75th} - X_{25th})$	1.84%	1.68%	1.66%	1.16%; .44%	1.2%; .39%
$\bar{Y}$	5.3%	5.3%	5.3%	5.3%	5.3%
School FE	No	Yes	No	Yes	No
Graduation Year FE	No	Yes	No	Yes	No
Major FE	No	Yes	No	Yes	No
School-Year-Major FE	No	No	Yes	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	No	Yes	Yes	Yes	Yes
#Engineers	32567	31768	31768	31736	31736
R-squared	0.136	0.150	0.167	0.150	0.167

- Probability of moving to finance measured between 2000 and 2008, using cohorts between 1998 and 2006.
- Likelihood of switching to finance is 30% higher for an engineer in 75^{th} percentile of MSA finance share compared to 25^{th} percentile, relative to mean of 5%

Excluding major financial centers

To address "geographic self selection" into metro areas that are financial centers.

	Full Sample		No NYC Metro		No NYC, CT, & Chicago	
	(1)	(2)	(3)	(4)	(5)	(6)
MSA Finance Share 1990	0.768***	0.689***	0.675***	0.613***	0.681***	0.588***
	(6.96)	(7.58)	(4.75)	(6.58)	(3.11)	(3.67)
Log (Total Emp in MSA)	-0.000	-0.003	-0.000	-0.003	-0.000	-0.003
	(-0.10)	(-1.51)	(-0.43)	(-1.61)	(-0.21)	(-1.46)
Share of Workers w/ College in MSA		-0.036*		-0.035*		-0.035
		(-1.91)		(-1.80)		(-1.61)
Emp Growth in MSA		-0.008		-0.009		-0.011
		(-0.46)		(-0.54)		(-0.63)
MSA Share Emp in Industry of Eng i		0.017		-0.046		-0.044
		(0.25)		(-0.94)		(-0.86)
MSA Growth in Emp in Industry of Eng i		-0.004		-0.002		-0.001
		(-0.91)		(-0.42)		(-0.16)
Econ. Impact $\beta \times (X_{p75th} - X_{25th})$	1.86%	1.66%	1.63%	1.48%	1.64%	1.42%
$\bar{Y}$	5.3%	5.3%	4.91%	4.91%	4.9%	4.9%
School FE	No	No	No	No	No	No
Graduation Year FE	No	No	No	No	No	No
Major FE	No	No	No	No	No	No
School-Year-Major FE	No	Yes	No	Yes	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	No	Yes	No	Yes	No	Yes
#Engineers	32569	31770	29986	29187	29207	28408
R-squared	0.136	0.167	0.086	0.118	0.084	0.118

Likelihood of switching to finance is 29% higher for engineer in 75^{th} percentile of MSA finance share compared to 25^{th} percentile, relative to mean of 5%.

Back to Additional Tests

Hometown

We measure the presence of finance in 1990 for the hometowns of engineers from Stanford and Caltech.

	Prob. of Switching to Finance		
	(1)	(2)	(3)
MSA Hometown Fin 1990	0.703*	0.716**	0.658**
	(1.90)	(2.15)	(2.55)
$\beta \times (X_{p75th} - X_{25th})$	1.18%	1.21%	1.11%
$\bar{Y}$	6.34%	6.34%	6.34%
School FE	Yes	Yes	No
Graduation Year FE	Yes	Yes	No
Major FE	Yes	Yes	No
School-Year-Major FE	No	No	Yes
3-Digit NAICS FE	No	Yes	Yes
Firm Size Class FE	No	Yes	Yes
#Engineers	1391	1391	1391
R-squared	0.026	0.166	0.209

Our conjecture: the higher the presence of finance the more likely the engineer knows people in the financial sector, increasing the likelihood of transitioning from an engineering job to finance.

Back to Additional Tests

Within firm analysis

labelFirmFE

To address "push" from declining fims and/or geographic selection we consider classmates who work in different branches of same firm in different locations.

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	Prob. of Switching to Finance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MSA Finance Share 1990	0.370**	0.314**	0.344**				
	(2.48)	(2.15)	(2.26)				
MSA Finance Share 1990: Securities				0.570*	0.655**		
				(1.96)	(2.20)		
MSA Finance Share 1990: Credit Interme.						0.540**	0.563**
						(2.14)	(2.09)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School FE	No	Yes	No	Yes	No	Yes	No
Graduation Year FE	No	Yes	No	Yes	No	Yes	No
Major FE	No	Yes	No	Yes	No	Yes	No
School-Year-Major FE	No	No	Yes	No	Yes	No	Yes
#Engineers	19657	19657	19657	19655	19655	19657	19657
R-squared	0.193	0.200	0.223	0.200	0.223	0.200	0.223

Rolling windows

To control for fixed industrial characteristics across regions we estimate the following:

$$
\begin{aligned}
\text{Prob. Switch to Finance}_i \quad = \quad & \beta_1 \times \text{Cohort 04\&05}_i && (2)\\
& \times \text{ MSA Finance Share in 1990}_i && (3)\\
& + \beta_2 \times \text{Cohort 04\&05}_i \\
& + \beta_3 \times \text{ MSA Finance Share in 1990}_i \\
& + \text{MSA Controls} \\
& + \text{School-Year graduation-Major FE} \\
& + \text{Firm Size Class FE} \\
& + \text{3-Digit NAICS FE} + \varepsilon_i,
\end{aligned}
$$

Rolling windows

labelTimeFE

	Switch to Finance in 06 & 07 vs 00 & 01		
	(1)	(2)	(3)
Cohort 04 & 05 × MSA Finance Share 1990	0.664***	0.741***	0.767***
	(3.69)	(4.22)	(4.17)
Cohort 04 & 05	-0.021***	-0.023***	-0.013
	(-2.96)	(-3.21)	(-1.04)
MSA Finance Share 1990	0.119	-0.197***	-0.258**
	(1.31)	(-2.81)	(-2.49)
Log (Total Emp in MSA)			-0.000
			(-0.11)
Share of Workers w/ College in MSA			-0.005
			(-0.58)
Emp Growth in MSA			0.004
			(0.35)
MSA Share Emp in Industry of Eng i			0.047
			(0.78)
MSA Growth in Emp in Industry of Eng i			0.005*
			(1.78)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	1.6%	1.79%	1.85%
$\bar{Y}$	1.49%	1.49%	1.49%
School FE	No	No	No
Graduation Year FE	No	No	No
Major FE	No	No	No
School-Year-Major FE	No	No	Yes
3-Digit NAICS FE	No	Yes	Yes
Firm Size Class FE	No	No	Yes
#Engineers	13988	13988	13653
R-squared	0.008	0.091	0.115

Robust to fixed industrial characteristics in metros that affect location of engineers; More moves in peak finance growth years.

Back to Additional Tests

Robustness: Do engineers move from the declining manufacturing sector?

	Manufacturing	Prof. & Serv.
	(1)	(2)
MSA Finance Share 1990	0.215	1.411***
	(1.35)	(6.30)
Share of Workers w/ College in MSA	-0.017	-0.104**
	(-0.87)	(-2.00)
Emp Growth in MSA	-0.010	0.044*
	(-0.63)	(1.83)
Log (Total Emp in MSA)	-0.001	-0.014***
	(-0.24)	(-3.02)
MSA Share Emp in Industry of Eng i	-0.104	0.234*
	(-1.58)	(1.88)
MSA Growth in Emp in Industry of Eng i	0.004	-0.019**
	(1.10)	(-2.01)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	.52%	3.41%
$\bar{Y}$	3.04%	6.67%
School FE	No	No
Graduation Year FE	No	No
Major FE	No	No
School-Year-Major FE	Yes	Yes
3-Digit NAICS FE	Yes	Yes
Firm Size Class FE	Yes	Yes
#Engineers	8824	9632
R-squared	0.076	0.089

Back to Robustness

Robustness: Is it CS majors?

	Civil Eng	Computer Eng	Electrical Eng	Mechanical Eng	Chemical Eng
	(1)	(2)	(3)	(4)	(5)
MSA Finance Share 1990	0.588**	1.114***	0.613***	0.322**	0.349**
	(2.39)	(6.21)	(2.78)	(2.15)	(1.99)
Share of Workers w/ College in MSA	-0.013	-0.057	-0.018	-0.011	-0.066
	(-0.55)	(-1.55)	(-0.71)	(-0.38)	(-1.60)
Emp Growth in MSA	0.030	-0.000	-0.026	-0.033	0.002
	(1.24)	(-0.00)	(-1.00)	(-1.17)	(0.08)
Log (Total Emp in MSA)	-0.005	-0.008**	-0.002	0.003	-0.002
	(-1.63)	(-2.27)	(-0.58)	(1.03)	(-0.59)
MSA Share Emp in Industry of Eng i	0.053	0.052	0.001	0.063	-0.181*
	(0.48)	(0.45)	(0.01)	(0.68)	(-1.68)
MSA Growth in Emp in Industry of Eng i	-0.008	-0.002	-0.010	-0.005	0.015*
	(-0.87)	(-0.24)	(-1.63)	(-0.60)	(1.91)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	1.42%	2.69%	1.48%	.78%	.84%
$\bar{Y}$	2.29%	7.01%	4.67%	5.08%	3.81%
School FE	No	No	No	No	No
Graduation Year FE	No	No	No	No	No
Major FE	No	No	No	No	No
School-Year-Major FE	Yes	Yes	Yes	Yes	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	Yes	Yes	Yes	Yes	Yes
#Engineers	3171	11960	3626	6996	4547
R-squared	0.154	0.154	0.207	0.221	0.149

Back to Robustness

Robustness: Effects after 2008

	Switch 2008 to 2010		Switch 2011 to 2016	
	(1)	(2)	(3)	(4)
MSA Finance Share 1990: Credit Interme.	0.366***	0.459***	0.757***	0.859***
	(2.95)	(3.54)	(4.75)	(4.14)
Log (Total Emp in MSA)		-0.002**		-0.002
		(-2.42)		(-1.41)
Share of Workers w/ College in MSA		-0.020**		-0.008
		(-2.12)		(-0.70)
Emp Growth in MSA		-0.004		-0.019
		(-0.51)		(-0.92)
MSA Share Emp in Industry of Eng i		0.006		0.011
		(0.16)		(0.16)
MSA Growth in Emp in Industry of Eng i		-0.002		-0.005
		(-0.70)		(-1.57)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	.38%	.48%	.79%	.89%
$\bar{Y}$	1.58%	1.58%	3.94%	3.94%
School FE	No	No	No	No
Graduation Year FE	No	No	No	No
Major FE	No	No	No	No
School-Year-Major FE	No	Yes	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes
Firm Size Class FE	No	Yes	No	Yes
#Engineers	30078	29361	30484	29752
R-squared	0.021	0.042	0.008	0.028

Back to Robustness

Robustness: Excluding moves from Management Consulting

	Prob. of Switching to Finance				
	(1)	(2)	(3)	(4)	(5)
MSA Finance Share 1990	0.695***	0.652***	0.636***	0.629***	0.632***
	(5.43)	(5.76)	(5.82)	(6.39)	(6.51)
Log (Total Emp in MSA)	-0.000	-0.001	-0.002	-0.002	-0.002
	(-0.36)	(-0.75)	(-1.16)	(-1.51)	(-1.45)
Share of Workers w/ College in MSA		-0.012	-0.014	-0.026	-0.026
		(-0.68)	(-0.84)	(-1.58)	(-1.56)
Emp Growth in MSA		-0.029	-0.021	-0.014	-0.013
		(-1.61)	(-1.28)	(-0.89)	(-0.85)
MSA Share Emp in Industry of Eng i		-0.009	-0.034	-0.048	-0.051
		(-0.24)	(-0.95)	(-1.13)	(-1.18)
MSA Growth in Emp in Industry of Eng i		0.003	0.002	-0.001	-0.001
		(0.72)	(0.60)	(-0.32)	(-0.26)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	1.68%	1.58%	1.54%	1.52%	1.53%
$\bar{Y}$	5.01%	5.01%	5.01%	5.01%	5.01%
School FE	No	No	Yes	Yes	No
Graduation Year FE	No	Yes	Yes	Yes	No
Major FE	No	No	No	Yes	No
School-Year-Major FE	No	No	No	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	No	No	No	Yes	Yes
#Engineers	31889	31101	31101	31101	31101
R-squared	0.144	0.154	0.155	0.158	0.174

Back to Robustness

Robustness: Moves to Management Consulting

	Prob. of Switching to Management Consulting				
	(1)	(2)	(3)	(4)	(5)
MSA Finance Share 1990	-0.008	-0.009	-0.001	0.001	0.003
	(-0.31)	(-0.36)	(-0.06)	(0.02)	(0.13)
Log (Total Emp in MSA)	0.000	0.000	0.000	0.000	0.000
	(0.26)	(0.95)	(1.00)	(0.97)	(1.06)
Share of Workers w/ College in MSA		0.003	0.003	0.004*	0.004
		(1.18)	(1.51)	(1.68)	(1.51)
Emp Growth in MSA		0.003	0.002	0.002	0.002
		(0.95)	(0.75)	(0.68)	(0.65)
MSA Share Emp in Industry of Eng i		-0.009	-0.007	-0.008	-0.007
		(-1.50)	(-1.27)	(-1.42)	(-1.32)
MSA Growth in Emp in Industry of Eng i		-0.001	-0.001	-0.001	-0.001
		(-1.16)	(-1.14)	(-0.97)	(-1.07)
$\beta \times (X_{\text{p75th}} - X_{\text{25th}})$	-.02%	-.02%	0%	0%	.01%
$\bar{Y}$	.14%	.14%	.14%	.14%	.14%
School FE	No	No	Yes	Yes	No
Graduation Year FE	No	Yes	Yes	Yes	No
Major FE	No	No	No	Yes	No
School-Year-Major FE	No	No	No	No	Yes
3-Digit NAICS FE	Yes	Yes	Yes	Yes	Yes
Firm Size Class FE	No	No	No	Yes	Yes
#Engineers	31889	31101	31101	31101	31101
R-squared	0.003	0.003	0.004	0.004	0.027

Why finance?

- Historically unprecedented growth in the size of the U.S. financial sector relative to GDP in recent decades (Philippon and Reshef, 2012), which we use to identify a "pull" of scarce talent into this sector.
- Increased demand for engineers in finance - 1/3 of MIT's engineering class before the crisis. 3rd most hired major in Financial sector.
- Macro data shows rising trend in transition of engineers to finance.

Transitions of Engineers to Finance: Evidence from CPS

Why engineers?

- Engineers are in demand across sectors - **highest paid undergraduate college major in the U.S.** (Carnevale, 2015).
- **Majority of U.S. inventors** have an engineering degree (Walsh and Nagaoka, 2009).
- **Supply of engineers limited** - "U.S. would need to produce 1 million more STEM professionals over the next decade to match demand" (President's Council of Advisors on Science and Technology, 2012).

Related literature

- Effect of labor market conditions affect **career choices** (Oyer 2006; 2008; Schoar and Zuo, 2017; Orepoulos et al., 2017).
- Literature on wages and human capital in finance shows a **wage premium**(Philippon and Reshef 2012; Axelson and Bond 2015; Boustanifar et al. 2017; Celerier and Vallee 2017) and consequences for income inequality(Kaplan and Rauh, 2010, Bell and Van Reenen, 2013, 2014) .
- Recent studies suggest that **finance workers not more skilled** (Bohm, Metzger, and Stromberg 2016; Shu 2016).
- Literature on **determinants of entrepreneurship** with a focus on professional experience(Hacamo and Kleiner 2016, Babina 2016, Gottlieb, Townsend, and Xu, 2016).
- Related to the labor literature on **education-occupation mismatch**(Robst 2007; Altonji, Blom and and Meghir 2012; Ransom and Phipps 2016).

Endogeneity concerns

Two problems arise when testing whether financial sector growth attracts engineers from non financial sectors and the impact of this move on the likelihood of becoming an entrepreneur:

1. Employment decline in engineering occupations may push engineers to seek careers in finance.

2. Individual preference and ability drives move to finance and/or entrepreneurship decision.