Growing by Grafting

Ezra Oberfield
Princeton University

Esteban Rossi-Hansberg
University of Chicago

Nicholas Trachter*
FRB of Richmond

Derek Wenning
Princeton University

Chen Yeh*
FRB of Richmond

* The views expressed herein are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Richmond or the Federal Reserve System.

How Do Firms Grow?

- ◇ Concentration has been rising ↔ fattening of the right tail of firm size distribution
- ◇ Most growth comes through new establishments [Cao et. al (2016)]
- ◇ We study how firms choose to grow on this dimension. Highlight two methods:
  - De Novo: creating new establishments
  - Grafting: taking over establishments of other firms [Eisfeldt & Rampini (2006)]
- ◇ These notes document several facts about the propensity of grafting...
  - ... over time
  - ... across the size distribution
  - ... across the *growth* distribution
  - ... between firms of different sizes

Data

Data Construction

- National Establishment Time-Series (NETS)
  - Establishment-level panel data with *establishment* and *firm* (parent) identifiers
  - Qualitative results similar to using Census LBD data

- A "firm" is an firm identifier-industry pair
  - Industries at the SIC8 level

Some Establishment Growth Accounting

◇ Accounting for establishment growth at the firm (i) - industry (j) level:

$$\underbrace{N_{ijt} - N_{ijt-1}}_{\text{establishment growth}} = \underbrace{D_{ijt}}_{\text{de novo}} + \underbrace{G_{ijt}}_{\text{grafted}} - \underbrace{O_{ijt}}_{\text{off-loaded}} - \underbrace{C_{ijt}}_{\text{closed}}$$

◇ Define *G*rafted/*O*ff-loaded establishments as those that:

1. Change *firm* identifier
2. Do not change *establishment* identifier and *industry (SIC8)*

∗ Grafted firms across industries classified as de novo

◇ Every off-loaded establishment is grafted by someone: $\sum_i G_{ijt} = \sum_i O_{ijt}$

Facts

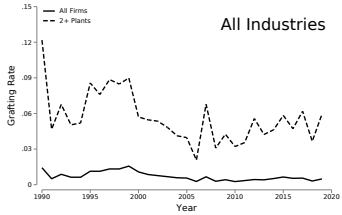
How Prevalent Is Grafting on a Yearly Basis?

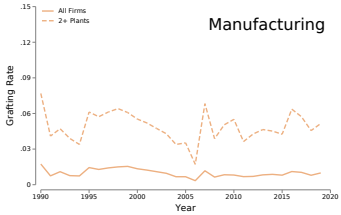
◇ Interested in the *G*rafted *R*ate of establishments each year:

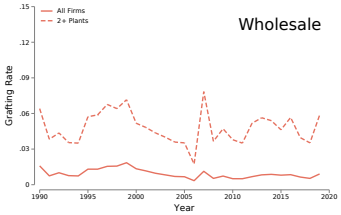
$$GR_{jt} \equiv \sum_{i \in \mathcal{I}_j} G_{ijt} \Big/ \sum_{i \in \mathcal{I}_j} N_{ijt}$$

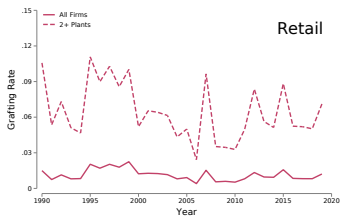
◇ Consider full sample of firms and firms with ≥ 2 establishments

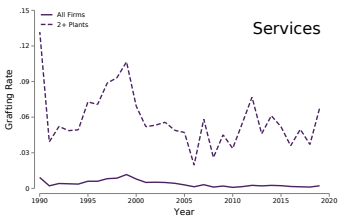
Fact 1: Grafting is Prevalent Across Time











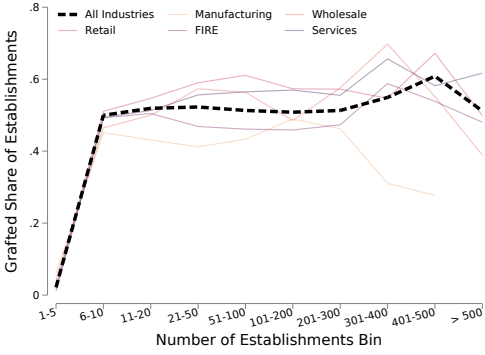
Firm Size and Cumulative Grafting Rates

◇ Aggregate grafting rate (among firms with at least 2 establishments) $\approx 5.6\%$ per year
  $\rightarrow$ what are the cumulative effects?

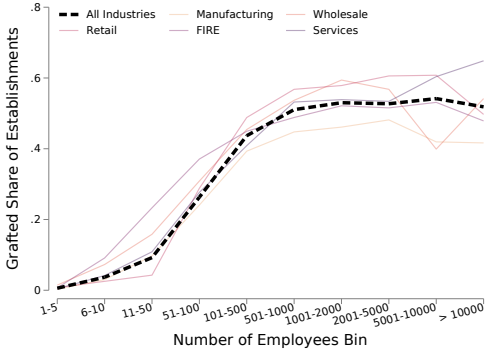
◇ Calculate share of grafted plants for a given firm. Study relation between share and size of firm
  (2019 cross-section of firms)

◇ Two measures of size:
  1. Total number of establishments
  2. Total number of employees

Fact 2: Large Firms Are Primarily Made Up of Grafted Establishments



(a) By number of establishments



(b) By total employees

How Does Propensity to Graft Relate to Growth?

◇ Idea: when firms grow, they want to grow quickly → graft rather than build

◇ Test formally with the following regression:

$$\frac{G_{ijt}}{G_{ijt} + D_{ijt}} = \beta_0 \log(N_{ijt-1}) + \beta_1 \log\left(\frac{N_{ijt}}{N_{ijt-1}}\right) + \gamma_{\text{age}(i)} + \gamma_j + \gamma_t + \varepsilon_{ijt}$$

◇ Interpretation: $\beta_1 > 0$ implies that the more a firm grows, the more it relies on grafting

Fact 3: Firms That Grow Faster Graft More

	Full Sample	Growing Firms	Growing, $N \geq 10$
$\log(N_{ijt-1})$	0.018^{***}	0.029^{***}	-0.010^{***}
	(0.000)	(0.000)	(0.001)
$\log(N_{ijt}/N_{ijt-1})$	0.069^{***}	0.098^{***}	0.108^{***}
	(0.001)	(0.001)	(0.003)
Age FE	✓	✓	✓
SIC8 FE	✓	✓	✓
Year FE	✓	✓	✓
Obs.	1,562,299	1,375,462	141,071
R^2	0.16	0.17	0.20

Is Off-Loading Divestment or Exit?

- ◇ Firms that grow faster tend to graft → do off-loading counterparts close or simply divest?
- ◇ Study relationship between off-loader size vs. share of remaining plants after event
  - size = # of plants

Interpretation

- ◇ Acquisition: no plants remaining
- ◇ Divestment: positive number of plants remaining

Fact 4: Off-Loading is Divestment, Not Exit

- Fraction of off-loaded plants increasing in off-loader size
- Off-loading is therefore:
  - an acquisition if small
  - divestment if large

Grafting vs. De Novo vs. Off-Loading Dynamics

Key Idea: Firms grow...

... *quickly* but *abruptly* through grafting $\rightarrow$ more expensive, little persistence

... *slowly* but *continuously* through de novo branching $\rightarrow$ cheaper, lots of persistence

◇ Regression framework:

$$\log(Y_{ijt}) = \beta_1 \log(Y_{ijt-1}) + \beta_2 \log(Y_{ijt-2}) + \theta \log(N_{ijt}) + \gamma_j + \gamma_{age(i)} + \gamma_t + \varepsilon_{ijt}$$

◇ Y_{ijt} = de novo plants, grafted plants, off-loaded plants

Fact 5: De Novo/Off-Loading is Persistent, Grafting is Lumpy

	De Novo	Grafting	Off-Loading
First Lag	0.057^{***}	-0.007	0.214^{***}
	(0.004)	(0.006)	(0.010)
Second Lag	-0.015^{***}	-0.049^{***}	0.157^{***}
	(0.004)	(0.006)	(0.011)
Size Control	✓	✓	✓
Age FE	✓	✓	✓
SIC8 FE	✓	✓	✓
Year FE	✓	✓	✓
Obs.	102,059	45,425	18,374
R^2	0.49	0.352	0.261

Who Grafts From Who?

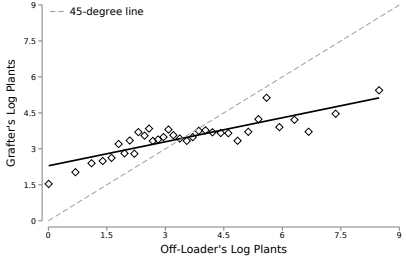
◇ Grafting is related to faster growth → does this affect who a firm grafts from?
  ○ M&A literature: sorting in acquisitions [David (2023)]

◇ Test with the following regression framework:

$$\log(\text{Size}_{ijt}^{\text{grafter}}) = \beta \log(\text{Size}_{ijt}^{\text{off-loader}}) + \gamma_j + \gamma_{\text{age}(i)} + \gamma_t + \varepsilon_{ijt}$$

- Size_{ijt} = number of plants or employment

Fact 6: Large Firms Graft From Other Large Firms



Dependent Variable: Grafter Size

	Plants	Employment
Off-Loader Size	0.058***	0.082***
	(0.001)	(0.001)
Age FE	✓	✓
SIC8 FE	✓	✓
Year FE	✓	✓
Obs.	1,562,299	1,375,462
R^2	0.16	0.17

How Many Firms Are Grafted From and Off-Loaded To?

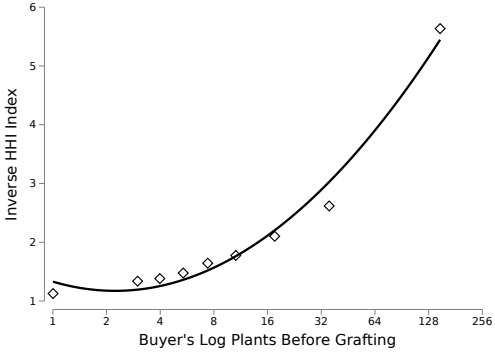
- Firms may want to grow beyond the available branches of an off-loading firm
  - do firms graft/off-load from more than one firm?

- Study how concentrated grafting and off-loading is using inverse HHI:

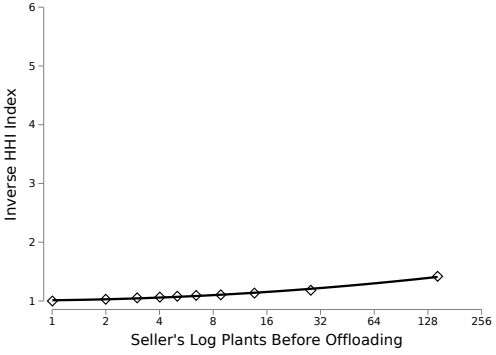
$$\text{Grafting Concentration} = \left[\sum_{o \in \{\textbf{grafted } \text{firms}\}_{it}} \left(\frac{G^o_{ijt}}{\sum_o G^o_{ijt}} \right)^2 \right]^{-1}$$

$$\text{Off-Loading Concentration} = \left[\sum_{o \in \{\textbf{grafting } \text{firms}\}_{it}} \left(\frac{O^o_{ijt}}{\sum_o O^o_{ijt}} \right)^2 \right]^{-1}$$

Fact 7: Firms Graft From Many Firms, But Off-Load to Few Firms



(a) Grafting Concentration



(b) Off-Loading Concentration

Summary of Facts

Grafting is...

... a prevalent form of growth for large firms
- $>$ 50% of large firm establishments were grafted

... largely used to grow quickly, while de novo is used to grow persistently
- Grafting is lumpy: not much persistence

... associated with
- sorting: large firms graft from large firms
- divestment: not all establishments are sold in a grafting event

Going Forward

- ◇ Confirming + adding new facts with establishment-level Census data
  - ○ So far: patterns are qualitatively similar across data sets
- ◇ Model of grafting in an otherwise standard firm dynamics framework