

Learning By Building: Complementary Assets and the Migration of Capabilities In U.S. Innovative Firms

Elisabeth B. Reynolds
Director, MIT Industrial Performance Center

with Hiram Samel, Ph.D., MIT Sloan School
Joyce Lawrence, PhD student, MIT Political Science Department

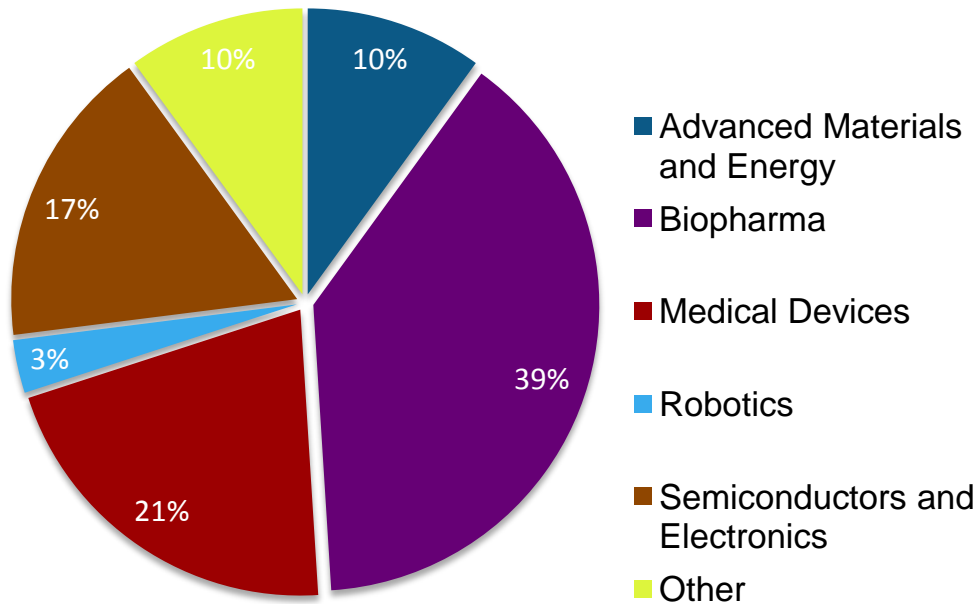
Scale Up of Innovative Firms

- Motivation
 - US economic model relies on new innovative firms
 - Debates about importance of manufacturing
 - Lack of research on how innovative firms develop complex technologies in manufacturing
- Research Questions
 - What are the implications of innovative firms' scale-up strategies for the US innovation ecosystem?
 - What are the processes and pathways by which innovative production-oriented firms scale their technology?
 - What are the critical factors necessary for scaling? What, if any, barriers exist?

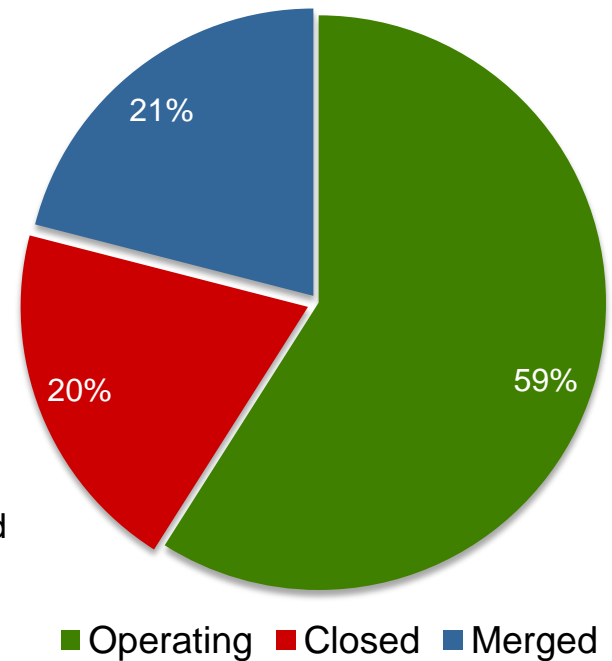
Critical Case of 150 Production Firms

Started with MIT Licensed Technology (1997-2008)

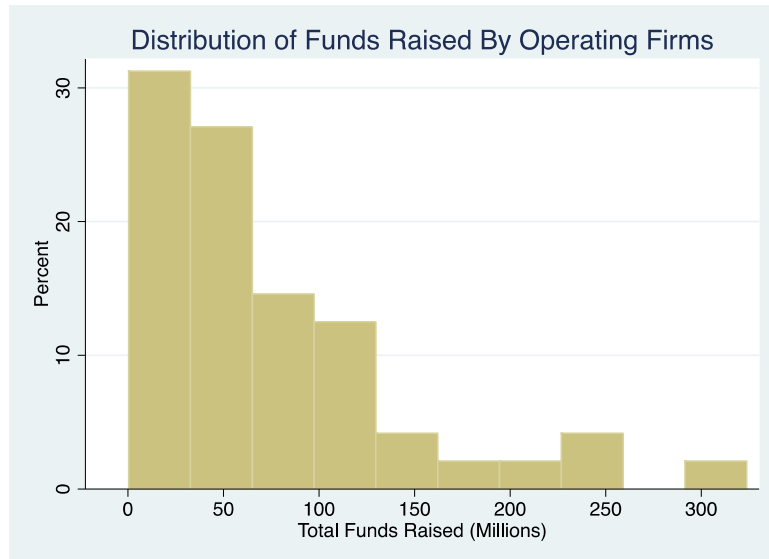
By Industry



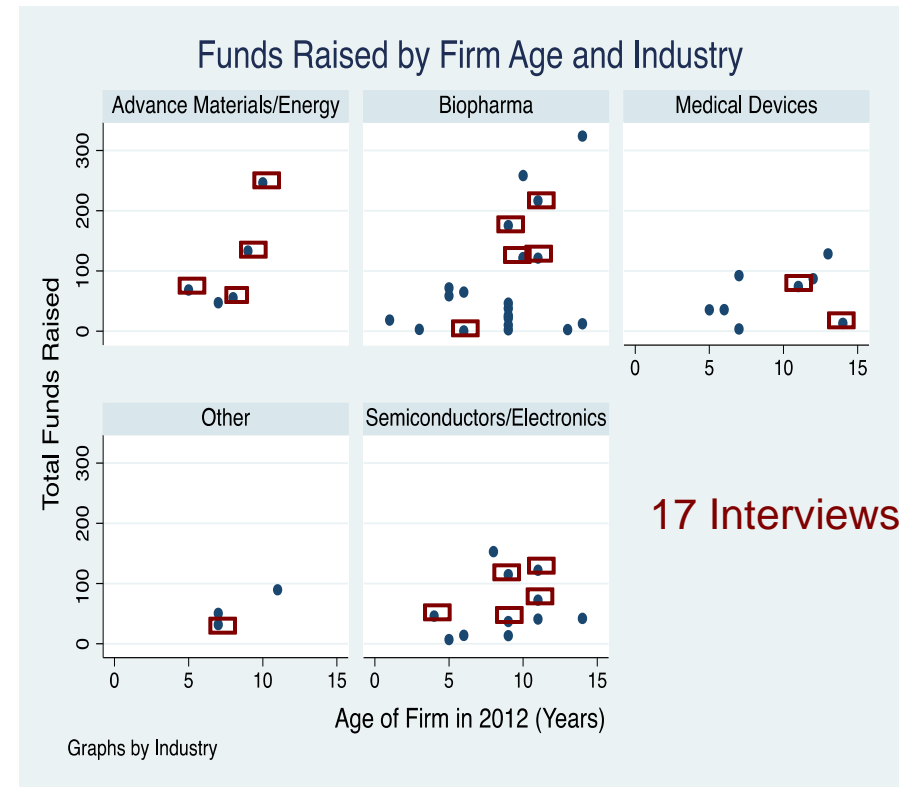
By Current Status



A Majority of the Firms Raised Large Amounts of Venture Capital



- 82 production firms received VC financing
- 52 of these still in operation
- Mean of \$74M over 9 years



Findings: Robust Innovation Ecosystem at the Early Stages of Scale Up

- **Capital Available for Up to 10 Years**
- **Thick Labor Markets:**
 - Need access to diverse “high intellect” talent
 - Easy to find for prototyping and pilot phases
- **Networks Matter**
 - Key individuals deliver resources
- **Thick Supplier Markets**
 - Range of suppliers with an emphasis on speed and quality
 - *“We kept eight machine shops busy for two weeks at full capacity getting a system ready.”*

Search for Complementary Assets Leads Firms Overseas

- **Significant influx of new capital** required to reach commercial scale
 - \$30 - 60 million
 - *“VCs cannot make any money on something that costs \$100 million and takes at least 10 years to build.”*
- **Strategic partners and foreign governments** provide complementary assets
 - *“When [the company] transitions from the normal VC model, there is no other model to jump to, so they go abroad.”*

Implications of this Shift Abroad

- Critical moment in firm's growth
 - **“Inflection band”** of 2-3 years
 - Knowledge is loosely codified;
 - Process of **“learning by building”** in manufacturing for scale up
- Financing, capabilities and customers/suppliers **pull technology development abroad**
 - Demand offers opportunity to iterate on technology
 - Reinforced by aggressive public policies

Long-Term Consequences for the U.S.?

- **Learning by doing** occurs overseas
 - Decline in capabilities means loss in “industrial commons”
(Pisano and Shih 2012)
- Reinforces **movement of center of gravity** for industries away from the U.S.
 - Initially resulted from de-verticalization of U.S. industry
 - Accelerated by laissez-faire venture capital markets
(Chesbrough et al. 2006)
- **Reduces benefits to the country of downstream activities** in terms of investments and jobs (*in situ* development)
 - Possibly breaks virtuous cycle of capabilities->innovation->capabilities

Directions for Future Research

- Financial structures like “megafunds” that can provide alternatives to non-dilutive foreign capital (Fernandez et al. 2012)
- Comparative analysis of industry-specific market conditions as shaped by demand and institutions in biopharma, clean energy, and advanced manufacturing
- Understand role of strategic partners and foreign investors for a larger national sample