A New View of the Skew: Quantitative Estimates of the Quantity and Quality of Entrepreneurship

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Innovation Science and Policy



"America's great challenge is to ... bring about a substantial increase in the numbers of highly successful new companies ... Nothing less than the future welfare of America and its citizens is at stake."

Litan, Robert E. "Inventive Billion Dollar Firms: A Faster Way to Grow." SSRN Working Paper #1721608 (2010).



"The problem is that it is very difficult, if not impossible, to know at the time of founding whether or not firms are likely to survive and/or grow. This is true even with venture-capital backed firms"

Ian Hathaway and Robert Litan, 2014. "Declining Business Dynamism: It's for Real". Brookings Institution.

A Tale of Two Bookstores





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What do Traditional Measures Tell Us?

• Quantity Based Measures:



The U.S. economy has become less entrepreneurial over time Firm Entry and Exit Rates in the United States, 1978-2011

- Decker, Haltiwanger, Jarmin, and Miranda (2013,2015)
- Haltiwanger, Jarmin, Kulick, and Miranda (2015)
- Hathaway and Litan (2014a, 2014b)

Outcome-Based Measures



VENTURE CAPITAL INVESTMENTS IN U.S. (B\$)

"Silicon Valley's denial is over: Everybody thinks we're in a bubble"

http://www.businessinsider.com/silicon-valleys-denial-is-overeverybody-thinks-were-in-a-bubble-2015-10

Conflicting Implications



- To maximize relevance and utility of data collection programs and statistical products on entrepreneurship to policymakers, NCSES should:
 - Recognize SMEs and IDEs as different in kind
 - Broaden entrepreneurial information systems to include measures of entrepreneurial quality
 - Develop tools that enable policymakers to evaluate SMEs and IDEs separately and in context at the time of formation

Outline

- Motivation: Mapping entrepreneurial growth potential from the time of founding
- Brief overview:
 - Introduction of quantitative methodology for estimating entrepreneurial quality
 - NCSES/CNSTAT Focus:
 - Business registration records
 - Choice of startup characteristics
- New Measures and Findings
- Potential as a policy tool at subnational and national levels

Accounting For Entrepreneurial Quality: Brief Overview of New Approach

- Calculates consistent estimates of the underlying growth potential of startups
 - Combines population-level business registration records with predictive analytics
 - Draws on startup characteristics at or near time of founding
 - Derives conditions under which predictive analytics yields consistent estimates
- Develops three new population-level statistics
 - EQI the average growth potential (or "quality") of any given group of new firms
 - RECPI the number of startups within a particular region expected to later achieve a growth outcome
 - REAI the ability of a region to convert entrepreneurial potential into realized growth
- Offers novel characterization of entrepreneurial ecosystems over time and at arbitrary level of geographic granularity, and also aggregates to (60% of) the State of American Entrepreneurship

NCSES/CNSTAT Focus: Developing New Data on IDE

- Approach builds on three interrelated insights to develop a "new" data source on IDE
 - Business registration is a practical requirement for growth.
 - Markers of entrepreneurial quality are observable at or near the time of business registration.
 - Meaningful growth outcomes can be observed with a lag, creating the potential for a mapping between growth and start-up characteristics.
- Entrepreneurial quality is the estimated probability of growth given startup characteristics.

Business Registration





- Defacto requirement for businesses seeking meaningful growth outcome
- Public
- Comprehensive
- Comparable over time and place

Example: MA Business Registration

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| Merged into COMPAQ COMPUTER CORPORATION on 12-31-1999 | | | | | | | | | | | | | | |
| Mer | Merged with MAYNARD DEVELOPMENT CO., INC. on 06-27-1974 | | | | | | | | | | | | | |
| Mer | Merged with APL SOFTWARE SYSTEMS, INC. (PA) on 06-27-1975 | | | | | | | | | | | | | |
| Merged with DEC REALTY TRUST(MA TR) on 08-13-1981 | | | | | | | | | | | | | | |
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NCSES/CNSTAT Focus: Developing New Data on IDE

- Approach combines three interrelated insights to develop a "new" data source on IDE
 - Business Registration as a Practical Requirement for Growth.
 - Markers of Entrepreneurial Quality are Observable at or Near the Time of Business Registration. Firms with the potential and ambition for a meaningful growth outcome likely have different "start-up characteristics" including measures directly observable within business registration records (firm name) as well as publicly available measures that can be matched in a systematic manner (e.g., have they applied for a trademark or patent?).
 - Meaningful growth outcomes can be observed with a lag, creating the potential for a mapping between growth and start-up characteristics.
- Entrepreneurial quality is the estimated probability of growth given startup characteristics.



Akamai Technologies Inc

- 1. Sharp, distinctive, and short name (2 words). (+)
- 2. "Technologies" suggest is a high tech business (+)
- 3. "Inc." says this is a corporation (+)

Benchmark & Pratt Realtors, LLC

- 4. Descriptive and long name (4 words). (-)
- 5. Eponymous: Has founder last name ("Pratt") in firm name (-)
- 6. "Realtors" suggest this is a local business (-)
- 7. "LLC" says this is a limited liability company (-)

Patenting and Firm Growth: Helicos Biosciences Corporation

United States Patent Lapidus, et al.

Short cycle methods for sequencing polynucleotides

10/852,482

May 24, 2004

The invention provides methods for sequencing a polynucleotide comprising

Inventors: Assignee: Family ID: Appl. No.: Filed:

Lapidus; Stanley N (Bedford, NH), Buzby; Philip Rich Helicos Biosciences Corporation (Cambridge, MA) 34595948

- December 5,
 2003: Founded
 in Cambridge
- May 24, 2004:
 First Patent
 Application
- December,
 2009: IPO as
 HLCS

Data: Measures

- Business Registration Measures
 - Corporation Firm registers as a corporation, rather than a partnership or LLC
 - Delaware Jurisdiction Firm is registered in DE w/ principal address in MA
 - *Eponymy* (Daley, Belenzon and Chatterji, 2015) Firm includes name element of founders
 - Short Name Firm name includes three words (including registration status such as Inc.)
 - Firm Name Has Last Name
 - Firm Name Has First Name
 - Firm Name is Unique Has a word that appears 5 times or less in a list of 10M firms.
 - US CMP Cluster Measures: Local Cluster, Traded Cluster, Traded Cluster Resource Intensive, Biotechnology Sector, Ecommerce Sector, IT Sector, Medical Devices Sector, and Semiconductor Sector.
- Intellectual Property
 - Patent: Patent Application or Assignment within One Year of Founding
 - *Trademark*: Trademark Application within One Year of Founding

NCSES/CNSTAT Focus: Developing New Data on IDE

- Methodology for measurement of entrepreneurial quality combines three interrelated insights to develop a "new" data source on IDE
 - Business Registration as a Practical Requirement for Growth.
 - Markers of Entrepreneurial Quality are Observable at or Near the Time of Business Registration.
 - Meaningful growth outcomes can be observed with a lag, creating the potential for a mapping between growth and start-up characteristics. Rather than assume the relationship between start-up characteristics and entrepreneurial quality, investigate relative importance of different factors by developing a predictive model of growth based on start-up characteristics.
- Entrepreneurial quality is the estimated probability of growth given startup characteristics.

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Table 1

The Empirical Model: The Predicted Relationship Between Startup Characteristics and Growth

| | Change in the Probability of |
|--------------------------------------|------------------------------|
| | Growth |
| Has Short Name | 248% |
| Firm Named after Founder | -70% |
| Corporation (Not Partnership or LLC) | 405% |
| Trademark in First Year | 501% |
| Patent and No Delaware Registration | 3,534% |
| No Patent and Delaware Registration | 4,470% |
| Both Patent and Delaware Reg. | 19,640% |
| Sectoral Controls | Included |
| State Controls | Included |

Guzman and Stern, 2016.

Out of Sample Tests of Estimated Entrepreneurial Quality

10-Fold Test of Predictive Quality of Model*

Top 1% includes 51% of growth outcomes (range: [49%, 53%]) Top 5% includes 69% of growth outcomes (range: [65%, 72%]) Top 10% includes 75% of growth outcomes (range: [70%, 79%])

*10-Fold analysis of model separates the model into 10 random samples and then uses each of those sample as a test sample. We report the average value as well as minimum and maximum (range) of such.



New Population-Level Entrepreneurship Indices

• Entrepreneurship Quality Index (EQI). *Average* estimated entrepreneurial quality within a group of start-ups:

$$EQI_{r,t} = \frac{1}{N_{r,t}} \mathop{a}\limits_{i\hat{i}} \mathop{a}\limits_{\{I_{r,t}\}} \hat{q}_{i,r,t}$$

• Regional Entrepreneurship Cohort Quality Index (RECPI). Expected number of growth events within a regional start-up cohort:

$$RECPI_{r,t} = EQI_{r,t} \land N_{r,t}$$

• Regional Ecosystem Acceleration Index (REAI). The ratio of realized vs. expected growth events in a region:

$$REAI_{r,t} = #GrowthEvents_{r,t} / RECPI_{r,t}$$

- Attributes:
 - Panel or cross-sectional
 - Arbitrary level of granularity
 - Not necessarily geographic in scope



The Quality of Entrepreneurship in Kendall Square

Boston Case Study: Quantity vs. Quality





Boston REAI maintained a low level during the 2000s



MOVING TO A NATIONAL ANALYSIS....

The State of American Entrepreneurship



RECPI / GDP:

The State of American Entrepreneurship Over Time



- RECPI / GDP shows
 - a sharp raise in potential during the late 1990
 - followed by a drop (but NOT a collapse) in 2001
 - and more moderate increase after the Great Recession.
- Nowcasted Index tracks closely and documents "boom" since 2010

Guzman and Stern (2016)

Regional Ecosystem Acceleration Index (REAI)



Guzman and Stern (2016)

Key Findings: National Level The State of American Entrepreneurship

- The expected number of growth outcomes (think successful startups) in the U.S. relative to GDP ("U.S. RECPI") has followed a cyclical pattern that appears sensitive to the capital market environment and overall market conditions.
 - U.S. RECPI reflects broad and well-known changes in the environment for startups, such as the dotcom boom and bust
 - Starting in 2010 there is a sharp, upward swing in the expected number of successful startups formed and the accumulation of entrepreneurial potential for growth
 - U.S. RECPI has exhibited an overarching *upward* trend, signaling that the state of American entrepreneurship is not imperiled by a lack of formation of highgrowth-potential startups, but, instead, by other dynamics or ecosystem effects that may be inhibiting the ability of startups to.
- Relative to quantity-based measures of entrepreneurship, regional variation in entrepreneurial quality appears to hold a stronger relationship to economic growth.
- REAI (the U.S.' ability to accelerate the growth of new businesses conditional on initial quality) has been falling since the late 1990s and only recently, and mildly, began to recover.

Potential as a Policy Tool: Subnational Level

- Provides new view of the skew of high-potential growth firms
- Enables shared evaluation of mix of IDE and SME at a more granular level
- Permits
 - Tailored analysis of each region's IDE and SME formation
 - Development of targeted policy interventions for specific goals
 - Experimentation around selected strategies

Opportunities for Collaboration:

Scaling the Implementation of Entrepreneurial Quality

- Developing real-time, quarterly metrics of entrepreneurial quality as a statistic for entrepreneurship in the U.S.
 - Report high-growth entrepreneurial activity in ways that go beyond venture capital
 - Offer complementary measure of business dynamism based on predicted growth potential
 - Inform policy as well as outlook of future of U.S. economy
- Connecting entrepreneurial quality with alternative measures of performance via LBD micro-data
 - Employment
 - Productivity
 - Lifecycle dynamics
- Extending the evidence-base for I&E program evaluation
 - Apply methodology to identify correlation between programs, interventions and design elements on growth outcomes

Opportunities for Collaboration:

Applying the Methodology to Study Other Facets of I&E

- Implement predictive analytics in statistical approaches
 - Move beyond counts in multiple areas of data (e.g. research outputs, innovation outputs)
- Complement data on innovation (e.g. patents) with the entrepreneurial potential of the patent-holding entities
 - Identify startup characteristics correlated with higher probabilities of filing for/receiving a patent
 - "Nowcast" firms likely to patent in the future
- Tailor entrepreneurial quality measures to complement Science and Engineering indicators with measures of local science-based entrepreneurship
 - Map predicted entrepreneurial quality for NCSES knowledge and technology intensive industries
 - Chart formation rates and locations over time

THANK YOU!