ENTREPRENEURSHIP

Studying the start-up system

There is seemingly limitless, often breathless, rhetoric championing "innovation" and "entrepreneurship" as keys to harnessing science and technology for economic advancement. More elusive, and illuminating, is solid evidence on features that allow a dominant technology commercialization ecosystem to thrive. *Science* invited social scientists to highlight insights from their research on what makes entrepreneur-driven systems flourish and how those lessons might inform policies and practices to help make rhetoric reality.

Financing experiments

*By Ramana Nanda* and *Matthew Rhodes-Kropf*

Venture capital (VC) investors have recently been criticized for no longer financing innovations related to society’s “biggest problems.” We have shown that two defining features of VC investments are an extremely skewed distribution of outcomes and an inability to tell—up front—which will be successful. VCs therefore learn about the viability of potential investments through a multistage financing process, where each round of funding is tied to results of “experiments” that create information about future prospects (I). The value of staging stems from being able to abandon investments partway if information from early experiments is negative. Startups for which experiments are cheaper to run and more discriminating are more attractive investments. The advent of cloud computing significantly lowered costs of early experiments for firms in software, Internet, and digital media and shifted funding away from sectors where early experiments cost more and are less discriminating, such as biotechnology and energy production. Advances in simulation technologies, rapid prototyping, and gene sequencing have also lowered costs of experiments in these sectors, as have platforms, such as Science Exchange, that allow startups to conduct early tests without investing in infrastructure upfront. Nevertheless, entrepreneurs in science-based ventures that are expensive to commercialize can also benefit from setting up experiments that help investors learn about viability early on. Although entrepreneurs are never happy when investors stop funding, structuring early experiments that facilitate such abandonment, by being highly specific (correctly identifying all failures), even if at the expense of sensitivity (correctly identifying every success), can actually help obtain investment in the first place. To increase the chances that innovations focused on society's biggest problems attract sufficient funding, government policy should focus on sectors or stages where the cost and the time to learn is high, thereby making it more difficult for private investors to finance experimentation.

REFERENCES


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Founders and joiners

*By Michael Roach* and *Henry Saner mann*

Most efforts to promote technology entrepreneurship, such as courses and incubators, focus on potential founders of startup companies. Yet the vast majority of scientists and engineers contribute to entrepreneurship as "joiners"—employees who join founders in their efforts to start companies. We investigated individuals’ entrepreneurial interests through a survey of nearly 4200 science and engineering Ph.D. candidates at tier 1 U.S. research universities (I), focusing on three questions: How prevalent are interests in joining a startup as an employee versus being a founder? How are joiners different from founders? How do contextual factors shape different entrepreneurial interests? Among the Ph.D.s surveyed, 46% were interested in joining a startup as an employee, whereas 11% expected to one day start their own company. Compared with Ph.D.s interested in careers in established firms, founders and joiners share similar preferences for an entrepreneurial work setting, such as a desire for greater autonomy, tolerance for risk, and a desire to commercialize technologies. However, founders are significantly more risk tolerant and have a stronger interest in management, whereas joiners are more interested in functional work activities.

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such as research and development (R&D). Preferences for financial income have little relation with interests in entrepreneurship. Together, these preferences shape individuals’ predispositions toward entrepreneurship, which in turn condition how they respond to factors thought to promote entrepreneurship, such as having a faculty adviser who has founded a company. Individuals with a strong predisposition toward entrepreneurship are most likely to be interested in becoming a founder, whereas those who lack preferences for entrepreneurial job attributes show no interest in founding, regardless of external factors. Individuals with a moderate entrepreneurial predisposition are most susceptible to external factors, which increase their interest in joining a startup as an employee. Efforts to foster technology entrepreneurship should recognize that individuals may respond in different ways; blanket efforts, such as mandated entrepreneurship training, are likely to be inefficient. Programs should also prepare scientists and engineers for a variety of entrepreneurial roles—joiners as well as founders.

REFERENCES

Cash from the crowd

By Massimo G. Colombo,§ Chiara Franzoni,§ Cristina Rossi-Lamastra

Crowdfunding (CF), in which financing for projects is sought via the Internet from large groups of individuals, is a $3.3 billion per year phenomenon. But it’s not clear how well CF, typically used for creative arts projects, can be used to finance science and technology (“tech”) projects. We analyzed nearly 112 thousand CF campaigns launched on Kickstarter.com through late 2014 (see supplementary materials). The share of tech projects is increasing, from 4% of total projects in 2009 to 6% in 2014. Tech projects have the largest average target budgets ($86,532; nontech average, $18,003). The rate of tech projects that reached their target budget and were funded, 38%, is lower than the overall 58% success rate. Tech projects received 14% of the capital raised through Kickstarter, totaling $339.8 million. Although this is a substantial amount, it is only 3% of the $4.7 billion invested by venture capitalists in high-tech ventures in the United States in 2013. CF also differs qualitatively from other forms of entrepreneurial finance.
Intangible but bankable

By Yael V. Hochberg, Carlos Serrano, and Rosemarie Ziedonis

Young science and technology companies are often rich in intangibles like patents but lack physical assets and cash flows required to secure a loan. Intangibles, such as patents, are effectively "unbankable" for traditional lenders because of international banking regulations. Intangibles also are often difficult to value and sell. External debt is therefore widely cast as an unlikely way to fund the risky intangibles-rich companies. Despite this conventional wisdom, we uncover a surprisingly active market for "venture lending" to patent-producing U.S. startups in three innovation-intensive sectors: medical devices, semiconductors, and software (I). Venture lenders fund startups in their early stages of development, most often alongside VC investors. According to one estimate, venture lenders supply roughly $5 billion in growth capital to startups each year, with funds originating from both regulated banks and specialized lenders. To minimize downside risk, lenders typically require a lien on assets, including intangibles, and record liens involving patents with the U.S. Patent and Trademark Office. Lenders also pay keen attention to the solvency and reputations of VCs backing startups that apply for funding. Among VC-backed startups in our sample, 36% received venture loans. Lending was more prevalent for startups with top-tier VCs and for startups with more "saleable" patents. After the NASDAQ crash of 2000, many VCs faced severe constraints in raising capital, whereas others were flush with recently raised funds. Lenders continued to finance startups backed by less capital-constrained investors but withdrew from otherwise promising projects that may have needed their funds the most. Thus, VCs play a vital intermediary role in lending relations with risky startups. Attempts to stimulate entrepreneurial activity through debt channels alone may have limited economic effects in the absence of well-developed markets for buying and selling patents and infrastructures for equity investing.

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Accelerators and ecosystems

By Yael V. Hochberg and Daniel C. Fehder

A new institutional form has emerged in the entrepreneurial ecosystem in recent years: the seed accelerator. These fixed-term cohort-based "boot camps" for startups offer education and mentorship for startup founders and culminate in a "demo day," during which graduates pitch their businesses to potential investors. Many local governments hope to use accelerators to transform their local economies through establishment of startup technology clusters. Evidence of accelerators' efficacy is limited, however, so we examine their effects on regional entrepreneurial ecosystems, particularly provision of venture capital (VC) financing to new startups (I). Accelerators emerge in different regions in different years, often for reasons exogenous to the nature of the ecosystem or precisely because of its lacking. This allows us to compare changes in regions that receive an accelerator with similar regions that do not have one. We see a shift in funding for startups in accelerator-treated regions: more deals, more dollars, and more local investment groups. This applies to startups that attend the accelerator and those that do not. Most accelerators focus on software companies, and regions with accelerators shift toward a higher share of early-stage software and information technology-related VC deals (although financing for other industry groups, such as biotechnology, is not necessarily reduced). These patterns hold both for high- and low-ranked accelerators in the annual Seed Accelerator Rankings, which suggests that the funding increase is less about the effect of accelerator programs on companies that attend them and more about what such programs
do to encourage latent entrepreneurial activity in the region more generally—providing role models, catalyzing establishment of other ecosystem institutions, and acting as a nexus for startup activity. Although accelerators studied so far focus on software startups, further research will be needed to assess new programs emerging to serve biotech and hardware startups.

REFERENCES AND NOTES

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Linking and leveraging

By Fiona Murray and Scott Stern

Beyond aspiring to become the “next” Silicon Valley, how can a region leverage innovation-driven entrepreneurship for economic and social progress? Given the poor performance of government support for entrepreneurship, should the job be left to the private sector? Moving beyond the traditional public-private debate, the MIT Regional Entrepreneurship Acceleration Program (REAP) (http://reap.mit.edu) charts a new approach.

REAP builds on an ecosystem framework drawing on recent research highlighting distinct, yet interdependent, roles of innovative capacity (the ability to develop new technology), entrepreneurial capacity (the ability to scale startup businesses), and the economic clusters supporting a region. Rather than focus solely on entrepreneurship (as do many government initiatives) or innovation (often focused on increased R&D investment), REAP builds on evidence that successful regions link the two to establish a comparative advantage through innovation-driven startups.

MIT REAP’s 2-year program brings together regional teams of entrepreneurs, risk-capital, corporate, and university leadership; and government. Although this approach is simple to describe, most regions have found it challenging to link high-level stakeholders for sustained effort (and are often surprised by the many connections that are “missing” from their ecosystem). Teams undertake data-driven, regional diagnoses, including assessing strengths and weaknesses in their regional capacities, and benchmarking their ecosystem using our novel methodology for measuring entrepreneurial quality through the use of business registration records and predictive analytics (1). These insights are turned into action: Teams aim to catalyze their innovation ecosystem in a measurable and sustainable way and build an organization for ongoing regional collective action.

For example, REAP Scotland is leading changes in Scotland’s economic-development approach to emphasize entrepreneurial mentoring (an area that had been previously downplayed) and the development of a dynamic network for Scottish entrepreneurs and expatriates (a potential strength that had not previously been leveraged). These initiatives upgrade the region’s entrepreneurial capacity in order to match its traditional strength in innovative capacity (see www.hie.co.uk/business-support/entrepreneurship/mit-reap/).

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