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The Effects of State Innovation Programs on Entrepreneurial Firms: Three Essays

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Abstract

My dissertation provides new evidence on the effects of state innovation programs on entrepreneurial science and technology companies in the Great Lakes region. The first essay examines the extent to which, if at all, competitive R&D awards from Michigan innovation programs enhance the performance of participating ventures relative to startups that seek but fail to receive an award. I then expand scope to other states in the Great Lakes region and investigate the broader implications of large-scale programs on entrepreneurial activity, including patterns of entry and survival (Essay 2) and the retention of innovation-oriented startups within a state (Essay 3).

Category: Entrepreneurship; Strategy; Public Policy
Key Words: Entrepreneurship; Innovation Policy; Entrepreneurial Finance; Founding Environment; Geographic Location Decisions

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July 2013

EXECUTIVE SUMMARY

Overview

With the belief that entrepreneurship is the main driver for economic growth and job creation, many U.S. states have launched ambitious programs aimed at stimulating entrepreneurial activity within their borders. Not surprisingly, most programs target science and technology-related sectors. The Michigan Life Sciences Corridor (MLSC), for example, emerged from the state's $1 billion legal settlement with the tobacco industry in 1999. Prominent among state innovation programs, the MLSC initiative is credited with making Michigan one of the fastest-growing U.S. states in the life sciences sector.[1] In 2002, the state of Ohio similarly launched a $1.6 billion, 10-year Ohio Third Frontier (OTF) Program to support technology-based economic development. According to OTF reports, the program has supported the creation and financing of over 571 Ohio-based companies since 2005.[2]

Despite large-scale experimentation, systematic evidence regarding the effects of these programs on entrepreneurial firms remains lacking. Unlike federal initiatives such as the Small Business Innovation Research (SBIR) program, information about state innovation programs is

[1] *A Foundation for the New Michigan Economy*. 21st Century Jobs Fund Report. Lansing, MI: Michigan Economic Development Council, 2010
[2] Making an impact: Assessing the benefits of Ohio's investment in technology-based economic development programs. *Stanford Research Institute Report*, 2009

fragmented and thus cumbersome to assemble. Teasing apart the causal impact of these initiatives is further complicated by an absence of viable baselines for comparison.

My dissertation provides new evidence on the effects of state innovation programs on entrepreneurial science and technology companies in the Great Lakes region. To do so, I assemble novel databases and use multiple research methods to address the effects in a series of studies. My first essay examines the extent to which, if at all, competitive R&D awards from Michigan innovation programs enhance the performance of participating ventures relative to startups that seek but fail to receive an award. I then expand scope to other states in the Great Lakes region and investigate the broader implications of large-scale programs on entrepreneurial activity, including patterns of entry and survival (Essay 2) and the retention of innovation-oriented startups within a state (Essay 3).

All three essays benefit from 25 semi-structured interviews with entrepreneurs, investors, and government officials in the Great Lakes states. These interviews deepen my understanding of the phenomenon and help me identify and interpret data sources. They also enable me to probe more deeply into the perceived effects of specific programs while capturing the viewpoints of entrepreneurs and investors that opt out of participation.

The Great Lakes region[3] is a useful context in which to investigate the interplay between public efforts at state level and entrepreneurial-firm behavior and performance. The ideas and human capital "at risk" of launching new science and technology companies are geographically distributed across this region, which houses numerous top-ranked universities and research institutions. Vital entrepreneurial resources nonetheless remain tightly agglomerated in the coastal states of Massachusetts and California. Between 1995 and 2009, for example, 16.1

[3] The Bureau of Economic Analysis (BEA) defines the Great Lakes region to include Illinois, Indiana, Michigan, Ohio, and Wisconsin.

percent of the doctorates in life sciences major were awarded by research institutions in the Great Lakes region, while 15.9 percent were awarded in California and Massachusetts. In same period, however, startups headquartered in Great Lakes states received only 3.9 percent of U.S. venture capital (VC) investments in the life sciences, with the overwhelming majority of such funds (56.2 percent) flowing to California and Massachusetts-based ventures.[4] While arguments exist for and against public efforts to boost local entrepreneurial activity, empirical evidence on the effects of these initiatives on private sectors remains limited.

Essay 1: State Governments as Financiers of Technology Startups: Implications for Firm Performance

Essay 1 tests whether state R&D awards enhance the performance of participating ventures using novel data compiled from Michigan government archives on all for-profit participants in competitions for public funding from 2002 through 2008. Importantly, I observe both pre-treatment characteristics and external reviewer scores for the entire applicant pool, including firms that sought but failed to receive an award. Also useful from a methodological perspective, these data reveal discontinuous cut-offs in the distribution of reviewer scores that correspond to receipt of funding. This artifact of the selections process makes it possible to use regression discontinuity design (RDD) methods to compile more comparable sets of participating and non-participating ventures than is typically possible for innovation scholars.

The results are quite striking. On one hand, I find strong and compelling evidence that program participation bolstered the commercial viability of Michigan-based technology companies: funded firms are 12-13% more likely to survive 2 years and 21-23% more likely to survive 4 years after the competition. The results hold in subsamples of firms proximate to the funding cut-off and do not appear to be driven purely by the selection of "better" companies for

[4] Authors' calculation using National Science Foundation (NSF) WebCASPAR and VentureXpert data.

the awards. This evidence is consistent with the view that the program helped ameliorate imperfections in the market for entrepreneurial financing: absent R&D awards from the state, companies of comparable quality were less likely to remain in business.

The effects of program participation on other aspects of entrepreneurial-firm performance—including patent productivity and receipt of follow-on financing—are more ambiguous. Surprisingly, I find no discernable effect of award receipt on patent productivity. The analysis reveals, however, that state R&D funding stimulates follow-on financing from other government (SBIR) and VC sources when capital-market imperfections are more severe. This latter evidence can be interpreted as consistent with the view that competition-based R&D awards help reduce informational inefficiencies in markets for entrepreneurial financing.

Essay 2: Founding Environment and New Venture Survival: The Role of State Innovation Programs

The phase between idea discovery and commercialization can be treacherous for new science and technology companies. In order to survive, new ventures must be able to steer their product ideas across the "valley of death" — a difficult transition period when a developing technology is too new to validate its commercial potential and therefore may be unable to attract the capital and other resources necessary to bring it to the market.

Essay 2 investigates the extent to which state innovation initiatives improve the development and availability of entrepreneurial resources within the state including but not limited to financial capital. More specifically, if the launch of a major innovation program improves allocative efficiencies in the input market for entrepreneurial resources within a state, I should observe a significant shift in the likelihood of post-entry survival for startup companies. I focus on the life sciences industry in this study since startups in that sector face a long and costly

product development process, providing a useful sample to investigate the potential effects of state programs intended to help new ventures bridge the resource gap.

To test the causal effects of focal programs, I compile two cohorts of startups including those formed "pre-treatment" and those formed in the immediate aftermath of the program. Using a differential treatment effect approach, I use new subsidiaries of established firms as an alternative group for analytical comparison: although new subsidiaries may reap indirect benefits from these public interventions, they (unlike startups) are not the direct beneficiaries targeted by the programs.

The results provide compelling and robust evidence that startups founded when a major state program exists are more likely to survive than those established without a program in place at their founding stage. This finding holds after I control for observable entrant-level and industry-level covariates identified in prior studies. In addition, my results based on a semi-parametric survival analysis show that the effect of major innovation programs on firm survival diminishes over time. Although Post-launch Cohort companies founded in the presence of an active innovation program face lower hazard rates in their initial years compared to those founded without an innovation program in place, the difference in survival probability between the two cohorts is less pronounced in the long-run.

As expected, my results also show that the program effect is more pronounced for pharmaceutical startup companies, which have higher resource requirements for commercialization, than for medical device companies. For medical device startup companies, the evidence suggests that higher proportion of less promising companies are established after the program launch, and these startups show higher exit rates in the long run.

Finally, my results show no effect of state innovation programs on either the short- or long-term survival rate for new subsidiaries. This lack of effect for subsidiaries suggests that the results are not impacted by some common industry or macroeconomic trends that may make Post-launch Cohort startups more likely to survive than those in Pre-launch Cohort.

The evidence from this study suggests that at least for some startup companies, the state innovation programs only solve their immediate liquidity constraint rather than helping them bridge the valley of death at their founding stage. At the same time, the innovation program may also entice some less promising startups that reveal higher hazard rates after certain period of time, especially in industries with lower resource requirement for commercialization.

Essay 3: Staying Local or Moving Away? Relocation Decisions of Entrepreneurial Firms and the Impact of State Innovation Programs

The third essay investigates the effects of state innovation programs on entrepreneurial-firm retention. The decision to "stay local" can pose difficult trade-offs for entrepreneurial firms, particularly in sectors that require external financing and support during the commercialization process. Prior research suggests that staying local allows entrepreneurs to leverage interpersonal networks and existing organizational ties (e.g., with universities or other research institutions) while avoiding the disruptions and costs of relocation. Yet failure to move could make it more difficult or costly to secure expansion capital, management talent or business services, thus limiting the upside potential of these ventures.

In this study, I focus on a sample of life sciences and IT startups established in the Great Lakes region between 1990 and 2010. Based on both nonparametric and semiparametric analyses, I find compelling evidence that high technology companies in the life sciences sector are more likely to relocate out their home states compared to those in the information technology sector

during the same observation period. Among startups, growing firms are disproportionately more likely to leave their originating state. These findings are consistent with the view that "leaving home" is in part driven by the need to secure access to external resources required for commercialization and expansion.

I also find that this proclivity of science and technology startups to relocate to other states declines significantly in the wake of major program launches by state governments in the Great Lakes region, particularly for young firms and for those firms in sectors directly targeted by the program.

In combination, these findings suggest that high technology companies initially located in a region with a good *innovation infrastructure* but a relatively weak *entrepreneurial ecosystem* may decide to relocate. A good entrepreneurial ecosystem is important as it corresponds to a well-developed entrepreneurial resource market. If the entrepreneurial resource market is perfect, capital, talent and other related services can be allocated effectively to startup companies at the right place and right time. Consequently, the findings in this study imply the existence of market frictions for entrepreneurial resources. They also suggest that one reason entrepreneurial firms may strategically decide to relocate is to overcome the market frictions. Indeed, even after controlling for local market and industry sector conditions, the empirical evidence shows that firms with higher requirements for external resources for commercialization and expansion are still more likely to relocate.

Interestingly, state innovation programs are often justified by market friction arguments. If such programs can improve the local entrepreneurial ecosystem, then there should be a lower hazard of relocation. The empirical results support this prediction. The results also show that these programs do not have a strong impact in retaining growing firms, which suggests that the

firms that remain are those with less promising growth expectations. From a public policy perspective, this selection process may have a long-term consequence that contradicts the main objective of these public initiatives.

Contributions to the Entrepreneurship Research

My dissertation research contributes to five main strands of literature. First, it contributes to a burgeoning literature in strategic management, finance, and economics on the performance implications of alternative sources of entrepreneurial financing. Prior work has investigated the various effects of corporate funding, venture capital, and federal government monetary support on the success of new ventures. The extent to which public efforts at the state level affect entrepreneurial-firm performance has received much less analytical attention, a gap that my studies help fill.

Second, my research contributes to a growing literature on how institutional and policy reforms affect entrepreneurial firms and whether public sector intervention can reduce new venture market failures. In doing so, it fills a gap in management research and could thus contribute to debates on public policy issues related to entrepreneur and economic development.

Third, my research is salient to the literature on the association between a firm's founding environment and its post-entry performance. Specifically, the second essay provides systematic and cross-state evidence on whether changes in the entrepreneurial founding environment created by state initiatives can affect new venture post-entry performance, and as a consequence, survival.

Fourth, my research extends current work on economic geography, industry agglomeration and firm location decisions by introducing a dynamic view of firm location

decisions. Although previous studies in international business and industrial agglomeration have identified institutional-, industrial- and firm-level factors that may affect firm location decisions, most of these studies focus on existing industry clusters and the initial location decisions of in-country or global ventures.

Finally, within strategic management, my dissertation contributes to the ongoing search for ways to tease apart the consequences associated with non-random actions using observational data, a methodological challenge that continues to garner widespread attention in the field.

My dissertation opens rich venues for future research and points to several directions for this research. First, future research could probe more deeply into the mechanisms of these public initiatives. For example, it would be interesting to investigate the different performance implications of the use of public funding to directly subsidize new ventures or to indirectly fund entrepreneurial firms through private sectors. In both my second and third essays, I treat major programs across states as homogeneous. Disentangling and comparing the effects of different program components would be interesting and could provide a more precise understanding of what drives the state innovation program effect on entrepreneurial firms.

A second area of interest for future research is the extent to which the results from my dissertation can be generalized to other contexts. Although my dissertation focuses on the Great Lakes region in the United States, future research could expand the scope to include other states or countries, ideally using insights from my dissertation research to inform comparative assessments of public efforts aimed at stimulating entrepreneurial activity. In particular, Asian countries such as China and Singapore could be interesting contexts to explore, as these countries have central and local governments that have launched large-scale initiatives with the aim to mitigate imperfections in resource markets for entrepreneurial firms.