The Design of Startup Accelerators

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Accelerator programs are an increasingly important part of entrepreneurial ecosystems. While accelerators have core defining features—fixed-term, cohort-based educational and mentorship programs for startups—there is also significant variation amongst them. In this paper, we relate key variation in the antecedents, organizational design and operation of these programs to theories of firm-level entrepreneurial performance. We then document descriptive correlations between these design elements and the performance of the startups that attend these programs. In doing so, we probe the connections between design and performance in ways that integrate previously disparate research on accelerators and expand our understanding of startup intermediaries. Our findings delineate the building blocks as well as an agenda for future researchers to build upon not only our understanding of accelerators, but also our understanding of what new ventures need to survive and flourish.

1. Introduction

Startup accelerators are a recent but rapidly growing phenomenon. A 2016 assessment (Hathaway, 2016) identified 160 U.S. accelerator programs, and researchers estimate that there are up to 2,000 such programs globally (Cohen and Hochberg, 2014). Accelerator programs, which are also referred to as seed accelerators, startup accelerators or business accelerators (hereafter we refer to them as simply 'accelerators'), are limited-duration programs, lasting roughly three to six months, that help cohorts of startup ventures with their entrepreneurial processes and aspirations. Most provide key resources: a small amount of seed capital, co-working space, and a plethora of networking, educational and mentorship opportunities from program directors, founders of peer ventures and a range of external participants commonly referred to as "mentors" (Cohen and Hochberg, 2014). The most notable accelerator programs include industry pioneers Y Combinator (founded in 2005) and Techstars (founded in 2007), which combined have helped launch over 2000 startups that have, in turn, collectively raised more than $16 billion in funding. Overall, a third of all startups receiving venture capital in 2015 had been through an accelerator program (Pitchbook, 2016).

While accelerators have proliferated quickly and startups are flocking to such programs, research on this new organizational form is still emergent. Initial studies of accelerators have focused on measuring their treatment effect, and yet the findings of these studies vary substantially. On the one hand, there are a number of studies that find a positive impact of acceleration on startups (Winston-Smith and Hannigan, 2015; Fehder, 2018; Hallen, et al., 2018). On the other hand, some studies find more muted or even negative impacts of accelerators on startups (Yu, 2016; Leatherbee and Gonzalez-Uribe, 2017). Importantly, much of the research to date has treated accelerators as largely homogenous in their business model and considered the potential treatment effect along only one or two dimensions. In doing so, it ignores the significant variation in accelerators along multiple design features – variation which is likely to be salient both for understanding their impact on and across startups, and their differentiated role in the ecosystems in which they operate.

In this paper, we seek to fill this gap by mapping the landscape of U.S. accelerators and analyzing variations in their critical design features. We provide preliminary cross-sectional relationships between different accelerator design elements and portfolio company performance.

In doing so, our work highlights potential fruitful avenues for the broader research community interested in a set of key questions: How do accelerator programs vary? And how does that variation affect their impact on startups and ecosystems? The goal of this paper is thus to provide a broader and deeper understanding of accelerator programs and their features, and to set forth a research agenda that leverages accelerators as laboratories to explore the entrepreneurial process.

We begin with a clear definition of what we categorize as an accelerator. While many programs have given themselves the moniker, not all necessarily meet a set of minimum criteria that would distinguish them from related programmatic forms, such as incubators, venture studios, startup competitions or angel investors. Accelerators are limited-duration programs that help cohorts of startups build and launch their ventures. They often provide a small amount of seed capital and working space to the teams in exchange for small equity stakes. They typically offer networking, educational and mentorship opportunities by drawing in peers and mentors from the wider regional community: e.g. successful entrepreneurs, accelerator program alumni, venture capitalists, angel investors, attorneys, accountants, or corporate executives. Finally, most programs end with a grand event, usually called a "demo day" (short for "demonstration day"), orchestrating a chance for participating teams to pitch their ventures to a large audience of qualified investors (Cohen, 2013; Cohen and Hochberg, 2014). Cohen (2013), points to the fixed-term and cohort-based aspects of these programs as being the primary distinguishing features separating the accelerator from other intermediaries such as incubators. Thus, the definition of an accelerator becomes: **A *fixed-term, cohort-based* program for startups, including *mentorship and/or educational components*, that culminates in a *graduation event*.**

The elements which constitute this definition of accelerators emerge from careful consideration of the features that distinguish accelerators from other types of programmatic interventions whose core role is to serve as intermediaries between start-ups and a complex landscape of resources. Intermediaries have been well-established as an important ingredient for entrepreneurial outcomes. At a high level, research suggests that intermediaries support startups by linking them to resources embedded in their local ecosystems (Clayton et al., 2018; Armanios et al., 2017; Dutt et al., 2016; Amezcua et al., 2010). Startups must then leverage the provided resources, while simultaneously avoiding becoming overly dependent on any given intermediary, which can limit future success (Rothaermel and Thursby, 2005). Accelerator programs address this challenge by providing access to abundant resources—education, mentoring, networking, physical space—but only for a short,

fixed time period. The fixed-term nature of these programs – culminating in a defined graduation event - ensures that startups are forced to contend with market forces, rather than being sheltered (or incubated) from them. The resources provided during the program connect the startups to the local innovation ecosystem and to elements such as funding networks, deal makers and mentors that are critical to the long-term entrepreneurial process (Feldman and Zoller, 2012), while simultaneously educating them on the process of entrepreneurship, and how to best engage and utilize these ecosystem's resources. Taking the second core definitional element, the cohort nature of these programs seems to enable basic agglomeration and support across startups in their infancy, and appears to be critical to efficiency with which resource providers such as investors, can engage with a large number of early-stage companies in an efficient time and geographic space (Cohen et al., 2018).

Consider the Techstars program, which has served as a model in the industry. For each cohort, Techstars provides an open, online call for applications. From thousands of applicants, roughly 50 finalist startups are interviewed, and approximately a dozen slots are awarded per cohort. Upon arrival, accepted founding team members receive a variety of resources. First, they are provided with a small amount of upfront capital, in exchange for 6-8% of the equity in their company. They are further provided with co-working space out of which the entire cohort will work for the duration of the program. For twelve-weeks, startup teams meet with a broad array of mentors, attend "mini-MBA" seminars, and work on their investment pitches. Throughout, they are required to provide regular updates to the program's managing directors describing what they have learned each day, and to respond to the questions and concerns raised in these interactions. They interact closely with each other, often learning from other participants' experiences and challenges. During the final month of the program, the startups develop and refine a pitch presentation that they deliver to a collection of investors and press on "demo-day." Afterwards, the Techstars team remains in contact, and continues to monitor their investment via online surveys and intermittent phone contact. The program also encourages ongoing networking among "alumni" firms through formal and informal meetings and online platforms.

As we will discuss in detail in this paper, however, the Techstars model is but one configuration of an accelerator program. Another canonical model is that of Y Combinator (YC). YC emphasizes interaction with the program's managing directors over input from their external mentorship network (who are deployed on an *ad hoc* basis only for some startups). Nor do YC firms have as

intensive interactions with cohort members; the portfolio companies work in separate offices, meeting together only weekly during the program session for dinner and speakers, thus limiting day-to-day interactions between companies in the cohort. Finally, in contrast to Techstars, Y Combinator's cohorts are quite large, often numbering 100 startups or more.

These examples demonstrate that accelerators vary widely in their design features. And, we will argue, these and other variations in accelerators are likely to be critical not only to our understanding of this new but powerful intermediary in our innovation ecosystems, but also associated with differences in subsequent performance of treated (i.e. accelerated) firms. Our article thus proceeds as follows. We begin by coalescing the emergent literature on accelerator programs. We next mobilize a novel dataset of 146 US accelerator programs, obtained from the Seed Accelerator Rankings Project. Our data suggest that accelerators vary not only in their programmatic features, but also in their founding stakeholders (founding managing directors and sponsors), and thus, in their objectives (Fehder and Hochberg, 2018). These differing objectives may ultimately drive their selection of portfolio companies, their design choices, and the ultimate performance of their graduates. Finally, we explore the relationship between key accelerator design elements, ecosystem elements, and performance of accelerator alumni companies.

We find several empirical patterns that we hope will be generative of future research. Firstly, we find systematic relationships between the professional experience of founding managing directors such that some professional experience (like investing) is negatively correlated with other types of experience (like government service) and that these patterns of professional experience parallel choices of founding sponsor organizations. It seems like some backgrounds and sponsors "fit" more naturally than others. Similarly, there are clear relationships between the founding sponsors of an accelerator and the design choices of the accelerator. For example, more equity is taken and less office space is provided on average by accelerators founded by managing directors with investing experience or sponsored by venture capital firms. Taken together these results suggest that there is a fit between the professional backgrounds of founding managing directors, the sponsors they engage to support their accelerator and the design choices of the accelerator at founding. These constellation of backgrounds, sponsors and design choices are associated with performance differences that we explore in detail below. We hope that these regressions provide clear indications of substantive patterns that will generates both theory and careful empirical work, but they should not be interpreted as causal as they do not have exogenous variation in founding

managing director, sponsors, or design choices. Rather, these results provide the correlations of all of these variables, and subsequent performance, after they have all been simultaneously endogenously determined.

Our paper contributes to the literature on early-stage entrepreneurship and to the emerging literature within it that deals with accelerator programs. Our findings serve both qualitative and quantitative researchers. On the qualitative side, scholars must understand overall accelerator performance and population descriptive statistics in order to assess the appropriateness and representativeness of the smaller samples they select for their inductive work. On the quantitative side, scholars also have a need to understand the larger picture; in particular, scholars working in the economics discipline are interested in understanding the equilibrium correlations between features and performance in order to be able to develop theory that will aid empirical testing of specific underlying causal mechanisms. Our study helps researchers new to the accelerator landscape, as well as those interested in adjacent topics (such as the entrepreneurial process, ecosystems, and, more generally, programmatic interventions targeted towards entrepreneurs), understand the empirical context in which to frame their research efforts. For practitioners and policymakers, our research has helped uncover the design choices that are available to those establishing accelerators, and their implications- a perspective which had not been available but which can assist in the design of new programs and interventions. Lastly, our quantitative analysis provides empirical guidance in the form of associational patterns between design choices and performance which had not previously been illuminated. We conclude by discussing where the uncovered patterns might lead future research.

Overall, we aim to offer a comprehensive understanding of the heterogeneous design elements of accelerator programs and set forth the building blocks for a research agenda that exploits the variation across programs to explore the resources startups need to grow and ecosystems need to flourish. While descriptive in nature, our study provides critical insights for key stakeholders in our community, including academic researchers, policy makers, corporations, and entrepreneurs.

2. Accelerator Research

Accelerators have attracted the attention of researchers as they provide a window into early stage entrepreneurship, which has historically been difficult to observe (Aldrich and Yang, 2012). However, the research that exists is highly fragmented, and has yet to cumulate into a robust corpus

of knowledge built around a core framework with a shared understanding of questions, methodologies and knowledge gaps.

Much of the literature to date focuses on evaluating whether accelerators can effectively improve startup outcomes (i.e. the effect of 'accelerator' treatment on the treated). Hallen et al., (2018) use a matched sample from four cohorts of top tier programs to compare treated and untreated startups on a variety of outcomes, finding that some of these top programs do in fact accelerate the time-horizon for reaching key milestones. Using a nested multiple case study approach, they also suggest that possible mechanisms for this effect is broad, intensive, and paced (BIP) consultation with individuals external to the firm, including mentors, peer venture founders in the same accelerator cohort and customers. In a companion inductive study, Cohen et al (2018) suggest that the divergence in treatment effects observed across accelerators in their sample is driven by the degree to which those accelerators time-compressed external feedback, increased transparency between startups in the same cohort, and used structured programming elements to mitigate the bounded rationality of startup founders.

While the preceding two papers provide suggestive evidence for heterogeneity in treatment effects across accelerators, with positive effects for some, other evidence suggests that even top startup accelerators can be detrimental to accelerated firm performance. In a different matched sample which compares startups affiliated with 13 accelerator programs to (non-accelerated) startups backed by venture capitalists, Yu (2018) finds that startups admitted to accelerators are less likely to achieve key milestones. Winston-Smith and Hannigan (2015) focus on differences in the founder backgrounds of startups admitted to two top accelerators relative to startups that received angel financing but were not accelerated. Startup founders in the accelerators come from more elite universities and are more likely to either raise significant money or fail more quickly than comparison group, indicating variation in who benefits from participation as well. The sensitivity of the estimated parameters to both the accelerator cohort construction and to the control sample construction across these studies suggests that there are substantial differences in the types of entrepreneurs who apply – not only to accelerators or not, but more importantly, to different accelerator programs or who select to directly pursue venture financing. Taken together, these studies suggest that the impact of an accelerator may be driven by features of both the accelerator and its applicants in ways that are difficult to untangle when considering accelerators are a homogenous population.

Other studies in this vein utilize regression discontinuity design (RDD) to measure the impact of particular individual accelerator programs and provide some initial insights into elements of programs that may contribute to treatment effects. For example, Leatherbee and Gonzalez-Uribe (2017) use such a design to measure the impact of Start-Up Chile. They find that access to certain basic services, such as the co-working space provided by the program, do not have a strong impact on future performance of Startup Chile graduates, but startups that are selected (from within the cohort) for access to entrepreneurship schooling experience a higher likelihood of achieving intermediate milestones. Fehder (2018) uses a similar RDD design to evaluate the impact of MassChallenge. He finds a large treatment effect for MassChallenge overall, but shows that that treatment effect is concentrated in startups originally located in regions that have a high degree of startup resources and entrepreneurial social capital. Studies of this type contextualize the impact of accelerators by diving into the details of a specific program and explaining variance in performance within the program, but draw general conclusions under the implicit assumption that accelerators are more or less comparable.

Our qualitative research with accelerator founders suggests not only that the internal design of these programs vary substantially, but also that the intentions of program founders differ significantly in a manner that is generative of different applicant populations and design choices which then shape widely varying impacts. Fehder and Hochberg (2018), in their work on the impact of accelerators on their local innovation ecosystems, note that many of the founders of accelerator choose locations that are near to their childhood home and those that do have intentions for founding are a mix of both regional development aspirations and pecuniary gains. While on average the efforts of these founders seem to bear fruit in terms of new startup growth and funding, this research suggests that the motivations and backgrounds of accelerator founders need to be taken into account when considering the effects of the programs they found. While some accelerators, like YC, might be viewed solely as an engine to improve startup performance (and bring returns to those running the fund associated with the accelerator), the more multi-faceted goals of other accelerators in less entrepreneurially-rich regions mean that they should potentially be evaluated on multiple dimensions. Consistent with these notions, Pauwels et al. (2016) draws out a framework based on an inductive study of 13 programs that identifies a core set of program design choices made by accelerator founders that vary depending upon the main purposes for building the accelerator.

A distinctive stream of research that has emerged suggests that accelerators can be viewed not only through their impact on individual startups but also as a catalyst for wide ecosystem development. Previous work on the evolution of startup clusters have shown that the most important element to the eventual development of a healthy cluster were the actions of individuals in building ties between different elements of the region's innovation ecosystem (Feldman, 2001; Feldman et al., 2005). This work has stressed the importance of members of the ecosystem working within the nascent cluster. From an accelerator perspective, this highlights the fact that many accelerator founders bring outside resources from their past work history and from existing clusters (e.g. Silicon Valley) when they return to their home regions to found accelerators. More importantly, these accelerators have the potential to act as focusing devices, allowing the coordination of resources from multiple stakeholders in a nascent ecosystem, including inputs from investors, large corporations, universities, and existing entrepreneurs.

By facilitating coordination across these disparate elements of the ecosystem, accelerator founders become central brokers to the developing social graph that in some senses defines the ecosystem. As such, they also become (or seek to become) focal deal makers, allowing new ties to emerge that might have not without this sort of facilitation. Indeed, much of the new investment in firms that arises from accelerator creation, emerges from new local investors, suggesting that this accelerator-led coordination enables the entry of new members to the ecosystem (Fehder and Hochberg, 2018). While this type of facilitation has been explored before (Feldman and Zoller, 2012), it has not previously been explored in the setting of a formal program. Understanding how the backgrounds and motivations of founders and sponsors, and the design choices they make when founding their programs affects the participants in these programs and the ecosystem in which it lives can thus be of great value in advancing our understanding of how ecosystems serve to support entrepreneurial activity.

Taken together, our literature review suggests that there are three key areas for additional scholarly inquiry, each of which is relevant to scholars, practitioners and policy-makers: First, research should explore the manner in which accelerators differ from each other in choices of sponsor objectives. Second, they must consider how design elements and sponsor objectives are linked, and their association with start-up outcomes. Thirdly, there is much that remains to be done to consider how accelerator design shapes startup outcome, conditioned by ecosystem location (and characteristics), and finally how ecosystem outcomes vary.

3. Data

A key hurdle in researching accelerators and their design has been the paucity of data available characterizing design features for a large sample of accelerators. In this paper, we therefore utilize a novel, large, and comprehensive sample of programs and their design features, which allows us to explore the various design features, sponsor types, and objectives along which accelerator programs exhibit heterogeneity. Our analysis includes both the antecedents to such design choices and potential measures that can be employed in future research to evaluate their impact. In doing so, we provide roadmap for future research elucidating the effects of accelerators and similar entrepreneurial programming.

Since our objective is exploratory in nature, we utilize a wide sample of data dating back to about 2005 and the original emergence of accelerator programs. Since 2010, accelerator founders and managing directors have been providing the Seed Accelerator Rankings Project (SARP) with detailed administrative data via its annual survey to overcome the lack of systematic data on accelerator programs and affiliated startups. To be part of the rankings, accelerators are required to provide historical data dating back to their founding, and to update data annually with new cohorts as well as activities of previous participants. The SARP team use the data to publish its annual ranking of U.S. programs which is widely used as a benchmark by accelerators to measure their performance. SARP also surveys the founders of over 400 program portfolio companies each year. Jointly, the surveys collect confidential data on each graduate of each accelerator program, including funds raised, valuations, company status, exits, and so forth. SARP's definition of an accelerator program is consistent with the definition used in this paper and set forth in Cohen and Hochberg (2014).

The SARP survey also collects information on accelerator managing directors, founding sponsors, locations, program goals, and other design features of the accelerator. Importantly, SARP's survey design and the design features that are collected are driven by significant primary qualitative research by a subset of the authors of this paper. The qualitative feedback used to build the list of program, founder and sponsor features includes over 200 interviews and over 30 site visits, along with attendance at a variety of industry events and conferences from 2010 to 2014. The SARP survey respondents provide additional highly sensitive information such as exit valuations and funding valuations and private data such as pre-program funding that are not widely available in public databases, and accelerator managers are motivated to provide such data so as

to ensure proper benchmarking against rival programs. The data collected by the SARP team thus provides us with an incomparable view of the accelerator industry.[1]

When programs do not provide proprietary data directly, SARP utilizes archival methods, such as the Internet Archive, press releases and newspaper articles to uncover program features at the time of founding, track startup cohorts and alumni identities, and fills in alumni company performance from public and commercial databases mentioned above. The dataset, which is updated with new programs, portfolio companies and performance measures each year, covers the years 2005 to 2017 and contains data on 146 accelerator programs[2] and their design features, sponsors, the backgrounds and work experience of their 287 founders, and deal-level data for the 5,921 alumni portfolio companies of these programs.

For the purposes of this paper, the SARP data were supplemented with hundreds of hours of fieldwork conducted by the research team. Semi-structured interviews were conducted with over 100 accelerator directors, mentors, and startups participating in dozens of accelerator programs. Additionally, we interviewed venture capitalists and angel investors who have invested in accelerators' portfolio companies, managers responsible for corporate acceleration programs, and state and local officials that have provided support to accelerators. While this is not an inductive study, we draw upon this rich fieldwork to provide examples and context to motivate our statistical analyses.

Based on this wealth of data, we produce summary statistics and linear regression estimates to illuminate three key dimensions of accelerators: program elements, sponsor identities, and accelerator founder backgrounds. We then provide descriptive regressions that shed light on the correlations and associations between these different elements and measures of performance of the accelerator graduates. Because we have no sources of exogenous variation in the design features, there are limitations in our ability to draw causal inferences. While our regression models are not

[1] This proprietary dataset is augmented by and spot-verified against other public and private data sources, such as LinkedIn (for director bios and backgrounds), Venture Economics and Crunchbase (for funding rounds, accelerator attendance status, company status and founder information), accelerator and portfolio company websites, demo day press releases, reference calls and generalized web searches. Large exits and valuations are verified against various databases and through calls to VCs and industry insiders, and a random sampling of other data is independently verified through proprietary means to ensure veracity of reporting. Submitting program managers are aware that data is spot-checked and independently verified.

[2] While a small number of the 160 programs identified by Hathaway (2016) are not included in this sample, their omission is due to them being small, new programs with an insufficient history of portfolio company graduations. We do not believe our sample is biased in a specific way due to the omission of these programs. Readers may want to consider the absence of these programs in drawing inferences from our descriptive work.

meant to provide causal evidence on the effects of design elements, the associations they uncover lay the building blocks for future theoretical and empirical research that use the accelerator setting to explore the effects of various resources and program features on firm-level and ecosystem-level outcomes.

4. Accelerator Emergence and Sponsors

We use our data first to illustrate the growth of the accelerator phenomenon, its geography and then its founders. We then turn to design choices made by accelerator programs. Following these descriptions, we share descriptive statistics to provide more insight into the frequency of each choice. We begin with decisions that are either a function of the accelerators' founding or a made at the time of founding, then move to programmatic design choices and conclude with outcomes.

4.1. The Accelerator Phenomenon over Time

We begin by exploring of the number of accelerators founded each year, starting in 2005, when the first accelerator program, Y Combinator, was established. Figure 1 depicts the distribution of founding years for U.S. accelerator program in our sample. The period with the largest growth in the number of accelerators in the U.S. was 2011-2013. These years corresponded with the beginning of the U.S. recovery from the recession following the financial crisis of 2008—as the recovery progressed, both investors and local governments had more resources available to pursue growth objectives. A number of local governments chose to pursue the accelerator model as an approach to economic development during this period. For example, MassChallenge (founded in 2010) received its founding grant from the government of Massachusetts specifically with the aim of achieving regional employment growth in the wake of the recession.

4.2. Geography & Origins

In addition to growing in number, accelerators have also diffused geographically throughout the country and around the world. Figure 2 shows the distribution of accelerators from 2005 – 2016 across the continental United States (excluding Hawaii and Alaska for ease of exposition). Accelerators are not only located in key entrepreneurship hubs such as Silicon Valley, Boston and New York, but also in areas with less activity such as Memphis, TN, Spartanburg SC and Cincinnati, OH. As accelerator industry pioneer Brad Feld of Techstars argues, "There is a startup

revolution occurring. Every major metro area in the world will eventually be able to support an accelerator."[3,4]

While some older accelerators, such as Y Combinator, are located in areas with many existing entrepreneurs and significant entrepreneurial resources, there are many exceptions to this rule, including early entrants in Boulder, CO, Cincinnati, OH, and Greenville, SC. Why did early adopters make these unlikely location choices? In some cases, it was sheer chance: Techstars was founded in Boulder largely because that is where its founder, David Cohen lived, and where he met another one of its founders, Brad Feld. Feld followed his wife's career to Boulder after the acquisition of one of his startups and joined Cohen because he wished to encourage more startup activity in his new hometown.[5] Dreamit's founders chose to locate the program in Philadelphia because that is where they lived, rather than any recognition of superior opportunity. In the case of The Brandery in Cincinnati, the establishment of the accelerator had more to do with a vision of what the region could be rather than its current condition.

These accelerator founders were actively looking for new ways to address deficits in their specific innovation ecosystems. Many informal historical accounts of accelerator founding stories are similar: a former entrepreneur or investor finds herself in a new location, or returning to a hometown, and wishes to encourage the development of a startup cluster and help local entrepreneurs. Other common founding reasons appear to be related to local government-backed economic development activities; many smaller cities in particular appear to have adopted the accelerator model as a low-cost intervention aimed to encourage the creation and support of innovation-driven entrepreneurship in their region. Overall, early programs seemed to be founded by entrepreneurs who wanted to see more startup activity in their home towns.

These anecdotes are consistent with empirical findings in the academic literature. For example, Fehder and Hochberg (2018) document that accelerators in locations that were not traditional strongholds of technology entrepreneurship tend to cite economic development objectives for their

[3] http://www.inc.com/magazine/201204/max-chafkin/future-techstars-step-forward.html

[4] Beyond the expansion of accelerators in the United States, there has been an equally stunning expansion of accelerator programs worldwide. Since 2007, accelerators have opened on every continent in the world except for Antarctica. While estimates vary considerably, there are at least 400 accelerators across the globe and as many as 2,000. There are no canonical estimates of the count of worldwide accelerators. On F6S, a popular platform for hosting applications to accelerator programs, there are 930 accelerator programs hosting applications on their site at the time of our writing this paper, but there are roughly half of the accelerator programs in our SARP U.S. sample that do not use F6S, yielding our estimate of 2,000 startup accelerators worldwide.

[5] This anecdote was shared in an interview with one of the authors.

founding, while those in entrepreneurial hubs cite founding objectives such as return on investment capital. Fehder and Hochberg (2018) further show that accelerator founders in relatively less developed ecosystems are typically local to the area: they are far more likely to have attended high school nearby than founders of accelerators in traditional entrepreneurial hubs, who often have migrated from great distances, presumably in search of economic opportunities. This observation both accords with and at the same time diverges with prior literature on the establishment of entrepreneurial support programs and institutions. This literature previously found that programs and institutions typically emerge endogenously from a growing ecosystem (Feldman, 2001; Feldman et al, 2005). In our setting, many accelerator founders appear to have spent significant time outside their founding region, yet maintain a tie to that region and eventually return to it to create programs that contribute to ecosystem growth. In founding their accelerator, they bring social capital and resources from other regions to bear on the development of startups and an entrepreneurial ecosystem in their area.

Importantly, the presence of accelerators with seemingly similar institutional forms in such disparate ecosystems as Fayetteville, Arkansas and Silicon Valley suggests that accelerators may serve different roles in different types of ecosystems, or at the very least can be adapted in form and function to meet the differing needs and objectives of different ecosystems and stakeholders. We explore the variation in form and function of different accelerators next.

4.3. Accelerator Founding Managing Directors

Accelerators have historically been very lean organizations, although some have seen organizational growth more recently. In their founding years, programs typically have between one and three managing directors (MD) responsible for running the daily operations of the program and only a few assistants or interns. The average accelerator has 2.0 founding MDs.[6] We begin by exploring variation in managing directors' backgrounds. Not only do accelerators' MD backgrounds have influence at the time of founding, but due to imprinting (Stinchcombe, 1965; Beckman and Burton, 2008), their backgrounds may have lasting effects on their programs. More broadly, these founding MDs often become lynchpins in their broader ecosystem as their accelerators become established, facilitating interactions between disparate ecosystem actors (e.g.

[6] We refer to them as founding MD so as not to confuse them with startup founders entering their accelerator program

corporations, universities, and entrepreneurs) which might not otherwise have a natural context to organize and form ties.

Prior literature has examined the importance of these central figures within ecosystems and has stressed the importance of concerted individual action to transform and the entrepreneurial environment of a region (Feldman and Zoller, 2012). Thus, the backgrounds that accelerator founding MDs bring to the table likely has considerable influence on program features and outcomes.

Panel A of Table 1 reveals that founding MDs have a wide range of education and experience. 65% of accelerator founders have prior corporate experience, with a substantial fraction having some entrepreneurial experience as co-founders of a company (54%). About 32% of the founding MDs of accelerators have investor experience (defined as having worked for a company that made risk-capital allocation to private companies, including as partners or analysts). Accelerator founders are more rarely from academia or from the government sector (7% and 10% respectively).[7] Panel A of Table 1 also shows the academic backgrounds of accelerator MDs. More than a quarter of accelerator founders have MBAs, and 35% have STEM degrees.[8] In Panel B, we display the correlation matrix between the different types of background each founding managing director might have.[9] There is a statistically significant negative correlation between an accelerator having a founding managing director with a background in government and also having a founding MD who previously worked in venture capital or angel investment or as an entrepreneur. In contrast, programs with founding MDs with prior government experience are more likely to also have a founding MD with prior university background. None of the correlations in our sample are large. The patterns, however, support the notion that the founding managing directors in our sample have a broad diversity of careers before establishing their accelerator.

The backgrounds and experience of founders can potentially have significant impact on the nature and success of the program through multiple channels. Background type and work experience may influence the network of mentors the managing directors can bring to bear for their startups. Similarly, the associated experience and skills may influence the ability of an MD

[7] These percentages need not sum to 100% as each founder can have multiple affiliations in their work history
[8] Rather like entrepreneurs in general, many fewer have a doctorate.
[9] Since there are often multiple directors and each director can have multiple types of prior experiences, we show the correlation between different managing director backgrounds. A negative correlation suggests that managing directors with each type of background are less likely to found a program together, while a positive correlation suggests that they are more likely to found a program together.

to directly advise or assist a startup on various dimensions. Finally, the accelerator founder's background may tie closely to the type of sponsors that are brought in to support the program initially; they may also define the objectives the founding MDs set for the program.

4.4. Program Sponsors

We define sponsors as external institutions that provide financial or in-kind support, including office space, professional services, mentors, and endorsement, to accelerator programs. Along with an accelerator's founding managing directors, its founding sponsors may have an imprinting effect on an accelerator, especially shaping their primary goals. These sponsors, along with the founding MDs, may then influence the choice of other program-specific design elements of the accelerator to best meet that intended goal. We code an accelerator's founding sponsors across six categories: corporations, investors (venture capitalists or angels), universities, governments, entrepreneurs and not-for-profit foundations. For example, MassChallenge received direct financial support at founding from the State of Massachusetts, as well as in-kind donations from corporations (including rent-free space in Boston's emerging innovation district). We, therefore, code MassChallenge as having government and corporate sponsors at founding. While some sponsors may lead or originate accelerators alongside the managing directors, in many ways, who sponsors the program is another design element, as the accelerator founding MDs make a choice: with whom shall I found this program, and from whom shall I solicit and accept support?

Table 2 Panel A documents the breakdown of sponsorship according to the six sponsor categories. Corporations sponsor the formation of the largest number accelerators: 62% of accelerators have some form of direct sponsorship from corporations. The next largest category is investors, who have sponsored the founding of 57% of the accelerators in our sample. Next, we find a smaller but sizable role for government sponsors, who helped found nearly 34% of the accelerators. The last two categories of organizational sponsors represented a substantially smaller role: non-for-profit foundations participated in founding 20% of the accelerators in our sample and universities sponsored 16% of the accelerators in our sample.

Programs often have multiple sponsor types; the average accelerator has 1.35 unique sponsor types. In Table 2 Panel B, we present a correlation matrix for sponsor types. In this correlation matrix, we see that accelerators that are sponsored by investors have statistically significant negative correlation with all other sponsor types. In contrast, we see positive correlations between corporations and other sponsor types, including a statistically significant correlation between

corporations and foundations. This might be associated with prior relationships between the executives of the corporation sponsoring the accelerator and the sponsoring foundations through board interlocks or other mechanisms. Similarly, government sponsorship is positively correlated with foundation and university sponsorship, including the largest magnitude correlation (0.499), between foundation and government sponsorship. Despite the statistical significance of many of these correlations, however, the small magnitude of the relationships overall demonstrate that a wide array of sponsor-type constellations is observed in the data.

In Panel C of the Table 2, we correlate sponsorship type with accelerator founder backgrounds. Government-sponsored accelerators are less likely to have founders with investor experience, while investor-sponsored accelerators are more likely to have founders with such experience. These patterns suggest that founding sponsorship and the backgrounds of founding executives have strategic fit in some, but not all, strategic designs.

We next discuss each of the sponsor types in detail, mapping the stakeholder incentives to accelerator mission and design.

4.4.1. Investors

Many accelerators have a core goal to improve startups to a point where they are able to attract institutionalized early-stage investment. Often, these accelerators are supported through direct investments from venture capital funds or angel groups that receive early access to participating startups. For an accelerator to serve such stakeholders, it must meaningfully shift either the quality of the startups to which investors have access or decrease the cost for investors to access startups of a given quality. Investor-led accelerators shift these variables by focusing on cohort selection, education and mentorship, and construction of their Demo Day.

Consider Y Combinator: Paul Graham and Jessica Livingston started Y Combinator in part because they wanted to help a group of college students start businesses. Graham and Livingston quickly learned that younger, more technically-minded cofounders were often overlooked by venture capitalists who expected startup CEOs to be more proficient in the financial and operational aspects of building a startup. Y Combinator thus educated younger startup founders in financial and operational literacy. Because of their focus on ties to investors, Y Combinator moved its initial location from Cambridge, MA to Silicon Valley in order to maximize its ability to establish this bridge to the venture capital community.

As programs gain credibility over time, they also decrease the search costs for early-stage investors, because admission into the accelerator becomes a certification mechanism—a signal of quality. Interestingly, this signal essentially becomes a public good equally available to investors affiliated with the program and those that are not. Investors want first access to high quality startups and startups want to efficiently raise funds from vetted investors on good terms.

4.4.2. Corporations

Corporations engage with accelerators for several reasons. Accelerators provide access to startups that can serve as a source of learning for the corporation. Genentech, CVS Health, and Exxon Mobile are all examples of firms that support existing accelerators as sponsors, providing money for the overhead and operation of these programs in exchange for access to the affiliated startups. Since startups experiment in both markets (problems) and technologies (solutions), corporations can learn about both by observing a startup's experiments. By sponsoring an accelerator program, corporations hope to harness the creative energy of startups in order to cement their competitive advantage. At the same time, startups participating in corporate-led programs gain new inputs from the corporation's market information and the potential for valuable alliances. Accelerators balance these interests by carefully crafting their mentorship program, funding and cohort selection.

Corporations often have internal capabilities or new products that they would like to develop but that are not a current priority (see Guedj and Scharfstein, 2004 for an exploration of the role of internal financing constraints on innovation). In programs such as Surge in Houston and Level 39 in London, corporations assist the accelerator in its screening function by providing detailed and confidential data on their priorities and preferences. An accelerator’s management can then push selection towards startups pursuing projects that are a strategic match for their partner company’s interests. A partner company effectively cedes exclusive control of and full profit from a new innovation in exchange for a reduction in their share in the cost of development. Interestingly, this accords with existing theories about the boundaries of the firm in an innovative context (Aghion and Tirole, 1994).

Once startups are admitted, corporations can help improve their performance by providing the startup with access to strategic resources. The most common of those resources is the time and attention of a corporation's executives. Other resources include financing, as well as pilot contract opportunities, which are often of higher value to the startups than other resources such as financing

(Fehder, Hochberg and Lee, 2018). Healthcare accelerators like Rock Health and Dreamit Health rely extensively on insurance and hospital executives to provide real world insights into complicated, highly regulated industries.

Accelerators can also spur innovation around a corporation's key assets. In such instances, companies provide special access to critical technology or other intellectual property. An example of an accelerator that leverages the corporation's intellectual property is Disney's accelerator, which lets companies experiment with their characters during the accelerator and promises a speedy approval path for licensing after the program. The spheroid robot BB-8 in the Star Wars movie "The Force Awakens" emerged from Disney's Techstars-operated accelerator.

4.4.3. Academia

While employment growth and worker compensation in a region has been tied to the degree of spillovers from university research to related industries (Hausman, 2018), ideas that might spur regional economic growth do not always escape the "ivory tower" (Bikard, 2012). Indeed, there are substantial variations in the capacity for universities to move ideas outside the "ivory tower". Moreover, increasing student interest in entrepreneurship has led to a call for mechanisms and co-curricular programs to support student entrepreneurship activity. University accelerators are therefore becoming an increasingly important element both in a university's support for the pathways from lab-based ideas out into the economy and in its support for entrepreneurial activity on campus more generally. In addition to augmenting the standard channel of intellectual property rights (IPR) out-licensing, accelerators can also facilitate the diffusion of less formal or contractible insights like the applications of publicly-available but complex technologies (e.g. bitcoin, Hadoop, or 3D printing) to new and potentially profitable applications (Shane, 2000). University-led accelerators thus have two primary goals: increase the diffusion of new ideas into the economy through firm formation or development of student's entrepreneurship skills. We use Arizona State University and MIT to illustrate.

The Arizona State University (ASU) Furnace Technology Transfer Accelerator encourages the commercialization of technologies developed in ASU laboratories as well as the Department of Defense and Navy Department of Defense research labs. The Accelerator posts descriptions of technologies and invites entrepreneurs to submit proposals for commercialization plans, which serve as applications for intellectual property licenses and admission to the nine-month long accelerator program, which runs near the government labs in California, New York, New England

and Arizona. The Furnace Technology Transfer Accelerator's goal is explicitly to commercialize technology and provide preferential access to intellectual property and access to researchers for participating teams regardless of their ASU affiliation.

In contrast, MIT's Delta V was built to reinforce entrepreneurial education for MIT students during the summer. Unlike programs focused on technology transfer and commercial success, Delta V measures its success by how prepared student participants feel to identify attractive opportunities and build new businesses after they graduate from the accelerator (regardless of whether they pursue the specific entrepreneurial opportunity that brought them to it). Thus it focuses on student capacity building rather than firm-level outcomes, which is in line with the university's broader educational mission. MIT further hopes to benefit from the long term success of its students through alumni donations. Thus, universities can have a longer time horizon on which to realize its benefit from investments in the human capital of its students.

4.4.4. Government

Governments – especially those with a regional focus (e.g. city and state government) find accelerators particularly attractive interventions for their regional innovation economy. Not only might they attract entrepreneurs into their locale, but they also hold out the promise of additional job creation and cultural transformation via startup growth. Government-led accelerators typically have one of two main goals: 1) to bring new entrepreneurs into an area or 2) to retain skilled entrepreneurs. Government-led accelerators are common both in the U.S. and worldwide, especially in developing economies. We consider the Ark (U.S.A.) as an illustrative example of such efforts locally and abroad.

The Ark Challenge, in Fayetteville, Arkansas was founded with government grants to retain talent in the region, especially those graduating from the University of Arkansas. Their design was to engage key corporate players in the region in developing new cohorts of entrepreneurs: While Fayetteville is not a hotbed of growth entrepreneurship, it does have several large corporation headquarters with resources and expertise to support startups. The leaders of Tyson Foods and Wal-Mart became supporters of The Ark for philanthropic reasons and to encourage entrepreneurs to pursue opportunities directly relevant to their interests. The Ark focused on building core entrepreneurial skills of potential entrepreneurs already residing in the region. The program closed in 2015 due to a lack of funding (Cooke 2015), illustrating some of the challenges inherent in

programs initially funded by public sources, but ultimately requiring ongoing external funding to survive.

For these sorts of programs, government agencies provided direct support to accelerator programs with the goal of facilitating the development of more high-quality firms in their region by solving some of the frictions that inhibit the creation and growth of such firms. A key risk for all government initiatives is therefore in keeping successful startups in the region post program. For example, promising graduates of Lighthouse Labs, in Richmond, Virginia have moved to other states offering tax and other incentives or richer ecosystems.

5. Program Elements

Once founded, accelerators make a host of decisions about the provision and structure of resources. We proceed to describe each of the spectrum of resources provided by accelerators and report summary statistics about the overall variation in the provision of each resource type. Table 3 Panel A describes the design features we discuss below. Table 3 Panel B provides summary statistics on the key design dimensions of accelerators in our dataset: cohort size, program duration, minimum and maximum funding given and maximum equity taken (for participation), external mentorship opportunities, formal education, co-working space, and graduation events.

5.1. Cohorts

The cohort structure used to admit startups serves as one of the most important design innovations introduced by accelerators. By grouping startups into cohorts, accelerators are able to organize and attract other key resources and increase incentives for participation of other stakeholders. The cohort structure attracts startups, mentors who can meet with multiple startups in each visit, and investors who can access multiple deals.

Accelerator managers have a few key design choices related to cohorts: the size of the cohort, the human capital characteristics of the cohort, the industry diversity of the cohort, and the stage of development of its cohort firms. Of course, accelerators can vary substantially in the process by which they admit the firms in their cohort. Some use a formal process involving deliberative scoring sheets, while others use a more ad hoc process of evaluation, similar to the “gut feel” used by other investors (Huang and Pearce, 2015). In addition, many keep the evaluation of candidate startups in the hands of managing directors, while others seek out the input of evaluators external to the accelerator's management team.

We present some of the different design elements of cohorts along which accelerators can vary, along with data for some of the elements describing the observed variation in our data (not all of these features are readily observable or tracked).

As illustrated in Table 1 Panel B, the average cohort size for an accelerator in our dataset is 12.28 companies, with a wide range from as low as 4 companies (Tech Wildcatters) to 128 (MassChallenge). Size is an important factor because it determines the scale of resources required to successfully service each cohort. This is especially important for the supply of human resources such as mentoring (described below in detail), since finding an adequate supply of the right types of mentors is challenging in some regions. On the other hand, having too small a program might limit the appeal for individuals or corporations to collaborate with the accelerator. Size is also important because it can influence the cohesion of the cohort, as well as the attention available for each startup from fixed resources, such as the managing directors or sponsors.

Not only does the size of the cohort vary, but the so does the composition. Some programs target specific industry verticals or founder populations (such as women-focused or minority-focused programs) while others are more generic. Industry composition and stage of development of the startups also vary. Table 4 details the industry/cluster composition of startups across the startups that have entered accelerators in our database through 2017, displaying the very wide variation in industries entered by accelerator startups. The plurality of these startups, however, seems to provide software as service solutions to either consumers or businesses.

Startups also enter at widely varying stages of development, as can be seen in Table 5. On average entering startups have around $3.5K in yearly revenue (with a large standard deviation and range from zero to over $11M). The mean funding level of startups on entry to accelerators is around $51k, and the maximum is $23M in pre-accelerator funding. 80% of the startups have no prior funding on acceptance into the accelerator cohort. Overall, this signals that the majority of firms entering accelerators have begun to implement their business but remain at a very early stage of development.

5.2. Funding and Equity

Accelerators have distinctive investment models for the deployment of capital to participating startups. Capital provision allows founders to cover basic expenses of experimentation over the course of the program, and perhaps for some period after. For many, the total number of dollars allocated to each startup is quite small, enough to allow development during the program but not

enough to allow significant development afterwards. Some accelerators provide a small amount of capital up front and a larger amount of follow-on capital, often as a convertible note. For instance, Techstars typically provides an optional $100K convertible note to firms, though the use of these funds is entirely at the discretion of its founders. The source of these additional funds can come directly from the accelerator or from an adjacent fund provided by investors. Others, like MassChallenge, provide non-dilutive funding at the end of the program to a selected subset of firms. Some programs, like MIT's Delta V, provide milestone-based funding if and when teams meet pre-defined milestones. Still others, like Lighthouse Labs in Richmond, Virginia, provide a small grant to each startup. As illustrated in Panel B of Table 3, across the 146 accelerators in our sample, the mean "minimum funding" is around $26K while the mean "maximum funding" is $68K. This relatively narrow range, however, hides widespread variation in the amount of capital that accelerators give to startups, which ranges from $0 – $600K.

There are also large differences in terms of the amount of equity an accelerator takes in return for funding. Table 3 shows that maximum equity stakes range from 0% to 15%, with a mean of 6.1%. These differences clearly impact the types of firms in the application pool, but may also affect the strategy for an accelerator's long-term survival. For-profit accelerators must provide favorable returns to their investors, while not-for-profit accelerators have to continuously seek outside funding from corporations, foundations and governments. The sustainability and alignment of these differing capital sources depends largely on the overall objective of the accelerator and the degree to which these objectives are consonant with the needs of the funders. These differences are important for startup founders considering programs, as an accelerator's incentives will likely be influenced by its business model.

5.3. Mentorship

Mentorship is a key component of many accelerator programs. In this context, mentorship is defined as the provision of technical and business feedback, advice and social support. Mentorship is meant to help startups access advice and insights that can help propel their business forward and validate market acceptance or rejection of their product or service. A key difference amongst accelerators is who provides the formal, structured advice and feedback that forms the core of the program. Some programs employ a small team of internal advisors who provide direct advice to participating firms (we call these advisors, and they include managing directors, partners and other closely affiliated experts) while others augment internal staff with external mentors (these may

include program alumni, entrepreneurs, investors, lawyers and other loosely affiliated experts). While most provide advisors and mentors, the choice of whether to include external mentors in the formal, required portion of the accelerator program varies.

In addition to advising startups directly, many accelerators also connect startups with external mentors. Our data suggest that 89% of programs have formal external mentoring programs. An illustrative contrast can be seen between Y Combinator and Techstars. At Y Combinator, each firm receives regular feedback from one of the program's partners. Y Combinator partners provide introductions to technical and industry experts as needed (i.e. external mentorship is not part of the required part of the program). Like Y Combinator, each Techstars managing director provides advice directly to startups. However, Techstars' directors also introduce each startup to as many as 75-100 additional mentors in a required, systematic schedule during the first month of the program and match each startup to a lead mentor who meets with the startup regularly throughout the program. Startups select a handful of mentors from this group with whom to build ongoing relationships. Techstars introduced the lead mentor based on the hypothesis that intense, consistent mentoring from a single voice helps founders incorporate advice garnered from the broader mentoring group in their decision-making.

There is also considerable variation in how mentors and firms are matched and the number of mentors provided. For example, some programs provide lists of up to several hundred mentors and instruct startups to research and contact the mentors as they see fit, while other programs are more heavy-handed in scheduling mentorship meetings. The structure of the mentorship and advisory function of the accelerator also varies in the frequency of updating and check-ins provided by the firms to their mentors and the management team at the accelerator. Y Combinator teams are encouraged to meet with the Y Combinator team once per week; while some Techstars programs have startups check in at the end of each day to share their progress.

5.4. Formal Education

Beyond mentoring, many accelerators provide either a shared program of formal education or create a tailored educational program for each startup. These education inputs are meant to ameliorate deficits in a startup founder's understanding of the technical aspects of running a high-growth business (e.g. the details of venture contracts) that could impact their ability to launch their firm. Our data suggests that 37% of accelerators provide formal, structured education to their startup companies.

Some, like HAX - an accelerator tailored for startups creating hardware products - follow a standard curriculum that begins before and extends throughout the program. In the HAX case, the curriculum is focused on a specific set of prototyping and design methodologies related to lean manufacturing. Others, like Tech Wildcatters and MassChallenge, provide frequent speakers throughout and allow startups to decide which programs to attend, though attendance is strongly advised. These lectures provide specific business insights from local experts and provide both content and networking opportunities. Others take a hybrid approach. For example, Surge accelerator in Houston, which closed in 2016, provided a formal curriculum component to their accelerator, but tailored the requirements depending on the business and technical backgrounds of each startup. Their objective was to provide Surge graduates with homogenous background business knowledge.

5.5. Workspace

Accelerators must decide whether to provide workspace for admitted firms. Our data show that 77% do so. The provision of group space (or decision not to) can generate major differences in terms of the social and cultural impact of the program on startup firms.

The provision of reduced cost space to entrepreneurs was a key feature of the first generation of business incubators which first emerged in the 1950s. Incubator programs have evolved substantially over time from providers of office space and ad hoc business services into more active partners in the creation of ventures (Bruneel et al., 2012). Indeed, some would argue that accelerators are a new iteration in the evolution of business incubator models (Pauwels et al., 2016).[10] Across these entrepreneurship programs, however, the provision of working space creates a natural distinction between accelerator programs and incubators and the rest of the ecosystem.

When an accelerator provides space, it most often does so in an open floor plan co-working space where the startups have nonpermanent or semi-permanent allocations of desks and tables. Techstars provides co-working space for its startups and expects them to spend the majority of their time in this space. MIT-based university accelerator Delta V also has strong expectations that startup teams will use the space throughout the summer, as does Boston-based MassChallenge.

[10] Research on the evolution of incubators suggests two main trends. First, there has been a clear evolution away from providing a "closed" internal ecosystem providing services in an a la carte manner. Second, incubator models have evolved toward more active collaboration with entrepreneurs and the broader entrepreneurship community outside the doors of the incubator (Rice, 2002; Bøllingtoft, and Ulhøi, 2005). These studies suggest that the emergence of accelerator programs comes in the context of change in the business incubation model.

These shared facilities allow teams to share their problems and help each other find solutions. They may also allow for more efficient provision of advice from the managing directors in the program.

In contrast, others programs, including Y Combinator, intentionally do not provide space — a design choice motivated by the idea that startup teams have different ideal work environments and should optimize accordingly to develop their own unique identity. Further, Y Combinator's founder was concerned that co-working space would create unhealthy co-dependencies between startups and the accelerator, which might hamper longer term survival. While Y Combinator provides some context for cohort peer effects (like weekly dinners and an online platform), it encourages more independence than those programs that offer co-working space.

5.6. Length of Program and Graduation Event

Accelerators vary in the length of their program: On average, they run 16.32 weeks with a minimum duration of 4 weeks and a maximum of 52 weeks. The length of the program is partly calibrated to the industries served, since the amount of time and investment required for young firms to significantly de-risk their business models and attract follow-on investment varies by industry. In addition, longer programs require greater commitments from external partners.

At the end of the designated time period, all accelerators provide some type of graduation event, however the scale and tenor varies quite substantially. Techstars holds demo days in large halls (often concert venues), invites investors, press, and industry insiders, and hosts a large party to mark the closure of each cohort. MIT's DeltaV fills its Kresge Auditorium with over 1,500 attendees including local alumni, investors and the entrepreneurial community. These events are part entertainment, part inspiration and part investor introduction. And, they are predicated on the belief that these celebrations of their graduate's achievements can both help the graduates receive follow-on investment as well as generate interest in entrepreneurship in a broader community of potential founders and ecosystem stakeholders. In contrast, Launchpad LA provides informal introductions to a small, curated set of investors tailored for each startup. Regardless of the exit structure of the "graduation" procedure, providing a standardized process for facilitating a company's entry into the standard day-to-day activity of building their startup venture.

5.7. Relationship between Founder Backgrounds, Sponsor Types and Program Elements

As noted in the discussion above, accelerator founders may be influenced by the incentives and motivations of their sponsor set in choosing which startups to admit, how to run their programs,

and what resources to offer. The type of sponsors and the nature of the key stakeholders may thus be linked to other program elements we have discussed. We next explore this directly.

Table 6 presents regressions that depict the correlations between various program elements and accelerator sponsorship type. Our regressions take the form:

$$I(founder\ background) = constant + \beta' X + \varepsilon, \text{ and}$$

$$I(sponsor\ type) = constant + \beta' X + \varepsilon$$

where *X* is a vector of program features, and ε is an error term.

Panel A correlates the program elements of the accelerator (duration, investment size in $, percentage equity taken, cohort size, offers workspace indicator, external-mentors indicator, formal education indicator) with the background of the founding managing directors of each accelerator. Accelerators that take more equity are more likely to have founding managing directors with a background in venture capital investing, whereas accelerators that provide free office space and longer duration are less likely to have founders with an investment background. This suggests that founding teams of managing directors with early-stage investment experience are more likely to create cost efficient programs with higher profit potential; this would be consistent with the likely motivation for initial creation of the program. Similarly, programs with formal education components are more likely to have founding managing directors with a background in a university, suggesting another linkage between the capabilities and preferences of the founding team and the design of the program.

Panel B correlates program elements (duration, investment size in $, percentage equity taken, cohort size, offers workspace indicator, external mentor indicator, formal education indicator) with sponsor types. As can be seen from the panel, government sponsorship is strongly and negatively associated with the percentage of equity taken in the startup. University-sponsored programs show a similar negative association with percentage of equity taken, though the size of the relationship is lower. In contrast, investor-sponsored programs—unsurprisingly—have a strong positive association with the percentage of equity taken in their participating startups. Investor-sponsored programs are also significantly and positively associated with provision of workspace to participating startups. While no other clear patterns emerge from the panel, these associations

suggest that it will be important to control for sponsor type when assessing the relationship between program design features and performance.[11]

In Table 7, we perform a similar statistical analysis as in Table 6, but now focus on how the broader regional ecosystem is related to the backgrounds of the founding managing directors and the types of founding sponsors, by relating these features to features of the Metropolitan Statistical Area (MSA) in which the accelerator is located: total employment and patenting activity. Panel A shows that the backgrounds of the founding managing are correlated with where they found their accelerators, and in interesting ways. Accelerators that have founding managing directors with a background in early-stage investing are more likely to found their accelerators in areas with higher patenting activity, an indicator of technically-related economic activity. Accelerators founded in MSAs with higher total employment are more likely to have founding managing directors with a background working in universities, perhaps because these accelerators are more likely to be connected to an urban university.

As can be seen from Panel B, government sponsored programs are more likely to be located in MSAs with higher employment (larger cities), but with lower patenting activity. This in contrast to investor-sponsored programs, which appear to be associated with cities with higher patenting, irrespective of the size of the city. Thus, it appears that governments are more likely to sponsor programs when they have large economic bases but lack innovation activity, consistent with a bid to diversify the economic base and create technology-driven employment. In contrast, investor-sponsored programs, which likely have significant profit motives, are more likely to be located in cities with significant innovation-related activity.

Corporate-led programs are also associated with larger cities (higher employment) but show no statistically significant association with patenting activity in the MSA. Given the strategic aims of most corporate sponsors, who desire "windows on technology," this is perhaps unsurprising, as many of these programs are started close to corporate headquarters or key business units. Finally, university-sponsored programs show no significant association with MSA size or patenting activity, consistent with the fact that these programs serve the university population, are primarily located on university campuses or immediately adjacent to them and are driven by educational and tech transfer motivations.

[11] Note that all government-sponsored and university-sponsored programs have external mentors; as a result, external mentorship falls out of those regressions.

6. Design Features and Accelerator Alumni Performance

We now turn to the relationship between accelerator design choices and the performance of the companies that graduate from these programs. Our data provide a rich feature set that allows us to document associations between particular elements of a program and the performance of the companies that graduate from it. We are careful to note that the documented associations are simply that; given the lack of exogenous variation in feature sets, causal statements cannot be made from our current dataset. A ripe area for future research will be to further explore the mechanisms and causality that stand behind the correlations we document.

We utilize three proxies for accelerator portfolio company performance: funding raised, valuation attained (Rothaermel and Thursby, 2005) and meeting a funding threshold. For funding raised, we use the log of the dollars of funding raised rather than the unlogged number because funding levels are highly skewed, and it is common in the literature to employ log funding as a result. Our valuation measure is often pointed to as a primary measure of the success of the company, more so than $ funding raised. As a third proxy, we use an indicator variable for raising over half a million dollars, as this could be considered an outcome of significance to the founders even if they do not choose to grow their companies to the point where they raise large amounts of VC or achieve high valuations. In our conversations with startup founders and accelerator MDs, we found that $500K was considered a reasonable threshold to get a smaller but sustainable (lifestyle-type) business off the ground. Finally, while exit via IPO or acquisition is often used in the entrepreneurial finance literature as a measure of startup success, given the newness of the accelerator phenomenon, and the lengthening times to exit for venture capital-backed startups over the last decade, it is likely too soon to use exits as a measure of success for accelerator alumni.

Table 8 provides summary statistics for our measures of performance of accelerator alumni companies. The average total funding raised by an accelerator alumni startup in our sample is $3.37M, and the average maximum valuation reached is $12.43M. While it is too early to expect many exits, we note that 3% of accelerator alumni companies achieved an exit valued at $1M or more. 23% of the alumni companies in our sample raise >$500K after completing an accelerator program. Our valuation measure is the maximal valuation attained by the startup post-graduation through end of 2016. As different startups graduated from programs at different points in times, our multivariate models will all include fixed effects for year of graduation from program.

In Table 9, we use OLS regressions to relate our set of accelerator design choices to the performance of the startups who graduate from them. We use three measures to measure performance of alumni startups. In column (1) the dependent variable is an indicator for whether the startup raised significant funding post-program (>$500K), in column (2) the dependent variable is the log of total $ funding raised by the alumni startup, in column (3) our dependent variable is the log of the maximum valuation attained by the alumni startup. All models contain cohort year fixed effects, to control for the fact that some companies have had longer since graduation than others to attain these performance metrics and standard errors are clustered by accelerator program in all models. Our regression models thus take the form:

$$Performance_i = constant + \beta' X_i + \mu_t + \varepsilon_i$$

where X_i is a vector of design choices, μ_t are cohort-year fixed effects, and ε_i is an error term clustered at the accelerator-level. Note that since an accelerator can have multiple types of sponsors, all four indicators are included in the models and there is no need for an omitted category. Similarly, an accelerator founder can have multiple types of experience, and thus all categories can be included in our models. For robustness, we additionally run models that control for the log pre-accelerator funding and pre-accelerator revenue. Models using the full sample without controls for pre-accelerator funding and revenue are presented in columns (1) – (3). Models that utilize the subsample for which we have data on pre-accelerator funding and revenue, and which add controls for the natural logarithm of these variables, are presented in columns (4) – (6), to control for the stage that the startup was at prior to entering the accelerator, as this may affect its performance upon graduation. We are able to include both pre-accelerator performance variables simultaneously because they are not highly correlated (r=0.217) and we can rule out significant bias introduced by their collinearity as their variance inflation factors are 1.13 (logged pre-funding) and 1.08 (logged pre-revenue). The patterns are consistent across both sets of specifications.

Some clear patterns of association between design choices and performance emerge from our regression estimates. Alumni of investor-sponsored programs are more likely to raise significant amounts of capital post-graduation, raise significantly larger total amounts of external funding post-graduation, and achieve higher valuations. In contrast, graduates of government-sponsored programs show no significant increase in the likelihood of raising significant funding relative to other sponsor types and raise significantly lower sums of capital post-accelerator. These findings are consistent with the fact that many of these programs have broader economic development

objectives, and startups are selected to participate in them reflect this broader set of objectives rather than being solely based on the profit potential of their business ideas as a venture investment. Similarly, graduates of corporate-sponsored programs do not show higher likelihood of raising significant funding or raising more money relative to the mean performance of startups in the sample but they are more likely to see higher valuations. These results suggest that engagement with corporations might provide a substitute for capital spurring startups to be able to achieve more (and thus be worth more) with less capital inputs.

Accelerator founder backgrounds also demonstrate certain clear patterns of association with the performance of their alumni. Alumni of programs with founder MDs that have either of prior investor experience, experience as an entrepreneur, corporate experience, or government experience are more likely to raise capital at significantly higher valuations post-graduation. In contrast, founder MDs that come from an entrepreneurial background are associated with statistically significant lower valuations post-graduation.

For all three performance variables, a longer program duration is associated with higher performance for alumni startups post-graduation. Similarly, the size of the accelerator $ investment in their participating companies appears to have a small but statistically significant impact on the likelihood of reaching a significant raise and the maximum valuation but not the total number of dollars raised. The percentage of equity taken by the accelerator, in contrast, is strongly and negatively associated with better performance post accelerator. This is consistent with the notion that programs with strong incentives to achieve high funding and valuation targets (namely, for-profit accelerators) are more likely to take equity stakes but that larger equity stakes might be associated with accelerators in locations with lower capital availability (and thus ability to extract a higher equity stake).

Turning to cohort size, we see a small, negative and significant relationship between the number of startups participating in the accelerator's cohort and the likelihood that the startup raises significant amounts of capital post-graduation, as well as with the total amount of external funding raised post-graduation, and the startup's valuation. Smaller cohorts thus appear to be associated with better performance for their graduates. External mentorship shows a negative relationship to performance across all three models, suggesting that the approach taken by some accelerators—such as AngelPad—of using only internal advisors and staff for mentoring startups, may be the superior approach. Finally, provision of work space has a mixed relationship with performance

showing a negative and statistically significant relationship with the probability of having a significant raise but is associated with lower performance in terms of maximum valuation. This negative relationship on probability of significant fundraising could be due to the outsized performance of Y Combinator graduates who have access to a rich network of investors in Silicon Valley as they graduate the program, given that Y Combinator does not provide workspace. Or, it may simply suggest that work space does not play nearly as much of an important role as other elements of the programs, given the opposite result for the maximum valuation achieved by accelerated firms.

Our data does not allow for exploration of causal relationships between design features and performance, as design features are endogenously chosen. Instead it provides for an understanding of the equilibrium relationship between accelerators and their alumni start-ups. Nevertheless, illuminating these equilibrium correlations is important for shaping future research, as it allows researchers to build theories that may explain the equilibrium patterns we observe, and lay the foundation for future research into the importance of specific design features or resources for the entrepreneurial production function.

7. A Laboratory and Agenda for Future Research

We close our paper by proposing a research agenda to further our understanding of how to stimulate entrepreneurship and related economic development through structured interventions such as accelerators that combine and integrate resources from an innovation ecosystem with start-ups and their entrepreneurial teams. Accelerators offer researchers a path to study important questions at multiple units of analyses – starting with ideas and founders and building to ecosystems.

First, accelerators provide a much-needed view into the startup process. Startups at the youngest stages of development have long been invisible to researchers. A fundamental question that can be answered in the context of accelerators is the relative contribution of startup's identified opportunity and the capabilities of its founders: i.e. the horse versus the jockey (Kaplan et al., 2009, Gompers et al., 2017). Accelerators are an ideal context to answer this question because they aggregate several "ideas" with founding teams of varying and differentiated skills, thus providing variation and aggregation needed for empirical research. Moreover, programs are addressed to mediate deficits in either, or both areas. The accelerator provides an opportunity for researchers to

see how stakeholders influence both the development of entrepreneurial ideas and the skills of founders. Future research could explore how accelerators' selection with respect to both the idea and the founders may differ from other types of investors.

Second, accelerators may be an important lever which can alter who becomes an entrepreneur. What induces teams to enter into entrepreneurship? Is there a relationship between how ideas are evaluated and the backgrounds of people who enter into entrepreneurship? How do the team and the idea coevolve? More specifically, the arrival of an accelerator in a region has also been shown to serve as a catalyst for the entry of new investors, but it might also have other effects: the emergence of more open, formal entrepreneurship institutions in a region might impact the type of people who choose to enter into entrepreneurship in the region. Similarly, the arrival of accelerators might facilitate partnering between existing companies and startups, leading to higher levels of local entry of high-capacity entrepreneurs with great ideas but who face substantial opportunity costs to entry.

Third, while the treatment effect of accelerators on participating startups is the area in which the most research has been conducted, there remain important questions to be answered. In the literature reviewed in this paper, we see varying estimates of the overall treatment effect of accelerators. Whether a positive treatment effect for accelerator programs is present for the average program is still undetermined. Moreover, estimates of individual treatment effects provide little insight into the potential for an optimally designed program to deliver improved startup performance, nor do they suggest which startups might benefit from which design elements. Accelerator programs are complicated in their design, and thus there could be multiple elements driving treatment effects. Further research is needed to evaluate the impact of different design elements of accelerators and of entrepreneurship programs more generally. As one example, the role of formal education, including the specific educational components, is an interesting avenue for future exploration. If there are indeed high returns to educating entrepreneurs, there might be ways to provide this education that are more efficient than delivery via an accelerator program which combines education with other elements. Similarly, if the main way accelerators provide value is by screening and certification of startups, then there are likely more cost-efficient means of providing this certification. More than anything, the emergence of accelerators signals the willingness of entrepreneurs to participate in programs that might improve their performance–even

when such promises lack empirical validation. Entrepreneurs who previously spent their early founding years in a garage are willing to come out and "play."

A fourth avenue for future research is understanding the nature and success of the differing business models employed by accelerator programs. For many for-profit, investor-sponsored programs, a key challenge is figuring out how to economically sustain the program over the medium-term. Equity stakes taken in participating startup companies are relatively small, are typically in the form of common stock, and, for high-growth innovation driven startups, likely to be highly diluted through multiple subsequent rounds of venture capital financing. For the types of startups considered by such programs, success is often driven by extreme right tail events: historically, 75% of venture capital investments are written off (Ljungqvist and Richardson, 2003). Accelerator startups are typically even earlier stage, and thus even more risky. It may take multiple cohorts to realize a true, high multiple successful exit. Furthermore, realizations of successful exits—which return the capital needed to generate returns—are usually 7-9 years in the future. Thus, many of these programs rely on other approaches to allow sustained operations.

One common approach is to have VC sponsors contribute to supporting the expenses of the accelerator over multiple years: rather than expecting a high return on that contribution, the VCs instead recoup that investment in the longer-term through their larger direct fund investments in the accelerator graduates that they identify through the mentoring process. A second approach is to diversify the activities of the accelerator. This can include creation of an accompanying venture fund that makes follow-on investments in the accelerator's graduates or in other promising adjacent startups.[12] It may also include operating accelerator programs for corporations or local governments, in return for a multi-year fee that in turn supports the larger accelerator organization.[13] Obtaining data on the business models employed by accelerator programs, however, has to date remained challenging. Most programs are reluctant to share data on their specific models, and categorizing business models is difficult and nuanced more generally Zott et al., 2011). As such, this remains a topic open to future research.

Fifth, the arrival of an accelerator in a region also provides the opportunity to answer a set of broader questions: How do accelerators influence the entrepreneurial capacity of their regions?

[12] Examples include Techstars Ventures, 500 Startup's VC fund, Y Combinator's Continuity Fund, and Dreamit Ventures.

[13] A notable example of this is the Techstars "powered by" program, which operates accelerator programs for numerous corporate sponsors.

Can they influence all regions, or are certain conditions necessary for both accelerators and their ecosystems to flourish? While the existing initial evidence presents an intriguing first look at the impact such programs can have on their local ecosystem, many gaps still remain in our understanding how accelerator programs impact and interact with their local ecosystems.

Finally, future research has an opportunity to draw a larger picture about how accelerators as a whole have impact on their stakeholders. Importantly, the scholarly community has yet to fully determine what mechanisms accelerators use to impact their stakeholders and how those mechanisms might vary to accommodate programs' broader ecosystem.

8. Conclusion

Our preliminary results, while correlational rather than fully causal, provide guideposts for researchers, policymakers and practitioners alike as they seek to explore and act upon the impact of accelerators. First, we find a strong correlation between the type of founding sponsor and the background of founding managing directors. These characteristics may lead to distinctive of accelerator designs, each optimized to meet the founders' objectives; for example, government-sponsored accelerators founded by directors with public service backgrounds may well focus on economic and regional development, while investor-led accelerators founded by former risk capital investors focus instead on the maximization of returns. Our results also suggest that these differently designed accelerators have differences in the performance of their portfolio firms, with investor-led accelerator portfolio companies tending to have higher amounts of capital raised post-graduation (a feature that may be driven by selection variation by managers). The implications for startups applying to accelerators are not immediately obvious, though, for the increased performance of portfolio firms in investor-led accelerators comes at a cost, in the form of equity. To deal with these variations, founders should be aware of such tradeoffs and align their goals and objectives with those of the accelerator. Policy-makers sponsoring accelerators should also be cognizant of the variation not only in accelerator outcomes, but also in objectives, as any increased performance for participating startups in investor-led accelerators may be fully captured by the sponsors and equity holders of the accelerator without regard to the interests of the policymaker.

Looking to the broader entrepreneurial ecosystem, however, we note that it is important to recognize that accelerators are only one of many types of intermediaries that are emerging and may exist in a region. Cataloguing the vast number of programs, as well as creating taxonomy of

entrepreneurship and innovation programs that allows us to compare across different types of programs, is another important endeavor. Once we have a catalogue of programs in a region and a way of comparing programs with one another, it becomes possible to systematically understand how the spatial distribution of entrepreneurship support programs alters the likelihood of entrepreneurial entry, the probability of success conditional on entry, and the fate of regional innovation ecosystems. While the SARP accelerator database provides a useful cataloguing of a specific type of program, more work is needed to assess and document the wide variety of interventions and intermediaries that contribute to the entrepreneurial process.

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Table 1: Accelerator Founding Managing Director Backgrounds

Panel A: Summary Statistics

	Mean	Std. Dev	Min	Max
Education				
MBA	0.26	0.44	0	1
STEM Degree	0.35	0.48	0	1
PhD	0.05	0.21	0	1
Prior Work Experience				
Corporate	0.65	0.51	0	1
Entrepreneur	0.54	0.54	0	1
Investor	0.32	0.47	0	1
Academia	0.07	0.25	0	1
Government	0.10	0.31	0	1
Observations	287			

Panel B: Correlation between Founding Managing Director Backgrounds

	Prior Investor Exp.	Prior Entrepreneur	Prior Corporate Exp.	Prior Uni. Exp.	Prior Gov. Exp.
Prior Investor Exp.	1				
Prior Entrepreneur	0.00618	1			
Prior Corporate Exp.	-0.171*	-0.0847	1		
Prior Uni. Exp.	-0.00628	-0.0323	0.0290	1	
Prior Gov. Exp.	-0.174*	-0.212**	-0.0274	0.146	1

Table 2: Accelerator Founding Sponsors

Panel A: Summary Statistics

	Mean	Std. Dev	Min	Max
Corporation	0.62	0.478	0	1
Investor	0.573	0.497	0	1
Academia	0.163	0.371	0	1
Foundation	0.204	0.405	0	1
Government	0.336	0.474	0	1
Observations	146			

Panel B: Correlation Between Founding Sponsor Types

	Investor Sponsor	Corporation Sponsor	Government Sponsor	University Sponsor	Foundation Sponsor
Investor Sponsor	1				
Corporation Sponsor	-0.106	1			
Government Sponsor	-0.475***	0.0518	1		
University Sponsor	-0.156*	0.0235	0.201**	1	
Foundation Sponsor	-0.261***	0.191**	0.499***	0.214**	1

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel C: Background of Accelerator Founders

	(1) Government Sponsor	(2) Investor Sponsor	(3) Corporation Sponsor	(4) University Sponsor
Accelerator Founder Prior Investor Exp.	-1.148***	0.715**	-0.424	-0.470
	(0.342)	(0.287)	(0.276)	(0.359)
Accelerator Founder Prior Entrepreneur	0.005	0.233	0.287	-0.250
	(0.319)	(0.292)	(0.283)	(0.358)
Accelerator Founder Prior Corporate Exp.	-0.275	-0.401	-0.004	-0.398
	(0.356)	(0.339)	(0.316)	(0.387)
Accelerator Founder Prior University Exp.	-0.286	-0.171	-0.182	-0.276
	(0.485)	(0.431)	(0.433)	(0.643)
Accelerator Founder Prior Government Exp.	-0.057	-0.322	-0.114	-0.747
	(0.400)	(0.389)	(0.380)	(0.601)
Constant	0.061	0.149	0.210	-0.344
	(0.443)	(0.422)	(0.401)	(0.481)
Observations	146	146	146	146
log-likelihood	-49.916	-58.679	-62.924	-36.085

Note: This table measures the association between founding sponsors and the backgrounds of founding MDs. The dependent variable is noted below the model number in each column. Each regression is a probit model at the accelerator level. Robust standard errors are reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Accelerator Design Choices

Panel A: Summary of Design Choices

Choice	Options	Importance
Cohort size	The number of startups in each cohort	The number of startups in each cohort influences the resources available to each firm and the level of interactions between firms. Some programs have strict cohort size limits while others fluctuate based on the strength of the admission pool or available funding.
Cohort composition	Generic, or focused by industry or founder characteristics, including gender or ethnicity	Homogenous cohorts may provide higher levels of specialized information but may also promote competitive behaviors. Limiting selection to a particular demographic may reduce the size and thus quality of the selection pool.
Program duration	Between 4 weeks and one year	Program duration may adjust to product development lifecycle with those targeting longer-cycle industries having longer programs.
Funding provided	The amount provided, when it is provided, from whom it is provided, and the terms on which it is given. Ranges from $0 – $600K	Funding provides incentives for entrepreneurs to participate in programs and allows them to commit full time to a program. It also allows startups to acquire additional resources.
Equity taken	Between none and 15%	Equity may align accelerator interests with founders
Mentorship	Who provides the mentorship, frequency and timing of mentor interactions	The quality and number of mentors may influence what the startup is able to learn, as well as its access to other partners.
Advisory and managing directors	Backgrounds of accelerator and startup founders	The background of the accelerator founders and managing directors influences the social networks and knowledge available to the participating startups. The number of and composition of the accelerator's management team impact the number of portfolio startups or the services provided.
Educational Programming	Required structured educational programming or a-la-carte offerings	Structured programing can be time consuming, but also provides comprehensive foundational education for startup founders. More experienced founders may prefer a-la-carte style programs but may lead to knowledge gaps since founders are not always accurate in their self-assessment.
Co-working space	Accelerators provide open, flexible co-working space, silo-style office space or no space	Space provides instant access to peer firms and attracts other resource providers, including mentors to the central location. However, some argue that co-working space could lead to unproductive codependency.
Graduation event, such as Demo day	Demo days with investors; conferences or prize competitions	Graduation events demark the end of the program and provide a vehicle for launching nascent startups to investors or the marketplace. They also provide exposure for the accelerators.
Program location	Geographic location	The composition of the local regional ecosystem influences the type of startups that apply to the program and the resources including mentors, and access to local knowledge via spillovers.
External stakeholders - Sponsors	Corporations Governments Academia Investors	External stakeholders who provide resources to accelerators in exchange for preferential access to participating startups differ in their reasons for affiliating with a startup and may influence accelerator outcomes. Corporations use accelerators to scan the environment for new technologies and markets or promote their own products and services, governments promote in regional development, academic programs use accelerators as a vehicle to either transfer technology or develop student skills and investors use accelerators to vet potential investments.

Panel B

	Mean	Std. Dev	Min	Max
Observations	146			
Cohort Size	12.28	14.05	4	128
Program Duration (Weeks)	16.32	13.03	4	52
Minimum Funding Provided	$ 26,694	$ 27,183	$ 0	$ 200,000
Maximum Funding Provided	$ 68,078	$ 120,642	$ 0	$ 600,000
Max Equity Taken	6.1%	3.2%	0%	15%
Provides External Mentors	0.89	0.28	0	1
Provides Formal Education	0.37	0.48	0	1
Provide Workspace	0.77	0.41	0	1

Table 4: Accelerator Portfolio Firm Industry Variation

Industry Cluster	Percentage
Business Services	22.13%
Marketing, Design, and Publishing	21.66%
Local Personal Services (Non-Medical)	11.84%
Distribution and Electronic Commerce	7.2%
Education and Knowledge Creation	4.58%
Financial Services	4.44%
Information Technology and Analytical Instruments	3.97%
Local Commercial Services	3.57%
Local Real Estate, Construction, and Development	1.88%
Communications Equipment and Services	1.82%
Hospitality and Tourism	1.62%
Local Health Services	1.62%
Local Logistical Services	1.62%
Recreational and Small Electric Goods	1.28%
Local Community and Civic Organizations	1.21%
All Other Clusters	9.56%

Table 5: Summary Statistics: Accelerator Portfolio Firm Entering Characteristics

	Mean	Std. Dev.	Min	Max
Revenue Prior to Entry (Yearly)	$ 3,565	$ 63,053	$ 0	$ 11,000,000
Funding Prior to Entry	$ 50,820	$ 454,123	$ 0	$ 23,000,000
Observations	5,921			

Table 6: Relationship between Founding Sponsors and Accelerator Design Variables

Panel A: Founding Managing Director and Program Variables

	(1) Prior Investor	(2) Prior Entrepreneur	(3) Prior Corporate Exp.	(4) Prior Uni. Exp.	(5) Prior Gov. Exp.
Program Duration	-0.046*	-0.021	-0.006	-0.151*	0.009
	(0.028)	(0.024)	(0.025)	(0.085)	(0.028)
Accel Invest ($)	0.001	-0.003	0.005	-0.004	0.001
	(0.001)	(0.002)	(0.004)	(0.005)	(0.001)
Accel. Max Equity Taken	13.931**	3.922	-1.744	-12.304	-3.566
	(5.445)	(5.192)	(5.699)	(7.788)	(6.053)
Cohort Size	0.001	0.007	-0.010	-0.004	-0.094*
	(0.011)	(0.012)	(0.017)	(0.024)	(0.052)
External Mentorship	-0.162	0.319	0.290		-0.679
	(0.638)	(0.620)	(0.676)		(0.792)
Workspace	-0.663*	0.421	-0.360	0.493	0.113
	(0.392)	(0.391)	(0.450)	(0.674)	(0.516)
Formal Education	0.176	-0.040	-0.112	1.362***	0.241
	(0.316)	(0.321)	(0.345)	(0.502)	(0.381)
Observations	146	146	146	146	146
log-likelihood	-53.719	-51.413	-45.853	-22.845	-32.664

Panel B: Founding Sponsors and Program Variables

	(1) Government Sponsor	(2) Investor Sponsor	(3) Corporation Sponsor	(4) University Sponsor
Program Duration	-0.001	0.032	-0.003	-0.019
	(0.011)	(0.025)	(0.009)	(0.032)
Accelerator Investment ($)	0.002	-0.002	-0.000	-0.001
	(0.001)	(0.002)	(0.001)	(0.002)
Accelerator Max Equity Taken	-20.327***	15.384***	1.875	-11.988**
	(5.421)	(4.989)	(4.316)	(5.863)
Cohort Size	-0.008	0.019*	0.006	-0.012
	(0.011)	(0.010)	(0.010)	(0.018)
External Mentors		0.553	0.534	
		(0.638)	(0.607)	
Work Space	-0.101	0.734**	0.023	0.543
	(0.338)	(0.318)	(0.302)	(0.448)
Formal Education	-0.362	-0.052	-0.408	-0.134
	(0.313)	(0.290)	(0.271)	(0.369)

Observations	146	146	146	146
log-likelihood	-53.775	-61.441	-70.563	-38.913

Note: This table measures the association between accelerator program design choices and other founding choices of the accelerator. Panel A relates these design choices to the backgrounds of founding MDs while Panel B relates them to founding sponsors. The dependent variable is noted below the model number in each column. Each regression is a probit model at the accelerator level. Robust standard errors are reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Relationship between ecosystem, founding sponsorship, and Founding Managing Director Backgrounds

Panel A: Accelerator Founding Managing Director and Regional Ecosystem Variables

	(1) Prior Investor	(2) Prior Entrepreneur	(3) Prior Corporate Exp.	(4) Prior Uni. Exp.	(5) Prior Gov. Exp.
MSA Employment	0.014	-0.010	-0.003	0.158*	-0.005
	(0.042)	(0.042)	(0.044)	(0.090)	(0.063)
MSA Patents	0.093**	-0.039	-0.005	-0.187	-0.076
	(0.047)	(0.046)	(0.049)	(0.145)	(0.071)
Constant	-0.619***	0.574***	0.693***	-1.371***	-0.925***
	(0.209)	(0.209)	(0.216)	(0.282)	(0.240)
Observations	146	146	146	146	146
log-likelihood	-63.865	-63.104	-55.931	-27.690	-35.585

Panel B: Accelerator Founding Sponsors and Regional Ecosystem Variables

	(1) Government Sponsor	(2) Investor Sponsor	(3) Corporation Sponsor	(4) University Sponsor
MSA Employment	0.145**	-0.053	0.095**	-0.096
	(0.067)	(0.047)	(0.044)	(0.062)
MSA Patents	-0.342***	0.187***	-0.002	-0.040
	(0.102)	(0.060)	(0.044)	(0.053)
Constant	-0.001	-0.157	-0.055	-0.639***
	(0.186)	(0.184)	(0.184)	(0.208)
Observations	146	146	146	146
log-likelihood	-60.778	-70.197	-74.141	-46.763

Note: This table measures the association between the accelerator's surrounding ecosystem and other founding choices of the accelerator. Panel A relates an accelerator's ecosystem to the backgrounds of founding MDs while Panel B relates them to founding sponsors. The dependent variable is noted below the model number in each column. Each regression is a probit model at the accelerator level. Robust standard errors are reported in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table 8: Summary Statistics: Accelerator Company Performance

	Mean	Std. Dev	Min	Max
Received > $500K within 1 year	0.23	0.42	0	1
Total Raised ($ M)	3.37	54.58	0	4,398.06
Logged Total Raised	0.39	0.88	0	8.39

Max Valuation ($ M)	12.43	32.19	0	30,000
Logged Max Valuation	1.84	1.02	0	10.31
Exit of $ 1 M or more	0.031	0.17	0	1
Observations	5,921			

Table 9: Relationship between Design Variables and Performance

	(1) Raised > $500K	(2) Logged Total Raised	(3) Logged Max Valuation	(4) Raised > $500K	(5) Logged Total Raised	(6) Logged Max Valuation
Investor Sponsor	0.182***	0.271**	0.956***	0.187***	0.318***	0.992***
	(0.048)	(0.116)	(0.111)	(0.048)	(0.115)	(0.111)
Corporation Sponsor	-0.010	0.075	0.424***	-0.011	0.079	0.418***
	(0.024)	(0.060)	(0.057)	(0.025)	(0.060)	(0.057)
Government Sponsor	-0.023	-0.125**	0.128**	-0.022	-0.126**	0.130**
	(0.023)	(0.056)	(0.054)	(0.023)	(0.056)	(0.053)
University Sponsor	0.028	0.154**	0.397***	0.026	0.149**	0.383***
	(0.027)	(0.066)	(0.063)	(0.027)	(0.066)	(0.064)
Prior Investor Exp.	0.009	0.109	0.572***	0.007	0.110	0.562***
	(0.028)	(0.069)	(0.066)	(0.029)	(0.069)	(0.067)
Prior Entrepreneur	0.035	0.028	-0.203***	0.030	0.004	-0.240***
	(0.022)	(0.053)	(0.050)	(0.022)	(0.053)	(0.051)
Prior Corporate Exp.	0.014	0.029	0.136**	0.011	0.016	0.116**
	(0.024)	(0.059)	(0.056)	(0.024)	(0.058)	(0.056)
Prior Uni. Exp.	0.109***	0.104	0.133	0.108***	0.065	0.119
	(0.036)	(0.087)	(0.082)	(0.036)	(0.086)	(0.082)
Prior Gov. Exp.	0.043	0.074	0.470***	0.044	0.121	0.476***
	(0.034)	(0.083)	(0.079)	(0.034)	(0.082)	(0.079)
Program Duration	0.005***	0.011***	0.019***	0.005***	0.011***	0.019***
	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)
Accel Invest ($000)	0.424**	0.711	1.467***	0.356**	0.522	1.227***
	(0.177)	(0.426)	(0.410)	(0.179)	(0.430)	(0.414)
Accel. Max Equity Taken	-1.235***	-2.167**	-5.007***	-1.253***	-2.181**	-5.077***
	(0.412)	(1.002)	(0.953)	(0.412)	(0.990)	(0.952)
Cohort Size	-0.005***	-0.008***	-0.021***	-0.005***	-0.007***	-0.020***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
External Mentorship	-0.142***	-0.415***	-0.829***	-0.142***	-0.418***	-0.825***
	(0.028)	(0.067)	(0.064)	(0.028)	(0.066)	(0.064)
Workspace	-0.082***	-0.039	0.344***	-0.079***	-0.019	0.370***
	(0.028)	(0.068)	(0.065)	(0.028)	(0.067)	(0.065)
Formal Education	0.069**	0.189***	0.480***	0.071**	0.199***	0.494***
	(0.028)	(0.067)	(0.064)	(0.028)	(0.067)	(0.064)
Logged Pre-Accel Funding				0.006	0.127**	0.124**
				(0.009)	(0.060)	(0.057)
Logged Pre-Accel Revenue				0.108*	0.621**	0.944***
				(0.062)	(0.276)	(0.266)
Observations	5,921	5,921	5,921	5,921	5,921	5,921
R-squared	0.315	0.227	0.257	0.316	0.232	0.259

Note: This table measures the association between accelerator portfolio firm performance and accelerator design choices. The dependent variable is noted below the model number in each column. Each regression is

an OLS model at the portfolio firm level with cohort-year fixed effects. Robust standard errors clustered at the accelerator level are reported in parentheses.

*** p < 0.1, ** p < 0.05, *** p < 0.01**

Figures

Figure 1: Distribution of Startup Accelerator Founding Years, 2005 - 2014

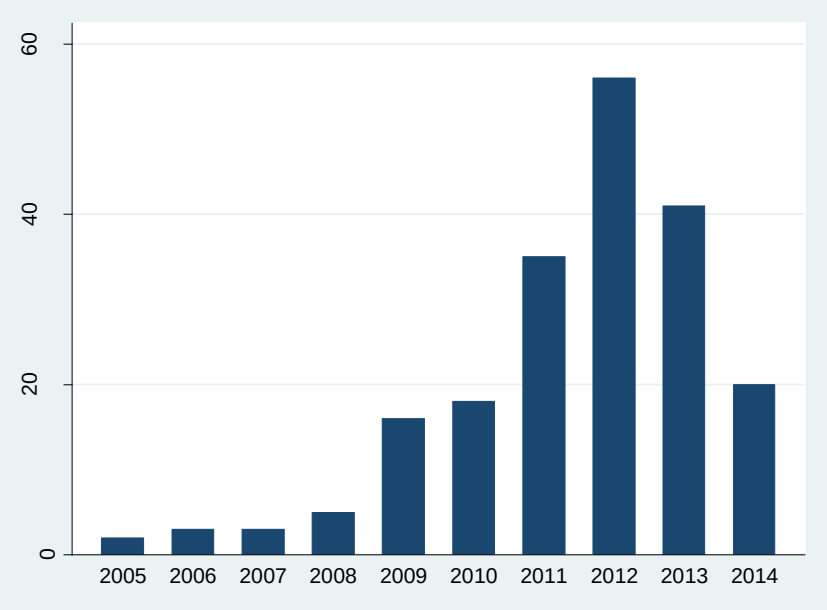

Figure 2: Geographic Distribution of Startup Accelerators, 2005 - 2016

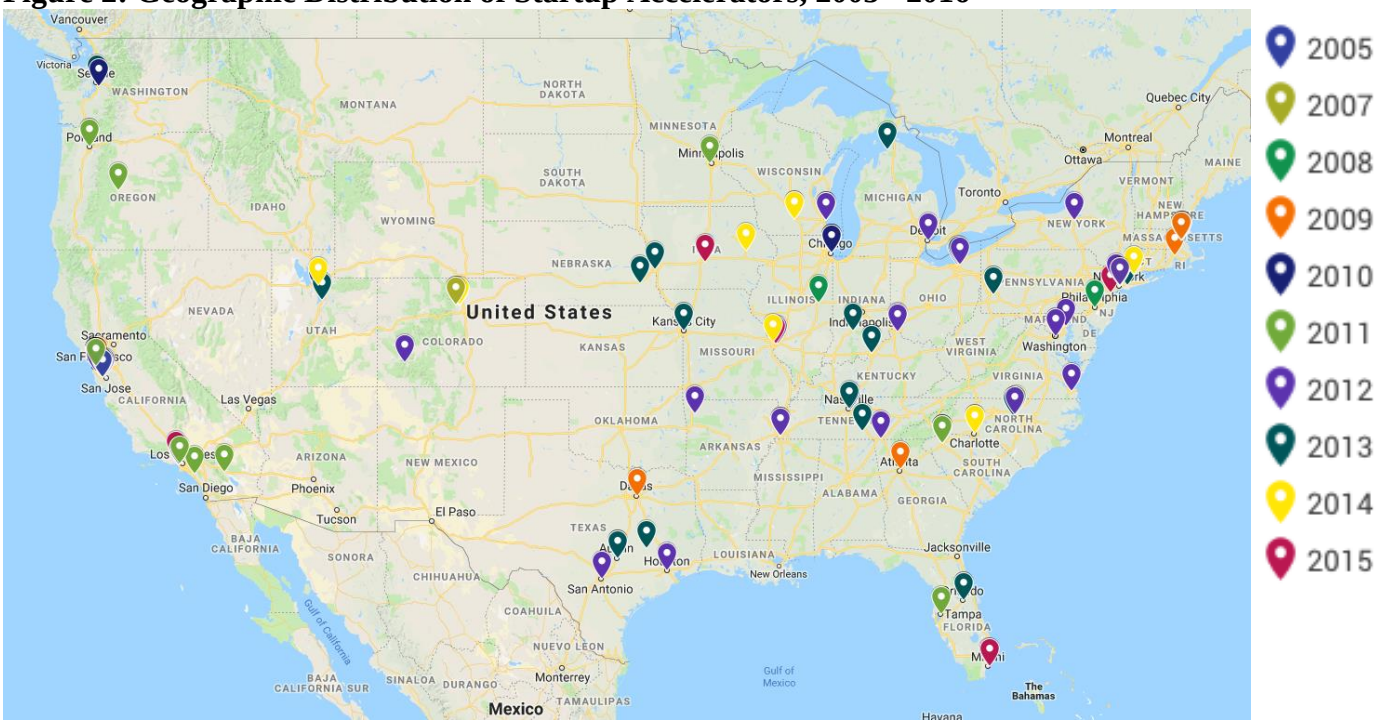

Figure 3: Cumulative and Year Counts of Accelerated Companies