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EXPLORING THE ROLE(S) OF RESEARCHER-BASED PROJECTS IN SWEDISH UNIVERSITY INCUBATORS

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INTRODUCTION

University incubators are an important part of how universities interact with society (Perkmann et al., 2013; Perkmann et al., 2019). In recent years, they have expanded their role. Beyond supporting academic entrepreneurship, they host and work with a variety of projects initiated by university employees other than researchers (Lindholm-Dahlstrand & Politis, 2013), students (Culkin, 2013), and even individuals without prior ties to the university. The effects of this diversity in terms of founder types have not yet been investigated in an incubator setting. In this paper, we investigate how founder, project and incubator characteristics relate to the likelihood of different types of projects to become knowledge-intensive entrepreneurial firms that have the potential to bring transforming innovations into the market (Malerba & McKelvey, 2018). Specifically, using a Swedish national dataset covering 37 incubators and a total of 3,383 projects over a ten-year period and applying competing risk models, we analyze the probability of different types of projects to either complete incubation or fail, i.e. exit from the incubator without having "graduated" into a viable firm.

Little research exists on the composition of founder backgrounds in university incubators. Prior studies have compared matched samples of incubated and non-incubated firms (Lasrado et al., 2015), or assessed the performance of university incubators relative to that of private ones (Ratinho et al., 2010; Rosenwein, 2000). The roles of university ties (Lasrado et al., 2015; Rothaermel & Thursby, 2005) and networking within single incubators (McAdam & Marlow, 2008) have also been explored. Our paper adds to the literature by providing further insight into how university incubators function, and by analyzing the development of projects with diverse founder backgrounds across a large number of university incubators. We are particularly interested in differences between researchers versus other types of project founders and their projects' respective likelihood of successfully completing incubation. We further analyze the role of incubator characteristics such as the breadth of admitted projects and incubator experience. We find that projects initiated by researchers have a lower hazard to complete incubation than other founders, but that they seem to create spillover effects on all other projects. Focusing on smaller numbers of project types in terms of founder backgrounds appears to be beneficial.

THEORETICAL CONSIDERATIONS

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Firms that universities produce through commercialization are included in the notion of knowledge-intensive innovative entrepreneurial (KIE) firms developed in Malerba and McKelvey (2020), which refers to newly created, independent and knowledge-intensive firms that exploit innovative opportunities. This definition of KIE firms is more inclusive than other concepts such new technology based firms (NTBFs), which limit their focus to high-tech industries such as biotechnology (Ferguson & Olofsson, 2004; Klofsten, 1994; Lindholm-Dahlstrand, 1997; Little, 1977; Rickne, 2000). KIE firms operate in diverse industries but are primarily differentiated from non-KIE firms by the knowledge and innovation component (Malerba & McKelvey, 2019). The original and inclusive conceptualization of KIE firms covers all potential firms in our data.

University incubators are physical places for innovation projects to evolve into functioning firms able to compete in the market. They may help transform scientific knowledge into innovation projects and then KIE firms. University incubators constitute a specific category of incubator facility, which has been suggested as suitable to foster product and technical innovations (Barbero et al., 2012), yet comparatively slow in bringing projects to the market (Rosenwein, 2000). Prior research on incubators highlights the importance of skilled business developers, financial resources and support structures (M'Chirgui et al., 2016) as well as internal and external networking (McAdam & Marlow, 2008). Extant results on the role of faculty as entrepreneurs as well as characteristics of university incubators per se are mixed. Rotharmel and Thursby (2005) find that strong university linkages reduce the probability of firm failure and also delay the completion of incubation. However, longer incubation periods appear to be associated with higher subsequent revenues (Lindholm-Dahlstrand & Politis, 2013; Rothaermel & Thursby, 2005). Involving researcher-inventors during the development process increases the probability that the invention becomes commercially successful (Thursby et al., 2001; Thursby & Thursby, 2002, 2004); researcher involvement can also speed up the commercialization process (Markman et al., 2005). Lasrado et al. (2015) find that firms incubated in university incubators perform better than matched non-incubated firms. Our approach in this paper differs from prior work in that we compare outcomes across projects hosted by 37 Swedish university incubators. These incubators are associated with different universities, may be owned by consortiums of private and public actors, and receive funding from various government and non-governmental actors.

Founder Types of KIE Firms Within Incubators

Founder types differ, such that projects within university incubators can be differentiated by founders' backgrounds, which we argue leads to variations in prior knowledge as well as in incentives and risks for starting KIE firms. We expect that how much projects benefit from co-location, and how much variation in founder types affects incubation processes for other projects, will vary by these types. In addition, co-location of projects at an incubator enables face-to-face interaction, learning, and networking for all founders. We further expect that the likelihood of interaction among projects depends on how (dis-) similar they are in terms of their background and technological focus (Bode et al., 2019; Nooteboom et al., 2007). These considerations suggest that both founders' own backgrounds and the composition of all projects at the incubator can condition the success of the incubation process. In the empirical context of our study, projects can be grouped into five different types of founder backgrounds.

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Researchers. Following a long line of research on different incentives and logics (Dasgupta & David, 1994), Siegel et al (2003) outline differences between businesspersons and researchers. Rather than maximizing profits, many researchers engaging in commercialization primarily seek non-market based rewards such as acknowledgement of their research in the wider academic community (Fini et al., 2008). Based on a large-scale survey of US TTO directors and licensing officers, Jensen and Thursby (2001) conclude that researchers' ideas tend to be embryonic and require ongoing inventor cooperation for successful commercialization. Concerns about academic reputation and competing demands on their time may limit the cooperation of researchers, which may hinder or delay commercialization.

Students. Prior research finds that students are more likely than researchers to engage in entrepreneurship. In relation to their respective peer groups, firms started by recent graduates appear to be of comparable quality to those of researchers (Åstebro et al., 2012). Students may be admitted to university incubators to commercialize their own ideas, but they may also work in incubation projects based on researchers' intellectual property (Culkin, 2013).

(Other) university employees. Not all employees of universities are researchers, and for instance technical staff members may develop ideas on the job that lend themselves to commercialization. In the Swedish governance system for university inventions, inventor ownership usually extends beyond researchers (SOU, 2005), and projects of non-researchers employed at universities are admitted to university incubators.

Corporate spin-offs. This category includes projects with either formal and informal links to companies, i.e. not only spin-offs but also employee spin-outs (Klepper & Sleeper, 2005). Spin-off and spin-out activities have found substantial scholarly attention, and at least in some contexts they have been found to outperform other startups, including those started by university researchers (e.g. Buenstorf, 2007), even though their competitive advantage may diminish with time (Ortín-Ángel & Vendrell-Herrero, 2014). From an incubation perspective, we expect that projects benefit from their formal or informal links to companies. They may also be more profit-oriented and closer to commercialization than those initiated by researchers.

Independent inventors. According to Sandström (2014), independent inventors account for a substantial share of Sweden's most important innovations. While they have not found much attention in previous work on university incubators, Swedish university incubators are open to host their projects and provide services to them.

Diversity in project population. Founders and founder teams require a broad set of skills to succeed (Cantner et al., 2013; Lazear, 2004). Individual founder backgrounds rarely provide the opportunity to acquire all required skills. Learning from other projects whose founders possess complementary types of experience should therefore be beneficial for turning projects into KIE firms, and richer learning environments are expected in incubators with more diverse projects.

The above considerations inform the following two hypotheses:

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Hypothesis 1: Researcher-based projects have the lowest hazard of completing incubation and the highest hazard of being cancelled as compared to projects by other types of founders.

Hypothesis 2: Diversity in terms of the number of different founder types accepted to an incubator has a positive effect on the hazard of completing incubation.

DATA AND METHODS

Since 2005, a national incubator program has provided government funding to university incubators in Sweden. In the process, unusually rich data have been collected by Sweden's innovation agency, Vinnova, which we utilize in this study. Our dataset encompasses information about the number of non-admitted projects per university incubator. Out of about 40,000 initial ideas, 3,383 were admitted as projects to the 37 studied incubators from 2005 to 2014. The data also include information about whether projects completed the incubation process and became a firm when leaving the incubator. A total of 1,563 projects left after completing incubation while 776 projects were cancelled during the process, leaving 1,044 right-censored project that were still undergoing incubation at the end of the observation period in December 2014. While we can infer from the data how selective incubators were in various years, i.e. what share of applying projects actually was admitted, the available information is insufficient to account for non-random selection into incubation. We therefore focus on within-group variation among projects regarding founder type and time of exit from the incubator, controlling for the selectivity of the incubator when the respective project entered.

We employ a number of explanatory variables and controls. Five indicator variables denote the types of founders discussed above: *researchers, students*, *university staff & related,* c*orporate spin-offs* and *independent inventors*. *Breadth of admitted projects* measures, on the incubator-level, the number of different types of founder backgrounds admitted to the incubator (each month). The maximum is all five types. We control for *competition at entry, applicants following month*, *public funding, age of incubator*, s*hare of researcher-based projects*, *incubation time*, *project size* and *potential revenues*, and also estimate specifications including full sets of *industry*, *region*, and *incubator* dummies.

As the Vinnova dataset includes the months in which each projects was admitted to and exited from the incubator, we use survival analysis to study incubation outcomes. Specifically, we employ a competing risks model (Fine & Gray, 1999) to account for the presence of various forms of exit in the data. Competing risks models can be applied to predict determinants of mutually exclusive events (Cleves, 2008; Gichangi & Vach, 2005); in our context, completion of incubation ("graduation") and cancellation of the project prior to completed incubation. The method of Fine and Gray (1999) censors projects that remain in the incubator. In contrast to a standard Cox regression, it does not censor projects that encounter the competing risk but rather, based on cumulative incidence functions, it calculates a proportional hazard model for the sub-distribution hazard. Reliability and validity of the competing risks model was assessed through the univariate Kaplan-Meier analysis as well as multivariate Cox regressions (unreported).

RESULTS

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In the overall dataset, the accumulated probability of completing incubation increases during the first four years, while few projects complete incubation thereafter. Project cancellation is concentrated in the first two years of incubation. Our baseline competing risk model including only founder type indicators and using completion of incubation as the exit event (cancellation as the competing event) finds that, consistent with Hypothesis 1, researcher-based projects have a significantly lower hazard of completion than all other types. Point estimates suggest a 68 per cent lower hazard of researcher-based projects as compared to student-based ones, for which the largest coefficient is estimated. Successively including the additional variables discussed above attenuates differences among project types, which however remain statistically significant and economically meaningful (22 per cent difference between researcher- and student-based project in the full model with incubator and industry dummies). Increasing breadth of admitted projects, measured by how many types of founders are admitted to the incubator, is associated with lower hazards of completing incubation. This finding is robust when additional variables are included. It suggests that, counter to Hypothesis 2, incubator specialization by type of project increases the odds of projects completing incubation.

Our results further indicate the importance of accounting for the intensity of selection into incubation. While more competition at the time of entry to the incubator is associated with lower hazards of successful incubation, the number of next-month applicants is associated with increased hazards. Interestingly, the hazard of successful incubation increases with the share of researcher-founded projects present in an incubator. In other words, while researcher-based projects tend to require longer to complete incubation (and, as suggested by models predicting exit through cancellation, may be more likely to fail), their presence appears to be beneficial for the other projects co-located in the same incubator. Comparing marginal effects of researcher-based projects across founder types suggests that projects initiated by all other types of founders benefit more than projects whose founders have a research background themselves.

DISCUSSION AND CONCLUSION

In this study, we studied how different founder types, as well as the composition of co-incubated projects, relate to the chances for a project to complete an incubation process at a Swedish university incubator, such that the project is turned into a firm. We adopted the concept of knowledge-intensive innovative entrepreneurship (KIE) as our theoretical point of departure and used a large-scale national dataset provided by Vinnova, the Swedish innovation agency.

Corroborating Hypothesis 1, our first main result is that projects founded by researchers have a lower hazard of completing incubation and becoming firms than projects with other types of founders. The lackluster performance of researcher projects resonates both with prior evidence and with practitioners' assessments. Researchers have been found to be less driven by profit motives than other founders. They have less incentive to complete incubation and if they do "graduate", this tends to happen relatively late (Siegel et al., 2003). In the view of Swedish incubator managers, researchers are stuck on technical verification, they lack the ambition to become entrepreneurs and devote limited time to their projects (Brunnström, 2020).

The relatively poor performance of researchers' projects might be taken as evidence that the Swedish regulatory environment leads to the wasteful support of marginal projects in subsidized university incubators. However, such a negative assessment of researcher-founders does not seem to do justice to their relevance. Researcher-founders not only transfer knowledge from universities to society. Our results also suggest they have an important role within the

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university incubators. Although researchers' own projects progressed slower and were less likely to complete incubation, their presence is associated with higher speed of other projects. Our results thus suggest that positive spillovers on other projects make researchers vital to the incubator. We suggest additional benefits from the national context of professors' privilege law in Sweden, which has been found to be more conducive towards entrepreneurship than licensing (Farnstrand-Damsgaard & Thursby, 2013). We propose that if the professors' privilege encourages more researchers to engage in entrepreneurship, then stronger positive spillovers may accrue to other project founders.

Hypothesis 2 predicted that the breadth of admitted projects (i.e. having a larger number of different types of project founders) in an incubator contributes to the success of the incubation process. Our results indicate that breadth of founder types is relevant. However, counter to Hypothesis 2, entering into incubation at an incubator with *less* breadth (or more focus) seems to be advantageous for project completion. As our analysis covers a time-span of about ten years, the benefits of incubator focus on a few project types rather than breadth do not appear to be limited to the short term, as predicted by Levinthal and March (1993) Peer effects among projects with similar backgrounds may provide an explanation to our finding. If project founders at an incubator have similar backgrounds, they may be in a better position to learn from one another. Overall, then, our results suggest that university incubators should limit the degree of variety among the non-researcher-based projects they admit.

Finally, in line with previous research on entrepreneurs' links to universities (Rothaermel & Thursby, 2005), our findings suggest that projects founded by researchers have a lower hazard of completing incubation than other types of founders. However, researcher projects also seem to create spillovers that positively affect other projects in the incubator. Other founders' chances of developing their ideas into KIE firms increase with the share of researcher projects present in the incubator at the same time. We also found that the probability of projects successfully completing incubation and become KIE firms increases if the university incubator is more specialized (has less breadth), as measured by admitting fewer types of project founders.

Why do university incubators continue to work with researcher projects even though they generally perform less well than other startups? One explanation is that they gamble for a "home run", i.e. hope to breed a high value university spin-off. After all, positive examples of successful university spin-offs are easy to find. Our results suggest another, and possibly less risky, reason why incubators may benefit from admitting researcher project: positive spillovers emanating from researcher projects to other type of project founders. The exact nature of these spillovers is an interesting question to explore in future research.

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