LOCAL PRIOR EMPLOYMENT AND ECOSYSTEM DYNAMICS

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This article utilizes a unique database (PLACE, the PLatform for Advancing Community Economies) to explore relationships between founders' prior work experiences and the outcomes of their entrepreneurial firms. The authors capture and compare multiple, intersecting, often overlapping, prior work experiences and assess their differential interactions within a local ecosystem. They augment existing empirical research, which has looked most closely at the impact of prior employment on firm financing and survival, to include labor market effects. Results show important differences in firm-level employment outcomes across prior work experiences, with an advantage accruing to founders with prior work experience in local life science firms.

Within any regional economy, a variety of pre-founding employment experiences nurture entrepreneurial ambitions and influence the performance of entrepreneurial firms. Some firms are started by individuals after they have worked for a prominent, well-established corporation within a region—a well-studied phenomena described as "spawning" (Klepper 2002). Other firms are started by academic employees to commercialize scientific discoveries; these academic employees often receive support in creating and managing new entrepreneurial ventures from technology transfer offices and business school programs. Still other entrepreneurial founders

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Authors are listed alphabetically. We received support from the UNC Office of Economic and Business Development and the Odum Institute for Social Science Research, as well as the National Science Foundation and the Ewing Marion Kauffman Foundation. We acknowledge the creative contribution and forensic skills of our UNC undergraduate and graduate research team, especially Keagan Sacripanti. Data include confidential sources and therefore we are not currently in a position to make these data available. For information regarding the computer programs used for this study, please address correspondence to Paige Clayton at clayton3@live.unc.edu.

Keywords: economic development, employment, regional economics, entrepreneurship, apprenticeship

ILR Review, XX(X), Month 201X, pp. 1–18
DOI: 10.1177/0019793919836756. © The Author(s) 2019
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first gain experience as employees of local start-up firms, thus becoming part of a second or subsequent generation of entrepreneurial firms.

Founders learn strategies for creating and managing new firms from their prior employment experiences. In this respect, prior employment functions as a de facto form of entrepreneurial apprenticeship, immersing the employee in the specific organizational setting and providing them with the skills, experience, and support networks that renowned urbanist Jane Jacobs (1969: 66) suggested would help inspire and influence the formation of "breakaway firms."

Scholars have long recognized the effects of prior employment on eventual entrepreneurial performance, especially with respect to firm survival or the ability of a newly created venture to attract and sustain high volumes of investment financing. Much less is known about the influence of prior employment on subsequent entrepreneurial choices regarding firm size and growth trajectory—that is to say, whether an entrepreneurial founder seeks to support a large, fast-growing operation or rather seeks to maintain a slow but steady pace of organizational growth and to keep their entrepreneurial venture small and nimble.

Tracing distinct founders' prior work experiences to patterns of organizational growth helps us to better situate entrepreneurial aspirations and decision-making. By differentiating the labor market effects of a concurrent set of entrepreneurial pathways, we can inform regional economic development strategy and give practitioners, who hope to leverage entrepreneurship for regional job creation, better insights for targeting public funding and policy support.

This article takes up the issue of differential employment impacts by looking at a range of pre-entrepreneurial employment experiences within one economic region. Our study includes the 13-county Research Triangle region of North Carolina, for which we draw on a unique data set (the PLatform for Advancing Community Economies [PLACE]) that captures the entrepreneurial development of the life sciences industry, including founder career histories (see Feldman and Lowe 2015 for details on construction of this database). We are able to identify the mix of prior employment experiences that founders bring to their new firms. Our approach extends prior literature by capturing and comparing forms of pre-entrepreneurial employment within a single regional economy. In this sense, we help to align insights from organizational theory and economic geography, recognizing that regions comprise a diverse mix of entrepreneurial experiences, each adding unique, and potentially complementary, economic strengths. Our approach contrasts with cross-sectional studies that make comparisons between places within one industry: Kenney and von Burg (1999) cautioned that great heterogeneity exists, even within a single industry, across regions. Conclusions from interregional studies often gloss over regional differences in industry composition and specialization,

including stages of development in an industry life cycle and structural or institutional differences that might cause inflection points or reverse trends.

Entrepreneurial Origins in a Regional Context

Innovative new ventures rarely start from scratch; more often they come from existing organizations, with founders likely to stay near home when starting their firms. This factor suggests the need to look at the types of organizations that are prevalent in a region, and how their dynamics can influence and shape entrepreneurial opportunity and vibrancy. Organizations imprint individuals with organizational logics, knowledge, and expectations that shape the ways in which new firms are organized and affect the profitability and success of new ventures (Feldman, Ozcan, and Reichstein, forthcoming). The strength of this imprinting is related to the duration of employment at various pre-entrepreneurial experiences, with any single individual having a variety of experiences and any founding team blending a mix of backgrounds. Organizational imprinting also affects how firms interact with, and influence, their external environments, which appears to have strong localized effects (Marquis 2003).

Consistent with the idea of organizational logics and internal cluster dynamics, Jacobs (1969) suggested the growth of innovative clusters is driven by breakaway firms that are started by entrepreneurs with experience in the same industry. This term "breakaway firms" was inspired by the practices of British medieval guilds in which "an apprentice learned the work in an existing organization, then became a journeyman employed in the same organization or others similar, and then, if all went well, he set up a shop on his own as a master and took on apprentices" (Jacobs 1969: 66). The breakaway process is tied to innovation as entrepreneurs experiment with variations learned from prior work and find new ways of creating value. Jacobs's conceptualization has a decidedly local orientation that grounds the entrepreneur in a community of practice and social relationships. She also recognized this relationship is not limited to two individuals—master and novice—but instead offers a space for connecting with others, including coworkers. In more formal terms, employees from existing organizations benefit from intellectual and social capital, including knowledge of certain technologies, as well as access to professional and peer networks. These benefits support founders who start companies in these same locations, in the same or related industries. Similar to the traditional apprenticeship model, this form of de facto apprenticeship provides fundamental skills and knowledge and endows nascent entrepreneurs with ideas and an understanding of markets and new technologies.

This breakaway process is certainly part of the lore of well-known entrepreneurial regions. In Silicon Valley, for example, semiconductor firms form a family tree in a cascading series of spin-offs from Fairchild Semiconductor (Kenney and von Burg 1999). The story is similar in

automotive manufacturing. Klepper (2002) found that firms performed better when started by entrepreneurs with experience in either older related industries—such as carriages and wagons, bicycles, or engines—or in incumbent firms in the auto industry. A particularly prominent incumbent was the Olds Motor Works, whose breakaway firms included Dodge, Cadillac, and Ford—all of which were located in Detroit, thus staying in the same region. In this way, Olds played much the same role as Fairchild in Silicon Valley: a training ground for subsequent entrepreneurs that formed the core of the new industry in the region. These examples raise the question of whether a single successful firm spurs the development of an industry in a region or if a general pattern of imprinting from multiple organizations occurs.

Scholarship concentrates on two dominant apprenticeship types, associated with either large corporations or prominent academic institutions. These two pre-entrepreneurship work experiences are typically studied in isolation. Entrepreneurial firms that are founded by individuals coming from a corporate setting are described as entrepreneurial "spawns" (Chatterji 2009: 185) or "spin-outs" (Agarwal, Echambadi, Franco, and Sarkar 2004: 501). One conjecture is that the type of entrepreneurial opportunity spawns identify will be closely related to the activity of their former employers, pursuing ideas their former employers did not want to pursue for fear of cannibalizing existing products or because the market was estimated to be too small (Baker, Miner, and Easley 2003).

A second strain in the literature recognizes academic entrepreneurship. Here, firm founders are individuals from an academic environment. Academic entrepreneurs—including faculty members, affiliated researchers, postdoctoral fellows, and students—have access to new ideas that may form the basis for a new company. University spin-off companies are embedded within networks of social, professional, and exchange relationships with other academic actors, who provide resources that are important to venture success (Siegel, Veugelers, and Wright 2007).

A third route to entrepreneurship involves prior work experience at an existing entrepreneurial firm, a phenomenon we call "second-generation entrepreneurship." As regions expand their entrepreneurial footprint, opportunities for securing work within an existing entrepreneurial organization also expand (Feldman 2001). Åstebro and Thompson (2011) posited that entrepreneurial firms attract a unique kind of worker with stronger entrepreneurial ambitions, suggesting self-sorting by these individuals as they select work environments they seek to eventually emulate. Other studies found that smaller entrepreneurial firms relax organizational hierarchies and require more frequent job rotation, thus allowing future entrepreneurs to develop a broad range of skills (Elfenbein, Hamilton, and Zenger 2010). In their national study of entrepreneurship, Elfenbein et al. (2010) also notably found a multigenerational effect as second-generation

entrepreneurial firms are spawned from the immediate offspring of large corporations—a result we also evaluate at the regional level.

Entrepreneurial research has tended to privilege one particular founding story or type of prior experience, which misses an opportunity to learn something more significant about the entrepreneurial region, not just the organizational type. Moreover, although empirical analysis has started to explore how founder history might affect entrepreneurial performance, studies have focused on firm financing and survival, steering away from employment impacts, which is a critical concern for regions looking to entrepreneurship as an economic development strategy.

Industry and Empirical Setting

The life sciences industry presents an ideal case for studying the relationship between work history and firm-level employment. Life science entrepreneurs are drawn from a diversity of backgrounds, allowing for a meaningful analysis of diverse career pathways. Among high-technology, science-based firms, de Jong and Marsili (2006) argued that life science offers a better choice for studying employment effects. Industries such as Information and Communications Technology (ICT) are known for large firms that acquire entrepreneurial firms that are still in their technological infancy, making it difficult to assess the link between an entrepreneur's work history and their firm's eventual employment levels; life science firms, by contrast, do not operate under this model.

Life science is also a practical choice from a policy perspective. For decades, local policymakers have assumed that life sciences—as a high-tech, product-producing industry—would lead to local employment growth. As a result, many regions have pinned their economic futures on the industry. These regions have invested in the recruitment of life science branch plants, the development of first- and second-generation entrepreneurial companies, and partnerships with university technology transfer offices to help firms spin off from academic laboratories (Lowe and Feldman 2018). We examine firm employment patterns to better understand their link to these investments. Previous research has focused primarily on innovation outcomes and related financing.

The life sciences cluster in North Carolina's Research Triangle region is one of the largest in the country. Yet, unlike Cambridge, Massachusetts, and the San Francisco Bay area—the country's leading life sciences regions—the Research Triangle region was not an obvious candidate to develop a life sciences industry. Three research universities, Duke University, North Carolina State University, and the University of North Carolina, define the points of the Research Triangle. These three universities lagged in spinning off life science companies, compared to their peers (Donegan 2016). The Research Triangle Park was established in 1958 and, as late as the

mid-1990s, the region was largely recognized as a hub for the satellite R&D operations of large multinational corporations.

Over time, the region has slowly nurtured an entrepreneurial environment through a combination of diverse work experiences, anchored in the region's research universities, the branch plants of global companies (in pharmaceutical and related industries), and a growing number of homegrown entrepreneurial start-ups. As a result, the region lacks a single, dominant pathway from the region's larger labor market to entrepreneurship. This setting makes the region ideal for studying complexities in the relationship between a founding team's prior work experience and the lasting firm-level employment outcomes—which is the ultimate goal of our article. Additionally, by focusing on a region that was not an obvious candidate for the development of a life sciences industry, our findings offer insight and greater applicability to less prominent regions seeking to develop industry concentrations. Moreover, by focusing on one region over time, we remove heterogeneous factors that vary between regions and may affect firm development.

Data and Methods

Our focus on life sciences allows us to use a subset of entrepreneurial firms from the PLatform for Advancing Community Economies (PLACE): Research Triangle Park (RTP) database, a comprehensive collection of data on the Research Triangle region's entrepreneurial firms (Feldman and Lowe 2015). Using PLACE: RTP, we identified the universe of 942 entrepreneurial life science firms founded in the 13-county Research Triangle region between 1967, the year of the earliest entrepreneurial firm entry in this industry in the region, and December 2016. From this group, we excluded 7 firms founded before 1980 and 142 firms founded after 2012, the last year for which we have firm-level employment data from the National Establishment Time Series (NETS) database (Walls & Associates 2013).[1] Limiting our sample to only those firms with NETS data available brought the sample to 488 firms. Finally, we also excluded 28 firms for which we lack work history information on all founding team members. This process left our sample with a total of 460 entrepreneurial life science firms founded between 1980 and 2012, linked to 872 founders with known work experience.[2]

[1]We drew our sample from the PLACE: RTP database in November of 2017, when the underlying data on firm survival and employment reflected the NETS 2013 data. NETS 2013 includes employment data from 1990 to 2012. This may result in an undercount of 2009–2012 firms (Kolko and Neumark 2007). Following Neumark, Wall, and Zhang (2011), we do not believe the undercount is enough to bias study findings.

[2]A founder is counted at the firm level, such that if a single individual founded two firms they are included twice.

The PLACE: RTP database includes detailed information about each founder's work history prior to the date of founding the new firm, including the prior firm names, locations, and start and end dates for each prior employment episode. Entrepreneurial imprinting is directly correlated with time spent in prior employment (Feldman et al., forthcoming). We carefully constructed categories of founder work experience that reflect the region's varied entrepreneurial pathways and identified four core categories of local work experience: 1) work at one of the region's three large research universities (Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill); 2) work at one of the region's prominent pharmaceutical corporations (GlaxoSmithKline,[3] Pfizer, Dupont, Eli Lilly, and Ciba-Geigy); 3) work at a local branch of one of 19 non-pharmaceutical multinational corporations (IBM, GE, Monsanto, Abbott, Hospira, Biogen, Grifols, Merck, Sony, Ericsson, Sony Ericsson, EMC, Data General, Nortel, Teleflex, Becton Dickinson, Bayer, Aventis, and BASF); and 4) work at one of the region's previously established entrepreneurial life science firms. These four groups of local work experience are used to build four independent variables of interest, representing the intensity (years) of each founding team member's cumulative local work experience. It is not uncommon for a single founder to have local work experience in multiple categories. For example, an individual founder may have worked for a large pharmaceutical company for seven years and then worked for a life science start-up for three years before starting his or her own firm. For each individual founder, we summed the total years of work in each category of prior local work experience to arrive at that individual founder's total years of local work experience in each category.

Next, we summed the years of founder-level work experience across all of a firm's founders, giving us firm-level measures of each founding team's cumulative work experience (CWE) in each category: *local academic CWE* is the cumulative number of years that firm-founding team members worked at the region's three research universities; *local pharma CWE* is the cumulative number of years that firm-founding team members worked at the region's big pharmaceutical companies; *MNC local branch CWE* is the cumulative number of years that firm-founding team members worked at local branch locations of one of the region's 19 other prominent multinational corporations; *local entrepreneurial CWE* is the cumulative number of years that firm-founding team members worked at entrepreneurial life science firms in the region.

Table 1 provides the distribution of founder work experience across the four categories: total firms with experience in that category and the average number of founders and years of experience per founding team for those firms. We found 206 firms linked to founders with academic work

[3]GlaxoSmithKline also includes work histories at the antecedent firms Burroughs Wellcome, Glaxo, and Glaxo Wellcome.

Table 1. Distribution of Founder Local Work Experience Type

Firms, with any founder work experience in category	*Total number of firms, with experience type*	*Average number of founders per firm*	*Average cumulative work experience per firm, in years*
Local academic	206	2.30	51.98
Local pharma	152	2.10	50.11
MNC local branch	76	2.28	54.34
Local entrepreneurial	198	2.14	51.40

Note: MNC, multinational corporation.

experience. Firms with academic work experience averaged 2.3 founders, with a cumulative average of 52 total years of experience. A total of 152 firms are linked to founders with work experience in the most prominent pharmaceutical corporations in the region, 76 firms are linked to founders with experience at one or more of the 19 multinational firms in the region, and 198 firms are linked to founders with experience in other entrepreneurial life science firms in the region. Firms are linked to multiple categories if their founders have work experience in more than one category. Of 460 total firms, 299 (65%) have founding teams where all founders have some work experience in at least one of the four local work experience categories.

We focus on firm-level employment. Employment data are from the NETS database. We sum employment in the case of multiple establishments of the same firm. We evaluate *maximum employment*, which we define as the largest observed yearly employment count. We also include employment in a series of snapshots: the firm's *first, third, sixth*, and *ninth* year from date of establishment, following Neumark, Wall, and Zhang (2011), who suggested that three-year intervals reduce much of the employment stickiness found in the NETS data.

Table 2 shows that employment levels (maximum employment, employment in year 1, and growth rates to years 3, 6, and 9) vary across groups of firms associated with the four categories of work experience. Firms linked to founders with prior experience at regional multinational corporations have the lowest average maximum employment (9.7 workers), and also experience the lowest average growth rates across all years (18% from year 1 to year 3, 92% from year 1 to year 6, and 115% from year 1 to year 9). Firms having at least one founder with regional big pharma experience reach the highest average maximum employment (16.01 workers) and have the highest average growth rates in their firm's early years (37% to year 3 and 169% to year 6). Firms linked to founders with prior experience at one of the three prominent research universities in the region have the highest average employment growth rate to year 9, at 237%.

We use a negative binomial model to estimate the relationship between employment outcomes and the independent variables of local CWE. The dependent variable, firm-level employment, is measured as a count of firm

Table 2. Initial and Maximum Employment Levels, and Employment Growth, by Associated Local Work Experience Type

Firms, by founder work experience	*Total number of firms*	*Average age of firms at closure*	*Average maximum employment per firm*	*Average year 1 employment per firm*	*Average growth from year 1 (%)*		
					Year 3	*Year 6*	*Year 9*
Local academic	206	7.84	13.01	4.70	25	122	237
Local pharma	152	6.67	16.01	4.75	37	169	227
MNC local branch	76	6.33	9.70	5.09	18	92	115
Local entrepreneurial	198	7.36	13.84	4.58	39	144	228

Note: MNC, multinational corporation.

employees. The mean maximum employment per firm is 16.52 with a standard deviation of 39.15. The distribution is highly skewed toward one employee and over-dispersed above 50 employees, with a maximum employment of 466. To assess the relationship between our local CWE variables and the firm's employment outcomes, we rely on five cross-sectional estimations of employment counts. The first set uses the maximum employment recorded at the firm as the dependent variable. The remaining four models use firm-level employment, measured at 1, 3, 6, and 9 years from firm birth, as dependent variables.

In our estimation, we control for the *number of founders* for each firm. The number of founders reflects potential interactions between the founders' networks, increasing the likelihood of employment growth. We also control for technology focus. The Research Triangle region's life sciences industry is diversified but has concentrations in human therapeutics and in contract research. We include dummy variables for *human therapeutics (HT)* and for *contract research organization (CRO)*. Firm development milestones are accomplished over time, suggesting that the total number of years a firm has been in existence may positively influence certain outcomes. We include a variable for age (*age*), as well as a squared form of age (age^2) to reflect the expectation that achieving milestones may slow over time. We do not include age and a squared form of age in our yearly employment models, as age would be redundant. In yearly employment models (with employment in years 1, 3, 6, and 9), we include a separate variable—*establishment date*—to control for cohort effects. To control for the work experience of founders that is not subsumed under our four categories of interest (local pharma, local academic, local entrepreneurial, or MNC local branch CWE), we include the control variable, *other CWE*. This is a firm-level control that captures the cumulative number of years of other work experience for the founding team. These data are all from the PLACE: RTP database.

We include two control variables to reflect funding raised by firms: *public funding* and *private funding*, which are also drawn from the PLACE: RTP database. Public funding includes money received from federal and state

Table 3. Variable Summary Statistics for Variables Used in Regression Models

Variable	*Mean*	*SD*	*Min*	*Max*	*N*
Local academic CWE	7.03	12.57	0	114	460
Local pharma CWE	4.53	9.72	0	90	460
Local entrepreneurial CWE	3.85	7.36	0	71	460
MNC local branch CWE	1.39	4.54	0	41	460
Other CWE	25.58	22.46	0	141	460
Age	8.64	4.94	0	26	460
Number of founders	1.90	1.04	1	6	460
Human therapeutics	0.33	0.47	0	1	460
CRO	0.20	0.40	0	1	460
Total public funding ($1,000s)	528.89	1,912.47	0	21,543	460
Total private funding ($1,000s)	8,909.88	34,504.66	0	252,055	460
Firms with observed closures	0.18	0.39	0	1	460
Employment maximum	16.52	39.15	1	466	460
Employment in year 1	5.40	7.61	1	66	457
Employment in year 3	6.91	9.64	1	86	383
Employment in year 6	13.18	26.18	1	253	283
Employment in year 9	21.49	44.45	1	466	178

Notes: CRO, contract research organization; CWE, cumulative work experience; MNC, multinational corporation, SD, standard deviation.

sources. Federal funding includes sources such as Small Business Innovation Research (SBIR) or National Institutes of Health (NIH) research awards. State funding includes sources such as awards from the North Carolina Biotechnology Center and the North Carolina SBIR matching fund. Private funding includes venture capital as well as crowd funding and angel investor funding, which has been collected from, and verified across, multiple sources. These variables are excluded from the yearly employment models to avoid counting funding received after the year in which employment is counted.

Tables 3 and 4 report summary statistics and correlations between variables. The correlations between the variables range from –0.19 to 0.60. Multicollinearity does not appear to be a problem.

For each employment dependent variable, we rely on two sets of models. In the first set of models ("model 1" for each employment model), we use the 299 firms for which all founders draw experience from one of the region's four core work experience categories (that is, all firm founders have gained some, or all, of their work experience in the region's dominant pathways to entrepreneurship). In the second set of models ("model 2" for each employment model), we present results that include all 460 firms. The difference between these sets is the 161 firms that have at least one founder with no work experience in one of the four core work experience categories. These founders could have no work experience at all (e.g., their first job after graduation was founding a company), only work experience outside of the region, or work experience in the region that was not included in one of the four local work experience categories. We consider the

Table 4. Variable Correlation Matrix for Variables Used in Regression Models

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
(1) Local academic CWE	1.00																
(2) Local pharma CWE	–0.11	1.00															
(3) Local entrepreneurial CWE	0.03	–0.05	1.00														
(4) MNC local branch CWE	0.10	–0.01	0.12	1.00													
(5) Other CWE	0.11	0.18	0.38	0.33	1.00												
(6) Age	–0.04	0.06	–0.14	–0.06	–0.16	1.00											
(7) Number of founders	0.40	0.22	0.11	0.22	0.60	–0.13	1.00										
(8) Human therapeutics	0.20	0.28	–0.14	0.05	0.10	0.15	0.16	1.00									
(9) CRO	–0.17	–0.08	0.02	–0.04	–0.17	0.21	–0.19	–0.11	1.00								
(10) Total public funding ($1,000s)	0.24	–0.02	–0.06	0.18	0.09	–0.09	0.16	0.12	–0.09	1.00							
(11) Total private funding ($1,000s)	0.03	0.18	–0.02	0.03	0.17	0.13	0.23	0.32	–0.07	–0.03	1.00						
(12) Firms with observed closures	–0.01	–0.09	0.00	0.02	0.01	0.02	–0.09	–0.12	–0.16	–0.08	–0.10	1.00					
(13) Employment maximum	–0.07	0.05	–0.12	–0.08	0.04	0.18	0.12	0.19	–0.02	–0.09	0.23	–0.13	1.00				
(14) Employment in year 1	–0.02	–0.01	–0.05	–0.03	–0.08	0.10	0.06	0.07	0.06	–0.06	0.08	–0.14	0.41	1.00			
(15) Employment in year 3	0.00	–0.02	–0.06	–0.05	–0.10	0.15	0.03	0.12	0.07	–0.06	0.08	–0.14	0.53	0.92	1.00		
(16) Employment in year 6	–0.06	0.10	–0.10	–0.08	0.00	0.11	0.14	0.21	–0.05	–0.05	0.15	–0.11	0.75	0.52	0.57	1.00	
(17) Employment in year 9	–0.03	0.05	–0.08	–0.05	0.08	0.14	0.17	0.24	0.01	–0.07	0.19	–0.10	0.85	0.43	0.50	0.82	1.00

Notes: CRO, contract research organization; CWE, cumulative work experience; MNC, multinational corporation.

smaller group of firms included in the first set of models to reflect Jacobs's (1969) ideas of de facto apprenticeships, in which founders form firms when adding new work to the old work that exists within the region; the full set of firms included in the second set of models reflects all work experience. We dropped three firms from the analysis because they were missing annual employment data.

Results

Table 5 presents results for the effect of our cumulative work experience categories (or "local apprenticeship") on firms' maximum employment levels. In model 1 and model 2, *Local academic CWE* is negatively related to maximum employment, indicating that the greater the amount of time any of the founders spent at an academic job at one of the region's research universities, the more the firm's realized employment decreased. *Local pharma CWE* and *MNC local branch CWE* have no statistically significant relationship with maximum employment when we restrict the models to only those firms made up of founders with local work experience (model 1), but have a negative and statistically significant relationship with maximum employment when we add in those firms with founders with geographically diverse work experiences (model 2). We tested the robustness of our results in several ways: using dummy variables for varying categories of experience, excluding outliers, and testing the proportions of founders with experiences that differ. The results remained consistent. By contrast, higher maximum employment is positively related to *local entrepreneurial CWE* in both models.

As expected, *age* is positively related and age^2 is negatively correlated with employment. The coefficient on *number of founders* is positive in both models, indicating that firms with more founders consistently have more employees than do firms with fewer founders. *Private funding* consistently has a positive relationship with employment. *Public funding* is negative when we consider founder experience outside the region (model 2). Additionally, a technology focus on *human therapeutics* is positively correlated with maximum employment.

Tables 6A and 6B present a series of employment snapshots, in years 1, 3, 6, and 9. For firms with founders with local work experience (Table 6A), work experience at local, entrepreneurial life science firms (*local entrepreneur CWE*) is positively associated with employment for all the yearly snapshots. *Local academic CWE* is negatively associated with employment across all the yearly snapshots except for year 9 employment. Founder work experience in both big pharma and other MNCs (*local pharma CWE* and *MNC local branch CWE*) has no relationship with employment, with the exception of *local pharma CWE* in year 3.

The associations between CWE and employment are generally weaker when we add in firms that include a founder without local work experience at a prominent organization or entrepreneurial firm (Table 6B). The results

Table 5. Negative Binomial Regression Analysis: Association of Local CWE with Maximum Employment Count

	Model 1	*Model 2*
	Maximum employment: Restricted to firms with local apprenticeships	*Maximum employment: All firms*
Local pharma CWE	–0.003	–0.006***
	(–0.83)	(–3.14)
Local academic CWE	–0.007*	–0.006***
	(–2.09)	(–3.36)
Local entrepreneurial CWE	0.013***	0.002
	(3.53)	(0.80)
MNC local branch CWE	–0.004	–0.005***
	(–1.24)	(–2.90)
Other CWE	–0.020***	–0.003
	(–4.46)	(–1.30)
Establishment date	–0.013**	–0.008***
	(–2.51)	(–2.80)
Age	0.055***	0.047***
	(4.62)	(7.33)
Age^2	–0.038***	–0.033***
	(–3.36)	(–5.40)
Number of founders	0.021***	0.011***
	(4.68)	(4.08)
Public funding ($1,000s)	–0.003	–0.003*
	(–0.94)	(–1.90)
Private funding ($1,000s)	0.008**	0.006***
	(2.54)	(3.28)
Human therapeutics	0.005*	0.004**
	(1.67)	(2.10)
CRO	–0.002	–0.000
	(–0.52)	(–0.21)
Log-Likelihood	–890.5	–1484.0
Wald Chi-squared	153.8	208.4
Number of observations	299	460

Notes: Standardized beta coefficients; *t* statistics in parentheses. CRO, contract research organization; CWE, cumulative work experience; MNC, multinational corporation.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

for *local entrepreneurial CWE* are no longer statistically significant. *Local pharma CWE* is negative and statistically significant not just in year 3 but also in year 1. *MNC local branch CWE* is negative and statistically significant in years 6 and 9. *Local academic CWE*, which had performed on par in year 9 in the model presented in Table 6A, is now negative and statistically significant across all years shown in Table 6B.

Control variable performance is generally consistent across both sets of firms. *Establishment date*, which we include instead of *age* and *age*^{2}, is negatively correlated with employment, indicating a cohort effect whereby firms founded in the study period's earlier years had higher employment at the yearly markers than did firms founded more recently. *Number of founders* and *human therapeutics* are positively statistically significant in both tables,

Table 6A. Negative Binomial Regression Analysis: Association of Local CWE with Annual Employment Count for Firms with Local Apprenticeship Experience

	Year 1 employment	*Year 3 employment*	*Year 6 employment*	*Year 9 employment*
Local pharma CWE	–0.018	–0.030***	–0.005	0.005
	(–1.33)	(–3.07)	(–0.96)	(0.79)
Local academic CWE	–0.040***	–0.028***	–0.013***	–0.005
	(–2.92)	(–2.77)	(–2.89)	(–1.06)
Local entrepreneurial CWE	0.031**	0.030***	0.010**	0.014***
	(2.38)	(2.78)	(2.18)	(2.75)
MNC local branch CWE	–0.008	–0.008	–0.005	–0.006
	(–0.67)	(–0.85)	(–1.09)	(–1.37)
Other CWE	–0.047***	–0.052***	–0.024***	–0.022***
	(–2.78)	(–3.63)	(–4.20)	(–3.73)
Establishment date	–0.065***	–0.042***	–0.014***	–0.012**
	(–5.10)	(–4.19)	(–3.13)	(–2.48)
Number of founders	0.078***	0.062***	0.029***	0.020***
	(4.94)	(4.79)	(5.19)	(3.38)
Human therapeutics	0.028**	0.045***	0.021***	0.010*
	(2.33)	(4.80)	(4.74)	(1.94)
CRO	0.020*	0.010	0.006	0.007*
	(1.82)	(1.14)	(1.60)	(1.75)
Log-Likelihood	–660.5	–608.0	–547.1	–447.2
Likelihood-ratio Chi-squared	70.31	67.71	65.29	37.49
Number of observations	296	243	177	126

Notes: Standardized beta coefficients; *t* statistics in parentheses. CRO, contract research organization; CWE, cumulative work experience; MNC, multinational corporation.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

suggesting that firms with more founders and firms that focus on therapeutics have higher employment in all years. *CRO* is significant in year 1 employment in both models. *Other CWE* has a negative and statistically significant coefficient for all employment years in the restricted set of firms (Table 6A), but is statistically significant only in years 6 and 9 in the full set of firms (Table 6B).

Conclusion and Policy Implications

Our models reveal two overarching trends at play. First, considerable variation exists in the relationship between a founder's prior work experience and his or her firm's subsequent employment level. The relatively positive employment level of firms linked to founders with experience at local entrepreneurial firms stands out when compared against the contributions of experience at local universities and multinational companies, including big pharma. But equally, note that when we consider the full universe of life science firms, the most consistent employment effects have little to do with the prior work experience or pedigree of the founders and much more to do with founding team size, technology choice, and firm age. Our findings here may appear to suggest that regions seeking immediate job growth

Table 6B. Negative Binomial Regression Analysis: Association of Local CWE with Annual Employment Count for All RTP Life Science Firms

	Year 1 employment	*Year 3 employment*	*Year 6 employment*	*Year 9 employment*
Local pharma CWE	–0.023**	–0.024***	–0.005	–0.004
	(–2.57)	(–3.44)	(–1.44)	(–1.40)
Local academic CWE	–0.023***	–0.022***	–0.010***	–0.007***
	(–2.78)	(–3.20)	(–3.33)	(–3.34)
Local entrepreneurial CWE	–0.008	–0.005	–0.003	0.001
	(–0.91)	(–0.72)	(–0.92)	(0.51)
MNC local branch CWE	–0.003	–0.010	–0.009***	–0.005*
	(–0.39)	(–1.47)	(–2.83)	(–1.91)
Other CWE	0.002	–0.006	–0.009**	–0.007**
	(0.15)	(–0.66)	(–2.14)	(–2.14)
Establishment date	–0.052***	–0.030***	–0.009***	–0.005*
	(–5.54)	(–3.80)	(–2.60)	(–1.94)
Number of founders	0.041***	0.034***	0.023***	0.013***
	(3.44)	(3.26)	(4.97)	(4.03)
Human therapeutics	0.016*	0.026***	0.013***	0.010***
	(1.92)	(3.66)	(4.00)	(4.10)
CRO	0.022***	0.010	0.004	0.003
	(2.73)	(1.50)	(1.28)	(1.46)
Log-Likelihood	–1132.7	–1054.6	–937.4	–672.4
Likelihood-ratio Chi-squared	65.53	49.15	62.55	46.17
Number of observations	457	383	283	178

Notes: Standardized beta coefficients; *t* statistics in parentheses. CRO, contract research organization; CWE, cumulative work experience; MNC, multinational corporation; RTP, Research Triangle Park.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

should reorient scarce public resources and policy attention to certain technology subfields or target further support to second-generation entrepreneurial firms. We caution against this narrow interpretation, however, and acknowledge the need for a more complete picture of the effects of entrepreneurship on local labor markets. To reinforce this point, we conclude by offering insights we have gleaned from related qualitative research. Our interviews with entrepreneurial founders in the Research Triangle region's life science industry shed light on the underlying reasons some entrepreneurial firms choose to start or remain small. For example, academic founders have noted that universities in the region often encourage early formation of a firm, even when the technology they are developing is less proven (Donegan 2016). Although this approach increases risk at the firm level, it does help these founders gain access to private and public funding tied to business incorporation. In this less certain organizational context, it is logical for founders to keep employment in check, which also helps control business expenses and overhead until a nascent technology has proven its commercial value and intent. Furthermore, our analysis of other economic metrics, including patenting, indicates that academic-affiliated firms display a higher relative propensity to introduce new, innovative products and processes compared to their non-academic counterparts (Clayton et al.

2019). In this regard, their contribution to the regional economy is greater than direct job creation. They add considerably to the region's innovative capacity, which in turn acts as a major draw for multi-establishment biopharmaceutical corporations that are looking to invest in communities and to create large numbers of jobs in the process (Lowe 2014). Similarly, interviews with founders of firms spawned from prominent regional pharmaceutical anchors, including pharmaceutical giant GlaxoSmithKline, indicate that these firms help bolster life science and related jobs by developing existing supply chains within the region, often relying on specialized service providers to complete essential activities that they might otherwise develop in-house. Former employees are able to participate in these local supply chains because of learning and networking that happened during their pre-entrepreneurial employment at large pharmaceutical establishments. The decision to outsource provides a model of opportunity for other regional firms that helps these services develop and to eventually find national and even international markets. This finding suggests an opportunity for further research that captures diffuse labor market effects across networks of interdependent firms, and in ways that complement studies of job creation within more confined organizational settings.

Additional research is also needed to better understand why notable employment differences disappear when we include firms whose founders lack a prominent local employment experience. Our preliminary interviews indicate that it is not uncommon for a founder to return to the Research Triangle if they previously attended a local college or had once lived in the surrounding region. Although career opportunities took them away from the region, they still maintain a strong regional affinity as well as social and professional connections. In this regard, we believe that the loss of significance within the larger model reinforces Jacobs's (1969) insights on regional entrepreneurship and its relation to prior work. Jacobs recognized that entrepreneurial opportunity and success is not solely dependent on founder or firm capacity. It can also reflect the work experience of many others within a region that in turn can extend support to regional newcomers or returnees. Our own work in mapping regional support institutions in life sciences points to a notable openness to outsiders, including targeted financing to encourage non-local founders to set up new firms and facilities within the region. This is not a closed community, but one that is inviting to founders without prior local employment, thus facilitating access to local knowledge, networks, and resources as needed. These insights speak to the value of further mixed-methods research for uncovering the varying types of knowledge and experimental learning that is transferred across one's professional and entrepreneurial career (Burton, Sørensen, and Dobrev 2016).

Our findings suggest policy implications as well and support the recommendation for regional decision-makers and practitioners to concurrently promote and serve a diverse array of entrepreneurial firms. With

entrepreneurship comes inherent risk, not just for a firm and its founders but also for the larger host region and workers within it. In fast-changing economic, technological, and even political environments, certain kinds of entrepreneurial opportunities and ventures—and thus associated jobs—can disappear or dissolve altogether. Others have raised related concerns of racial or gender bias that can undermine entrepreneurial growth for equally qualified business ventures, suggesting that entrepreneurial growth is not simply a case of good apprenticeships, but a matter of access (Bates and Robb 2016). This area is an important one for additional study. We reference it to reinforce the case for supporting a diversity of entrepreneurial investments and opportunities within a regional economy. Some entrepreneurial firms will undoubtedly generate more immediate job opportunities than others. But strategies that enable founders from diverse backgrounds to start firms can also diversify the entrepreneurial workforce and, with it, foster greater entrepreneurial inclusion.

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