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Does the Winning Region Take All? Entrepreneurial Ecosystems, Support Organizations, and Domain Knowledge

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Forthcoming

Abstract

The role of entrepreneurial ecosystems (EEs) receiving increased attention. These EEs are composed not only of startups but also organizations and individuals that support startups. Research has been ambivalent about whether an EE is spatially bounded or can include distant organizations. Further, the literature has not reached a consensus as to whether entrepreneurial versus industrial domain knowledge is of greater importance. Finally, most EE studies, when empirical, use panel data, though conceptual development recognizes that EEs are not static but, rather, are emergent and evolving.

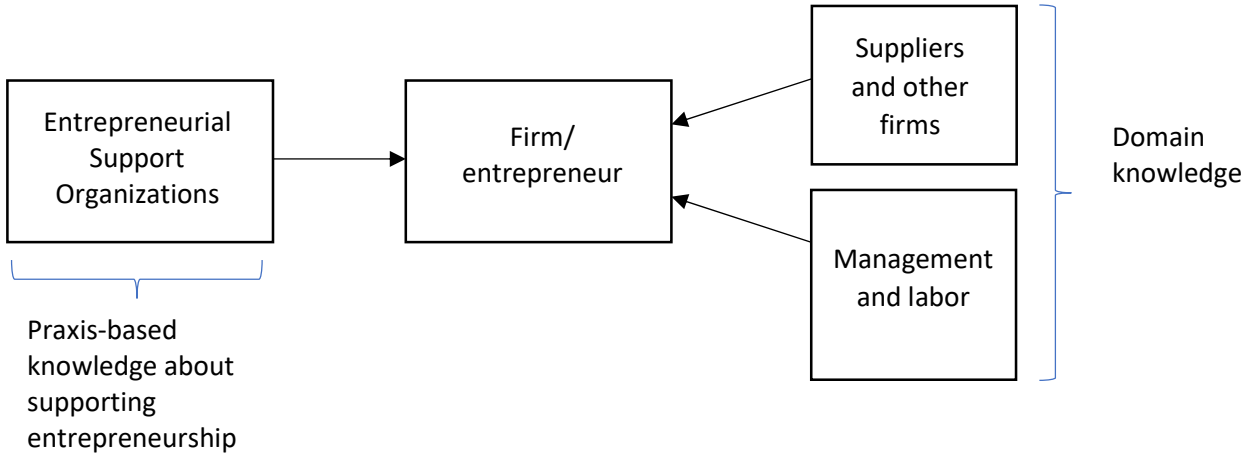
We use the history of initial public offerings (IPOs) in the internet industry to explore the location of not only the IPO firm but also the firm's lawyers, lead investment banker, venture capitalists (VCs), and other board members. This data provides insight into how the location of the EE actors evolves as an industry matures. We show that, although startups have become slightly more concentrated in the greater Silicon Valley (SV), the organizations that support entrepreneurship have tended to become more concentrated, particularly among VCs and non-VC board members. We hypothesize that, whereas entrepreneurial support skills are generic, a region that can combine these support skills with domain skills can become dominant in providing startup support not only within a region but also across regions. Thus, although knowledge about how to start an internet firm remained dispersed, a merger of entrepreneurial support and domain knowledge occurred in SV and increased the concentration of organizations that support entrepreneurship.

1. Introduction

Entrepreneurial ecosystems (EEs) are composed of startups and the organizations that provide entrepreneurial assistance to startups, which we call entrepreneurial support organizations (ESOs) (Feldman 2001; Roundy et al. 2017). These EEs not only encompass entrepreneurs but include many other organizational actors, such as venture capitalists (VCs), law firms, accountants, and others, whose function is to assist entrepreneurs (Mason and Brown 2014; Spigel 2017). ESOs provide specialized services to entrepreneurial firms and reciprocally benefit when and if the firms are successful. Moreover, as these service providers emerge, they alter the context in which entrepreneurs function (Autio et al. 2014: 1099).

Previous research argues that EEs "are agnostic relative to industry or technology domain, although there are exceptions." This perspective suggests that knowledge about entrepreneurial praxis can be separated from industrial (i.e., domain) knowledge about what needs to be done to create market value (Autio et al. 2018: 77). It implies that the skills for supporting entrepreneurship are generic and not specific to particular industrial knowledge. Further, the literature has not reached a consensus about whether an EE is locationally based or whether entrepreneurial services to startups can be supplied from outside the region (Autio et al. 2014). In this paper, we show that the line between domain knowledge and the network of organizations that support entrepreneurship is not clear and that the relationship shifts over an industry's life cycle. Moreover, the coevolution has spatial implications for the location of ESOs. Figure 1 illustrates the interaction between an industry with its domain knowledge and its relationship to the knowledge of EE actors.

Figure 1. The Two Types of Knowledge Necessary in an Entrepreneurial Ecosystem



The earliest studies of industrial agglomeration found that domain knowledge is embedded within local firms, suppliers, and other organizations (Marshall 1890). These studies examined organizations as constituents in networks that coproduce particular products or services and knowledge (e.g., Storper and Venables 2004). Later, scholars in the regional innovation systems school observed that some of these specialized regions also excelled at innovations that were the result of knowledge that was endogenously developed (Cooke 2001). They also found that entrepreneurship was only one of many ways that a region could commercialize its innovations (Cooke et al. 1997).

For those concerned with the formation of regional industry entrepreneurship was vital as new firms catalyzed the exploitation of new technologies and, as a result, often created new regions (Klepper 2002; Klepper and Sleeper 2005; Morrison and Boschma 2019; Neffke et al. 2018). More recently, scholars have suggested that certain regions become hosts for specialized intermediaries that support and encourage entrepreneurship (Isenberg 2010; Spigel 2017; Spigel and Harrison 2018) and that these intermediaries could support startups outside their region.

These ESOs can be seen as a part of what Kenney and Patton (2005) named an "entrepreneurial support network" (ESN) (Kenney and Patton 2005). Although organizations that support entrepreneurship are at the heart of EE theorizing, few studies have been conducted on coevolution of the location of startups and the ESOs and how it interacts with the location of domain knowledge as an industry matures. Even less exploration has been done on the relationship between an industry life cycle and ESO geography, though it is implicit in the work of scholars such as Steven Klepper (2002, 2007, 2010; Buenstorf and Klepper 2010) and the EE concept (Acs et al. 2017; Spigel 2017). This study explores changes in the geography of the US web-based global internet industry and the individuals and organizations support the entrepreneurial firms that created the industry.[1]

Thus, because of the difficulty in identifying and locating ESOs in a way that enables analysis, the literature has an important gap (Mack and Mayer 2016). More recently, important progress has been made in terms of understanding the relationship between an EE and its region. For example, Vedula and Fitza (2019) and Vedula and Kim (2019) show that a higher-quality regional EE contributes to the survival of focal firms. Because our interest is in the evolutionary relationship between ESOs and focal firms, we employ a different strategy. We examined data from the entire population of firms that undertook an initial public offering (IPO) from the inception of the internet industry 1994 until 2017. This allowed us to measure changes in the location of the firms and their affiliated VCs, law firms, investment bankers, and independent board members at the time of the focal firm's IPO. This data makes it possible to capture the changing geography of the successive IPOs with their affiliated ESOs and thus to measure

[1] Hereafter, when we refer to the "internet" industry, we are only including those whose business model was based on the use of the worldwide web protocols to build their businesses.

changes in the spatial location of ESO members over the life cycle of an industry and to correlate that with the location of the focal firm. This methodology enables us to better understand the interaction between domain and entrepreneurial support expertise.

In Section 2, we explore the previous literature on industrial cluster life cycles, EEs, and ESOs. Section 3 presents our propositions regarding the evolution of the locational relationship between the focal IPO firm and the type of ESO actor. In Section 4 we provide a brief history of the internet industry as context for our study and we describe the data collection methodology. Section 5 describes the results and their implications for understanding the relationship between EE knowledge and domain/industrial knowledge and how this has changed as the internet industry has evolved. In Section 6, the overall results as well as their implications are discussed. In the conclusion, we discuss the limitations of this study and possible new research directions.

2. Industrial Cluster Life Cycles and Entrepreneurial Ecosystems

Life-cycle models are often used to explain the growth and development of regional industries (e.g., Feldman et al. 2005), which are linked to theories about product life cycles (Menzel and Fornahl 2010).[2] It is widely accepted that some stages in the product cycle have implications for the ways in which firms in an industry evolve and compete (Audretsch and Feldman 1996; Klepper 1997; Menzel and Fornahl 2010; Ter Wal and Boschma 2011). The

[2] Although the general idea of a product life cycle had been observed in the business literature and in international trade (Vernon 1966) before 1975, Utterback and Abernathy's (1975) concept of stages of product evolution currently provides the framework for industry and cluster life cycles.

literature on cluster life cycles argues that clusters experience a life cycle closely related to, but not identical to, the life cycle of the underlying industry of the cluster.

It is generally accepted that the initial location of a cluster is quite random and almost impossible to predict (Storper and Walker 1989). The reasons for a cluster's emergence are usually explained after the fact, but evidence suggests that new industries grow out of related industries in a "branching process," in which new activities spin out of existing activities (Boschma and Frenken 2011; Frenken and Boschma 2007; Jacobs 1969). In studies of the automotive, television, and tire industries (2002, 2003, 2007), Klepper found that the likelihood of a new industry entrant in a region was higher if it had existing related firms there. This is largely because the individuals best equipped to launch new ventures in a particular field are high-level employees at established companies in the same or a closely adjacent field (Aldrich, 1999; Burton et al. 2002; Klepper, 2002; Klepper and Sleeper, 2005; Sorenson and Audia, 2000).

Great attention has been paid to the role of networks in their characterization of the cluster life cycle (Ter Wal and Boschma 2011). In the growth stage of the cycle, a dominant design emerges as the market for the new industry expands (Anderson and Tushman 1990). The number of new firms grows rapidly, with a tendency for a stable core-periphery network to emerge within the cluster. At the spatial level, clustering becomes more important. Other regions that are not part of this clustering in the growth phase of the new industry will find the "windows of locational opportunity" close to them (Storper and Walker 1989; Ter Wal and Boschma 2011).

Another line of theory holds that other mechanisms are at work in promoting clustering. It places spinoffs at the center of the clustering process even in the absence of agglomeration economies. Sorenson and Audia (2000) were the first to argue that no agglomeration economies were required to explain clustering, as increases in firm density in the early stages of the cluster

raised the rate of both firm entry and firm exit. Because of imperfect information, new firms concentrate near incumbents even in the absence of cluster-based advantages described by Marshall (Boschma 2015). Building on the observation of proximity, Klepper (2003) found that firm heritage, together with spinoff dynamics could explain clustering. In this theory, clusters are the result of the differing capabilities of firms and progeny, and this process, rather than different cluster characteristics, explains clustering. Both approaches suggest the geographical concentration of firms increases during the growth stage in the cluster life cycle.

The EE approach recognizes two types of knowledge. The first type of knowledge is typically the knowledge possessed and shared by individuals and firms in the cluster regarding the production and marketing of products and/or services (Autio et al. 2018)—which we call "domain-specific" knowledge. The second type of knowledge is "generic" because it can be applied across entrepreneurship opportunities (Stam and Spigel 2016: 5). It is shared through an EE by networks of entrepreneurs and the actors that assist them. The relationships among these actors and firms, and how they influence each other, is conceptualized as analogous to the interactions among organisms in a spatially bounded biological ecosystem (Spigel 2017).

Both types of knowledge—domain and entrepreneurial-process knowledge—are diffused through the EE by a variety of actors, both local and distant. Brown and Mason (2017) refer to these actors as entrepreneurial connectors, and a dynamic EE has networks of such actors in abundance. These networks include specialized financial intermediaries, such as the VCs in regions such as the greater Silicon Valley (SV) (Feldman and Zoller 2012; Florida and Kenney

1988a; 1988b).[3] In a local context, these networks provide the information flow or "buzz" based on face-to-face contacts (Bathelt et al. 2004; Storper and Venables 2004).

The key constituents of an EE are a variety of organizations that specialize in providing services to entrepreneurs.[4] Although entrepreneurship is a fundamentally local phenomenon, several EE scholars have recognized the role of distant support organizations (see Brown and Mason 2017; Spigel 2017). The concept of global pipelines, which are the connections that local entrepreneurs develop with distant sources of information and resources to access knowledge that is not available within the cluster, captures the importance of distant support organizations (Bathelt et al. 2004). This can be extended to thinking about organizations that support entrepreneurial activities. The importance of these conduits is recognized by Ter Wal and Boschma (2011), who maintain that the literature on clusters overstates the importance of proximity and underplays the role of networks.

The role of institutional actors that provide services to firms within a cluster is recognized as an essential element in the evolution of clusters. As Feldman et al. (2005) observed, successful clusters are built by a wide variety of entrepreneurial actors. These clusters evolve to become more complex and competent when an increasing number of firms are born and succeed, and, at the same time, organizations that provide them with specialized services emerge and grow.

[3] We use the abbreviation "SV", rather than the San Francisco Bay Area, which is the regional conurbation where these firms are located, as investment in San Francisco is now roughly equivalent to the Palo Alto/San Jose region (Florida and Mellander 2016).

[4] In a discussion on Silicon Valley, Kenney and von Burg (1999) suggested that the region could be divided between entrepreneurial firms (Economy 1) and the various actors and institutions that support entrepreneurship (Economy 2), ranging from specialized financial and legal organizations and other entities, including established firms and universities that were often the source of the entrepreneurs and had the knowledge and desire to form a new firm.

These ESOs are the foundation of an EE and offer entrepreneurs a context within which to operate (Autio et al. 2014: 1099).

Despite being central to the definition of an ecosystem, actors other than entrepreneurial firms have received limited attention. EEs, like biological ecosystems, are communities that include not just entrepreneurs but also a variety of other spatially proximate actors, such as VCs, law firms, and accountants that provide specialized services for entrepreneurial firms (Clayton et al. 2018) and benefit when the entrepreneurial firm is successful (Kenney and von Burg 2000). Essentially, an EE is a set of actors and institutions that assist in the creation and growth of startups. These actors act independently of the firms and produce competitive advantages through their interaction with these firms and one another.

As EEs have become conceptually popular, scholars have recognized the gaps in our knowledge about the operation and evolution of EEs (Alvedalen and Boschma 2017; Stam 2015). In general, few EE papers explain why ESOs form clusters or how their location changes as an industry evolves over time.

The type of organization consistently included in the classification of EEs is the professional business service firm, or business consultancy. These service firms are widely distributed across entrepreneurial regions around the world, but they are particularly concentrated in top-tier cities (Moulaert and Djellel 1995; Gluckler 2007). Theorizing and empirical research on the geography of business service firms indicate that, like manufacturing firms, firms form clusters, but the factors that contribute to clustering by service firms differ from those typically cited in explaining industrial clusters.

Venture capital firms are always included among actors that contribute to an EE. The earliest discussions of the geography of VC firms date to the 1980s. Early surveys of venture capital investment patterns on behalf of the Small Business Administration in the 1980s found that venture capital was concentrated in four centers: New York City (NYC), SV, Boston, and Chicago (Thompson 1989; Florida and Kenney 1988b). More recent scholarship confirms that the most important centers of venture capital are the same as those observed decades earlier. Chen et al. (2010) found that around half the VC offices in the US are located in just three metropolitan areas: SV, NYC, and Boston. Moreover, this distribution has remained stable over time.[5] These findings are echoed by Moulaert and Djellal (1995), who stated that business service firms expand into existing clusters, rather than second-tier cities. Business service and venture capital firms locate, and expand into, cities where business opportunities are most likely to be identified and acted on.

One shortcoming in the EE approach is the paucity of empirical studies (Malecki 2018; Spigel 2017; Brown and Mason 2017). Some of the difficulties include the choice of the appropriate metrics and regional scale to be examined. Among the most commonly noted problems is the shortage of cross-sectional and longitudinal empirical research (Mack and Mayer 2016).

One suggested empirical approach stresses the processes that create resources within an EE and how entrepreneurs access these resources (Spigel and Harrison 2018). Applying this

[5] These three top cities were home to 46.5% of the VC main offices in 1985, and in 2005, twenty years later, this share increased only slightly, to 47.4%. SV increased its share over these years from 15.0% to 21.6%, whereas the share in NYC fell from 21.4% to 18.4%, and Boston's share fell from 10.1% to 7.4% (Chen et al. 2010: 93).

approach requires measuring the phenomenon consistently over time and across comparable regions within the same industry, preferably beginning at the inception of the industry. Moreover, the metric chosen must in some way capture the resources created within the EE and accessed by entrepreneurs in all regions involved in the industry. We argue that the geographical distribution of the members of the ESN should change over time, and these changes can offer new insights into the evolution of EEs.

3. Propositions Regarding the Focal Firm and Its Entrepreneurial Support Organizations

In this section, we advance our expectations regarding the ways in which we believe the spatial dimensions of internet entrepreneurship and the relationships between firms and EEs actors will change over the life cycle of an industry. The industrial life-cycle literature expects increasing concentration in terms of the location of entrepreneurship, but has not empirically examined the changes in the location of the EE members.

3.1 Focal Internet Firms Undertaking an IPO

The knowledge necessary to establish an internet firm was widespread at the inception of the industry. Therefore, the expectation is that new internet firms would be widely dispersed, but would become more concentrated as the industry matures. To measure Internet startups, we confined our study to those funded by venture capitalists. Given the remarkable strength of SV EE, which benefits from the largest concentration of VC in the US, great knowledge about how to construct a high-growth startup firm, and a concentration of knowledge in adjacent industries (e.g., software, telecommunication equipment, and semiconductors), at the time, observers

expected SV entrepreneurs to rapidly dominate the emerging industry (Zook 2002). Therefore, as the literature on industrial emergence and clusters suggests (Klepper 2010), agglomeration economies should result in an increasing concentration of newly formed internet firms and, in particular, those likely to be most successful. Because this research is exploratory, we formulate our expectations as propositions

Proposition 1: As the industry matures, the proportion of internet firms established will become more spatially concentrated.

Proposition 2: As the industry matures, the proportion of internet IPOs will become more spatially concentrated.

3.2 The Focal Firm's Law Firm

Research has shown that a knowledgeable law firm is vital for drafting the articles of incorporation for the new firm in a way that can accommodate rapid growth and the corporate governance changes necessary when receiving venture capital or later undertaking an IPO (Suchman 2000). Moreover, experienced law firms can provide introductions to VCs and other ESOs. The intimacy of the relationship between the firm's founder(s) and its law firm suggests that its lawyers are likely to be located nearby. Yet lawyers embedded in an EE where substantial domain knowledge has accumulated should be more valuable to the startup than simple proximity. For this reason, we propose that at the inception of an industry, when little domain-specific knowledge is available, legal counsel is likely to be spatially nearby. However, if a particular region develops a deep concentration of domain-specific entrepreneurial knowledge, distant legal counsel is likely to become more attractive.

Proposition 3: In the early period of an industry's existence, the focal firms' law firm will likely be spatially proximate to the IPO firm; however, as the industry matures, startups are more likely to seek law firms located in the dominant region, thereby decreasing proximity as the determinate of law firm location.

3.3 Investment Bankers

Investment bankers work with firm management to prepare the firm for a public offering; therefore, they normally become involved in a focal firm later than other actors. Investment banking knowledge and firm headquarters are concentrated in NYC City but often have their technology practice offices in SV (Kenney 2000). Therefore, we expect the focal firm to recruit a lead investment banker in one of these two regions. However, as industrial domain knowledge concentrates as the industry matures, we expect a shift in the location of the IBs to the region where the domain knowledge is concentrated. Therefore, we expect to see an increasing concentration of IBs in that region and a concomitant effect of extra-regional firms accessing from the region developing the dominant domain knowledge.

Proposition 4: Investment bankers initially will be divided between NYC and SV, but, as domain knowledge concentrates in one region, extra-regional firms will access services from that region.

3.4 Venture Capitalist Board Members

VCs are key service providers because they provide the funds, advice, and connections that can assist the growth of a new firm (Gompers and Lerner 2004; Florida and Kenney 1988a, 1988b). Ample evidence indicates that VCs prefer to invest in firms in close proximity to their

offices (Chen et al. 2010; Florida and Kenney 1988a; Sorenson and Stuart 2001; Zook 2004). Since the 1980s, venture capital has been and, continues to be, highly concentrated in SV, NYC City, and Boston. Prior findings suggest that the concentration of VC firms will mirror any changes in the concentration of IPO firms. Therefore, we propose that,

Proposition 5: Initially, the VC directors will be dispersed and firms will access knowledge extra-regionally, however as the industry matures domain knowledge will concentrate and firms will increasingly access VC directors from the dominant region.

3.5 Non-Venture Capitalist Board Members

Unlike other EE actors, directors assist firms in a variety of ways, including useful connections, signaling external actors, and other services (Pfeffer 1972). The variety of services performed suggests that they would, at the inception of the industry where there is no concentration of domain knowledge, be spatially dispersed. However, as the industry concentrates, we would expect the concentration of non-VC directors to increase mirroring any concentration in the industry.

Proposition 6: Initially, **t**he non-VC directors will be dispersed and firms will access knowledge extra-regionally, however as the industry matures domain knowledge will concentrate and firms will increasingly access non-VC directors from the dominant region.

The biography and prior employment of non-VC directors can be useful in establishing their industry expertise. One conjecture with a basis in theory regarding emerging industries is that experience in the industry increases in importance as the industry becomes more routinized and industry-specific skills become available. Therefore, the number of non-VC directors with internet industry, i.e., domain, experience is expected to increase over time.

Proposition 7: As the internet industry evolves, the share of non-VC directors who have industry domain knowledge will increase at the expense of directors that possess more general EE knowledge.

4. Setting, Data, and Methodology

The internet began as a federally funded network (known as ARPAnet). In the early 1990s, the military transferred the bulk of the network to the National Science Foundation, which initiated a process of privatization. The key development was the release in 1993 of the worldwide web protocols developed at CERN in Geneva, Switzerland that allowed the creation of websites that internet users could visit. Almost immediately, VCs funded new firms formed in order to exploit the internet (Greenstein 2015; Kenney 2003). At this point, the knowledge underlying the worldwide web was widely available nationally and globally as new technologies were developed in a wide variety of locations.

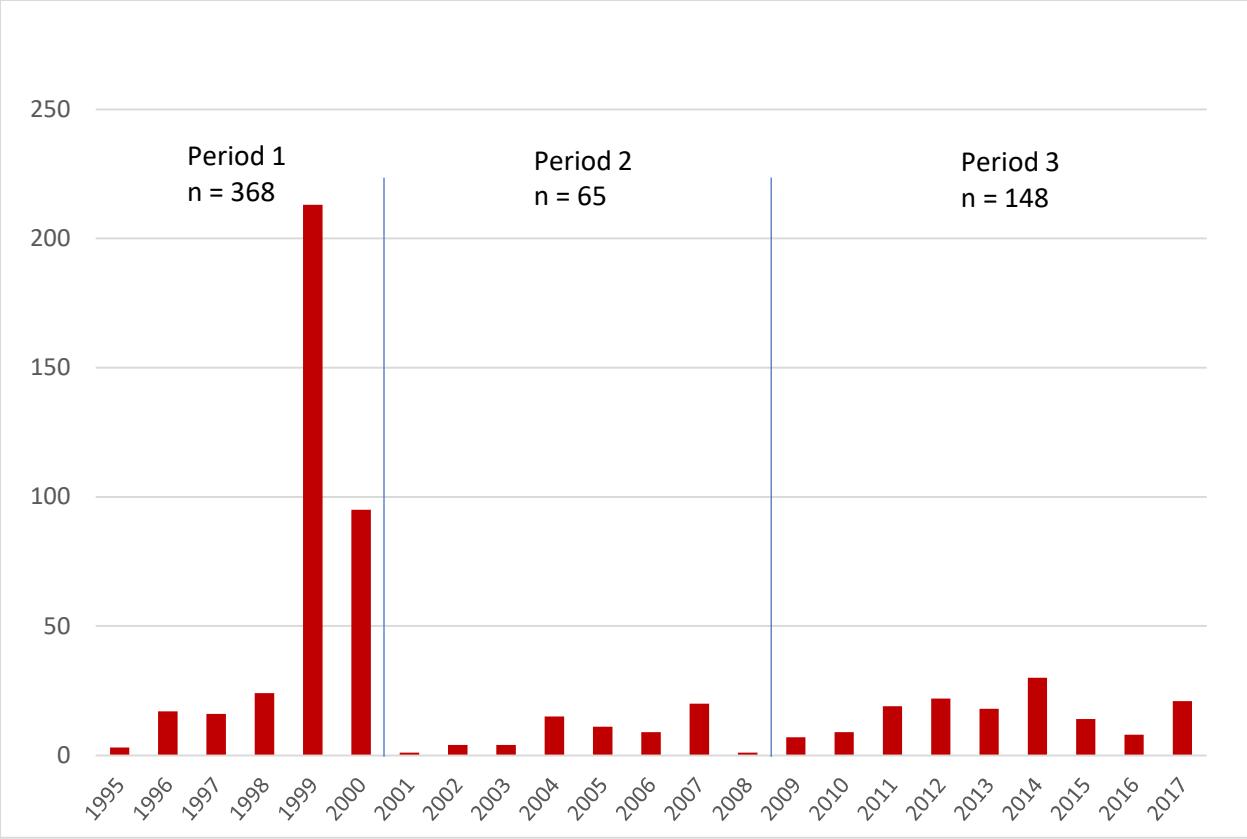
The opportunity sparked by the release of the WWW protocols in 1993 ignited a Schumpeterian gold rush, as entrepreneurs around the world formed new firms to take advantage of the WWW.[6] The rapid adoption of the internet and growth of these new firms was accompanied by enormous excitement making investors eager to purchase shares in internet firms listed on the stock market. A flood of successful IPOs ignited the dot.com bubble, one of the most frenzied stock market bubbles in US history. As Figure 2 shows, 1999 and early 2000 was the peak of the Bubble, with 213 internet IPOs and 95 IPOs in the first three months of 2000, after which public appetite for internet IPOs collapsed. Because of the collapse and the

[6] Our definition of an internet firm is a firm whose business model is based on creating a website as its main asset.

enormous losses by investors, there were few internet IPOs in the succeeding years. It was only during the recovery from the 2008 stock market collapse, the emergence of the Web 2.0, and the corresponding surge in internet use that investors again became receptive to internet IPOs.

Because of these distinct periods, we divided the population of 581 internet IPOs into three periods based on the changes in the investment climate for internet firms that corresponds to the periodic economic recessions. As Figure 2 illustrates, Period 1 was from 1995 to the dotcom bust in 2000. During period 2, from 2001 to the beginning of the Great Recession in 2008, few IPOs occurred. Period 3 was from 2009 to 2017. Because of our focus on the locational changes and to smooth out the annual variations, we compare periods 1 and 3 with each other.

Figure 2. Internet IPOs by Year and Periods, 1995-2017, n = 581



Because the web was based on WWW protocols publicly released in 1993, no startup in our database could have been formed prior to that year. We included only startups that had never been listed before and were not spinoffs of an existing firm. We extracted information from the IPO filings on the firm, its industry, its lawyer, its investment banker and the investment banker's lawyer, and the names and addresses of its board members, both VCs and other independent board members. The address data came from internet searches. The law firm's address was used to identify the location of the lead investment banker (thus this location is approximate). We searched for the address of every VC on the board of directors, and, following Chen et al. (2010), we attributed the individual's location to their actual location not the VC

firm's headquarters. This is an improvement over previous studies that used the headquarters' location.

5. Results

Previous research and theory predicts increased regional clustering as an industry matures. Given that our time period is 23 years, it might be expected that industry would exhibit maturity and the concomitant drastic decline in new entrants and successful firms that conducted IPOs. While there were fewer firms established and conducting IPOs than in Period 1, firms continued to be established and conduct IPOs. While our study period ended in 2017, the following four years have been active both in terms of new internet firms established and IPOs. In Table One, we provide the results in terms of increased concentration between the two periods with respect to SV, which was the dominant region in each case. Our first six propositions, derived from theory, confirm our expectations of increased industrial concentration and of the entrepreneurial support organizations. However, there were marked differences between concentration depending upon type of organization.

Table One: Propositions, Percentages in Periods One and Three, and Change between Periods for the Dominant SV Region

	Period One (%)	Period Three (%)	Inter-Period Change (%)
Proposition One: VC-Backed Startups	19.4	29.0	+9.6
Proposition Two: IPOs	33.4	38.5	+5.1
Proposition Three: Law Firms	38.6	47.3	+8.7
Proposition Four: Investment Banks	42.7	52.0	+9.3

Proposition Five: Venture Capital	49.0	72.1	+23.1
Proposition Six: Non-VC Directors	22.7	46.2	+23.5

Table One A: The Change in Internet and Software Experience of Non-VC Directors from Period One to Period Three

Proposition Seven: Non-VC Director Internet and Software Experience	22.2	36.3	+14.1

5.1 Location of Venture Capital-Financed Internet Firms and Those Undertaking an IPO

As one would expect from the literature, in Propositions 1 and 2 we suggested that there would be greater concentration in terms of both startups and IPOs in the later period. As Table 2 indicates, SV became increasingly dominant. The number of startups increased from 19.4% in Period 1 to 29% Period 3 suggesting that its share of total startups increased rather dramatically. This is a powerful indicator that domain expertise concentrated in SV. Interestingly, the other two regions showed an increase in the percent of new firms being established were NYC and Southern California. As would be expected, the greatest declines were in the regions that were already less active and this decline was followed by a lesser decline in the second-tier regions. The startup data confirms previous results by Klepper (2010; Buenstorf and Klepper 2010) and others regarding how as an industry matures, the concentration of domain knowledge increases and provides sources for inspiration of new formation (Sorenson and Audia 2000; Vedula and Fitsa 2019).

Table 2. Measurement of Concentration by IPOs and Venture Capital-Funded Startups by Periods (in Percent)

	SV	Mass.	NYC	SoCal	Second Tier (n = 3)	Other regions
All Internet Startups*						

Period 1	19.4	5.6	11.5	11.0	12.3	40.3
Period 2	22.2	5.6	10.9	10.6	12.9	37.8
Period 3	29.0	3.7	15.3	11.7	10.6	29.6
Period 3 minus Period 1	9.6	-1.9	3.8	0.7	-1.7	-10.7
IPOs						
Period 1	33.4	9.5	9.5	8.2	13.9	25.5
Period 2	28.1	10.9	4.7	12.5	15.6	28.1
Period 3	38.5	7.4	8.1	10.8	13.5	21.6
Period 3 minus Period 1	5.1	-2.1	-1.4	2.6	-0.4	-3.9

Source: Crunchbase, accessed June 16, 2020.
Notes: *9,954 startups classified as internet services with more than 10 employees and headquartered in the US. See Appendix A for definitions of the regions.

When one turns to IPOs, in Period 1 SV was the home of more IPO firms than it was to startups. This was likely due to both the strength of the existing EE and, perhaps, the presence of so many adjacent firms. Interestingly, in Period 2, SV actually lost market share in terms of IPOs as its firms decreased in terms of the percentage of all IPOs. However, in Period 3, SV rebounded and in total increased 5.1% over Period 1. More interestingly, every other region decreased except Southern California, which had a marginal increase. Moreover, with this increase, SV maintained its position as having a greater percentage of successes than the percent of firms funded by VCs. As a macro-level signal, this suggests that Bay Area firms have a higher probability of IPO success than firms formed in other regions.

Given that our data encompasses 23 years, while it does show a growing concentration of firms in SV, it does not yet exhibit winner-take-all spatial characteristics. The increasing concentration of startups and IPOs in SV suggests that the domain knowledge, initially derived from adjacent industries, provided SV an advantage that grew and combined with the existing EE to allow the spawning of a greater percentage of US firms.

5.2 Company Law Firms

The relationship between a law firm and a startup is particularly intimate. For this reason, in Proposition 3, we expected that in Period One, the firms' law firm would be spatially proximate. However, that the desire for proximity should decline as the industry matured and domain knowledge became more spatially concentrated. First, in Period 1 we found that, as Table 3a shows, 81.5% of all IPOs were served by law firms in their region. These are the law firms counted on the diagonal of Table 3a. This high level of proximity was particularly pronounced in SV where 119 of 123 IPOs were served by SV law firms. SV law firms also served 23 firms outside the region. SV law firms, in total, served 39% of all focal firms. As we proposed, service provision was largely local, though SV was the leading interregional service provider.

In Period 3, as we expected the number of firms serviced locally decreased to 74.3%, a change that favored SV and NYC law firms, as they slightly increased their provision of services extra-regionally from 6.3% to 8.8% (see Table 3b). While the increase is small, SV raised its extra-regional service provision of the total and also none of SV focal firms in Period 3 used extra-regional law firms. Similarly, NYC focal firms decreased their use of extra-regional lawyers and in percentage terms increased their servicing of extra-regional firms.

With regard to this most intimate of EE service, the lure of distant and presumably more capable legal service providers did increase somewhat, but only slightly. SV and NYC slightly more attractive in period 3 and they now serviced nearly all of their local focal firms. The fact that the two dominant regions only marginally increased their centrality suggests that in terms of legal assistance it is proximity, not domain knowledge, that determines focal firm choice.

Table 3a. Company Law Firms by Regional Source and Target in Period 1

		Source (location of law firm)

Target (focal firm)	Mass.	NYC	SoCal	SV	Other†	Total		Target % of Total
Mass.	32	1	0	1	1	35		9.5%
NYC	1	32	0	0	2	35		9.5%
Southern CA	0	2	18	9	1	30		8.2%
SV	0	0	2	119	2	123		33.4%
Other	10	11	1	13	99 on-diag. 11 off-diag.	145		39.4%
						300 on-diag. 68 off-diag.	81.5% on-diag.	
Total	43	46	21	142	116	368		100%
Source % of Total	11.7%	12.5%	5.7%	38.6%	31.5%	100%		

† As the "Other" category summarizes the other regions it includes both off-diagonal and diagonal firms.

Table 3b. Company Law Firms by Regional Source and Target in Period 3

	Source (location of law firm)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other†		Total	Target % of Total
Mass.	10	0	1	0	0		11	7.4%
NYC	2	10	0	0	0		12	8.1%
Southern CA	0	1	8	7	0		16	10.8%
SV	0	0	0	57	0		57	38.5%
Other	3	10	1	6	25 on-diag. 7 off-diag.		52	35.1%
						110 on-diag. 48 off-diag.	74.3% on-diag.	
Total	15	21	10	70	32		148	100%
Source % of Total	10.1%	14.2%	6.8%	47.3%	21.6%		100%	

† As the "Other" category summarizes the other regions it includes both off-diagonal and diagonal firms.

5.4 Lead Investment Banker

The role of lead IB is to shepherd the focal firm through the IPO process and thus becomes part of the focal firm's ESN relatively late. It is important to note that nearly all of the key investment banks have their headquarters in NYC. As Proposition 4 suggested, we expected increased domain knowledge would be increasingly more important than general EE knowledge, therefore the IB would increasingly be located in SV. As Table 4a and 4b show, SV IBs increased their share of all IPOs from 42.7% in Period One to 52% in Period Two. The initial market share was likely a legacy of the fact that SV IBs had significant experience with technology IPOs, was already dominant, and already served nearly all local and some extra-regional IPOs. In Period 3, SV increased its total share to 52% of all IPOs, and, as was the case with law firms, SV IPOs no longer used external IBs (Table 4b). Moreover, SV IBs took market share from all of the other regions (except SoCal). NYC, which was and is the headquarters for all the most important investment bankers, and thus is particularly interesting because it experienced

a significant loss of market share for its own IPOs. This suggests SV IBs increased their domain knowledge and this increased its importance versus EE skills that were focused on taking generic firm's public -- presumably a strength with which NYC is amply endowed.

Table 4a. Lead Investment Banker by Regional Target and Source in Period 1

	Source (location of lead investment banker)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	28	4	0	1	2		35	9.5%
NYC	7	24	0	0	4		35	9.5%
Southern CA	0	2	10	17	1		30	8.2%
SV	0	3	8	109	3		123	33,4%
Other	16	46	2	30	39 on-diag. 12 off-diag.		145	39.4%
						210 on-diag. 168 off-diag.	54.3% on-diag.	
Total	51	79	20	157	61		368	100%
Source % of Total	13.9%	21.5%	5.4%	42.7%	16.6%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

Table 4b. Lead Investment Banker by Regional Target and Source in Period 3

		Source (location of lead investment banker)						
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	9	1	0	1	0		11	7.4%
NYC	2	6	1	1	2		12	8.1%
Southern CA	0	2	5	9	0		16	10.8%
SV	0	0	0	57	0		57	38.5%
Other	8	17	3	9	12 on-diag. 3 off-diag.		52	35.1%
						89 on-diag. 59 off-diag.	60.2%	
Total	19	26	9	77	17		148	100%
Source % of Total	12.8%	17.6%	6.1%	52.0%	11.5%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

5.5 Venture Capital Directors

When the internet industry emerged, SV, NYC, and Boston, respectively, had the largest concentration of VCs. For this reason, in Proposition 5, we expected that in Period One VC investment would be dispersed and VCs tend to invest locally (Florida and Kenney 1988b; Sorenson and Stuart 2001). However, we proposed that, in Period 3, as domain knowledge increased, one region, SV, would increase its overall share of VC investors to the determinant of other regions as the focal firms would be drawn to SV investors.

The evidence for the dispersion is that in Period 1, there is a remarkable amount of off-diagonal activity, which suggests that no single location had yet become dominant in terms of domain knowledge (see Table 5a). Of course, because of SV legacy, as a technology-driven VC location, it already was the home to 49.0% of the VCs (Table 5a). Due to the power of the existing VC concentration, one might have expected SV to be largely autarchic, however this was not the case as 25.6% of SV VC directors were extra-regional. NYC and Boston supplied more directors to firms outside their regions than they did in their own region. While, in Period One, as Table 1 shows, VCs was already more centralized in SV than either the startups, the IPO firms, or the other ESO actors. And yet, the large number of extra-regional VCs affiliated with the focal firms suggests domain knowledge was not particularly regionally concentrated.

The situation in Period Three changed dramatically (see Table 5b). Now, 72.1% of all the VCs were located in SV—an increase of nearly 23%. Further, SV was nearly autarchic, as only 9.2% of its focal firms' VCs were extra-regional. The most telling change was that SV became the source of almost as many directors to other regions (106) as these regions provided for themselves (129). The percentage of local VCs declined in every region significantly in terms of being an extra-regional source of VCs while becoming dependent upon SV. This result suggests

that the increase in internet-related domain knowledge that SV VCs developed was so powerful that focal firms in other regions sought investments from the distant SV VCs, rather local or more proximate VCs.

Table 5a. Venture Capital Directors by Regional Target and Source in Period 1

	Source (location of venture capitalist)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	37	4	0	12	11		64	10.5%
NYC	4	18	1	7	9		39	6.4%
Southern CA	6	5	13	22	6		52	8.6%
SV	16	13	7	201	33		270	44.4%
Other	14	24	5	56	50 on-diag. 34 off-diag.		183	30.1%
						319 on-diag. 289 off-diag.	52.5% on-diag.	
Total	77	64	26	298	143		608	100%
Source % of Total	12.7%	10.5%	4.3%	49.0%	23.5%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

Table 5b. Venture Capital Directors by Regional Target and Source in Period 3

	Source (location of venture capitalist)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	3	0	1	17	2		23	7.1%
NYC	1	6	1	16	11		35	10.7%
Southern CA	2	2	6	18	4		32	9.8%
SV	4	2	2	129	5		142	43.6%
Other	5	6	2	55	17 on-diag. 9 off-diag.		94	28.8%
						161 on-diag. 165 off-diag.	49.4% on-diag.	
Total	15	16	12	235	48		326	100%
Source % of Total	4.6%	4.9%	3.7%	72.1%	14.7%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

5.6 Non-VC Directors

Non-VC directors are a mechanism for accessing resources, such as knowledge and connections (Pfeffer and Salancik 1978). In Proposition 6, we suggested that in Period One, at the birth of an industry, many different types of knowledge are needed and therefore we expected the directors would be sourced from a wide variety of locations. However, as the industry matures knowledge internal to the industry becomes more relevant and available. For this reason, we expected the distribution of non-VC directors would mirror changes in the distribution of the focal firms.

Our conjecture that in Period One, knowledge would be widely distributed was confirmed, as Table 6a indicates, less than half (45.4%) of all non-VC directors were local. This is even more strongly confirmed in that SV was home to only 22.7% of all directors—a percentage that is lower than focal firms and most resembles that of all startups. SV barely provided the majority of its own directors (51.6%). To further confirm how little director knowledge SV possessed, it sent far fewer directors to other regions than NYC did (65 vs. 119). The fact that the distribution of non-VC directors was less concentrated than the focal firms suggests that domain knowledge was quite diffused and NYC was quite important having only 7.2% less of the total than SV. The remarkably wide sourcing of directors is likely because the Internet firms were so diverse and required not only technologists but also employees with marketing, advertising, media, and logistics skills. So, although SV was a technology center, it was not the knowledge center for these other skills -- a topic we return to in the next section.

In Period 3 (see Table 6b), the locational calculus had changed significantly as the industry matured. SV now sourced of 68.9% of its directors locally -- an increase of 17.3%. Further, it now provided 46.2% of all directors and dramatic increase from Period 1. With the exception of SoCal, the share for all the other regions decreased and particularly affected was the

"other" region. This is perhaps the strongest indicator that internet-related domain knowledge had become more concentrated in SV. And yet, in contrast to all of the other EE constituents, SV had not become autarchic and continued to secure directors from other regions. In most other regions, SV now provided as many non-VC directors as the region did. The sole exception was SoCal, whose overall share increased and, most remarkably, had an almost equal exchange of non-VC directors with SV. The increased role of SoCal may be due to the increasing importance of content where it continues to have superior domain knowledge. In contrast, NYC's share of directors had dropped, but the most dramatic decline was in the "other" category, and the concomitant increase in overall concentration.

Table 6a. Non-VC Directors by Regional Target and Source in Period 1

	Source (location of non-VC director)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	43	11	4	10	20		88	8.4%
NYC	4	44	4	5	37		94	8.9%
Southern CA	0	10	37	16	42		105	10.0%
SV	8	40	14	174	101		337	32.0%
Other	17	58	18	34	180 on-diag. 121 off-diag.		428	40.7%
						478 on diag. 574 off-diag.	45.4% on-diag.	
Total	72	163	77	239	501		1052	100%
Source % of Total	6.8%	15.5%	7.3%	22.7%	47.6%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

Table 6b. Non-VC Directors by Regional Target and Source in Period 3

	Source (location of non-VC director)							
Target (focal firm)	Mass.	NYC	SoCal	SV	Other		Total	Target % of Total
Mass.	9	4	1	12	13		39	7.9%
NYC	3	6	1	9	19		38	7.7%
Southern CA	0	8	19	13	14		54	10.9%
SV	6	12	18	131	23		190	38.3%
Other	3	14	9	64	38 on-diag. 47 off-diag.		175	35%
						203 on-diag. 293 off-diag.	40.9% on-diag.	
Total	21	44	48	229	154		496	100%
Source % of Total	4.2%	8.9%	9.7%	46.2%	31.0%		100%	

The "Other" category summarizes the other regions and includes both off-diagonal and diagonal firms.

When building firms in an entirely new industry, particularly one as enormous and diverse as the internet, a diverse set of skills must be attracted, because there is no existing reservoir of domain knowledge. Between the two periods, the necessary skills were increasingly located in SV, though even its firms continued to find it valuable to recruit a significant number of external non-VC directors. From this pattern, we infer that that the necessity for what Bathelt et al. (2004) termed pipeline information continued to be important for SV even as it provided more pipeline-like information to other regions. In the next section, we explore the backgrounds of the non-VC directors to better understand how the needed knowledge changed as the industry matured from Period 1 to Period 3

5.6.1 Non-VC Directors' Backgrounds

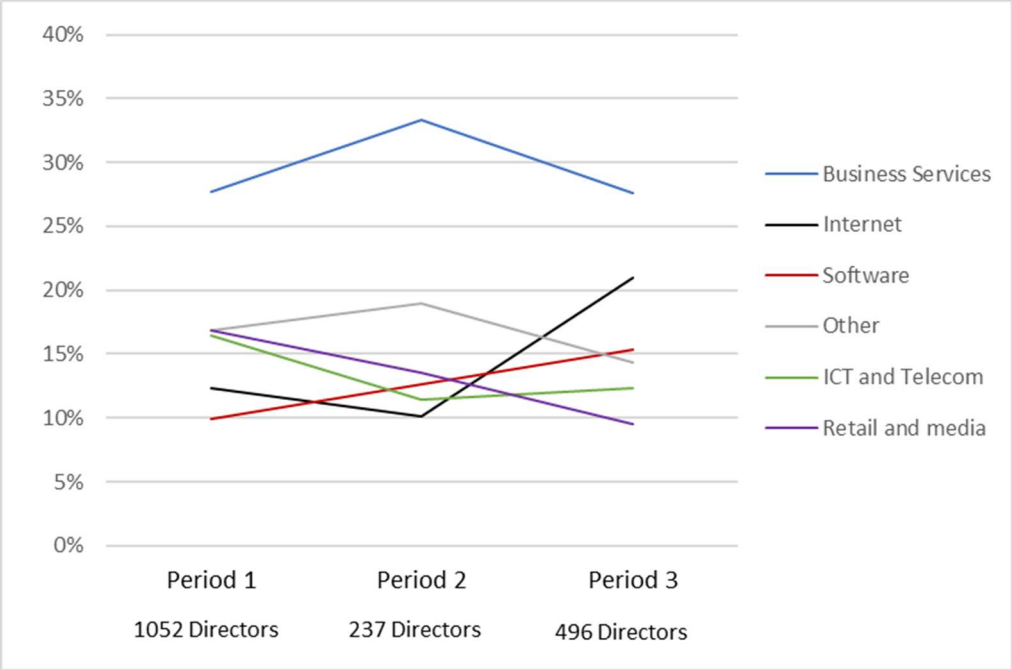
In keeping with Steve Klepper's findings and, as proposed in Proposition 7, we expected in an industry so diverse in terms of firms and business models that the non-VC directors in

Period 1 would be particularly heterogeneous in terms of their experience and background.[7] In the internet industry, the two general business models that were first employed and became dominant were website-based retailing and providing content to be monetized through advertising. These business models required domain knowledge on retail or media/advertising--SV was not a location with such skills. Proposition 6 also expected that as the industry matured, domain-specific knowledge would be created, e.g., not advertising but internet advertising, etc. and become more prevalent in Period 3.

In Figure 3, it can be seen that the backgrounds of the non-VC directors shifted to those with a background in the internet industry, rather than general EE-related backgrounds or ones from other industries. For example, backgrounds in the general category of business services remained largely unchanged. While this category is quite general, likely many of these provided EE-related services. The backgrounds that experienced the greatest decline were those with retail and media experience. The greatest increase was in directors that had direct internet industry domain knowledge, which increased from 12% to 21%. The closely related category of software also experienced an increase from 10% to 16%. The other categories experienced significant declines. This confirms Klepper's findings and supports Proposition 6. Likely the industries that Klepper studied such as automobiles, tires, and semiconductors were more narrow than the internet and thus may have become inward looking more rapidly. What this does confirm is the increasing importance of internal domain skills, but perhaps not at the cost of general EE skills as represented by business services.

[7] We divided the 1,785 non-VC directors into 20 industrial categories and 6 classifications (business services, information, communications, and technology [ICT], telecom, software, retail and media, internet, and other; see Appendix B for details on these classifications). This allows us to explore the domain knowledge changes as the industry matured.

Figure 3. Percentage of All Non-VC Directors by Background in the Three Periods



To better understand the spatial distribution of domain versus EE skills, we compared the changes in the backgrounds of the non-VC directors in SV versus those in NYC. As discussed previously, in period 1 the two regions had roughly similar percentages of the total population of directors, as SV and NYC were the source of 22.7% (239) and NYC 15.5% (163), respectively (see Figures 4 and 5). In period 3, the balance shifted dramatically as NYC directors constituted only 8.9% (44) of the total, even as SV share increased to 46.2% (229).

Figure 4. Proportion of the Total Number of Non-VC Directors with Each Background from SV in the Three Periods

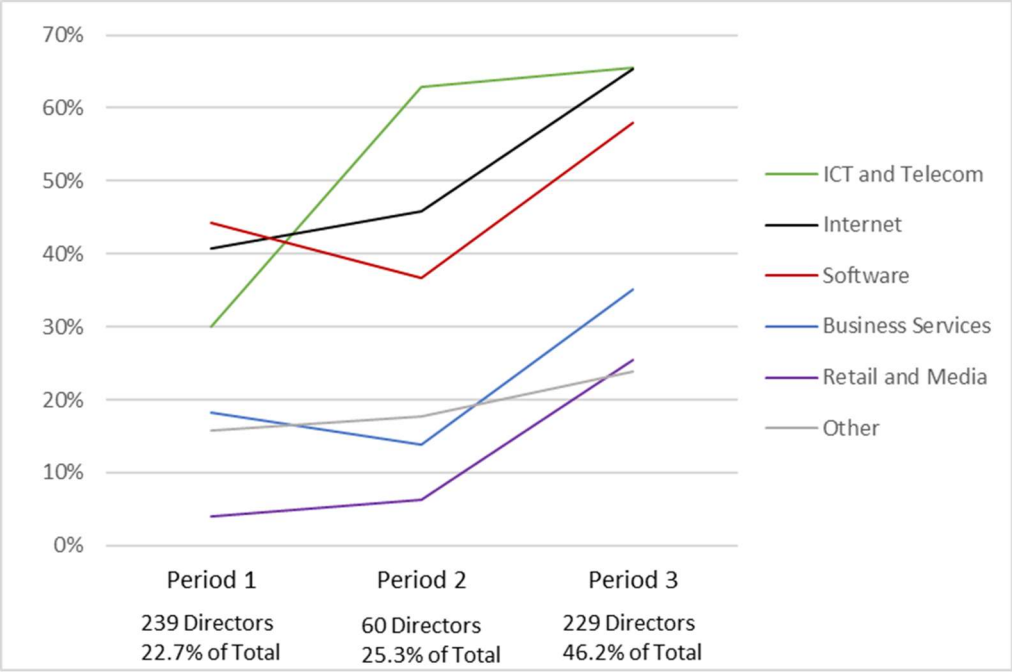
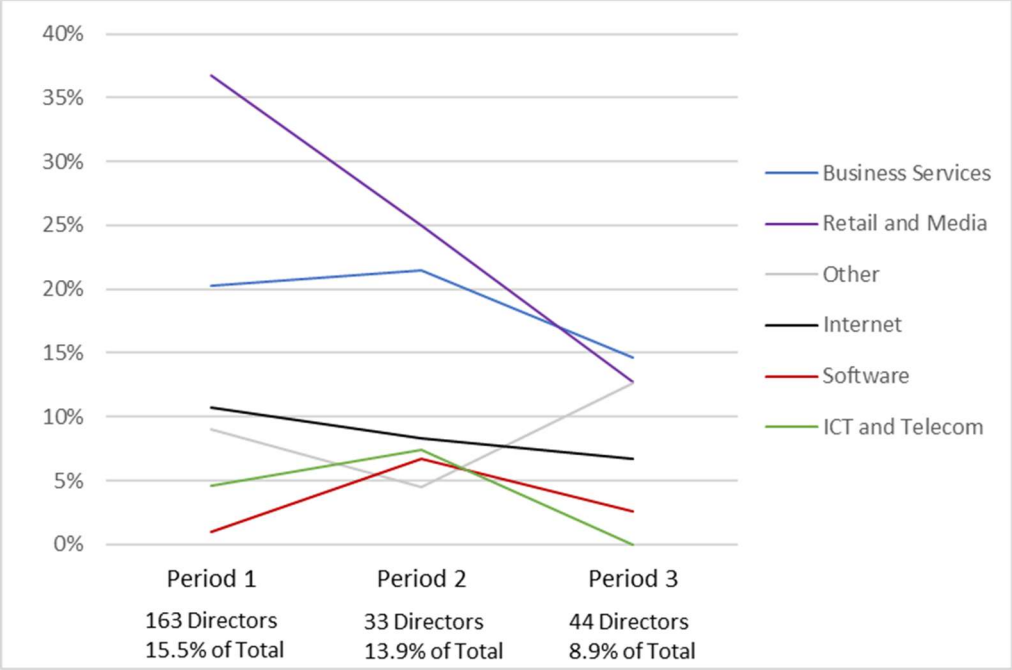


Figure 5. Proportion of the Total Number of Non-VC Directors with Each Background from SV in the Three Periods



The overall change in the mix of backgrounds for both regions was marked. First, as expected SV increased its share of the total in every category. The greatest increases were in

digital industry-related skills, internet, software, and ICT and telecom. This may, in part, be due to the fact that the internet became a general purpose technology that increasingly is a part of every business and it had become difficult to separate these three subsets of the digital technologies. In Period 1, NYC was an important source of directors in business services, retail, and media backgrounds. Although NYC remained a source for directors with retail and media background, demand for these industry backgrounds declined, generally, but, more specifically, from NYC. More pointedly, SV increased its share across all of these backgrounds indicating that these non-ICT skills may have become specialized for the internet. Put in another way, general marketing was no longer as desirable as internet-specialized marketing, business services, retail, etc. This becomes clearer in Table 7, where this shift is illustrated in the changes from Period 1 to Period 3. As these became specific fields, the general skills located in NYC became less relevant to the internet industry's needs. The standout exception is SoCal, where it experienced a significant percentage increase in providing retail and media directors with those backgrounds.

Table 7. Percentage Change of Non-VC Directors by Background and Overall Regional Change from Period 1 to Period 3.

Period 3 minus Period 1	Business Services	Software	Internet	ICT and Telecom	Retail and Media	Other	Regional Change
SV	16.8	13.7	24.6	35.5	21.6	8.1	23.5
NYC	-5.7	1.7	-4.0	-4.6	-24.0	3.6	-6.6
Southern CA	6.5	2.5	-6.0	-0.5	7.8	5.3	2.4

Proposition 7 was confirmed and, more important, it suggested that, in the case of these Internet firms they attracted directors from a remarkable variety of backgrounds and places. The increase in directors directly from the internet industry, particularly in SV was marked, but also

the increased recruitment locally of directors with other backgrounds was notable. The sheer magnitude of the change in the spatial concentration of the non-VC directors resembles that of the VC directors, though the final concentration remained far lower.

6. Discussion

The EE literature has developed rapidly during the last decade, and explored the regional features of such ecosystems. Our paper addressed a number of gaps in the EE literature and also helps reconnect the EE literature to that of industrial clusters. First, we considered the location of EE actors over an industry's life cycle, both the entrepreneurial firms and organizations and individuals that assist entrepreneurs. Second, we demonstrated the dynamics of spatial location can differ between entrepreneurial firms and EE actors. Moreover, the various actors in an EE may exhibit different spatial dynamics. Third, the rise of dominant EE, in a particular industrial sector, is predicated upon a combination of EE skills and industrial domain knowledge -- even the industry does not become concentrated.

After more than two decades, there has been some greater concentration of both startups and IPO firms, and yet the clustering was not overwhelming as startups and IPOs continued to be established throughout the US. This suggests that the entrepreneurial capability necessary to establish a firm successful enough to attract VC support and, even to build a firm successful enough to achieve an IPO remains dispersed. While SV is the center of the internet entrepreneurship and increasing its total share of startups, it is not yet overwhelming dominant in terms of spawning or attracting startups, though it did attract Mark Zuckerberg and his young firm from Boston and Marc Andreesen from Illinois to start Netscape. Given the concentration of the most valuable internet firms outside of China are on the West Coast, it is possible that Zook's intuition in 2006 in the near future will be fulfilled and SV will become predominant.

The location of ESOs, from the beginning of the industry, was more concentrated than that of either the startups or IPO firms. The location of each of the ESO actors, in varying degrees, changed in favor of SV, and, for certain groups, more slightly positive for NYC and SoCal. This is an indicator of the region's ability to provide domain-specialized EE services to firms in other regions. Interestingly, for venture capital and, also, non-VC director services the region did become more self-supporting but also, as Bathelt et al. (2004) suggested, continued to access personnel from outside the region.

The ESO that showed the greatest affinity for proximity was between the focal firm and its law firm. This is unsurprising as the firm's outside legal counsel must develop a strong in-person relationship with the firm's founders and leaders as counsel must be privy to must valuable and intimate information; something only likely to occur if there are high levels of trust (Suchman 2000). As we proposed that proximity only decreased from 81.5% to 74.3% in Period Three. It does not appear as though accessing industry domain knowledge that was increasing rapidly in SV was sufficient to overcome the desire for a proximate corporate counsel.

The location of IBs is particularly important for those interested in EE ecosystem actors. The generic EE skills of taking a firm public that are concentrated in NYC lost some attractiveness even for local internet firms. SV appears to have merged industry knowledge and EE IPO skills allowing it to increase its share of the total IB business. In fact, SV became the home to IB information technology rainmakers, such as, Frank Quattrone and, more recently, Mary Meeker (for a popular account, see, for example, Kessler 2003). This increase may also be linked to the increased concentration of the key financial intermediaries, the VCs.

With the exception of the entrepreneurs, the constituent of an EE that has received the most attention are the VCs. The change in the location of VCs was remarkable as the percentage

located in SV increased to 72.1%, as entrepreneurs now raised capital and put SV VCs on their board of directors. This was not because SV increased its overall share of all available venture capital -- that remained roughly the same. Interestingly, Period One 74.4% of all SV VCs were local, but this increased to 90.8% in Period Three -- the region had become roughly autarchic. This was reinforced by the increasing number of outside firms that looked to the region for capital and presumably the knowledge and connections that its VCs possessed. By Period Three, SV had developed such an advantage in how to do internet industry investment that it became a part of the EE for internet firms throughout the US.

The non-VC directors provide a wide variety of services to the firm. In the early days of the industry, SV, as was the case with other regions, sourced directors from outside their home region, as valuable knowledge was scattered in a large number of locations. And yet, in contrast to VCs, even though the non-VC directors SV did become more concentrated in the region, even SV continued to source them from outside the region. This illustrates the need for even the most centralized industrial clusters to need the knowledge that is provided by pipelines to outside sources of information. Not surprisingly, entrepreneurs in other regions increased their sourcing of non-VC directors from SV. Our analysis of the non-VC directors shows how previous experience in the Internet and closely related software and ICT industries increased significantly, while the, more general, business services sector remained unchanged. These results reinforce the intuition that SV's increasing dominance of the ESO provision is due to the merger of domain and EE knowledge in particular individuals.

To return to the fundamental insight, namely that, entrepreneurs when faced with securing support for their new venture will, all things being equal, source EE services locally, but if they decide to source extra-regionally, it will be relatively dispersed. However, as the internet

industry matured, it was in SV that an EE for the Internet industry emerged and, with the exception of the firm lawyers, the EE members became more concentrated than the industry itself and began offering specialized business services to internet startups established in other regions. Our research provides important insights into the difficulty of creating a powerful general EE, as the ability of one or more regions to offer EE services based on specialized domain knowledge can create non-ergodic dynamics that result in a greater concentration of these services than the concentration of entrepreneurial firms.

7. Conclusions and Limitations

Our study does have limitations. The first limitation is that it is a study of only one industry and it could be that the location of EE actors in other industries may exhibit different evolutionary paths. As always, generalization from a single case is always risky, especially in an industry that would become as large and important as the Internet. A second limitation is an artifact of our data that analyzes the ESO members at the time of the IPO and may miss ESOs that were affiliated with the firm earlier. This may overlook some EE actors that were particularly important earlier in the life of a firm. This could also be the case with the non-VC directors. And, finally, we only look at four EE actors and thus omit many others such as auditors, executive recruiters, etc. Finally, we do not measure either EE or domain knowledge directly; rather, we infer it from the increased concentrations in SV. For these reasons, generalization and policy recommendations derived from this research has its limits.

If focusing on the focal firm's ESO at the IPO was a limitation, it also has the advantage of providing us with a more holistic perspective on EE actors and allowed us to identify the

location of the actual individuals providing the services. In this way, we provided a middle ground between the rich case studies of single regions that enumerate and describe the various actors that assist entrepreneurs and the quantitative studies that usually focus on a single actor, usually the VC firm (and not the venture capitalist) and measure the proximity between the focal firm and its VC firm.

The EE literature has always suffered from somewhat of a schizophrenic attitude toward industrial knowledge. There clearly are aspects of building an EE that are general and may not be industry-specific. And yet, these entrepreneurial firms are either members of an industry or, in the process of building their firms will create an industry. In either way, they will have to make decisions about whether they should get general EE services, either locally if they are available, or from a location that provides such general services, such as NYC or, in the information technologies, SV. At the inception of an industry, these are, naturally the only choices. However, as the industry matures, a particular region may combine those EE services with domain knowledge. We saw this in the case of the internet and SV soon developed such a domain-specific advantage that it soon became predominant in providing IBs, SVs, and non-VC directors and even made slight inroads in the most intimate service of all, law firms.

Policy-makers wishing to build a local EE must understand that it will be difficult to provide all of the services locally. Our research suggests that they focus first on ensuring that the region develop experienced local legal talent. To illustrate, building upon Feldman et al (2005), universities might contribute to the region by hiring local attorneys to assist in licensing to entrepreneurial spinoff firms. Similarly, incubators could direct their tenants toward local lawyers, as this would have the greatest likelihood of reinforcing the local EE. Developing a local VC industry may also be a goal, but our data shows that as the industry matures, local VCs

appear to be less important. However, the goals for the local VCs should be modest, as a successful local entrepreneur is likely to search for VCs from a location where industry knowledge is concentrated, as EE actors from that location are more likely to add the value to the fledgling firm. This is also likely to be the case for non-VC board members that can contribute advice, connections and credibility to the fledgling firm.

The recognition that domain and entrepreneurial support skills are analytically different is an important contribution by EE scholars, as is the observation that EE skills can be accessed extra-regionally. In our case, regions such as NYC and Boston that had general EE skills were ultimately out-paced by SV with its combination of industry-specific knowledge with general EE skills. Further research on other sectors with significant entrepreneurship could be undertaken in an attempt to calibrate whether EE skills without specific domain skills are sufficient to promote entrepreneurship.

The interest in EE has resulted in far greater attention to the organizations that support entrepreneurship. Much of the quantitative research has treated EE as existing and, as emerging and evolving. EE has generally not considered the implications of industry evolutions as relevant to their understanding. By examining the changes of EE actors over the life of an industry we have provided another perspective on EE. To better understand the relationship between a focal firm, the local EE, and extra-local EE actors, we suggest extending similar life cycle research to other industries. Also, deeper rich case studies studying the emergence of other EE actors is vital for understanding EE dynamics.

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Appendix A: Regional Definitions

DC area	Washington, DC; Montgomery and Prince George's Counties in Maryland; Arlington and Fairfax Counties, and Fairfax and Alexandria in Virginia
Midwest	All Midwestern states
NYC	NYC State
Other East	All areas in the Eastern states, not including MA, NY, or the DC area
Other South	All areas in the Southern states, not including Texas or the DC area
Other West	All areas in the Western states, not including Washington, SV, or Southern California
Southern California	Los Angeles, Orange, San Diego, Santa Barbara, and Ventura Counties
SV	Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara Counties
Washington	Washington State
Top 4	SV, Southern California, NYC, and Massachusetts
Second Tier	DC Area, Texas, and Washington
Other Regions	Midwest, other East, other South, and other West

Appendix B: The Classification of the Industry Backgrounds of Non-VC Directors

The database includes 1,785 non-VC directors. The backgrounds of all directors were determined by examining their biography in the prospectus and the position held by the director at the time of the IPO. These affiliations were determined by their occupation.

Affiliations were found for 1,534 non-VC directors. The remaining 251 directors fell into one of three categories: retirees, former employees of the company going public, or private investors. Former employees were located at the firm's headquarters. Retirees and private investors were either searched for online or assumed to be located at their last affiliation in their biography. Thus, in some cases, the location is approximate, i.e., in the same city or county.

Non-VC Director Occupational Categories

The non-VC directors were distributed across 20 occupational categories. Unsurprisingly, some of these categories are not directly related to the internet industry (listed below). To simplify the analysis, we grouped the categories into six more-inclusive classifications: business services, ICT and telecom, software, retail and media, internet, and a general category, other.

Within business services, consulting and investment were the largest. Finance is a large category. Consulting, investment, and finance were difficult to distinguish and often required a judgment call. Accounting, banking, and insurance classifications were applied to directors who were or had been employed at accounting firms, banks, or insurance companies.

The technology category was made up of directors with experience in information or technology firms, such as IBM, HP, Cisco, and Intel. Directors whose experience is at software companies were put into the separate category, software, while those with experience in telecommunications were put in the telecommunications category.

The media occupational category was defined as encompassing movie and television studios, music and publishing, and firms that describe themselves as multimedia enterprises. The retail category includes not only brick-and-mortar retail but also catalogues or other forms of sales. This category does not include internet retail.

Internet experience includes experience with any firm based on web-related activities. These firms are usually identified as such in the prospectus biography. Experience at a retail or media internet firm results in classification as having come from an internet firm.

The final category, other, consists of seven individual categories that have little to do with internet firms, although they may be important areas of experience in other industries. It also includes directors who could not be classified or whose experience is in airlines, hotels, casinos, amusement parks, and even professional sports.

Occupational Categories of Non-VC Directors, 1995-2017

		Number of Directors	Percent of total
Business Services		507	28.4
	Accounting	15	0.8
	Banking	42	2.4
	Consulting	174	9.7
	Finance	112	6.3
	Insurance	22	1.2
	Investment	142	8.0
Software		210	11.8
Internet		258	14.5
ICT and Telecom		261	14.6
	ICT	189	10.6
	Telecom	72	4.0
Retail and Media		256	14.3

	Retail	75	4.2
	Media	181	10.1
Other and Unclassifiable		293	16.4
Total		1,785	