J Evol Econ (2003) 13: 513–527
DOI: 10.1007/s00191-003-0165-9

Journal of Evolutionary Economics

Social networks and industrial geography*

Olav Sorenson

Anderson Graduate School of Management, University of California, Los Angeles, 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, USA
(e-mail: osorenso@anderson.ucla.edu)

Abstract. In many industries, production resides in a small number of highly concentrated regions; for example, several high tech industries cluster in Silicon Valley. Explanations for this phenomenon have focused on how the co-location of firms in an industry might increase the efficiency of production. In contrast, this article argues that industries cluster because entrepreneurs find it difficult to access the information and resources they require when they reside far from the sources of these valuable inputs. Since existing firms often represent the largest pools of these important factors, the current geographic distribution of production places important constraints on entrepreneurial activity. As a result, new foundings tend to arise in the same areas as existing ones, and hence reproduce the industrial geography. In support of this thesis, the article reviews empirical evidence from the shoe manufacturing and biotechnology industries.

Keywords: Social networks – Entrepreneurship – Agglomeration – Spin-offs

JEL Classification: L11, M13, R30

1 Introduction

Production in a wide range of industries resides in a limited number of highly clustered geographic locations often referred to as industrial districts. In California, for example, Silicon Valley has become famous for its dense concentration of high technology companies while Los Angeles provides a home to a large share of the entertainment industry. The same pattern appears in other countries as well. Tijuana, a Mexican city near San Diego, hosts a large contingent of electronics manufacturing

* Adapted from a plenary talk delivered at the 8^{th} annual meetings of the International Schumpeter Society in Gainesville, FL. Constança Esteves and Lee Fleming provided comments useful to developing this written version.

firms and the region around Geneva in Switzerland dominates the high end of the watch industry. Simply detailing the long list of documented examples would require more pages than this paper permits.[1]

Explanations for this spatial distribution of industrial production have focused on arguing that these dense concentrations might increase the efficiency of the production and distribution of goods. The earliest research by German scholars maintained that the minimization of transportation costs could explain the concentration of heavy manufacturing in Bavaria because locating there allowed these firms to benefit from their close proximity to coal and iron ore (von Thünen, 1826; Weber, 1909). These transportation cost-based arguments, however, fail to account for the concentration of a variety of light manufacturing and service industries, such as high technology or entertainment, where these costs make up a negligible fraction of the value of the good. Attempts to explain the clustering of these industries has lead researchers to revisit the agglomeration economies proposed by Alfred Marshall (1920). Thus, recent work has elucidated the potential benefits of an extended division of labor (Romer, 1990), labor pooling (Diamond and Simon, 1990; Rotemberg and Saloner, 1990) and informational spillovers (Arrow, 1962). The logic of this literature implies that managers accurately recognize the benefits of certain locations and therefore locate there (or that strong selection pressures produce an equilibrium geographic dispersion from random entry).

Although these factors undoubtedly play a role in the maintenance of many industrial districts, geographic concentration can persist even when economic efficiency (at least in production) does not support it. The explanation for this phenomenon comes from a more nuanced consideration of the process of entrepreneurship – specifically, the importance of social networks to it. Two factors must converge for a nascent entrepreneur to found a new firm. First, the potential entrepreneur must perceive an opportunity for profit in a particular segment, or market niche, of the economy. Since much of the relevant information only exists privately, awareness of potentially profitable opportunities requires connections to those with the pertinent knowledge, typically those currently engaged in business in a particular industry. Second, the individual that perceives an opportunity must build a firm – assemble the necessary capital, skilled labor and knowledge – to exploit it. Again, social relationships play a crucial role in acquiring tacit information and in convincing resource holders to join the fledgling venture, whether as employees or investors. Because the social ties that facilitate both of these antecedents rarely extend beyond the regions in which these relevant resources and knowledge reside, entrepreneurs within a given industry most frequently arise in close proximity to industry incumbents. This regularity implies that industries can remain geographically concentrated even when co-location disadvantages firms.

The remainder of this piece delineates the reasoning behind this idea. Section 2 reviews the relationship between social networks and geography. Section 3 details the various mechanisms through which social networks enable entrepreneurship. The subsequent sections present some examples of how these processes affect the dynamics of two quite different industries: footwear production and biotechnology.

[1] For those interested in additional cases, Porter (1990) provides numerous examples.

Section 6 summarizes the material and its implications for theory and regional policy.

2 The spatial distribution of social networks

Social networks influence the geographic distribution of industries because networks do not randomly link individuals. Rather, people interact most frequently with those who live in close geographic proximity and with whom they share backgrounds, interests and affiliations (often referred to as social proximity). The parallel patterns – relating social and physical distance to the likelihood of a relationship – reflect the fact that both arise from influencing the probability of random interaction. To form a relation, two individuals typically must meet in space and time. Because both physical and social locations strongly influence people's activities, proximity on these dimensions increases the likelihood of a chance encounter (Blau, 1977). Moreover, even after an initial contact, each of these factors importantly influences the likelihood of forming and maintaining a relationship. Confirming the adage that "birds of a feather, flock together," people appear to prefer to develop and maintain social ties with those of similar backgrounds and with related interests (Lazarsfeld and Merton, 1954). And geographic proximity also strongly influences the durability of relationships by reducing the costs of maintaining a relation. Distance increases the direct expenses associated with engaging in the frequent and extended interaction necessary for the maintenance of social relationships (Zipf, 1949), particularly close personal ties. It also escalates the opportunity costs of interaction, in the sense that the number of equally preferred but more proximate individuals increases with distance (Stouffer, 1940).[2] Hence, individuals' social networks primarily contain ties to others like themselves that live nearby.

Roughly 80 years of empirical research support this principle. Beginning with Bossard (1932), a number of researchers have investigated the role of propinquity in marriage and friendship, consistently finding that the likelihood of a relationship declines precipitously as the physical distance between the two parties increases (Festinger, Schacter and Back, 1950). Studies of interaction patterns within organizations similarly observe that employees communicate more frequently with co-workers in nearby offices (Allen, 1977). More recently, researchers have begun to show that business relationships also follow this pattern. For example, corporate board interlocks more frequently occur among firms with geographically proximate headquarters (Kono, Palmer, Friedland, and Zafonte, 1998). Floor traders on an options exchange prefer to deal with those situated nearby on the floor (Baker, 1984). And venture capital firms rarely invest far from their offices (Sorenson and Stuart, 2001). A parallel line of research demonstrates that the probability of forming a relationship rises when two individuals reside closer to each other in 'social space' (i.e. have similar backgrounds or share demographic characteristics). For

[2] Stouffer (1940) and Zipf (1949) derive formal models predicting the expected functional form relating distance to the likelihood of interaction – the former based on the opportunity costs involved and the latter focusing more on the direct costs. Both models predict that the likelihood of a relationship should change roughly proportional to the inverse distance between two individuals.

example, social similarity so strongly structures interaction that it explains most of the variation in social networks in the 1985 General Social Survey (Marsden, 1988). Numerous other studies also find proximity in social space a salient factor in explaining who interacts with whom (for a review, see McPherson, Smith-Lovin and Cook, 2001).

3 Social networks and entrepreneurship

To understand the importance of social networks to entrepreneurship, let us think about the process of starting a firm from the point of view of a nascent entrepreneur. In considering this issue, we can usefully divide the process of entrepreneurship into two stages: (1) opportunity identification, and (2) organization building. In other words, our potential entrepreneur must first come up with a concept for a new business, and then she needs to assemble a company that will allow her to pursue her idea. Social networks play an important role in each of these stages.

Identifying opportunities

Our hopeful entrepreneur must first access social networks to identify opportunities in the economy. In emerging industries, knowledge of the existence of the enterprise itself may elude attention in the media. Our potential entrepreneur, hence, will only consider these ventures if she knows someone in the business, either directly or through an acquaintance. Even in more mature lines of business, much of the information necessary to assess the potential value of an opportunity only exists privately. Incumbent firms notably have incentives to conceal, for example, the profitability of their operations lest it encourage others to enter their attractive market segment. Private companies can simply avoid making public such sensitive data, while public firms – particularly those operating in multiple lines of business – can obscure their accounting statements to minimize the amount of information they reveal. Regardless, companies likely have difficulty completely stemming the flow of such knowledge. Many employees, chiefly in the managerial ranks of the firm, necessarily have access to this valuable information, potentially allowing them to pass it on to others. As a result, private information regarding entrepreneurial opportunities flows through social networks.

Multiple lines of empirical research confirm the importance of social networks as conduits for communication flows. For example, a substantial body of research investigating the diffusion of innovations has demonstrated that these ideas progress along the transmission lines made available by existing social ties (Coleman, Katz, and Menzel, 1966; see Rogers, 1995, for a review). In the study of labor markets, Granovetter (1973) and others have shown that much of the information on the availability of jobs passes through informal social ties. Research outside of sociology also increasingly pays attention to the importance of these knowledge flows. For example, recent studies in finance find that investors who invest locally earn positive abnormal returns (Coval and Moskowitz, 2001; Garmaise and Moskowitz,

2003), presumably because social networks bring them preferential access to data regarding the attractiveness of local opportunities.

The localized structure of social networks thus implies that our potential entrepreneur will be most aware of opportunities in the industry in which she works, particularly if she works for a firm situated in a regional concentration of like firms. Many of our nascent entrepreneur's relationships will tie her to those with whom she works, making her most aware of opportunities in her industry of employment. If a number of rival firms in that industry also operate in the local region, the likelihood that her non-work contacts also connect her to information flows within the industry increases. However, not just the number, but also the pattern of relationships often matters in the identification of valuable opportunities. The expansiveness of a person's social network, in particular, determines the breadth of information available to them. Sitting at the nexus of diverse knowledge flows offers opportunities to bring these ideas together into novel combinations (Schumpeter 1942). Therefore, entrepreneurs in regions with a large population of firms in an industry tend to occupy positions in communication networks that lend themselves to identifying promising opportunities and assessing market conditions in the industry.

Building new organizations

After identifying a potentially profitable opportunity, our entrepreneur requires access to a variety of resources to begin operations. Even in an emerging industry, she will need capital and labor. As industries mature, the efficiency of production increases due to a combination of capital investments, improvements in human capital specific to the business and the accumulation of tacit knowledge through learning-by-doing. For new entrants to compete effectively with incumbents, they require access to each of these elements – a process referred to as resource mobilization in the sociology literature. Social relations facilitate the acquisition of each of these three elements: (1) tacit knowledge, (2) financial capital, and (3) human capital.

Social networks may operate most strongly in structuring the flow of tacit information. By its very definition tacit knowledge defies codification. Regardless, tacit information frequently underlies the profitability of enterprises in many industries; precisely because of the difficulty of replicating such knowledge, it can provide valuable rents to those that hold it. New firms that can access the existing knowledge in the industry enjoy a large advantage (Klepper and Sleeper, 2000; Klepper, 2001). Despite its value, tacit information does not lend itself to market-based exchange. Potential buyers may question the value of the knowledge, and sellers cannot easily assuage their concern without revealing their valuable information. Dense social networks often prove useful in such circumstances because they facilitate the trust necessary for exchange to occur (Coleman, 1990). Moreover, accessing this information typically requires strong social ties. Complex, tacit knowledge eludes transfer in the absence of the high bandwidth that face-to-face contact makes possible (Nelson, 1959). For example, ethnographic accounts of science and industrial R&D commonly note that individuals acquire research capabilities through hands-on experience and apprenticeships with skilled researchers (Latour, 1989).

Together these factors suggest that our potential entrepreneur will need strong ties to individuals within the industry to access the valuable tacit knowledge she needs.

In fledgling industries and in concentrated, mature ones, the limited geographic availability of this important resource will influence the ease across regions of beginning a new venture within an industry. Industry-specific tacit knowledge resides primarily in the incumbent firms within an industry; thus, potential entrepreneurs need strong social connections to employees currently working in the industry. This condition virtually requires that new entrepreneurs in an industry hail from the ranks of current employees (Sorenson and Audia, 2000). Although the likelihood of any tie declines with physical and social distance, the odds of having the strong ties needed to acquire this tacit knowledge likely decline particularly quickly. Developing and maintaining these strong ties requires frequent and intensive interaction, a situation unlikely to occur except among co-workers and close, personal friends.

Though more efficient markets exist for the distribution of capital and labor, two factors impede access to these resources in the absence of social networks. First, all new ventures represent fundamentally uncertain propositions – not only is the undertaking risky, but even the level of risk is unknown. Notably, experimental studies have demonstrated that even risk-neutral investors exhibit ambiguity aversion when faced with an inability to quantify the risks (Fox and Tversky, 1995). Hence, both potential investors and employees likely view opportunities to join fledgling ventures with considerable suspicion. Compounding these issues, resource holders also face an information asymmetry problem when assessing a potential entrepreneur: The hopeful founder likely knows more about the quality of her idea than the investors and potential employees that she approaches. Hence, they cannot simply rely on her judgment because she has clear incentives to overstate the attractiveness of her proposition (Akerlof, 1970). These factors create a friction in the flow of financial and human resources that social networks can help lubricate.

By mitigating the perceived risk associated with investing, social ties to capital holders elevate the likelihood of an entrepreneur obtaining financial backing. At least two dimensions of an entrepreneur's contact network facilitate this process. First, individuals place greater confidence in information collected from trusted parties, making investors more likely to rely on information garnered from entrepreneurs if they share a strong social bond. For example, studies of the venture capital industry find that VCs prefer to finance investments that come to them through referrals from close contacts (Fried and Hisrich, 1994). Second, lacking a strong tie, consistent information across multiple independent sources might offer the investor some assurance regarding the reliability of their information regarding the potential investment (Sorensen and Stuart, 2001).

The importance of social networks in access to capital further limits the choice of locations for new firm builders. Mutual social ties with potential investors improve our entrepreneur's odds of obtaining capital. Although the availability of financial capital in general may vary little from region to region, the usefulness of these close social relations in obtaining financing tends to bind entrepreneurs to the regions in which they have contacts, even if other locations might seem more attractive. Moreover, the venture capital critical to the financing of many high tech

industries does not exist everywhere; hence, its availability may constrain the spatial distribution of industries that rely on it for financing (Sorenson and Stuart, 2001).

In addition to financial capital, our entrepreneur must also recruit human capital to join her venture. Established firms often provide the largest pool of labor to new ventures of like kind (Sorenson and Audia, 2000). Given the uncertainties faced by fledgling companies, it may take considerable persuasion on the part of entrepreneurs to attract highly skilled workers away from secure positions at established organizations. Unlike investors, employees cannot easily diversify their risk making them even more sensitive to these problems. To acquire staff for her new company, our entrepreneur must leverage her network of industry contacts to persuade employees to leave their current employers to join the new firm. Without trust in the founder of the company and confidence in her ability and judgment, managerial and technical workers will not likely leave their secure positions to join a new startup. Again, strong social relationships facilitate the trust necessary to obtain these scarce human resources, particularly in the face of competition in the labor market (Løvås and Sorenson, 2003). Assuming that these relationships concentrate spatially, then proximity to existing firms should greatly expedite the recruitment of a workforce.

To summarize, nascent entrepreneurs have the best information on opportunities and the best ability to mobilize the resources necessary to build a firm (1) in the industries in which they have experience, and (2) in the regions in which they live. Together, these propositions imply that the geographic distribution of production tends to reproduce itself even when this spatial pattern offers no particular advantage to the firms involved. The next two sections detail how these forces play out in two industries: footwear manufacturing and biotechnology.

4 Example 1: Footwear manufacturing[3]

Footwear manufacturing provides a particularly appropriate industry for examining these processes because small firms continue to account for a large portion of manufacturing, making the geography of entrepreneurship relevant to the distribution of the industry as a whole. Non-rubber shoe manufacturers turn leather into footwear through the application of more than 200 mechanized processes and a great deal of labor. Small firms dominate the industry; as late as 1991, roughly half of all firms still employed fewer than fifty workers (Raehse and Sharkley 1991). Two factors likely contribute to the continuing pervasiveness of small manufacturers. One, economic studies have repeatedly attributed rather insignificant cost savings to increasing scale (e.g., Szenberg, Lombardi and Lee 1977); particularly in the medium- and high-quality segments of the market, plants can operate efficiently with a small number of employees. Two, potential entrepreneurs face relatively low financial barriers to entry. With a modest deposit, anyone can lease equipment from the United Shoe Machinery Corporation for a small royalty on each pair of shoes

[3] Sorenson and Audia (2000) provide a far more detailed exposition on the forces driving geographic concentration in the U.S. footwear industry from 1940 to 1989. The empirical evidence reported in this section largely summarizes their findings.

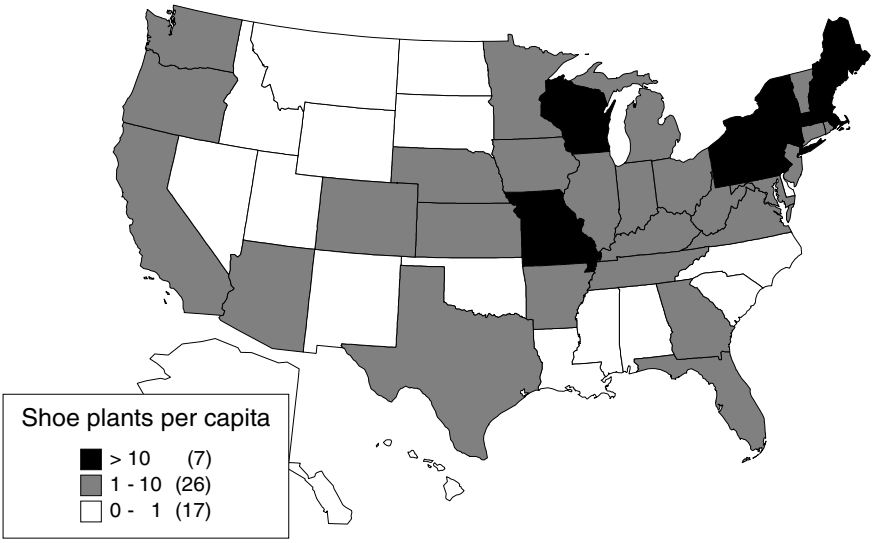

Fig. 1. Distribution of shoe plants in 1940

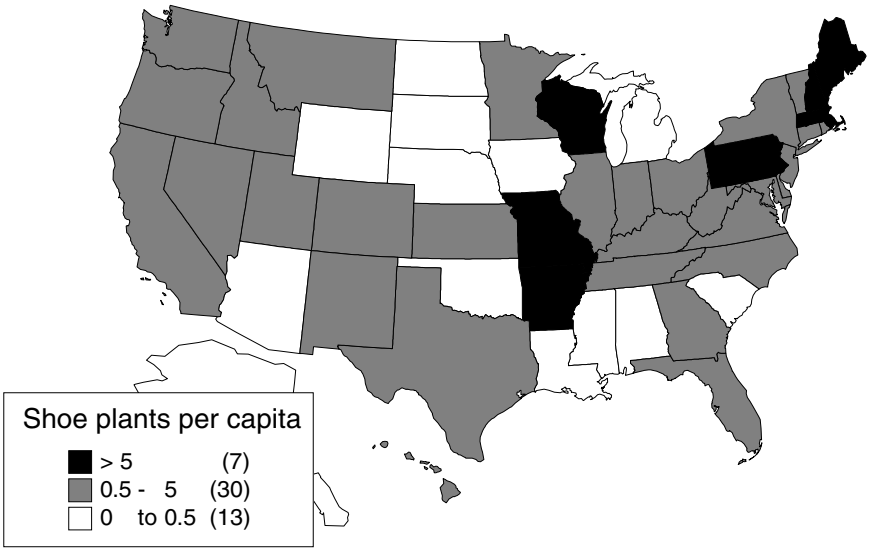

Fig. 2. Distribution of shoe plants in 1989

(just under 2% of total costs). The absence of strong scale economies and barriers to entry allows small, independent plants to continue playing an important role in this industry.

The shoe industry displays a high degree of spatial concentration. Figure 1 illustrates the geography of shoe production in 1940. Darker shadings denote states

Fig. 3. Entry and exit rates of footwear manufacturers as a function of local density

with larger numbers of shoe plants per capita. Several states have no production, while the most crowded states, Massachusetts and New York, have 281 and 264 plants respectively in 1940. Figure 2 depicts the distribution of shoe plants per capita in 1989. Although the total number of plants declines due to an influx of imports, the states with heavy concentrations of plants in 1940 generally continue to have the heaviest concentrations in 1989.

Though the raw per capita counts of plants reveal strong regional heterogeneity in density, these graphs actually understate the concentration of production activity. First, these maps mask the concentration of production within states; even within states, plants typically cluster in small regions: around Boston in Massachusetts, near St. Louis in Missouri, and close to Milwaukee in Wisconsin. Moreover, individual towns even specialize in the types of shoes they produce. In Massachusetts, for example, Haverhill and Lynn produce women's shoes, while the South Shore makes men's shoes.

At least two processes could account for this geographic concentration. On the one hand, co-location may offer benefits to the firms that reside in these industrial districts, presumably externalities resulting from economies of agglomeration. Alternatively, social networks may constrain the geography of entrepreneurial opportunities such that new firms rarely arise in regions far from incumbents. These two possibilities suggest a critical test: If firms benefit from co-location, then the local concentration of plants in the industry should correlate positively with firm performance. Conversely, if companies do not benefit from locating near to one another, constraints on entrepreneurship likely drive the geographic distribution of industry.

To determine which of these two processes explained the stability of geographic concentration among U.S. footwear manufacturers, Sorenson and Audia (2000) estimated the relationship between the density of existing firms in a region and the rates of both firm failure and new firm founding. Figure 3 displays the relationships between average state-level failure and founding rates predicted by their results.[4]

[4] Density in this graph corresponds to the mean local density in the state, where local density refers to the plant-level sum of inverse distances to all other plants. The failure rate models estimated the

Failure rates clearly rise with the local density of firms – shoe manufacturers located in the densest states fail at nearly three times the rate of those in the most isolated ones – suggesting that economies of agglomeration cannot account for the geographic distribution of footwear production. Furthermore, additional analyses revealed that no identifiable subset of firms (e.g., larger firms, older firms, multi-unit organizations) benefited from locating near to other firms. These differential failure rates would lead to a rapid dispersion of production if new firms appeared at random on the map; however, concentration stimulates founding rates even more strongly – the densest states experience founding rates nearly seven times higher than the most remote ones. Since locating among dense concentrations of rivals offers no clear benefits, one might question why entrepreneurs (if unconstrained in their geographic choice) would locate there.[5] Social networks, however, can explain this phenomenon: Most entrepreneurs arise from the ranks of employees currently working in the industry; when they found new firms, they tend to do so in close proximity to where they live, thereby reifying the distribution of production.

Qualitative accounts of entrepreneurship in the shoe industry tell a consistent story. The biographies of the founders of various shoe companies all report that the individual had worked in the industry, usually as a plant manager, prior to starting their own firm. Moreover, when starting their new firms, these entrepreneurs usually located them in the same town as their previous employer, or in a neighboring one. Thus, a spin-off process with offspring landing close to their parents appears to account for the geographic concentration of non-rubber footwear production in the United States.

5 Example 2: Biotechnology[6]

The second fitting example comes from an examination of the dynamics of the biotechnology industry. On the one hand, biotechnology may seem different in virtually every respect from non-rubber footwear manufacturing; its highly skilled labor force primarily engages in innovation rather than in the production of a consumer product that has changed little over the last two centuries. On the other hand, the two industries have very similar structures when we look at the size distribution of firms. Small, young firms account for a large proportion of each population; hence, entrepreneurship plays an important role in the geography of both industries.

continuous hazard of firm closure and included controls for firm age, plant size, imports, exports, total domestic production, and the number of shoe firms at a national level. To compare these firm-level rates to the state-level founding models, I averaged the predicted failure rates across all firms in a state; this averaging actually somewhat truncates the relationship between the local concentration of production and failure rates. Using negative binomial regression, the founding rate models estimated the number of new firms founded in a state, explicitly accounting for imports, exports, total domestic production, state population, wages, the availability of leather suppliers, national density, lagged failures and time-invariant state effects (through the use of state-level fixed effects).

[5] Other possibilities clearly exist: a risk-return tradeoff, local institutional factors, etc. Sorenson and Audia (2000) consider each of these in detail and provide evidence that suggests that these factors cannot account for the dynamics of the shoe industry.

[6] The empirical evidence reported in this section largely reviews the more detailed findings summarized in Stuart and Sorenson (2003).

Like the shoe industry, biotechnology in the United States clusters in a relatively small number of regions. Biotechnology firms first appeared in force in San Diego, the San Francisco Bay Area and around Boston. Today, these regions remain home to the largest concentrations of biotech firms, though important clusters have also emerged near to Oakland, Seattle, and Washington, DC. The dispersion beyond its initial origins has been slow. Historical accounts have attributed this evolution to a spin-off process whereby early incumbent firms, such as Hybritech in San Diego, act as incubators for generations of future founders who locate their firms nearby their parent.

The biotechnology study sought to address the same issue as the shoe industry analysis: namely, do social networks, or externalities in production, account for the concentration of the industry. Once again, the researchers estimated the effects of the local density of firms in the industry on performance and entrepreneurship rates, though in this case time-to-IPO rather than firm failure provided the performance metric.[7] Stuart and Sorenson (2003) also extend the shoe industry analysis by looking not just at the proximity of firms in the biotech industry, but also at the local presence of skilled labor (biotech patent holders), venture capital firms and universities with leading biological sciences departments.

The results established three findings.[8] First, confirming the importance of access to vital resources, proximity to three of these four types of resources – incumbent biotech firms, venture capitalists and universities – stimulates the founding of new ventures. Second, the importance of proximity to these resources declines as the industry matures – possibly due to the emergence of industry-specific institutions (e.g., conferences, professional societies and industry associations) that extend the geographic reach of individuals' networks. Third, parallel to the shoe industry findings, locating near rivals hurts firm performance (i.e. increases the time-to-IPO).

Figure 4 helps us understand the implications of these results. The dark bars illustrate the rate at which new firms appear in each zip code, while the light bars depict the likelihood that an existing private firm goes public. As one can see in the chart, the regions with the highest entry rates have the slowest times to IPO; in fact, the lowest likelihood of an IPO occurs among firms located in South San Francisco, one of the densest concentrations of dedicated biotech firms.

[7] Few biotech firms had failed by the end of the observation period in 1996, so failure rates offer little statistical power in this sample; however, several studies of the industry have used time-to-IPO and IPO valuation as measures of performance since access to public markets represents an important stage in the lifecycle of these firms.

[8] Using negative binomial regression, the full analyses estimated the zip code-level count of the number of biotech companies founded each year, controlling for the demand for public biotech stocks, the national count of biotech firms, the local population, the age of the local biotech industry, as well as time-invariant state-level effects (using fixed effects). The time-to-IPO models estimated the continuous hazard of going public while accounting for the following factors: firm age, firm financing rounds, firm capital raised, firm patents, the demand for public biotech stocks, the number of biotech firms nationally, and the age of the local biotech industry.

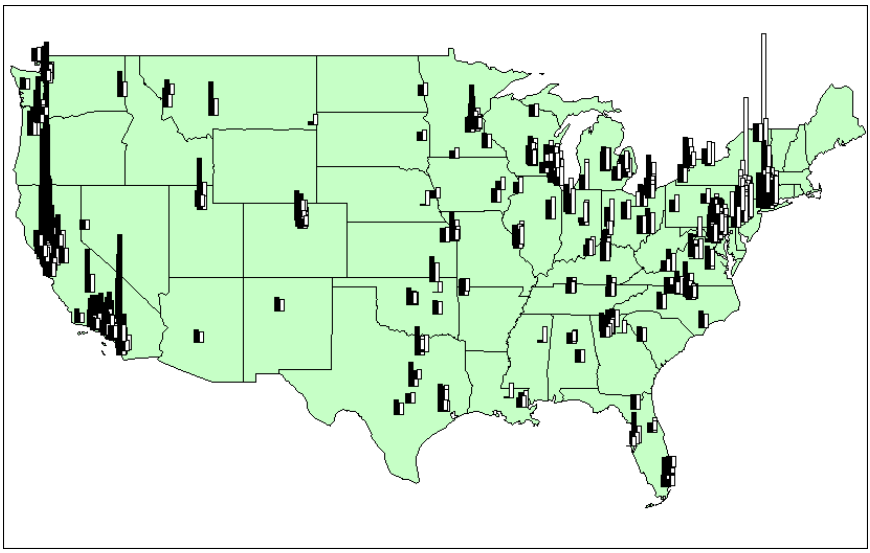

Fig. 4. Predicted entry (dark) and IPO rates (light) of biotech firms in 1995

6 Conclusion

Social networks play an important role in the entrepreneurial process, and in doing so also significantly influence the dynamics of the geographic dispersion of industry over time. Traditional explanations for geographic concentration have centered on the production efficiency of such spatial distributions, through either the minimization of transportation costs or economies of co-location. These accounts fail, however, to explain why entrepreneurs would continue to locate their firms in close proximity to rivals even when these locations promise lower average performance – the pattern found in both footwear manufacturing and biotechnology. These dynamics do accord with an understanding of how social networks influence the entrepreneurial process. Entrepreneurs primarily arise from within an industry because few outsiders have the deep social networks necessary to recognize new opportunities in the industry and to mobilize the intellectual, financial and human capital to realize their vision. These networks also bind entrepreneurs to the locations in which they reside because only there do they have the access to the resources and social support required to sustain their entrepreneurial ventures. Even though better locations exist, most entrepreneurs cannot exploit them due to these constraints.

Integration of these ideas with a closely related line of research, spin-offs, may further improve our understanding of industry spatial dynamics. Like the social networks based account, a growing literature on spin-offs also points to the importance of access to information in determining who founds new firms (for a review, see Klepper, 2001). Empirical work in this tradition tends to focus on how both environmental and organizational factors influence the likelihood that an employee will exit the firm to found their own venture. For example, Brittain

and Freeman (1986) found that three factors increased the likelihood of a spin-off: a change in CEO, an acquisition, and slowed firm growth. Hence, this research importantly alerts us to the fact that not all firms in an industry equally stimulate the founding of new ventures, though it has left unstudied the ecological dynamics of regions. Combining these two lines of research offers the opportunity to enhance our understanding of the spatial dynamics of industries, as well as their evolution on other dimensions.

In addition to its contribution to theory, understanding the dynamics underlying industrial clusters can also inform public policy. Regional planners have shown interest in replicating the successes of established industrial districts in new locations. As manufacturing jobs shift to countries with lower wages, policymakers increasingly look to high tech districts as a stimulus for regional growth; for many, Silicon Valley represents the archetype for stimulating employment and economic growth. Regional and local governments around the world have launched initiatives in an attempt to duplicate this success in their own backyards. Despite this enormous investment, relatively few systematic empirical studies analyze the effect of geographic location on organizational viability. As a result, although urban planners have been informed by several detailed case studies of industrial districts, they lack systematic empirical evidence upon which to ground policy. The results of these studies suggest that firms, at least, do not benefit from agglomeration. Thus, one might question the wisdom of promoting agglomeration. Regardless, additional research must determine whether the benefits of co-location accrue to other stakeholders (e.g., to employees through higher wages).

Though the desirability of encouraging industrial concentration remains uncertain, these results offer clearer implications for how to pursue such a course of action. Traditional approaches to regional development point to the building of infrastructures, such as technical schools, efficient transportation routes, etc. as key steps favoring the formation of agglomerations. These results suggest instead that policymakers might enjoy greater success by seeding the pollination process through the recruitment of one or more successful companies to the region to 'fertilize' the area. Once the entrepreneurial process has started, it may become self-sustaining. Employees will leave the new organizations to create a second generation of ventures, and so on. Interestingly, although this process might benefit the community, these benefits probably come at the expense of any given firm that gets caught in these waves of creative destruction.

Although the geographic distribution of industry has received limited attention from sociologists, my colleagues and I find ample evidence to suggest that social networks play an important role in determining this distribution. Indeed, we believe that the availability of entrepreneurial opportunities largely drives the geographic distribution of industry. Although this research represents an early investigation along these lines, I believe this perspective can bring fresh insight to the analysis of industrial geography.

References

Akerlof GA (1970) The market for 'lemons': qualitative uncertainty and the market mechanism. Quarterly Journal of Economics 84: 488–500

Allen TJ (1977) Managing the flow of technology. MIT Press, Cambridge, MA

Arrow KJ (1962) The economic implications of learning by doing. Review of Economic Studies 29: 155–173

Baker W (1984) The social structure of a national securities market. American Journal of Sociology 89: 775–811

Blau PM (1977) Inequality and heterogeneity. Free Press, New York, NY

Bossard JS (1932) Residential propinquity as a factor in marriage selection. American Journal of Sociology 38: 219–224

Brittain JW, Freeman J (1986) Entrepreneurship in the semiconductor industry. Mimeo

Coleman JS (1990) Foundations of social theory. Harvard University Press, Cambridge, MA

Coleman JS, Katz E, Menzel H (1966) Medical innovation: a diffusion study. Bobbs-Merrill, New York, NY

Coval J, Moskowitz TJ (2001) The geography of investment: informed trading and asset prices. Journal of Political Economy 109: 811–841

Diamond C, Simon C (1990) Industrial specialization and increasing returns to labor. Journal of Labor Economics 8: 175–201

Festinger L, Schacter S, Back KW (1950) Social pressures in informal groups. Harper, New York, NY

Fox CR, Tversky A (1995) Ambiguity aversion and comparative ignorance. Quarterly Journal of Economics 110: 585–603

Fried VH, Hisrich RD (1994) Toward a model of venture capital investment decision making. Financial Management 23: 28–37

Garmaise MJ, Moskowitz TJ (2003) Confronting information asymmetries: evidence from real estate markets. Revew of Financial Studies: forthcoming

Granovetter MS (1973) The strength of weak ties. American Journal of Sociology 78: 1360–1380

Klepper S, Sleeper S (2000) Entry by spinoffs. Mimeo

Klepper S (2001) Employee startups in high-tech industries. Industrial and Corporate Change 10: 639–674

Kono C, Palmer D, Friedland R, Zafonte M (1998) Lost in space: the geography of corporate interlocking directorates. American Journal of Sociology 103: 863–911

Latour B (1989) Science in action. Harvard University Press, Cambridge, MA

Lazarsfeld PF, Merton RK (1954) Friendship as a social process: a substantive and methodological analysis. In: Berger M, Abel T, Page CH (eds) Freedom and control in modern society. Van Nostrand, New York, NY

Løvås B, Sorenson O (2003) Social capital, competition and resource mobilization. Mimeo

Marsden PV (1989) Homogeneity in confiding relations. Social Networks 10: 57–76

Marshall A (1890) Principles of economics. MacMillan, London

McPherson M, Smith-Lovin L, Cook JM (2001) Birds of a feather: homophily in social networks. Annual Review of Sociology 27: 415–444

Nelson RR (1959) The simple economics of basic scientific research. Journal of Political Economy 67: 297–306

Porter ME (1990) The competitive advantage of nations. Free Press, New York, NY

Raehse SL, Sharkley MF (1991) Footwear. Fairchild Fashion and Merchandising Group, New York, NY

Rogers EM (1995) Diffusion of innovations. Free Press, New York, NY

Romer P (1987) Growth based on increasing returns to specialization. American Economic Review 77: 56–62

Rotemberg JJ, Saloner G (1990) Competition and human capital accumulation: a theory of interregional specialization and trade. Mimeo

Schumpeter JA (1942) Capitalism, socialism and democracy. Harper, New York, NY

Sorenson O, Audia PG (2000) The social structure of entrepreneurial activity: geographic concentration of footwear production in the United States, 1940–1989. American Journal of Sociology 106: 424–462

Sorenson O, Stuart TE (2001) Syndication networks and the spatial distribution of venture capital investments. American Journal of Sociology 106: 1546–1588

Stouffer SA (1940) Intervening opportunities: a theory relating mobility and distance. American Sociological Review 5: 845–867

Stuart TE, Sorenson O (2003) The geography of opportunity: spatial heterogeneity in founding rates and the performance of biotechnology firms. Research Policy 32: 229–253

Szenberg M, Lombardi JW, Lee EY (1977) Welfare effects of trade restrictions: a case study of the U.S. footwear industry. Academic Press, New York, NY

von Thünen JH (1826). Der isolierte staat in beziehung auf landtschaft und nationalokonomie. G Fischer, Jena

Weber A (1909). Ueber den standort der industrien. J Verlag, Tübingen

Zipf GK (1949) Human behavior and the principle of least effort. Addison-Wesley, Reading, MA