ORGANIZATIONAL FOUNDINGS IN COMMUNITY CONTEXT: INSTRUMENTS MANUFACTURERS AND THEIR INTERRELATIONSHIP WITH OTHER ORGANIZATIONS*

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ABSTRACT

Combining insights from organizational ecology and social network theory, we examine how the structure of relations among organizational populations affects differences in rates of foundings over geographic locales. We argue that symbiotic and commensalistic inter-population relations function as channels of information about entrepreneurial opportunities, and differing access to such information influences the founding rate. Empirical analyses of U.S. instruments manufacturers support this argument. The founding rate of instruments manufacturers rises with the densities of organizational populations having symbiotic and commensalistic relationships with instruments manufacturers. These variables encourage the initial foundings of instruments manufacturers in areas where they were not previously found. Dominance of organizational populations tied to instruments manufacturing by symbiotic or commensalistic relations increases the rate of instruments manufacturer foundings, whereas dominance of organizational populations that lack these relations decreases it. Finally, we find that inter-population relationships that hinge on direct contact have less impact on initial foundings as geographic distance increases. These results have implications for research on organizational ecology, entrepreneurship, urban sociology, and economic geography.

A growing body of organizational research combines ideas from organizational ecology and social network analysis. Researchers use this approach to explain the impact of innovations on a technological field (Podolny and Stuart, 1995), changes in group composition (McPherson, Popielarz, and Drobnic, 1992), the proclivity of firms to form alliances (Stuart, 1998), product changes (Dobrev, Kim, and Hannan, 2001), market entry (Haveman and Nonnemaker, 2000), the growth of firms (Podolny, Stuart, and Hannan, 1995), organizational mortality (Dobrev, Kim, and Hannan, 2001), and founding rates across national industries (Sorensen, 2004).

In this emerging synthesis, organizations gain access to resources as a function of structural position in networks. Organizations similarly positioned in such networks display a "shared fate." So niches of organizational populations can be defined through the network analyst's concept of structural equivalence (Burt, 1992). This paper extends these ideas by noting that, in many applications, the community is the habitat in which these structured flows of resources impact concrete organizational populations. This view of networks and organizations is very much in keeping with the insights of Human Ecology (Hawley 1950). In this study, we link the founding of instruments manufacturers to the locations of communities within the market structure. We present ideas that build on the assumption that the resources employed by those who would start such organizations are unevenly distributed in space. *Where* one chooses to start a specific kind of organization matters greatly. This paper reports research intended to answer the question, "Why do births of instruments manufacturers occur more often in some communities and less often in others?" The answer we propose is that the combination of other economic actors in those communities and in nearby communities provides differential access to the resources founders need to set up new organizations. To examine relations between various kinds of resource providers and purchasers, we developed measures of key ecological ideas that to our knowledge have never before been operationalized.

The concepts from human ecology we find most useful are *commensalism*, the degree to which organizations develop patterns of interdependency based on "supplemental similarities," *symbiosis*, the degree to which these interdependencies are based on "complementary differences," and *dominance*, which we define as the population with the largest resource share in the area (Hawley, 1950). We believe these interdependencies characterize organizational forms and are not simply the idiosyncratic exchange relationships negotiated by individual organizations. So one can view commensalism, symbiosis and dominance as situating an organizational population in resource or market space.

Where foundings occur has been a topic of considerable interest to scholars of organizations. Most of the work seeking to explain differences in founding rates identifies internal attributes of spatial units – be they nations, states, regions, cities, or even zip codes areas. Laws (Dobbin and Dowd, 1997), infusions of capital derived from IPOs or acquisitions (Stuart and Sorenson, 2003b), and the number of pre-existing organizations (Carroll and Wade, 1991; Lomi, 1995; Sorenson and Audia, 2000) are examples of internal attributes of spatial units that have been shown to influence the founding rate. The relations that link spatial units to each other and that determine their structural position have received relatively less attention. A few studies have examined the relations of spatial units in geographical space, focusing in particular on the effect of geographical proximity on founding rates (e.g., Hedstrom, 1994; Wade, Swaminathan, and Saxon, 1998). The effects that the position that communities occupy in market space may have on the founding rate have been largely overlooked.

We maintain the emphasis on ecological conditions favoring organizational creation but, instead of focusing solely on internal attributes of spatial units, we propose a positional explanation of the phenomenon. We begin with the premise that the probability that a certain kind of organization will be created in a community is in part driven by the opportunities tied to that community's market position. We follow this route because a key input in the organizational creation process is information about entrepreneurial opportunities, and the market relations within which local communities are embedded likely facilitate or constrain access to such information. Although our primary focus is where communities are situated in the exchange relations among organizational populations, we also consider the importance of a community's geographical position because geographic distance is known to create friction in the transfer of information across space.

We examine how the market positions of local communities influence the spatial distribution of foundings for two related reasons. First, ecological research on foundings has been focused for the most part on understanding evolutionary dynamics of single organizational populations. The few studies that examine the impact of multiple organizational populations on entrepreneurial activity tend to focus on a small subset of populations that researchers assume *a priori* to be particularly influential. Much of this work focuses on the role of venture capital firms and universities (e.g., Zucker, Darby, and Brewer, 1998; Stuart and Sorenson, 2003a). Those studies yield insights regarding inter-population dynamics. However, because they focus on a small subset of populations and because they do not directly measure relations of interdependence, the research designs do not allow comparison of relations of different kinds and strength across a variety of organizational populations tied to the population under study. A focus on the position of local communities provides an opportunity to address this gap. Second, in studies that focus on internal dynamics of single population, members of the organizational population must already be present in a locality in order to examine founding rates there. This restriction has discouraged organizational scholars from addressing important questions such as why some unoccupied areas experience initial foundings whereas others do not. In contrast, the positional approach suggested here shifts emphasis from a single population to the relations linking organizational populations. The presence in a locality of the members of the organizational population under study is not a prerequisite in our analytical framework because other populations can provide a second best source for information.

Our empirical research is on founding rates of instruments manufacturers in the United States. We focus on instruments manufacturing for several reasons.[1] First, although the history of instruments manufacturing extends over several centuries (Williams, 1994; Baird, 2004), this industry is still characterized by high rates of innovation, largely because it lies at the forefront of developments in

[1] Within the Standard Industrial Classification (SIC), SIC 38 includes instruments manufacturers and related organizations. In a later section we discuss how the SIC classification meets identity-based definitions of organizational populations (Carroll and Hannan, 2000).

scientific, technical, and industrial research. We believe these high rates of innovation create information flows that define opportunities for organization founders. These information flows and the social networks through which they are channeled are central to our theoretical interests. Second, creating an instruments organization often requires modest capital and scale economies are not large. In general, barriers to entry are low. Consequently, there is a constant flow of new organizations (U.S. Department of Commerce 1977, 1983, 1990). And third, for most instruments manufacturing companies, shipping costs of raw materials and finished products are only a small fraction of the total value of the products (Darnay, 1989). As a result, instruments manufacturing is not greatly dependent on proximity to buyers and suppliers. Geographical dispersion is feasible. This means that the processes of interest are unlikely to be overwhelmed by simple transportation economies.

Consistent with our expectations, we find that the structure of relations among organizational populations affects the spatial evolution of foundings. The founding rate of instruments manufacturers rises with the densities of organizational populations having symbiotic and commensalistic relationships with instruments manufacturers. We also find these variables encourage the initial foundings of instruments manufacturers in areas where they were not previously found. Dominance of unrelated organizational populations in an area depresses the rate of instruments manufacturer foundings. Finally, we find that inter-population relationships that hinge on direct contact have less impact on initial foundings as geographic distance increases.

FOUNDING PROCESSES IN POPULATIONS OF INSTRUMENTS MANUFACTURERS

The Social Structure of Niches

Organizational ecologists have studied founding processes of organizations for more than twenty years. (For reviews see: Hannan and Freeman 1989; Aldrich and Wiedenmayer, 1993; Carroll and Hannan, 2000; Carroll and Kessina, 2005; Aldrich and Ruef, 2006.) Their work revolves around two related problems founders face. First, they must secure resources for their nascent organizations. Organizations are started with endowments of such resources as money, technology, commitments of effort, and information. Entrepreneurs spend much of their time gathering these resources. Second, they attempt to build legitimacy for the nascent organization. That is, they seek to build agreement among those whose cooperation they need that the new organization will operate in acceptable ways. Obviously, the legitimacy problem feeds into the resource problem. Organizations lacking legitimacy have a more difficult time developing a resource base.

One of the most important ways in which organizational founders solve these two problems is by adopting an existing organizational form. It is more economical to build a new organization as a variant on a commonly accepted theme (Hannan and Freeman, 1977; Brittain and Freeman, 1980). Such forms are legitimated through everyday observation. Since the frequency of observation of an organizational form is partly a function of its density, the more common a kind of organization is, the more likely it is to be taken for granted (Hannan, 1986). This is a central insight in the theory of Density Dependent Selection (DDS). The legitimacy of a new organization can also be enhanced if the founders are personally well-reputed or affiliated with other legitimate organizations (Baum and Oliver 1992).

Each of these processes works better when distances are small and the context is local. The idea of population density itself is conventionally defined within a bounded geographical system (Carroll and Wade, 1991; Lomi, 1995). Obviously, if the phenomenology of legitimation is driven by frequency of observation, it matters whether a given population size is spread out over a large expanse or concentrated locally. Similarly, the personal reputations of founders and backers are likely to carry more weight in the areas where they are best known. Only the most famous and highly respected people in a society can establish an organization's legitimacy far from home. The same can be said for organizational affiliation. For a new organization to "borrow" legitimacy from another, those who are granting or withholding that legitimacy have to know and accept as legitimate the sponsoring organization.

Evidence supporting the local nature of the founding process can be found in studies of breweries (Carroll and Wade, 1991; Wade *et al.*, 1998), banks (Freeman and Lomi, 1994; Lomi, 1995; Greve, 2002), automobile producers (Bigelow *et al.*, 1997), biotech firms (Stuart and Sorenson, 2003a, 2003b), newspapers (Carroll, 1985), and footwear producers (Sorenson and Audia, 2000), to name a few. A common theme emerging from this literature is that a community is not simply a place where a founder happens to be when the organization creation process begins. Instead, variables describing the community produce systematic effects, accelerating and decelerating the rate of founding.

This work, however, suffers from two related limitations. First, although organizational ecology was inspired by the question, "Why are there so many kinds of organizations?" (Hannan and Freeman, 1977), most ecological studies of foundings give only limited attention to the implications of the diverse sets of organizational populations envisaged by Hannan and Freeman. Researchers usually compare spatial units by focusing on the number of organizations of the population under study. The few studies that examine relations between populations focus on failure or exiting processes (e.g., Barnett and Carroll, 1987; Barnett, 1990; Ingram and Simons, 2000; for a recent reviewe see: Freeman and Audia, 2006). Furthermore, studies of foundings across spatial units tend to be confined to a small set of organizational populations, usually similar organizational forms performing similar economic or social functions (e.g., Carroll and Wade, 1991; Lomi, 1995; Zucker, Darby, and Brewer, 1998; Simons and Ingram, 2003; Stuart and Sorenson, 2003a). It seems obvious that very dissimilar organizational forms can produce interesting and important effects on the vital rates of any of the populations.

Consider Cottrell's study (1950) on the effects of changes in railroads on the survival of towns in the American West. These towns were built to support steam locomotive maintenance. Organizational populations ranging from churches to retail stores and schools arose as the railroads were founded and grew into previously sparsely settled territories. When these railroad organizations adopted diesel electric locomotion after World War II, locomotives required less frequent servicing, and towns along the right of way shriveled and died. With them, organizational populations found in those towns went locally extinct. This study clearly illustrates that other organizational populations are a key component of the community context and that confining the analysis to the demography of single populations, or to the study of a small set of similar forms, may severely constrain our ability to explain the trajectories of organizational populations.

The second limitation of ecological studies of foundings is that the main underlying theory, DDS, although one of the most robust organizational theories, does not fully address issues of location. Consider the question of why some communities, that do not have organizations of a certain kind, experience initial foundings while others do not. Arguably, this is a central question since the extant theory holds that once the first organizations appear, foundings become more likely and a process of growth through proliferation is initiated. DDS, however, is not well equipped to address this question because it links the probability of foundings to the number of existing organizations. Consequently the existence of a given kind of organization is presupposed. Since accurate estimation of density dependence models requires following populations from the start, this means that populations must be chosen opportunistically. The theory is silent about where one would expect them to arise.

Some studies implicitly address this limitation but provide only partial answers. Hannan *et al*. (1995) argue that foundings tend to disperse in space as information about the viability of new organizational forms spreads across geographical boundaries through mechanisms such as print media and industry events. This argument, however, applies only to the early stage of an organizational population and does not explain which geographical areas may be most likely to experience initial foundings. Hedstrom (1994) argues that foundings disperse in space through localized social networks that span geographically adjacent communities, but he does not address whether and when initial founding emerge in isolated areas.

DDS alone is also limited in its ability to explain the question of why communities that have similar numbers of organizations diverge in their founding rates. Why, for example, did the founding rates of high technology organizations in Silicon Valley and Route 128 diverge (Saxenian, 1994)? An ecologist might answer this question by delineating how relations among organizational populations colocated in space facilitate or constrain access to resources, but DDS focuses on intra-population dynamics.

We believe that a useful avenue to address these unanswered questions is to extend DDS into analysis of *realized niches* (Hutchinson, 1957; Hannan and Freeman 1989), niches of organizational populations conceptualized in ways that include competitive and mutualistic effects of other populations. To do this, we combine insights from organizational ecology and social network theory as it has been suggested by DiMaggio (1986), Burt (1992) and White (2002). We advocate measuring flows of resources between organizational populations to assess relationships of interdependence. We think such studies can complement the analysis of community matrices based upon inter-population densities (e.g., Brittain and Wholey, 1988). An important benefit of this form of analysis is that it permits the development of models that take into account economic supply and demand. We think that such models may substantially extend the credibility and relevance of such organizational research.

Networks and Communities

A fundamental point of contact between organizational ecology and network research is that both draw attention to constraints imposed on social actors by similarity in resource dependence. In organizational ecology, the unit of analysis is the organizational population, which is defined as the set of organizations manifesting an organizational form. One of the most common defining characteristics of an organizational form is its niche: the combination of resource abundances in which it is found. Because most of the resources organizations utilize come from other organizations, such flows of resources correspond to relations between organizational actors.

In social network analysis, actors are said to be structurally equivalent and to occupy the same position within the social structure if they have the same pattern of relations with others (Lorrain and White, 1971; White, 1981, 2002; Burt, 1992). The parallel with organizational ecology is especially clear in network analyses of markets. White (2002) conceives of markets as assemblages of ego-nets defined around producer organizations. Each organization acquires resources from upstream suppliers, often through the development and maintenance of enduring social ties. Such a producer also pushes product downstream to customers. As with the supplier relations, these may be single “one off” transactions of standardized goods for prices known in advance, or they may be enduring relationships based on incomplete contracts. These ego-nets aggregate into markets, as structurally equivalent sets of buyers and sellers operate in resource environments that have common properties. Viewed in this way, organizational population niches reflect structural equivalence among population members, as both DiMaggio (1986) and Burt (1992, Chapter 6) note. So the link between the ecologist's concept of niche and the network analyst's concept of structural equivalence is based on the view that organizations provide resources for other organizations and that organizational actors are identified through the resources they provide for and consume from other organizations.

To combine these two perspectives in our study of foundings, we focus on an important idea found widely in network research, that interorganizational networks are vehicles for the transfer of information. As we elaborate below, this function of networks is important because information is a key resource in the organizational creation process. A rich literature including insightful qualitative studies (Larson, 1992; Uzzi, 1997) as well as quantitative analysis of innovations (Bothner, 2003), practices (Davis, 1991; Davis and Greve, 1997), investment decisions (Sorenson and Stuart, 2001), and strategic behaviors (Haveman, 1993; Greve, 1995; Haveman and Nonnemaker, 2000) provides evidence of information transfer through inter-organizational networks. This literature also identifies two mechanisms of information transfer ─ direct contact and competitive monitoring ─ which are examined in greater detail below. Although much of this work focuses on individual organizations rather than organizational populations, information transfer should be as relevant to inter-population relations as it is to inter-organizational relations.

Network research points to two features of the movement of information across organizations that are particularly important in our analysis (Strang and Soule, 1998). First, much information transfer flowing through inter-organizational networks is localized in geographical space. A growing body of work indicates that the probability that two organizations are connected, like the probability that two individuals will interact, declines as a function of the geographic distance between them. Lincoln, Gerlach, and Takahashi (1992) report that Japanese corporations are more likely to share directors when they are headquartered in the same prefecture. Kono *et al.* (1998) and Marquis (2003) find the same pattern of local interlocking in the U.S. and also show that spatially proximate companies are more likely to share directors when the institutional context of the community facilitates interactions among the corporate elite. Sorenson and Stuart (2001) find that venture capitalists are far more likely to invest in entrepreneurial ventures that are located close by. Romo and Schwartz (1995) observe that the overwhelming majority of establishments in the State of New York do not migrate to lower-wage areas. They attribute this spatial stickiness of organizations to their embeddedness in the local economy. It seems clear that the positive effect of geographical propinquity on network formation occurs partly because the cost of interacting increases with geographic distance. A complementary explanation is based on organizational decision makers' limited ability to collect information about distant places (Pred, 1977).

Local interorganizational linkages are not the only type of ties facilitating the flow of information among colocated organizations. Professional and personal ties often overlap with inter-organizational ties (Saxenian, 1994; Kono *et al.*, 1998; Almeida and Kogut, 1999). An implication of this multiplexity of local networks is that information spills through different pathways among loosely connected organizations (Owen-Smith and Powell, 2004).

Second, networks linking spatially dispersed organizations are also vehicles for the transfer of information across geographical boundaries, although geographical distance may decrease the frequency and quality of the information transfer. Davis (1991) and Davis and Greve (1997) show that board interlocks facilitate the diffusion of novel management practices among spatially dispersed organizations. Sorenson and Stuart (2001) report that venture capital firms with many and dispersed relationships with other venture capital firms overcome the constraints of geographical distance by gaining access to information about distant investment opportunities through these inter-organizational linkages. Greve (1995) shows that intra-corporate networks linking spatially dispersed units facilitate the transfer of information about strategic decisions. Similarly, Hansen and Lovas (2004) report that intra-corporate linkages increase the probability of transfer of technical information among geographically dispersed units.

The observation that information travels through interorganizational connections both locally and across geographical boundaries may help us understand the link between community context and foundings of instruments manufacturers. A recurring theme in the entrepreneurship literature is that information about entrepreneurial opportunities is a key resource for organizational creation (Kirzner, 1973; Freeman, 1986; Romanelli, 1989; Venkatraman, 1997; Shane, 2000; for a review see: Audia and Rider, 2005). Researchers suggest that those who are aware that there are untapped opportunities in a particular business are more likely to take the steps necessary to create new organizations of that kind. Untapped opportunities can take many forms, including knowledge of unmet customer needs, awareness of technological developments that can improve the functionality of existing products, access to inputs under favorable conditions, or detailed information about market demand. The underlying mechanism linking organizational creation and access to information about entrepreneurial opportunities is motivational. Specific and timely information about entrepreneurial opportunities is likely to increase individuals' expectations that entrepreneurial efforts will lead to entrepreneurial rewards, thereby increasing entrepreneurial motivation (Vroom, 1964).

Much of this information is not publicly available, but rather is accessible only by individuals situated in favorable positions. Ecologists recognize the importance of access to information about entrepreneurial opportunities in organizational creation (Brittain and Freeman, 1980; Freeman, 1986), but they view these information flows as taking place primarily within the boundaries of organizational populations (Sorenson and Audia, 2000; Phillips, 2002; Stuart and Sorenson, 2003a, 2003b; for an exception see: Romanelli, 1989). The network literature reviewed above complements that argument by suggesting that information about entrepreneurial opportunities relevant to a particular population also flows from one organizational population to the other through inter-population relations. Therefore, it implies that access to entrepreneurial opportunities relevant to instruments manufacturing in a community is a function not only of the presence of members of the focal population but also is a function of the presence of organizational populations linked to instruments manufacturing. Furthermore, although network studies, like ecological studies of foundings, recognize that much information flows through inter-organizational relationships that are localized in space, they add the idea that organizational populations introduce information to the community through relations to organizational populations located elsewhere.

Hypotheses

We now turn to deriving specific implications of this integration of ecology and network analysis for the study of instruments organization foundings across communities. The first step is to identify the organizational populations that are tied to instruments manufacturing. Such organizational populations increase the availability of information about entrepreneurial opportunities relevant to instruments manufacturing. As we noted above, network research suggests two main mechanisms by which a given organizational population may be tied to the population of instruments manufacturers: direct contact and competitive monitoring. These mechanisms parallel two types of inter-population relations studied by ecologists, symbiotic and commensalistic relationships, respectively.

Direct Contact and Symbiotic Relationships. When two organizations engage in continuing economic exchange, they can be said to be in direct contact. Therefore, both suppliers and purchasers come into direct contact with instruments manufacturers. Ecologists would say that suppliers and purchasers are tied to instruments manufacturers by a symbiotic relationship because their differences complement each other. A by-product of these economic relations is the transfer of information across organizational boundaries. While specific features of the nature of the relationship may affect the kinds of information transferred (Uzzi, 1997), undoubtedly some information transfer occurs between the connected parties. Larson (1992) and Uzzi (1997), in their qualitative studies of buyer-supplier linkages, provide excellent examples. In Larson's study, a retailer reports how information passed on by a supplier facilitates decision processes: "They tell us their needs in excess of a year. We use that forecast information for our capacity planning and in working with our fabric suppliers so that we can support a particular need." One of Uzzi's garment manufacturers reports passing market signals to a buyer: "I get on the phone and say to a buyer, ‘this group is on fire’ [i.e., many orders are being placed on it by retail buyers].” Information about opportunities is routinely communicated in exactly this way, we think.

The social network literature reviewed above suggests that this information transfer may occur both between organizations colocated in space and between organizations located in different geographical areas. We believe that symbiotic relations to instruments manufacturing are likely to be both local and remote because instruments organizations sell to the national market and purchase inputs from geographically dispersed suppliers. Meyer (1990) classifies instruments manufacturing as a national market industry, producing high-value goods for which transportation costs are a small percentage of the purchase price. Furthermore, although producers locate near suppliers when transportation costs are a large part of the cost of the input (Weber, 1928), transportation costs are only a small fraction of the value of many of the components and technologies used to make instruments (Darnay, 1989). Electronic technologies and, in particular, semiconductor devices, which became an integral component of most instruments in the late 1970s, are an example. In a study of the computer industry, a sector that has much in common with instruments manufacturing in terms of technologies and components, Angel and Engstrom (1995) found that computer manufacturers usually acquired key technology inputs such as electronic components from suppliers that were geographically dispersed, with the notable exception of computer firms located in Silicon Valley.

Symbiotic interdependencies between organizational population produce social relationships through which information about entrepreneurial opportunities diffuses. Therefore, the spatial distribution of symbiotic organizational populations should influence the spatial distribution of foundings. Consider, for example, Baird Associates, a precision instruments company founded in the late 1930s in Massachusetts (Baird, 2004: 226–227). Before founding this company, John Sterner and Walter Baird worked for the Watertown Arsenal in Watertown, Massachusetts. The arsenal used DuPont instruments to analyze the quality of metals used in guns and ordinance. Sterner and Baird recognized an entrepreneurial opportunity when they discovered that the analysis of metals could be done more effectively by using X-ray diffraction tubes rather than the traditional chemical analysis. By interacting with DuPont executives – who were located in Wilmington, Delaware – Sterner and Baird realized that their innovative idea had value. DuPont, in fact, was the first organization that ordered their X-ray diffraction apparatus, which shortly thereafter became the first product of Baird Associates, a new instruments company based in Cambridge, six miles away from Watertown (personal communication, David Baird).

Two clarifications must be noted in our theoretical analysis. First, although our main argument focuses on inter-organizational ties as information channels, the linkages arising from symbiotic relations also provide individuals with opportunities to form social ties with other actors who may support new organizations in the focal population. These contacts may prove useful not only for recruiting individuals who have in-depth knowledge of the business, but also for securing support from future exchange partners, just as the Baird Associates founders' contacts with DuPont helped them secure their first sales of X-ray diffraction tubes. In addition, such social embeddedness increases the personal credibility and legitimacy of the new organization.

Second, as we noted in the introduction, one of the reasons we chose to study instruments manufacturing is that shipping costs of raw materials and finished products are only a small fraction of the total value of the products in this industry (Darnay, 1989). This feature of instruments manufacturing allows us to alleviate the concern that the potential positive effect of symbiotic organizational populations on foundings simply reflects entrepreneurs' preference to create new firms in locales where they can economize on transportation costs. Because shipping costs are modest, this industry is not greatly dependent on proximity to buyers and suppliers and in principle could be geographically dispersed. If a positive relationship between symbiotic organizational populations and foundings of instruments organizations is found, it is more likely to be due to the tendency of symbiotic organizational populations to facilitate access to information about entrepreneurial opportunities than to the fact that entrepreneurs choose to locate near suppliers or purchasers to minimize transportation costs. This alternative scenario is more likely in industries in which transportation economies are a primary concern.

Defining a community's symbiosis as the extent to which a local community is characterized by the presence of organizations that either supply goods to (supplier symbiosis) or purchase goods from (purchaser symbiosis) instruments producers, the above argument suggests the following prediction:

HYPOTHESIS 1: The greater a community's symbiosis, the higher the rate of instruments manufacturing company foundings.

Competitive Monitoring and Commensalistic Relationships. Competitive monitoring is another mechanism through which information flows within the market structure (Burt, 1992; Haveman and Nonnemaker, 2000; White, 2002; Bothner, 2003). Social network researchers suggest that structurally equivalent actors closely monitor each other because they compete for prominent positions within the network (Burt, 1987). The threat of being replaced prompts structurally equivalent actors to pay attention to each other. Importantly, direct contact is not a necessary condition for the transfer of information among structurally equivalent actors. As Burt notes (1987: 1293), structurally equivalent actors are likely to have "a direct and indirect awareness of each other: direct by meeting when interacting with mutual acquaintances and indirect by hearing about each other through mutual acquaintances."

This logic can be readily extended to organizational populations. Members of the same organizational population exhibit the highest degree of structural equivalence because they target the *same* inputs and the *same* customers. Organizational ecologists refer to this as "diffuse competition." This relation of structural equivalence prompts them to monitor each other (Haveman and Nonnemaker, 2000; White, 2002; Bothner, 2003). The resulting information exchange informs potential entrepreneurs about opportunities that emanate from changing markets and technologies. The positive effect of information on founding rates closely resembles the legitimation effects posited by organizational ecologists in the theory of Density Dependence Selection (Hannan, 1986; Hannan and Freeman, 1989).

If relations of structural equivalence facilitates the flow of information, then information also flows across the boundaries of organizational populations that have a similar pattern of relations within the market structure. Machinery producers and instruments manufacturers, for example, pay attention to each other because they compete among themselves to secure electronic components under the best possible conditions. We describe these inter-population relations as commensalistic, using the concept of commensalism which “literally interpreted, means eating from the same table” (Hawley, 1950: 39). The concept of commensalism allows us to differentiate relations of structural equivalence among distinct organizational populations from relations of structural equivalence tying members of the same organizational population.

By monitoring the actions of instruments manufacturers, commensalistic organizational populations such as machinery producers can anticipate situations that may potentially damage their position and, more important, can prepare themselves to follow suit (White, 2002; Bothner, 2003). Note that commensalistic organizational populations may monitor instruments manufacturers both locally and non-locally.   In either case, information transfer takes place. Obviously, the individuals doing the monitoring may learn of entrepreneurial opportunities in the instruments business. Some of these individuals can then capitalize on the information to which they have access by creating new instruments manufacturers. This information will not be uniformly distributed in space. It will be more readily available in communities that have organizational populations tied to instruments manufacturing by commensalistic relationships.

The mutualistic effect of commensalism is suggested by a study of high-technology start-ups in Silicon Valley (Cooper, 1970). This research showed that 63% of 220 start-ups were founded by individuals who came from organizations that served similar markets. Historical accounts of the origins of the automobile and television receiver industries provide additional evidence. Many of the first automobile producers came from organizations such as bicycle and horse-drawn carriage makers that served similar markets (Rae, 1959; Carroll *et al.*, 1996). Similarly, many of the founders of television receiver manufacturers had worked in firms that made radios ─ again, an organizational population that served the same market (Klepper, 2003). Furthermore, detailed histories of specific companies seem consistent with the idea that close monitoring of the actions of commensalistic organizations often precedes the recognition of entrepreneurial opportunities that stimulates organizational creation. Rae (1959: 16), for example, reports that Studebaker Brothers, the largest producer of horse-drawn vehicles, "made a point of keeping in touch with every development in the vehicle field." Although the company had considered and rejected the idea of making bicycles, their constant monitoring of organizations addressing transportation needs likely led to the decision to enter automobile production. Similarly, Barber (1917: 72–73) recounts how Charles Dureya, a bicycle mechanic, produced a gasoline-powered automobile by "merely assembling the ideas that had been accumulated." Presumably, to assemble these ideas, Charles Dureya must have paid attention to developments in the vehicle field, as people in Studebaker Brothers did.

Just like symbiotic organizational populations, commensalistic organizational populations are likely to provide individuals not only with information about entrepreneurial opportunities relevant to instruments manufacturing but also with social ties to resource providers. The fact that commensalistic organizations engage in exchange relations similar to those of the focal population suggests that aspiring entrepreneurs coming from the ranks of these organizations do not have to start a new business from scratch. Compared to individuals located elsewhere in the social structure, they are in a position to know exchange partners who might be able and willing to support a new organization in the focal population. Their reputations may also help them secure favorable exchange conditions from suppliers and early commitments from purchasers.

We define a community's commensalism as the extent to which a community is characterized by the presence of organizational populations that are similar to instruments manufacturing in terms of the markets they serve or the suppliers from which they acquire inputs. Based on the above argument, we make the following prediction:

HYPOTHESIS 2: The greater a community's commensalism, the higher the rate of instruments manufacturing company foundings.

Our argument that inter-population relations serve as channels for the transfer of information about entrepreneurial opportunities suggests three additional predictions.

Information Redundancy. If much information about entrepreneurial opportunities relevant to instruments manufacturing originates within this same organizational population, then the extent to which the information channeled by symbiotic and commensalistic organizational populations is unique and nonredundant will be a function of the local density of instruments manufacturers. In communities that have many instruments manufacturers, information about this business may already be widely available. A large number of instruments organizations means that many individuals employed by these organizations know of entrepreneurial opportunities relevant to this business. Furthermore, information that resides within pre-existing instruments manufacturers is likely to spill over within the community through professional and personal networks. In contrast, in communities having few instruments manufacturers the information channeled by symbiotic and commensalistic organizational populations serves as a "second best" source. This reasoning suggests that the effect that symbiotic and commensalistic organizational populations have on the founding rate may be contingent on the local density of instruments manufacturers.

HYPOTHESIS 3: The smaller the number of instruments manufacturers, the greater the positive effect of a community's symbiosis and commensalism on the rate of instruments manufacturing company foundings.

Initial Foundings. Taking this logic one step further, the theoretical argument developed here provides a possible explanation for the emergence of the first instruments manufacturers in unoccupied communities. Symbiotic and commensalistic organizational populations in unoccupied communities by definition are tied to instruments manufacturers located elsewhere. These related organizational populations introduce information into the community that would otherwise not be available. Because information about entrepreneurial opportunities increases the probability that some individuals might create new organizations, the probability of initial foundings should be higher in those communities than in unoccupied communities that do not have organizational populations with commensalistic and symbiotic patterns of exchange with instruments manufacturers.

HYPOTHESIS 4: The greater a community's symbiosis and commensalism, the higher the probability of the first foundings of instruments manufacturing companies.

Information Decay. Furthermore, if the effect of symbiotic and commensalistic organizational populations on foundings arises from information transfer, we can also expect that whether an unoccupied locality is situated in geographical proximity to instruments manufacturers or, instead, is far removed from them will be consequential. Specifically, the flow of information arising from direct contact or competitive monitoring should be hindered by geographical distance. As geographic distance increases, the opportunity for face-to-face interaction declines due to time constraints and transportation costs. Furthermore, the means of communication that replace face-to-face interaction likely decrease the quantity and quality of the information exchanged. Evidence supporting this reasoning comes from studies of intra-organizational information transfer. Hansen and Lovas (2004) find that spatially dispersed teams that have similar competencies are more likely to transfer information than spatially dispersed teams that do not have similar competencies, but this effect declines with geographic distance. Similarly, Audia, Sorenson, and Hage (2001) report that multi-unit organizations benefit from knowledge transfer across units but those that are more geographically dispersed benefit less. The friction created by geographic distance in the transfer of information leads us to expect that the impact of symbiotic and commensalistic organizational populations on initial foundings should be weaker as the geographic distance from instruments manufacturers increases.

HYPOTHESIS 5: The greater the geographic distance between an unoccupied community and instruments manufacturers, the smaller the positive effect of a community's symbiosis and commensalism on the probability of the first foundings of instruments manufacturing companies

Local dominance. Thus far we have focused on organizational populations tied to instruments manufacturers by a relationship of interdependence. We conclude our analysis by considering whether and when unrelated organizational populations may influence foundings of instruments manufacturers. As we noted above, ecological studies of foundings suggest that founders face two problems: finding the necessary resources, one of which is information, and building legitimacy for the nascent organization. We have argued that information moves among organizational populations tied by symbiotic and commensalistic relations. This implies that organizational populations that lack these ties to instruments manufacturing are less likely to be a source of information about instruments manufacturing. However, unrelated organizational populations that occupy a position of *local dominance* may influence the legitimacy attributed to the organizational forms present in the community.

Hawley defines dominants as those units performing a key function, and notes that "the key function is determined by the comparative importance of production and of trade as sources of sustenance" (Hawley, 1986: 35). Dominance involves both power and resource distribution. At times, dominant actors are viewed as those having a disproportionate share of the resources. These conceptualizations are especially common when the analyst is studying metropolitan area dominance (Duncan *et al.*, 1960). In other treatments, actors are dominant because they have power over others (Friedland and Palmer, 1984). Hawley's (1986) theory combines the two, arguing that standing higher in the flow of resources of a community itself creates hierarchy. Other actors, standing downstream in the resource flow, depend on those above them and are subject to extortionate demands by dominant actors. This would be true whether those actors are cities within a metropolitan area, or organizations within a region, or families within a city or town.

In this study we are primarily interested in the dimension of dominance that pertains to resource distribution. We treat an organizational population as dominant if it has the largest share of resources in the area. The main argument proposed in this paper implies that the presence of a dominant population so defined should influence the type of information available within the community. Residents likely have greater access to information relevant to both the dominant population and to the populations to which it is related by commensalistic and symbiotic relationships. A dominant population related to instruments manufacturing by a symbiotic or commensalistic relation should have a positive impact on the flow of information that may propel individuals into creating instruments organizations. A dominant population unrelated to instruments manufacturing should not have an impact on the availability of information relevant to instruments manufacturing, but it may modify the founding rate of instruments manufacturers by influencing the legitimacy attributed to different organizational forms present in the community.

As Carroll and Hannan note (2000: 339), an organizational form becomes legitimate in part "as a greater number of individuals come into contact with it and thereby become aware of its features." A form acquires legitimacy through repeated contact because it is gradually perceived as "a natural way to effect some kind of collective action" (Carroll and Hannan, 2000: 223). Given that the legitimation process is driven by the frequency of contact, it is no great leap of logic to suggest that the dominant population often will be perceived by residents as more legitimate than other organizational forms since it is the organizational form most frequently encountered within the community. Furthermore, the pattern of market relations in which the dominant population is embedded is likely to influence the extent to which residents become aware of the features of other organizational forms. Because the dominant population facilitates direct and indirect contact with organizational populations to which it is related by symbiotic and commensalistic relations, holding other community characteristics constant, these organizational populations should be perceived as more legitimate than organizational populations that are not tied to the dominant population. This reasoning suggests that in communities that have a dominant population unrelated to instruments manufacturing, instruments organizations may suffer from a legitimacy gap compared to the dominant population and to the organizational populations to which the dominant population is related

The frustrations of a New York City (NYC) software entrepreneur named Bernstein help illustrate this point. According to Stites (1999), investors overlooked Mr. Bernstein's software venture because NYC, unlike Silicon Valley or Boston's Route 128, is not recognized as a center for software development. NYC, as Stites puts it, is known for its content, not for its code. Stites reports that unless Mr. Bernstein can link his venture to the media industry with which New Yorkers are familiar, he faces a battle in gaining support for his business. One venture capitalist approached by Bernstein notes that investors will be persuaded to invest in software in NYC "when they see that the software industry is here and thriving."

Because New York City has a more diverse local economy than, say, Detroit or Silicon Valley, this example probably understates the legitimacy gap that an organizational form may incur when its presence in a community is overshadowed by an unrelated dominant population. Nonetheless, it helps illustrate our conjecture that foundings of an organizational population may be lower when the organizational population occupies a peripheral position in a community. Specifically, we view the presence of a dominant population unrelated to instruments manufacturing as a local condition that renders instruments manufacturing peripheral in the community and, therefore, an organizational form with dubious standing. The constraining effect of an unrelated dominant population should be moderated by the density of instruments manufacturers in the community because the more instruments manufacturers there are, the more people are likely to take for granted this organizational form and the lower the gap between the legitimacy of instruments manufacturing and the legitimacy of the dominant population. Furthermore, this constraining effect of an unrelated dominant population on foundings of instruments organizations may also be a reason why some unoccupied communities experience initial foundings whereas others do not.

When the dominant organizational populations are unrelated to instruments manufacturers:

HYPOTHESIS 6: The larger a community's dominant population, the lower the rate of instruments manufacturing company foundings.

HYPOTHESIS 7: The larger the number of instruments manufacturers, the smaller the negative effect of a community's dominant population size on the rate of instruments manufacturing company foundings.

HYPOTHESIS 8: In an unoccupied community, the larger a community's dominant population, the lower the probability of the first foundings of instruments manufacturing companies.

THE GEOGRAPHY OF FOUNDINGS IN INSTRUMENTS MANUFACTURING

Between 1978 and 1988, the period examined in this study, instruments manufacturing experienced sustained growth in the United States (U.S. Department of Commerce 1977, 1983, 1990). The high costs of energy and raw materials in the early 1970s were important factors underlying this growth. The surge in energy prices led to demand for instruments designed to increase energy efficiency through improved measurement and control (e.g., thermostats with timers to minimize fuel use when buildings are empty). Furthermore, federal fuel emissions regulations had a beneficial effect, as corporations demanded instruments that could both measure emissions and limit the release of harmful substances. The introduction of the microprocessor also proved to be important, as it helped the industry develop new and improved products. For example, microprocessor technology enabled smaller devices, which led to the generation of analytical instruments that could be taken outside laboratories and into the field.

Under these favorable conditions, the value of shipments increased from $46 billion in 1977 to $105 billion in 1987 (constant dollars), and many new organizations were formed. Data from Dun and Bradstreet indicate that the density of instruments manufacturers, including both autonomous firms and branches of existing organizations, went from 10,422 in 1978 to 16,295 in 1988. During this period, 11,726 new autonomous firms were added. But where did these new organizations emerge?

{Figures 1 and 2 about here}

In Figures 1 and 2, the unit of observation is the Labor Market Area (LMA), a geographical area defined by the Census Bureau on the basis of journey-to-work reports (Tolbert and Killian, 1987). An LMA encompasses the territory where people work and live and thus matches ecological definitions of the local community reasonably well (Hawley, 1950). (More details on the procedure used to form LMAs are provided below.) These two figures show, respectively, the distribution of instruments manufacturers in 1978 and the distribution of instruments manufacturers formed between 1978 and 1988. Darker shadings indicate LMAs with larger numbers of instruments manufacturers. Together, the figures suggest that most new autonomous organizations were formed in areas that already had organizations of the same type.

Figure 1 shows that 56% of the establishments were located in 15 LMAs where 24% of the human population resided in 1978. The largest concentrations of instruments manufacturers were in Los Angeles, New York City, Chicago, Boston, Philadelphia, Trenton, and San Jose. The LMAs with the highest density per capita were San Jose and Boston, with 16 and 13 organizations per 100,000 inhabitants, respectively. Figure 2 is strikingly similar to Figure 3. Between 1978 and 1988, 49% of the new organizations were formed in the 15 LMAs that had the highest concentration of organizations in 1978.

Although this evidence that the spatial distribution of founding mirrors the spatial distribution of pre-existing organizations is consistent with DDS, a closer look at the data reveals two deviations from this general pattern. First, local communities with zero density in 1978 took different paths. Some did not generate any new organizations during the entire period, as would be predicted by the theory of DDS. Others became fertile during the following decade. For example, Kalispell, Montana, the fourth LMA from left to right in the upper left corner of the United States, despite having zero density in 1978, generated nine new instruments manufacturers between 1978 and 1988. Second, areas with similar numbers of instruments organizations also took diverging paths. Austin, Fort Collins, Tampa, and San Jose generated many more new organizations during the decade than they possessed in 1978, as DDS would suggest. However, other areas that were densely populated in 1978, such as Evansville, Louisville, Binghamton, Rochester, and Trenton, added new organizations at much lower rates, showing signs of stagnation. Next, we examine how relations among organizational populations may help explain these differences in the location of foundings.

METHOD

Data

To examine how inter-population relations influence foundings of instruments manufacturers, we use a dataset assembled by the U.S. Small Business Administration (SBA). This dataset contains information on U.S. establishments in all two-digit nongovernmental SIC sectors between 1976 and 1988. The two-digit classification parallels ecological and network definitions of organizational populations as sets of structurally equivalent actors because it groups establishments on the basis of the type of raw materials used and the skills involved as well as similarities in the technical organization of the production process (Miernyk, 1965).

Furthermore, this classification meets the requirements of an identity-based definition of the boundaries of organizational populations (Carroll and Hannan, 2000). Two-digit SIC categories imply distinct identities, as each defines organizational properties for inclusion. These identities are also external in the sense that they are recognized and enforced by outsiders. Government analysts define whether an organization belongs to SIC 38, which comprises instruments manufacturers and related organizations, as opposed to other two-digit level industries. Furthermore, empirical evidence suggests that securities analysts view two-digit SIC categories as distinct organizational identities. In a study which shows that firms were more likely to de-diversify when they were not perceived by analysts to have a clear identity, Zuckerman (2000: 602) treats cases in which firms replace a three-digit SIC code in their business segment profiles with another three-digit SIC code (within the same two-digit category) as continuation of the firm identity. Furthermore, in a related study showing that a firm's "coverage mismatch" has a negative effect on the stock value, Zuckerman (1999: 1418) obtains similar results when firms are categorized using two-digit or three-digit SIC codes. Two-digit SIC categories are easily recognized by outsiders such as securities analysts because they are stable over time, and are embedded in societal institutions such as directories published by government organizations and business service organizations.

The SBA dataset is based on Dun and Bradstreet's *Dun's Market Identifiers* files, which assign a numerical identifier to every U.S. establishment in December of every even-numbered year from 1976 to 1988 (see Reynolds and Maki, 1990). Dun and Bradstreet identifies establishments by combining information collected through its credit-reporting function with information gathered from other organizations that compile lists of companies. A comparative analysis of the strengths and weaknesses of alternative sources of data regarding U.S. establishments found that Dun and Bradstreet data provide better coverage of the entire economy than other sources (e.g., White Pages) and constitute one of the most useful sampling frames for studying organizations (Kalleberg et al., 1990). An establishment is defined as a single physical location where business activity is conducted, and the data distinguish between autonomous establishments and branches (i.e., establishments that belong to a company). Comparison of two consecutive years made it possible to identify new organizations. For each two-year period, organizational foundings are defined as those autonomous establishments present only in the second year. As a result, the data incorporate organizational foundings between 1976 and 1978 (which we date 1978) and so on for 1980, 1982, 1984, 1986, and 1988. There are six two-year waves of observations for the United States. Besides the number of organizational foundings, each wave includes the total density of each population, which we define as the count of all establishments, both autonomous units and branches.

The data were aggregated at the level of the Labor Market Area (LMA), a geographical area defined as the territory where people work and live and identified on the basis of journey-to-work patterns reported in the 1980 census (Tolbert and Killian, 1987). Information about commuting patterns was used to distinguish "bedroom" counties (where people live) from "in commuting" counties (where people work). The resulting areas made up 382 LMAs. Some LMAs, those in rural areas in particular, were aggregated to reach a minimum human population of 100,000. Both the definition of the LMA and the manner in which the data were aggregated match human ecologists' definition of the residential community reasonably well. Sections of the maps of LMAs in Figures 3 and 4 may look unfamiliar because one third of these LMAs involve counties from two or more states.

There are two reasons for preferring LMAs over Metropolitan Statistical Areas (MSA) and/or U.S. states for empirical analyses. First, LMAs cover the entire U.S. and, unlike MSAs, are not required to contain a metropolitan area with at least one urbanized area of 50,000 people. So, LMAs include the rural U.S. Second, the basis for LMA identification is commuting patterns and not arbitrary geopolitical boundaries, which is consistent with human ecologists's definition of community – the geographical area where people work and live (Hawley, 1986).

Measures

To gather information on relationships of interdependence among organizational populations, we focused on patterns of resource utilization (Pfeffer, 1972; Burt, 1983, 1992). Organizational population A is tied to the population of instruments manufacturers by a *commensalistic* relationship to the extent that it uses similar inputs in the production process or serves similar markets. Organizational population B is tied to the population of instruments manufacturers by a *symbiotic* relationship to the extent that it is either a supplier of inputs or a purchaser of instruments. Because the exchange relations of instruments manufacturers often transcend the geographical boundaries of local communities, we determine these relationships of interdependence by examining the pattern of transactions at the national level. Specifically, we use information from the U.S. Department of Commerce's benchmark input-output tables for 1977 and 1987 (U.S. Department of Commerce, 1984, 1994) and obtain input-output information for the missing years through interpolation. For each sector, the tables report the amount in dollars of purchases from other sectors and the amount in dollars of sales to other sectors. Direct evidence of transactions at the level of the local community — separating transactions within the community from transactions among communities — would be preferable, but such data do not exist

(Dietzenbacher and Lahr, 2001: 10; cf. Romo and Schwartz, 1995). Inter-regional input-output models are usually computed by "regionalizing" national data on the basis of complex estimation procedures (Dietzenbacher and Lahr, 2001). However, researchers note that these procedures provide little improvement over national averages (Round, 2001; Canning and Wang, 2003). Here we use national exchange patterns to generate weights that are applied to organizational population densities observed at the LMA level.

To match the input-output dataset to the SBA dataset, we had to resolve some discrepancies between sectors in the input-output tables and those in the two-digit SIC classification. The reason for these discrepancies is that, in more recent input-output tables, some of the two-digit SIC sectors have been disaggregated to reflect the expansion of certain industries, and a few others have been aggregated to reflect the maturity of certain industries. The *Benchmark Input Output (IO) Account* for 1987 (U.S. Department of Commerce, 1994) reports precise information that allowed us to closely match IO sectors to two-digit SIC sectors. The only major discrepancy between the two data sources that we were unable to address concerned retail organizations. Although there are ten two-digit SIC retail sectors (e.g., food stores, general merchandise, apparel, auto, and gas stations), the benchmark input-output tables differentiate only between wholesale and retail trade. Consequently, our data did not allow us to trace patterns of exchange between the ten two-digit SIC retail sectors and instruments organizations. For this reason, our community variables do not include information about retail organizations.

We computed two measures of community symbiosis. *Community supplier symbiosis* is the degree to which a community is characterized by the presence of organizational populations that supply inputs to the focal population.

$$CS_j = \sum_k (Z_k / R_k) * (d_{kj} / D_j),$$

where

j indexes all communities,

k indexes organizational populations excluding the focal population,

Z_k is the dollar value of inputs that the focal population acquires from population k,

R_k is the dollar value of sales made by population k to all organizational populations,

d_{kj} is the density of establishments of population k in community j,

and D_j is the total density in community j.

To illustrate how Z_k / R_k varies across organizational populations, the value of this ratio is zero or very close to zero for tobacco, crop production, and metal mining, whereas it has the highest values for electric and electronic equipment, fabricated metal, and rubber and plastic. Community supplier symbiosis equals zero if a community does not have any organization that supplies inputs to instruments producers. As the proportion of organizations that supply inputs to instruments manufacturers increases, and as the proportion of sales made to instruments manufacturers increases, a community's supplier symbiosis increases. We use proportions rather than absolute counts of organizations to avoid overwhelming the measure with the effects of metropolitan size. The results obtained using this proportional measure of community symbiosis were equivalent to those obtained including the total density of the local community as a separate variable and measuring community symbiosis as the sum of the density of the organizational populations in the local community weighted by the proportion of trade.

We also use proportion of sales made to the focal population because we believe that the more suppliers are dependent on transactions with the focal population to make their sales, the more they will pay attention to this exchange relationship. Presumably greater attention implies greater potential recognition of information about entrepreneurial opportunities relevant to the focal population.

Community purchaser symbiosis is the degree to which a community is characterized by the presence of organizational populations that purchase goods from the focal population and is measured using the same equation. The only differences are that Z_k is the dollar value of sales from the focal population to population k, and R_k is the dollar value of purchases made by population k from all organizational populations. Health, transportation equipment, and printing and publishing are the organizational populations with the strongest purchaser symbiosis relationship to instruments whereas textiles, food and kindred, and tobacco have the weakest, with values of Z_k / R_k equal or very close to zero.

To compute *community commensalism,* which we define as the degree to which a community is characterized by the presence of populations of organizations that have a pattern of transactions similar to that of the focal population, we first calculated the degree of similarity in transactions with suppliers (or transactions with purchasers) between each population k and the focal population. This is an instance of structural equivalence, and, following prior studies (e.g., Burt, 1983), was operationalized as a Euclidean distance converted into similarity:

$$S_k = \exp\left\{-[\sum_r (p_{kr} - p_r)^2]^{.5}\right\}, \quad k \neq r$$

where

k and r index organizational populations excluding the focal population,

S_k is the degree of similarity between organizational population k and the focal population,

p_{kr} is the proportion of population k's input supplied by population r (or output sales to population r),

p_r is the proportion of the focal population's input supplied by population r (or output sales to population r).

The value of S_k would be 1 if a population k and the focal population had identical profiles of transactions. The degree of similarity in transactions with suppliers has a strong positive correlation to the degree of similarity in transactions with purchasers (r = .95). This is because sectors similar to instruments manufacturers in terms of the inputs acquired tend to serve similar product markets (Burt, 1983). Given the high correlation between the two similarity measures, we computed the community commensalism measure using only similarity in transactions with suppliers. Printing and publishing, machinery, and electric and electronic equipment have the highest values of S_k, whereas food and kindred, tobacco, and health have the lowest. Community commensalism was computed as the weighted sum of the proportion of each population in a community times its similarity to the focal population.

$$CC_j = \sum_k (S_k) * (d_k / D_j),$$

where

j indexes all communities,

k indexes organizational populations excluding the focal population,

S_k is the degree of similarity between organizational population k and the focal population,

d_k is the density of establishments of population k,

and D_j is the total density in community j.

{Table 1 about here}

The correlations between our measures of symbiosis and commensalism are only moderately positive, as reported in Table 2. To examine the dampening effects of geographic distance on the effects of symbiosis and commensalism, we constructed a time-varying, distance-weighted measure of non-local density. We weighted each non-local instruments organization's contribution to the measure according to the inverse of the geographic distance between the community in which it is located and the focal community. We then summed these weighted contributions across all non-local instruments organizations. Smaller values on this variable indicate greater geographical distance from instruments manufacturers located outside the community.

To calculate the geographic distance between a focal community and non-local instruments organizations, we identified the center point of each LMA, which we defined as the center of the most populous county in the LMA. We then assigned to each non-local instruments organization the latitude and longitude of the center of the LMA in which it is located and computed the geographic distance from that point to the center of the focal LMA. To take into account the curvature of the earth, these geographic distances were computed using spherical geometry (see Sorenson and Audia, 2000).

The measure of nonlocal density weighted by geographic distance is given by the following formula:

$$NLDW_j = \sum_u (D_u) * (1/d_{uj}), \quad u \neq j$$

where

j indexes all communities,

u indexes communities excluding community j,

D_u is the local density of instruments manufacturers in community u,

and d_{uj} is the geographic distance between community u and community j.

We also created a measure of a community's dominant population weighted by the degree of interdependence with instruments manufacturing. The first step was to identify the organizational population with the largest share of resources in each LMA. The best available indicator of resources controlled by an organizational population was the total amount of wages paid by each organizational population, which is a function of both the total number of people employed and the value of the economic activities performed. The source of the wages data was the Bureau of Labor Statistics. For each population we then computed the ratio of its aggregate wages over the total wages in the community and identified the local dominant population as the one with the highest ratio.

The next step was to create a measure of the degree to which the dominant population lacked symbiotic and commensalistic ties to instruments manufacturing. To compute this measure we first averaged the three indicators of supplier symbiosis, purchaser symbiosis, and supplier commensalism. These indicators were standardized and transformed so that they varied between 0 and 1 before the average was computed. We then subtracted this average from 1 to obtain a measure of unrelatedness to instruments manufacturing. Producers of tobacco products and food and kindred products had the highest values on this measure whereas printing and publishing organizations and producers of electronic and electrical equipment had the lowest scores. The last step was to weight the ratio of the wages of the dominant population over the total wages in the community by the degree of unrelatedness. The greater the degree of unrelatedness, the more the dominant population was positively weighted. This weighted measure is useful to the extent that the effect of a community's dominant population is contingent on the degree of unrelatedness to instruments manufacturing. We therefore report results of preliminary analyses in which we probed this assumption.

Models

We modeled organizational foundings at the LMA level. Organizational foundings is an event-count variable that takes only non-negative values. This type of variable is usually examined using the Poisson model unless it displays overdispersion (a violation of the assumption that the mean and variance are equal). A likelihood ratio test showed significant evidence of overdispersion (mixture $\chi^2 = 3825.5$; $p < .05$). Consequently, negative binomial regression was chosen (Cameron and Trivedi, 1998). We clustered observations by LMA and used robust variance estimates to allow for non-independence of the observations belonging to the same LMA.

Besides the main independent variables of interest reported above, the models include the *local density* of instruments manufacturers and its squared term. The theory of DDS holds that in organizational populations studied from their origin density has a non-monotonic effect whereby high levels of density increase the number of foundings but at a decreasing rate, because the legitimating effect of density fades and available inputs become scarcer. Our dataset does not allow a proper test of the theory of density dependence at the level of the local community because each LMA contains left-censored data structures. The coefficients of the density dependence terms therefore must be interpreted with caution. We chose to include them for completion, and to contribute comparability.

To take into account the geographical position of a given LMA in relation to instrument manufacturers located in other LMAs, we included as a control *nonlocal density weighted by geographic distance* which we discussed in detail above. Empirical studies show that the density of organizations in nearby communities may have either mutualistic effects (e.g., Hedstrom, 1994) or competitive effects (e.g., Sorenson and Audia, 2000) on foundings. Regardless of the sign of the effect, this form of spatial interdependence may contribute to correlated error terms and therefore may be a source of spatial autocorrelation (Doreian, 1981). As the distance from instruments manufacturers located outside the community increases, values on this variable decrease.

We differentiated between urban and rural communities by including *human population density*, which is the number of persons per square mile. The extremes are Alaska (0.7 persons per square mile) and the New York City-Long Island LMA (5,675 persons per square mile). We also controlled for the availability of a *skilled work force*, which may render communities particularly attractive to would-be entrepreneurs. This was computed by creating a composite indicator based on U.S. Census information about persons with postgraduate degrees per 1,000 square miles, professional and technical employees per 1,000 square miles, patents granted per 1,000 square miles, and doctorates granted per 1,000 square miles (reliability = .99). Finally, we included *year dummy variables,* using 1978 as a base, to rule out the possibility that some of the independent variables captured the passage of time. We do not include variables that change over time but are the same across LMAs (e.g., national density of instruments manufacturers, exports) because the coefficients of such variables are not identified when year-dummies are present. Our specification emphasizes differences across LMAs. Independent and control variables were lagged and correspond to the previous two-year wave beginning with 1978. Therefore, five time periods entered the analyses.

{Table 2 about here}

RESULTS

The first set of results are shown in Table 3. In Model 1, the coefficient of local density is positive while the coefficient of density squared is negative. Thus, as the theory of DDS predicts, the founding rate rises with increasing local density but the rate of founding tapers off as the carrying capacity is reached. Furthermore, the inflection point is approximately 1000 and falls within the range of the data. Importantly, these effects remain significant when community characteristics that capture inter-population relations are included. Model 1 also shows several significant effects for the control variables. Foundings of instruments organizations are less likely in urban areas that have greater human population density. Non-local density weighted by geographic distance has a negative and significant coefficient which suggests a competitive effect of instruments manufacturers in nearby communities. Furthermore, a skilled work force has a positive and significant coefficient whereas the coefficients of the year-dummies indicate that the founding rate is greater in later years than in 1978. Note though that, with the exception of the year-dummies, the effects of these control variables become weaker or disappear when independent variables are added to the models. Note also that throughout the analyses we use one-tailed tests when the sign of the coefficient is specified theoretically and two-tailed tests for the control variables.

In Model 2 we added community variables to discern the effect of organizational populations related to instruments manufacturing. The coefficients are positive and significant and therefore indicate that community purchaser symbiosis, community supplier symbiosis, and community commensalism increase foundings as predicted in Hypotheses 1 and 2. Furthermore, these variables improve model fit considerably (Model 2 versus Model 1 likelihood ratio test statistic = 532.68; change in df = 3; $p < .001$). We then entered in Model 3 product terms to see if there are interaction effects between each of these variables and the local density of instruments manufacturers. Multicollinearity does not appear to be a problem. The correlations among the interaction terms and the independent variables are not high (the largest is 0.50), probably because we obtained the product terms by using mean-deviated terms. Furthermore, preliminary analyses show that regression coefficients as well as standard errors are stable when product terms are entered in a hierarchical manner. The coefficients of these interaction terms are negative and significant, indicating that the greater the number of instruments manufacturers, the smaller the positive effect of related organizational populations densities on the founding rate of instruments manufacturing companies. This evidence therefore supports Hypothesis 3. Model 4 shows that these effects remain unchanged when we include fixed effects at the state level, which allow us to control for determinants of entrepreneurial activity that may vary across geopolitical boundaries (e.g., corporate tax rates, special incentives). The last two columns show that negative binomial regression with random effects and zero-inflated Poisson yielded the same results.

It is worth noting that the effect of community supplier symbiosis is substantially stronger than the effect of community purchaser symbiosis and community commensalism. A possible explanation for this is that organizations invest more efforts in downstream transactions than in upstream transactions or competitive monitoring, a scenario which, according to some researchers, seems consistent with the apparent greater concentration of resources and staff in marketing functions than in purchasing or competitive intelligence functions (Burt 1983; Romo and Schwartz 1995). This tendency might have been even stronger in the setting of this study because instruments manufacturing experienced a phenomenal period of growth during our observation period. One would expect suppliers to be particularly attentive to clients that requested increasingly larger volumes of their products. This downstream orientation may have led to greater information transfer between suppliers and instruments manufacturers and thus to a greater impact on the founding rate of instruments organizations.

{Table 3 about here}

Next, we considered the effect of symbiotic and commensalistic organizational populations on the founding rate of communities that do not have instruments manufacturers at the beginning of the observation period. These analyses helped us address the question of why some unoccupied communities experience initial foundings whereas others do not. Of the 382 LMAs, 52 were unoccupied in 1978, 34 of which experienced foundings during the observation period. LMAs are removed from the sample when the first founding takes place yielding a sample size of LMA-year observations equal to 190. We dealt with left-censoring by including a variable that records the local density of instruments manufacturers in 1973. County Business Patterns, a yearly document published by the Bureau of the Census, revealed that only 7 of the 52 LMAs unoccupied in 1978 had one or more instruments manufacturers in 1973. We also checked local densities ten years prior to the beginning of the observation period (1968) and found that 4 of these 7 LMAs had one or more establishments in 1968, whereas the others had zero density. So LMAs that were unoccupied by instruments manufacturers at the start of the study had been unoccupied for years. Poisson models are appropriate to examine the probability of infrequent events such as initial foundings (Tuma and Hannan, 1984; Cameron and Trivedi, 1998) and are reported here. In supplemental analyses we also modelled a community's probability of being unoccupied and a community's probability of experiencing initial foundings using bivariate probit regression (Greene, 2000). A bivariate probit model, however, could not be estimated due to convergence problems. Failure to obtain estimates is common in models, such as the bivariate probit model, that try to estimate correlation coefficients between two equations (Limdep Version 8.0). In this case, the non-converging results may have been caused by too few initial foundings in the sample. We also report logit models as a robustness check. As in the negative binomial models, we clustered observations by LMA and used robust variance estimates to allow for non independence of the observations belonging to the same LMA.

Despite the much smaller sample size, the pattern of results for the entire sample is confirmed in our analyses of initial foundings. Model 1 in Table 4 shows that most control variables have negligible effects on entrepreneurial activity in unoccupied LMAs. In Model 2 we drop unessential control variables to maximize degrees of freedom and the log likelihood remains virtually unchanged. Model 3 shows positive and significant effects of community purchaser symbiosis and community commensalism as predicted in Hypothesis 4. The coefficient of community supplier symbiosis is not significant but interpretation of this effect must wait until the interaction terms between community symbiosis and community commensalism and nonlocal density weighted by geographic distance are included. Model 4 adds these interactions and shows positive and significant interactions for community supplier symbiosis and community purchaser symbiosis. Furthermore, the main effect of community supplier symbiosis turns significant.

Recall that when the variable nonlocal density of instruments manufacturers weighted by geographic distance is larger, the geographical distance between the community and instruments manufacturers located elsewhere is smaller. These interactions then indicate that the greater the geographic distance between an unoccupied community and instruments manufacturers, the weaker the positive effect of community symbiosis on the founding rate. The interaction between non-local density weighted by geographic distance and community commensalism is negative and not significant. This may be because information transfer between commensalistic organizational populations is less dependent on face-to-face interaction than information transfer between symbiotic organizational populations. Geographic distance impedes information transfer especially by reducing the frequency and quality of information transferred through such forms of direct contact. Thus Hypothesis 5 receives ony partial support.

Model 5 does not include the non-significant interaction between community commensalism and nonlocal density and provides the best fit over the reduced baseline model (Model 5 versus Model 2 likelihood ratio test statistic = 13.96; change in df = 5; $p < .05$). Model 7 shows that logit estimates yielded the same results. Additional analyses (not shown) indicate that the interactions between community symbiosis and community commensalism and nonlocal density weighted by geographic distance are non-significant in the models that include all LMAs. Those interaction terms, however, do not provide a meaningful test of geographic decay in information transfer because, in communities that have instruments organizations, symbiotic and commensal organizational populations can channel information about instruments manufacturing through both local and nonlocal relations.

{Table 4 about here}

The last set of analyses reported in Table 5 examined whether unrelated organizational populations that occupy a position of local dominance within the community have a negative effect on foundings. We started by exploring whether the effect of a dominant population is contingent on its degree of relatedness to instruments manufacturing. If information about instruments manufacturing flows through inter-population linkages and greater access to such information increases the founding rate, as implied in Hypotheses 1 and 2, then a dominant population related to instruments manufacturing by a symbiotic or a commensalistic relationship should increase the founding rate. Furthermore, if a dominant population unrelated to instruments manufacturing decreases the perceived legitimacy of unrelated organizational forms, as we suggest, then it should have a negative effect on foundings.

Model 1 reports the effect of the unweighted measure of a community's dominant population which equally weights organizational populations occupying a position of local dominance regardless of their relation of interdependence to instruments manufacturing. Models 2 and 3 separately examine the effect on the founding rate of dominant populations strongly related to instruments organizations (i.e., with values below the median of the degree of unrelatedness) and the effect on the founding rate of dominant populations weakly related to instruments organizations (i.e., with values above the median of the degree of unrelatedness). The results are consistent with our expectations. *Dominant populations related to instruments organizations increase the founding rate whereas dominant populations unrelated to instruments organizations decrease it.* The overall effect of the unweighted measure is negative but non-significant. Because the effect of dominant populations unrelated to foundings is already reflected in the measures of community symbiosis and community commensalism, our interest lies in examining the measure which gives greater weight to dominant populations unrelated to instruments manufacturing.

In Model 4 the coefficient for this variable is negative and significant thus providing support for Hypothesis 6. Model 5 then includes the interaction term with the local density of instruments manufacturers. The coefficient is positive and significant, which means that the negative effect of unrelated dominant populations is weaker in communities that have greater numbers of instruments manufacturers, as we predicted in Hypothesis 7. The pattern of results remains unchanged when we include community symbiosis and community commensalism in Model 6 and Model 7 and when we include state-fixed effects (not shown). The main effect of the weighted measure of a community's dominant population is negative but becomes non significant in Model 7 when the other interaction terms are included. The interaction term, however, remains positive and significant. We also examined whether a dominant population decreases the probability of initial foundings, as predicted in Hypothesis 8 (Table 4, Model 6). The sign of the coefficient is negative as predicted, but the one-tailed test is only significant at the .10 level.

A final issue concerns the level of aggregation implied by treating two-digit SIC categories as distinct organizational populations. As we noted above, the best available evidence supporting the idea that outsiders such as analysts may view two-digit SIC categories as distinct organizational identities comes from Zuckerman's research (1999, 2000). A skeptic, however, might argue that the results might be driven by heterogeneity within SIC 38. We believe that four considerations discount this concern. First, using information contained in County Business Patterns, we were able to identify the three-digit level of the initial foundings in previously unoccupied LMAs. We found that these foundings belonged to five different three-digit level industries within SIC 38: 382, 383, 384, 385, and 386. This alleviates the concern that the results of the initial founding analysis might have been driven by a particular sub-population.

Second, supplemental analyses indicate that the negative effect of a community's dominant population weighted by the degree of relatedness to instruments organizations holds when restricting the analysis to states with a prevalence in 1978 of establishments in SIC 382 (measuring and controlling instruments) or in SIC 384 (medical instruments), the two largest three-digit industries by value of shipments within SIC 38. These states were identified using 1978 data about establishment counts at the three-digit level made available by the Bureau of Labor Statistics (BLS) Covered Employment and Wages program.

Third, heterogeneity within SIC 38 might imply very different patterns of spatial location of establishments at the three-digit level within SIC 38. However, using the BLS data, we found that three-digit-level industries within SIC 38 tended to co-locate in space. Because of this tendency of three-digit industries within SIC 38 to co-locate in space, it was difficult to identify states that were dominated by a certain type of instruments manufacturer. This was evidenced by a cluster analysis which showed that three-digit industries within SIC 38 emerged as an independent cluster and by a multivariate analysis of variance which showed greater variance in spatial location between two-digit industries than within them. (Details of these analyses are available upon request.)

Fourth, the indications that we derive from our supplemental analyses are consistent with the only study (Moomaw, 1998) that explicitly examined what is lost when two-digit data are used instead of three-digit data in analyses of localized economies. That study concluded that estimates obtained using two-digit data are similar to estimates obtained using three-digit data.

CONCLUSION

Suppose there is a general awareness in society that a new technology has been developed that will create opportunities to start businesses. Suppose further that potential entrepreneurs are randomly distributed through the human population. They are to be found in every town and city. The question is, which of them actually starts a company? The premise of this paper has been that the social structure channels the resources that will impel some to engage in entrepreneurial activity while others fail to take action. Specifically, we have argued that those who reside in communities that provide access to information about entrepreneurial opportunities are more likely to start a new company because such information propels them into action. Furthermore, we have proposed that organizations play a key role in this natural selection process because they are an important vehicle by which this information is made available in geographical space.

Past studies emphasize that much of this information originates and resides within the same organizational population. The results of this paper support the view that this information also flows from one organizational population to another through direct contact and through competitive monitoring. These are two network mechanisms of information transfer that we think underlie ecological relations of symbiosis and commensalism, respectively. As a result, at the community level the founding rate is affected not only by the number of organizations in the same population but also by the market relations in which the community is embedded.

Concretely, if the community already has a population of organizations such as that being contemplated, residents in that community are more likely to start new companies because they have specific knowledge about entrepreneurial opportunities and about how to create products and operate organizational routines that have been developed previously. Populations of organizations doing business with the kind of organization in question (symbiotic organizational populations) and populations of organizations doing business similar to the kind of organization in question (commensalistic organizational populations) can also provide such information. So it is easier to start an instruments company if there are many computer hardware and software firms and microelectronics firms nearby, which explains why some communities that do not have organizations of a certain kind experience initial foundings whereas others do not. In contrast, an interested potential entrepreneur is more likely to remain passive if very few people in the area know about the business in question, or know about similar kinds of businesses. On the other hand, if the local environment is built around some very different kind of organization, service suppliers such as local bankers and accountants are likely to know about that business, and will probably display less interest in supporting a kind of organization far from their experience. So a dominant, unrelated kind of organization can discourage foundings of an incompatible organizational form. This is the reverse of the legitimation process that has most interested organizational ecologists. Finally, of course, the information and knowledge that existing organizational populations generate is less useful when nascent founders are far away. This is especially important in the processes that convert general interest into action. Such information is likely to be communicated by accidental, informal social interaction.

Although a strength of our analysis is that it directly examines inter-population relations focusing on patterns of resource utilization evidenced by input-output flows, we do not directly measure the information flows that take place as a consequence of the position that organizational populations occupy in the market structure. To alleviate the concern that information diffusion is indeed the primary mechanism underlying the results, we developed corollary hypotheses that follow from our core argument. Specifically, the findings regarding information redundancy (Hypothesis 3) and information decay (Hypothesis 5) are consistent with the information diffusion argument but cannot be easily explained by prevalent accounts of the forces underlying the geographic distribution of industries, such as, for example, the proximity-to-other-resources story. It is possible, however, that other processes complement rather that replace our information diffusion argument. For example, research on embeddedness suggests that exchange relations often foster the development of trust among actors (Granovetter, 1985; Uzzi, 1997). This in turn may facilitate entrepreneurial activity by encouraging the observance of norms of mutual support (Aldrich and Zimmer, 1986).

This study makes a number of contributions to organizational ecology. First, we add to the few ecological studies that emphasize the importance of information diffusion in the founding process. Hannan *et al.* (1995) suggest that, in the early stages of an organizational population, foundings disperse in space as processes of cultural diffusion make a new organizational form legitimate beyond its home ground. They emphasize print media and industry events as mechanisms by which information about the new organizational form diffuses. Hedstrom (1994) suggests that information diffuses through localized social networks that span adjacent geographical areas. Our analysis complements that work by adding that information also flows from one organizational population to another through direct contact and through competitive monitoring. Although our results show how symbiotic and commensalistic relations influence where foundings occur in an already established organizational population, a potentially important extension would be to examine whether these inter-population relations also influence the dispersal of foundings in the early stage of a new organizational population. If new organizational forms becomes legitimate in part "as greater number of individuals come into contact with it and thereby become aware of its features" (Carroll and Hannan, 2000: 339) and if symbiotic and competitive organizational populations facilitate such contact, then the presence of symbiotic and commensalistic organizational populations in an area may accelerate the accretion of legitimacy of new organizational forms.

Viewing symbiotic and commensalistic relations as vehicles of information diffusion has broader implications for the study of inter-population relations. In particular, our information-based perspective leads us to predict that commensalistic organizational populations may increase each other's founding rates. This prediction departs from the often-held view that organizational populations that use similar resources and serve similar markets constrain each other's growth (McPherson, 1983; Hannan and Freeman, 1989). The premise of this alternative view is that commensalistic organizational populations inevitably decrease the stock of resources available for would-be entrepreneurs. Based on this premise, researchers argue that greater competition for resources may dissuade entrepreneurs from starting an organization in an already crowded niche (Baum and Singh, 1994; Baum and Oliver, 1996).

Our argument differs from this work because we highlight the importance of information as a critical resource in the organizational creation process. Information differs from other resources, such as specialized labor or raw materials, in that it can be used by those who have access to it concurrently as well as sequentially without being diminished (Arrow, 1962). Our focus on information leads us to view commensalistic organizational populations not as depleting the stock of a finite resource but rather as vehicles of diffusion of this resource. It is also true that commensalistic organizational populations consume resources that are depleted with use. But unlike the competitive relation tying members of the same population, commensalism entails only a partial overlap in the kinds of depletable resources used. These partial overlaps are likely to have only a modest negative impact on the carrying capacities of commensalistic organizational populations in comparison to the negative impact that an increasing number of members of the same population has on the common pool of resources from which a population depends.

The second contribution to ecological research is the operationalization of inter-population relations focusing on patterns of resource utilization evidenced by input-output flows. This measurement method is a viable alternative to the more common approach which consists of hypothesizing relations of interdependence on the basis of qualitative considerations specific to the organizational populations under study and then estimating the effects of these relations. (For reviews see: Rao, 2002; Aldrich and Ruef, 2006.) The advantage of the method used here is that it sets criteria for determining the presence of inter-population relations that can be applied across studies. Therefore it facilitates the accumulation of comparable findings. The disadvantage is that it produces plausible coefficients of interdependence only when all populations are considered. This disadvantage suggests that when researchers are interested in examining only a small set of populations, qualitative assessment of inter-population relations may still be the most practical measurement approach.

This study's third contribution is to research that emphasizes the social structural conditions that promote entrepreneurship (Freeman, 1986; Romanelli, 1989; Sorenson and Audia, 2000; Burton, Sorensen, and Beckman, 2002; Phillips, 2002; Stuart and Sorenson, 2003b; Audia and Rider, 2005; Dobrev and Barnett, 2005). A key insight of this literature is that members of established organizations are in a favorable position to create organizations of that same type because work experiences help would-be entrepreneurs to build confidence, form social ties to resource providers, and gain access to information about entrepreneurial opportunities. Our findings extend that perspective by suggesting that market relations may also be important points of access to resources critical to the founding process. Our results support the view that would-be entrepreneurs are affected by the market relations characterizing the community where they reside. The market relations present in a community channel information that propels individuals into creating certain kinds of organizations. In other words, our study suggests that, like other forms of economic action (Granovetter, 1985), entrepreneurial activity is embedded in social and market relations.

A fourth contribution is to research in urban sociology that conceptualizes the urban structure on the basis of the distribution of economic activities in space (Wilson, 1984; Sassen, 1990). A classic distinction in that body of work is that between higher order places that perform the coordinating function and lower order places that specialize in the production of goods (e.g., Lincoln, 1978; Meyer, 1990; Palmer et al., 1990). In recent work, attention has shifted to the position that spatial units occupy within both national and global networks. The different functions that spatial units perform within these networks underlie the newer concepts of global cities (Sassen, 1991) and edge cities (Knox, 1997). Although theorists increasingly refer to spatial units as nodes in networks (Perry and Harding, 2002), this insight is rarely carried forward in empirical work. The positions of spatial units are usually inferred from internal attributes such as size, occupational specializations, and local industry mix, rather than from market relations linking spatial units to each other and to the broader system. (For an exception see: Goe, 1994.) This study adds to that literature by suggesting one way in which the position of spatial units can be defined by explicitly taking into account market relations. By examining the pattern of market relations linking organizational populations dispersed in geographical space, we have shown that it is possible to array communities within the market space on the basis of their symbiotic and commensalistic relations to a focal population. We have also shown that a community's market position influences where foundings of a particular kind of organization are more likely to occur. This approach can be readily extended to studying the position that communities occupy in relation to each other. For example, future studies could examine how communities are affected by the extent to which they occupy a crowded niche.

This study's explicit consideration of how market relations characterize the position of communities within the urban system also highlights how it differs from the burgeoning literature in economic geography that focuses on information spillovers. Consider, for example, the important and still unresolved debate about whether cities benefit more from intra-industry information spillovers or from inter-industry information spillovers (Glaeser et al., 1992). (For reviews see: Audretsch and Feldman, 2003; Quigley, 1998.) Like that work, we acknowledge the localized nature of information flows arising from both market and nonmarket relations that take place within the geographical boundaries of communities. This study, however, differs in that it gives greater emphasis to market relations as a key mechanism of information diffusion and explicitly recognizes that these relations take place not only within the community but also among communities. Our analysis of initial foundings illustrates this difference well because it indicates that the nonlocal market relations in which communities are embedded influence the kinds of new economic activities that they may undertake. Furthermore, while economic geographers debate whether the stock of information that stimulates cities' growth is more a function of the presence of agglomerations than of industrial diversity, our information-based theoretical framework is more fine-grained in that it seeks to explain the specific types of information present in a locality as a function of the organizational populations that it comprises and the pattern of market relations in which they are involved.

The effects of the structure of inter-population relations on the rate of organizational foundings highlighted by this study may be contingent on at least two conditions that set boundaries on the generalizability of our results. First, our argument assumes that information about entrepreneurial opportunities relevant to a focal population is unevenly distributed in both market and geographic space. Inter-population relations may have little or no effect on the foundings of organizational populations for which the information that propels individuals into entrepreneurial action is widely available. Second, our core argument implicitly assumes that the information flowing through inter-population relations points to attractive entrepreneurial opportunities. This assumption fits instruments manufacturing well. Due to a confluence of technological and market developments, this industry was growing rapidly during the period of this study. However, when a focal organizational population is experiencing a sustained period of decline, it is possible that symbiotic and commensalistic organizational population may not have the positive effect on foundings shown in this research.

This study has reported research in which concepts and analytic techniques from social network analysis were applied in combination with those of population ecology of organizations. One of the important points of intersection of these social research traditions is the local community. Organizations conduct their activities in local context. They do so in ways that show the commonalities of structure and process that are reflected in organizational forms. These commonalities represent structural equivalence in markets, and they also represent patterns of competition and mutualism among organizational populations. The structure of the communities can be seen as mechanisms that provide easy or difficult access to both resources and information. Opportunity is constrained and channeled to those who would set up new organizations. If this is true, communities vary in ways that matter for the organizations that are founded, live and die within their boundaries. People who live and work in those communities have much at stake.

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Table 1
Descriptive Statistics and Correlations (N=1910)[a]

	Mean	S. D.	1	2	3	4	5	6	7	8
1. Foundings	5.13	16.80								
2. Community supplier symbiosis X 100	.419	.122	.524							
3. Community purchaser symbiosis X 100	1.462	.571	.458	.534						
4. Community commensalism	.492	.006	.162	.007	.245					
5. Community's dominant population weigthed by degree of unrelatedness	.147	.067	-.112	-.122	-.147	-.024				
6. Human population per square mile	132.920	328.970	.583	.434	.385	.219	-.062			
7. Skilled work force	-.001	1.055	.423	.599	.632	.250	-.068	.531		
8. Nonlocal density of instruments manufacturers weighted by geographic distance	24.909	11.094	.148	.126	.465	.329	-.032	.392	.602	
9. Local density of instruments manufacturers	33.520	115.100	.956	.497	.472	.192	-.111	.694	.454	.217

[a] All correlations are significant at the .05 level

Table 2
Effect of Community's Symbiosis and Commensalism on Foundings of Instruments Manufacturers – Negative Binomials including All Communities (N=1910) [a]

	1	2	3	4	Random Effects	Zero Inflated Poisson
Local density of instruments manufacturers	.017$^+$ (.002)	.006$^+$ (.001)	.014$^+$ (.001)	.011$^+$ (.001)	.007$^+$ (.001)	.009$^+$ (.001)
(Local density of instruments manufacturers)^2 / 1000	-.009$^+$ (.001)	-.003$^+$ (.000)	-.003 (.004)	-.0006$^+$ (0004)	-.009$^+$ (.000)	-.007$^+$ (.003)
Community purchaser symbiosis X 100		.171$^+$ (.089)	.281$^+$ (.083)	.282$^+$ (.091)	.204$^+$ (.081)	.380$^+$ (.089)
Community supplier symbiosis X 100		7.901$^+$ (.6)	7.695$^+$ (.552)	7.806$^+$ (.553)	5.926$^+$ (.356)	5.350$^+$ (.550)
Community commensalism		16.909$^+$ (5.874)	21.792$^+$ (5.808)	17.282$^+$ (6.598)	20.124$^+$ (5.142)	26.230$^+$ (6.539)
Community purchaser symbiosis X Local density of instruments organizations			-.003$^+$ (.000)	-.001$^+$ (.000)	-.001$^+$ (.000)	-.001$^+$ (.000)
Community supplier symbiosis X Local density of instruments organizations			-.020$^+$ (.003)	-.016$^+$ (.002)	-.009$^+$ (.002)	-.010$^+$ (.001)
Community commensalism X Local density of instruments organizations			-.249$^+$ (.057)	-.190$^+$ (.041)	-.093$^+$ (.024)	-.137$^+$ (.024)
Human population per square mile / 100	-.086* (.016)	-.032* (.009)	.016 (.014)	.004 (014)	.045* (.022)	.006 (.005)
Skilled work force	.552* (.094)	.099 (.061)	-.031 (.053)	.067 (.072)	.095* (.043)	-.046 (.065)
Non-local density of instruments manufacturers weighted by geographic distance	-.02* (.006)	.006 (.004)	-.006 (.003)	-.003 (.004)	-.009* (.003)	-.005 (.003)
Year 1980	.106 (.065)	.393* (.076)	.32* (.074)	.3580* (.072)	.297* (.055)	.178 (.111)
Year 1982	.332* (.081)	.909* (.093)	.799* (.092)	.861* (.097)	.791* (.068)	.569* (.132)
Year 1984	.228* (.088)	1.045* (.109)	.885* (.108)	.966* (.117)	.850* (.082)	.567* (.161)
Year 1986	.383* (.097)	1.267* (.128)	1.094* (.126)	1.174* (.137)	.993* (.099)	.692* (.168)
Constant	-.011 (.088)	-.562* (.097)	-.593* (.094)	-.002 (.401)	.329 (.176)	.162 (.151)
State fixed-effects	No	No	No	Yes	No	No
Log likelihood	-3543.2	-3276.9	-3195.0	-3084.8	-3088.1	-3655.2

[a] one-tailed tests: $^+$ < .05; two–tailed tests: * p < .05

Table 3
Poisson Models of Initial Foundings of Instruments Manufacturers – Only Unoccupied LMAs (N=190) [a]

	1	2	3	4	5	6	7. Logit
Community purchaser symbiosis X 100			.937^{+} (463)	1.188^{+} (.56)	1.161^{+} (.551)	1.008^{+} (.604)	2.003 (1.893)
Community supplier symbiosis X 100			2.605 (3.207)	5.837^{+} (2.718)	5.693^{+} (2.764)	7.007^{+} (2.964)	7.832 (5.469)
Community commensalism			52.030^{+} (19.964)	22.053 (17.218)	30.377^{+} (15.604)	31.882^{+} (15.247)	41.308^{+} (20.453)
Community purchaser symbiosis X Non-local density weighted by geographic distance				.153^{+} (.062)	.149^{+} (.06)	.160^{+} (.068)	.305^{+} (.129)
Community supplier symbiosis X Non-local density weighted by geographic distance				.513^{+} (.241)	.505^{+} (.225)	.556^{+} (.225)	.665^{+} (.363)
Community commensalism symbiosis X Non-local density weighted by geographic distance				-.871 (2.665)			
Community's dominant population weighted by degree of unrelatedness						-3.604 (2.307)	-4.759^{+} (2.567)
Human population per square mile / 100	.078 (.716)	.043 (.516)	-.380 (.49)	-.510 (.484)	-.531 (.463)	-.574 (.401)	-.366 (.618)
Skilled work force	-.158 (.310)						
Non-local density of instruments manufacturers weighted by geographic distance	-.036 (.037)	-.059 (.032)	-.071 (.053)	-.038 (.047)	-.037 (.045)	.047 (.053)	.080 (.093)
Local density of instruments manufacturers in 1973	-.069 (.376)						
Year 1980	-.170 (.35)						
Year 1982	.613* (.307)	.749* (.307)	.791* (.251)	.785* (.246)	.783* (.248)	.820 (.255)	1.079* (.357)
Year 1984	-.214 (.393)						
Year 1986	1.212* (.502)	1.439* (.433)	1.393* (.305)	1.327* (.458)	1.298* (.475)	1.319 (.439)	1.906* (.801)
Constant	-2.351* (.619)	-2.47* (.313)	-1.594* (.441)	-1.365* (.381)	-1.354* (.384)	-.774* (.431)	-.393 (.756)
Log likelihood	-86.5	-86.7	-82.4	-79.7	-79.7	-78.9	-72.3

[a] one-tailed tests: $^{+} < .05$; two–tailed tests: * $p < .05$

Table 4
Effect of Community's Dominant Population on Foundings of Instruments Manufacturers – Negative Binomials including All Communities (N=1910) [a]

	1	2	3	4	5	6	7.
Local density of instruments manufacturers	.017^{+} (.002)	.017^{+} (.002)	.017^{+} (.002)	.017^{+} (.002)	.018^{+} (.003)	.007^{+} (.001)	.014^{+} (.001)
(Local density of instruments manufacturers)^2 / 1000	-.009^{+} (.001)	-009^{+} (.001)	-009^{+} (.001)	-.008^{+} (.001)	-.008^{+} (.001)	-.003^{+} (.000)	-.002^{+} (.000)
Community's dominant population	-.876 (.613)						
Community's dominant population with high degree of unrelatedness		-.971^{+} (.36)					
Community's dominant population with low degree of unrelatedness			.804^{+} (.421)				
Community's dominant population weighted by degree of unrelatedness				- 1.381^{+} (.67)	- 2.118^{+} (.703)	-1.145^{+} (.643)	-.721 (.631)
Community's dominant population weighted X Local density of instruments manufacturers					.058^{+} (.031)	.038^{+} (.015)	.022^{+} (.010)
Community purchaser symbiosis X 100						.170^{+} (.088)	.279^{+} (.083)
Community supplier symbiosis X 100						7.899^{+} (.608)	7.629^{+} (.537)
Community commensalism						17.148^{+} (5.899)	22.491^{+} (5.857)
Community purchaser symbiosis X Local density of instruments organizations							-.003^{+} (.001)
Community supplier symbiosis X Local density of instruments organizations							-.021^{+} (.004)
Community commensalism X Local density of instruments organizations							-.266^{+} (.059)
Human population per square mile / 100	-.084* (.016)	-.085* (.016)	-.087* (.016)	-.083* (.016)	-.085* (.015)	-.035* (.009)	-.019 (.014)
Skilled work force	.557* (.092)	.536* (.092)	.534* (.093)	.552* (.092)	.547* (.091)	.094 (.059)	-.034 (.053)
Non-local density of instruments manufacturers weighted by geographic distance	-.021* (.006)	-.019* (.006)	-.019* (.005)	-.020* (.006)	-.021* (.005)	-.007 (.004)	-.005 (.003)
Year 1980	.120 (.065)	.147* (.066)	.126* (.066)	.130* (.066)	.091* (.07)	.369* (.078)	.324* (.074)
Year 1982	.346* (.082)	.347* (.08)	.331* (.08)	.35* (.081)	.321* (.084)	.892* (.095)	.795* (.091)
Year 1984	.253* (.09)	.218* (.086)	.196* (.087)	.249* (.088)	.212* (.093)	1.021* (.111)	.881* (.107)
Year 1986	.407* (.098)	.346* (.096)	.331* (.097)	.392* (.097)	.357* (.099)	1.240* (.129)	1.083* (.124)
Constant	.139 (.145)	.085 (.095)	-.068 (.094)	-.181 (.135)	.294* (.141)	.383* (.139)	-.575* (.136)
Log likelihood	- 3541.3	- 3537.5	- 3540.2	- 3539.6	- 3531.7	- 3266..9	- 3193.12

[a] one-tailed tests: $^{+}$ < .05; two–tailed tests: * p < .05

Figure 1
Spatial Distribution of U.S. Instruments Manufacturers in 1978

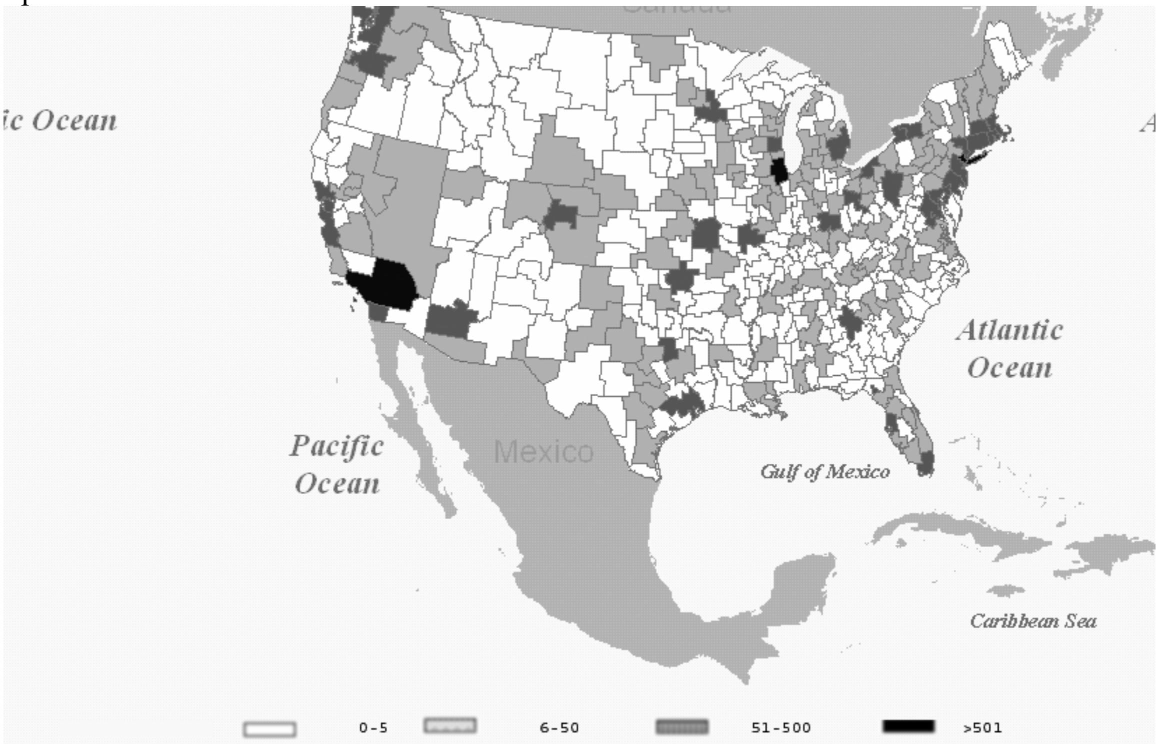

Figure 2
Spatial Distribution of Foundings of U.S. Instruments Manufacturers between 1978 and 1988