Spatial and Temporal Heterogeneity in Founding Patterns

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Abstract

A growing body of literature suggests that populations of organizations are not homogeneous, but instead comprise distinct subentities. Firms are highly dependent on their immediate institutional and competitive environments. The present paper further explores this issue by focusing on the spatial and temporal sources of industry heterogeneity. Our goal is threefold. First, we explore founding rates as a function of spatial density, arguing that density-dependent processes occur along a geographic gradient ranging from proximate, to neighboring, to more distant contexts. Second, we show how multiple, local evolutionary clocks shape such entrepreneurial activity. Third, we provide evidence on how diffusion processes are directly affected by social contagion, with new organizational forms spreading through movements of individuals. Results from data on the Dutch accounting industry corroborate these patterns of heterogeneity.

(*Density-Dependence; Spatial and Temporal Heterogeneity; Social Contagion; Industry Evolution*)

1. Introduction

The study of the relation between organizational dynamics and geography has a long tradition that traces back to research on human ecology (e.g., Park 1926, Hawley 1950). Human activities assume an orderly arrangement in space resulting in the formation of "human ecologies" whose boundaries are spatially or geographically delimited (see McKenzie 1968). Spatial considerations have been the object of growing interest in fields such as strategic management, sociology, and economics (for a review, see Sorenson and Baum 2003). However, investigation of the conditions under which local interactions shape industry evolution have received scant attention.

Density-dependence theory, at least in its original formulation (Hannan 1986), shares a similar limitation.

Although a large body of empirical evidence has been collected in support of this theory (for a comprehensive review see Baum 1996 and Carroll and Hannan 2000), some of its basic assumptions have been questioned. Two recurrent criticisms revolve around (1) choice of the unit of analysis for studying ecological processes (Singh 1993) and (2) dearth of evidence regarding microbehaviors that engender legitimation of new organizational forms (Hedström 1994, Baum and Powell 1995).

The development of this discussion has drawn growing attention to the degree of heterogeneity as a precondition for the emergence, rise, and decline of organizational populations. Spatial considerations have gained momentum (Lomi 1995, Greve 2002, Sorenson and Audia 2000) and geography is now widely acknowledged to condition founding patterns. Although the effects of density-dependent legitimization have been found to span national boundaries (Hannan et al. 1995, Wezel and Lomi 2003), other studies have shown that ecological processes originate from smaller geographical areas within national organizational populations (Lomi 2000, Greve 2002). Similarly, time has come to be seen as an important source of heterogeneity because the intensity of legitimation and competition is a function of the age of the industry (Hannan 1997), and selection pressures vary over time (Sorenson 2000, Barnett et al. 2002). A joint examination of the spatial and temporal dimensions of legitimation and competition, therefore, is "important because processes, structures and functions of organizational populations are defined by time and space (e.g., Dendrinos and Sonis 1990, Hawley 1986)" (Lomi and Larsen 1996, p. 1289).

Building upon this stream of research, the purpose of this paper is to investigate evolutionary patterns

of spatial and temporal heterogeneity. Our contribution is threefold. First, we argue that local density-dependent processes occasion organizational foundings on the grounds that proximity facilitates communication and stimulates diffusion of information (Rogers 1962, Bala and Goyal 1998). Second, since industries undergo significant transformations as they age (Hannan 1997, Hannan et al. 1998), we show how multiple local rather than national evolutionary clocks affect organizational foundings. Third, we provide empirical evidence on how social contagion produces diffusion of new organizational forms.

To this end, we examine founding rates in the Dutch accounting industry during the period 1880–1986, both at the population and the subpopulation levels of analysis. The natural division of The Netherlands into provinces, which represent important administrative and political units (e.g., de Pree 1997, Lee and Pennings 2002, Boone et al. 2002), allows us to consider the pools of potential entrepreneurs to be geographically embedded in such institutional and socioeconomic identities. Furthermore, the choice of a professional service industry, where local relationships with clients and competition for labor stand out (Maister 1993), is consistent with our theoretical assumption that organizations are mainly dependent upon local demand and supply.

The paper is organized as follows. The next section presents the theory and the hypotheses. Section 3 describes the empirical setting, the data we used for our empirical analysis, and our independent and control variables, respectively. In §4 we motivate the choice of the models we estimate and the method we employ to test our hypotheses. Results are shown in §5. The discussion of the main implications of the analysis and the conclusions are presented in §6.

2. Theory

2.1. Space Heterogeneity in Organizational Founding

Organizational ecologists have developed a theory of industrial evolution based upon the concept of density-dependence (Hannan 1986). Density conditions both mortality and founding rates through legitimation and competition. A new organizational form acquires legitimacy when it displays a template or architecture that becomes socially recognized (Meyer and Rowan 1977). At the time of its first appearance, an organization with a new form generally lacks this kind of recognition. Customers and suppliers need to be cultivated, and employees socialized into new roles. Institutionally, we observe time compression diseconomies because

some period elapses before the preponderance of a new form becomes apparent. In the early stages of the industry life cycle, higher density enhances social recognition (i.e., legitimation) of the new organizational form, with the effect of attracting additional entrepreneurs and reducing the risk of mortality of incumbents. Eventually, the industry becomes unable to accommodate a growing number of organizations. Competition intensifies as organizations draw from the same set of resources (Hannan and Freeman 1977, Hawley 1950), depressing their growth and survival rates while diminishing the motivation of others to enter the industry.

A large body of empirical evidence supports density-dependence theory (see Chapter 10 in Carroll and Hannan 2000), yet some of its assumptions have been challenged. The industry is rarely homogeneous. The neglect of local differences in density, and associated founding or mortality rates, results in imprecise estimates of the effect of legitimation and competition (Baum and Amburgey 2002, Lomi 1995). Carroll and Wade's (1991) study of the American brewing industry is compelling and has drawn renewed attention to the "spatial dimension" that is central in the work of human ecologists (e.g., Hawley 1950). Researchers have begun to investigate boundary-spanning processes across nations. In their study of the European automobile industry, Hannan et al. (1995) showed that legitimation spills over to other countries while competition remains largely domestic. Empirical support for the multilevel density-dependence theory of evolution, however, is still scant and limited to the European auto industry (Hannan et al. 1995, Hannan 1997, Dobrev et al. 2001). To clarify the unit of analysis, some ecologists have focused on the relative influence of smaller geographical areas (e.g., regions, states, provinces). Bigelow et al. (1997), for example, argued that geography and *physical distance* "account for the different scale of effects of legitimation and competition rather than nation-state political boundaries" (p. 394). This echoes Lomi's (2000) findings for the core-periphery relationship between commercial banks in Copenhagen and in the rest of Denmark.

Different arguments have been advanced for the local nature of both legitimation and competition. First consider legitimization. According to ecological theories, the lack of cognitive legitimation significantly constrains the action of potential entrepreneurs. The contextual factors that render a novel form increasingly acceptable and cognitively appropriate require visibility. The new form also requires acceptance in the minds of founders and their stakeholders (Lee et al. 2001). As Aldrich and Fiol put it, "[C]ognitive legitimation refers to the spread of knowledge about a new venture" (1994, p. 645) such

that it becomes so familiar that it is taken for granted, with the effect that "attempts at creating copies of legitimated forms are common, and the success rate of such attempts is high" (Hannan and Freeman 1986, p. 63).

Entrepreneurs—as boundedly rational actors (March and Simon 1958, Cyert and March 1963)—seek new market opportunities, mainly locally. Founding a new venture requires the mobilization of various resources such as human and physical capital, goodwill, reputation, and social capital (Lee et al. 2001)—many of which are accessible primarily at the local level. Coping with these problems requires the cooperation of, and interaction with, different individuals, groups, and organizations (Aldrich and Fiol 1994, Lee et al. 2001). Social interaction (e.g., Festinger 1953, Sorenson and Stuart 2001) and network ties emerge among actors who are spatially colocated (Park 1926, Hawley 1950), as the relative costs increase with geographical distance (e.g., Lazarsfeld and Merton 1954). Proximity stimulates information exchange (e.g., Saxenian 1994), knowledge circulation through personal contacts (Scherer 1984), and localized knowledge spillovers with the associated economies of agglomeration (see Marshall 1922, Arrow 1962, Romer 1986).

Competition, too, might vary by geography. Rivalry is a small number phenomenon and the number of competitors a firm recognizes is mediated by local information (Baum and Lant 2003). Proximity intensifies rivalry for local buyers and suppliers, as shown in the study by Carroll and Wade (1991). In the service sector, physically proximate firms also vie for local human capital (Cattani et al. 2002). Dependence on a local resource pool fosters greater mutual awareness and rivalry among firms (Hawley 1950, Sørensen 1999). We hold, therefore, that local rather than national competition shapes founding activity (see also Sorenson and Audia 2000).

Actually, both legitimation and competition are subject to geographic variations within nationally defined industries. The studies by Lomi (1995) and Greve (2002) addressed the local nature of these evolutionary phenomena explicitly. Lomi (1995) discovered how different groups of rural cooperative banks in Italy reacted differently to the same national competitive and institutional pressures. His results suggest an asymmetric influence of local and nonlocal density. While no real "difference in legitimation was found across models based on local and non-local specification of density, competition is seven times stronger at the regional than at the national level" (Lomi 1995, p. 137). Greve (2002) showed that local density occasioned the evolution of a population within a given geographical area. His findings demonstrate how

"density dependence operated locally within small areas and spilled over from neighboring areas" (p. 870).

Summarizing, the effects of density-dependence should be stronger at the local than at the national level. Cognitive legitimacy and competitive constraints are proportional to the degree of physical proximity among organizations. We thus hypothesize:

HYPOTHESIS 1 (H1). *Founding rates in a given population of organizations are more strongly affected by local rather than national density-dependent legitimation and competition.*

The bifurcation of populations into "national" versus "local" presents boundary definition issues: Foundings occur in neither purely local nor national space. Rather, they occur along a geographic gradient ranging from focal and proximate, to neighboring, to more distant contexts. Along this gradient, we might observe physical, institutional, or cognitive discontinuities. To date, however, "neighbor effects are rare in regional founding studies (but see Wade et al. 1998), since they have not been made the focus of theory yet" (Greve 2002, p. 861).

The existence of these neighbor effects is consistent with the presumption in biology that the environment is divided into *adaptive zones*. An adaptive zone is an ecological space or niche comprising a unique set of resources that a given species can exploit (Ridley 1999, Schluter 2000). Because adaptive zones constitute discrete clusters, the members of the same species are exposed mainly to the selection forces within their specific zone. However, ecological processes are never entirely discretely clustered. Only in the presence of discontinuities in the environments, like when natural gaps or barriers (e.g., a mountainous chain) keep different zones completely separate, can clusters actually develop. Resources are distributed along a continuum, and proximate adaptive zones tend to overlap to some degree. The absence of natural gaps or barriers allows for some level of interaction among individuals coming from proximate areas. It is the presence of boundary permeability that renders the local evolution susceptible to the development in adjacent areas.[1] Just as in nature competition for scarce resources is more frequently intraspecific (i.e., within the same adaptive zone), and less so interspecific (i.e., among proximate adaptive zones), so organizations are likely to be affected by the behavior of firms from proximate rather than more distant subpopulations.

Interactions among firms across neighboring subpopulations further legitimize a new organizational form and stimulate its spatial diffusion (e.g., Hedstrom 1994, Hannan et al. 1995). Mitchell's (1969) classic study on

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the Huk rebellion in the Philippines was among the first to document the social influence of neighboring areas on the focal area. His research on spatial diffusion of the guerrilla ideology against the Philippine Republic's government is germane to our assumption that density-dependence unfolds along a geographic gradient. The interest in geographic diffusion goes back to Hägerstrand's *Innovation Diffusion as a Spatial Process* (1953) that showed how contagious behavior enhanced the adoption of agricultural innovations (e.g., vaccination against bovine tuberculosis) by Swedish farmers. Contagion represents the transmission of practices, beliefs, and attitudes through direct or indirect contacts whose presence is moderated by the physical environment. A growing body of literature on contagion has examined the spatial nature of diffusion in such fields as geography (e.g., Cliff et al. 1981), epidemiology (e.g., Bailey 1976), and sociology (e.g., Rogers 1962).

Social interaction among actors fosters diffusion, but also raises the level of competition (see Lomi and Larsen 1996). Whenever boundaries have diminished political and institutional saliency, the separation among subpopulations hinges on sheer permeability of their boundaries. Under such conditions, transportation costs represent the main constraint to the spread of competitive forces. Greve (2002) followed such a line of thought in his study of the Tokyo banking industry. The author investigated the impact of changing number of competitors in neighboring areas on the local founding rate, and demonstrated how

> competition should also have non-local effects such as those posited by spatial competition theory. Taking spatial density-dependence to be the result of the joint effect of spatial competition...suggests that the effect of a given subpopulation's density gradually weakens as the distance from that subpopulation increases, but it retains the same inverted-U-shaped effect on founding (Greve 2002, p. 854).

These observations lead us to qualify the first hypothesis and further elaborate on the notion of localness and associated spatial heterogeneity. We now argue that legitimation and competition affect new entries along a geographical gradient and, therefore, we hypothesize:

HYPOTHESIS 2 (H2). *Founding rates in the focal area are more strongly affected by local rather than neighboring density-dependent legitimation and competition.*

2.2. Time Heterogeneity in Organizational Founding

A recurrent criticism of ecological theories holds that they do not account for the historical dynamics of organizational populations. Perhaps density-dependence is a mere reflection of timing effects (Zucker 1989). Legitimation and competition, however, are not timeless, as "the effects of density rates on founding and mortality change systematically as organizational populations age" (Hannan 1997, p. 193). A Darwinian perspective on evolution, in fact, assumes that it is more difficult to enter a mature than a young population. Over time, surviving organizations increase their average fitness and spread out across the resource space with the effect of deterring new entries (Sorenson 2000). Temporal variations in selection thresholds thus condition entries and organizational life chances (Barnett et al. 2002). However, as a population ages, the perceived risk of founding a new venture declines: Employees, customers, and investors become more readily available to potential entrepreneurs. Cognitive legitimacy improves with time when the cumulative number of organizations entering a population grows.

Because aging industries undergo significant transformations, it is paramount to specify at which level of analysis such transformations take place. A national perspective on industry evolution might overlook differences in (1) resource endowments and (2) time of diffusion among geographical areas. The observed heterogeneity in the development of regional economies hinges on intranational differences in resource endowment (Sabel 1989). Shifting the level of analysis from the population to the subpopulation predicated on the spatial heterogeneity hypothesis leads us to consider intertemporal patterns of change at the same level. As noted before, the idea that the environment comprises distinct adaptive zones implies that peer organizations belonging to the same subpopulation are predominantly exposed to selection pressures within their specific zone. Such local variations constitute the basis for claiming temporal heterogeneity. While one region might experience severe competition—with the effect of discouraging new entries—the same industry in another region might still be in its formative stages and attract prospective entrepreneurs. However, even when ecological clocks were to be initially synchronous, regional differences might produce different evolutionary patterns over time. Within the same industry, opportunities and constraints are spatially and temporally uneven in their distribution. Since local evolutionary clocks influence organizational foundings more than national evolutionary clocks do, we hypothesize:

HYPOTHESIS 3 (H3). *Founding rates are more likely to be affected by the age of the local population than by the age of the national population.*

Over time, information about new organizational forms spreads across geographical boundaries through networks of people and organizations (e.g., Hedström 1994). As the industry matures, its cultural image gets crystallized and becomes diffused through several avenues. Avenues include media, transportation and telecommunications, and mobility of individuals (e.g., Hannan et al. 1995).

Knowledge spillovers are not confined to firms colocated within the same geographical area. When organizational knowledge diffuses across geographical boundaries, it becomes available to other—more distant—firms (see Powell and Brantley 1992, Jaffe et al. 1993). Tacit knowledge (see Polanyi 1967, Winter 1987), such as the governance of new organizational forms, spreads more gradually than articulate knowledge because its transfer requires social relationships that typically concentrate more tightly in space (Sorenson and Baum 2003). The same argument holds for the diffusion of a new organizational form that depends critically on the presence of social contagion.

To date, ecological research has devoted only scant attention to social contagion spanning distinct subpopulations and their amalgamation into a single national industry. We infer such microbehaviors from the migration of individuals across geographical areas. Interregional mobility results in the creation and breaking of social ties that constitute avenues for information and knowledge dissemination. Webs of relationships form and evolve by dint of the movements of potential "entrepreneurs" across distinct geographical areas, so reducing local variation in organizational forms. In their study on the locational incidence of contacts between biotech firms and university-based scientists affiliated with them, Audretsch and Stephan (1996) found that older scientists were affiliated with spatially more-distant firms than their younger peers and that their social networks were less geographically bounded. Such movements produce contagion from distant to more proximate areas. Social contagion ultimately affects the scope of diffusion through both the atomistic behavior of adopters and contacts "between members of the population who have and have not yet adopted" (Strang and Tuma 1993, p. 614).

Social contagion reduces the sparseness of ties among localized clusters. Interaction across neighboring areas generates new chains of connection and concatenates them into a single national or contextual industry. The migration of individuals across different locations significantly affects the adoption of a new organizational form. In the Paris Commune of 1871, overlaps in National Guard battalion enlistments played a crucial role in establishing "a stable network of social links among neighborhoods, bridging the insularity of the *quartier* that predominated in political activity during the siege" (Gould 1995, p. 184). By stimulating cross-neighborhood exposure, overlapping enlistments proved to be a conduit for communication and social interaction among otherwise-sparse urban areas that significantly shaped the mobilization of the insurgent forces. Another compelling case is the study of Hedström et al. (2000) on the diffusion of the Swedish Democratic Party during the period 1894–1911, which showed how visits of political agitators from neighboring areas had the effect of establishing "bridges" over geographically distinct locations and speeding up the overall diffusion. These mesolevel networks proved to be important not only for "recruiting members to *existing* movement organizations, they [were] important for understanding the process that generates *new* movement organizations as well" (2000, p. 149).

Just as contagion engenders the spread of an epidemic, so it drives diffusion of innovations. Individuals often function as traveling salesmen or brokers carrying information from one area to another and making distant imitation possible. The migration of knowledgeable individuals across geographical areas facilitates the diffusion of a new organizational form through social contagion. By "word of mouth" communication, new adopters can access the experience of early adopters, especially that part of their knowledge that is tacit and therefore difficult to transmit (Geroski 2000). Local interaction generates positive feedback, with the adoption of a new form depending on its frequency of adoption by proximate organizations. Cognitive legitimacy increases with the cumulative number of organizations so that the incentive to adopt a new organizational form rests largely on the number of previous adopters.

Social contagion figures prominently across local subpopulations having their own local clocks. Contagion across boundaries is important during the early stages of the evolution when individuals from neighboring areas contribute to spreading relevant information in the focal area. We expect their impact to diminish as local evolutionary time passes and organizational subpopulations gravitate towards a national form. We thus hypothesize:

HYPOTHESIS 4 (H4). *Interlocal mobility, more than the intralocal one, positively affects local founding rates during the early periods of population development. As local evolutionary time passes, the opposite relationship holds true.*

3. Empirical Setting

To test our hypotheses, we traced founding patterns within the Dutch accounting industry during the period 1880–1986 at the population and the subpopulation levels of analysis, respectively. Previous studies using the same data (see Boone et al. 2000, p. 372 and Table 2 in Pennings et al. 1998, p. 436) found the effects of density-dependence processes to be opposite to those predicted by the theory in their analyses. We argue that one of the possible explanations for these findings is the absence of any control for the geographical heterogeneity of this population. In line with more recent studies using data on Dutch industries (e.g., see the resource-partitioning study by Boone et al. 2002 on the Dutch newspaper industry), we studied the impact of the temporal and spatial dimensions on founding rates after dividing the overall population of accounting firms into 11 subpopulations, each corresponding to a different province. Our basic assumption is that each province represents a distinct selection environment (or adaptive zone) where legitimation and competition processes take place. In the next section we briefly explain why provinces are the appropriate unit of analysis to study how spatial heterogeneity affects founding rates within each subpopulation.

### 3.1. The Geographic Location of the Study

When considering geography, we should ask not only whether "mere" distance matters, but also, and more importantly, whether "borders" matter. It is not, in fact, the mere proximity that determines the spatial heterogeneity of organizational founding rates. Entrepreneurs are embedded in geographic entities that have more or less well-defined boundaries, comprise institutional and socioeconomic identities, and are endowed with distinct bundles of resources. Geographic entities within a country include Standard Metropolitan Statistical Areas (SMSAs), provinces or states, counties, industrial districts, and autonomous regions. They are distinct because of historical as well as developmental and administrative reasons. The study by Pennings (1982) found sharp differences among SMSAs in entrepreneurial activity within specific four-digit SIC codes because SMSAs vary considerably in relevant resource endowments. Other studies show the existence of significant geographical differences, as illustrated by Putman's (1996) classic study on social capital (for example, with some exaggeration, Alabama is a world of loners, while Minnesotans are well endowed with social capital), and by the famous paper on Spain by Linz and de Miguel (1966), in which they identify the existence of eight Spains.

Over the period spanned by our study—i.e., 1880–1986—The Netherlands comprised eleven provinces—i.e., North Holland, South Holland, Fryslan, Groningen, Drenthe, Overijssel, Gelderland, Utrecht, North Brabant, Zeeland, Limburg. The Northern seven provinces in the 17th century constituted autonomous regions held together through a confederation called "The Republic of the United Provinces." Perhaps it was the extraordinary degree of autonomy and home rule that accounts for the disinclination of provinces to secede. Such autonomy might also have further engendered their unique socioeconomic identity. Two of the three southern ones—located below the Rhine and the Meuse rivers—were ruled partly by the Republic, partly by Spain and Austria, and showed much-delayed economic development.

Figure 1 provides a map of The Netherlands, with its twelve provinces. Flevoland, the 12th province, is a *recent* addition due to land reclamation, but is not pertinent to this study and its examination of provinces as local ecologies. The map also hints at geographic distance as a conditioning variable in shaping diffusion and legitimation. For example, let us consider Utrecht. The first founding event followed similar events in the neighboring provinces Noord and Zuid Holland. Gelderland experienced the same event only after its neighboring province Utrecht.

Apart from history, the eleven provinces vary in soil structure, geology, religion, economic development, urbanization, and language or dialect (Frysk is an officially recognized language, spoken in the northern province of The Netherlands, while other provinces like Groningen and Limburg speak a sublanguage or dialect).

Figure 1   Map of The Netherlands and Its Provinces
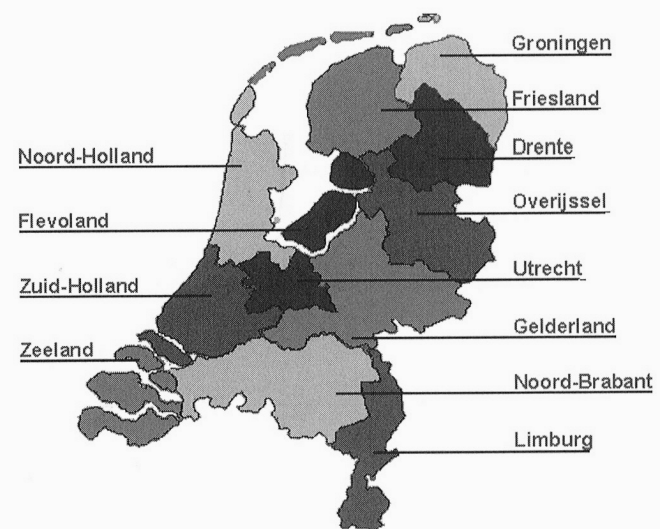
Two of the three below-Rhine provinces are Roman Catholic rather than Calvinist. The provinces are thus not merely administrative units but are also historically, culturally, institutionally, and economically distinct. Even if their significance is declining, they have been critical in determining the current administrative structure of The Netherlands (Centraal Bureau Statistiek 2000). In short, geography matters for organizational activity such as recruitment and service delivery because firm embeddedness is largely local and, as institutional-competitive environment, provinces still hold sway (de Pree 1997).

3.2. Data

The data we used in this paper cover the entire population of Dutch accounting firms during the period 1880–1986 (see Pennings et al. 1998). Because the first firm was founded in 1880, there is no problem of left truncation. Data consist of information about individual organizations and were collected from the membership lists (or directories) of accountant associations with one- to five-year intervals. More precisely, we cover a total of 110 years with 53 observation points that (in percentage terms) are distributed as follows: 24% with a one-year, 60% with a two-year, 6% with a three-year, 8% with a four-year, and 2% with a five-year interval, respectively. The complete industry comprises 1,920 firms observed over a period of 106 years.

The Dutch accounting industry shares many of the features of those industries that Porter (1980) defines as fragmented, where no single firm has a dominant position, entry barriers are low, and services are differentiated. Furthermore, the capital investments to start up a new venture are low. Given their small size, firms tend to operate at the local (province) level and their critical resources (e.g., clients) tend to be local as well. This is particularly relevant in service industries where the client-firm relationship (especially for small, individual firms), as well as competition on the labor market, are more likely to be local (Maister 1993). The accounting service industry is in fact "entirely a personal service industry" (Benston 1985, p. 47). Figure 2 illustrates the fragmented nature of this industry by plotting the market share of the four largest firms (*C4*) over the period 1880–1986. It is worth noting that although the scope of the activity of some firms spans over several provincial boundaries, the province is still the relevant environment for most of the firms.

The Dutch accounting industry has witnessed several fundamental regulatory changes, particularly since the late 1960s, which (among other things) have shaped the founding patterns of new organizations. For example, the need for higher levels of education and experience, and the examination to become a C.P.A. have set more stringent requirements and raised entry barriers into the profession. Four major regulatory changes have significantly affected the supply and the demand of professional accounting services. For the purpose of this paper,

Figure 2   Concentration Index of the Four Biggest Firms
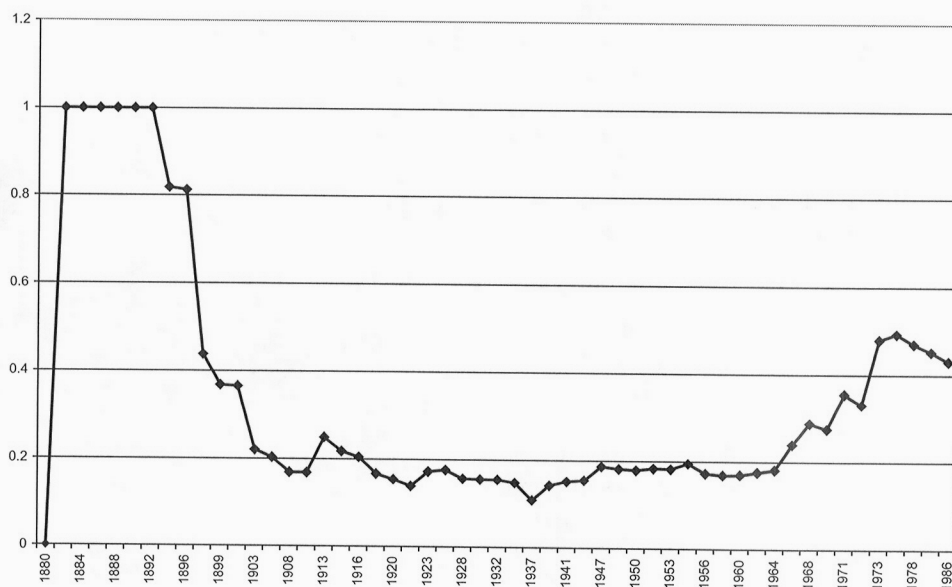
the creation of one professional organization or NIvRA (Nederlands Instituut van Register Accountants) in 1966 is of particular importance. Since then, every professional accountant in public practice has been required to become one of its members. Besides establishing disciplinary rules, the organization grants the Registered Accountant (RA) license on the condition that a prospective auditor acquires "knowledge of complicated audit techniques (such as statistical sampling, risk analysis and analytical review) and extensive knowledge of financial accounting (measurement methods, regulations and standards)" (Maijoor and van Witteloostuijn 1996, p. 555). As for the demand side, additional entry barriers were introduced in 1970 with the Act on Annual Accounts of Companies (which took effect in 1971), which increased the number of firms required by law of disclosing audited annual accounts. This was further increased in 1983 when every company, public or private, and every cooperative society had to disclose audited annual accounts (see Title 8 of Book 2 of the Civil Code). However, the obligation was eventually softened for small and medium-sized firms (Boone et al. 2000, p. 366). While raising the entry barriers into the profession, these changes in the institutional context have also bolstered the demand for auditing services, thereby creating new opportunities for entrepreneurial initiatives.

3.3. Variables

In our model the independent variables include spatial, nonlocal density-dependence, temporal heterogeneity, and migration of professional accountants. With respect to spatial density-dependence, we tested our first hypothesis (H1) by creating two variables, focal provincial density (*FocalPrDensity*) and focal provincial density squared (*FocalPrDensity2*), to estimate the impact of processes of legitimation (through the linear effect) and competition (through the squared effect) at the province level. We also accounted for the influence of density-dependence processes measured at the national level (*NationalDensity* and *NationalDensity2*).

As for our second hypothesis (H2), the influence of neighboring subpopulations was measured by a variable—*NearPrDensity*—computed as the sum of the density values of neighboring provinces. The variable is meant to capture the influence from these areas. We also squared the same variable—*NearPrDensity2*—to verify the nonlinear effect of this influence.

We tested our third hypothesis (H3) regarding the effect of temporal heterogeneity among different subpopulations on founding rates, by including in the model a variable—*ProvAge*—that measures the age of the industry at the province level and comparing it with

a similar variable at national level—*IndustryAge*—that controls for the age of the entire industry. Building on previous work (Cattani et al. 2002), we tested the effect of the migration of professional accountants across geographical provinces in diffusing the new organizational form by reconstructing the histories of individual organizations. To this end, we kept track of the geographical movements of 4,272 accountants during the overall study period—i.e., 1880–1986. More specifically, for each year we established whether during the year before the foundation of a new venture the founder worked: (1) within the same geographical area (*Local Founders*); (2) in any of the neighboring provinces (*Neighboring Founders*); (3) in more distant provinces (*Distant Founders*); or (4) in no province because he or she was new to the industry and therefore was not in our database the year before (*New-to-Industry Founders*).

By way of an example, suppose a new firm is founded in a given year in Noord Brabant, a southern province of The Netherlands (see Figure 1). The founder might be a professional accountant who used to work for a firm located within the same province or a different one. In the latter case, if the firm is located in Zeeland, Limburg, Gelderland, or Zuid Holland, the professional accountant is coming from a neighboring province, otherwise from a more distant one. By contrast, when the founder was not working for any firm, we could not establish the geographical area of origin. To avoid using the same-year founders, for every province we lagged the sum of the values in each of these categories. We test our fourth hypothesis (H4) by interacting each of these categories with the local evolutionary time—i.e., *ProvAge*.

Drawing from Pennings et al. (1998), several control variables were also included in the model to control for changes in the environment at the national level. In particular, two dummies were created for the occurrence of *World War I* (1914–1918) and *World War II* (1941–1946). Because *Indonesia's independence* was supposed to have a persistent effect due to the shrinkage of the market for auditing services, we used a dummy taking on the value of 1 if year > 1949, 0 otherwise. The government *Regulation of 1929*, in the wake of the Great Depression, was presumed to be most impactful during 1929 and 1930 (1 if year = 1929 and = 1930, 0 otherwise). Another institutional event was the emergence of a *Single Association*, NIvRA, which represented the collective interests of all Dutch accounting firms and was established in 1966 (1 if year > 1966, 0 otherwise). The industry also experienced two regulatory changes in 1971 and 1984. In the former case, the Act on Annual Financial Statements of Enterprises

Table 1   Year of First Founding of Accounting Firms Among Dutch Provinces

Area	Province	Year of First Founding
Mid-West	Zuid Holland	1880
Mid-West	Noord Holland	1890
Mid-West	Utrecht	1901
Center	Gelderland	1916
Mid-East	Overijssel	1921
South West	Zeeland	1921
South East	Limburg	1921
South	Noord Brabant	1925
North East	Drenthe	1928
North	Groningen	1906[1]
North	Fryslan	1934

Note. [1]This province is an exception. In fact, the second firm entered this area was after 19 years, in 1925.

required annual audits. In the latter, definitive guidelines for auditing were promulgated and enforced by NIvRA in collaboration with the Dutch Ministry of Justice. Both regulations significantly heightened the demand for audit services. Two variables were then used, namely *Regulation of 1971* (1 if year > 1971) and *Regulation of 1984* (1 if year > 1984). We included *C4*—a measure of concentration of the market share of the four largest firms—to control for the influence of concentration on foundings. Finally, to capture diversity in growth opportunities at the province level, we used a time-varying variable—*ProvInhab*—that measures the number of inhabitants in each province. More densely populated areas are expected to generate more entrepreneurs. Table 1 provides evidence of the tempo-

ral asymmetry in the starting time of different provinces, whereas Table 2 presents the descriptive statistics and the bivariate correlation of our covariates.[2]

4.   Model and Method of Analysis

As is common in studies of organizational foundings, we assume entries to be a realization of an arrival process. In these cases, the Poisson regression represents the most appropriate solution for studying dependent variables that take on only integer values. Under the assumption that the process of founding follows a Poisson distribution, the main problem to deal with is overdispersion—i.e., the tendency of the variance of the founding rate to increase faster than its mean. To correct for overdispersion and time dependence in the rate of foundings—our data set is a pooled cross-sectional/time series—we used a negative binomial regression model. Thus, we inserted a stochastic component—ε_{it}—to account for this problem. Using z to denote a vector that controls for the geographical origin of nascent entrepreneurs and w to denote a vector that contains controls measured at different levels of aggregation, we estimated the following regression model:

$$
\begin{aligned}
r_i(t) \\
= \exp\big(&\alpha_1 NationalDensity_{t-1} + \alpha_2 NationalDensity2_{t-1} \\
&+ \beta_1 FocalPrDensity_{it-1} + \beta_2 FocalPrDensity2_{it-1} \\
&+ \gamma_1 NearPrDensity_{it-1} + \gamma_2 NearPrDensity2_{it-1} \\
&+ \delta IndustryAge_{t-1} + \zeta ProvAge2_{it-1} \\
&+ z'_{it}\theta + w'_t\delta\big) \cdot \varepsilon_{it}, \qquad\qquad [d]
\end{aligned}
$$

Table 2   Mean, Standard Deviation, and Correlation Values

Variables	Obs.	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) *ProvInhab*	583	770,488.30	643,767.50	1.00												
(2) *NationalDensity*	583	157.15	107.51	0.33	1.00											
(3) *NationalDensity2*	583	36,235.75	32,356.74	0.30	0.97	1.00										
(4) *FocalPrDensity*	583	14.42	28.07	0.79	0.35	0.34	1.00									
(5) *FocalPrDensity2*	583	994.28	2,811.10	0.67	0.30	0.30	0.96	1.00								
(6) *NearPrDensity*	583	63.74	62.96	0.41	0.70	0.68	0.48	0.39	1.00							
(7) *NearPrDensity2*	583	8,019.86	11,590.18	0.33	0.60	0.62	0.42	0.34	0.94	1.00						
(8) *IndustryAge*	583	51.82	30.56	0.41	0.69	0.65	0.25	0.17	0.49	0.39	1.00					
(9) *ProvAge*	583	25.72	26.31	0.72	0.59	0.56	0.59	0.47	0.52	0.47	0.68	1.00				
(10) *Local Founders*	583	0.85	2.30	0.67	0.10	0.07	0.53	0.46	0.19	0.13	0.28	0.54	1.00			
(11) *New-To-Industry Founders*	583	1.69	4.27	0.50	0.06	0.02	0.48	0.41	0.18	0.12	0.14	0.36	0.55	1.00		
(12) *Neighboring Founders*	583	0.49	1.35	0.62	0.09	0.06	0.47	0.40	0.24	0.19	0.25	0.52	0.66	0.54	1.00	
(13) *Distant Founders*	583	0.31	0.86	0.35	0.07	0.01	0.15	0.08	0.06	0.00	0.37	0.41	0.41	0.21	0.23	1.00

where $\exp(\varepsilon_{it}) \sim \Gamma[1, \alpha]$. In this formulation of the negative binomial model, the parameter alpha, estimated directly from the data, captures overdispersion. More precisely, we used a variant of the negative binomial estimator that allows correcting for the interdependence among observations due to the presence of multiple observations within each geographical area. To correct for the bias resulting from the fact that founding rates systematically vary among provinces, we employ the fixed-effect version of the negative binomial model proposed by Hausman et al. (1984), which conditions the estimation on the total count of events in each area. Because we assume that important factors shaping founding activity are geographically grounded, the fixed effects are defined at the province level. The different length of the intervals has been controlled by creating a variable accounting for diverse time spans and using the OFFSET option. We estimated the final model using STATA (Version 7).
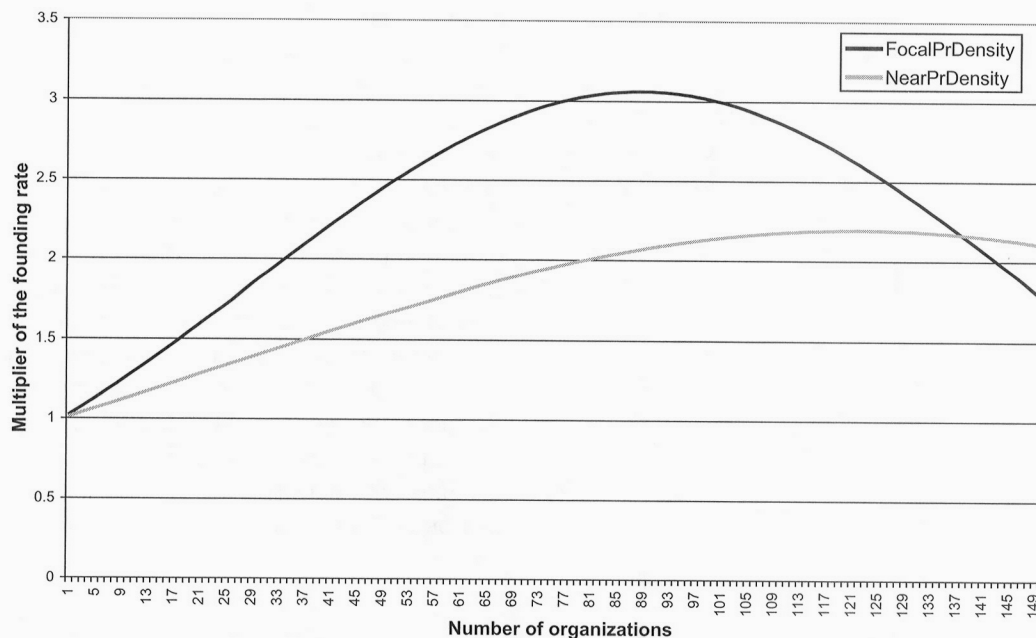
5. Results

Table 3 presents the estimates obtained from a conditional fixed-effect negative binomial model. The first model in Table 3 tests the classical population ecology hypothesis on density-dependence processes at the national level. Both the linear effect of density—*NationalDensity*—measuring legitimation, and the quadratic effect of density—*NationalDensity2*—measuring competition, are statistically significant, though opposite to those predicted by ecological theory. In their analysis of the exit rates within the same population, Boone et al. (2000) found a similar inverted pattern of density-dependence. They concluded that "the parameters of the contemporaneous density variables show the opposite signs of what has usually been found in ecological studies.... That is, exit first rises and then declines with density. Apparently, density-related legitimation processes did not occur at the onset of the Dutch

Table 3   Conditional Fixed-Effects Negative Binomial Regression Models for the Founding Rate of Dutch Accounting Firms 1880–1986[1]

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	−0.95** (0.33)	−0.87** (0.32)	−1.50** (0.39)	−1.70 (0.47)	−1.79** (0.49)
ProvInhab (in millions)	−0.54** (0.15)	−0.80** (0.17)	−0.93** (0.17)	−0.38* (0.22)	−0.35* (0.22)
World War I	−0.81** (0.32)	−0.64* (0.33)	−0.71** (0.34)	−0.59* (0.34)	−0.49 (0.36)
Regulation of 1929	0.84** (0.42)	0.92** (0.40)	0.78** (0.39)	0.60 (0.39)	0.63* (0.37)
World War II	−0.09 (0.46)	0.06 (0.45)	0.07 (0.44)	0.18 (0.43)	0.21 (0.42)
Single Association	1.57** (0.30)	1.59** (0.29)	1.58** (0.27)	2.50** (0.33)	2.12** (0.35)
Indonesia's Independence	1.62** (0.30)	1.71** (0.29)	1.85** (0.26)	2.64** (0.28)	2.56** (0.28)
Regulation of 1971	−0.69** (0.21)	−0.67** (0.21)	−1.12** (0.26)	−1.22** (0.25)	−1.08** (0.27)
Regulation of 1984	−0.40** (0.17)	−0.45** (0.18)	−0.44** (0.18)	−0.06 (0.19)	0.14 (0.21)
C4	−2.70** (0.48)	−2.71** (0.49)	−1.94** (0.56)	−1.96** (0.60)	−1.77** (0.61)
NationalDensity	−0.01** (0.00)	−0.01** (0.00)	−0.01** (0.00)	−0.003 (0.003)	−0.003 (0.003)
NationalDensity2 (in hundreds)	0.003** (0.001)	0.004** (0.001)	0.003** (0.001)	0.001 (0.001)	0.001 (0.001)
FocalPrDensity		0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)
FocalPrDensity2 (in hundreds)		−0.012** (0.006)	−0.014** (0.006)	−0.014** (0.006)	−0.017** (0.006)
NearPrDensity			0.01** (0.00)	0.02** (0.00)	0.02** (0.00)
NearPrDensity2 (in hundreds)			−0.005** (0.001)	−0.006** (0.002)	−0.006** (0.002)
IndustryAge				−0.01 (0.01)	−0.01 (0.01)
ProvAge				−0.04** (0.01)	−0.02* (0.01)
Local Founders					−0.18** (0.09)
New-to-Industry Founders					0.04 (0.03)
Neighboring Founders					0.44** (0.12)
Distant Founders					0.44** (0.15)
Local Founders * ProvAge					0.002* (0.001)
New-to-Industry Founders * ProvAge					−0.0003 (0.0005)
Neighboring Founders * ProvAge					−0.01** (0.001)
Distant Founders * ProvAge					−0.01** (0.002)
Log Likelihood	−887.36	−878.53	−870.70	−859.07	−839.28

Note. [1] *p* < 0.10; **p* < 0.05; Standard errors in parentheses.

Figure 3   Multiplier of the Founding Rate for Density at the Focal Province (*FocalPrDensity*) and Contiguous Provinces (*NearPrDensity*) Level

audit industry" (2000, p. 372). This result confirms the limited explicative power of national ecological models for this industry. Market concentration—measured using the $C4$ index—is significant and, on average, has a negative impact on foundings. The Act of Financial Statement—*Regulation of 1971*—and the regulation of 1984 have a similar effect. On the contrary, the benefit of a single association representing the collective interest of all Dutch firms is evident. These results are by and large consistent with those obtained by Pennings et al. (1998).

The second model tests H1—i.e., how density-dependence, measured at national level, hides unobserved spatial heterogeneity. The value of the log likelihood in Model 2 shows that the model with the variables measuring local legitimation—*FocalPrDensity*—and local competition—*FocalPrDensity2*—fits the data better than the previous one ($\chi^2 = 2[L_2 - L_1] = 17.66$ with p-value < 0.0001 for 2 df). The results support our hypothesis on spatial density-dependence. This is consistent with previous works (e.g., Lomi 1995, Greve 2002) and suggests that geographical heterogeneity significantly affects both legitimation and competition.

Following recent developments in ecological theories (e.g., Wade et al. 1998, Greve 2002), we explored whether the evolution of neighboring provinces affects the evolution of a given subpopulation. We estimated a model including the linear and the quadratic term of *NearProvDensity*. Not only does Model 3 better fit the

data ($\chi^2 = 2[L_3 - L_2] = 15.66$ with p-value < 0.0001 for 2 df), but both coefficient estimates for *NearPrDensity* and its squared term are statistically significant as well. The effect of local density-dependence remains highly significant. Furthermore, the magnitude of *FocalPrDensity* and its squared term (*FocalPrDensity2*) is three times as large as the estimates of the corresponding density measures in contiguous provinces, and in both cases the difference is statistically significant (p-value < 0.10 with 1 df). The relationship is represented graphically, as shown in Figure 3. The numeric values used to plot the graph were generated from the coefficient estimates of the variables in Model 3.

Based on these estimates, the multiplier[3] of the curvilinear founding rate for focal provincial density reaches its maximum ($\lambda^* = 3.1$) when the density of the average subpopulation is at $N = 88$. At that value, the founding rate is about three times larger than the same rate when $N = 0$—i.e., when no firm has been founded as yet. This value is similar to that found by Lomi (1995) in his study on rural cooperative banks in Italy. Put differently, the rate at which new organizations are created initially increases with the level of density due to the provincial legitimation effect. However, beyond a certain level, which corresponds to a subpopulation's carrying capacity, the rate of founding declines as higher levels of density entail more competition. For the average subpopulation of our sample, this threshold is reached when density is equal to 88. This finding confirms the importance

of the local legitimation and competition processes for each subpopulation. The maximum value of the multiplier of the founding rate for neighboring provincial density is reached when $\lambda^* = 2.19$. The same value obtained at the local level of analysis is 50% larger. The difference in magnitude between the maximum values of the multiplier of the founding rate for focal and neighboring provincial density, respectively, suggests that local density-dependence effects dominate those from contiguous provinces.

Whereas all of these models have been estimated to test whether spatial dimension represents a source of heterogeneity among subpopulations, in Model 4 we included age or duration of the industry—*IndustryAge*—and a variable—*ProvAge*—that accounts for differences in age among subpopulations and was created to test the temporal dimension of organizational heterogeneity (H3). Identifying the unit of analysis of temporal evolution of a population is critical in order to understand at which level of analysis selection processes take place. The model shows that local clocks, more than the national one, shape evolution of the Dutch accounting industry. In particular, for each one-year increase in the age of the subpopulation, the number of new foundings decreases by approximately 4% (exp 0.04). Thus, these results support Hypothesis 3.

The logic behind Hypothesis 4 is that migration of individuals from established organizational populations facilitates the diffusion of a new organizational form across geographical areas. However, we also argued that the effect of these movements in the focal area diminishes over time. Model 5 tests this hypothesis by including both the main and the interaction effect between founders' geographical origin and local evolutionary time—*ProvAge*. As the coefficient estimates indicate, the impact of movements of professionals from neighboring and more distant provinces on founding in the focal area diminishes over time. As time passes, however, local dynamics—mostly in the form of spinoffs—become increasingly important in driving entries. It is worth noting that adding these variables significantly improves the fit of the model with our data ($\chi^2 = 2[L_5 - L_4] = 39.59$ with p-value < 0.0001 for 8 df). This pattern of results is consistent with Hypothesis 4.

6. Discussion and Conclusions

Two recurrent criticisms of the density-dependence model (Hannan 1986) refer to the choice of the proper unit of analysis and the neglect of microbehaviors leading to legitimation. While a growing body of research has stressed the neglect of unobserved heterogeneity and the corresponding misrepresentation of the significance of ecological processes, a main challenge has been the decomposition of national populations into subpopulations (Baum and Amburgey 2002, Lomi 1995). Understanding the geographical sources of heterogeneity has both theoretical and normative consequences for entrepreneurs and policy makers alike.

We have therefore advocated a perspective on organizational foundings that focuses on the spatial and temporal sources of heterogeneity in new entries within a population of organizations. We first explored organizational foundings as a function of spatial density, showing that local, more than national, density-dependence processes help explain industry evolution. Second, we demonstrated how multiple, heterogeneous local clocks shape density-dependence processes unfolding in different geographical areas. Third, we showed how spatial diffusion unfolds through interlocal mobility. In this regard, the migration of individuals across geographical areas is an important micromechanism for the spreading of new organizational forms.

One of the most interesting implications of the present analysis is the identification of micromechanisms driving macroevolutionary processes (Schelling 1978). The existence of distinct subpopulations of organizations exhibiting idiosyncratic evolutionary trajectories suggests that a more fine-grained examination of the forces shaping the evolution of an industry can be obtained by shifting the level of analysis to that of the subpopulation. Local entrepreneurial deeds have repercussions beyond the boundaries of the geographical area in which a given subpopulation is residing. However, the overall spectrum of these deeds—entry, competition or collaboration—cannot be fully captured simply by looking at entries. A multilevel analysis therefore endorses our contention for studying mortality rates within populations.

We believe that our findings improve knowledge of ecological processes. It is worth noting that most of the findings on multilevel density-dependence have been anchored in manufacturing industries, if not solely in the automobile sector (Hannan et al. 1995, Hannan 1997, Dobrev et al. 2001, but see Wezel and Lomi 2003). By contrast, for service industries results are still scant (but see Greve 2002, Lomi 2000), in spite of their growing importance in the modern economy. The nature of the service sector partly explains some of the inconsistencies of results observed in the multilevel density-dependence literature. By showing the existence of spatially heterogeneous density-dependence processes, our findings have interesting implications for research dealing with resource partitioning (Carroll

1985). In their analysis of the dynamics of resource partitioning among Italian rural cooperative banks, Freeman and Lomi (1994, p. 291) noticed that this process is observable only when regional fixed effects are not introduced into the model. Their results hint at the possibility that resource partitioning might be geographically distributed or simply be the by-product of spatial and temporal heterogeneity. Boone et al. (2000) found strong evidence for resource partitioning within the same industry, especially during the years before 1971—i.e., when the concentration of the industry was still low; small provinces like Groningen, Overijssel and Limburg were still growing and one of the biggest provinces (North Holland) had just reached its density peak. Our results demonstrate the relevance of considering legitimation and competition at a less aggregate level than the entire industry to fully understand the firm's environment and its impact on organizational creation and dissolution.

Ecological theories dwell on the evolution of organizational populations. The study of their evolution concerns six main subprocesses, each characterized by its own vital rate: (1) creation of new organizational forms (speciation rates), (2) founding of new organizations (founding rates), (3) growth and contraction of organizations (growth rates), (4) change in the existing organizations (rates of change), (5) disbanding of organizations (failure rates), and (6) extinction of populations (rates of extinction). While organizational ecologists have widely studied foundings and failures, and have extensively investigated the organizational processes related to change and growth, scant effort has been devoted to understanding extinction events (for two notable exceptions see Lomi et al. 2001, Wezel 2002) and, in particular, organizational speciation—i.e., the emergence of a new organizational form (see Rao and Singh 1999). Dealing with the emergence and diffusion of new organizational forms, institutional theorists emphasize the influence of social and governmental institutions—e.g., regulatory and professional organizations (DiMaggio 1991). Besides such normative and regulatory effects, however, cognitive legitimacy can spread through the movement of individuals across geographical areas. Our study provides an illustration of how the migration of professional accountants has directly conditioned the diffusion of new organizational forms. Similar considerations are consistent with recent developments in organizational theory that explore the relevance of personnel turnover in diffusing new social movements (Hedström et al. 2000) and influencing organizational innovation (Rao and Drazin 2002) and performance (Cattani et al. 2002, Phillips 2002).

The choice of the province as a meaningful social entity might be questioned on the grounds that social contagion significantly reduces the cognitive distance among separate geographical areas and renders administrative boundaries less salient. However, our findings on the relative importance of ecological processes observed at different levels of analysis signal that geography should not be disregarded. As implicit in the hypothesis on spatial heterogeneity, competition among firms tends to be local. More distant firms are less likely to compete for the same pool of resources or to interact with one another. The intensity of the interaction among new and existing organizations is proportional to their degree of physical proximity (Baum and Mezias 1992, Sorensen and Audia 2000). In professional services sectors, with a preponderance of personal (i.e., based on trust and reputation) and local (i.e., embedded in the existing social fabric) relationships, the possibility of starting a new venture and its subsequent survival is primarily—though not exclusively—geared to garnering locally available resources. Firms acquire and retain such resources by offering customized services and adapting their practice to the special needs of local clients (see Smigel 1969, Porter 1980, Maister 1993).

Finally, by showing how local, rather than national, ecological processes shape organizational foundings in different geographical areas, we believe that the results of our paper offer a new perspective on entry decisions. The existence of spatial and temporal sources of heterogeneity suggests that industries comprise distinct subpopulations, each experiencing distinct and nonsynchronous evolutionary phases. Similar considerations suggest that opportunities and constraints for entrepreneurs are asymmetrically distributed in space. A deeper understanding of the conditions affecting vital processes should thus consider spatial dynamics when investigating patterns of industrial evolution.

Endnotes

[1] Similarly, Levin argues that "ecological communities and ecosystems are heterogeneous in space and time, and this heterogeneity affects diversity and the evolution of life histories. Such biotic heterogeneity reflects underlying heterogeneity in the abiotic environment, frequency-dependent habitat and niche partitioning, and the stochastic phenomena associated with disturbance and colonization" (1989, p. 248).

[2] Some correlation values are above 0.50. Although the coefficient estimates are unlikely to be biased, the standard errors are inflated, rendering the test of the hypotheses more conservative (Allison 1999). We controlled for multicollinearity by estimating a series of hierarchically nested models. This procedure allowed us to carefully verify the coefficient estimates and control whether the standard errors were inflated across models.

[3] The multiplier is found by computing $\exp[(\xi_i * N) + (\omega * N^2)]$ based on the estimates of Model 3, where N is equal to the density of organizations, and N^2 and the subscript i refers to the fact that we are comparing two measures, namely the *FocalPrDensity* and the *NearPrDensity*.

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