

EVOLUTIONARY DYNAMICS AND THE DETERMINANTS OF CLUSTER FIRMS' PERFORMANCE

DINAMICA EVOLUTIVĂ ȘI DETERMINANTELE PERFORMANȚEI GRUPURILOR DE ÎNTREPRINDERI

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Abstract. *This research article aims at investigating the evolutionary dynamics of geographical cluster and the determinants of cluster firms' performance. Differently from prevailing tendency in literature to approach performances of co-localized firms on case-based research strategies, this research departs from a purely descriptive ground in favor of empirically based research that relies on analytic techniques, hypothesis and rigorous formalization. The distinctive feature of this article lies in integrating more classical methodologies of analysis, such as network analysis and cognitive maps, to the promising simulations and computational tools. Moreover, evolutionary dynamics and cluster firms' performances are studied by approaching them from several units of analysis, within different selected geographical clusters characterized by a great variance concerning both the characteristics of co-localized actors and the stages of their lifecycle.*

Rezumat. *Acest articol are ca obiect studierea dinamicii evolutive a grupurilor geografice și determinantelor posibile ale performanței întreprinderilor localizate în astfel de grupuri. În mod diferit de tendințele întâlnite în literatura de specialitate, această problemă privește performanța entităților co-localizate prin cercetări de tip calitativ bazate pe studii de caz, autorii intenționând a se baza pe tehnici care sunt prevalent descriptive, numai în faza inițială a lucrării, privilegiind mai degrabă investigările empirice ale cercetării cantitative, în măsură să garanteze aplicarea de tehnici analitice riguroase; formularea adecvată de ipoteze și formularea adecvată de modele statistice. Elementul distinctiv al acestei lucrări este de a întrevădea printr-o alegere deliberată de integrare a metodologiei cazurilor celor mai practice, cum ar fi acela de „network analysis” și a elementelor cognitive, cu instrumentele cele mai inovative cum ar fi cele de modele de simulare și instrumentele competiționale. Studiul evoluției dezvoltării dinamice a grupurilor, cât și a performanței întreprinderilor localizate, sunt analizate recurgând intenționat la diferite unități de analiză, focalizând atenția asupra grupurilor geografice foarte diferite între ele.*

This research aims at investigating the evolutionary dynamics of geographical clusters and the determinants of clusters firms' performance. In order to reach this aim, this research will depart from a purely descriptive ground in favor of empirically based research that relies on analytic techniques, hypothesis and rigorous formalization. The distinctive feature of this paper lies in studying

different geographical clusters, characterized by a great variance concerning both the characteristics of co-localized actors and the stages of their lifecycle, using heterogeneous methodologies of analysis.

MATERIAL AND METHOD

Differently from other contexts of research, this diversity will not constitute a barrier to systematical investigation, but a wide range of knowledge to use with simulations and computational tools. Normally the diversity of geographical clusters and the heterogeneity of research methodologies have posed huge barriers to systematical investigations of clusters dynamics and clusters firms' performance.

RESULTS AND DISCUSSIONS

On the contrary, in this research geographical clusters in a huge variety of firms size distribution, network arrangements, content and impact of communications, involvement of public agencies will be examined.

Moreover, evolutionary dynamics and clusters firms' performance will be studied by approaching them from several units of analysis (single actor or complex organizations, inter-personal and inter-organizational ties, internal and external networks, etc.), differently from several studies about geographical clusters that have analysed only a single actor or a single typology of relationship. Indeed, although geographical clusters are high in research agendas we lack tools to evaluate their performance and predict their dynamics.

Essentially, the problem is that the clusters of co-localised firms exhibit an aggregate behavior that results from self-organization of local decisions. Consequently, the tools of mathematical analysis do not apply.

Thus, in this research our aim will be to integrate more classical methods of inquiry, such as network analysis and cognitive maps to the promising simulations and computational tools, which can provide a virtual environment where to test set of hypotheses for robustness and consistency.

After a period of discontinuous interest during the 1970s and 1980s, over the last fifteen years geographic clusters, (Porter, 1998; 2000), also known as Industrial Districts (Beccattini, 1979), Neo-Marshallian Nodes (Amin and Thrift, 1992), or Hot Spots (Pouder and St. John, 1996), have been the object of a growing and renewed attention across a broad range of academic disciplines (Malmberg and Maskell, 2002) generally interested in unraveling the link between spatially concentrated industries and the economic prosperity of nations.

Thus, for instance, it has been long established that clustered networks of small medium firms constitute a prominent competitive and economic driver of the Italian industry, but similar arrangements can be found in productive systems as diverse as Motorsport Valley in South England (Pinch and Henry, 1999), Hollywood (Scott, 1998), Silicon Valley (Saxenian, 1994), as well as the software districts in the emerging countries of East Asia. Obviously, such a wide diffusion comes along with an extreme diversity of organizational and structural forms.

Both because of their diffusion and because of their structural variety, geographical clusters are crucial to characterize and improve the performance of national productive systems (Pyke and Sengenberger 1990; Porter 1998).

Since the time when Becattini recognized in Italy the features of the "industrial districts" depicted by Marshall, however, many features have changed. Those agglomerations of large numbers of minuscule firms specialized in tiny fractions of the productive process have paved the way to more complex organizational forms, in which the variety of firms' size and behaviors contributes to the richness and multiplicity of interactions (Park and Markusen 1995; Nuti and Cainelli 1996; Lazerson and Lorenzoni 1999).

In the last few years important attempts have been made to understand in which directions the structures and networks of such systems may evolve and, possibly, to identify an evolutionary lifecycle of industrial clusters (Carminucci and Casucci 1997), however the diversity of industrial clusters and the heterogeneity of research methodologies still poses significant barriers to systematical investigations (Staber, 1998; Staber and Morrison, 2000). In particular, because of the limited attention many investigators give to measurement issues, it is unclear whether the cluster model is becoming more or less successful.

In light of the argument that some of the previously much celebrated clusters in Italy are deteriorating or are transforming into a different mode of production (Harrison, 1994), it would be extremely helpful if researchers collected data that would permit a better evaluation of the causes and consequences of changing cluster dynamics. Further, it is notable that while business networks and industrial clusters have been the object of numerous studies looking at their influence on national competitiveness and/or local growth, much less emphasis has been placed on the antecedents of clusters firms' performance.

These issues point to at least two important and interlaced problems: the first, essentially methodological, is that clusters of networked firms exhibit an aggregate behavior that results from self-organization of local decisions. Consequently, when trying to predict cluster dynamics and evolutionary patterns, standard tools of mathematical analysis do not fully apply.

The second, mainly theoretical, is that there has long been a prevailing tendency in the literature to consider geographical clusters as a whole, without focusing on what is happening at the micro level of the single firm. While this 'macro perspective' has undoubtedly favored our understanding of the overall phenomena and its implications, it has also contributed to nurturing a somewhat latent assumption that all cluster firms tend to be homogenous and thus do not merit special attention in their own right (Lazerson and Lorenzoni, 1999).

It is especially in the last few years - thanks both to significant methodological shifts made possible by use of computer simulations, and to a sharper focus of research on the micro foundations of cluster development and growth - that scholars have started tackling such crucial issues as the prediction of

cluster dynamics and the determinants of clusters firms' performance in a more analytic and systematic way.

These feedbacks at the micro level may originate collective macroscopic dynamics of a considerable complexity (Forrester 1961, 1968; Goodman 1983; Sterman 2000). It is a top-down approach aimed at identifying those relational structures that may trigger explosive and destructive dynamics for the cluster as a whole. Consequently, the systems dynamics approach is able to detect key microstructures for the aggregate behaviour of a cluster (Delauzun e Mollona, 1999; Marafioti e Mollona, 2000; Mollona, 2001). As an example, such approach may prove particularly helpful in assessing the effects of such crucial processes as business maturity, firm exit or delocalization of production due to internalization strategies (Perretti, 2003a), on the cluster mutation over time and its survival rate (Marfioti and Perretti, 1998).

On the other hand, connectionist models lend themselves to a bottom-up modelisation of geographical clusters. After initial attempts with neural networks (Giaccaria 1997) and cellular automata (Brusco, Minerva, Poli and Solinas 2002), agent-based models conquered the scene (Cavezzali and Rabino 2003). Recently, a series of agent-based models of industrial clusters appeared on the *Journal of Artificial Societies and Social Simulation*, the leading journal in this rapidly growing field (Brenner 2001; Fioretti 2001; Squazzoni and Boero 2002; Albino, Carbonara and Giannoccaro 2003).

Just like bottom-up does not oppose top-down, agent-based models are complementary to systems dynamics models. In fact, the reliability of agent-based models is greatly enhanced if systems dynamics macro-equations are available, that anchor the results of agent-based models to a well-known framework.

The great attraction of such methodologies is that they allow the understanding of economic actors' actions and paths of change in a context of time and space.

They account for the fact that behavior of clustered agents is situated and highly conditioned, but not determined, by structures accumulated at the level of the organization and the environment (e.g. social networks, institutions). In other words, these surrounding structures enable and constraint, but do not determine actions of system agents: chance events and human agency, often in combination with increasing returns, may result in unforeseeable changes. That is, actions and repeated interaction of agents adapt, transform, upgrade, or lock-in, both at the level of the organization and the external environment.

Because computational models may incorporate all these crucial features in a simulated environment, they allow for a much deeper and more realistic evolutionary understanding of cluster dynamics than it would otherwise be permitted by rigorous mathematical formalization.

Turning to the theoretical dimension, at least two interesting bodies of research have emerged that look at the determinants of cluster development and of clusters firms' performance: First, organizational scholars have started to investigate the antecedents of network formation within firm clusters. In

particular, given the crucial role of interorganizational ties in shaping the competitive advantage of cluster located firms, initial attempts have been made to understand and single out the generative rules leading to the establishment of an effective interorganizational field (Kogut, 2000; Antonelli, 2003). This stream of research has moved along two complementary directions.

One relatively more focused on the role of the individual actors (i.e. the firms) in shaping the local system; the second, mainly concerned with the institutional and social features of the local context, as enablers of network formation and development. Likewise, research has been undertaken that investigates the possibility of institutional and public actors to act as 'meta-organizers', that is actors capable to initiate, forge and propel interorganizational arrangements among key cluster nodes (Rullani, 1999; Meneguzzo, 2001; Consiglio and Antonelli, 2004), so as to enhance the cluster competitive edge.

Drawing on the structural embeddedness approach à la Granovetter (1985), a second body of research has evolved that suggests the benefits of looking at the structural and relational properties of the interorganizational configurations that occur within localized industries (Grabher, 1993; Uzzi, 1997; Lorenzoni and Lipparini, 1999). In particular, scholars have started to show that these firms do actually differ in their interorganizational arrangements, and that such difference may represent a major source of variety within the cluster community (McEvily and Zaheer, 1999). Many novel analytic angles have been proposed to unveil the nature and consequences of this interorganizational heterogeneity.

The adoption of cognitive maps methodologies has provided suggestive insights on how dramatically different may be the perception of competitive interactions among co-localized organizations (Odorici and Lomi, 2001; Boari, Odorici and Zamarian, 2003).

Taken together, these emerging strands of research delineate the boundaries of a fascinating field of inquiry, whereby the integration of computational methodologies with original conceptual frameworks, offer unprecedented possibilities to enhance our understanding of how modern geographical clusters are changing over time, and what the key drivers of their competitive success are going to be.

CONCLUSIONS

The article is articulated along two different interconnected phases. By means of a sharply focused literature review, the first phase aims at identifying a set of possible determinants of the performance of clustered firms, through the construction of a significant theoretical framework mainly concerning the evolutionary paths of clusters of firms.

Moreover, it aims at developing a set of techniques to observe the alleged determinants and the actual performance of firms in selected clusters. Specifically, network analysis and cognitive maps will be used in order to identify

elementary structures of interaction between co-localized actors and the content and purpose of their business relationships. Additional information will be collected by means both of a software for group communication and of a significant revisitation of available statistical information.

In the subsequent phase, a casual relationship between the previous selected determinants and the actual performance of firms is identified through the construction and utilisation of two complementary simulation models: System Dynamics models (SDMs) and Agent-based models (ABMs).

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