# COMPETITIVE SUCCESS OF INDUSTRIAL DISTRICTS: AN EXPLORATIVE STUDY IN ITALY

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**Abstract**
The paper conducts an explorative research on the competitive success of the Industrial Districts IDs (GCs), due to their capacity to adapt and evolve to the environment. Our aim is to identify the ID structural features supporting adaptation by using the complexity theory. We consider the IDs as complex adaptive systems (CASs) and identify the ID features on the basis of the main CAS properties that foster adaptation, i.e. interconnectivity, heterogeneity, and control. To formulate the theory linking the values of the ID structural features with the ID competitive success, a multiple case study is carried out. In particular, it is aimed at comparing IDs with different competitive performances in terms of their CAS properties using network theories and measures. Three theoretical propositions are finally derived.
**Keywords:** Industrial districts, complex adaptive systems, network, complexity science, adaptive capacity
**JEL classification:**

## 1. Introduction

Industrial Districts (IDs) are geographically defined production systems, characterized by a large number of small and medium sized firms that are involved at various phases in the production of a homogeneous product family. These firms are highly specialized in a few phases of the production process, and integrated through a complex network of inter-organizational relationships (Porter, 1998).

The literature on IDs is quite rich and involves different streams of research, such as social sciences, regional economics, economic geography, political economy, and industrial organization. Referring to this literature, studies have mainly provided key notions and models to explain the reasons of ID competitive success that has largely contributed to the regional and national economic development. Examples of such models are: the flexible specialization conceptualized by Piore and Sabel (1984); the localized external economies concept anticipated by Marshall (1920) and further formalized by Krugman (1991); and the industrial atmosphere notion conceived by Marshall (1920).

The foregoing models show that the main critical factors governing the success of ID firms can be traced back to the following ID features: physical and cultural proximity of many small and medium sized firms; division of labor among firms; presence within the area of complementary competencies and skills; high degree of specialization of both firms and workforce; existence of a dense network of inter-firm relationships where firms co-operate and compete at the same time; presence of a dense network of social relationships based mainly on face-to-face contacts; and the easy and fast circulation of knowledge and information in the area.

These features appear relevant where the competitive context is characterized by both increasing and not particularly sophisticated demand, but they seem to be insufficient to guarantee the ID success in the recent competitive scenario. In fact, by looking at several dynamic and competitive IDs we have observed that they are modifying their structures and strategies, thereby losing some of their traditional features.

In such a context, the foregoing studies do not explain why some IDs fail when facing the new competitive scenario while others not. Nor do they explain why some IDs evolve by assuming different structures to remain competitive and others not. These studies in fact, adopt a static perspective to analyze IDs by restricting their analyses to the definition of a set of conditions explaining ID competitive advantage in a particular context. In addition they focus on the system as a whole and not on the single components (firms), observe the phenomena when they are already happened at the system level, and describe them in terms of cause-effect relations by adopting a top-down approach.

Our intention is to overcome these limitations by adopting a different approach. We look at the ID competitive advantage as not the result of a set of pre-defined features characterizing IDs but as the result of their capability to adapt and evolve with the external environment. In fact, if the IDs possess the conditions that allow them to adapt and co-evolve with the environment, they will modify themselves so as to be more successful in that environment. In this way, IDs have competitive advantage not because they are characterized by a set of features but because they are able to evolve exhibiting features that are the spontaneous result of the adaptation to the environment. This result is not known a priori, but emerges from the interactions among the system components and between them with the environment.

This approach is based on the complexity theory (Gell-Mann, 1994), which studies the complex adaptive systems (CASs) and explains causes and processes underlying emergence in CASs. In particular, CASs consist of an evolving network of heterogeneous, localized and functionally-integrated interacting agents. The latter interact in a non-linear fashion and can adapt and learn, thereby evolving and developing a form of self-organization that enables them to acquire collective properties that each of them does not have individually. CASs have adaptive capability and co-evolve with the external environment, modifying it and being modified. CAS theory identifies the main features influencing adaptation, namely interconnectivity, level of control, and heterogeneity. The values of these variables that foster adaptation are also defined: a moderate level of interconnectivity, a high value of heterogeneity, and a moderate level of control (Kauffman, 1993).

Once the IDs have been recognized as CASs, the CAS theory is used to look for the ID features that allow the adaptability of IDs in "high velocity" environments. In particular, these ID features are identified by translating the three CAS properties supporting adaptation into ID structural features.

In the light of this argument, the major contribution of our paper is to derive theoretical propositions that link the competitive success of the IDs to specific ID structural features and to their value. Based on the literature we associate the level of interconnectivity with the number of links among ID firms, the heterogeneity with the distribution of the links in the IDs, and the level of control with the degree of control of the ID organizational structure. We argue that specific values of these features are able to foster adaptation of the ID to the external environment and, as a consequence, to improve the ID performance. Finally, we conduct an explorative empirical research based on a multiple case study design (Yin, 1989), with the aim of comparing the ID features captured in the analysis and articulating theoretical propositions regarding the values that foster the ID performance.

We choose four cases of Italian ID located in Southern Italy characterized by different competitive performances and we compare them in terms of their CAS properties. To compare the four IDs we use methods of social network analysis (Borgatti and Everett, 1999; Wasserman and Faust, 1994). Therefore, firstly we model each ID by means of the network of business inter-firm relations and then we compare the network structure by using network attributes. In particular, the network density, the network centrality, and the Gini coefficient of the coreness values are calculated as proxy of the three main ID features influencing adaptation, namely interconnectivity, level of control, and heterogeneity, respectively.

The paper is organized as follows. First, the main theories explaining the sources of the ID competitive advantage are briefly reviewed. Then, the complexity theory is presented and the key CAS properties fostering adaptation are defined. Finally, the case studies are discussed and the theoretical propositions presented.

## 2. Industrial district competitive advantage

### 2.1. Traditional sources of competitive advantage for Industrial Districts

Traditional studies on IDs have analyzed the main advantages of IDs that explain the reasons of their success.

In particular, the studies of economic geography have pointed out the benefits associated to the "agglomeration external economies", mainly due to the lower input costs, the development of common suppliers, specialist labour pools, spillover of technical know-how, and the development of a greater comprehension of the workings of the particular industry by individuals and firms (Becattini, 1990; Marshall, 1920).

Studies on industrial economics have highlighted the reduction of the transactional costs due to geographical proximity of firms and informal and face-to-face contacts among them as one of the most important benefits of IDs (Powell, 1987). Other studies have stressed that one of the key source of ID competitive advantage is their capacity to develop product and process innovations. In particular, many authors have pointed out that the ID innovative capacity mainly results from the presence of high specialized technical competencies, the existence of networks of formal and informal relationships, and the geographical proximity that creates an environment wherein information, codes, languages, routines, strategies, and knowledge are easy to be transferred and shared (Cooke, 1999; Cooke and Morgan, 1998; Henry and Pinch, 2002; Lundvall and Johnson, 1994).

Synthesizing the results of these studies, the key source of the ID competitive advantage is the static efficiency, namely cost advantages gained by clustered firms, due to a set of features characterizing them: the specialization of firms, the presence of a specialized workforce, the division of labour among firms, the accumulation of specific knowledge in the local area, the networking processes among both the economic and social system, the development of a widespread innovative capacity, the presence into the local area of a common system of social-cultural values.

However, in the recent years these factors determining the success of IDs in a competitive context characterized by both increasing and not particularly sophisticated demand, seem to be insufficient to guarantee competitive advantage to both the system and its firms. In this new situation, new sources of competitive advantage based not only on the paradigm of the static efficiency are needed.

### 2.2. Knowledge-based competitive advantage of Industrial Districts

Recently strategic management literature has pointed out that in today economy the source of sustainable competitive advantage for firms can not more be limited to cost and differentiation advantages and has recognized the importance of knowledge as a fundamental factor in creating economic value and competitive advantage for firms (Barney, 1991; Grant, 1998; Leonard-Barton, 1995). What firm knows, how it uses what it knows, and how fast it can develop new knowledge are key aspects for firm success (Hamel and Prahalad, 1994; Prusak, 1997). Therefore, knowledge is a key asset for competing firms and, consequently, learning is a key process. This in fact increases the firm cognitive capital (knowledge stock).

These new strategic management theories have forced new studies on IDs. In particular, in the last years some scholars have analyzed the role of knowledge in IDs and proposed a knowledge-based theory of IDs (Malmberg and Maskell, 2004; Maskell, 2001). These works have investigated the nature of knowledge circulated in IDs, the knowledge transfer and creation processes embedded in IDs, and the learning processes activated by firms in IDs (Albino et al., 2005; Tallman et al., 2004). This superior capacity of IDs to support processes of learning and knowledge transfer and creation has been identified as the key source of their competitive advantage.

Oppositely to the traditional studies on IDs where the source of competitive advantage is static based on the possess of given features, in these knowledge-based studies on IDs the competitive advantage results from dynamic processes activated by ID firms, namely the learning and knowledge management processes.

In line with this new perspective, we seek new dynamic sources of competitive advantage by adopting a different theoretical approach, namely complexity science.

## 3. The key properties of complex adaptive systems

Three basic schools have given rise to complexity science: the European, American, and Econophysics Schools. The European School consists of Prigogine (1955), Haken (1977), and Mainzer (2004), amongst many others. It is math intensive, and originates with the natural science experiments on "Bénard processes". The American School consists largely of scholars associated with the Santa Fe Institute (Anderson, et al., 1988; Arthur, et al., 1997; Cowan, et al., 1994; Pines, 1988). Drawing from the life sciences and making extensive use of computational approaches and agent-based models, the American school complexity literature mainly focuses on Complex Adaptive Systems (CASs) and on the conditions called the "edge of chaos" (Kauffman, 1993; Lewin, 1992). The Econophysics School dates back to the discovery that communities ranked by population form a Pareto-distributed rank/frequency by Auerbach (1913) and Zipf (1949). Its focus is on how order creation actually unfolds once the forces of emergent order creation by self-organizing agents are set in motion. Key elements of this third phase are fractal structures, power laws, and scale-free theory.

During the 1990s, there was an explosion of interest in complexity science as it relates to organizations and strategy. Complexity science offers a number of new insights that can be used to seek new dynamic sources of competitive advantage. In fact, application of complexity science to organization and strategy identifies key conditions that determine the success of firms in changing environments associated with their capacity to self-organize and create a new order, learn and adapt (Levy, 2000; Mckelvey and Maguire, 1999; Mitleton-Kelly, 2003).

Amongst the different streams of study of complexity science, we focus primarily on the American School and in particular on the Complex Adaptive System theory, identifying the main properties of CASs and studying their dynamics. A CAS is a set of heterogeneous and interacting agents that emerges as a new order, or new structure/process over time. The agents interact in a non-linear fashion, can adapt and learn, thereby evolving and developing a form of self-organization that enables them to acquire collective properties that each of them does not have individually. CASs adapt to changing environmental conditions without any singular entity deliberately managing or controlling them and co-evolve with the external environment, modifying it and being modified (Axelrod and Cohen, 1999; Choi et al., 2001; Gell-Mann,1994; Holland, 1995; Lane, 2002).

Based on the main contributions of CAS theory three main structural properties of CASs are identified that foster their adaptive capacity, namely interconnectivity, level of control, and heterogeneity.

### 3.1. Interconnectivity

CAS theory identifies the number of interconnections within the system as a critical condition for self-organization and emergence. Kauffman (1995) points out that the number of interconnections among agents of an ecosystem influences the adaptive capacities of the ecosystem. He uses the NK model to investigate the rate of adaptation and level of success of a system in a particular scenario. The adaptation of the system is modeled as a walk on a landscape. During the walk, agents move by looking for positions that improve their fitness represented by the height of that position. A successful adaptation is achieved when the highest peak of the landscape is reached. The ruggedness of the landscape influences the rate of adaptation of the system. When the landscape has a very wide global optimum, the adaptive walk will lead toward the global optimum. In a rugged landscape, given that there are many less differentiated peaks, the adaptive walk will be trapped on one of the many suboptimal local peaks.

By using the concept of tunable landscape and the NK model, Kauffman (1995) demonstrates that the number of interconnections among agents (K) influences the ruggedness of the landscape. As K increases, the ruggedness increases and the rate of adaptation decreases. Therefore, in order to assure the adaptation of the system to the landscape, the value of K should be moderate.

This result has been applied in organization studies to modeling organizational change and technological innovation (Kauffman et al., 2000; Levinthal, 1997; Rivkin and Siggelkow, 2002). In organization studies the K parameter has an appealing interpretation, namely, the extent to which components of the organization affect each other.

### 3.2. Heterogeneity

Different studies on complexity highlight that variety destroys variety. For example, Ashby (1956) suggests that successful adaptation requires a system to have an internal variety that at least matches environmental variety. Systems having agents with appropriate requisite variety will evolve faster than those without. The same topic is studied by Allen (2001), LeBaron (2001), and Johnson (2000). Their agent-based models show that novelty, innovation, and learning all collapse as the nature of agents collapses from heterogeneity to homogeneity. Dooley (2002) states that one of the main properties of a complex system that supports the evolution is diversity. Such a property is related to the fact that each agent is potentially unique not only in the resources that it holds, but also in terms of the behavioral rules that define how it sees the world and how it reacts. In a complex system diversity is the key towards survival. Without diversity, a complex system converges to a single mode of behavior.

### 3.3. Level of control

The governance of a system is another important characteristic influencing CAS self-organization and adaptive behaviors. Le Moigne (1990) observes that CASs are not controlled by a hierarchical command-and-control center but instead manifest a certain form of autonomy. The latter is necessary to allow evolution and adaptation of the system. A strong control orientation tends to produce tall hierarchies that are slow to respond (Carzo and Yanousas, 1969) and invariably reduce heterogeneity (Jones, 2000; Morgan, 1997). The presence of "nearly" autonomous subunits characterized by weak but not negligible interactions is essential for the long-term adaptation and survival of organizations (Sanchez, 1993; Simon, 1996). Furthermore, Granovetter's (1973) research finding is that novelty and innovation happen more frequently in networks consisting mostly of "weak ties" as opposed to "strong ties". The latter tend to produce "groupthink" (Janis, 1972).

## 4. The complex adaptive system properties and the industrial district features

The basic assumption of our study is that IDs are CASs. They exhibit different CAS properties: the existence of different and heterogeneous agents (e.g. firms and institutions), non-linear behaviors, many types of interactions and motive to connect among agents and between agents and the environment, distributed decision making, decentralized information flows, and adaptive capacity (Albino et al., 2005; Carbonara et al., 2010). Once the IDs have been recognized as CASs, by exploiting the analogy between CASs and IDs, the ID features that foster its adaptive capacity may be identified. In particular, to do this, we recognize what ID features can be associated with the three CAS properties enabling adaptation, i.e. interconnectivity, heterogeneity, and level of control.

The interconnectivity property of CASs is associated with the interconnectivity level of IDs, that results form the business and social linkages among the ID firms. Business linkages among firms of the same ID are due to the horizontal and the vertical labour division characterizing the ID production model and these links may occur for any business matters, e.g. trade of inputs, participation in the same business association, exchange of information. Social links are established thanks to the face-to-face contacts and the friendship and kinship existing among employees of different firms.

The heterogeneity property of CASs is expressed for the IDs as the diversity among ID firms (the agents) that vary in terms of resources, knowledge, competitive strategies, etc. As such, we consider that the ID heterogeneity is influenced by the specific network of relationships that firms establish with the other firms. In fact, since the network of relationships acts as a mean of diffusion of information, knowledge, competitive strategies (Giuliani, 2007; McEvily and Zaheer, 1999), it tends to increase the homogeneity across the firms.

Finally, we associate the level of control of CASs with the level of control characterizing an ID that is determined by the governance of the ID's organizational structure. Two main alternative ID's organizational structures may be identified: the so-called Marshallian ID where firms are mostly independent one from each other and the ID with the leader firms, characterized by the existence of firms taking a leader position in the district that assume a role of managerial guide and control their own network (Albino et al., 2006).

Aiming at formulating theoretical propositions on the value that the ID features should exhibit to foster adaptation to external environment, we develop an explorative empirical research based on multiple case-study.

## 5. Methodology

### 5.1. Research design

Our explorative research adopts a multiple-case study approach (Yin, 1989). This methodology is particularly appropriate when theory building is the main aim of the research and a further exploration on the constructs of the theory is required. We selected four IDs localized in Southern Italy. The selection was driven by the argument to identify polar cases of declining district and successful district in order to compare them in terms of CAS properties. Eisendhardt (1989) in fact argues that theory building from case studies can be enhanced by choosing cases that highlight extreme situations or polar types in which the phenomenon under investigation is observable.

We focused on Made-in-Italy sectors and chose the four cases on the basis of mainly secondary data and previous studies.

At the end of this activity, we identified the four following IDs: (i) Barletta knitwear district, (ii) Andria underwear district, (iii) Barletta footwear district, and (iv) Foggia agro-food district.

To measure the competitive performance of the four cases we have used two different measures: the return on investment index (ROI) and the value added (VA). In particular, the performance index of the network based on the ROI is calculated asking each firm to indicate whether its ROI is lower, equal, or higher than the average ROI of the sector. Then we have assigned the value of 1, 2, and 3 to each case, respectively. The performance index of the network is the average across the performance index of the firms. As for the VA, national statistical data are used .

**Table 1. Industrial district's dimension and sample.**

| | The knitwear district of Barletta | The underwear district of Andria | The footwear district of Barletta | The agro-food district of Foggia |
|---|---|---|---|---|
| Population of firms | 498 | 371 | 336 | 284 |
| Sample | 217 | 188 | 179 | 142 |
| Respondents | 151 (70%) | 125 (66%) | 117 (65%) | 88 (62%) |
| ROI | 2.1 | 2.4 | 1.7 | 1.2 |
| Value Added (million €) | 85.34 | 97.59 | 69.45 | 40.46 |

To model and compare the four considered IDs we used methods of social network analysis. Therefore, firstly we modelled each ID by means of the network of business inter-firm relations and then we compared the structure of the four networks by using network attributes. In particular, we used the following set of measures: network density; network heterogeneity; and network centrality.

The network density (*ND*) is defined as the proportion of possible linkages that are actually present in a graph. The network density is calculated as the ratio of the number of linkages present, *L*, divided by its theoretical maximum in the network, $n(n-1)$,[1] with *n* being

[1] A directed graph without self-loops has at most n(n-1) possible edges and an undirected graph has half this value.

the number of nodes in the network (Borgatti and Everett, 1997; Wasserman and Faust, 1994):

$$ND = \frac{L}{n \cdot (n-1)}$$

The network heterogeneity is referred to the "coreness" of each actor in the network, where the coreness is the degree of closeness of each node to a core of densely connected nodes observable in the network. Using actor-level coreness data, we calculated the Gini coefficient, that is used as an index of heterogeneity (Borgatti and Everett, 1999). An high Gini coefficient means that the actors in the network are characterized by different distribution of linkages.

The network centrality is calculated by the normalized average degree centrality of the nodes and the normalized average closeness centrality.

The degree centrality of a node DC(i) is defined as the number of edges incident upon that node. Thus, degree centrality refers to the extent to which an actor is central in a network on the basis of the ties that it has directly established with other actors of the network. This is measured as the sum of direct linkages x of node i with other j nodes of the network:

$$DC(i) = \sum_{j=1}^{n} x_{ij}$$

To compare network of different size is better to use the average normalized degree centrality, calculated by averaging the normalized degree centrality of each node, where the normalized degree centrality is the degree centrality divided by the maximum possible degree expressed as a percentage (Borgatti and Everett, 1997).

The closeness centrality is most frequently used to measure relative access to network resources and information, and can also be interpreted as measuring the degree of independence from others in the network (Borgatti and Everett, 1997). It is inversely proportional to the total geodesic distance from the node to all other nodes in the network. Geodesic distance is defined as the length (number of edges) of the shortest path linking two nodes (Freeman, 1979). As for the degree centrality, to compare the closeness centrality of the different networks we use the normalized averaged closeness centrality.

Network measures were evaluated using the network analysis software toolkit UCINET 6.0 (Borgatti et al., 2002).

## 5.2. Sampling

A sample of firms has been selected within each IDs using a stratified sampling technique rather than a random one. In particular, we have stratified the population on the basis of the production phase that firm performs (production stages) or the manufacturing specialization of firm. In this way the risk that the network of business inter-firm relationships is influenced by a random selection of firms is reduced. In fact, the random sampling technique could select disproportionally firms belonging to the different stages.

## 5.3. Data

### 5.3.1. Data collection

The study is based on micro level network data, collected at the firm level in the four IDs. To collect data we conducted interviews on the field with managers and owners of the companies. Interviews were carried out on the basis of a structured detailed questionnaire aimed at identifying the business inter-firm relations. In particular, we asked firms to indicate the firms in the sample with which they have business exchange.

### 5.3.2. Data analysis

Data analysis consists into two steps: firstly, we carried out the case studies and then, we employed a cross-case analysis aimed at identifying similarities and differences among the analysed cases and generating hypotheses (Sammarra and Belussi, 2006; Choi and Hong, 2000).

## 5.4. Four cases from Italy

### 5.4.1. The Barletta knitwear district

Nowadays the district is formed by 498 firms, employing more than 2.000 workers. The district is specialized in the knitwear production and main products are: casual clothes, women dress, woollens, sweatshirts, etc. Firms are classified into the following five main stages of the production process:

- Yarn and fabric producers,
- Screen printings, which put trimmings, make molds and print fabrics,
- Laundries, which dress the clothes and iron them,
- Knitwear producers, which make the knitted clothes,
- Garment makers, which assembly the final products and sell them to the distributors.

In order to analyze the whole structure of the local district, we selected a stratified sample of 217 firms (Table 2). We received about the 70% of answers to the questionnaires and on the basis of the information collected we have first built the incidences matrix and then represented the district network by using the software UCINET.

**Table 2. Key information on the Barletta knitwear district and the sampled firms.**

| | District | Sample | Respondents |
|---|---|---|---|
| **Number of firms in 2006** | 498 | 217 | 151 |
| **Firms by specialization** | | | |
| - Yarn and fabric producer | 10 | 4 | 3 |
| - Screen printing | 10 | 4 | 3 |
| - Knitwear producer | 142 | 63 | 43 |
| - Laundry | 46 | 20 | 14 |
| - Garment maker | 290 | 126 | 88 |

The network is formed by 151 nodes and linked by 3070 bidirectional ties. In Table 3 the network attributes are reported.

**Table 3. Barletta knitwear district network attributes.**

| Attributes | Value |
|---|---|
| No of nodes | 151 |
| No of ties | 3070 |
| Network density | 13.6% |
| Gini coefficient | 0.14 |
| Average DC | 20.3% |
| Standard deviation | 5.2 |
| Normalized Average DC | 14% |
| Standard deviation | 3.5 |
| Normalized Average CC | 52.1% |
| Standard deviation | 2.1 |

### 5.4.2. The Andria underwear district

The district is located in the province of Bari, in the northernmost part of the Italian region of Puglia and comprises 3 municipalities, namely Andria, Bisceglie and Canosa, with the great concentration in the municipality of Andria (301 firms).

The district is specialized in the underwear production, main products are:

- Ladies underwear and lingerie (e.g. panties, petticoats, bras), men underwear (pajamas, underpants);
- Woollen underwear (undershirts, panties, petticoats, etc.).

In the district there are 371 firms operating in the underwear sector out of which we chose a stratified sample of 188 firms specialized in five different production phases: yarn and fabric producers, screen printings, woollen underwear producers, laundries, and underwear makers (Table 4).

**Table 4. Key information on the Andria underwear district and the sampled firms.**

| | District | Sample | Respondents |
|---|---|---|---|
| **Number of firms in 2006** | 371 | 188 | 125 |
| **Firms by specialization** | | | |
| - Yarn and fabric producers | 40 | 21 | 14 |
| - Screen printer | 12 | 4 | 3 |
| - Woollen underwear producer | 126 | 65 | 43 |
| - Underwear maker | 167 | 84 | 56 |
| - Laundry | 26 | 14 | 9 |

In order to analyze the whole structure of the local district, on the basis of the information collected through the questionnaires, we have built the district network. In this case study we had a rate of return equal to 66%. Table 5 shows the network attributes.

**Table 5. Andria underwear district network attributes.**

| Attributes | Value |
|---|---|
| No of nodes | 125 |
| No of ties | 1862 |
| Network density | 12.1% |
| Gini coefficient | 0.2 |
| Average DC | 14.9 |
| Standard deviation | 5.3 |
| Normalized Average DC | 12.1% |
| Standard deviation | 4.3 |
| Normalized Average CC | 49.2% |
| Standard deviation | 3.4 |

#### 5.4.3. The Barletta footwear district

The district is located in the new-born province of Barletta-Andria-Trani, in the Puglia region. The concentration of small and medium-sized firms is focused on the production of casual shoes for lower market spheres, mostly provided with so-called injected soles. Some of the larger firms in the district are devoted to the production of the more advanced safety shoes that are developed for use in dangerous working circumstances.

The most recent Census of Industry, carried out in 2001, made clear that the industrial district of Barletta officially consists of 369 firms in the footwear sector, with final firms and specialised suppliers both accounting for about 50 percent. At the end of 2006, by using the Infocamere database we have registered 336 firms operating in the footwear sector. In particular, district firms encompass branded and non-branded end-product manufactures, several specialized suppliers (such as shoe string manufacturers, die-sinkers, heels manufacturers, etc.) and subcontractors (such as upper and sole producers).

In order to analyze the structure of the local district, we selected a stratified sample of 179 firms. We received about the 65% of answers to the questionnaires and on the basis of the information collected we have built the district network (Table 6).

**Table 6. Key information on the Barletta footwear district and the sampled firms.**

| | District | Sample | Respondents |
|---|---|---|---|
| **Number of firms in 2006** | 336 | 179 | 117 |
| **Firms by specialization** | | | |
| - Die-sinkers | 14 | 8 | 5 |
| - Parts and accessories (shoe string, heels, etc.) | 43 | 23 | 15 |
| - Upper producers | 95 | 50 | 33 |
| - Shoe producers | 184 | 98 | 64 |

The network is formed by 117 nodes and linked by 3024 ties. In Table 7 the network attributes are reported.

**Table 7. Barletta footwear district network attributes.**

| Attributes | Value |
|---|---|
| No of nodes | 117 |
| No of ties | 3024 |
| Network density | 22.3% |
| Gini coefficient | 0.1 |
| Average DC | 25.8% |
| Standard deviation | 5.5 |
| Normalized Average DC | 22.3% |
| Standard deviation | 4.8 |
| Normalized Average CC | 56.2% |
| Standard deviation | 1.7 |

#### 5.4.4. The Foggia agro-food district

The district is located in the province of Foggia, in the Puglia region. Agriculture and the whole food and agriculture industrial system represent the mainstay of the economy of the province of Foggia, as confirmed by the total agricultural surface area of the province that exceeds 560.000 hectares, the number of farms (about 61.000), and by the number of agricultural employees (the incidence of agriculture employment is the 13,9% in the province of Foggia versus the average national value of 4,4%). The area so called "Tavoliere" is among the major Italian producers of tomatoes, olives, wine grapes, and vegetables, but shows high production ratios also for vegetable oils, the processing and preservation of fruit and vegetables, and the production of corn seed and starch products. Alongside the primary cultivation activity, a reasonably sized satellite district of SMEs specialized in the food-processing, food-packaging, and fresh fruit and vegetables conditioning has developed in the last few decades. In the district we have counted in the 2006 284 firms out of which we chose a stratified sample of 142 firms specialized in the three main agri-food productions characterizing the district, namely the olive oil, the wine and the fruit and vegetable production (Table 8).

**Table 8. Key information on the Foggia agro-food district and the sampled firms.**

| | District | Sample | Respondents |
|---|---|---|---|
| **Number of firms in 2006** | 284 | 142 | 88 |
| **Firms by specialization** | | | |
| - Vine production | 77 | 39 | 20 |
| - Olive oil production | 121 | 61 | 42 |
| - Fruit and vegetable production | 86 | 43 | 26 |

In order to analyze the whole structure of the local district, on the basis of the information collected through the questionnaires, we have built the district network. In this case study we had a rate of return equal to 62%. Table 9 shows the network attributes.

**Table 9. Foggia agro-food district network attributes.**

| Attributes | Value |
|---|---|
| No of nodes | 88 |
| No of ties | 378 |
| Network density | 4.9% |
| Gini coefficient | 0.04 |
| Average DC | 3.4% |
| Standard deviation | 5.5 |

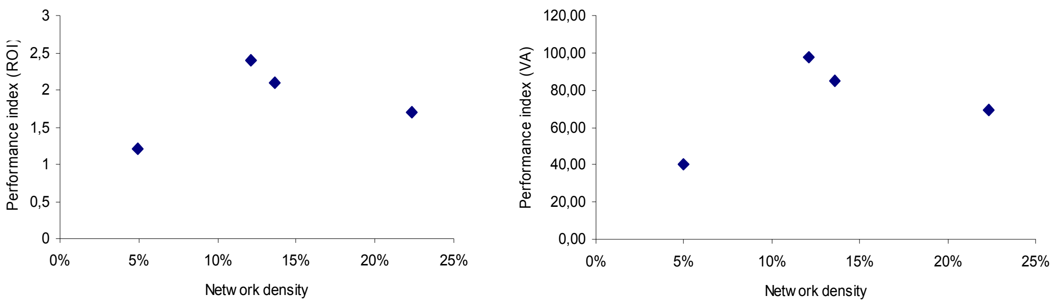
| Attributes | Value |
|---|---|
| Normalized Average DC | 4.9% |
| Standard deviation | 3.9 |
| Normalized Average CC | 17.1% |
| Standard deviation | 1.1 |

## 6. Result of the cross-case analysis

The four networks are compared in terms of network attributes and performances. Note that network density is used as a measure of the interconnectivity among firms, the Gini coefficient measures the ID heterogeneity, and the normalized average degree centrality and the normalized average closeness centrality are measures of the level of control inside the ID.

Figure 1 plots the values of the network density and the performance indexes for the four networks.

**Figure 1. Comparison of the network density and the performance indexes**



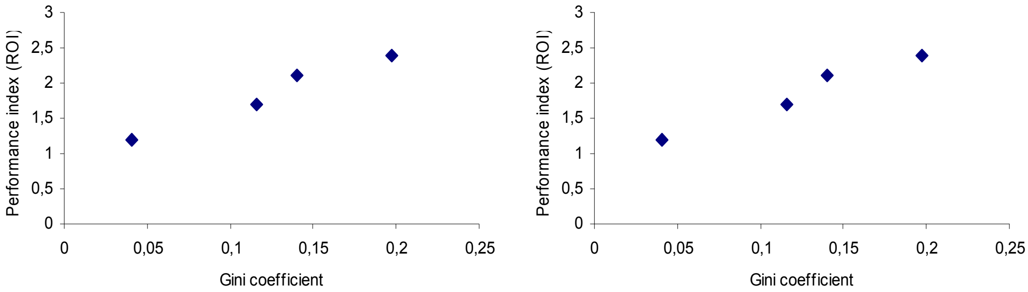

Notice that the relationship between the performance indexes and the network density follows an inverse U-shaped relationship, in fact the performance indexes increase when the network density increases, but till a certain value (threshold). When the network density overcomes the threshold the performance indexes decrease. This result is coherent with what CAS theory affirms on the relation between the level of interconnectivity of the CAS and its capacity to adapt to the environment and successfully evolve. Too many links make the system of firms more vulnerable. In fact, for example, in the Barletta footwear district firms are densely connected by buyer-supplier relationships. As a consequence, the decline of some buyer firms and the strategic decisions of some other buyers to delocalize great part of production in Albania and Romania has decreased the performance of the connected firms and determined the district crisis. Too few links make the district firms isolated and in such a condition they lose the benefits of the information and knowledge sharing.

On the basis of the discussion above, we formulate the following proposition:

*Proposition 1. The ID performance first tends to increase and then to decline with the number of links among ID firms. It seems that a threshold of the number of links among ID firms exists.*

Figure 2 plots the values of the Gini coefficient and the performance indexes of the four districts. As the Gini coefficient increases, the performance indexes raise. Being the Gini coefficient a proxy of the network heterogeneity, the obtained finding is consistent with the CAS theory that highlights the importance of the heterogeneity as a source of innovation and adaptiveness.

**Figure 2. Comparison of the Gini coefficient and the performance indexes.**




A low Gini coefficient characterizes a network where the agents are equally connected, and thus have the same network of relationships. This determines an even distribution of information, knowledge, and competitive strategies which flow through the network of relationships, and then the homogeneity of the system.

On the contrary, a high Gini coefficient means that the actors in the network are characterized by different distribution of linkages. The system is characterized by an uneven distribution of information, knowledge, and competitive strategies and then there is a greater heterogeneity in the system.

What is happened in the Foggia agro-food district and in the Barletta footwear district, both presenting a low value of the Gini coefficient, is that firms have adopted similar manufacturing and marketing strategies. In particular, a great part of the firms operating in the Foggia district is mainly involved in the first stages of the agro-food supply chains and they are scarcely distributed on the downstream stages of the supply chain. Such a condition has negatively affected the performance of the district firms, which do not have a direct control of the final market and are unable to add value to their products. As regards the Barletta footwear district, most of the firms have focused on lower market segments, for many years they have adopted conservative strategy characterized by an absence of significant efforts to innovate and to upgrade the locally embedded knowledge. This behavior in a not particularly dynamic market has guaranteed the survival of the district, but recently, when the market has become more competitive, due to a more sophisticated demand of the consumers oriented to brand names and due to the increasing competition from low-cost countries, has led to the district crisis.

The Andria underwear district has faced with the same change of the competitive context but the differentiation of firms in terms of capabilities and knowledge has favoured the formulation of different competitive strategies, e.g. some firms created a brand or acquired licensing exploiting their marketing capabilities, some others focus on niches such as the handmade embroidered products or low cost products exploiting their manufacturing capability, some others became sub-contractors of large firms external to districts exploiting their capacity to provide high logistics performances. Such a differentiation has determined less internal competition and protect the district from the crisis.

Therefore, we posit that:

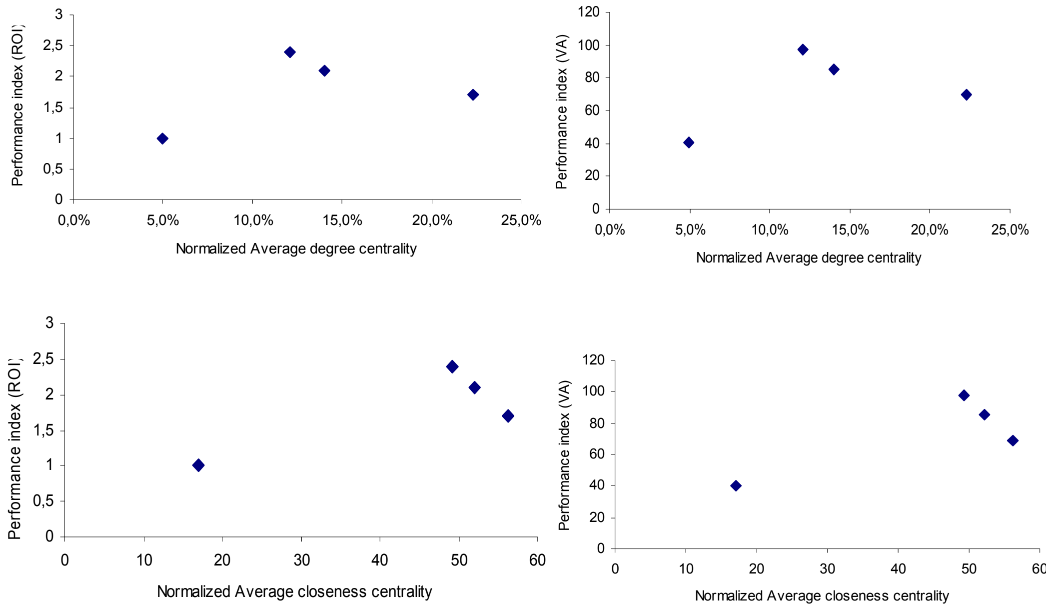
*Proposition 2. More uneven the distribution of the linkages across the ID firms, higher the ID performance.*

Figure 3 shows the values of the normalized average degree centrality/closeness centrality and the performance indexes of the four networks. As the average degree centrality/closeness centrality increases, the performance indexes first increase and then decline. Being the average normalized degree centrality/closeness centrality a proxy of the level of control/level of independency of the actors in the network, this trend is coherent with the CAS theory which puts in evidence the need to balance hierarchy and autonomy.

The Barletta footwear district is characterized by a high level of normalized average degree and closeness centrality. This is due to the presence in the ID of some large-sized firms that assume a focal position in the network and that create their own supply chains managed using a centralized control. This reduces the flexibility of the supply chains operating in the district and narrows the information flows inside the supply chains without any sharing among them.

On the other extreme, the Foggia agro-food district is characterized by firms that are scarcely interconnected both by vertical and horizontal linkages. They are neither integrated along the supply chain nor cooperate in the same stage of the supply chain. This reduces the possibility to offer on the market a wider range of products, to implement a system of product traceability that ensures the quality and security of products, and to increase the contractual power of the district SMEs toward the big buyers.

**Figure 3. Comparison of the centrality measures and the performance indexes.**




The districts with intermediate level of normalized average degree and closeness centrality, namely the Andria underwear district and the Barletta knitwear district, present higher performances. The supply chains inside these IDs are mainly managed using a decentralized control where each firm makes independent production and inventory decisions. Thanks to this form of governance, the IDs gain the advantages of the flexible specialization model and keep high their performance.

Therefore, we hypothesize that:

*Proposition 3. ID performance first increases with the level of control of the ID organizational structure and then tends to decrease. This suggests the presence of a threshold of the level of control of the ID organizational structure.*

## 7. Conclusions

This paper used complexity science concepts to offer a new perspective on the theoretical understanding on Industrial Districts (IDs) competitive success. In fact, complexity science has been used as a conceptual framework to investigate the reasons for the competitive success of IDs. This approach is particularly valuable given that it allows the limits of traditional studies on IDs to be overcome. In particular, the ID competitive advantage is not the result of a set of pre-defined features characterizing IDs, but it is the result of dynamic processes of adaptability and evolution of the IDs with the external environment. Therefore, the ID competitive success is linked to the system adaptive capacity that is a key property of complex adaptive systems (CASs).

Using the theory of CAS, the key structural features of IDs that give them the adaptive capacity have been identified, namely: i) the number of links among ID firms, ii) the heterogeneity in the distribution of the links across the ID firms; and iii) the level of control of the ID organizational structure.

We conducted an explorative research adopting a multiple-case study approach. It involved four in-depth case studies on Italian IDs selected as polar cases of declining district and successful district. We compared them in terms of CAS properties using the social network theory and measures.

In particular, the networks of the business inter-firm relationships have been mapped and then their attributes of network density, Gini coefficient, and degree centrality and closeness centrality calculated. These attributes are used as measures of the ID structural features fostering adaptation: the network density is used as proxy of the number of links among firms, the Gini coefficient as proxy of the heterogeneity in the distribution of the links across the ID firms, and the degree centrality and closeness centrality as proxies of the level of control of the ID organizational structure.

Comparing the four networks we generated three theoretical propositions regarding the values of the ID structural features that foster the ID performance. In particular, our findings suggest that the ID performance first increases and then declines as the number of links among firms and level of control of the ID organizational structure raise, so suggesting the existence of a threshold. Moreover, a high heterogeneity in the distribution of the links across the ID firms assures higher ID performance.

These findings have broader policy implications. For example, policies addressed to sustain ID competitive advantage should be devoted to avoid the formation of overcrowded networks of links among ID firms, to increase the heterogeneity, and to assure the balance between hierarchy and autonomy in the ID organizational structure.

We recognize certain limitations in our research. In particular, the main limitation of the study concerns that we included only four networks and we compared networks of different industries. Thus, further researches should be devoted to improve empirical investigation and test extensively the hypotheses.

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