

SOCIAL RESEARCH AND FUZZY LOGIC. THE ANALYSIS OF INDUSTRIAL DISTRICT

***Abstract:** The aim of this work is to analyze the social and economic development in Italy and the role of industrial districts. This work describes the Italian model of industrial districts and the method to locate the presence of an industrial district in the region. The presence of small and medium-sized firms in the area often give rise to complex organizations based on cooperation and competition between them. In this work, Fuzzy logic is used as a methodological instrument to offer a view over Italian industrial districts.*

Given that Fuzzy logic recognizes more than simple true and false values, propositions can be represented with degrees of truth and falsehood. Fuzzy logic can be considered as an equivalent of the fuzzy set theory: we can define social phenomena in terms of degrees of belonging to a homogeneous set of phenomena.

This paper presents a method to identify clusters according to a Fuzzy logic; the perspective is sociological. Furthermore, In this paper, a method of study is proposed in practical terms with the sociological aspects of interpretation.

Key words: Fuzzy logic, economic development, industrial districts.

1. Fuzzy logic and social research. Introductory aspects

Social research can be both quantitative and qualitative. In the first case, the phenomena are described on the basis of the correlation between variables and the construction of interpretative models able to explain and predict behaviour and social change. In the second case, the study is focused on the description of the interaction and social relations between individuals and social groups.

Quantitative methods assume that social phenomena can be measured; this assertion requires as a condition that social facts and individuals themselves can be described in their qualitative variables through quantitatively measurable criteria, which can translate the variables into indicators and indices. Through this step methodological social phenomena are measured and quantified.

In social research, most surveys are made with quantitative methods based on statistical techniques: they produce data directly, whether the survey studies different territorial units or different moments in the same area.

As part of sociological research, the description of social phenomena is realized through indicators, because the logic followed in empirical studies presupposes an exact measurement of social phenomena through indicators. As a consequence,

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quantitative methods of social research require precision in measurements and classifications of social phenomena. The logic followed combines precision and specificity.

The methods employed allow to represent effectively a condition of social phenomena in which the inaccuracy is an intrinsic characteristic of the data. It is possible, in fact, to assign to each observation units different degrees of belonging to a group.

«While it might appear to most social scientists that a fuzzy set is merely the transformation of a binary variable into a continuous variable, this understanding is not correct. Indeed, this common misperception of fuzzy sets may explain why social scientists have been so slow to grasp their analytic power of significance. A fuzzy set is much more than a “continuous” variable because it is much more heavily infused with theoretical and substantive knowledge. Despite the adjective “fuzzy”, compared with the conventional variable, a fuzzy set is more empirically grounded and more precise» (Ragin 2000: 6).

The fuzzy methods permit effective dealing with the situation of the study of social phenomena in which the imprecision is often present in the data, because they imply the possibility of assigning to each unit a different level of participation within a group. «Fuzzy analysis is based on set theorem of pure mathematics. For social research, usually we use basic statistical tools, scales, indices both for cross-sectional and longitudinal study. The basic difference between crisp set and fuzzy set might generate a new thinking for using fuzzy tolls for sociological analysis» (Uddin 2012: 8).

Gradual transition from the traditional view to such an alternative view has clear advantages for the sociological analysis of some social phenomena: «Among the various paradigmatic changes in sciences and mathematics in this century, one such change concerns the concept of *uncertainty*. In science, this change has been manifested by a gradual transition from the traditional view, which insists that uncertainty is undesirable in science and should be avoided by all possible means, to an alternative view, which is tolerant of uncertainty and insists that science cannot avoid it” (Uddin 2012: 9).

Uncertainty is considered to be essential to science: «According to the traditional view, science should strive for certainty in all its manifestations (precision, specificity, sharpness, consistence etc.); hence uncertainty (impression, nonspecificity, vagueness, inconsistency, etc.) is regarded as unscientific. According to the alternative (or current) view, uncertainty is considered essential to science; it is only an unavoidable vague, but it has, in fact, a great utility» (Uddin 2012: 9).

Fuzzy logic recognizes more than simple true and false values in as much as propositions can be represented with degrees of truth and falsehood. We can define social phenomena in terms of degrees of belonging to a homogeneous set of phenomena.

In symbolic logic we are dealing with statements which can assume exclusively one out of two truth values: true or false. It is important to consider that this kind of formal-logical tools are essential, in sociological studies, for the elaboration of a theory and the construction of models. The ability to operate with sociological structure and the operative knowledge of the concepts of symbolic logic are both essential to the research. (Garzia, Ravelli 185: 77).

«A conventional (or “crisp”) set is dichotomous: An objet (e.g., a survey respondent) is either “in” or “out” of set, for example, the set of Protestants. Thus, a conventional set is comparable to a binary variable with two values, 1 (“in”, i.e., Protestant) and 0 (“out”, i.e., non-Protestant). A Fuzzy set, by contrast, permits membership in interval between 0 and 1 while retaining the two qualitative states of full membership and full nonmembership. Thus, the fuzzy set of Protestants could include individuals who are “fully in” the set (membership = .90), some who are neither “more in” nor “more out” of the set (membership = .5, also known as “crossover point”), some who are “barely more out than in “ the set (membership = .45), and so on down to those who are “fully out” of the set (membership = 0)» (Ragin, 2000: 6).

This aspect of the method can be applied also to the analysis of social phenomena. An example can be given by the industrial development based on industrial districts. The fuzzy logic is definitely helpful when it is necessary to proceed to the analysis of a social reality in several variables: a complex and fluid situation (Massaro, 2005: 73). Our case study lends itself well to this type of analysis.

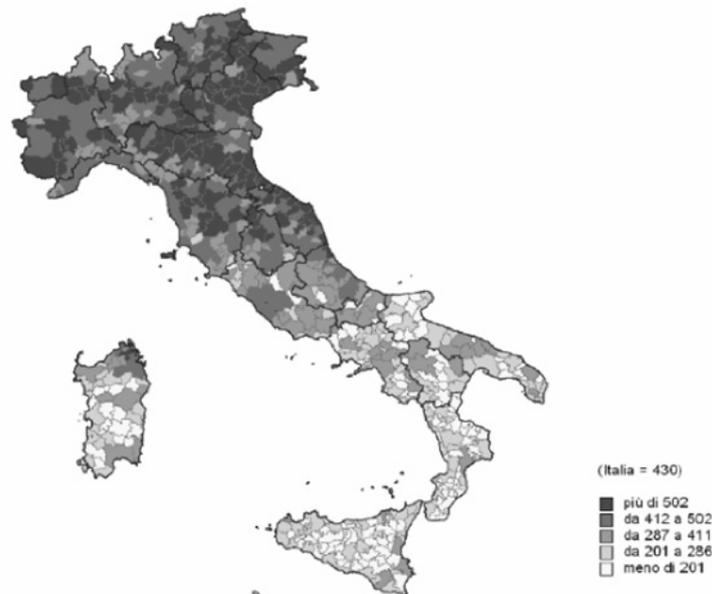
2. Industrial districts in Italy

In this study I offer an analysis of industrial districts using a model aimed at the identification of their presence in an area. I use the data given by Istat (Italian National Institute for Statistics). The study of industrial districts regards the analysis of the socioeconomic development of the area from the point of view of the presence and growth of small and medium-sized firms.

The concept of an industrial district is owed to Alfred Marshall: “When one talks of an industrial district one refers to a socioeconomic entity composed of a conglomeration of businesses, actors generally part of a single sector of production, situated in a specified area, between which one finds collaboration but also competition” (Marshall 1919, 283).

The industrial districts are identified in the context of the local systems of work, of which they constitute a subsection. The current local systems of work were defined by the Istat based on the data collected during the general census of the population, with reference to the movement of the population from region to region due to work. To each local system of work Istat has applied the data relevant to the local units, to economic activities and the employees identified by the

general census of industry and services. This aspect of methodological structure opens the way for a study of the Italian socioeconomic structure from a local perspective (chart 1).



Source: Istat 2001. *8° Censimento generale dell'industria e dei servizi. Distretti industriali e sistemi locali del lavoro 2001*. Roma: Istat.

Chart 1 – Employees of the individual units of the businesses active within the local system of work. Year 2004 (Figures per thousand residents of working age 15-64 yrs).

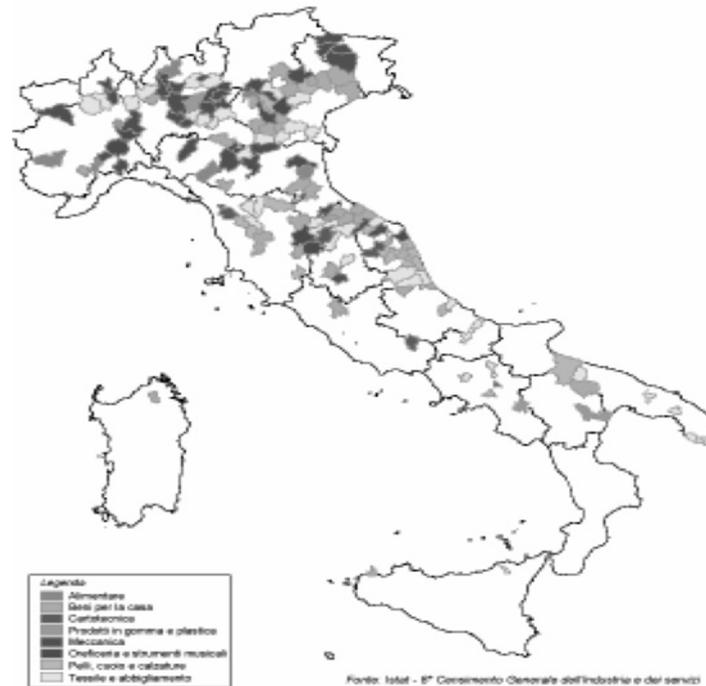
The social characteristics of the districts are given as being the “socio-geographical entities in which a community of people and a presence of industrial firms are reciprocally integrated. The firms of the district belong predominantly to a single industrial sector, which thus constitutes the primary industry. Each firm is specialized in products, parts of products, or phases of the production process typical of the region. The firms of the district are therefore characterized by being numerous and of modest dimensions” (Istat 2001, 9).

Such aspects confirm the sociological characterization of social and economic development of Italian society in the context of a clearly Fordist matrix, but with a strong presence of small and medium-sized firms rooted in society and with reference to local culture (Becattini, 1989).

The industrial districts have a primarily manufacturing tendency, and are characterized by the presence of a unit of small and medium-sized firms, which express their type of production.

The industrialization by industrial district is a model of social and economic development typical of the geographical area of North East and of Central Italy

(Fuà 1983, 22; Bagnasco A. 1977; Bagnasco 1985). It extends to other areas of the peninsula according to a model powered by systems of a great variety of production: from textiles and clothing to leather and shoe-making, from machinery to household goods, from paper-production to foodstuffs, from metalwork to musical instruments (Chart 2).



Source: Istat 2001. *8° Censimento generale dell'industria e dei servizi. Distretti industriali e sistemi locali del lavoro 2001*. Roma: Istat.

Chart 2 – Industrial districts of the 8th general census of industry and services 2001 by type of production.

The types of local industrial production are manifested in terms of primarily monocultural firms activity, engaged in specific sectors or products. The firms generate between themselves networks of interdependence, cooperative or competitive, which contribute to the economic growth of the district. These interdependences have been created but at the same time create other networks and other interdependences, which distinguish between economic activities, local cultures, local public and political institutions, creating network relations that encourage forms of exchange between the factors, public and private, institutional or informal, of material or immaterial goods, favourable to the social and economic growth of the community.

There are four main variables that permit the identification of an industrial district in a concentration of firms:

- a) the existence of a reality of production which has either economic or social relevance;
- b) the specialization of production for a predominant type of product;
- c) the concentration of firms in a determined geographical area;
- d) the existence of mutual relations of collaboration or competition between the firms that make up the district.

These variables are shown to be related, they are either socioeconomic or sociocultural, and they turn the industrial district into a reality of local development of firms and of economic and social growth of the area.

In Italy, industrial districts have represented over the years a strong point within the industrial system, and amongst other sequences, they continue to occupy roles involved in the economic growth of the country. The diffusion of small and medium-sized firms, from which the development for districts originates, has wide roots that are based on agricultural tradition of the various regions, the presence of the extended family understood as a community of production and work which determines a functional relationship between family and industrialization, and a long tradition of artisan craftsmanship.

In Italy there is great presence of industrial clusters with the following characteristics:

- Small and medium-sized firms;
- Reduced capital intensity;
- Low degree of vertical integration;
- Strong spatial density of local units.

In the analysis I propose to use the Brusco and Paba (1997) model which can be found in the following work: Presidenza del Consiglio Dei Ministri. Commissione per la garanzia dell'informazione statistica. *Le metodologie di misurazione dei distretti industriali. Rapporto di Ricerca* – 05.02 Febbraio 2005 pp. 33-35.

To identify industrial districts we need the following assumptions fulfilled:

- The territory is divided into “n” areas;
- “Zip” is the number of employees in the “p” (sector “p”) in “i” (area “i”);
- “Zp” the total number of employees in the same sector;
- “Zm” total manufacturing employment;
- “Z” the total employment in all economic sectors.

From algorithm Sforzi².

1[^] condition:

$$(Z_{im} / Z_i) / (Z_m / Z) > 1$$

It indicates that the first location “i” is specialized in manufacturing.

² In this work, I used the work present in Presidenza del Consiglio dei Ministri – Commissione per la garanzia dell'informazione statistica, *Le metodologie di misurazione dei distretti industriali. Rapporto di Ricerca* – 05.02 Febbraio 2005 p. 33-35. The responsibility of this adaptation is only mine.

- “Zim” – total employment in the manufacturing sector “i” (area “i”);
- “Zi” – total employment of all economic sectors in the “i” (area “i”);
- “Zm” – total manufacturing employment;
- “Z” – total employment of all sectors of the economy.

2[^] condition:

$$(Z_{im, small} / Z_{im}) / (Z_{m, small} / Z_m) > 1$$

The second condition requires that the share of small manufacturing enterprises in the area is higher than the national average.

- “Zim” – total employment in the manufacturing sector “i” (area “i”);
- “Zm” (total manufacturing employment).
- “Small” (indicating the use in small firms)

3[^] condition:

The third condition requires that in the area there is a sector of production “p” in which the area is specialized

- “Zip” – the number of employees in the “p” in the area “i”);
- “Zim” – is the total employment in the manufacturing sector “i” (area “i”);
- “Zp” – this is the total number of employees in the same sector;
- “Zm” – is the total manufacturing employment;

4[^] condition:

$$(Z_{ip, small} / Z_{ip}) / (Z_{p, small} / Z_p) > 1$$

The fourth condition requires that the share of small firms in this sector “i” is greater than the national average.

- “Zip” – the number of employees in the “p” in the sector “i” (area “i”);
- “Zp” (this is the total number of employees in the same sector);
- “Small” (indicating the use in small firms).

3. Conclusion

Only when there is in the “i” an industry that meets all four conditions, then “i” will be referred to as industrial district (based on the algorithm of Sforzi). If only one of the four indices is even slightly less than the unit (the situation often occurs for indexes 2³ and 4⁴) the zone “i” is not referred to as industrial district (Presidenza del Consiglio Dei Ministri, Commissione per la garanzia dell’informazione statistica 2005: 33-35).

Proposal of Brusco and Paba: If one of the four indices is slightly less than the unit, we can compensate with a better performance in one of the other indicators. According to a compensation process and collaboration among the various indices

³ The second condition requires that the share of small manufacturing enterprises in the area is higher than the national average.

⁴ The fourth condition requires that the share of small firms in this sector “i” is greater than the national average.

you can obtain a synthetic indicator and continuous district intensity area that replaces the dichotomous variable of efforts.

In this case, Fuzzy logic is an opportunity to obtain a different view of the social reality where the manifestation of social phenomenological reality is intrinsically characterized by the fuzzy effect.

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