CLUSTERING THE HETEROGENITY OF EU URBAN PERFORMANCES

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Abstract
Cities represent today the intrinsic socio-economic complexity of local systems. Looking at the performances of urban systems enable us to explaining the main factors of territorial development. By moving from the theory of "progressive systems", and assigning to the cities some of this theory's properties, it is possible to outline a methodological perspective to capture the emerging phenomena describing the cities' performances. Keeping this view in mind, the aim of the paper is facing the intrinsic socio-economic complexity and heterogeneity of cities within the EU integration policies.. In order to better qualify this issue, we provide a mudimensional scaling approach, as a quantitative method useful to compare the several urban performances by letting a cluster evidence among the EU cities emerge.

Key words: Urban trajectories, progressive system, multidimensional scaling.
JEL codes: R10, R11

1. Introduction

It is widely believed that cities are a key driver of local development and a special unit of analysis in explaining the economic trajectories of a country. Cities represent today the intrinsic complexity of an socio-economic systems because urban areas are the places of human economies and the majority of agents productive and consumptive activities. In this sense the State of European Repost (Urban Audit, 2007) underlie the role of cities as laboratories because of they are places where economic and societal changes are often experienced first and most profoundly. Moreover, as hubs of globalising world economy, bigger cities generally contribute to competitiveness, growth and jobs (OECD, 2006).
The relevant literature about cities shows a thematic and methodological eclecticism in order to highlight the way in which the city has been interpreted in urban economics (see Capello, 2008, for a critical review). Among the several features that a city shows it can be traced city as: an agglomeration of relations and externalities; a place with endogenous capacity to allocate resources efficiently; a place of interaction; an complex economic system. Actually the modern and critical economic theorisation of the city shows an enrichment of the classical and neoclassical principles whit new theorization, that have more recently produced an heterodox interpretation of urbanization using (i) a cognitive approach; (ii) a complexity approach. In the former case the city is seen as innovation and knowledge milieu (Aydalot, 1986; Camagni,1999; Feldman and Audretsch, 1999; Maillat et al. 1993). In the latter case the city is conceptualized moving by the complex system theory (see Nijkamp and Reggiani,1999 for a critical review).
With the introduction of complexity among the issue of urban development, the boundaries between urban economics and other social sciences are notably weakening in order to describe the cities' performances. Keeping this view in mind, the aim of the paper

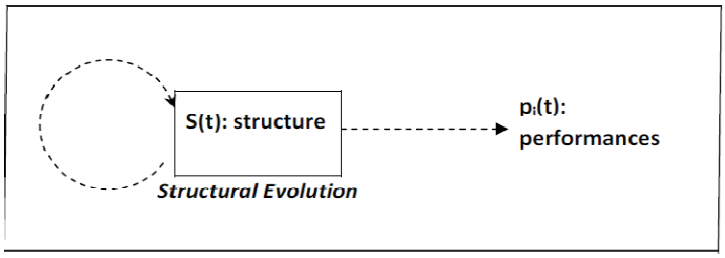
is to outline a methodological perspective to study the economic development of cities, so in section 2 we adopt a "progressive system" approach and define its methodological assumptions. According to the causal relation "structure-performances" in section 3 we define the "structure" thanks to a set of indicator provided by Urban Audit data. This paper copes the intrinsic socio-economic complexity and heterogeneity of cities within the EU integration policies. In order to better qualify this issue, in section 4, we provide a mudimensional scaling approach, as a quantitative method useful to compare the several urban performances by letting a cluster evidence among the EU cities emerge.

2. Cities as progressive system

City is a complex open system because is the coming out of heterogeneous interactions among several elements, these interactions originate a peculiar behaviour that is an *emergent* phenomena that could not be analysed focusing only on the single behaviour of the interacting elements (Bertalanffy, 1972). Moreover this phenomena and the following interactions coevolves progressively during the time, assigning a specific characteristic to the city as a system. Keeping this in mind in order to cope with the eclecticism of theoretical and methodological contributes, more and more present within the scientific literature, we decided to conceptualize the city as a complex system by moving from the theory of "progressive systems" (Calafati, 2007).

Thinking of cities as complex open systems bring us closer to outline a new research programme on performances' analysis. As a matter of fact, assigning to the cities some of this theory's properties it is possible to outline a methodological perspective to capture the emerging phenomena that originate from the cities. That is to say that conceptualizing the city as progressive system means that, in order to evaluate the emerging development trajectories, it is necessary to delineate three pertinent levels of description that are: (i) the structure of the system; (ii) the metabolic processes of the system, i.e. the processes that organize inputs as matter, energy and information into goods and services functional to the system's objectives; (iii) the regulation mechanisms of the system.

Fig. 1- From structure to performances



Source: Calafati, 2007

In this work, the issue we are talking about regards the deep causal relationship between "structure and performances". In virtue of that cities' development trajectories have to be described and consequently analyze in the way of the specific urban system structure. These epistemological choice very reflect itself in a clear methodological perspective, that we have tried to adopt in this paper. That is to say that, at this stage, we are focusing on the first of the three levels of description of the city as progressive system. So what we present at this first step is a delineation of 15 cities' structure adopting a seminal set of *ad hoc* indicators describe, in a very first experimental way the heterogeneity of different urban system and then to process data in a multidimensional scale analysis.

3. Cities' structure and dataset

Starting from the data collected in the Urban Audit project in order to compare statistics and indicators for European cities, we have construct a data set able to delineate the "structure" of 15 cities according to the information and data available. This exercise represents a first experimental exploration of the paper methodological assumptions, by moving from the causal relation "structure-performances". In this cases we try to provide a first step in the description of the "city as progressive system" performances, at this moment represented basically in a meta-theoretical way.

Starting from the intrinsic heterogeneity of cities structure, in order to cope with the EU integration processes we have chosen the Multidimensional Scaling Analysis (MDS) as a quantitative method useful to compare the several urban performances by letting a cluster evidence among the EU cities emerge. That is to say that the MDS shows a series of similarities defined by cluster of heterogenic urban performances.

MDS includes several techniques of multivariate statistic analysis starting with a data matrix, cases per variables, in witch variables provide information about specific properties obtained from cases. By moving from this matrix and comparing all the couples of cases in regarding of their properties, it could be point out a new matrix in which all the comparisons emerge. The output is a proximity relation of cases, organized in triangular matrix set by the differences between the couple of cases contained in the first data matrix. In this way the MDS provides a data representation able to point out in specific modality the complexity of the relationships behind the first data matrix. This quantitative choice operate a reductionism that entails a sort of information's lack, that is to say that there is less correspondence whit he phenomena observed. By the way it provides the identification of the best coordinate in a two-dimensional space that represent the best adjustment to the proximities observed in the data. In any cases the error (distortion) of the MDS analysis can be measured by the *Stress* indicators.

About the 15 cities observed (Tab.1) we selected a group according by the demographic homogeneity, focusing the analysis on medium urban system. Then we selected 8 indicators regarding the economic, demographic and social dimensions. So the analysis is based by observing the following variables: total resident population, density population, GDP per capita, employment rate, summer smog (nota: number of day in which the level of ozone exceed the threshold fixed in the air), public green space (square meter per capita), percentage of journeys to work by car, number of crimes (per 1000 persons).

Table 1 - Reference Dataset

Cities	Tot. Resid. Population	Pop. density	GDP per head	Employment rate	Summer smog	Public green space	Journeys to work by car (%)	Num. of crimes
Wien	1,598,626	3,855	19,607	0.64	23	11	0.41	29.39
Bruxelles	999,899	6,196	52,975	0.47	15	13	0.53	160.74
Praha	1,170,571	2,357	14,860	0.74	19	83	0.27	85.51
Berlin	3,387,828	3,789	23,458	0.58	6	27	0.44	159.3
Frankurt	646,889	2,608	73,932	0.64	19	18	0.43	182.6
Munchen	1,249,176	4,030	53,073	0.72	22	32	0.41	90.81
Budapest	1,695,814	3,230	16,622	0.6	11	43	0.71	68.11
Rome	2,553,873	1,987	21,225	0.57	48	15	0.57	69.2
Milan	1,299,439	6,986	27,988	0.63	46	15	0.46	91.24
Amsterdam	739,104	4,439	38,897	0.7	4	35	0.41	142.99
Madrid	3,099,834	5,127	79,516	0.65	28	7	0.47	36.66
Barcelona	1,578,546	15,770	80,894	0.63	3	4	0.32	34.71
Valencia	785,732	5,764	73,320	0.64	1	3	0.58	39.57
Stockholm	761,721	4,052	59,244	0.69	1	96	0.33	206.81

Source: Urban Audit (2004)

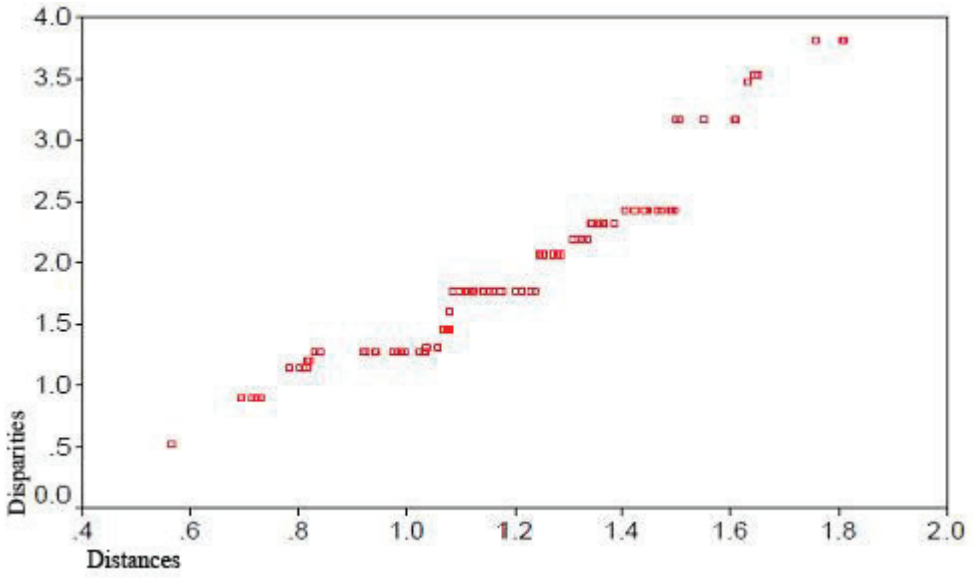
These variables was chosen because of their meaningful within the data set available and according the main literature in terms of: (i) sustainable development (Daly, 2001, Grossman

1955, Hamilton and Atkinson, 1996, La Camera 2005); (ii) socioeconomic development (Glaeser et al. 1992; 1999, Becker et al. 1964; 1999, Jacobs 1968).
From this table is possible to note, even if an approximate way, a kind of heterogeneity among the observed cities. That is to say that, for example, as regards GDP per head or population density or number of crimes, a different dimension of the cities' structures emerges. Even these are only proxies in a explicative exercise, comparing cities with similar number of people (i.e. Milan and Munchen, or Wien and Barcelona, etc), it is possible to observe some differences in terms to the others variables. This supports the concept of cities as progressive system that we have examined in this paper.

4. MDS findings

Performing a standardization (interval 0-1) on all the values to prevent the influence of the metric in order to get the index of dissimilarity, we provided the proximity matrix based on the original one. After, we have proceed the analysis fixing the number of dimensions (K=2), achieving therefore a Stress Index[136] equal to 0.171 (according to the condition of Kruskal). Significativity of the model is, moreover, confirmed form the value of RQS Index (Squared Correlation), which is 0.82. The figure 1 above shows how the model could be implemented in our case, according to distribution of the coordinate of points, that are in proximity of the first square bisector.

Fig. 2 – relation disparities-distances

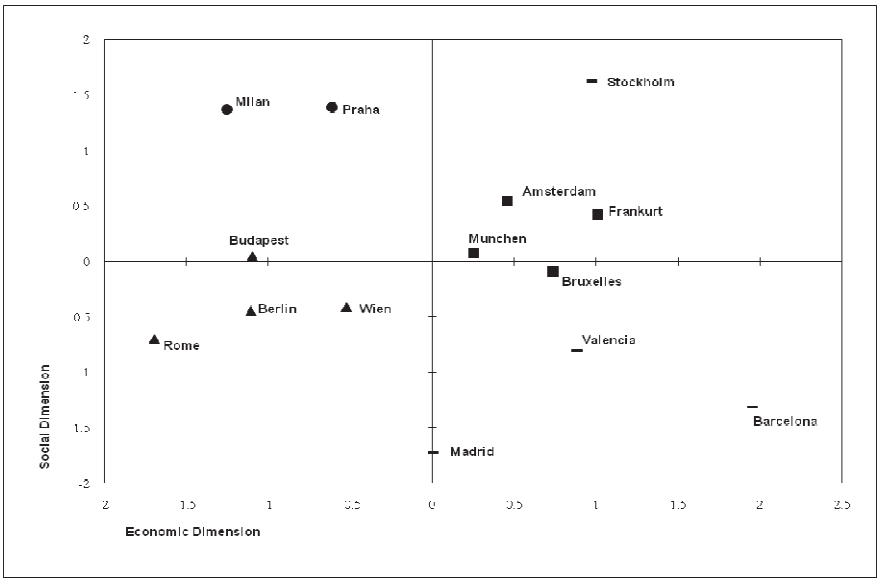


Source: our elaboration

The final map coming out from MDS shows a simple and intuitive finding a meaning to the representative space, labelling the Cartesian axes in relation to "semantic" position of the variables. That is to say that the configuration of the cities along the map is in function of the two main characteristics: social dimension and economic dimension (Fig.2)..

[136] Kruskal Stress formula 1 varies between 0 and 1. When it assumes 0, data have a perfect performance. Generally a good result of the *k* dimensions is obtained when the Stress Index presents a value lower then 0.1. The outcome is satisfactory when the value is smaller then 0.2 (De Lillo et al., 2007).

Fig. 3 – urban configuration ina two-dimensional space



Source: our elaboration

As the graphic shows, the MDS provided the presence of three groups of cities and four outliers (Stockholm, Valencia, Madrid and Barcelona). Despite the mentioned observations about heterogeneity of cities structure, it is still plausible for the purposes of analysis to represent a kind of homogeneity among some cities subject of our study. Amsterdam, Munchen, Frankurt and Bruxelles seem to show an almost similar social-economic profile and better than other cities observed. The opposite situation is found instead for the group composed by Rome, Berlin, Wien and Budapest, which highlight a negative standard for both analyzed dimensions.
Finally it is opportune to underline also the situation presented by the group Milan – Praha, which social dimension seem to assume a predominant weight within of own structure.

5. Final remarks

With the help of a Multidimensional Scaling analysis (MDS), the work in progress presented in these pages obtains an seminal mapping of an emergent process of UE cities' clusterization. By moving from the EU integration policies the main goal of this work is to reflect on the importance of urban size (structure) for urban performances going beyond the meta-theoretical approach in literature. The second main goal is to provide a methodological tool to let some homogeneity (thanks to the cities' clustering) emerge, coping the heterogeneity of EU cities performances. In these sense, at this first stage this analysis should therefore be used as a experimental tool for a better understanding the heterogeneity of urban performances, expressed in terms of different cities' structures. For this reason it could be useful to highlight the question of which EU integration policies are most appropriate for different types of structures.
Even if the paper provides an empirical analysis of the city as progressive system it is based on a sample data set, the next step is to find more relevant data and try to evaluate the binomial heterogeneity-homogeneity with the help of a family of artificial neural networks known as Self-organising Maps (SOM), obtaining an original mapping of EU cities moving by the idea of multi-dimensional similarity in different urban systems' structures.

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