EL COMPORTAMIENTO DE LOS ACTORES ECONÓMICOS ANTE EL RETO DEL FUTURO

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XI ACTO INTERNACIONAL

JUEVES, 10 DE NOVIEMBRE DE 2016

"EL COMPORTAMIENTO DE LOS ACTORES
ECONÓMICOS ANTE EL RETO DEL FUTURO"

APERTURA Y PRESENTACIÓN

Excmo. Sr. Dr. Jaime Gil Aluja
Presidente de la Real Academia de Ciencias Económicas y Financieras

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"The new approach to regional competitiveness"

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THE NEW APPROACH TO REGIONAL COMPETITIVENESS

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Introduction

Globalisation increased the level of competition between regions all over the world. Although the country effect is still significant, the (competitive) advantage of regions has dramatically changed and some areas--even in some industrialised countries--are suffering a general worsening of their economic performance (i.e. GDP trends), while some others are enjoying astonishing development. The ongoing situation confirms part of the theoretical conclusions of the New Economic Geography, and, at the same time, creates a huge number of opportunities for further research on regional development.

An innovative theoretical approach extends to drawing the economic dynamic as the evolution of complex systems. Complexity can be introduced in economic formalization in many different shapes and patterns. A crisis of traditional economic models and (accordingly) of related policies is often a first result. The "Agent Based" models are sophisticated formalisations for studying complexity within regional economy and they also will be the main background for the analysis presented in this section. Specifically, by using sophisticated mathematical instruments it is possible to assess ongoing dynamics by combining three main issues. First of all, the presence of multiple specialisations in regions and their effect on consumer utility function (monopolistic competition à la Dixit – Stiglitz, 1977). Secondly, the effect that territorial contiguity of actors has on local development (shipping charges in transportation costs as in the ice-berg model of Samuelson). Lastly, the source of higher performance in those regions which host haphazard interactions among firms of different branches and industries (Aoki, 2002 – Storper, Venables, 2003). The first two points are embedded in the New Economic Geography (especially in the Krugman formalisation), which is the starting point of modern regional economics. The third (the evolutionary one) characterizes this contribution, which aims at giving a new interpretation of the concept of endogenous development, here considered as the dynamic development of a complex economic system.

This part of the essay will assess the economic dynamic as a *self-reinforcing mechanism*: positive (or negative) feedback that characterizes the evolution of a dynamic system. The concept of a self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and positive feedback, which tends to produce a large variety of asymptotic states. Every evolutionary step of the system influences the next and thus the evolution of the entire system, so generating *path dependence.* Such a system has a high number of asymptotic states, and the initial state (Time zero), unforeseen shocks, or other kinds of fluctuations, can lead the system into any of the different domains of the asymptotic states (Arthur, 1988). Furthermore, the system selects the state in which it places itself. Such dynamics are well known in physics, chemistry and biology and the final asymptotic state is called the *emergent structure*. The concept of positive feedback is relatively new in economics. The latter generally deals with problems of optimal allocation of scarce/insufficient resources, thus the feedback is usually considered to be negative (decreasing utility and decreasing productivity).

Sf-reinforcing mechanism dynamics can be used to assess many different economic problems with different origins, from those related to the international dimension to those typical of the industrial economy, and, last but not least, problems related to regional economics. Many scholars have assessed multiple equilibria and their inefficiency (Marshall 1891, Arrow, Hahn 1971, Brown, Heal 1979, Scarf 1981). Multiple equilibria depend on the existence of increasing returns to scale. If the self-reinforcing mechanism is not counterbalanced by some opposite force, the output is local positive feedback. The latter, in turn, will amplify deviation from some states. Since these states derive from a local positive feedback, they are unstable by definition, so multiple equilibria exist and are efficient. If the *vector field* related to a given dynamic system is regular and its critical points follow some particular rules, then the existence of other critical points or of stable cycles (also called *attractors*) is a result (Marino, 1998).[1] The multi-attractor systems have some particular properties that are very useful to our research (Marino, 1998). Strict path dependence is therefore manifested, and the final state of the system will depend on the particular path it has covered during its dynamic evolution from one (unstable) equilibrium to another (unstable) equilibrium. Accordingly, the system's dynamic is a non-ergodic one.

1 For instance, this issue justifies the efficiency of the lower technology pattern of production within the market

Three are the points where the research can be focussed. First of all, the identification of forces that act as attractors for the system; secondly, if these forces exist, assessing the possibility that the system will move from a lower to a higher equilibrium (and if so, in which way and how); finally, whether this transition from one level to another is spontaneous or needs some particular policy (effectiveness of policies). A first remarkable result is that different mathematical instruments give the same result. Accordingly, patterns of evolution can be numerous and different from each other, because of the existence of many stable multiple equilibria, and convergence paths (or phase transitions between the states). The stylized facts confirm that the process of regional development is discontinuous and unexpected: as in the case of new territorial agglomeration (clusters) created by a collective reorganization of the local productive framework.

Self-reinforcing mechanism and complexity in regional economics

For many years, regional economics has not been considered as the economic mainstream. The main reasons for such a situation are mainly related to two orders of factors. First of all, the perfect competition approach required a world in which all agents were equal (or divided into well-defined categories such as households or firms), without any difference between them. Secondly, the economic system as a whole was trying to reach a stable equilibrium and then to maintain it for as long as possible. In other words, the steady state was considered as a *locus* in which the system had no more incentives to move toward any other state. The result of this kind of formalization was weak and counterfactual, too weak to be benchmarked with the empirical evidence of many regions.

The first attempt to give a theoretical (even though qualitative) basis to the empirical evidence for agglomeration dynamics dates back to 1890, when Alfred Marshall defined as "external economies" those economies which are external to a single firm but are internal to a specific area which is characterised by an "industrial atmosphere" (the latter being a form of public good). According to his definition, there are three main pillars that underpin the individual location choice of firms and workers:

1. the existence of a pooled labour market that enhances the probability of finding a job for workers, and, on the other hand, lowers the probability of labour shortages for firms;

2. the localized production of non-tradable specialized inputs;

3. the possibility for firms to gain a better production function thanks to the existence of informational spillover.

Marshall didn't leave a formalized model of his insight. He avoided facing a theoretical "Gordian Knot" since the existence of a source of competitive advantage for firms localized in a specific area was a sort of "shock" for *orthodox* economic theory: the presence of "unexhausted economies of scale at the level of firms undermine[d] perfect competition" (Krugman, 1998). The aim of preserving the coherence and elegance of the "perfect competition" formalization led many scholars to bypass the problem of the competitive advantage of firms by using the concept of "central city" in their static models considering the territory in a passive form[2]. This clearly appears, for example, in the Christaller (1933) assumption that larger cities can support a wider range of activities, and in the hexagonal market formalized by Lösch (1940), where some specialized economic activities can be undertaken only at a limited number of sites.[3]

2 Territory, in those pioneer formalizations, was homogeneous and isotropous (i.e. the same in every direction). In other words, the basic concept of land space was that of the endless plains of the central USA.

3 It is important to note that neither the formalisation of Christaller or Lösch gave any explanation for the development of the central city, which existed "by default".

Both the models of Christaller and Lösch considered a manufacturing sector which sells its products to an agricultural sector. Accordingly, this kind of approach was not able to describe the circular feature of production in which some of the demand for manufacturing commodities comes from the manufacturing sector itself (*commodities produced using other commodities*). Empirical evidence shows that the presence of a well developed, strongly localized, manufacturing sector is attractive for other firms of the same sector or production chain[4]. This dynamic can be summarised with the expression "circular causation" utilized by Myrdal (1957) to describe a self-fulfilling process in which a given location starts attracting firms from a certain dimension of its manufacturing sector. The circularity of the process is due to the "backward and forward linkages" (Chenery, Watanabe, 1958; Rasmussen, 1956; Hirschman, 1958) that link firms to each other[5]. Furthermore, the physical proximity to suppliers and seller makes for lower transactional costs (Coase, 1937; Williamson, 1981).

The next step in the theory was to recognise the evolutionary nature of external economies. Vernon (1962), having analysed the New York productive framework during the 1950s, stressed the "rise and spread of external economies": new sectors are localised in central areas be-

4 The existence of strong relationships between clusters of firms in a well-defined territory was first discovered during the 1920s, as a consortium of economists of Columbia University analysed the collocation of firms and industries in New York. They discovered that standardisation of output played a remarkable role in location decision of agents. Firms with a low level of standardisation operating, for example, in the fashion sector, were located in the centre, closely related to their suppliers or sellers by wide use of face-to-face relationships. On the contrary, firms with a high level of standardisation and vertical integration (cooperage is the original example), were located in the outskirts of the city.

5 "The economies are external in the sense that the firm obtains them from outsiders, and they are economies in the sense that the firm can satisfy its variable or part-time needs in this manner more cheaply than it could satisfy them from within. The outsiders, in turn, can afford to cater to the firm's fractional needs because they also cater to many other firms" Hall (1959). This kind of inter-firm relationship, under some particular conditions (high level of environmental trustiness, strong meso-institutions, etc.), can be so strong that firms start to externalize their "Value Chain", forming what some scholars call a "Value Constellation".

cause they need a high concentration of positive externalities. The standardisation of the production reduces the need for a specialised external economy and thus firms leave the expensive urban centre and locate in the periphery of metropolitan areas.

The last issue was to discover the way in which a territory was able to achieve the right concentration of (manufacturing) firms to start a self-sustaining process of circular causation. Only in the early 1990s did economists find a sound theoretical basis for the empirical evidence by modelling a system of "monopolistic competition" (à la Dixit-Stiglitz) and, so, consider the "increasing returns of scale" which firms gain by choosing (or by being in) a particular region[6].

Specifically, the three fundamental conditions are:

1. the manufacturing sector has to employ a large proportion of the local population in order to generate large local demand;

2. the sector has to be characterised by large economies of scale;

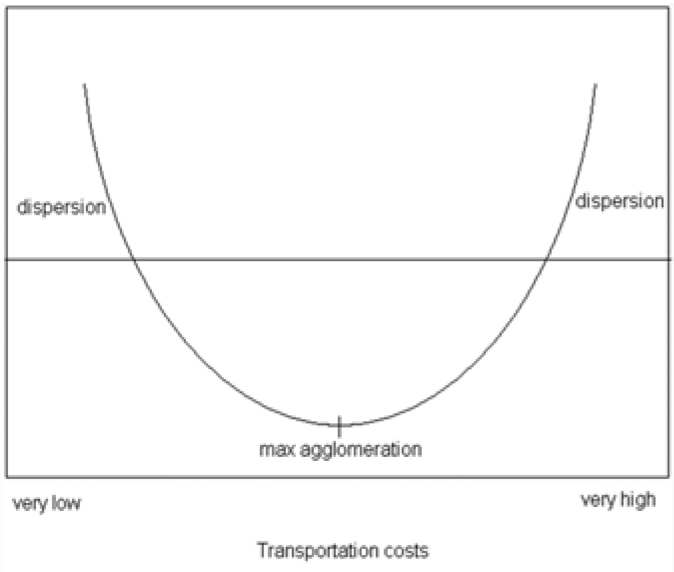
3. low transportation costs.

When these conditions are satisfied, a region (or an urban area) with a *large local market* and *large availability of goods and services* will attract population from regions whose economic frameworks don't have such as characteristics (or have then in a less intensive form). In other words, *territories start competing against each other to attract manufacturing activities*. The approach to agglomeration seen above (New Economic Geography) can be useful to assess some long run dynamics. Indeed, when a broad temporal horizon is considered (i.e. start-

6 We are referring to the contributions of Fujita, Krugman, and Venables, among others, in the creation of the so called "New Economic Geography"

ing from the Industrial Revolution) the importance of cheaper transportation costs in the development path of agglomeration is clearly apparent. However, "circular causation" seems to reduce dramatically when a shorter period (e.g. from the 1970s) is considered. Given that transportation costs were in a constant decreasing trend, empirical evidence seems to suggest a U-shaped relationship between the level of agglomeration and the cost of transportation, as shown in the figure below.

Figure 1 - Impact of transportation costs level on agglomeration



This dynamic can be explained theoretically by considering a system in which firms produce both for other firms and for the agricultural sector: when transportation costs are very high firms disperse to meet the demand of farmers in every region, on the other hand, if the cost of transportation is very low firms disperse, because of easy access to other firms and consumers. However, this formalisation assumes the intra-city transportation cost to be zero and the inter-city transportation cost to be positive. In other words, it is useful only to understand the conditions in which agglomeration arises in a given large region.

Heterogeneity of agents

Regions are often the location of a complex structure of heterogeneous agents acting in different ways. Agents do not actually optimize a common utility function and they do not share a common endowment of perfect information. Conversely, agents are part of a complex system and every agent (or group of agents) evolves toward unstable equilibria in which they adjust their strategies and their expectations continuously. Strategies and expectations together change the environment itself.

Accordingly, the path toward the equilibrium point, or the linear dynamic of growth, as in the neo-classical Solow (1970) formalization, is only one of an infinite number of patterns in which the system may evolve. In this situation, even small changes in some variables are able to change the system from one pattern to another (an emergent structure). As Arthur recently stressed (2005) a dynamic like that has three main features:

- *Perpetual novelty*: there is a constant incentive to evolve (while according to static economics, agents should not have any incentive to move from the equilibrium once it is achieved).

- *Equilibrium indeterminacy* and a selection process that means the evolutionary path of the system is not given and even small variations can change the intensity or the direction of the vector field.

- *Expectational indeterminacy and inductive behaviour*. In static economics, agents try to form their expectations about an outcome that is a function of their very expectations: a self-referential situation. With rational expectation the problem remains; indeed to avoid the onset of multiple equilibria, all the agents should adopt the same base theory (i.e. based on the same assumptions), which is at least a very special event.

Accordingly, complexity theory can be regarded as an emerging paradigm for understanding the complex dynamics underlying processes in regional economics, as, according to our definition above, regions are complex systems made up of many interacting parts. Complex systems can be described as a graph with nodes (elements) and edges (interactions). The number of interactions that exist between elements can define complexity. Accordingly, it is a function of the number of elements (N) acting in the defined domain.

Complexity ranges thus from a maximum level of N elements or agents generating N(N-1) interactions (assuming that interactions are not necessarily mutual) to a minimum of complexity in which there is only one agent (or a group of agents – firms and households) without any direct relationship (or with direct and linear relationships). However, empty graphs cannot really be considered systems because the elements have no relations with other elements.

Agent interactions can also have differing degrees of intensity, they can be weak or strong, and usually intensity of interaction is a function of proximity to different agents. The presence of a dense network of agents (i.e. firms), in fact, is a necessary but not a sufficient condition for creating dynamic regional competitiveness. According to Schmitz (1998), for instance, this *static* (or *passive*) *dimension of clustering*, characterized by the mere spatial concentration of agents should not be mistaken with a patterns of *active cooperation and interaction* among agents that are constantly cooperating and exchanging information to achieve a *collective efficiency* (Schmitz, 1998).[7] In this way it is possible to describe a pattern of interactions between elements along a continuum (instead of using a dichotomy approach). For instance, it is possible to use a range in which 0 represents the absence of interactions, and 1 represents a point of the system that is fully connected to the others. Nonetheless, it is also possible that some interactions are strong and effective over a long distance.[8] This methodology allows the use of a single parameter for studying complexity. Hence, the latter should not be mistaken for complicated models with many parameters and multiple behaviour patterns (Axelrod 1997). There are three main approaches to model complexity that satisfy the conditions imposed above: **Fitness landscapes** or **Adaptive landscapes, Complex networks, and Percolation.**

Fitness Landscape Models

In evolutionary biology, **fitness landscapes** or **adaptive landscapes** (Wright, 1932) are used to visualize the relationship between genotypes (or phenotypes) and replicatory success. It is assumed that every genotype has a well defined replication rate (often called *fitness*). This fitness is the "height" of the landscape. Genotypes which are very similar

7 There are several indicators that could be used to measure the passive/static and active dimensions of clustering. Most of national and decentralized statistics allow the elaboration of some measure of spatial concentration in terms of employment, production/value added or the number of establishments. The active dimensions are more difficult to capture through quantitative measures alone, and require additional qualitative assessments of such variables as the pattern of relationships among firms (through technical collaboration and assistance within production and value chains, membership of business associations, informal mechanism of collaboration among business, relationships between businesses), the relation between firms and local governments and universities, among others. Schmitz (1998) and Nadvi and Schmitz (1994) elaborated specific surveys in the context of developing countries in order to detect the degree of collaborative networks within city-regions.

8 Storper and Venables (2003) developed a model in which the diffusion of information (intellectual spillovers) depends on face-to-face interactions of agents. Accordingly, geographical contiguity plays a fundamental role in developing some particular sectors in which knowledge evolves quickly. For a deeper assessment of the role of face-to-face interaction in spreading innovation, see Maggioni M.A. Roncari S.N. in this publication.

are said to be "close" to each other, while those that are very different are "far" from each other. The two concepts of height and distance are sufficient to form the concept of a "landscape". The set of all possible genotypes, their degree of similarity, and their related fitness values is then called a fitness landscape. A typical formalization is the *NK-model*. Every component of the system has an "epistatic" relationship with the other components or elements.[9] In other word, each agent affects all other elements through a particular property. In the formalization of Kaufman (1993) each element of the system (where N is the total number of elements) is affected by K other elements. Through this model it is possible to simulate the effects of epistasis by constructing a *fitness landscape*. The original model deals with technology, and fitness landscapes are used to refer to efficiency or quality (for production process, and for products respectively). The fitness value W of a certain strategy s is calculated as the mean of the fitness values w_i of each element i.

$$W(s) = \frac{1}{N} * \sum_{i=1}^{N} w_i(s)$$

This model analyses mutation in the system due to epistatic relationships between the elements. If $K=0$ there are no epistatic relationship and w_i has only two random values 0 or 1. When the epistatic relationships are at their maximum level ($K=N-1$), any mutation in a single element will produce new fitness values for each element within the system. It is important to note that in the case of clusters of epistatic relationships, the system tends to develop a variety of local equilibria at different heights. If the information is moderately complex, the level of equilibrium reached through a local search (within the epistatic cluster) will be quite efficient, and the level of local equilibria (on average)

9 In biology epistatic relationships refer to the case in which the action of one gene is modified by one or several genes that are classed independently. The two genes may be quite tightly linked, but their effects must reside at different loci in the genome. The gene whose phenotype is expressed is said to be epistatic, while the phenotype altered or suppressed is said to be hypostatic.

could be quite high. On the contrary, if the information is complex, the local search carried out by the cluster could be insufficient to generate a high equilibrium and the local search (or research) will be inefficient.

Complex network models

Complex networks are related to the idea of many agents connected in different patterns and with different intensities. The proprieties of networks are measured by using two fundamental dimensions: the "cliquishness" or *local density of the network*

$$C = \frac{1}{N} \sum_{i} \sum_{j,l \in \Gamma_i} \frac{X(j,l)}{\|\Gamma\|(\|\Gamma\| - 1)/2}$$

(where Γ_i is the set of neighbours of agent I and $\|\Gamma_i\|$ is the size of neighbourhood, while X can be either 0 absent – or 1 – present); and *average path length between any two agents*:

$$L = \frac{1}{N} \sum_{i} \sum_{j \neq i} \frac{d(i,j)}{N-1}$$

(where d(i,j) is the shortest path between I and j). According to these two properties, the formation of a cluster of the closer (or less distant) elements is highly probable in complex networks.

Percolation Models

Percolation Models refer to the movement and filtering of fluids through porous materials. In others words, they concern a stochastic dynamic of a phenomenon that can evolve in an environment that is able, in turn, to influence the dynamic. In economics percolation has been used to model the transmission of information in a given environment. It is mostly based on the concept of phase transition: a change of a given condition in the agent, or in the system, causes the agent to "jump" from one state into another. Broadly speaking, every step in the evolution of the system is influenced by the previous one, generating *path dependence.* Such a system has a huge number of asymptotic states, and the initial state (Time zero), unforeseen shocks, or other kinds of fluctuations, can conduct the system in any of the different domains of the asymptotic states (Arthur, 1988). Accordingly, the concept of a self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and positive feedback, which tends to lead to a large variety of asymptotic states. Furthermore, the system selects the state in which it places itself. Such dynamics are well known in physics, chemistry and biology and the final asymptotic state it is called the *emergent structure*. The concept of positive feedback is relatively new in economics. Indeed, economics generally deals with problems of optimal allocation of scarce/insufficient resources, thus feedback is usually considered to be negative (decreasing utility and decreasing productivity). Path dependence, in turn, is the main characteristic of sf-reinforcing mechanisms (the other being multiple equilibria in the system, possible inefficiency of the equilibrium, and lock-in).The next section focuses on this approach and shows two different applications of it.

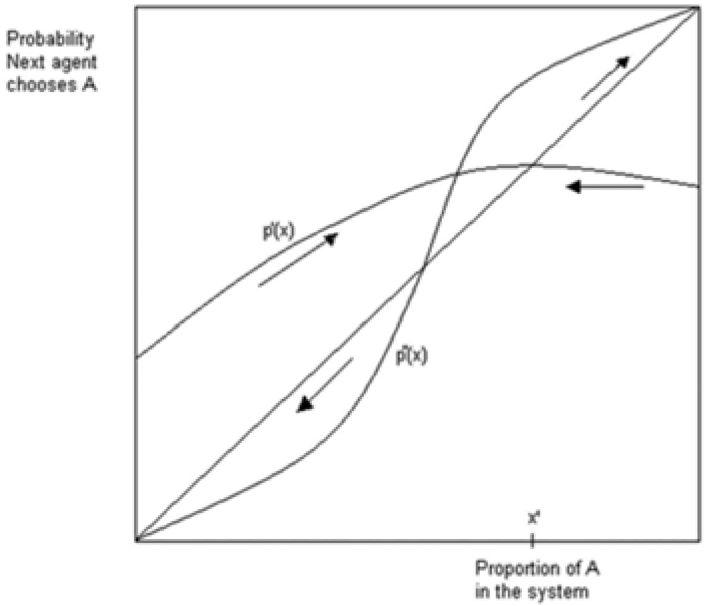
A. Path dependence as an allocation process.

It is not possible to define precisely the dynamic occurring in a system which has the tendency to lock-in in a specific equilibrium, given the existence of multiple equilibria and a sf-reinforcing mechanism. Nonetheless, it is possible to define a system which has some characteristics that allow broad classes of analytical systems to be designed that encompass large number of examples. First of all, to avoid excessive complexity, the system should follow the linear sequence in which choices are undertaken. Second, the proportion of groups of feasible alternatives influences the choice itself (a concentration of alternatives in a particular group at a particular time influence the choice of the system). Finally, a self-reinforcing mechanism usually begins from a "balanced" but unstable position, thus the end-state can be determined by both the initial conditions of the system and by small events outside the model. In this case, a small variation in a given exogenous variable could cause a catastrophic effect on the entire system. Therefore, the actual state of the system cannot determine the next position of the system, but rather the probability of the next action and then of the next position. Considering a general class of dynamic systems, it is possible to assess the dynamic of the allocation process. One of the possible applications of the allocation process concerns, for instance, the distribution of firms in K locations at a certain "event time". The probability that the next firm will join category *i* is $p_i(x)$ where *x* is the vector of current proportion or firm location.[10] That formalization allows us to determine *p*, at least implicitly. By taking only two territories (K = 2) into account, it is possible to show (Figure 2) all the possible dynamics of the system graphically. In the graph, it can be seen the quantity of agents concentrated in the A region is influenced by the number of agents that are already there. Specifically, if the number of agents in A is larger than a given proportion x^i, the probability that the next agent will decide to locate in region A will be higher. Therefore, the region A will attract more agents. On the contrary, if the number of agents in A is lower than the proportion x^i, the probability that agents will choose A as their next location will decrease over time. It is worth noting that it is impossible to use the *Strong Law of Large Numbers* in this stochastic distribution of elements, since past distributions influence the dynamic of the system, while in the Strong Law increments are independent. In this dynamic process, each choice of the system is irreversible and the process *must* converge to one of the points *p* of the feasible allocations.

10 "The vector of probabilities $p = (p1(x), p2(x), \ldots, pK(x))$ is the allocation function that maps the unit simplex *SK* of proportions into the unit simplex of probabilities" (Arthur, 1988)

System at t +1 = System at t + the choice with the highest probability + a random exogenous dynamic

Figure 2 - Two illustrative allocation functions for dimension K = 2



Source **:** Arthur, 1988

Without the random exogenous variable the expected value o System at time + 1 will be equal to the actual state at time + 1:($E(X_{t+1}|X_t) = X_{t+1}$), which is the equivalent deterministic solution. The formalization assessed above is the pillar of many studies on the location of firms by a spin off process.[11] In these models new firms are added by "spinning off" from parent firms one at time. According-

11 See Cohen, 1976 or Klepper, 2004.

ly, firms are added incrementally to regions with probabilities equal to the proportion of firms in each region at that time. Empirical evidence underpins this process especially in the high-tech/knowledge-intensive sectors. Every point of the unit simplex (the total of regions) may become an attractor point, so the system can converge to any point. In other words, "chance" dominates the dynamic completely.

B. Path dependence with recontracting processes.

In the allocation process assessed above, choices made by the system are irreversible. But what happens if every time the system can "change its mind", it decides to re-contract previous choices? To model this dynamic it is necessary to consider a Markov-transition in which the concentration of firms in region A influences the location choice of firms in region B which can change their location every time by "jumping" into the other region. The region that attracts more firms increases its probability of attracting the "next one" at time t + 1; hence, a self-reinforcing mechanism is still possible.

To give a formalization, let's imagine a case in which there are only two regions K ($K = (A, B) = 2$) and total population is $T = 2N$, with a state variable m. Accordingly, $N + m$ firms will prefer region A, and $N - m$ firms prefer region B. Since $p_{AB}(m)$ *is* the probability that a firm will change its location from A to B, and $p_{BA}(m)$ the probability that a firm will change its location from B to A (at every unit of time), the probability P(m,t) of finding the system at state m at time t will evolves as:

$$P(m,t+1) = P(m,t)((1 - p_{AB}(m) - p_{BA}(m)) + P(m+1,t)p_{BA}(m+1) + P(m-1,t)p_{AB}(m-1)$$

From which we derive the Master Equation:

$$\frac{dP(m,t)}{dt} = \left[P(m+1,t)p_{BA}(m+1) - P(m,t)p_{BA}(m)\right] + \left[P(m-1,t)p_{AB}(m-1) - P(m,t)p_{AB}(m)\right] \quad (*)$$

which normalized to the variable x in the continuous interval (-1, 1),

$$x = \frac{m}{N};$$

$$\varepsilon = \frac{1}{N};$$

$$P(x, t) = NP\ (m, t);$$

$$R(x) = \frac{\left[p_{AB}(m) - p_{BA}(m)\right]}{N};$$

$$Q(x) = \frac{\left[p_{AB}(m) + p_{BA}(m)\right]}{N}$$

yields the possibility of rewriting (*) in the form of a one-dimensional Fokker-Plank diffusion equation

$$\frac{\partial P(x,t)}{\partial t} = -\frac{\partial}{\partial x}R(x)P(x,t) + \frac{\varepsilon}{2}\frac{\partial^2}{\partial x^2}Q(x)P(x,t)$$

By substituting diffusion functions R and Q to describe some specific transition mechanism, it is possible to study the evolution of P over time and its distribution. It is worth noting that in recontracting process dynamics, transitions remain constant over time, while transition magnitude decrease over time in the allocation process formalization

To give another example, we can show a model that refers to this kind of dynamic in the labour market (Aoki, 2003). By adopting the mathematical instrument of the *master equation* (also called Chapman-Kormogorov equation), it is possible to assess a stochastic dynamic in which heterogeneous agents face the same limitations in their mobility or in their possibility of being hired by some sectors of the economy.[12] One of the first results that this kind of formalization gives is a stationary distribution of equilibria instead of a single stable equilibrium. Another feature of this approach is the possibility of considering workers with differences in **work experience**, **human capital stock**, **geographical location,** and the **sector** in which they work. The economy has K sectors, and sector i employs a certain number n_i, $i = 1, \ldots, K$ of workers. There are two "states" in which a sector could be: the first is the "normal time":

$$y_i = c_i n_i .$$

In this situation the sector produces an output that is equal to the demand expressed by the market for the sector's commodities. In the second case the demand is higher than the level of supply, and the sector goes into *overtime* capacity; with the same number of workers producing a higher output than before:

$$y_i = c_i (n_i + 1) .$$

Demand for goods i is given by $s_i Y$, with

$$Y = \sum_{i=1}^{K} y_i$$

12 The model refers to the entire dynamics in the macroeconomic environment but here we refer to the part of labour market.

and s_i is a positive share of the total output Y referred to goods pr duced by sector i with $\sum_i s_i = 1$. Every sector has the excess demand defined by:

$$f_i = s_i Y - y_i$$

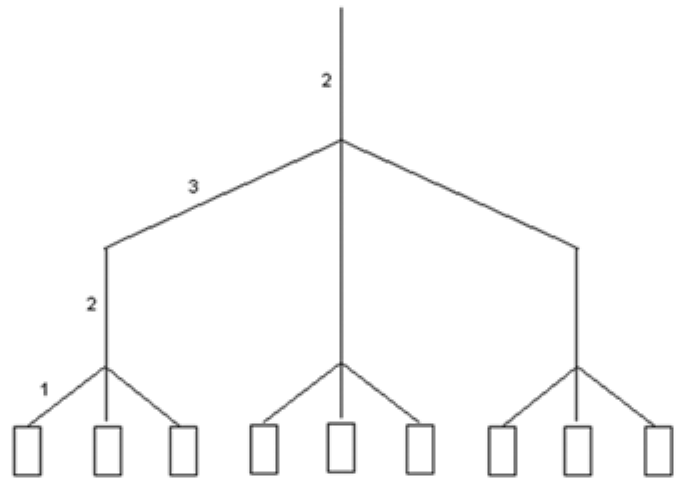
with $i = 1, 2, \ldots, K$.

Sets of sectors with positive and negative excess demand are denoted by

$$I_+ = \{i : f_i \geq 0\} \quad ; \quad I_- = \{i : f_i < 0\} . (**)$$

Changes in Y due to changes in any one of sectors affect the excess demand of all sectors. The model uses (**) as proxy to indicate which group of sectors is profitable (and thus whose production it wants to expand), and, conversely, which one is unprofitable (and whose production it tries to reduce). According to the model, only one sector can adjust its production up or down by one unit at any given time. The sector with the shortest *sojourn time* will be the one to jump first (because of path dependence). And so dynamics are only determined by the transition rates in continuous-time Markov chains. Distance between different sectors is defined by using ultrametric distance. Therefore, the economic environment is structured as a tree diagram in which every sector is a "leaf" which is connected to the rest of the tree through "nodes". Transmission of economic shocks in the environment depends on distance between leaves and branches. The distance is measured between "nodes" (Figure 3).

Figure 3 - Ultrametric distances



Ultrametric distance $d(i, j)$ has the following properties:

a. it is positive unless $i = j$ (in which case it is zero);

b. it is symmetric $d(i, j) = d(j, i)$;

c. it satisfies $d(i, j) \leq max_k \{d(i, k), d(j, k)\}$

Every sector in overtime fills its vacancies (if there are no vacancies the overtime condition creates them) with workers laid off by itself or by the other sectors of the economy. Obviously, workers belonging to the hiring sector have more possibility of being hired than workers belonging to more distant sectors. The distribution of the stochastic probability that a certain worker of a certain sector will be hired by a sector can be assessed by using the master equation. Ultrametrics can also be introduced as dummies for institutions and other kind of "special agents" whose actions can influence the system as a whole. Accordingly, the analysis can be used not only to forecast the evolutions of the system sic *rebus stantibus*, but it can also show which are the main attractors in the system.

Another important result of this approach is that it may be helpful to design policies taking into account other variables characterising the contemporary economy such as natural and environmental resources, human resources, and technology. Furthermore, incorporating these factors into the model does not increase the complexity of the mathematical instrument. This specific issue is broadly analysed in the next section.

Economic Policies in Spatially Extended Systems: New Paradigms

Description of the evolution of spatialised economies emphasizes the role of new rather than classical paradigms. New factors seem to have replaced land, work and physical capital. Natural and environmental resources, human resources and technology are beginning to get the upper hand following the "technological revolution". Co-operation within businesses and between businesses and business systems takes place on a vertical and horizontal scale in which the local dimension and the territorial variables constitute the catalyst for processes of development. Technological expertise and social capabilities (Latella - Marino, 1996) are the basic elements capable of explaining the different levels of development seen in different territorial contexts. Territorial variables, in other words, are decisive factors in explaining development differentials, especially when they are associated with the idea of the market conceived as a social construction. This new market requires rules that will guarantee its smooth running given that access rights, exchange mechanisms and opportunities for distribution of the wealth generated not only do not re-assemble uniformly and autonomously in time and space (Sen, 1984 and 1985), but almost always require outside intervention to achieve the objectives set for development policies. Re-equilibrium policies thus appear necessary to guarantee a more equitable development process. Within the market it is necessary to define collective rules ensuring that positive dynamics (increasing returns) can develop through the interaction of the agents operating in it. The territorial dimension and the systemic nature of the production process are fundamental elements to understanding and governing development processes.

Public intervention in such a scenario cannot simply be thought of as a mechanism for allocating resources within the economy but must assume the role of guide and director of processes. It must taking the shape, on the one hand, of a set of actions aimed at defining and guaranteeing individual access rights and, on the other , of interventions aimed at developing the exchange capacities of markets and business systems (Bianchi, 1995). An explanation may be sought in the fact that local communities increasingly interact with the rest of the world in a continuous process of integration and globalization without necessarily responding to stimuli from the central state. This obliges us to re-examine the composition of the economic policy maker's "tool box" and, at the same time, forces us to radically rethink the very meaning of government policies, given that the central public authority is no longer able to guarantee the development of the local community in the presence of particular actions enforced by the central authorities (Bianchi, 1995).

Traditional economic policies lose their capacity to produce the expected results when enforced in the context of an open market or of a market characterized by strong interrelations between agents, because the mechanism of response to the policy maker's input has to deal with a system characterized by high levels of interrelations between individual decisions and which therefore displays collective response characteristics which are different from individual response mechanisms. The consolidated logic of public intervention in economics assumes that the government authority will identify objectives for which the instruments most likely to achieve results (which can be verified and therefore simulated) are chosen. Traditional macroeconomic policies only work if acting on a closed system for which it is possible to order objectives and priorities with certainty. In this case the policy maker can govern the system of underlying relations by assuming linear-type response mechanisms. If these assumptions are not verified, the complexity of the system makes traditional policies pointless; therefore, to govern complex system policy-makers must equip themselves with a set of objective instruments and programming actions able to cope with non-linearity and the consequences of complexity.

Planning Actions in Spatially Extended Systems: Old and New Approach

From the aforementioned concept that an economy is a “complex evolving system” in which single individuals are linked to each other by strong relationships, it follows that dynamic characteristics cannot be represented by individual approaches but rather by collective properties subjected to subsequent non-reversible scansions (Arthur, 1988). It is thus conceivable that each economic system, in its evolution, might manifest both a multiplicity of equilibria, each dependent on previous historical interrelations, and the presence of inefficiencies and lock-in which can be selected during the evolutionary course of the system to the detriment of possible efficient solutions. Government of an economy seen as a complex evolving system therefore excludes the possibility that commands might be expressed with a prescriptive-type mechanism in mind, as would happen if the system being analysed were essentially closed and characterized by low levels of interactions between agents. To this must be added the considerable incidence of variables of a territorial nature. Territory cannot be thought of simply as a physical support for business activities but must itself become an active factor conditioning the exploitation of local resources and the capacities of single businesses to cope with international competition. Therefore, the general objective of regional policy becomes that of structural adjustment with a view to greater economic and social territorial integration. So new regional policy must firstly contemplate a "transactive" rather than a "prescriptive" type of approach and the basis for any action must consider not just "what must be done" but "in what manner, by what procedures and with whom". This means making systematic and widespread use at all levels of the principle of subsidiarity which implies that decisions should be taken as near as possible to the problem and be appropriate to its solution, and individual responsibilities should also be identified using the same criterion. Thus the main task of decision-makers in each Spatial Extended System is to aim at reassembling the rules and re-establishing the access rights which are the basis of any subsequent action designed to re-appropriate local culture and raise the threshold of contextual knowledge. On these premises it is possible to imagine the transfer of outside knowledge and the creation of networks which build up the basis for the realization of a self-sustained model of development.

To achieve these aims the *Spatially Extended System* (SES) needs to equip itself with instruments capable of identifying moments of participation and complementarity among all the actors that make up the local system. To do this opportunities must be created to allow the human resources to increase the know-how and acquired cognition that will qualify them to introduce innovative codes and routines within the productive system. If such cognitive improvement occurs, there will be an increase in flexibility and specialization and a greater capacity to understand and govern change and innovation and ultimately an improvement in the overall efficiency of the productive system. The government of a local system which is complex because of the continuous, strong interrelationships between the individuals operating within it cannot be of a deterministic kind unless part of it is isolated from the rest of the relationships.

The government of a complex system demands a series of deliberations over interventions, which by their intrinsic nature are irreversible, i.e. they produce permanent changes in the state of the system. To return to the now extensively examined concept of SES, multiplicity of equilibria, co-operation, proximity, resilience and freedom of access can be pointed to as some important categories in the description and government of a complex system. The conceptual field within which the local system has to move is, in fact, of a bottom-up kind and provides the archetype for programming actions capable of leading the evolutionary paths of the SES towards states of greater growth.

Bianchi's (1995) taxonomy of interventions identifies the following three procedures:

1. programming according to exogenous concepts;
2. programming according to critical situations;
3. programming according to integration contexts.

Programming according to exogenous concepts is nothing more than the traditional concept of programming, achieved by means of the exogenous definition of objectives by the policy maker in conjunction with the identification of the instruments necessary to achieve the pre-established goals. If complexity and environmental turbulence are low, this method of programming is effective. This type of programming enters a crisis when the system enters those critical areas characterised by high levels of turbulence or uncertainty. In such circumstances it is necessary to programme according to critical situations, i.e. to devise programming capable of self-regulation in the presence of criticality and of varying parameters in order to overcome any lock-in or bottle-neck situations. As long as the critical areas are small in size, this approach is sufficient. If, however, levels of turbulence and complexity are so high that criticality can occur at any moment, then it is necessary to programme according to integration contexts, i.e. considering the system as a whole as an organism capable of adapting continuously to the outside environment.

In this case policies have to take into account the changes they induce in the system itself, i.e. the way the system metabolises them. The need for programming according to integration contexts therefore justifies, as fundamental elements for regional policy, forms of structural adjustment whose objective is to lower the costs of transaction and which concern:

- the social dimension, linked to the quality of life and culture;
- the ecological aspect, closely connected to the urban habitat, the landscape and the ecosystem;
- public institutions and productive sectors, with special reference to the organizational aspect and the quest for efficiency.

Public-private co-operation, improved social standards, the construction of R&D networks and appropriate territorial policies designed to provide the basis for integration are irreplaceable instruments for governing the economy and for leading it to the highest levels of development.

The Transmission Mechanism of Economic Policy in the Presence of Complexity

The collective properties of a territorial economic system in relation to the link existing between productivity growth and information could be represented in terms of response function. We would like, at this point, to generalize the previous relationship by constructing an interpretative model which describes the propagation mechanism of economic policy in a situation of complexity. The description of the transmission mechanism logically completes the previous observations regarding objectives and instruments. Single economic policy decisions, aimed at achieving the *j-th* objective through the use of the *i-th* instrument, can be represented as an outside stimulus which superimposes itself on interactions between agents.

Agents in this approach are thought of as being spatially distributed and linked to each other by local mutual interactions (of a nearest neighbour type). We use H to indicate the effect of the economic policy. We can thus define an effective *Heff* stimulus which includes both outside stimulus and agent interaction.[13] Obviously, without agent interaction *H* and *Heff* are equal. *Heff* therefore assumes the form:

$$Heff = H + \int dr' c(r-r')\delta\gamma(r')$$

Where *c(r-r')* is a function of correlation between agents which can constitute an acceptable means of modelling the concept of proximity, *δγ(r')* is a variation in the behaviour of agents induced by the policy applied, the integral can be linked to the concept of resilience. This type of behaviour arises in the area of a linear response model for systems with collective properties. The effect of an economic policy on a complex system made up of many agents interacting with each other

13 Heff represents the actual output of the implemented policy.

can therefore be described in this way and modelled, as seen in the previous chapter, by means of the response properties of the system itself. Therefore, in the area of linear response theory we have a cause-effect relationship of the type:

$$E(X) = G(X) \otimes H(X)$$

where *E(X)* represents the generalized effect, *G(X)* the response function, and *H(X)* the generalized cause.

Therefore it is possible to study the generalised transmission mechanism of economic policy by describing the response function as a sort of susceptivity which comes to depend on the distribution of agents within the market. Obviously the type of response depends not only on distribution, but also on the type of interaction between agents.

Some concluding considerations

The debate in economics between those who maintain that complexity and its causes play a decisive role in the construction of models with high levels of realism and those who think that a complete and exhaustive description of economic phenomena can be achieved by using linear and equilibrium-type models regardless of the complexity of the behaviour of agents and markets is relatively recent. In this work we analysed the relationship between complexity and economic policies from the point of view of regional and territorial economics. The economy as a complex evolving system (Arthur, 1988) therefore implies that:

- individuals are bound to each other by strong relationships;

- dynamic characteristics cannot be represented by means of individual approaches but only by collective properties;

- evolution manifests itself by means of multiple equilibria;

- each equilibrium depends on previous historical interrelations through possible inefficiencies and/or lock-in.

From a conceptual point of view, the main characteristics of the effects that emerge in the dynamic evolution of a system with complex behaviour can be explained by:

- the difficulty prescriptive-type regional and territorial policies have had in promoting and sustaining economic development;

- the loss of importance of the national dimension: the local dimension clashes with the global dimension;

- the faltering view of economic policy and its propagation mechanism as being based on principles of command and control;

- the inability of a central planner to govern all the underlying relationships between economic agents at any given time according to linear-type response procedures.

REFERENCES

Amin, A. and N. Thrift, (1995), *Globalization, Institutions, and Regional Development in Europe*, Oxford University Press, Oxford

Aoki, M. (1999), *Analysis of an open model of share markets with several types of participants*, UCLA, working paper.

Aoki, M. (2003), *A new model of labour dynamics: Ultrametrics, Okun's law, and transient dynamics,* UCLA, working paper.

Aoki, M (2004), *New frameworks for macroeconomic modelling: some illustrative examples*, UCLA, working paper 2004.

Arrow, K. J. and F. Hahn (1971). *General Competitive Analysis*. Holden-Day, San Francisco

Arthur, W. B. (1988), *Self-Reinforcing Mechanisms in Economics*, in Anderson, P. W., Arrow, K. J. and Pines, D.,(eds.), *The Economy as an Evolving Complex System, Reading*, MA: Addison-Wesley.

Arthur, W. B. (1989), "Competing technologies, increasing returns and lock in by historical events". *The economic journal* vol. 99.

Arthur, W. B. (1989), "Complexity and the Economy", *Science*, vol. 284, pp.107-109

Arthur, W. B. (2005), "Out-of-equilibrium and Agent-based Modelling", *Hand-book for computational economics*, Vol. 2.

Barkley Rosser J. (2003), *A reconsideration of the role of discontinuity in regional economic models*, Chaos, Solitons and Fractals.

Bailey, M. N. and R. Z. Lawrence (2001). *Do We Have a New Economy,* National Bureau of Economic Research, Working Paper No. 8243, April 2001.

Barewald, F. (1969), *History and Structure of Economic Development*, India Book House.

Barro, R. J. and X. Sala i Martin (1995), *Economic Growth*, McGraw-Hill.

Baumol, W.J and Oates, (1988) W.E. The Theory of Environmental Policy. Cambridge: Cambridge University Press.

Beaudry, C. (2001), "Entry, Growth and Patenting in Industrial Clusters: A Study of the Aerospace Industry in the UK", *International Journal of the Economics of Business*, Vol. 8, No. 3, pp. 405-436.

Becattini G. (1979), "Dal "settore" al "distretto" industriale. Alcune considerazioni sull'unità di indagine nell'economia industriale", *Rivista di Economia e Politica Industriale*, n.1.

Becattini G., and E. Rullani (1993), "Sistema locale e mercato globale", in *Economia e Politica industriale*, n. 80.

Behrens, R. and Wilkinson, P. (2003). Housing and Urban Passenger Transport Policy and Planning in South African Cities: A problematic Relation?. In: Phillip Harrison, Marie Huchzermeyer and Mzwanele Mayekiso (eds). Confronting Fragmentation: Housing and Urban Development in a Democratising Society. Cape Town, University of Cape Town Press.pp. 154-172.

Bentollila, S., J. J. Dolado, W. Franz and C. Pissarides (1994), "Labour Flexibility and Wages: Lessons from Spain", *Economic Policy*, Vol. 9, No. 18, pp. 53-99.

Van den Berg, L., E. Braun and J. van der Meer (2004), *National Urban Policies in the European Union*, Euricur, Rotterdam.

Bianchi, P. (1995), *Le politiche industriali dell'Unione Europea,* Bologna, Il Mulino.

Boix Domènech, R. (2006), "Economía del conocimiento, tecnología y territorio en España", CDTI and UAB, mimeo.

Borjas, G. J. (1999), "The Economic Analysis of Immigration", in O. Ashenfelter and D. Card (eds.), *Handbook of Labour Economics*, Vol. 3A, North Holland.

Borjas, G. J. and L. Hilton (1996), "Immigration and the Welfare State: Immigrant Participation in Means-Tested Entitlement Programmes", *Quarterly Journal of Economics*, Vol. 111, No. 2, pp. 575-604.

Borjas, G. J. (1987), "Self-Selection and the Earnings of Immigrants", *American Economic Review*, Vol. 77, No. 4, pp. 531-53.

Breschi, S. and F. Lissoni (2001), "Knowledge Spillovers and Local Innovation Systems: A Critical Survey", *Industrial and Corporate Change*, Vol. 10, No. 4, Oxford University Press, pp. 975-1005.

Briggs, X. (2007) Democracy as Problem Solving. Civic Capacity in communities across the Globe. MIT Press, Forthcoming.

Brusco, S. and C. Sabel (1981), *Artisan Production and Economic Growth*, in Wilkinson F. (ed.), *TheDynamics of Labour Markets Segmentation*, Academic Press, London

Brusco, S. and E. Righi (1989), *Enti locali politica per l'industria e consenso sociale. L'esperienza di Modena* in Brusco S., *Piccole imprese e distretti industriali*, Rosenberg&Sellier, Torino.

Buesa, M. (2002), *El sistema regional de innovación de la Comunidad de Madrid, informe sobre Situación económica y social de la Comunidad de Madrid 2001*, Consejo Económico y Social de la Comunidad de Madrid.

Castells, M. (1983), *The City and the Grassroots*, University of California Press, Berkeley.

CEBR (2006), *The Importance of Wholesale Financial Services to the EU Economy 2006*, City of London.

Coase, R. H. (1937). *The Nature of the Firm.* Economica, vol. 4, n. 386.

Conway, P. and G. Nicoletti (2006), "Product Market Regulation in the Non-Manufacturing Sectors of OECD Countries: Measurement and Highlights", *OECD Economics Department Working Papers*, No. 530.

Conway, P., D. de Rosa, G. Nicoletti and F. Steiner (2006), "Regulation, Competition and Productivity Convergence", *OECD Economics Department Working Papers*, No. 509.

Danson, M., Halkier, H. and Cameron, G. (2000) "Regional governance, institutional change and regional development", in Danson, M., Halkier, H. and Cameron, G. (Eds) *Governance, Institutional Change and Regional Development*, Ashgate, Aldershot.

David, P. (1985), "Clio and the Economics of QWERTY", *American Economic Review*, Papers and Proceedings, vol. 75, pp. 332-337.

Foster, G. (1973), *Traditional Societies and Technological Change*, Harper & Row, New York, NY.

Frenken, K. (2005), *Technological innovation and complexity,* Urban and Regional research centre Utrecht (URU), working paper.

Freeman, A. (2004), "Measuring and Comparing World Cities", GLA-Economics, working paper n. 9.

Friedmann, J. (1986), "The World Cities Hypothesis", *Development and Change*, Vol. 17, No. 1, pp. 69-84.

Gordon, R.J. (1993), *The Jobless Recovery: Does It Signal a Era of Productivity Growth?*, Brookings Papers on Economic Activity, vol. 1, pp. 271-306.

Hall, P. (2000), "Creative Industries and Economic Development", *Urban Studies*, Vol. 37, No. 4, pp. 639-649.

Harrison, J. and D. Corkill (2004), *Spain: a Modern European Economy*, *Modern Economic and Social History Series*, Ashgate, Aldershot, Hants, England.

Heimler, A. (1991), "Linkages and vertical integration in the Chinese economy", *Review of Economics and Statistics*, vol. 73, n. 2, pp. 261–267.

Hirschman, A. O. (1959), *The Strategy of Economic Development*, Yale University Press, New Haven, CT.

Jacobs, J (1984). *Cities and the wealth of nations*. Vintage Books, New York.

Kauffman, S. A. (1993), *The origin of Order. Self-Organisation and Selection in Evolution,* Oxford University Press.

Krugman, P. (1991), "History Versus Expectations"*, Quarterly Journal of Economics*, vol. 106.

Krugman, P. (1991), *Geography and Trade*, MIT Press.

Krugman, P and A. J. Venables, (1995), *The Seamless World: A Spatial Model of International Specialization*, 1230, C.E.P.R. Discussion Papers.

Krugman, P. R., A. J. Venables and M. Fujita (1999), *The Spatial Economy*, The MIT Press, Cambridge, MA.

Latella, F. and D. Marino (1996), "Diffusione della conoscenza ed innovazione territoriale: verso la costruzione di un modello*", Quaderni di Ricerca di Base dell' Università Bocconi,* n. 2, 1996.

Lester R. and M. Piore (2004), *Innovation: The Missing Dimension*, Harvard University Press, Cambridge, MA.

Lublinski, A. E. (2003), “Does Geographic Proximity Matter? Evidence from Clustered and Non-Clustered Aeronautic Firms in Germany”, *Regional Studies*, Vol. 37, No. 5, pp. 453-467.

Marino, D. (1998), “Territorial Economic Systems and Artificial Interacting Agents: Models Based on Neural Networks”, *International Journal of Chaos Theory and Applications*”, vol.3, 1/2.

Markusen, A. (1999), “Fuzzy Concepts, Scanty Evidence, Policy Distance: The Case for Rigor and Policy Relevance in Critical Regional Studies”, *Regional Studies*, Vol. 33, No. 9, pp. 869-884.

Myrdal, G. (1957), *Economic Theory and Underdeveloped Regions*, London Duckworth.

Nelson, R.R. and S.G. Winter (1977). “In Search a Useful Theory of Innovation”, *Research Policy*, vol. 6, pp. 36-76.

Nelson, R. R. and S. G. Winter (1982), *An Evolutionary Theory of Economic Change*, The Belknap Press of Harvard University Press, Cambridge, MA.

Niosi, J. and M. Zhegu (2005), “Aerospace Clusters: Local or Global Knowledge Spillovers?”, *Industry and Innovation*, Vol. 12, No. 1, pp. 1-25.

Porter, M. (1990). *The Competitive advantage of nations*. The Free Press, New York.

Rodríguez Pose, A. and A. Bwire (2003), “The Economic (In)Efficiency of Devolution”, *Environment and Planning A*, 36.

Schweke, W. (1995) “Making comparative advantage work for economic opportunity”. *Review of Black Political Economy*, vol. 24, 2/3, pp. 233-50.

Scott. A and Storper, M. (1986). *Production, Work, Territory: The Geographical Anatomy of industrial capitalism*. Allen & Unwin, Boston.

Scott. A and Storper, M. (2003). Regions, Globalisation, Development, Regional Studies, vol. 37, 6/7, pp. 579-593

Storper, M. (1997). Regional Economies as relational assets. In: Lee, Roger and wills, Jane (ed). Geographies of Economies. London: Arnold.

Storper, M. (1998), *Civil society: three ways into a problem*, in Douglas, M. and J. Friedman (eds.), *Cities for Citizens*, Chichester, Wiley, pp. 239-246.

Storper, M and Walker, R. (1999) The capitalist Imperative: Territory, Technology and Industrial growth. New York: Basil Blackwell.

Storper, M. and A. J. Venables (2004), "Buzz: Face-To-Face Contact and the Urban Economy", *Journal of Economic Geography*, vol. 4, no. 4, pp. 351-370.

Taylor, P. J. (2004), *World City Network: A Global Urban Analysis*, Routledge, London.

Taylor, P. J. (2005), "Leading World Cities: Empirical Evaluations of Urban Nodes in Multiple Networks", *Urban Studies*, vol. 42, n.9, pp. 1593-1608.

Thrift, N. and K. Olds (1996), "Refiguring the economic in economic geography", *Progress in Human Geography*, vol. 20, pp. 311-337.

Tirmarche, O. and P. Le Galès (2004), " Life After Industrial Decline in St. Etienne: Robust SMEs, Deterritorialization, and the Making of a Local Mode of Governance", in C. Crouch, P. Le Galès, C. Trigilia and H. Voelzkow, *Changing Governance of Local Economies: Responses of European Local Production Systems*, Oxford University Press, pp. 160-180.

Venables, A. J. (1996), "Equilibrium locations of vertically linked industries" *International Economic Review*, vol. 37, n. 2, pp. 341-359.

Ward, S. V. (2002) *Planning the Twentieth Century City: The Advanced Capitalist World*, Chichester, Wiley.

Wheeler, S. (2002). The New Regionalism: Key Characteristics of an emerging movement. Journal of the American Planning Association, Vol (68), 3, Summer 2002, pp. 267-78.

Williamson, O. E. (1981). *The economics of organization: The transaction cost approach*. The American journal of sociology, vol. 87, n. 2, p. 233.