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EVOLUTIONARY ECONOMICS and REGIONAL POLICY

paper to be presented at the 38th Congress of the European Regional Science Association

28 august-1 september 1998, Vienna

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Abstract

The principal objective of this paper is to formulate some possible links between evolutionary economics and regional policy, a topic that has not (yet) been covered by the literature. We firstly give a brief overview of some issues of regional policy, conceived as a strategy to influence the spatial matrix of economic development. Then, we outline what we take to be the essential arguments and components of evolutionary economics. More in particular, we focus attention on the economic foundation of technology policy from an evolutionary perspective, and how this deviates from the so-called "equilibrium" rationale. Then, we examine in what way evolutionary insights may be helpful for regional policy matters. Our main emphasis is to investigate the degrees fo freedom policy makers may have to determine the future development of regions.

When evolutionary mechanisms like *chance* and *increasing returns* are mainly involved in the spatial formation of new economic activities, there are several, but quite contradictory, options for policy makers. On the one hand, the importance of early chance events implies that multiple potential outcomes of location are quite thinkable. This is a principal problem for regional policy because new development paths can not be planned or even foreseen. On the other hand, policy makers may have a role to play here. Since space exercises only a minor influence on the location of new economic activities, there is room for policy makers to act and to build-up a favourable local environment. In this respect, *urbanisation economies* may offer advantages of flexibility secured by a diversity of activities which tends to prevent a process of *negative lock-in*.

When evolutionary mechanisms like *selection* and *path dependency* are crucial for the geography of innovation, policy makers are expected to have more influence on the spatial pattern of innovation. In such circumstances, new variety is regarded as strongly embedded in its surrounding environment: the local environment acts as a sort of selection mechanism because it may, or may not, provide conditions favourable to meet the new requirements of new technology. Adaptation to change is largely constrained by the boundaries of the spatial matrix laid down in the past: only minor modifications tend to take place and do not undermine the logic of the spatial system.

1. Introduction

Economic theory has developed an increasing number of approaches. Apart from further developments within the mainstream (the neoclassical school), other directions of research programs have evolved, e.g. evolutionary economics and institutional economics. In this paper we will show how evolutionary economics can be used to dealing with spatial issues, more in particular with that of regional policy. This subject has been chosen because it is a field which combines issues concerning decision-making with structural change. Mainstream economics mainly focuses on decision-making within given structures; it confines the concept of structure to indicate the composition of production and the configuration of institutional arrangements. The principal effort of this branch of economics is to show how economic actors deal with changes *within* the structure, not *of* the structure. Evolutionary economics deals with the long-term processes of changing economic structures, more in particular with the increasing variety of technology and organization, and with the strategies of economic actors to adapt to changing structures: strategies to survive. This is exactly one of the major issues of regional policy.

Evolutionary economics emphasizes the continuously growing variety of the economic structure, continuously creating new technologies, organizations and firms, in contrast to mainstream economics which deals with one encompassing production function and with the ‘representative firm’. Differentiation, complexity and uncertainty are key issues of modern economic theories, mainly based on the input of the Austrian School with contributions of - in our case - Schumpeter. He also stressed the fundamental impact on the economic structure by entrepreneurs, which he considered to be the real innovators. This is the reason why evolutionary economics is sometimes called ‘Neo-Schumpeterian’ economics. It also opens the way to investigate the interrelations between structure and economic actors as a feedback mechanism. It is not only the given structure which influences the actors, these actors (specially the 'innovators') also change the structure. An economic structure is a an environment with many options for the actors; it can be called the ‘selection environment’ - the structural composition of a society within a framework of time and space - which influences the actors and is influenced by them. We will not deal with the 'Impossibility Theorem' of Hayek. According to Hayek, an evolutionary market order cannot be directed by governments acting with well-defined 'end-states'. Market outcomes emerge from decentralized decision-making and are, as aggregate results,

unpredictable and unintended. Hayek is very sceptical on the principle of economic policy. (Wegner, 1997).

In this paper we first give a brief overview of some issues of regional policy, conceived as a strategy to influence the ‘spatial matrix of economic development’. Then we focus on evolutionary economics. Consecutively we formulate evolutionary economics and regional policy, and formulate some conclusions as to the usefulness of this approach for regional policy. We contend that those regions which possess certain characteristics more in particular agglomeration economies and an attractive environment are in general in the position to attract the innovators (innovators of organization included) and the bearers of new knowledge (‘the brainworkers’). These regions have better prospects to enjoy economic prosperity. A policy focusing on improving the physical and social environment may be one of the important tools to attract these sources of economic growth. Evolutionary theory shows, however, that there are no certainties where new technologies will have their main locational impacts.

2. Regional economic problems: theory and policy

In various countries governments are engaged in the process of designing, or implementing, regional policies, attempting to improve the economic conditions of, mostly, peripheral and de-industrializing areas. Also on the European level, authorities are developing various plans to further the economic growth of regions having structural problems: first, the peripheral areas, often confronted with restructuring their agriculture, and second, many previously well-developed urbanized manufacturing regions, now having an unfavourable economic structure. In these ways the European Union is allocating a large part of its budget (the so-called 'structure funds') to these regions, but it is expected that the regions themselves also contribute to these efforts.

Many regions - even those with an acceptable level of economic growth- are developing new strategic plans aiming at keeping up in the 'rat-race' of inter-regional competition to attract the best investments. This competition may be seen as the result of an increasing variety of production opportunities in a growing number of regions across the world. New variety has evolved by the development of new technologies and new organizational structures. Many regions feel the threat of being outperformed by other

areas. The regional authorities, the labour unions and other institutions are well aware of the fact that many economic activities are not locationally fixed any more. Capital is, more than ever, free to move to other locations. Many regions have dreams of becoming a 'New Silicon Valley', a 'Technopolis', or 'The Major Gateway', and others have similar highly speculative goals.

Regional policy presupposes the possibility to intervene in the process of development of a regional economy and of the inter-regional 'spatial matrix of economic development'. Policy means that intervention should lead to a self-defined path of development, different from that which is being perceived as the current one. Policies are often focused on short term problems, such as declining unemployment, although quite often a changing structure can only be influenced over a longer period. The choice of a theory by politicians can influence the design of the policy. Keynes's much quoted remark 'that we will be all dead in the long run' has had a negative effect on the interest on structural issues and on the supply side of the economy. His theory was focused on intervention in the business cycle via the demand side. The perspective of intervention via the supply side - which is very important for regional policy - is sustained by several economic theories. In the USA and many other countries the present focus is on rationalization (mainly by deregulation and a stronger focus on the market mechanism) and on the supply side, that is, first, strengthening the motivation to seek higher rewards, and, second, improving the quality of the factors of production, e.g. physical infrastructure and knowledge. For regional policy this has resulted in abandoning the emphasis of subsidies for unfavourably developing regions and to shifting attention to the strengthening of structures, mainly infrastructure. In national economic policy - more in particular in 'Technology policy' and 'Industrial policy' - a strategy of 'picking the winners' (often the new sectors with 'increasing returns', e.g. electronics and biotechnology) is pursued. The same is often happening in regional policy, but as is also true for countries, most regions tend to attract the same 'winners' which results in a hefty competition.

The policies pursued can be distinguished in four major approaches:

- *first*, those focused on specific industries or technologies because of the pre-supposed cumulative effects of direct or indirect linkages with other industries and firms or because of the perception that 'modern, high-tech' industries are necessary for economic growth;

- *second*, those emphasizing the local development or the attraction of high-tech firms, producer services and highly qualified workers, by policies based on developing an attractive environment and a perfect physical and social infrastructure;
- *third*, a focus on SME's (small and medium enterprises), on innovating entrepreneurs by means of the establishment of regional centres (Regional Innovation Centres) to coordinate, and to foster new ideas and new technologies; the aim is not only to increase the number of innovators, but also to enhance institution building by SME's, e.g. by developing networks; and,
- *fourth*, the mainstream approach with its reliance on microeconomic reforms, improving cost-effectiveness, based on strengthening the market mechanism, which then would result in the inter-regional clearance of disequilibria. In this paper we pay special attention to the first three approaches.

Regional policy as a distinct kind of policy developed in the 1930's in the US (e.g. the Tenessee Valley Authority) and in the UK (often associated with town and country planning). The basic idea was that the markets did not produce the neoclassical equilibrium with inter-regional convergence, so that governments, as part of the New Deal, intervened with special programmes. One option was to subsidize enterprises located in peripheral areas; another option was to enhance the basic attractiveness of such regions by heavily investing in infrastructure, public utilities, and large manufacturing industries with many linkages, like the steel industry, oil refineries and the automotive industry.

Many approaches were being used in regional policy. One of the earlier and very influential theories is the so-called 'growth-pole theory' (Lambooy, 1969), based on the ideas of the French economist Perroux (1955). This theory focused on the idea that economic development occurs via the expansion of networks of connected firms, wherever their location ('espace economique' as Perroux called it), with 'nodes', or 'growth poles', the focal points in the networks consisting of the principal firms, the driving forces of economic growth. These economic relations were not only dependent on location, but more decisively so on the nature of market relations in economic space, not in geographical space. Nevertheless, governments could decide to invest in heavy industry, considered as 'growth poles', in peripheral locations, which then could develop their own networks of related firms, by outsourcing and subcontracting. In that case, part of the multiplier effects

of these investments were expected to develop in those regions and consecutively should start a cumulative regional development process.

A related approach can also be found in the theory of Gunnar Myrdal (1957). In contrast to the neoclassical theory of inter-regional convergence via the market mechanism, he used the idea of 'cumulative development', a process in which a virtuous cycle of investment and increased attraction created spatial disparities of regions. Metropolitan regions, or other regions with an initial advantage, would develop even more; while peripheral regions, even with low wages, would decline, not grow. The theoretical 'end-product' of neoclassical theory should be equilibrium and convergence towards equalised wage- and profit levels, not increased differences in growth, such as Myrdal's approach would predict.

The theoretical base to start from is very important when regional authorities decide upon devising and implementing a regional policy. They have to consider the many uncertainties of economic, institutional and technological developments and the history of the region. In evolutionary economics various concepts have been developed which can be used to understand how regional economic structures evolve and change. It has a specific interest in historical paths of development and in changing structures (Boschma & Lambooy, forthcoming).

Regional policy cannot start from scratch, it has to accept history (path dependence) and the stochastic results of (previous) developments (Lambooy, 1986; Boschma, 1994). However, governments and other regional institutions are not only dependent on history or on markets. Their degrees of freedom to act are related to the argument that the specific local, regional and national patterns of institutions and national technology systems may offer opportunities for urban and regional authorities to influence the direction of the development paths of the technological and organisational processes.

In this paper we investigate the degrees of freedom regions (an indication of a mix of actors: authorities, entrepreneurs, labour unions, etc.) possess to determine their own future. Although it is virtually impossible for politicians (and economists as well) to pick the winners; for certain regions it may seem possible to attract producer services and firms with already acknowledged new technologies. Anyway it seems to be important to attract people who are the decisive workers in the new economy: the 'brainworkers', more in particular in the 'knowledge-intensive services'. Not all regions possess the opportunities to attract the new sources of economic growth. In regional economics characteristics such as

agglomeration economies and the differentiation of economic activities (Jacobs, 1968) are assumed to be important to develop or to attract new strong economic activities

3. Some aspects of evolutionary economics

We begin by outlining what we take to be the essential arguments and components of evolutionary economics (Nelson and Winter, 1982; Dosi et al. 1988). We focus on how new activities and organizational and institutional structures lead to new and more variety in economic activities, or increasing complexity. More complexity and new variety (the development of new 'species' of technologies and economic activities) is seen as a fundamental attribute of development. In a certain sense *economic growth may be conceived as reflecting the increasing complexity* associated with the evolution of new variety and with the changing environment. New variety and increasing complexity will be the result of new technologies, new products, new locations, new organizations and new institutions. According to evolutionary economics, this new variety may be affected by the environment, but not in a predictable way. Variety in behaviour and in structures is a key assumption for evolutionary economics. Here we claim that, even when stochastic events occur, key concepts in evolutionary thinking, such as *variety*, *uncertainty*, *routines*, *path dependency*, *bounded rationality* and *selection*, suggest that new variety is strongly embedded in its surrounding environment, and that various, although often unpredictable, kinds of reaction can occur.

These concepts were used by Nelson and Winter (1982), following Simon (1956); they replaced the neoclassical notions of rational, optimal (maximizing) behaviour in favor of a more satisfactory, realistic concept of *satisficing behaviour* in uncertain situations without perfect information. This latter notion accounts for the fact that the decision-making process often takes place within the boundaries of existing routines. *Uncertainty* and *bounded rationality* are, probably, the most important *behavioural assumptions* of the evolutionary theory; they have major implications for the particular nature of decision-making and for the problem of adjustment. Economic agents are confronted with a high rate of uncertainty because the production environment in which they operate is complex and unstable, while the information on which they base their decision-making is far from freely available. This is also true for locational developments (Webber, 1972). It is, sometimes rational from the point of view of the firm to ignore promising (even superior) alternatives which deviate from their

existing routines because high adjustment costs as well as high risks and uncertainty are involved: the boundaries of existing trajectories act as constraints on the ability of economic agents to react to changing market signals or to changing technologies.

Firms will not adopt or implement new technology, or adapt to a changing environment as smoothly as is assumed by the conventional neoclassical model. It is because of evading uncertainty that firms or organizations tend to undertake routinized, more or less predictable behaviour. The common attitude of producers and consumers is to form *habits* and *conventions*, and they do that more often than consciously maximizing profits or utility functions. Habits and conventions are developed within regional contexts of social networks of 'embedded' participants. According to Storper (1997) this is one reason why innovation of technology and institutions are often a regional phenomenon. Searches for new technology are likely to be undertaken locally, that is, directed to technologies and markets with which firms have become familiar in the past (Nelson and Winter, 1982; Heiner, 1983). In other words, history matters in evolutionary thinking. History in terms of the inheritance of (regional) structures, institutions and ideas often acts as a filter for assessing new opportunities. New developments, even within the very region in which these happen, are not always being perceived as a new way of organizing or producing. People (such as politicians and economists) notice much later that there have been fundamental changes.

Dosi (1982) has proposed the notion of *technological trajectory* to stress the importance of investigating longer periods of development, when describing the peculiar, evolutionary nature of innovative behaviour of organizations. Innovative behaviour is considered to proceed along rather narrowly defined paths which guide the exploratory activities of firms. This *path dependency* is related to the accumulation of knowledge, information and experience (learning processes). This is quite relevant for assessing the dimensions of the processes of adjustment to the increasing complexity, which is associated with evolving technologies.

Evolutionary economics (or Neo-Schumpeterian economics), the approach we will follow in this paper, focuses primarily on structural, long term developments, and as such it emphasizes more specifically the 'structural' parameters of development -such as the composition of industries, technological and organizational factors (Boschma, 1997). However, evolutionary economics also focuses on the dynamic relation of economic actors and their ('selection') environment because development can be conceived as being the result of the dynamic interaction between actors and the selection environment (Boschma

& Lambooy, 1998). The increasing variety of economic activities leads to more complexity. In economic development the selection of the 'best', 'the strongest', or 'the fittest' is a process which differs from biology, because of human actions.

Hence, evolutionary economics has two faces. The *first* one focuses on the longer term growth-paths, or trajectories, and the *second* one has an emphasis on human strategies in the struggle to survive, sometimes in adverse environments. This latter one emphasizes the ways to improving the properties of the structure, or the conditions of production, in order to raise the productivity of the actors, by influencing the selection environment by well devised strategies of innovation. In general, evolutionary economics does not consider individual decision-making as such. Schumpeter, however, argued that individual entrepreneurs were able to enjoy extra benefits by using innovation strategies. But he did not investigate individuals as such, but instead he focused on the entrepreneurs as a general category of people, who are willing to take risks in a context of economic uncertainty. Later he accepted the role of large corporations and governments in the process of innovation (Schumpeter, 1943).

We contend that actors, such as entrepreneurs and politicians, do have a certain influence on the path of development, once a particular path has started to evolve. The deliberate creation of a new development path is almost impossible, because it is the result of, first, surprising, unexpected discoveries or not consciously made decisions, and second, many unrelated decisions, divided by time and space. In these circumstances, it is very difficult to plan a new path of (technological or organizational) development. In our perspective we emphasize the principle of a plurality of development paths. Evolutionary economics argues that selection environments and agents are interacting in an mutually adaptive process with uncertain outcomes. As chaos theory would predict, the development process can not be investigated as a linear process. Small changes in the variables can result in large deviations from the expected outcomes of a planning process (Kemp, 1997).

The principal objective of this paper is to formulate some possible links between evolutionary economics and regional policy, a topic that has not (yet) been covered by the literature. Whereas evolutionary economics is often believed to be at its initial stage of development (Nelson, 1995), this certainly applies to the analysis of policy implications of evolutionary thinking. We briefly discuss the contrasting perspectives provided by the "equilibrium" and "evolutionary" approach with respect to the theoretical foundation of technology policy. By doing so, we draw heavily on the work of Metcalfe (1994; 1995).

The so-called "equilibrium" theory of policy is well-developed in the literature. It focuses attention on the notion of "market failures" which underpin the rationale for technology policy. In short, market incentives will not produce a Pareto-optimal allocation of resources to innovation. This is attributed to the problem of assymetric information (imperfect distribution of information across economic agents), externalities, and monopolistic powers. Moreover, it is assumed that the policy maker is fully informed and is capable of identifying and implementing optima.

The evolutionary approach focuses attention on the extent to which the selection mechanism generates socially acceptable outcomes, and how problems of adjusting to change can be minimized. This view differs from the equilibrium approach because market power and information assymetries are regarded as anything but problems. On the contrary, these are the necessary conditions for technological change to occur in a technologically progressive world, because they provide the sources of profit opportunity. Technology policy has two main purposes in an evolutionary world. The first is to ensure the creativity of the economic system and the diversity of behaviour by stimulating the technological and innovative capabilities of the economic system. This may be achieved through the openness of competition and appropriability, which lower the barriers to innovative entry. Moreover, according to Metcalfe (1994), "the effective operation of an evolutionary innovation system depends on the effective coupling between firms and other knowledge-based institutions to jointly enhance the process of learning and creativity" (p. 497). The second purpose of technology policy is to ensure the efficient selection of market and non-market environments. For example, this may be guaranteed by an efficient capital market. According to Metcalfe (1994), the role of the policy maker is completely different in an evolutionary world: "the evolutionary policy maker adapts rather than optimizes" (p. 418). In a world of uncertainty, policy makers pursue a policy of trial-and-error. They learn and adopt in the light of experience, and there is no guarantee of success.

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4. Selection and path dependency in space

We stated elsewhere that evolutionary notions like *path dependency*, *increasing returns*, *chance* and *selection* can be useful concepts in the geography of innovation (Boschma and Lambooy 1998; forthcoming). Many economic geographers suggest that regions matter in

innovation, despite the fact that it remains difficult to assess the particular impact of the local environment on the innovative behaviour or capabilities of persons and firms. The concept of *agglomeration economies*, which basically deals with the advantages of geographical proximity, implicitly encompasses evolutionary notions like *path dependency* and *learning processes*. We now examine in what way evolutionary insights may be helpful for regional policy matters. Our main emphasis is to investigate the degrees of freedom policy makers may have to determine the future development of regions. In this Section, we discuss the options for policy makers when evolutionary mechanisms of *selection* and *path dependency* determine to a large extent the geography of innovation. In Section 5, we deal with this issue in case the evolutionary mechanisms of *chance* and *increasing returns* lay at the root of the spatial formation of new economic activities.

Though stochastic events take place, randomness is often constrained by *Darwinian selection*. The selection mechanism guides and constraints creative and adaptive behaviour and, therefore, determines to a large extent which innovations thrive or fail. New variety which does not fit into the production environment is bound to disappear. In other words, the local environment acts as a sort of selection mechanism that may, or may not, provides conditions favourable to meet the new requirements of change. According to Nelson (1995), this is exactly what the essence of evolutionary theory is all about, that is, to provide an explanatory framework for '... mechanisms that systematically winnow on extant variation' (p. 56). In evolutionary thinking, the selection environment consists of markets and a set of non-market factors. These latter include technological principles or opportunities, institutions and 'socially held and enforced values, norms, beliefs, customs, and generally accepted practices' (Dosi and Nelson 1994, p. 159). Storper (1997) states that the development of habits, conventions and tacit knowledge in certain regions are enabling factors for the location of new economic growth.

Following this line of thought, we may identify a set of *structural parameters* that determine the suitability of a region for the start and further development of new economic activities (Boschma and Lambooy, 1998). Agglomeration advantages only result when such a set of structural parameters exists in a certain region. With *structural parameters* we denote factors like the composition of the current production structure (including the importance of sectors characterized by *increasing returns*), the number of workers and their knowledge level, the size of demand for certain goods and services, the efficiency of market institutions (such as financial organizations, business clubs), and an efficient system of fiscal and non-

fiscal regulations by the government. This implies that the capacity of regions to adjust is likely to differ. Regions, defined as socio-economic entities, not only differ in their ability to generate, emulate or apply new technology, they also differ in their adaptive capacity (Jacobs, 1968). This may be the case because local actors, embedded in a regional culture, form individual or collective strategies (even on a local level, formalized in local institutions) in order to influence the course of development in their regions. Others have stressed the process of localized technological learning (Feldman and Florida, 1994): knowledge spillovers are facilitated by geographical proximity and, therefore, are often region-specific. In other words, much new variety is largely directed and channeled by the existing environment. Uncertainty provokes firms to conduct routinized behaviour which limits to a large extent available options, while the selection environment (the institutional and economic structures) guides, enables and constraints its local actors to retain and expand their competitive position.

This may be related to the notion of *path dependency*: innovative behaviour and adaptation to change are largely constrained by the boundaries of the *spatial matrix* laid down in the past. Only minor modifications tend to take place, and do not undermine the logic of the spatial system. In traditional location theory the main source of this spatial polarization are *external economies of scale* (Weberian *localization economies*) in a limited spatial area, due to the clustering of similar, strongly related, groups of economic activity. This view is based on a static approach of external economies. A more dynamic approach uses the concept of *cumulative causation*. Since Myrdal (1957), *cumulative causation* has been the key notion to describe the persistence of centre-periphery relations, particularly in development economics (Dicken and Lloyd, 1990; Krugman, 1995). Though the adaptive ability of some lagging regions may improve as new technologies mature and standardize due to specific cost-advantages (low labour costs), this catching-up process is utmost based on static locational advantages, which is unlikely to erode the dynamic position of the original region (Storper, 1992). Regional policy (and national economic policy as well) sometimes faces the dilemma to have to choose between 'the devil and the deep blue sea': either to be independent from foreign headquarters and have unemployment, or to attract branch plants, which can easily be 'transplanted' again to other tax-friendly locations.

This brings us to the question what the options are for policy makers to determine the future development of regions in a spatial system in which *selection* and *path dependency* are important mechanisms. In regional policy the intervention is oriented to altering the

configuration of the *structural parameters*. The impact of regional policy may be quite large when it is strongly embedded in the surrounding environment. Adjusting of acquired characteristics, which is achieved by *learning*, is essential because it determines to a large extent available options and probable outcomes of policy. But how do regional authorities 'scan' 'new' technologies: how can these be evaluated as to their fitness to being used as driving forces for their region's restructuring? They are often more directly influenced by the representatives of their 'old' technologies, which is the reason why 'old' corporations and labour unions often oppose new developments: they are 'locked-in' by their interests and their 'old' knowledge (Grabher, 1993). This remains a problem to be solved. However, regional policy is likely to fail when local strategies deviate considerably from the local context. Policy makers have to account for the fact that adaptation to change is largely constrained by the boundaries of the spatial matrix carried over from the past: only minor modifications may take place.

5. Accidents, human agency and agglomeration economies

Besides the emphasis on *selection* and *path dependency*, the evolution of the spatial matrix of economic development may also be associated with the occurrence of *chance events* and *increasing returns*. We now discuss the degrees of freedom regional policy makers may have in case the evolutionary mechanisms of *chance* and *increasing returns* lay at the root of the spatial formation of new economic activities.

Nelson and Winter (1982) argue that new technology or new routines may be quite unexpected, stochastic results of search activities undertaken by firms. According to Arthur (1989), as chaos theory would predict, small, arbitrary triggers, which are hard to know beforehand, let alone predict, may set in motion *mutations* of structures, and thus should be conceived as pure accidents. In this view, the selection mechanism is of minor importance, especially when new basic variety in terms of technological breakthroughs is involved: selection will be weak because there are no specific stimuli (besides general factors) to benefit from (Boschma and Van der Knaap, 1997). Accordingly, the selection environment can not decisively determine the location of new variety because of its discontinuous nature. Therefore, other mechanisms are necessarily involved, like accidents and local strategies of adjustment. The importance of randomness rather than selection has many equivalents in

many fields of economic research, such as why one type of industrial organization (mass-production) became dominant over others (Piore and Sabel, 1984; Chandler, 1990), why a particular technology became more diffused than other competing ones (David, 1985; Arthur, 1989), and why a country was able to industrialize earlier than another country (Crafts, 1977). In economic geography, we are preoccupied with a similar problem: why the (quite accidental) early phase of development of a new industry evolves into a self-reinforcing process of growth and development in one or a few regions, and not in other (similar) locations (see e.g. Scott and Storper, 1987). The relevance of this problem may be shown in several examples in economic history (Boschma, 1994). The importance of early *chance events* implies that multiple potential outcomes of locations are quite thinkable, that is, other arbitrary events might have caused history and spatial patterns to take another course. The outcome is then unpredictable *ex ante*, while the winner does not necessarily possess superior qualities.

This sheds particular light on the problem of why some regions lose their position where others maintain or regain a strong position. Although the concept of adjustment to the environment is a basic one, evolutionary economics is not as such a contextual approach. In fact, we need the notion of *human agency* to explain the spatial patterns of new variety of economic actors, products, technologies and organizations which can be linked to the dynamic dimension of *agglomeration economies*. In fact, there may be new forms of variety (major technological breakthroughs) which may be influenced by local selection mechanisms, but are often quite 'location-free' in its further development: they shape their local environment in accordance to their needs as their development proceeds. Thus, the selection environment is anything but treated as given, and allows firms and related institutions (such as regional authorities) 'to mould their own selection environment' (see Nelson, 1995, p. 77). The fortunes of regions may depend to a large extent on their own ability to create locally or attract their necessary conditions of growth (Storper and Walker, 1989). In this respect, firms and other organizations are not viewed as merely passive actors in a Darwinian sense: they are regarded as actors in a Lamarckian meaning who display purposeful and learning behaviour, adapt their behaviour to the external environment, but also adapt their environment in accordance with their own needs (Saviotti, 1996). If this would not occur, new variation which strongly deviates from the surrounding environment would not arise, and should be completely ruled out. The efficiency of the *structural parameters* based on *urbanization economies* will only emerge after a period of development of the new

technology, after the surrounding environment has been adjusted in accordance to the needs of the new technology and of the new kinds of knowledge-intensive workers in manufacturing and the services. This not only results in local accumulation of (tacit) knowledge, which is partly inappropriable, that is hard to copy or emulate by competitors, but it also leads to increasing variation, resulting in *increasing returns*, not only for individual firms or sectors, but also for other parts of the complementary, associated networks.

The basic characteristic of *increasing returns* and *cumulative causation* is mainly found in new, rapidly developing, technologies. Arthur (1994; 1996) argues that an important feature of industries is whether they possess *increasing returns*. Industries with this attribute are highly dynamic and knowledge-intensive sectors with many unexpected developments, e.g. the micro-electronic sectors. Other peculiar properties of *increasing returns* are: '... market instability (the market tilts to favor a product that gets ahead), multiple potential outcomes (under different events in history, different operating systems (of the software-industry) could have won), unpredictability, the ability to 'lock-in' a market, the possible predominance of an inferior product, and fat profits for the winners' (Arthur, 1996, p.102). This stands in contrast with industries which are characterized by diminishing returns, such as bulk-processing activities, where the operations are largely repetitive day to day or week to week. This latter part of the economy resembles most to the neoclassical perfect competition: '..because such products are normally substitutable for one another, something like a standard price emerges. Margins are thin and nobody makes a fat profit' (p. 102). *I-sectors* are not yet well perceived and documented, and markets as well as governments are not yet well aware of their significance. Imitators will, however, soon arrive and enter the market. But during the first period, the characteristic of cumulative and feedback developments may strongly limit the possibilities of neoclassical optimal allocation - if we would ever be able to know what that is. In sum, a basic property of economic activities is *increasing returns*, a concept related to the advantages accruing from innovations, increasing variety and differentiation of economic activities

As far as geography is concerned, the concept of *increasing returns* becomes relevant when it is related with notions, such as Myrdal's 'cumulative causation', 'external economies' and 'network relations', complementary relations between producers, their suppliers and their distribution systems (Arthur, 1989). Spatial clustering can bring about *increasing returns* in a rather limited area (Lambooy, 1986). The notion of *agglomeration economies* plays a crucial role in the explanation of how this spatial configuration comes about (Lambooy, 1976;

Harrison *et al.* 1996). *Agglomeration economies* can be defined as the advantages that accrue to firms which have a better access to resources (production factors and power) than would be the case when they were located elsewhere. This is the result of historical events and economies of scale and scope, a topic already noticed by Marshall in his famous book of 1890 *Principles of Economics*. Local external economies may be associated with *market-size external economies* (deep division of labour, specialisation) and information or *technological spillovers* (experience, learning and knowledge diffusion) concentrated in a particular area (Krugman, 1995). With respect to the latter, Pred (1966) claims that regions that are the centres of communication and interaction networks have the highest probability of obtaining access to relevant information and thus the best chance to adapt, because these networks '... provide ideas, conceptual stimuli, observations, and other bits of information that are less available under conditions of relative geographic isolation ...' (p. 99). Schamp (1996), however, notes that more understanding is required as to whether learning processes are indeed often embedded in such a narrowly-defined regional context, and which type of agglomeration mechanism, besides selection - which may be held responsible for why only one or two regions become dominant - may be related to the notion of *increasing returns*. It is not always necessary that selection is involved in the selection of regions which become successful innovators. In the words of Nelson (1995), '... for some chance reason, it gained an initial lead, and this started a rolling mechanism' (p. 74). This latter combination of *chance* and *increasing returns* implies that there may be a multiplicity of spatial outcomes of long term economic development of regions. Sub-optimal outcomes are possible, that is, the dominant region may not necessarily possess superior qualities, because non-optimal locations may become 'locked in' through *increasing returns* (Martin and Sunley, 1996).

Nevertheless, having said this, certain environments may be more favourable for the development of new technologies and economic processes, and certainly for the bearers of new developments in the i-sectors, the 'brainworkers'. These regions possess factors of a basic (non-specific) nature (such as basic knowledge and skills, which are generally accessible), which may be rather favourable to generate new technology, but are not beforehand geographically determined. We specify more in detail in what way the surrounding environment may exercise influence on the location of new variety, and how this may be combined with accidental and creative events by human agency. The notion of *urbanization economies* may be relevant here. The notion of *urbanization economies* is related to local externalities associated with the proximity of actors (and more in particular the people with

specific knowledge) from many diverse industries, which is typical for so-called diversified regions with products and services in almost all sectors. In fact, *urbanization economies* may be based and built on general factors because of the advantages of flexibility secured by a diversity of activities which tends to prevent a process of *negative lock-in*. It is especially the highly diversified type of regions, such as the Parisian region and the London region, that seems to possess potential or well-developed competences ('knowledge'), based on *urbanization economies*, to develop new ideas, organizations, and technologies again and again and to keep up with new regions that base their fortune on a specific kind of new technologies only (Castells and Hall, 1994). This type of region seems to possess in particular the *i*-characteristics and are 'service-rich'; therefore they have the competences to using general factors (especially *k* and *e*) to transform them into specific ones (specialized *k* and *e*), from which new technology may take further advantage. In fact, these factors are susceptible to human learning and to strategic behaviour of entrepreneurs, organizations and governments. Thus, it is especially the type of regions that are highly diversified (with agglomeration economies) that seems to possess such a potential or well-developed ability to develop new technologies again and again. Selection is even more likely to occur when specific factors hamper the process of adjustment, as has been the case in many traditional industrial regions.

In sum, *spatial accidents* and *human agency* have a considerable impact on the place where new basic variety emerges. Selection by the environment alone hardly determines the success or failure of regions to generate or develop major new technologies. When evolutionary mechanisms like *chance* and *increasing returns* are mainly involved in the spatial formation of new economic activities, there are several, but quite contradictory, options for policy makers. On the one hand, the importance of early chance events implies that multiple potential outcomes of location are quite thinkable. This is a principal problem for regional policy because new development paths can not be planned or even foreseen. Regional policy may be defined as a type of purported spatial change, in which a region attempts to match the requirements of new technologies and new location processes. However, policy makers have to cope with a key problem here: how to define *selection*, and how to specify *fitness*.

On the other hand, policy makers may have a considerable role to play. Since space exercises only a minor influence on the location of new economic activities, there is room for policy makers to act and to build-up a favourable local environment. Given this scope for

human action, we specify and define what are the possibilities (or degrees of freedom) for regions to develop successful strategies in order to stimulate variety in regions. In this respect, *urbanization economies* may offer advantages of flexibility secured by a diversity of activities which tends to prevent a process of *negative lock-in*. However, it leaves unanswered the question to what extent local strategies may be successful that do not account for existing economic, environmental and institutional structures. Can local strategies ever be successful that deviate from the existing production structure, and that are directed to change fundamentally the course of regional development? We contend (Lambooy, 1986; 1996; Boschma, 1994) that even with optimal strategies there is no guarantee for being the region in which the next technology will be located. In many cases new technologies developed first in new, unexpected locations, not in the main regions where the previous technologies developed. Those regions, however, with a good *parametrical structure* can often catch up. So, even now, one can notice that the Paris region or the region in North Italy have well-developed *i-sectors* with new technologies. Other regions like Walloon and the Ruhr region with a *lock-in* of old technologies display the troubles which can arise if a region cannot adjust rapidly enough to new conditions. The internal structure of the Ruhr region, however, seems to be better equipped with adjustment potential than Walloon, because of its greater internal variation and also because of the stronger resistance of old structures in Wallon, which seems to be more 'locked-in' than the Ruhr area.

We contend that organizational and local strategies which are aimed at changing the existing production structure and directed to alter fundamentally the course of regional development, have to be based on the development or the attraction of knowledge workers and the so-called *i-activities* (Arthur, 1996); these regions tend to be characterized by an increasing complexity of the composition of the local economic structure. However, it is unpredictable whether innovative industries based on new technologies will follow the old locational patterns or whether they will by their own force create new structures. New markets often display types of production with *increasing returns*, the *i-activities*. This means that the entrepreneurs are less susceptible to old sectoral and locational patterns. Their style of management and production as well as their location choices may be different (Arthur, 1996). It is not only the entrepreneur who decides upon the locational structure, it is also the scarce knowledge worker, who is an essential asset to the firm, more in particular in the earlier knowledge-intensive stages of development, but even in those cases where the share in the

market depends strongly on the continuous efforts of R&D, such as in the pharmaceutical and design-intensive industries (Garnsworthy and O'Connor, 1997).

In considering the options for regional policy, it seems also essential that enterprises in the *i-sectors* are developing relatively fast. So the barriers to entry should be low, especially the costs of producing or acquiring knowledge, and the availability of flexible regulations and access to credit seem to be decisive for success. It should be possible to foster the region's learning processes, not only by enhancing training and education, but also to assist SME's to innovate and establish networks of cooperation; also it is possible to create an environment which retains or attracts the innovators and the workers which are decisive for the development of competences. Attractive physical environments, the availability of a diversified structure of educational and medical facilities, and the inter-regional means of transport and communication can be considered as very important in the first place, and which can be influenced by the regional community in the second place. The comparison of the examples of the Boston region and the Silicon Valley by Saxenian (1994) shows that the managerial lock-in of the computer sector (with its corporate rigidities) prevented the Boston region to successfully adapt to the new opportunities of the transistor and the rapid developments of new software and the PC, although the attractive environment and the diversified knowledge base provided plenty of new opportunities for the Boston-region. However, the large computer industries did organize themselves in a rigid way, without sufficiently noticing the fundamental changes which were evolving in the Silicon area and other West Coast regions. Various large companies, like Wang, met with serious difficulties. Looking back at the sixties and seventies, the rise of Silicon Valley (and of California in general) is not a strange phenomenon. Its development trajectory already started to evolve decades before with the results of human agency, the establishment of Stanford University and its developing social network of brainworkers (what we would like to call the *human ecology of technological nerds*) and with a strong impetus from defence projects. It was not a deterministic process, but a process with a large, though unconscious, influence of human agents, developing increasing returns in the new *i-sector*.

There are many different ways the strategies of adjustment can be organized (internal, external). Regions and regional actors should put effort to create the conditions which facilitate the development and growth of this type of activities. This may be realized by upgrading the surrounding environment where necessary, that is strengthening the weak elements in the local context. Given the scope for human agency, there may be possibilities

for regional actors to influence their destiny to some extent with well-chosen strategies. Some regions have internal and external selection-mechanisms of innovation and survival that ensure their relative success. Regions which choose a path with a strategy of saving old sectors and cost-reduction instead of aiming for innovation and diversification will compete with other core regions in the less profitable sectors, with few positive effects on the development of new knowledge and the development of sectors based on *increasing returns*.

There are two selection mechanisms for the regions involved: one is focused on the internal selection of successful restructuring of the economic attractiveness, the second one is related with the selection of successful strategies compared with competing regional systems. In the first case the entrepreneurs and the institutions are engaged in finding solutions for internal problems such as wages rates and taxes, or improving the access to the region or to sub-regions, e.g. by improving the infrastructure. In the second one, the search is for developing measures for attracting 'foreign direct investments' or knowledge-intensive activities: the related investments can be Science Parks, a high regional R&D-effort and the improvement of the physical and residential environment.

6. Conclusion

The principal objective of this paper was to formulate some possible links between evolutionary economics and regional policy, a topic that has not (yet) been covered by the literature. In other words, the paper made an attempt to explore whether evolutionary economics provides a new way to understand the role of regional policy. Our main emphasis has been to investigate the degrees of freedom policy makers may have to determine the future development of regions. This has been done by distinguishing between two ideal-types of regional development based on evolutionary principles.

We concluded that the options for policy makers to determine the future development of regions may be regarded as rather limited in a spatial system in which *selection* and *path dependency* are important mechanisms. Though the impact of regional policy may be quite large when it is strongly embedded in the surrounding environment, regional policy is likely to fail when local strategies deviate considerably from the local context. In this context, policy makers have to account for the fact that adaptation to change is largely constrained by the boundaries of the spatial matrix carried over from the past.

When *chance* and *increasing returns* have a considerable impact on the spatial formation of new economic activities, it is impossible to predict the new *spatial matrix* of the economic system. Selection by the environment alone hardly determines the success or failure of regions to generate or develop major new technologies. In this context, there are several, but quite contradictory, options for policy makers in order to stimulate variety in regions. On the one hand, regional policy have to cope with the fact that new development paths can not be planned or even foreseen. On the other hand, policy makers may have a considerable role to play: there is room for policy makers to act and to build-up a favourable local environment. This is especially true for regions where *urbanization economies* offer advantages of flexibility secured by a diversity of activities which tends to prevent a process of *negative lock-in*. Many regions possess the opportunities to improve their local environments in order to attract the knowledge workers which can develop new ideas and new economic activities, probably comprising some which can be the nucleus for new developments.

In either case, evolutionary theory shows that there is no certainty about where new technologies will have their main locational impacts. Selection environments and agents are interacting in a mutually adaptive process with uncertain outcomes. Nevertheless, local strategies that are directed to change fundamentally the course of regional development are unlikely to be succesful when these deviate from the existing local structures.

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