Why is economic geography not an evolutionary science? Towards an evolutionary economic geography

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Abstract

The paper explains the commonalities and differences between neoclassical, institutional and evolutionary approaches that have been influential in economic geography during the last couple of decades. By separating the three approaches in terms of theoretical content and research methodology, we can appreciate both the commonalities and differences between the three approaches. It is also apparent that innovative theorizing currently occurs at the interface between neoclassical and evolutionary theory (especially in modelling) and at the interface between institutional and evolutionary theory (especially in 'appreciative theorizing'). Taken together, we argue that Evolutionary Economic Geography is an emerging paradigm in economic geography, yet does so without isolating itself from developments in other theoretical approaches.

1. Introduction

Since the 'Geographical Turn' in economics, a true *Methodenstreit* has been raging in the field of economic geography (Martin, 1999). From the 1980s onwards, economic geography moved away from traditional economic analysis and transformed into a more interdisciplinary approach using insights from social, cultural and political sciences. This turn has been characterized by the 'Cultural Turn' (Amin and Thrift, 2000; Barnes, 2001) or the 'Institutional Turn' (Martin, 2000) in economic geography.[1] A decade later, following a seminal contribution by Krugman (1991a), neoclassical economists have re-entered the field of economic geography (Fujita *et al.*, 1999;

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1   A similar institutional approach exists in economics, yet by far has not gained the support within the community of economists as it did within the community of geographers.

Brakman *et al.*, 2001; Fujita and Thisse, 2002; Puga, 2002), yet met harsh resistance from the side of economic geographers. Neoclassical economists are renewing their interest in geography while geographers are moving away from economics; the debate between economists and geographers has been little fruitful, and is probably best characterized by a 'dialogue between the deaf' (Martin, 2003).

Evolutionary economics can be considered a third approach in economic geography, yet has hardly drawn serious attention. Although it is noticeable that, to an increasing extent, lip service is paid to evolutionary thinking and concepts (e.g., Storper, 1997; Cooke and Morgan, 1998; Martin, 1999; Sjöberg and Sjöholm, 2002; Cooke, 2002; Scott, 2004), there are few systematic attempts to apply evolutionary economics into the realm of economic geography (Rigby and Essletzbichler, 1997; Boschma and Lambooy, 1999; Essletzbichler and Rigby, 2005). According to Martin (2003) evolutionary economics has not (yet) developed into 'a coherent body of theory and empirics' in economic geography. It is even fair to say that evolutionary economists themselves have been somewhat more active in linking evolutionary economics with geographical issues (Arthur, 1987, 1990; Swann and Prevezer, 1996; Antonelli, 2000; Caniëls, 2000; Breschi and Lissoni, 2001, 2003; Bresnahan *et al.*, 2001; Klepper, 2002a; McKelvey, 2004; Brenner, 2004; Werker and Athreye, 2004). Perhaps one of the reasons of the relatively minor impact of evolutionary economics in economic geography so far is that economic geographers tend to refer to evolutionary economics and institutional economics as being more or less indistinguishable.

As reflected in the title, we propose an evolutionary approach in economic geography paraphrasing Veblen's (1898) seminal article *Why is economics not an evolutionary science?* Our main objective is to outline the basic elements of Evolutionary Economic Geography. Before sketching the main contours of this new approach, we show that Evolutionary Economic Geography is reducible neither to the neoclassical approach nor to the institutional approach in economic geography. In order to do so, we first sketch two theoretical developments in economic geography that have been taken place in the last couple of decades; that is, the New Economic Geography around the 1990s and the 'cultural or institutional turn' in economic geography around the 1980s. We explain in Section 2 why the interface between these two strands of thought has shown to be a fertile ground for conflict rather than for exchange. In Section 3, we present three key issues that represent dividing lines within economic geography (and economics): the assumption debate, the use of mathematics, and statics versus dynamics. This framework will allow us to discuss the main similarities and differences between neoclassical, institutional and evolutionary approaches, because we argue that each key issue unites two approaches and differentiates them from the third. We also show the value added provided by the evolutionary approach and claim that Evolutionary Economic Geography indeed puts 'new wine in new bottles'. With this purpose in mind, we compare the Evolutionary Economic Geography approach with the Neoclassical Economic Geography and the Institutional Economic Geography in Sections 4 and 5, respectively. The exchanges along the interfaces are shown to be fruitful and should be further encouraged, although synthesis between the evolutionary approach and the neoclassical or institutional approach is not expected. Rather, an Evolutionary Economic Geography approach is unique in its core assumptions, units of analysis and type of explanations. To support this thesis, we briefly present, in a programmatic manner, the basic outlines of Evolutionary Economic Geography in the final section.

Before introducing the three approaches in economic geography, it should be reminded that our objective is not to discuss and compare each approach in all its details (for this see Nelson, 1995a; Hodgson, 1998; Marchionni, 2004). Consequently, we inevitably dispense some of the nuances. We refer mainly to 'textbook versions' of the three theories, without claiming that modern writings would all perfectly fit into one of the three categories. On the contrary, it should be reminded throughout the text that our stylized differentiation into three approaches primarily serves a heuristic use and ultimately aims to contribute to theorizing at the interfaces between the approaches.

2. *Methodenstreit* in economic geography

Economic geography has been subjected to a lot of turmoil during the last two decades or so (Martin and Sunley, 1996; Amin and Thrift, 2000; Barnes, 2001; Meardon, 2001; Overman, 2004; Scott, 2004). If any 'revolution' has hit economic geography recently, it must be the application of neoclassical economics in economic geography by Krugman (1991a) and others. Below, we refer to this new research programme as New Economic Geography, a term proposed by Krugman, although we share Martin's view that Krugman's models are better characterized as economics than as geography (Martin, 1999).[2] We will also make use of the term Neoclassical Economic Geography, by which we refer to both the pre-Krugman contributions in regional science and the more recent New Economic Geography, as both start from the neoclassical assumptions of utility maximization and the 'representative agent', and both derive model conclusions from equilibrium analysis, as in neoclassical economics.

Krugman's (1991a) approach can best be considered as a recent extension of neoclassical thinking to explain trade, specialization and agglomeration, relaxing the frequently used assumptions of perfect competition and constant returns to scale. It basically is a micro-economic theory that explains the existence and persistence of agglomerations in terms of rational decisions of economic agents. Assuming increasing returns to scale at the firm level and imperfect competition between firms, the contribution of Krugman has been to show that agglomeration can occur without having to assume regional differences or external economies. In particular, with transportation costs falling, a critical transition point is reached when both firms and workers find it more profitable to cluster in one region rather than to spread out over more regions. The transition point depends on the balance between internal scale economies for firms and economies of product variety for consumers related to clustering on the one hand and inter-regional transportation costs on the other hand. What is more is that the core model of Krugman has been shown to be extendable in many directions, including other factors such as congestion and unemployment (Fujita *et al.*, 1999; Brakman *et al.*, 2001; Puga, 2002; for a critical review see Neary, 2001).

Not long before Krugman and others set out their main ideas, the community of economic geographers itself had undergone an important reorientation. We refer to this change as the institutional turn in economic geography. One can view the institutional turn in economic geography as the successful development of the programme of

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2 Krugman's approach fits within the regional science tradition in geography, which is based on general-equilibrium-analysis from neoclassical economics. Thus, one may better speak of the 'new regional science' or 'geographical economics' (Martin, 1999; Brakman *et al.*, 2001).

institutionalism, which had little success within the boundaries of the economics profession.[3] Having said this, it is important to note that there is not (yet) a fully articulated 'institutional economic geography approach' (Martin, 2000). The same is true for institutional economics, which has never developed into a coherent, systematic paradigm (Hodgson, 1998). Both are better described as a collection of approaches that share common concepts and interests in explaining particular phenomena (Samuels, 1995). For most institutional scholars, the methodological and theoretical pluralism does not reflect incoherence. On the contrary, pluralism lies at the heart of methodology and is to be encouraged, at least if one accepts Institutional Economic Geography as an interdisciplinary and contextual science (Hodgson, 1988).

In its most stringent form, institutional approaches argue that differences in economic behaviour are primarily related to differences in institutions (Hodgson, 1988, 1998; Whitley, 1992, 2003; Saxenian, 1994; Gertler, 1997). Institutional differences can be present among firms (in terms of organizational routines and business cultures) and among territories (in terms of legal frameworks, informal rules, policies, values and norms). Comparative analysis between these units with different institutions can then be related to differences in economic outcomes, such as profit, growth, income distribution and conflicts. It should be noted that this definition of the institutional approach is only partial. One can distinguish between over- and under-socialized accounts, related to putting primacy to institutions and social class regulating individual behaviour or individuals whose rational actions result in institutions (Granovetter, 1985). In economics, for example, the 'old' institutional economics corresponds largely to the over-socialized account, while the 'new' institutional economics (Williamson, 1985) is in line with the under-socialized account (and, in this respect, is closer to neoclassical economics). Our characterization of institutional approaches in economic geography deals primarily with the over-socialized account, because a large part of economic geography research can fairly be characterized as being closer to that account, putting primacy at institutions rather than individual action (Gertler, 1997).[4]

The New Economic Geography and the Institutional Economic Geography have developed independently from each other. There has been some debate between the two (e.g., Amin and Thrift, 2000; Martin and Sunley, 2001), but we agree with Martin (2003) that it has led to little fruitful exchange of ideas so far. On the contrary, debates have been fierce and with little progress. This comes as no surprise, because the

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3 An exception is transaction costs economics, which has become an important institutional theory in economics (Williamson, 1985). The success of transaction costs economics is most probably related to the fact that both transaction costs economics and neoclassical theory share a micro-economic atomistic view on economic agents. For that same reason, transaction costs economics has hardly found applications in economic geography, a notable exception being Scott (1993).

4 Still, it must be recognized that the division between the two accounts is no longer as sharp as before. In many cases, institutional analyses do no longer explain economic behaviour from institutions alone. In fact, we argue below that the interesting developments in economic geography take place exactly on the interfaces between different approaches; for example, on the institutional/evolutionary interface. Still, for heuristic reasons, we find it useful to characterize the institutional approach in economic geography as an over-socialized account. Central to this definition is the idea that institutions determine the larger part of economic behaviour, and, consequently, differences in economic behaviour and performance can be related more or less directly to differences in institutions. Accordingly, we define institutional approaches in economic geography as an archetype way of reasoning, rather than a coherent school of thought (which it is not).

two strands of thoughts differ in fundamental ways. We understand the clash between the two approaches as reflecting at least two important incommensurabilities.

First, institutional and neoclassical approaches differ in methodology and, they conceptualize space in very different ways. Institutional economic geographers dismiss *a priori* the use of formal modelling and econometric specifications derived from these. Instead, they apply an inductive, often, case-study research approach, signalling out the local specificity of 'real places'. One of the objectives of institutional analysis is to understand the effect of the local specificity of 'real places' on economic development, which is mainly attributed to place-specific institutions at different spatial scales. Thus, an institutional approach takes differences between localities as the starting point of the analysis and analyses how place-specific institutions affect local economic development. In contrast, the New Economic Geography approaches the matter deductively using formal models assuming utility maximization and representative agents, and using equilibrium analysis to come to theoretical conclusions or predictions. Proponents of the latter approach do not value or even reject altogether case-study research highlighting local specificity (e.g., Overman, 2004). The New Economic Geography does not even require differences between regions to exist, be it differences in factor prices or institutional set-ups. Rather, the models start from a 'neutral space' and aim to explain how agglomeration can *occur* from this. Their main goal is to show how uneven spatial patterns can emerge from an initially uniform world and, thus, they abstract from local specificity and different levels of spatial aggregation.

Second, the two approaches differ in their behavioural assumptions underlying explanations of economic phenomena. The New Economic Geography aims to explain geographical patterns in economic activity from utility-maximizing actions of individual agents. Institutional scholars start from the premise that economic behaviour is not described accurately as utility-maximizing but is better understood as being rule-guided. Agents are bounded rationally and rely heavily on the institutional framework they operate in, guiding their decisions and actions. Institutions are embedded in geographically localized practices, which imply that localities ('real places') are the relevant unit of analysis. By doing so, Institutional Economic Geography analyses how institutional specificity affects economic behaviour and thereby local patterns of economic development. In contrast, institutions play no role in neoclassical models, or do only in a loose and implicit sense (e.g., relating to particular parameters in the model) (Olsen, 2002). Local institutional and cultural factors are left out of the analysis, because these are not regarded as essential to an economic explanation and should therefore be 'best left to the sociologists', as Krugman once put it (Martin, 1999, p. 75).

Our argument holds that Evolutionary Economic Geography should be regarded as a third approach in economic geography that differs in turn from neoclassical and institutional approaches. Evolutionary Economic Geography applies core concepts and methodologies from evolutionary economics in the context of economic geography. It provides alternative explanations for the main *explananda* including agglomeration and regional growth differences. The starting point is to open the black box of organizations and to view organizations as competing on the basis of their routines that are built up over time (Nelson and Winter, 1982; Maskell, 2001). Evolutionary models of organizations' decision-making are based on the concept of bounded rationality and routine behaviour, rather than on utility maximization (Simon, 1955a). Routines can be understood as organizational skills, which cannot be reduced to the sum of individual skills (Nelson and Winter, 1982). Routines are manifested at the firm level due to

division-of-labour and thereby due to division-of-skills between workers in a firm. Organizational routines, as for individual skills, consist of a large part of experience knowledge (learning-by-doing) and tacit knowledge, which are hard to codify. Both aspects of routines render them difficult to imitate by other firms (Teece *et al.*, 1997). Consequently, organizations are heterogeneous in their routines, and persistently so. Modelling organizations can thus no longer rely on assuming a 'representative agent'. It is this variety that fuels the selection process as an open-ended and out-of-equilibrium process of economic development (Hodgson, 1999). And, as organizations compete on the basis of their routines, and competition is driven by Schumpeterian innovation based on new products and technologies requiring new routines, rather than on production costs alone as assumed in neoclassical models.[5]

Basically, evolutionary economics explains the (changing) distribution of routines as the outcome of search behaviour and selection forces (Alchian, 1950). First, firms learn from their own mistakes through trial-and-error. When routines do not work well, failure induces active search for other routines (Nelson and Winter, 1982); for example, by investing in Research and Development. Evolutionary economics predicts most firms to innovate incrementally and to exploit their knowledge built up in the past. Empirical research shows that while innovations generally increase the life chances of firms (Cefis and Marsili, 2006), major organizational transformations tend to decrease the survival rates of firms (Anderson and Tushman, 1990; Carroll and Hannan, 2000). Organizations can also learn by networking while running the risk of competencies being copied by other firms (Cowan and Jonard, 2003), and by imitating, although imitation is failure-prone because the tacit components of routines are hard to copy (Teece *et al.*, 1997). Second, 'intelligence' also exists at the level of an industry as a whole, analogous to the population level in biology (Nelson and Winter, 1982). As long as firms show routinized behaviour, market competition acts as a selection device causing 'smart' fit routines to diffuse and 'stupid' unfit routines to disappear. In particular, differential profits leading to differential growth rates render fitter routines to become more dominant in an industry. This selection logic is in line with evidence that firm growth is temporally autocorrelated, meaning that some firms persistently grow over time (Bottazzi *et al.*, 2002; Cefis and Orsenigo, 2001; Cefis, 2003; Garnsey *et al.*, 2006).

Evolutionary Economic Geography aims to understand the spatial distribution of routines over time. It is especially interested in analysing the creation and diffusion of new routines in space, and the mechanisms through which the diffusion of 'fitter' routines occurs. Following this reasoning, the emergence of spatial agglomerations is to be analysed neither in terms of rational location decisions, as in neoclassical theory, nor in terms of the set-up of specific local institutions, as in institutional theory, but in terms

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5   Our definition of evolutionary economics is closest to neo- or post-Schumpeterian economics as defined by Nelson and Winter (1982), Andersen (1994) and Nelson (1995a). We recognize that other evolutionary branches are distinguished in the literature. For example, there is a growing literature on evolutionary game theory, which is close to neoclassical economics in its reliance on equilibrium analysis (Friedman, 1998a, b). Other scholars include 'old institutionalism', which, confusingly, is often referred to as evolutionary economics in the United States (Hodgson, 1998; Martin, 2000). One could also mention complexity theory as a branch of evolutionary economics (or *vice versa*), with its explicit focus on modelling concepts such as path dependence and emergence (e.g., Foster and Holzl, 2004; Frenken, 2006). In particular, Colander (2000) argued that complexity theory is emerging as an alternative modelling paradigm in economics.

of the historically grown spatial concentration of knowledge residing in organizational routines. In this respect, there are several evolutionary mechanisms that may produce the spatial concentration of firms.

Agglomerations may be the result of a process in which chance events become magnified by positive feedbacks at the firm level (Arthur, 1990). As success breeds success through learning, some firms will be lucky and grow out into industry leaders while other firms are unlucky and have to exit. Successful firms also produce more spin-offs, and more successful spin-offs, which almost invariably remain in the region of the parent firm. The resulting industrial and spatial dynamics involve path dependence in firm and regional leadership, and once a spatial pattern has settled historically it becomes largely irreversible. In this case, evolutionary processes lead to spatial concentration in the absence of agglomeration economies (Klepper, 2002b). Spatial agglomeration may also be the result of increasing returns at the regional level. Knowledge not only is embodied in organizational routines in firms, but may also spill over from one firm to the other. As tacit knowledge is hard to be exchanged through contracts in global markets, knowledge spillovers occur more often among geographically proximate agents (Jaffe *et al.*, 1993; Breschi and Lissoni, 2003; Verspagen and Schoenmakers, 2004). Agglomeration economies act both as an incentive and as a selection mechanism, explaining why economic activity become more and more concentrated in leading regions, driving out firms in other regions (Malmberg and Maskell, 2002; Boschma, 2004). It must be recognized, however, that the tacit nature of knowledge and routines implies that spillovers do not occur automatically ('in the air') but rely on transfer mechanisms, such as inter-firm collaborations, professional networks and labour mobility (Camagni, 1991; Capello, 1999; Breschi and Lissoni, 2003; Giuliani and Bell, 2005). Although they often are, these mechanisms are not tied to regional levels *per se*, and may even become increasingly detached from local contexts over time (Breschi and Lissoni, 2001).

In the following, we argue that Evolutionary Economic Geography is linking the neoclassical and institutional approaches in that it agrees with the neoclassical approach methodologically (using formal modelling), and it agrees with the institutional approach in terms of behavioural foundations (as captured by the concept of bounded rationality). Given these similarities between the evolutionary approach on the one hand and the neoclassical and institutional approaches on the other hand, one can expect the exchange of ideas along these two interfaces to be fruitful in economic geography. We will therefore explore in detail the interface between Evolutionary and Neoclassical Economic Geography (Section 4) and the interface between Evolutionary and Institutional Economic Geography (Section 5), respectively. In Section 3, though, we first start with a brief description of three key issues in economic geography that are helpful in understanding the nature of the interfaces between the three approaches in more depth.

3. Three key issues in economic geography

Since we plead for an Evolutionary Economic Geography approach that shares certain features and also differs in many ways from the Neoclassical and Institutional Economic Geography, we aim to clarify the similarities and differences with these two latter approaches. Though any attempt to describe and characterize the major theories in any discipline is inherently difficult and complex, we feel that it is useful as a way to

differentiate a new approach from existing ones, as well as to show the linkages between the proposed approach and more familiar lines of thought. We will do so by introducing three key issues, which are positioned within the triangle depicted in Figure 1. Each of the issues unites two of the three approaches and differentiates them from the third. The three issues recurrently show up both in the history of economics and in the history of economic geography.

The first issue concerns the usefulness of formal modelling, which unites evolutionary and neoclassical scholars, and differentiates them from institutional scholars. As mentioned before, most institutionalists reject the use of formal modelling because it does not capture the contextual nature of economic and social life (Martin, 2000). According to institutional scholars, formal models take an anti-realist stance almost as a rule, because they exclude place-specific qualitative factors (such as culture and institutions) that are hard to put into 'Greek letter economics', but which are considered essential to the explanation of regional differences (Gertler, 1997).[6] In contrast, neoclassical and evolutionary scholars use formal modelling as a tool in theorizing albeit in slightly different ways.

The second issue centres on what might be called the assumption debate. Evolutionary and institutional approaches share a fundamental critique on the neoclassical assumption of utility-maximizing individuals. As Dosi (1984) once put it, 'we must abandon the neoclassical framework because we cannot assume an exogenous and given context and many God-like actors who behave in accordance with a uniform rationality' (p. 107). In contrast, evolutionary and institutional scholars claim that economic agents are bounded rationals and base their decisions on routines and institutions (Veblen, 1898; Simon, 1955a; Nelson and Winter, 1982). This is not to say that evolutionary and institutional approaches assume that agents do not strive to maximize utility, but that real-world agents are not able to do so due to bounded rationality. Instead, agents have to rely on routines (at the micro-level) and institutions (at the macro-level). Since routines and institutions are context-specific, with routines being specific to organizations, and institutions being specific to territories ('real places'), both approaches reject the atomistic view of neoclassical theory that ignores the contextuality of human action.

The third issue is about the conceptualization of time. Here evolutionary approaches take a critical stand towards static analysis in neoclassical and institutional approaches. Characteristic for evolutionary theory, be it as a theory of natural history in biology or as a theory of economic development in economics, is that it explains a current state of affairs from its history: 'the explanation to why something exists intimately rests on how it became what it is' (Dosi, 1997, p. 1531). Thus, the current state of affairs cannot be derived from current conditions only, since the current state of affairs has emerged from and has been constrained by previous states of affairs. Evolutionary theory deals

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6   Though institutional scholars often take a realist stance on scientific explanation in social science, it is important to recognize that realist explanations do not exclude the use of mathematics *per se* even though many mathematical models take an instrumentalist stance. Interestingly, Marchionni (2004) claims that Krugman is best regarded as a realist who uses models as a research strategy to come closer to unravelling the complex mechanisms underlying the economy, rather than an instrumentalist who judges mathematical models primarily on the basis of its predictive value. Mäki (1992) and Mäki and Oinas (2004) also argue at length that the use of abstract modelling does not imply an anti-realist stance *per se*.
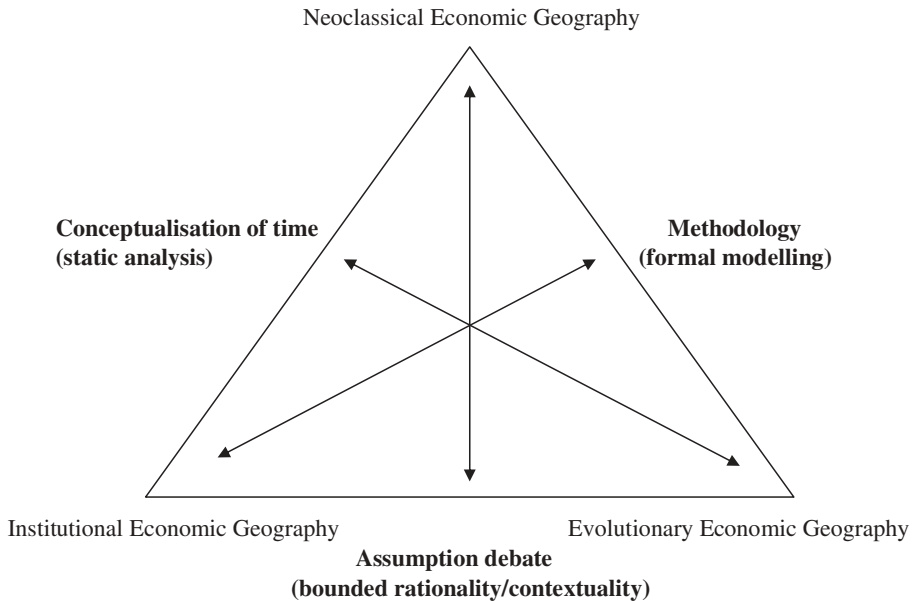
Figure 1. Three key issues within the triangle of neoclassical, institutional and evolutionary economic geography.

with *path dependent* processes, in which previous events affect the probability of future events to occur. In this view, small events can have large and long-lasting effects due to self-reinforcing processes (Arthur, 1989). In short, history matters (David, 1985).[7] In this respect, evolutionary approaches differ in a fundamental sense from those approaches in neoclassical and institutional thinking that share an interest in static analysis.[8]

Summarizing, the clash between Neoclassical and Institutional Economic Geography can be understood as a result of two fundamental differences, related to methodology (use of formal modelling) and key behavioural assumptions (bounded rationality and routines/institutions guiding decision-making). Evolutionary Economic Geography takes an intermediate position: it agrees with the neoclassical approach in the usefulness

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7   See also the early critique by Atkinson and Stiglitz (1969) on neoclassical growth theory and the notion of production function. They argued that economic growth is essentially a historical process that cannot be understood without taking into account historical specificity.

8   We do not, however, claim that all institutional approaches make use of static analysis. On the contrary, the evolution of institutions is often an object of study. Hodgson (1998), for example, stresses that institutional economics does not only concern static comparative studies on different institutional regimes, but is also engaged in studies of institutional *change*, which is, very often, described as an evolutionary process (North, 1990). Some, including Samuels (1995), characterize institutionalism as an evolutionary approach, due to its emphasis on process and evolution: 'Veblenian evolutionism is Darwinian in having neither cause of causes nor predetermined end state; it is non-teleological and open-ended' (p. 580). Taking the evolution of institutions as object of study, institutional and evolutionary approaches have more in common than suggested in Figure 1. This proves again that new developments in research are often taking place at the interface of approaches. Still, when institutions are being explained and explanatory, it remains unclear what are the factors that drive institutional change, unless one adopts a teleological approach after all.

of formal modelling that requires some degree of abstracting from local contexts and with the institutional approach in its assumption of bounded rationality and its emphasis on the contextuality of human decision-making. This seemingly paradoxical position can be clarified as stemming from different levels of analysis: evolutionary economics views the organizational routines as the relevant context to explain decision-making under bounded rationality, while institutional approaches start from territorial institutions. Therefore, Evolutionary Economic Geography does not explain regional growth differences from macro-institutional differences, but from micro-histories of firms that operate in territorial contexts.

4. The interface between neoclassical economic geography and evolutionary economic geography

As described earlier, the main contribution of neoclassical economics to economic geography in recent years has been the development of a new family of models based on Krugman's (1991a) core model. As these models are better understood as economic models treating only some aspects of geography (in particular transportation costs), the New Economic Geography has been attacked on various occasions by economic geographers and others for not dealing with 'true' geography (e.g., Martin and Sunley, 1996; David, 1999; Amin and Thrift, 2000; Nijkamp, 2001). Nevertheless, the New Economic Geography can be considered an important contribution to our theoretical understanding of possible mechanisms creating uneven spatial development. We argue that, despite fundamental differences, the New Economic Geography shares some properties with Evolutionary Economic Geography, and can thus be considered to be located at the interface between Neoclassical Economic Geography and Evolutionary Economic Geography. At the same time, we make clear it would be wrong to assume that convergence between the two approaches will necessarily occur. As argued earlier, evolutionary and neoclassical approaches share a common methodology of modelling, including the usage of the concept of neutral space and the possibility of lock-in and irreversibility, yet the two approaches differ in key behavioural assumptions, units of analysis, treatment of time and their conceptualization of agglomeration economies.

The New Economic Geography can be considered as being part of a family of increasing-returns models in neoclassical economics, including growth theory, trade theory and economic geography. The new family of models has replaced the assumption of constant or decreasing returns to scale and perfect competition by the assumptions of increasing returns to scale and imperfect competition. These assumptions better capture the characteristics of most sectors in the modern economy, these being oligopolies with large firms realizing increasing returns to scale internally. As for evolutionary approaches, the New Economic Geography differs in important respects from the traditional neoclassical approaches that typically involve models of ahistorical and reversible processes with a unique optimal equilibrium. In contrast, both in evolutionary and New Economic Geography models, there is the possibility of multiple equilibria, path dependence in the process leading to one of the possible equilibria, irreversibility of outcomes leading the system to lock-in and sub-optimal outcomes.

Another feature both approaches share is that they are keen on explaining how uneven spatial patterns emerge from uniform or 'neutral space'. Even when assuming away regional differences, it is still possible to explain spatial concentration. In New

Economic Geography models, agglomeration occurs when both consumers and firms foresee that it is more advantageous to cluster in one location, thus minimizing transport costs and maximizing profits (increasing returns to scale) and utility (higher variety of consumption goods). The precise location, then, does not matter as long as agents cluster somewhere in space.[9] A similar question preoccupies evolutionary thinking. For example, assuming that new firms are spin-offs, and each firm has an equal probability to create a new firm by spin-off, the resulting locational dynamics can be modelled as a stochastic Polya urn process (Arthur, 1987), leading to skewed spatial distributions of firms. Similarly, Klepper (2002a) explains how Detroit became the capital of the U.S. car industry using a spin-off model assuming that routines are carried over from parent to spin-off, implying that survival rates of parents and spin-offs are correlated. From the 'industry life cycle' model, Klepper (1996, 2002b) derived that early entrants have a higher survival probability than late entrants, because they have more time available to improve their organizational routines than firms entering later in time. Only spin-off firms that enter later but stem from parent firms with fit routines are able to overcome the latecomer disadvantage, because these spin-offs inherit the fit routines of the parent firm. And as spin-offs locate in the same region as the parent firm, firms with fit routines will cluster in geographical space (Klepper 2002a).

The stochastic logic underlying evolutionary models has also been applied to the spatial evolution of networks where new nodes can occur anywhere in space, and connections between nodes are made dependent on both geographical space (negatively) and preferential attachment (positively). Preferential attachment means that a new node prefers to link with a node that is well connected as to profit from its connectivity (Barabasi and Albert, 1999; Albert and Barabasi, 2002). The resulting topology and spatial organization of a network can then be understood as a purely stochastic and myopic sequence (Andersson *et al.*, 2003, 2006) that may generate hubs-and-spokes networks observed in infrastructure networks (e.g., Guimerà and Amaral, 2004; Barrat *et al.*, 2005). Equally, the historically grown network patterns between cities in urban systems can be conceptualized as stemming from preferential attachment (Castells, 1996).

Thus, although the precise modelling techniques and underlying theoretical assumptions greatly differ between evolutionary and neoclassical approaches, both use formal models assuming 'neutral space' to explain the emergence of uneven distributions in an initially even world. Despite these common features, the New Economic Geography and the Evolutionary Economic Geography differ fundamentally on at least four grounds.

First, the New Economic Geography remains firmly within the neoclassical framework using the core assumptions of utility maximization of economic agents and homogeneity of agents ('the representative agent'). In this, it differs greatly from evolutionary theory that is based on a different set of assumptions including bounded rationality, routine behaviour and heterogeneity among agents. While neoclassical models assume a given market structure (monopolistic competition in the case of the New Economic

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9   This has been called 'putty-clay geography' by Fujita and Thisse (1996): 'there is a priori considerable uncertainty and flexibility in where particular activities locate, but once spatial differences take shape they become quite rigid' (Martin, 1999, p. 70).

Geography), evolutionary models take into account entry, exit and innovation, and let market structure to evolve endogenously. Put differently, the New Economic Geography has rather weak foundations in modern industrial organization (Neary, 2001).

Second, the economic levels of aggregation in the two approaches differ. Neoclassical models address the spatial economy at the macro-level in terms of location decisions of agents (firms and consumers) at the micro-level assuming a given market structure. In this context, Martin (1999) is right in stating that the New Economic Geography is 'unable to tell where it (industrial localization and specialization) occurs, or why in particular places and not in others' (p. 78).[10] In contrast, evolutionary approaches aim to explain the spatial *evolution* of industries and networks at the meso-level of the economy. The spatial evolution of the economic system at the macro-level, then, is addressed in a framework of structural change, in which catching-up and falling-behind of territorial units is analysed in terms of the rise and fall of sectors and infrastructure networks in space (Hall and Preston, 1988), be it at the level of countries (Dosi and Soete, 1988), regions (Boschma, 1997) or cities (Hohenberg and Lees, 1995).[11]

Third, the treatment of dynamics in both theories is different. Although the New Economic Geography models are often interpreted as reflecting the formation of agglomerations in time, its conclusions are based on static equilibrium analysis, as in other neoclassical models. Model predictions are derived by computing the one-off locational choice of all individual agents, such that their joint actions are in equilibrium.[12] In these models, a change in equilibrium is 'caused' by a change in the exogenous parameters and not endogenously in time. For example, a fall in transportation costs or a removal in trade barriers may lead firms to cluster in one region rather than being uniformly distributed in space. It follows that true dynamics are only addressed in terms of comparative static analysis of different equilibrium states with different parameter settings.[13] This aspect of neoclassical models differs from

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10 Furthermore, regarding the spatial unit of analysis in New Economic Geography models, Neary (2001, p. 551) rightly remarked that 'there is nothing intrinsic to the models that conclusively identifies these units.'

11 Note that analysing regional convergence and divergence in a multi-sector analysis also provides a straightforward theory of spatial leapfrogging (Martin and Sunley, 1998), in which regions specializing in new sectors take over regions locked in mature industries.

12 As noted by proponents of the New Economic Geography (Krugman, 1996, 1998; Brakman and Garretsen, 2003), model outcomes are derived from Nash-equilibria, as in game theory. In this respect, one can consider the New Economic Geography as dealing with location games involving many players. See especially Krugman (1998, p. 11) who stated that new economic geography models can be regarded as 'games in which actors choose locations rather than strategies—or rather in which locations *are* strategies—in which case one is engaged not in oldfashioned static expectations analysis but rather in state-of-the-art evolutionary game theory!' Krugman (1998, p. 11) continues by explaining that evolutionary game theory, as it is used in economic geography models, is just an alternative way to incorporate equilibrium analysis in models with maximizing agents: 'To middlebrow modellers like myself, it sometimes seems that the main contribution of evolutionary game theory has been to re-legitimize those little arrows we always wanted to draw on our diagrams.'

13 According to Martin (1999), history is not regarded as 'real history' in the New Economic Geography: 'there is no sense of the real and context-specific periods of time over which spatial agglomerations have evolved' (p. 76). It is relevant to distinguish between two different meanings of path dependence here. Path dependence may reflect a dynamic process in which small events, magnified by increasing returns, produce spatial outcomes. This meaning of path dependence has been adopted by

evolutionary models, in which economic dynamics only show temporary convergence towards equilibrium to be 'upset' by endogenously determined innovative firm behaviour (Nelson and Winter, 1982). The disequilibrium tendency caused by deviant firm behaviour is not regarded as 'noise' but as the fundamental driving force underlying economic development. Evolutionary economists view the search for supra-normal profits by innovation, called Schumpeterian competition, as the primary dynamic in the economy (moving away from equilibrium), while the erosion of profits due to price competition is only considered as a secondary dynamic (converging to equilibrium). In modelling terms, this implies that the growth and decline of firms, sectors and territories are modelled explicitly in time, assuming some underlying stochastic process to reflect innovation. In this vein, evolutionary economics increasingly makes use of interacting agent models from complexity theory (for a review, see Frenken, 2006). Within the context of economic geography, both simple stochastic models (Simon, 1955b; Arthur, 1987; Gabaix, 1999) and more elaborated models (Klepper, 2002a; Andersson *et al.*, 2003, 2006; Bottazzi *et al.*, 2004; Brenner, 2004; Guimerà and Amaral, 2004; Barrat *et al.*, 2005) have recently been developed.

A final difference between neoclassical and evolutionary approaches concerns the underlying theory of agglomeration economies. As described earlier, the New Economic Geography relies in their explanation of agglomerations on pecuniary rents (increasing returns to scale internal to the firm). Evolutionary approaches, instead, are more interested in agglomeration economies arising from knowledge externalities.[14] In an evolutionary perspective, knowledge spillovers contribute to the self-reinforcing nature of agglomeration economies in which firms locating in a region generate and attract new firms in the same region as knowledge spillovers rise with the number of firms (Arthur, 1990; cf. Myrdal, 1957). At the same time, knowledge spillovers may be responsible for sustained regional variety in technological trajectories as knowledge specific to each technology spills over primarily among proximate firms (Essletzbichler and Rigby, 2005).

A number of research questions follow from the concept of knowledge spillovers in an evolutionary perspective (Feldman, 1999; Schamp, 2002). First, as knowledge can spill over in more than one way (imitation, spin-offs, social networks, labour mobility, collaborative networking), one question is which of the mechanisms of knowledge spillovers are most important (Breschi and Lissoni, 2003). In the particular case of networks, one can ask the question to what extent networks of knowledge spillovers are different from other economic networks, and whether network centrality affects one's

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New Economic Geography models and some evolutionary models, including the ones developed by Arthur (1989). Another notion of path dependence is employed by evolutionary (but also institutional) approaches, which interpret spatial outcomes as directed and channelled by structures (as embodied in routines and institutions) laid down in the past. Or, as Martin (1999) has put it, 'path dependence does not just 'produce' geography as in the 'new economic geography' models; places produce path dependence' (p. 80). To be more precise, it is the dynamic interplay between agency and structure producing specific outcomes in particular places, and leading to real space that are put central in an evolutionary approach (Boschma, 2004).

14 Krugman (1991b) also criticized the notion of knowledge spillovers on empirical grounds when claiming that knowledge flows could hardly be measured: 'knowledge flows are invisible, they leave no paper trail by which they may be measured and tracked' (p. 53). Since, a number of scholars have developed methodologies to indicate knowledge spillovers, in particular, by making use of patent citations as pioneered by Jaffe *et al.* (1993).

ability to absorb such spillovers (Lissoni, 2001; Giuliani, 2005; Giuliani and Bell, 2005). Second, for each of these mechanisms one can analyse whether geographically close or more distant relationships are driving knowledge creation and spillovers (Rallet and Torre, 1999; Malmberg and Maskell, 2002; Bathelt *et al.*, 2004). Lastly, evolutionary theory is likely to contribute to a still unresolved issue about whether regional variety (Jacobs, 1969) or specialization is more favourable for knowledge spillovers (Glaeser *et al.*, 1992). Theoretically, evolutionary theory would predict variety to be more important for knowledge spillovers to occur, at least with regard to knowledge supporting radical innovation, involving a recombination of knowledge. It would also claim that some degree of related variety (defined as complementary capabilities among sectors) is needed to enable effective interactive learning and enhance regional growth (Frenken *et al.* 2005). In addition, evolutionary theory would expect that the effect of regional specialization depends on the stage of the product life cycle of the respective industry (Boschma and Wenting, 2005).

5. The interface between institutional economic geography and evolutionary economic geography

As stated in the introduction, it is quite common to share evolutionary approaches under the umbrella of institutional approaches (e.g., Martin, 2000, p. 83). This association has largely been based on the aforementioned common critiques on neoclassical economics, rather than on the fundamental principles that evolutionary and institutional approaches would share *per se*.[15] Both approaches reject utility maximization and equilibrium analysis, and both stress the important role of institutions in economic development. However, we claim that it is not only confusing but potentially misleading to equate institutional and evolutionary approaches in economic geography. Few people would agree that all studies gathered under the umbrella of institutional geography could equally be called evolutionary and *vice versa*. This is especially true for those studies that assess the impact of particular institutional arrangements on economic performance, but which tend to ignore the role of dynamics central to evolutionary approaches. Conversely, quite some influential evolutionary studies do not include the role of institutions in their analyses (e.g., Arthur, 1987; Klepper, 2002a; Bottazzi *et al.*, 2002). Having said this, it is clear that evolutionary and institutional approaches have more 'family resemblance' than evolutionary and neoclassical approaches, if only in that they both account for the historical and geographical context in the analysis of economic agency (Bathelt and Glückler, 2003; Martin, 2003).

One issue of disagreement, which has been explained earlier, holds that Institutional Economic Geography takes a critical stand towards formal modelling. Evolutionary Economic Geography uses formal modelling as a theoretical tool to derive testable hypotheses, while Institutional Economic Geography tends to dismiss the use of formal models *a priori*. In regional studies, for example, institutionalists call for anti-reductionist qualitative methodologies, in particular in-depth case-study research, to appreciate the complex and multi-faceted nature of regional development. The use of

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15 Illustrative is that followers of the 'old' institutional economics in the US have somewhat confusingly called themselves evolutionary economists (Hodgson, 1998).

qualitative methodologies more or less follows from the nature of theorizing. However, in some cases their core concepts turn out to be hard to operationalize also in qualitative research designs. For example, the notion of 'institutional thickness' (Amin and Thrift, 1994; Keeble *et al.*, 1999) has been influential as a concept in economic geography, but has also been criticized for being a vague concept that can not be accurately measured, let alone that its impact on regional development can be determined and tested (Markusen, 1999). More generally, according to some criticasters, institutional and cultural approaches in economic geography show 'a lack of rigour, lack of hypothesis testing and ill-defined concepts' (Martin, 2003, p. 36).[16] The contributions of institutional approaches in economic geography have thus been, most importantly, theoretical, by suggesting new explanations and mechanisms underlying regional development, and in terms of policy implications, by opening up new discourses on the cultural meaning and heritage of places and the limited transferability of locally rooted economic production (e.g., Gertler, 1997).

Even if research methods often follow from theoretical premises, the use of qualitative research methods does not automatically follow from theoretical premises in Institutional Economic Geography in all instances. For instance, recent network approaches in Institutional Economic Geography could make use of statistical techniques from social network analysis (Wasserman and Faust, 1994) and modelling techniques from graph theory (Barabasi and Albert, 1999; Watts, 2004). However, in their programmatic contribution on relational economic geography, Boggs and Rantisi (2003, pp. 114–115) argue that 'doing relational economic geography' implies, as a rule, a case-study approach. Thus, some seem to have *a priori* objections to the use of quantitative tools, even if theoretical contributions allow for their fruitful application. The same observation has been made recently in Markusen's (2003) reply to institutional economic geographers, in which she pleas to go beyond the oppositional distinction between inductive and deductive research, and between qualitative and quantitative research. Her argument is in line with the methodological foundations of evolutionary economics that has combined what Nelson and Winter (1982) called 'appreciative theorizing' and 'formal modelling' from its very start.

A second more subtle issue in comparing evolutionary and institutional approaches is their treatment of context. While evolutionary approaches start from organizational routines at the firm level, institutional approaches start from institutions at some territorial level(s). Thus, both acknowledge the importance of context in economic decision-making and reject the framework of utility maximization central to the neoclassical paradigm, yet they differ in the precise context that is assumed to underlie economic behaviour. Organizational routines are specific to each firm providing a micro-context that results from the past experience and activities of the firm. Institutions, in contrast, are specific to communities and territories providing a macro context. This institutional context may exert considerable influence on the routines of firms. In this respect, it is meaningful to speak of varieties of capitalism, in the sense that the routines of firms will share many characteristics in one institutional system but will differ from one system to the other (Gertler, 1997; Hall and Soskice, 2001).

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16 Though cultural studies have become well developed and established in sociology, anthropology and geography, some suggest that these studies suffer from 'conceptual imprecision, theoretical ambiguity and empirical open-endedness' (Martin and Sunley, 2001, p. 10).

Understanding the fitness of routines thus requires an analysis not only of markets but also of institutions as relevant constraining contexts. Having said that, from an evolutionary perspective, to take institutions as explanatory variables in economic analysis is not without conceptual difficulty. While institutions may indeed constrain economic behaviour, as routines should not conflict with territorial institutions, the presence of institutions still allows for heterogeneity in routines among firms. Accordingly, a territory as the unit of analysis is problematic, though not without meaning, as there is no strong reason to assume beforehand that routines are place-specific[17]. Some regions may be characterized by a strong degree of homogeneity in routines, while others may not. Conversely, many firms have multiple sites in different territorial contexts, yet these sites share corporate routines, even if some routines may be adapted to local contexts (Kogut and Zander, 1993; Cantwell and Iammarino, 2003). Thus, despite being a contextual approach, Evolutionary Economic Geography is mainly interested in determining whether, and if so in what way, geography matters, rather than theoretically preassuming that it matters in all cases.[18]

Let us illustrate the previous remarks when dealing with the innovation system approach, which is a good example of fruitful exchange between evolutionary and institutional concepts in geography (Freeman, 1987; Nelson, 1993; Edquist, 1997; Cooke *et al.*, 1998; Cooke, 2001; Asheim and Isaksen, 2002; Simmie, 2005). This approach has its historical roots in evolutionary economics, yet shares many characteristics of an Institutional Economic Geography approach. The initial concept of national systems of innovation, for example, aimed to uncover the institutional setting in a country affecting the interaction patterns between actors involved in the innovation process. As such, it takes the existence of institutions for granted and tries to link differential economic performances to different institutional settings. This approach has later been extended to the regional level (Cooke *et al.*, 1998; Cooke, 2001; Asheim and Isaksen, 2002). More recently, however, evolutionary scholars stress the specificity of sectoral innovation systems and the properties these innovation systems share across regions (Breschi and Malerba, 1997; Breschi, 2000). This sectoral approach suggests that the history of innovation systems, in specific places, should be understood from a *dynamic* perspective, by analysing how institutions have co-evolved with the emergence of a new sector.[19] In doing so, it acknowledges that the implementation

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17 Boschma (2004) claims that territories can only be called relevant and meaningful units when the idea of routines and competences can be transferred from the organizational level to the regional level. In that respect, the region has become an entity on its own, providing intangible and non-tradable assets based on a unique knowledge and institutional base, which is not accessible for non-local firms. Only in those (quite exceptional) circumstances, one needs to understand the success and failure of firms through their local context (Lawson, 1999).

18 This also requires a multi-level analysis to test at which spatial levels behaviour and performance of firms are conditioned (Van Oort, 2004; Phelps, 2004). Within an evolutionary context, multi-level decomposition measures of selection using Price's equation (Frank, 1998; Andersen, 2004) and of variety using the entropy measure (Theil, 1972; Frenken *et al.*, 2005) are particularly useful.

19 While it may be true that institutions are primarily sector-specific, it may not be excluded that sector-specific institutional models may converge to some extent over time, due to evolutionary forces such as competition, selection and imitation. For instance, a key sector in a country may become so dominant that its institutions (e.g. research system, or property rights) become part of a national system (Hollingsworth, 2000). However, in practice, the transfer of institutional models between sectors is expected to be subject to many problems, due to, among other things, the systemic nature of institutions.

and diffusion of novelty often requires the restructuring of old institutions and the establishment of new institutions (Freeman and Perez, 1988; Galli and Teubal, 1997). A well-known example is the rise of the synthetic dye industry in the second half of the nineteenth century, which induced many institutional changes (such as new scientific and educational organizations and new patent laws), which Germany succeeded to implement, but the UK and the US did not (Murmann, 2003). Another example is a study of the evolution of the UK retail banking industry from the 1840s to the 1990s emphasizing the co-evolution of industrial organization, technology and institutions (Consoli, 2005). Consequently, in an evolutionary framework, the key issue is to ana-lyse the extent to which institutions are flexible and responsive to changes in different places. Institutional differences between regions or nations, in this view, are part of the *explananda*, as institutions co-evolve with processes of technological innovation and industrial dynamics (Nelson, 1995b). When adopting such a co-evolutionary perspect-ive, in which technology, markets and institutions mutually influence each other over time, it becomes apparent that institutional and evolutionary approaches converge.[20]

The question that is still to be answered is how Evolutionary Economic Geography can reconcile the notion of neutral space in formal models (similar to neoclassical approaches) with the concept of real places in real-world cases (as in institutional approaches). In an evolutionary perspective, neither can specific institutions in real places provide a sufficient explanation for differences in regional growth, nor can tra-ditional determinants (e.g., factor prices) from neoclassical growth theory. While these factors certainly constrain the set of regions where growth may occur, they fail to explain why even regions with similar institutions and factor endowments can have different rates and patterns of growth. Consequently, factors related to institutions and factor endowments are to be supplemented by a dynamic analysis at the sector and network level, in which the path dependent and self-reinforcing nature of locational dynamics is at the core of a systematic explanation. As a result, Evolutionary Economic Geography claims that real places emerge from actions of economic agents, rather than fully determining their actions.[21]

When dealing with the emergence of new sectors and new networks in particular regions, Evolutionary Economic Geography has theoretical reasons to assume that

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In that case, differences between sectoral systems of innovation are likely to co-exist and persist in one territory (Amable, 2000). What this example shows is that a dynamic perspective on institutions is highly relevant and exactly what an evolutionary approach is all about.

20 See also, as an example, a recent application of evolutionary economics in the field of transportation planning by Bertolini (2005).

21 Differences between territories can only be understood as the outcome of a long-term evolutionary process. Therefore, imitation of successful routines or institutions by other territories is inherently dif-ficult and, more importantly, the effects are expected to be very different, depending on the set of routines and institutions in which it is introduced (Gertler, 2003). Consequently, comparative analysis, including benchmarking of regions, has its limitations, because a set of successful micro-routines and macro-institutions cannot simply be carried over to different historical contexts. Comparisons are useful to analyse which dimensions of an innovation system perform relatively poor and require adaptation, but they are less useful in providing solutions to fit the historical context of specific innovation systems. The core problem of policy by imitation concerns the high degree of tacitness and interdependencies that exist between the factors contributing to a successful model (Boschma, 2004). In sum, the trajectory of a territory sets limits on copying an external strategy that owed its success to its roots in an alien environment (Zysman, 1994; Rivkin, 2000).

firms operate in neutral space (rather than for reasons of modelling simplicity, cf. Krugman, 1991a). Place-specific features do not determine the location of new sectors, because the selection pressure of existing spatial structures is still rather weak when new industries emerge. That is, the environment is considered to be of minor importance at the initial stage of development of a sector, because a gap is likely to exist between the requirements of the new firms (in terms of knowledge, skills, etc) and its environment. Utmost, regional conditions may play a generic and rather unimportant role at the start of a new sector, such as providing generic knowledge and skills, functions that are often equally well provided in many other regions (Boschma and Lambooy, 1999). The crucial inputs, being sector-specific knowledge and skills, are to be developed by firms themselves as their organizational routines evolve over time. For this reason, one can expect firms in new sectors to emerge in many different locations. In this context, Storper and Walker (1989) have used the term open windows of locational opportunity to describe the locational dynamics of firms in new sectors, which comes close to the assumption of neutral space in evolutionary models.[22] Over time, windows close again, and, after a shake-out, the industry prospers in few regions only, while remaining marginal in most other regions. Similarly, the spatial evolution of networks can be understood as a process that starts off in neutral space, where many but probably not all locations are candidates to become new hubs. Yet, over time, only few locations will develop a central hub function with high connectivity, and consequently the windows of locational opportunity will close again (Castells, 1996).

Over time, the initial neutral space is transformed in real places as the new sectors and new infrastructure networks become spatially concentrated in some regions according to a path dependent process, and trigger the institutional base of these regions to transform and adapt. The renewal of institutions to become supportive of new economic activity is an outcome of a long process of co-evolution, rather than the initial determinant of new sectors locating in a region (recall the example of Germany's chemical industries at the end of the nineteenth century). Thus, regional development is more about path dependence than place dependence, although some places may be better in renewing their institutions than others. Institutions play only a generic role at the start of a new sector, and become more specific and better developed in those areas where a critical mass of firms locates. Thus, at one moment in time, the same institutional base

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22   Such an evolutionary approach should, however, not take the notion of neutral space for granted, but, instead, should test it in empirical research. In doing so, neutral space is not confused with empty space, because it would be wrong to rule out the impact of regional conditions when a new industry emerges (Boschma, 1997; Boschma and Frenken, 2003). What we claim is that these regional structures only condition the range of possible behaviour of agents, but do not determine their actual behaviour and location. Consequently, the essence of an evolutionary approach applied to the spatial evolution of an industry is 2-fold: (i) to determine which territories are likely candidates (i.e. endowed with favourable conditions) and which territories can be excluded from the beginning. This provides an answer to what degree the windows of locational opportunity are open when a new industry emerges. (ii) to explore the mechanisms behind the path-dependent nature of the spatial evolution of a new industry. Here we answer the question that which of the candidate region(s) become the winner(s), and why. Such an approach has been adopted in a long-term study of the evolution of the British automobile industry (Boschma and Wenting, 2005). The study demonstrated that a local supply of related industries (such as bicycle and coach making) provided a basis for the emergence of the British automobile sector, but it was the success of early entrants and spin-off companies (especially the ones that had acquired experience in successful parent automobile firms) that contributed to the concentration of the automobile industry in the Coventry-Birmingham area.

Table 1. A comparison of the three approaches in economic geography

Key issues	Neoclassical	Institutional	Evolutionary
Methodology	Deductive	Inductive	Both
	Formal modelling	Appreciative theorizing	Both
Key assumptions	Optimising agent	Rule-following agent	Satisficing agent
	A-contextual	Contextual (macro)	Contextual (micro)
Conceptualization of time	Equilibrium analysis	Static analysis	Out-of-equilibrium analysis
	Micro-to-macro	Macro-to-micro	Recursive
Geography	Neutral space	Real place	Neutral space → real place
	Transport costs	Place dependence	Path dependence

Table 2. Summary of Evolutionary Economic Geography (EEG)

- EEG combines <u>appreciative theorizing</u> (inductive) and <u>formal modelling</u> (deductive)
- EEG takes firms, and their <u>routines,</u> as the basic but not the sole unit of analysis
- EEG assumes the behaviour and success of firms to be dependent primarily on the routines a firm (or its founder) has built up in the past (<u>path dependence</u>)
- EEG views the <u>traditional determinants</u> of firm (location) behaviour as being price signals (neoclassical) and place-specific institutions <u>as conditioning</u> the range of possible (location) behaviours and potential locations, but <u>not determining</u> actual (location) behaviour and locational outcomes
- EEG views institutions as primarily influencing innovation in a generic sense, and as <u>co-evolving</u> with technologies over time and differently so in different regions
- EEG describes the spatial evolution of sectors and networks as a dynamic co-evolutionary process transforming <u>neutral space</u> into <u>real places</u>
- EEG explains regional economic development from the dynamics of <u>structural change</u> at the level of sectors, networks and institutions at multiple territorial levels

of a region may be functioning well for mature industries and may be irrelevant, or even dysfunctional, for emerging sectors. Naturally, the paradox of regional policy holds that it can be effective in conserving economic activity, yet it has difficulties to trigger new economic activity necessary for long-term development (Pasinetti, 1993; Saviotti, 1996).

6. Towards an evolutionary economic geography

To sum up our discussion on neoclassical, institutional and evolutionary approaches in economic geography, we present in Table 1 the similarities and differences between them. The three categories of methodology, key assumptions and conceptualization of time correspond to the interfaces in the triangle presented in Figure 1. For reasons of clarity, we have included geography as an additional category to underline the notions of neutral space and real place. As a first attempt, we also listed in Table 2 the key propositions of the evolutionary approach in economic geography, as discussed throughout the paper.

Methodologically, we can conclude that Evolutionary Economic Geography disagrees with institutional approaches in their dismissal of formal modelling and

their reluctance to test statistically theoretical propositions. However, different from neoclassical thinking, evolutionary scholars also acknowledge the value of case studies as tool in appreciative theorizing. Thus, Evolutionary Economic Geography strongly supports 'methodological variety and openness' in economic geography, as recently advocated by Plummer and Sheppard (2000), Markusen (2003) and Scott (2004). Following Nelson and Winter (1982), an evolutionary approach employs formal modelling (being more deductive) as well as 'appreciative' theorizing (being more inductive). Thus, Evolutionary Economic Geography makes use of formal theorizing grounded in more realistic assumptions (like bounded rationality), but it also conducts case-study approaches that analyse regional specificities from a dynamic perspective. In short, evolutionary scholars favour methodological pluralism.

Concerning key assumptions, Evolutionary Economic Geography is closer to the institutional approach in assuming economic action to be contextual rather than driven by maximization calculus. However, while institutional scholars tend to relate behaviour of agents to macro-institutions of territories, evolutionary scholars put primacy on micro-routines of organizations. In this view, price differentials (the neoclassical view) and place-specific institutions (the institutional view) only condition the range of possible behaviours and potential locations of firms, but the actual behaviour and location is largely determined by organizational routines acquired in the past. Having said this, firms are not only victims of their history in time and space: routines can be changed by innovation and relocation also. Accordingly, it is the dynamic interplay between structure and agency that produce the evolution of real places.

As far as the conceptualization of time is concerned, Evolutionary Economic Geography takes an explicit dynamic perspective, in which processes of birth and death of firms and sectors are put central, as well as the role of innovation and the co-evolution of firms/sectors with institutions. In contrast, the New Economic Geography is based on a static account of equilibrium analysis, while institutional approaches often focus, though not exclusively, on quite static analyses of institutions employing case studies and comparative studies. From this, it follows that the notions of neutral space (as assumed in neoclassical models for modelling simplicity) and real place (central to Institutional Economic Geography) can be reconciled in evolutionary thinking by viewing the spatial evolution of new sectors or new networks as a dynamic process transforming neutral space into real places.

To further underline and support our claim that Evolutionary Economic Geography potentially provides a comprehensive framework for theoretical and empirical research in economic geography, we propose a multi-layer scheme as depicted in Figure 2. The micro-unit of analysis in Evolutionary Economic Geography is the firm and its routines (Maskell, 2001). The location behaviour of firms is analysed from a historical perspective. One can make use of behavioural geography, in particular Pred (1967), to develop theoretically informed explanations of location decisions. Like evolutionary economists, adherents of behavioural geography start from bounded rationality, which implies that firms' location decisions are heavily constrained by the past. For example, most firms start from home, and spin-offs typically locate in the region of the parent firm. In both cases, previous decisions taken in a different historical context determine the location decision of a new firm. Furthermore, firms are expected to display a considerable degree of locational inertia. The probability of relocation decreases over time as a firm develops a stable set of relations with suppliers and customers and sunk costs accumulate *in situ* (Stam, 2003). In line with Nelson and Winter (1982) and
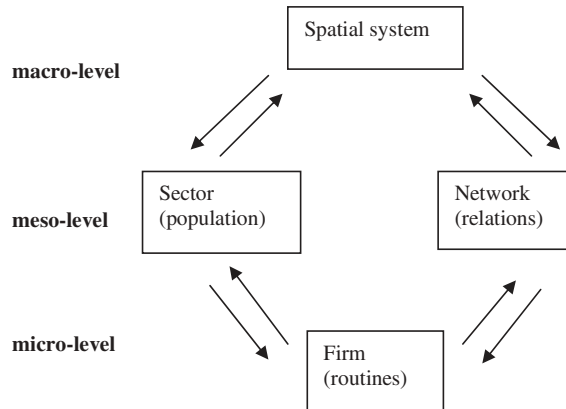
Figure 2. Evolutionary Economic Geography applied at different levels of aggregation.

Cohen and Levinthal (1990), Pred (1967) also emphasized that firms have different capabilities to absorb information about potential locations. Thus, firms are not only imperfectly informed about locations, but are also heterogeneous in their capability to use information in a meaningful way. The final spatial pattern, then, is the outcome of a selection process operating on heterogeneous firms and their location choices. When firms choose, intentionally or by accident, a location that falls within the so-called spatial margin of profitability, they have a better chance to survive and prosper (Smith, 1966).

Taking this one step further, one can assume that some firms develop sophisticated strategies to replicate their routines in different territorial contexts, while other firms continue to pursue strategies in an *ad hoc* manner. Kogut and Zander (1993), for example, argue that successful multinational corporations are those displaying a superior efficiency to transfer knowledge across borders. Also in service firms, systematic replication of routines in new branches constitutes an important part of firms' competitiveness (Winter and Szulanski, 2001). In general, the ability of a firm to replicate its routines in different geographical contexts is expected to contribute to a firm's performance.

Starting from the theory of the firm, Evolutionary Economic Geography applies to two meso-levels; that is, the spatial evolution of sectors and of networks. Firms' relations at the sector level are mainly of a competitive nature, which renders entry-and-exit models and survival analysis obvious techniques for analysis. The core models of the spatial evolution of industry are Simon's (1955b) model on stochastic growth and Arthur's (1987) models on spin-offs and agglomeration economies, while more elaborated methodologies have been developed by Klepper (2002a), Bottazzi *et al.* (2002), Maggioni (2002) and Brenner (2004). Taking a dynamic perspective, the spatial evolution of a new industry in these analyses is described in terms of locations of entry, spin-offs and exits driving the distribution of organizational routines in a population of firms over time (Boschma and Frenken, 2003).

Importantly, in an evolutionary context, spatial concentration (or its absence) is not only an outcome of a process of industrial evolution, but also affects an industry's further evolution. This recursive relationship has, at least, three dimensions

(Hannan *et al.*, 1995; Stuart and Sorenson, 2003; Boschma and Wenting, 2005; van Wissen, 2004). First, geographical concentration of industrial activities can generate agglomeration economies fostering start-ups and innovation and, possibly, the birth of a related industry in the region. Second, geographical concentration of firms increases the level of competition and makes exits of firms raise the average fitness of routines. Third, spatial concentration of firms can also affect the opportunities of collective action as such initiatives are more likely to emerge among proximate agents that can more effectively control opportunistic behaviour.

Networks provide another unit of analysis. One important aspect of networks in Evolutionary Economic Geography is that these act as vehicles for knowledge creation and knowledge diffusion (Cowan and Jonard, 2003). A key research question is then to determine whether knowledge diffusion and innovation is more a matter of being in the right place or in the right network, or in both (cf. Castells, 1996). A recent study found that, using co-inventor data to indicate networks and patent citations to indicate knowledge flows, geographical localization of knowledge spillovers can be largely attributed to social networks and labour mobility (Breschi and Lissoni, 2003). Since most network relationships and job moves are local, with job mobility in turn strongly channelled through network structures, the understanding of knowledge diffusion requires a detailed understanding of the underlying social networks. Using social network analysis, success and failure of economic agents, and regions as an aggregate, can be related to the network centrality of agents within local and global networks of knowledge. As noticed before, this implies that empirical studies on the innovative performance of firms should not take for granted the impact of the region, but should also explore the impact of firm characteristics (competences, market power) and the network position of firms (Boschma and Weterings, 2005; Giuliani, 2005; Giuliani and Bell, 2005). Another important research question becomes to what extent regional and national institutions affect the propensity of agents to network locally and globally (Bathelt and Glückler, 2003).

Apart from analysing network structure, an issue shared with many institutional theories, Evolutionary Economic Geography also aims to explain the spatial evolution of networks. In evolutionary models of network formation, network evolution is understood as an entry process of new nodes connecting with certain probability to existing nodes depending on geographical distance and the latter's connectivity (Barabasi and Albert, 1999; Guimerà and Amaral, 2004; Barrat *et al.*, 2005; cf. Castells, 1996). Well-connected nodes become even better connected nodes rendering the final distribution of connections skewed: networks automatically evolve towards a hierarchy with some nodes becoming highly connected primary hubs, other secondary hubs, while most nodes evolve into poorly connected spokes. A powerful feature of models of network evolution holds that these equally apply to the spatial evolution of social networks between actors as to the spatial evolution of infrastructure networks among locations (e.g., transportation networks, ICT networks, trade networks).

Reasoning from the dynamics of sectors and networks, Evolutionary Economic Geography also applies to the macro-level of the spatial system as a whole. The economic development of cities and regions can be analysed as an aggregate of sectors and networks in a region, and its geographical position in a global system of trade and commerce. The sectoral logic underlying the evolution of spatial systems is better known as the process of structural change (Freeman and Perez, 1988; Pasinetti, 1993; Boschma, 1997). Cities and regions that are capable of generating new sectors with new product

life cycles and expanding demand will experience growth, while cities and regions that are locked into earlier specializations with mature life cycles will experience decline. Importantly, there is no automatic economic or political mechanism that assures cities or regions to successfully renew themselves. Rather, one expects localities in most instances to experience decline after periods of growth due to vested interests, institutional rigidities and sunk costs associated with previous specializations.

Theorizing about the network logic underlying the evolution of spatial systems is more recent, in which geographers play a prominent role (Hohenberg and Lees 1995; Castells, 1996). According to these contributions, growth crucially depends on a city's or region's inclusion in global networks of trade and commerce. A central network position can be achieved by attracting corporate headquarters, developing specialized business services and functioning as transportation hubs. Again, one can expect central cities in one era (e.g., based on railways) to be less successful in the next era (e.g., based on airlines) due to institutional rigidities and sunk costs associated with previous infrastructures.

Following from the meso-levels of sectors and networks, differential regional growth patterns and processes of convergence, divergence and leapfrogging can be modelled by simulation or econometrically. For example, research interest has been renewed in stochastic models of urban growth using time series on city size. These models investigate *sustained* growth and decline in urban growth thus going beyond the simple logic of Gibrat's Law stating that urban growth rates are stochastic and independent of city size (Pumain, 1997; Gabaix, 1999). Complementary to this research, historical analysis is required to understand the co-evolution of regional economic development and institutional structures underlying the individual regional histories of systematic growth or decline (Nelson, 1995b, 2002). In that respect, institutions can become an integral part of an Evolutionary Economic Geography framework when applied to the analysis of the dynamics of industries, networks and spatial systems.

Having said this, Evolutionary Economic Geography is still at an early stage of development. Some of its fundamental concepts, such as routines and path dependence, need more careful elaboration both theoretically and empirically (see, e.g., Martin, 2003; Becker, 2004). Furthermore, there are relatively few studies to date that can serve as 'Kuhnian exemplars' of this new approach. Notwithstanding these shortcomings, we believe that Evolutionary Economic Geography provides genuine new explanations for the main *explananda* in economic geography, such as location behaviour of the firm, the spatial evolution of sectors and networks, the co-evolution of firms, technologies and territorial institutions, and convergence/divergence in spatial systems. The comparison of evolutionary approach with neoclassical and institutional approaches shows that Evolutionary Economic Geography indeed offers value added to the field of economic geography. What is more, an evolutionary approach offers interfaces with neoclassical and institutional approaches that are potentially much more fertile than the uneasy interactions that we have witnessed between neoclassical and institutional scholars so far. We realize there is still a long way to go before Evolutionary Economic Geography becomes an established field. Having said this, we are convinced that evolutionary theory constitutes a truly new and promising paradigm in economic geography. Time will tell whether it will live up our expectations: it is evolution as usual.

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