The emerging empirics of evolutionary economic geography

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Abstract
Following last decade's programmatic papers on Evolutionary Economic Geography, we report on recent empirical advances and how this empirical work can be positioned vis-à-vis other strands of research in economic geography. First, we review studies on the path dependent nature of clustering, and how the evolutionary perspective relates to that of New Economic Geography. Second, we discuss research on agglomeration externalities in Regional Science, and how Evolutionary Economic Geography contributed to this literature with the concepts of cognitive proximity and related variety. Third, we go into the role of institutions in Evolutionary Economic Geography, and we relate this to the way Institutional Economic Geography tends to view institutions. From this discussion, a number of new research challenges are derived.

1. Introduction

In recent years, economic geography has been subject to new and promising developments. In the first ten years of its existence, the Journal of Economic Geography has played a key role in promoting these developments, by providing an interdisciplinary platform through which new research programmes have been disseminated. One such programme has been Evolutionary Economic Geography (Storper, 1997; Boschma and Lambooy, 1999; Boschma and Frenken, 2006; Martin and Sunley, 2006; Frenken, 2007; Journal of Economic Geography *special issue*, 2007, Economic Geography *special issue*, 2009; Boschma and Martin, 2010).

Evolutionary Economic Geography (EEG) explains the spatial evolution of firms, industries, networks, cities and regions from elementary processes of the entry, growth, decline and exit of firms, and their locational behaviour. What renders evolutionary theory attractive in economic geography, is that it may develop into a general theory in economic geography while being applicable empirically to specific processes in space and time. This feature "… makes evolutionary theory compatible with a contextual view as advocated in economic geography, without giving up the ideal of developing a theoretical framework that goes beyond the specific and the unique" (Frenken and Boschma, 2007, pp. 635-636).

Here, we report on recent research that has explicitly been motivated by the evolutionary programme. Due to lack of space, we cannot provide a comprehensive account.[1] Rather, we focus on three main areas that have attracted most attention: (1) clustering of economic activity; (2) the nature of agglomeration externalities; and (3) the role of institutions in regional development. For each of the three areas, we discuss how this empirical work in EEG can be positioned vis-à-vis other strands of research in economic geography. Regarding clustering, we link EEG to New Economic Geography, regarding agglomeration externalities to Regional Science, and regarding institutions to Institutional Economic Geography.

2. A short recapitulation

In our evolutionary approach to economic geography, we start from the definition of economic geography as dealing with the uneven distribution of economic activity across space. An evolutionary approach specifically focuses on the historical processes that produce these patterns. The current distribution of economic activity across space is thus understood as an outcome of largely contingent, yet path dependent, historical processes, or as Dosi (1997) has it: "the explanation to why something exists intimately rests on how it became what it is" (p. 1531).

We follow the seminal work by Nelson and Winter (1982) in taking organizational routines as the unit of analysis. Firm-specific routines are underlying a firm's organizational capabilities on the basis of which it competes (Teece et al., 1997). Economic evolution can then be understood as the selective transmission of routines among organizational entities, particularly, firms. As the replication of routines among firms is imperfect, variety in routines persists over time as routines are passed on with small modifications. Nevertheless, variety is constantly reduced due to competition and constraining institutions. At the same time, radically new routines can be introduced through innovations, even if not many of them will survive the selection process.

With spinoff firms and labour mobility being its prime vehicles, routine replication is mostly a local affair (Maskell, 2001; Essletzbichler and Rigby, 2007; Klepper, 2007). What follows is that the spatial evolution of firm-specific routines develops along a geographically localised lineage structure, in which successful routines have a higher chance not only to survive, but also to be transferred to other local firms. This process results in regional branching in which new routines develop out of technologically related routines (Frenken and Boschma, 2007; Boschma and Frenken, 2011), underlining the importance of 'related variety' for regional development (Frenken et al., 2007). The process of evolutionary branching that underlies economic development is not only a path dependent process, but also a place-dependent process (Martin and Sunley, 2006). That is, spatial conditions for the creation, transmission and influx of new routines are expected to differ at various spatial scales, for example, depending on the set of institutions, the structure of networks and patterns of migration.

[1] For example, we will not pay attention to the study of knowledge networks from an EEG perspective, despite the fact that progress has been made in recent years (see Boschma and Frenken, 2010 for an overview). In particular, some have integrated the evolutionary analysis of networks into a proximity perspective, in which the different proximities (geographical proximity being one of those) may act as drivers of network formation (Ter Wal, 2009; Balland, 2010; Vinciguerra et al., 2010).

3. Clustering as an evolutionary process

From an evolutionary perspective, clusters are analysed by tracing regional entry and exit patterns over time. Following a demographic logic, the number of firms in a region at a particular moment in time equals the cumulative number of entries (possibly including inward migration) minus the cumulative number of exits (possibly including outward migration). Entry rates are highly dependent on the number of incumbent firms in a region, as each firm constitutes a potential source for spinoffs (Arthur, 1994; Sorenson and Audia, 2000; Stuart and Sorenson, 2003) as well as a signal to (re)locating firms (Suire and Vincente 2009). This explains why clusters, once established, tend to persist over time. That is, clusters are self-reproducing even if localisation economies are absent (Klepper, 2007; Wenting, 2008) or negative (Sorenson and Audia, 2000; Stuart and Sorenson, 2003; Boschma and Wenting, 2007).[2]

The central question, though, is how one explains the emergence of clusters in certain places rather than others. Klepper's (2007) industry lifecycle study on the U.S. car industry has provided a comprehensive explanation for the emergence of clusters, which has subsequently been replicated for the British car industry by Boschma and Wenting (2007) as well as for a series of other industries as diverse as the global fashion design industry (Wenting 2008), the U.S. tire industry (Buenstorf and Klepper, 2009), the U.S. semiconductor industry (Klepper, 2010), the Dutch banking industry (Boschma and Wenting, 2010), the Dutch publishing industry (Heebels and Boschma, 2010) and the global video game industry (De Vaan et al., 2010). In short, Klepper explains clusters as a snowball process where clusters emerge through a spinoff process. In this framework, firms are assumed to be heterogeneous in their capabilities, partly because of different pre-entry experience and partly because of idiosyncratic factors. Spinoffs inherit a large part of their capabilities from their parent, which explains why successful firms tend to give birth to successful spinoffs. Thus, following a Darwinian genealogy reasoning (Boschma and Frenken, 2003, 2006), more successful firms produce more, and more successful, spinoffs. Since spinoffs tend to locate in the same region as the parent firm, a cluster emerges once a single firm or a few successful firms start to create many successful spinoffs, which, in turn, create successful spinoffs themselves. Once exit rates start to increase due to rising competition levels stemming from economies of R&D at the firm level (Klepper 1996), these firms will survive while firms with less fit capabilities will have to exit. As a result, a cluster emerges in the region(s) where the initial successful parents happen to have located in the past.

This evolutionary theory to spatial clustering has two important implications. First, there is regional path dependence (Martin and Sunley 2006). Since the first generation of firms is not composed of spinoffs, but mostly by entrepreneurs coming from related industries, regions that host industries that are related to the new industry, have a higher probability to create this new industry (Boschma and Wenting, 2007; Buenstorf et al., 2010). So, a more dynamic perspective on industry relatedness would claim that regional diversification requires the local presence of technologically related industries, out of which new industries will develop through

[2] See Fritsch and Mueller (2007) and Andersson and Koster (2010) for analysis of persistence in regional startup rates. Also note that this finding is in line with Rigby and Essletzbichler (2006) who found that technological heterogeneity across regions tends to persist over long periods of time.

recombination, a process which can be defined as 'branching' (Frenken and Boschma, 2007; Boschma and Frenken, 2011).[3] However, regional success in one industry is not automatically reproduced in the next industry, as the success of firm is only partly determined by pre-entry experience. As new industries also rely on newly created knowledge and institutions, the windows of opportunity are open for regions at least to some extent, although this differs strongly from industry to industry (Storper and Walker, 1989; Boschma and Lambooy, 1999). Yet, regions hosting related industries clearly enjoy an advantage, because related industries provide a large pool of potential experienced entrepreneurs, among other regional assets.

The second implication of this line of research holds that clusters are expected to emerge even in the absence of localisation economies. In all aforementioned industry studies on cars, fashion design, tires, semiconductors, banking and publishing, it has been shown that the sheer presence of a firm in a cluster does not affect its survival rate. Rather, the emergence of a cluster could be explained by interacting the spinoff and cluster variables, indicating that the cluster emerged due to well-performing spinoffs coming from a selected number of successful parents in the region (Klepper, 2007; Boschma and Wenting 2010; Heebels and Boschma, 2010). Yet, one recent study on the evolution of the global video game industry did find cluster advantages to exist (De Vaan et al. 2010). Concluding, clusters emerge as an evolutionary process of spinoff formation, while the role of localisation economies in this process is limited, at best.

An important question that remains concerns the precise nature of inheritance. It is apparent from the high correlation in performance between parent and spinoff that 'something' is being transmitted from the parent firm to spinoff. However, whether the spinoff inherits knowledge, or organizational capabilities, or network relations, or reputation remains unclear. One can also ask the question under what conditions transmission is more or less noisy, leading to higher or lower correlation in performance. Both what has been transmitted, and how noisy the transmission process has been, is likely to depend on industry characteristics (e.g. the nature of knowledge, appropriability conditions), the motivation to start a spinoff (whether a disagreement is underlying the spinoff), and the geographical distance between parent and spinoff (with the performance correlation between parent and spinoff declining with geographical distance).

Another question holds whether the theory equally applies to services and creative industries as to manufacturing. Even though the mechanism of spinoff creation and clustering has been found to operate in the same way in service and creative industries as in manufacturing industries (Wenting, 2008; Boschma and Wenting, 2010; Heebels and Boschma, 2010; De Vaan et al., 2010), the *location* of clusters seems to differ. Industries like banking, publishing and design tend to cluster in the largest cities while manufacturing clusters typically emerge in smaller cities. This suggests that some form of agglomeration economies may play a role in the largest cities attracting service/creative industries – possibly the presence of related industries – that is yet to be explored in industry lifecycle studies. We continue the discussion of related industries as a source of agglomeration externalities in the next section.

[3] For example, Neffke et al. (2009) found in a recent study on Swedish regions that industries had a higher probability to enter a region when these were technologically related to other pre-existing industries in that region. Interestingly, as expected, industries that were not technologically related to existing industries in a region were also more likely to exit the region, as compared to related industries. See also Hildago et al. (2007) for similar findings at the level of countries. See also case studies evidence (e.g., Staber, 2001; Bathelt and Boggs, 2003).

Interestingly, the evolutionary economic geography (EEG) approach to clustering has quite a lot in common with the core model in New Economic Geography (NEG) (Krugman, 1991; Brakman et al., 2001): (i) spatial distributions are derived from location choices and market competition rather than from regional differences in factor prices; (ii) competition is driven by scale economies at the firm level, (iii) clustering results from a self-reinforcing and irreversible dynamic process, and (iv) the location of a cluster is path dependent on early decisions in its formative stage. Yes, despite these common features, we have argued before that the evolutionary perspective is different from NEG in a number of important respects (Boschma and Frenken 2006, pp. 283-286). Most fundamentally, EEG explains the spatial distribution of economic activity as a historical process, where path dependence in the location of economic activity results from the local spinoff creation. Even if the location of a cluster is historically contingent upon the location of a few well-performing entrepreneurs, the reason why a cluster emerged in a certain region can be explained *ex post* from the genealogy of entrepreneurs. By contrast, NEG explains spatial distribution of economic activity as resulting from optimising behaviour by workers and firms leading to an instant (a-historical) equilibrium. Path dependence, then, means in NEG that once a parameter is changed resulting from an exogenous event (e.g., a fall in transport costs due to advances in transport technology), the system can change from having a single equilibrium to having multiple equilibria, without the ambition to explain 'where it (industrial localization and specialization) occurs, or why in particular places and not in others' (Martin, 1999, p. 78). Thus, NEG describes clustering as a general phenomenon underlying the historical formation of cities and shifts in the urban system that can be expected from changes in transportation costs or trade barriers (Krugman, 2011).

4. Agglomeration externalites in an evolutionary framework: beyond 'MAR versus Jacobs'

Since the seminal paper of Glaeser et al. (1992), the agglomeration externalities literature investigates whether a specific composition of sectors in a region enhances agglomeration externalities and, hereby, regional growth. A central question holds whether firms benefit primarily from other local firms in the same industry, or from local firms that are active in other industries. As Marshall (1920) once argued, agglomeration externalities based on regional specialization may arise from thick, specialized labour markets, local access to specialized suppliers and markets, and the presence of local knowledge spillovers. These externalities are now better known as localisation economies or MAR externalities (referring to Marshall-Arrow-Romer). Others followed the work of Jacobs (1969) in emphasizing the blessings of diversified cities, which would induce cross-industry knowledge spillovers and recombinant innovations. Jacobs was among the first to acknowledge that a deep division of labour in a city could contribute to urban growth, not only because of efficiency reasons, as Adam Smith once argued, but also because it gives rise to opportunities for innovation.

Recently, a comprehensive review (Beaudry and Schiffauerova, 2009) and meta-analysis (De Groot et al., 2009) of this literature concluded that the empirical evidence is indecisive. There are almost as many studies that found no evidence for either type of externalities, evidence for one type of externalities, or evidence for both types of externalities. Clearly, the specification of agglomeration externalities in regional growth models needs to be improved as to advance our

understanding of agglomeration externalities. From an evolutionary perspective, four strategies are currently being explored.

First, studies have gone beyond the dichotomy of variety versus specialization underlying the 'MAR versus Jacobs' debate. Regarding knowledge spillovers, it has been argued that knowledge is more likely to spill over between agents when their cognitive distance is neither too large, as some degree of cognitive proximity is required to ensure effective learning, nor too small, as agents with the same knowledge will have little to learn from each other (Nooteboom, 2000; Boschma 2005). Accordingly, the higher the number of related industries in a region, the more opportunities exist for effective knowledge transfers between sectors.[4] That is, related variety, rather than variety or specialisation *per se*, is expected to enhance regional growth (Frenken et al., 2007). In a study on regional growth in The Netherlands, Frenken et al. (2007) have addressed the effects of related variety. As expected, regions with a high degree of related variety showed the highest employment growth rates. Such an effect has also been found in studies on regional growth in Italy (Boschma and Iammarino, 2009) and Spain (Boschma et al., 2010) using export data. Another study looking at regional growth in specific industries in the UK only found evidence for related variety as a source of agglomeration economies for ICT-related industries (Bishop and Gripaios 2010).

Second, following product lifecycle theory, it has been suggested that the type of agglomeration externalities varies according to the stage of the product lifecycle in an industry (Potter and Watts, 2010. Henderson et al. (1995) found that new industries benefit from Jacobs' externalities supportive of product innovation through recombination of technologies available from other industries, while more mature industries benefit more from MAR externalities in more specialized cities supportive of process innovation and supply chain optimization. Neffke et al. (2011) found similar results in a study on Swedish industries. Whereas the importance of MAR externalities increased with the maturity of industries, the significance of Jacobs' externalities declined when industries matured. Product lifecycle theory also predicts that the dominant flow of relocation will be from the diversified core to a specialist location in the periphery once firms start to mass-produce a standardized product. Such relocation patterns have indeed been found for French (Duranton and Puga, 2001), Dutch (Pellenbarg and Van Steen, 2003) and Portuguese manufacturing firms (Holl, 2004).

Third, an increasing number of studies on agglomeration externalities move down from the regional level to the firm level. As firms are heterogeneous in their routines and capabilities, it is likely that the costs and benefits that firms enjoy from co-location differ. In particular, more knowledge-intensive firms have more to lose and less to gain from local knowledge spillovers than firms that are less knowledge intensive. Indeed, there is evidence that the extent to which firms profit from MAR externalities falls when their level of knowledge increases (Shaver and Flyer 2000; Cantwell and Santangelo 2002; Alcacer 2006; Alcacer and Chung 2007). A recent study by Brown and Rigby (2010) has tested whether MAR externalities assist newer plants to compensate for their lack of internal capabilities, while distinguishing between knowledge spillovers, labour market pooling and buyer-supplier relationships as three different sources of

[4] Industry relatedness can thus be defined as to the extent two which the knowledge and skill base of two industries overlap (Neffke and Henning, 2009).

MAR externalities. They found that, indeed, relatively new plants benefit the most from two of the three types of Marshallian economies: knowledge spillovers and labour market pooling.

Fourth, studies have attempted to 'open the black box' of knowledge spillovers as a source of agglomeration externalities by specifically examining the channels through which such spillovers are expected to occur (Almeida and Kogut, 1999; Breschi and Lissoni, 2001; Giuliani, 2007; Desrochers and Leppälä, 2010). Labour mobility is one such channel through which knowledge is being transferred between companies, and there is some evidence that especially labour flows between related industries are of particular relevance for firms' performance (Boschma et al., 2009). What is more, the social network ties between moving individuals and their former colleagues may well remain a channel for knowledge exchange. Evidence of knowledge spillovers of this sort has been found by Agrawal et al. (2006) and Breschi and Lissoni (2009) by examining patent citations in social networks, and by Maggioni and Uberti (2007) and Ponds et al. (2010) using inter-regional collaboration networks. Concerning the specific nature of the knowledge, Sorenson et al. (2006) found that the advantages of being geographically proximate to some knowledge source depend crucially on the nature of the knowledge at hand. Simple knowledge flows equally to actors near and far, while complex knowledge is unlikely to diffuse, no matter how proximate actors are. With knowledge of moderate complexity, however, they show that more close actors are in a better position to benefit from knowledge diffusion, in contrast to more distant recipients.

In sum, an evolutionary approach on agglomeration externalities opens up a series of new perspectives. It argues that the nature and extent of agglomeration externalities depend on the relatedness among industries present in the region and the stage of the product lifecycle an industry is in. And, highlighting firm heterogeneity, evolutionary studies have begun to examine what type of firms are most likely to benefit from clusters and through what kind of interaction mechanisms. All these perspectives have been addressed in empirical research designs using rich datasets that tend to produce consistent results. As such, these evolutionary approaches to agglomeration externalities provide a useful complement to Regional Science approaches that make use of (knowledge) production approaches and related models.

5. Institutions in evolutionary economic geography

In our programmatic paper (Boschma and Frenken 2006), we argued that institutions play a important role in evolutionary economic geography. Yet, to explain regional differences in economic development first and foremost from differences in institutions plays down the central roles played by creative entrepreneurs and global firms as drivers of economic change. Thus, as further elaborated in a later contribution (Boschma and Frenken 2009), we argued that institutions can be integrated in evolutionary economic geography if institutions are treated as conditioning, rather than determining firm behaviour and regional development.

First, in our view, an evolutionary approach perceives the behaviour of firms mainly as stemming from their routines, rather than from territorial institutions. Firms develop routines in a path-dependent and idiosyncratic manner, which makes that routines of firms vary greatly, even under the same institutions. One should therefore avoid reading off the behaviour and

performance of firms from territorial institutions in a deterministic manner (Gertler, 2010). There is little evidence showing that agents act and perform the same when subject to the same institutions. For instance, Giuliani and Bell (2005) have demonstrated that agents in clusters differ widely in terms of economic power, absorptive capacity and network positions, despite the fact that they are all part of the same institutional setting, such as a local culture. This is not to say that institutions do not have an impact on firms. On the contrary, major ruptures, like the collapse of Communist regimes, may transform the selection environment of firms in such a manner that it will lead to firm dynamics and induce institutional change. Yet, we expect their routines will still have an effect on how responsive firms and organizations are to such dramatic changes (Spicer et al., 2000).

Second, to link evolutionary economic geography more firmly to political economy approaches (McKinnon et al., 2009), we suggested (Boschma and Frenken 2009) to explore more fully the political dimension of routines, as advocated by Nelson and Winter (1977, 1982). Research in this area could focus on how firms regulate internally potential conflicts of interests between stakeholders like labour and capital, and how firms develop different routines in that respect. A geographical approach would extend such an analysis to the creation and diffusion of such routines among firms within and across regions, and determine under what conditions such a diffusion process leads to the institutionalization of these routines at various spatial scales. This is an area of research that is still largely unexplored.

Third, EEG avoids treating institutions as pre-given and fixed, but as co-evolving with technologies and markets (Nelson, 1995, Schamp, 2010). Murmann (2003), for example, analysed the entry and exit rates of synthetic dye industries in various countries and attributed the success of Germany primarily to institutional innovations in patent law and university-industry collaboration. And, in her study of the German software sector, Strambach (2010) found that an institutional system is not necessarily coherent, but subject to institutional plasticity, meaning that a range of options for new paths are open within the overarching institutional system. Creative agents can deliberately deviate from the established path, creating new institutions but not necessarily breaking with the institutional system. As Strambach showed, plasticity explains how the customized business software sector in Germany could develop in an unfavourable institutional setting at the national level. These studies show how a dynamic approach to institutions can be fruitfully linked to the study of industrial dynamics at the regional level, by investigating how regions are more likely to adapt their institutions to seize opportunities provided by new industries, or to enable the revival of mature industries, and under what conditions institutional adaptation fails to occur (Maskell and Malmberg, 2007; Hassink, 2010; Martin, 2010). An important question that remains to be studied is the degree to which related industries have overlapping institutional frameworks, and whether regional branching in related industries smoothen the process of institutional adaptation.

Taking up institutions in such a dynamic evolutionary framework, as outlined above, may throw new light on how institutions may matter in economic geography. Such an approach would (1) take the micro-scale of the firm (and its routines) as point of departure; (2) highlight the variety of routines existing in the same institutional setting; (3) argue that, as institutions condition rather than determine behaviour, actors may respond differently to the same institutional change;

(4) throw light on how firms, individually or collectively, can change institutions; and (5) analyse co-evolution of technologies, market structure and institutions at various spatial scales.

6. Concluding remarks

Following our programmatic papers on Evolutionary Economic Geography, we have outlined a number of recent empirical advances. We have tried to demonstrate that evolutionary economic geography has provided new insights on clustering, agglomeration externalities, and the role of institutions in regional development. Having said that, we believe that evolutionary economic geography is still under construction. Some of these empirical applications need to be developed further, and more advanced methodologies that can cope with longitudinal data are required to accomplish this task. And, much can be learnt from the contributions by our fellows in New Economic Geography, Regional Science, and Institutional Economic Geography. We sincerely hope that the Journal of Economic Geography will continue to provide a platform to support plurality and advance scholarship in our field.

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