14 Geographic clustering in evolutionary economic geography

Koen Frenken and Ron Boschma

1. INTRODUCTION

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. In an evolutionary approach to economic geography, one typically reasons from the historical processes that have led to particular spatial patterns such as uneven levels of economic development or clustering of economic activity. The current distribution of economic activity across space is thus understood as an outcome of largely contingent, yet path-dependent, historical processes.

Many of the explanations in EEG are based on firm-level theorizing. That is, rather than taking the region, or any other spatial unit, as the unit of analysis, the firm is considered the locus of development and change (Maskell, 2001). Economic evolution can then be understood as stemming from innovation leading to new organizational routines and their selective transmission across organizational entities, particularly firms (Nelson and Winter, 1982).

This evolutionary perspective, introduced into economic geography in the 1990s (Storper, 1997; Boschma and Lambooy, 1999, among others), and further elaborated by Boschma and Frenken (2006), Martin and Sunley (2006) and Rigby and Essletzbichler (2006), among others, has led to a rich empirical research programme. In this chapter, we report on empirical advances in the area of EEG and discuss open questions and challenges that remain. Rather than giving a comprehensive account of empirical progress made under the label 'evolutionary economic geography' (for an earlier account, see Frenken, 2007; Boschma and Frenken, 2011), we have chosen to focus on the debate on cluster advantages and localization economies. This debate is central to economic geography as a discipline and highlights differences between the evolutionary and other approaches.

The chapter is organized as follows. We first summarize the empirical evidence on cluster advantages by looking at studies that take the firm (rather than the cluster or region, as unit of analysis). We conclude that there is little evidence of localization economies in a strict sense (advantage of co-location with firms in the same industry), while there is quite some evidence for economies stemming from the co-presence of firms active in related industries. We then discuss the evolutionary perspective on geographic clustering and argue that this perspective can accommodate a large part of the empirical findings in one single framework.

2. EMPIRICAL EVIDENCE FOR LOCALIZATION ECONOMIES ON FIRM PERFORMANCE

Over the past decade or so, a large number of empirical studies have been carried out to assess whether firms profit from localization economies (Marshall, 1920), which we define here as the economies stemming from being co-located with firms active in the same or related industry. Most empirical studies are based on either firm growth or firm survival as indicator of performance. Concerning firm growth, many fewer studies exist compared to firm survival, probably due to limited data availability. Frenken et al. (2015) provide a comprehensive overview of these studies, while here we limit ourselves to the main studies and the overall conclusions that can be drawn from this research.

Probably the first comprehensive study on firm growth and localization economies is the study by Beaudry and Swann (2009) on firm growth for 56 two-digit industries in the UK. They found that, in about half of these industries, there is a positive and statistically significant association between firm growth and own-sector employment. Significant associations between firm growth and total employment in other sectors (an indicator of 'urbanization economies') are less common, but where they arise, these associations are generally negative. Cluster effects are strongest in manufacturing and infrastructure industries, but weaker in services.

Other studies have looked at the growth of young firms specifically. For example, Rosenthal and Strange (2005) investigated all new plants in the greater New York metropolitan area in 2001 and found that specialization, measured as location quotients, was positively related to job creation among new firms. Similarly, Wennberg and Lindqvist (2010) analyse firm-level data for Swedish firms that started in the telecoms and consumer electronics, financial services, information technology, medical equipment, and pharmaceutical sectors. They find evidence for localization economies when using absolute measures (firm density or employee counts), yet evidence is substantially weaker when using location quotients as a measure of localization economies. Note here that localization economies are best captured by absolute counts, as benefits are expected to rise with the number of co-located firms in the same or related industry.

Many more studies exist that are based on firm survival as performance indicator. Compared to the few studies on localization and firm growth, the literature on localization and firm survival is much richer. Undoubtedly, this reflects the fact that data on firm survival are easier to collect than data on firm growth. However, whereas the little evidence on firm growth seems to point to localization economies, the evidence of such economies on firm survival is rather weak, if not even opposite to the hypothesis that localization entails positive externalities.

The aforementioned studies by Rosenthal and Strange (2005) and Wennberg and Lindqvist (2010) on firm growth also found evidence for the influence of localization economies on firm survival. Note, however, that these results can be biased in the sense that only new firms are analysed. More comprehensive studies covering all firms and a larger set of industries typically find mixed evidence. The study by Nyström (2007) on Swedish firms found evidence for localization economies in 16 out of 26 industries. Similarly, Renski (2011) finds that industrial localization has a positive influence on new firm survival in five out of eight industries examined.

More detailed studies on firm survival in particular industries analysed cluster effects while controlling for other determinants of firm survival, in particular the pre-entry experience the founder of a firm brings to the firm. Controlling for pre-entry experience is important because founders with more experience often start in clusters as they have worked for another firm as employees (spinoff firms). In a series of studies looking at firm survival in particular industries, including the US car industry (Klepper, 2007), the global fashion design industry (Wenting, 2008), the US tyre industry (Buenstorf and Klepper, 2009), the US semiconductor industry (Klepper, 2010), the German machine-tool industry (Buenstorf and Guenther, 2011) and the Dutch publishing industry (Heebels and Boschma, 2011), firms in clusters did not survive longer than firms outside clusters. Indeed, the absence of cluster effects in all these studies becomes apparent only when controlling for pre-entry experience attributed to spinoffs. This means that clusters typically host more successful firms, yet this success does not stem from clustering, but from the experience entrepreneurs have gained working as employees before they founded their firm.

Some studies take into account localization economies stemming from co-location with firms active in the same industry and economies stemming from co-location with firms active in related industries. This approach more closely follows the definition of clusters as a geographic concentration of a set of related industries (Porter, 2003). Staber (2001) found that co-location of same-industry firms increased business failure rates, while location in diversified clusters of firms operating in complementary industries reduced failure rates. Similarly, Boschma and Wenting (2007) showed for British car manufacturers that firms had lower survival rates when founded in clusters, but higher survival rates in regions with high levels of employment in industries that are related to car production. In a study on all industries in Sweden (1970–2004), Neffke et al. (2012) also found no evidence for localization economies, while the local presence of technologically related industries substantially increased survival rates of plants.

The empirical evidence so far tends to demonstrate that clusters show high levels of firm entry as well as high exit levels (Sorenson and Audia, 2000). Note that we do not consider high entry rates in clusters as evidence that new firms are drawn to clusters due to localization economies (on this, see Frenken et al., 2015). The positive association between clustering and entry rates is likely to reflect the high economic and social costs of relocation. Indeed, studies on tyres (Buenstorf and Klepper, 2009) and lasers (Buenstorf and Geissler, 2011) found no evidence that entrants are drawn to clusters because of the presence of other firms, once controlling for their regional origins. Most founders prefer to locate in the region where they are already located, reflecting the high costs of relocation (Figueiredo et al., 2002), as well as social ties (Dahl and Sorenson, 2012). Heebels and Boschma (2011) found that the main book publishing centre of Amsterdam did not attract many publishing firms from elsewhere. Instead, they found that many book publishers relocated away from the main cluster, probably due to high selection pressures.

3. CLUSTERING AS A DARWINIAN PROCESS

In EEG, the dominant explanation of clustering as resulting from purely localization economies has been challenged (Boschma and Frenken, 2003). From a dynamic

perspective, clustering can be both a source and an outcome of firm performance. That is, localization economies may be a source of firm performance, yet better-performing firms that are co-located will create clusters as worse-performing firms located elsewhere exit.

Klepper (2007) argued that the latter type of process led to the famous Detroit cluster in the US automobile industry. In his framework, firms are assumed to be heterogeneous in their capabilities, partly because of different pre-entry experience and partly because of idiosyncratic (stochastic) factors. The level of pre-entry experience is associated with the extent to which the founder of a firm brings relevant knowledge and capabilities to the newly founded firm. Intra-industry spinoff firms, which are founded by former employees of firms operating in the same industry, bring the most relevant pre-entry experience. Spinoffs or firm diversifying from related industries also carry relevant experience, but less so than intra-industry spinoffs, where industry relatedness refers to the extent to which production in two different industries relies on the same technologies and skills (Neffke and Henning, 2013). Finally, firms started by people without experience in the same or related industry bring no relevant experience to the firm.

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 be forced to exit. As a result, a cluster emerges in the region(s) where the initial successful parents happen to have located in the past.

Klepper's (2007) industry life-cycle study on the US car industry has provided a comprehensive explanation for the emergence of clusters, in this as in other industries (see above). The important contribution of these evolutionary studies on geographic clustering is that they provide an explanation of why clusters emerge even if localization economies do not operate. In all the aforementioned industry studies on cars, fashion design, tyres, semiconductors 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 can 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. As such, an evolutionary explanation of clustering is not contradicted by the weak evidence on localization economies found in other studies reviewed in the previous section.

4. CLUSTERING AND PROXIMITY

From our previous discussion, it has become clear that high entry rates may be held responsible for spatial clustering of industries. This may be due to the spinoff process in which incumbent firms give birth to new firms in the same industry or in related industries. In this latter respect, the local presence of related industries provides assets out of which new industries develop. However, this literature ignores relational issues that may

explain why firms develop in particular places and cluster there. Spinoff companies may perform better because of relevant pre-entry experience of their entrepreneurs, but this may also be due to the fact that spinoffs have maintained close relationships with the parent or have been able to attract the best employees (Wenting, 2008). Clustering may provide opportunities to make (local) connections between people and firms. Recent empirical studies have focused on whether cluster firms are really connected or not, and whether that affects their performance.

As noted earlier, an evolutionary approach reasons from the fundamental logic that firms develop firm-specific routines that differ from each other, and therefore do not easily connect, let alone learn from each other. Clusters are no exception to that rule. Being part of a cluster does not necessarily mean that all cluster firms are connected to each other, as the cluster literature often argues. On the contrary, there is now overwhelming empirical evidence that some cluster firms are highly connected in (local) knowledge networks, while other cluster firms are poorly or not connected at all (Giuliani and Bell, 2005; Boschma and Ter Wal, 2007). Studies have found that some cluster firms excel, while others do not perform economically, despite the fact that they share the same values, norms and other institutions. This has led to a growing empirical body of literature that investigates the drivers behind network tie formation in clusters, and whether these affect the performance of cluster firms. This relational take on clustering and the emphasis on the network position of cluster firms has incorporated insights from the proximity literature, which claims that geographical proximity may facilitate the formation of network ties, but there are also other forms of proximity, such as cognitive, social and institutional proximity, that make firms interact and collaborate (Boschma, 2005). In this way, institutional and social dimensions are more fully incorporated into the evolutionary framework of spatial clustering.

Empirical studies show that the various proximity dimensions do indeed matter for knowledge tie formation. Broekel and Boschma (2012) showed that various forms of proximity, including geographical proximity, are important drivers for network formation in the Dutch aviation industry. Balland et al. (2013) came to similar conclusions when studying network tie formation in the global video game industry. Breschi and Lissoni (2009) found that inventor networks are driven by both social and geographical proximity, because social relationships are more easily established and maintained over short distances. Other studies found that geographical proximity may act as a substitute for other forms of proximity. Singh (2005) found that geographical proximity is especially important in the establishment of interdisciplinary research collaborations, when cognitive proximity between organizations is low. Ponds et al. (2007) found that geographical proximity is especially important in the establishment of university–industry–government relationships, when institutional proximity between those organizations is low. By and large, these studies tend to confirm that geographical proximity is an important driver of knowledge networks, next to other forms of proximity that play a complementary role.

So, the various forms of proximity encourage firms to connect, although it is important to emphasize that most of the studies outlined above have not been carried out at the level of clusters. However, the findings concerning the effect of proximity on firm performance are less straightforward. What tends to emerge from empirical studies is that connections with proximate firms (in their various dimensions) do not enhance

firm performance, but their organizational routines (as often proxied by their absorptive capacity) do matter (Giuliani and Bell, 2005; Boschma and Ter Wal, 2007; Morrison, 2008). This comes close to our earlier observation that clustering does not necessarily enhance firm performance, while the routines of firms (as proxied by the pre-entry background of entrepreneurs) do.

The empirical finding that proximity does not necessarily enhance and possibly even harms firm performance has been called the proximity paradox (Broekel and Boschma, 2012). This perspective states that cognitive proximity between two firms may enhance the risk of involuntary knowledge spillovers, reduce the scope for learning and lead to lock-in situations (Boschma, 2005). Some scholars have opted for the notion of optimal cognitive proximity instead, in which some cognitive distance is needed to stimulate new ideas and creativity, while some degree of cognitive proximity is needed to enable communication and effective knowledge transfer (Nooteboom, 2000). The same line of reasoning has been applied to social proximity, in which too much social proximity leads to excess loyalty such that a firm puts its friends' interests before its own (Uzzi, 1996). Fleming et al. (2007) even found evidence of some optimal social distance that consists of a balance between embedded relationships within cliques and strategic 'structural hole' relationships among cliques. What is still unexplored, though, is the question whether excessive proximity in one dimension may be compensated by lower levels of proximity on other dimensions. For instance, the negative effect of an overload of local linkages in clusters, with little or no extra-cluster ties, may be counteracted when these local ties provide access to a variety of complementary knowledge. This view is supported by Broekel and Boschma (2012), who found that local knowledge ties with technologically distant actors increased the innovative performance of firms in Dutch aviation.

There is also an emerging literature on the long-term dynamics of clustering (Pouder and St John, 1996; Maggioni, 2002; Brenner, 2004; Iammarino and McCann, 2006; Belussi and Rita Sedita, 2009; Fornahl et al., 2010; Menzel and Fornahl, 2010; Boschma and Fornahl, 2011; Martin and Sunley, 2011; Potter and Watts, 2011). Menzel and Fornahl (2010) proposed a cluster life-cycle model in which firms enter and exit the cluster, capabilities of cluster firms develop and interact (and might converge), and inter-organizational linkages within and beyond the cluster are established and dissolved along the cluster life cycle.

Several recent studies have grounded a dynamic view on clustering in a proximity framework. Ter Wal (2014) found evidence that geographical proximity was of less importance as a driver of co-inventor networks in German biotech as time went by, which was explained by the increasing codification of knowledge in biotech. An opposite result was found by Balland et al. (2013) for the video game industry; they demonstrated that geographical proximity became a more important driver of network formation as the industry evolved, as firms were more likely to partner with firms over shorter geographical distance. This tendency of more interfirm collaboration at smaller geographical distances may be explained by the increasing technological complexity of video game development (Sorenson et al., 2006) and the project-based nature of video game production, which make this industry less exposed to processes of standardization and codification of knowledge.

Promising research avenues are the extent to which new clusters build on related industries, and how institutions are created and reshaped to enable the take-off of

clusters (Krafft, 2004). Giuliani (2011) has found evidence that leading firms acting as technological gatekeepers become progressively more important sources of local learning during the early-growth stage of a successful cluster. Besides cluster formation, other core transitions are the renewal and transformation processes of existing clusters, which help them to adapt to changing technological or market environments and to keep their competitiveness over a long period of time. Some studies point to the importance of related diversification (Neffke et al., 2011). Staber and Sautter (2011) have investigated the evolution of the institutional setting in clusters by means of cluster identity. Based on a study of two mature German clusters, they found that cluster identity may form both a threat and an asset for diversifying the cluster in more promising future directions, but that it is human action in the end that makes the difference. However, little is known about how these network structures in clusters change over time, and how it affects the behaviour and performance of cluster firms and the evolution of a cluster as a whole (Cantner and Graf, 2006; Hendry and Brown, 2006; Balland, 2012; Ter Wal, 2014; Li et al., 2011; Vicente et al., 2011).

5. REGIONAL DEVELOPMENT AS A BRANCHING PROCESS

The evolutionary theory of geographic clustering has wider implications for theorizing in economic geography. From this model, it can be derived that the presence of industries that are related to a new industry increases the probability for a new industry to occur. Since the first generation of firms in an industry cannot be composed of spinoffs, they mostly come from related industries bringing relevant pre-entry experience. This means that regions that host industries that are related to the new industry have a higher probability of creating this new industry (Boschma and Wenting, 2007; Buenstorf et al., 2015). That is, there exists 'regional path dependence' (Iammarino, 2005; Martin and Sunley, 2006; Fornahl and Guenther, 2010) in that the existing set of industries conditions the likelihood of new industries emerging.

This 'branching phenomenon' has been analysed in great detail for national growth trajectories. These studies show that countries tend to develop by exporting new products that are related in 'product space' with existing export products (Hidalgo et al., 2007; Hildago and Hausmann, 2009; cf. Saviotti and Frenken, 2008). The product space specifies the relatedness between products as derived from the frequency of co-occurrence of products in countries' portfolios.

The same reasoning can be applied to understand the development of regions becoming active in new markets while building and diversifying their capabilities. Regions are expected to develop new branches of activity that are related to the pre-existing capabilities (Boschma and Frenken, 2011; Neffke et al., 2011). In particular, Neffke et al. (2011) found in a recent study on Swedish regions that industries had a higher probability of entering a region when they were technologically related to other pre-existing industries in that region. Boschma et al. (2013) have tested empirically that this process of branching into related activities is more prominent at the regional (i.e. the sub-national) scale than at the national scale, because the spread of capabilities from old to new sectors is expected to occur through labour mobility and spinoff entrepreneurship, which have a strong local bias. In their study on the emergence of new industries in 50 Spanish regions

in the period 1988–2008, they found that proximity to the regional industrial structure indeed plays a much larger role in the emergence of new industries in regions than proximity to the national industrial structure.

Underlying this regional process are two entrepreneurial strategies (Frenken and Boschma, 2007). First, firms tend to diversify into related activities and the few firms that do not follow this patterns tend to fail. Second, entrepreneurs who found spinoff companies tend to engage in activities that are related to the parent firm (the firm where the founder worked before as an employee). In both cases, it holds that the more that the new and the existing economic activities are related, the higher the probability that knowledge created in one context proves relevant in another industry context. The capabilities developed in one domain can be reused in related domains, and the more two domains are related, the more effective is such reuse.

Considering entry in new industries as stemming from related industries, this framework also captures the phenomenon of recombinant innovation (Fleming and Sorenson, 2001; Van den Bergh, 2008). This concept echoes Schumpeter's (1912) description of innovation as 'Neue Kombinationen', that is, new combinations of existing resources or production factors. Recombinant innovations refer to new technologies or services emerging from recombining parts of pre-existing technologies or services in a novel way. Just to mention one example: photovoltaic films combine solar cells and thin-layer technologies. To the extent that new technologies and services stem from recombination of parts of existing technologies or services, the existing variety in a region largely conditions the scope for innovation to take place.

Yet many technologies and services cannot be meaningfully combined. Rather, one expects that recombinant innovation more often stems from related industries being based on similar knowledge and skills. Hence one expects 'related variety' (Frenken et al., 2007; Boschma and Iammarino, 2009) to be the main source of innovation. Thus firms located in regions with higher levels of related variety are expected to perform better, in accordance with the evidence presented in the section on the benefits of co-location of firms active in related industries. This hypothesis also motivated a study on labour mobility as a vehicle for regional spillovers where it was found that especially labour flows between related industries increase firm performance (Boschma et al., 2009; cf. Breschi and Lissoni, 2009). This can be explained by the logic of recombination: inflow of labour with skills related to the skills already present in the firms leads to new recombinations, while skills unrelated to the skills already present in the firms are much more difficult to recombine.

Note, however, that evolutionary theorizing is non-deterministic. This general remark has two important implications for a theory of regional branching. First, regional success in one industry is not automatically reproduced in the next related industry, as the success of firms is only partly determined by pre-entry experience from related industries. What is more, regions may attract experienced firms from outside the region. Nevertheless, from an evolutionary perspective one expects strong conditioning effects of the existing set of industries in a region on the set of industries and firms that can be expected to emerge.

Second, industry relatedness itself is expected to change over time, albeit slowly. In fact, in the rare cases that recombination innovations between unrelated technologies or services succeed, this in itself can lead to higher level of relatedness among the tech-

nologies or services initially recombined. In this context, one may even argue that 'true' innovation is about making the unrelated related (Desrochers and Leppälä, 2011). Such a radical new combination not only opens up complete new markets and innovation opportunities; it can also be the basis for long-lasting regional competitive advantage, since other regions will face difficulties in copying such radical innovations.

6. CONCLUSION

In this chapter, we have tried to give a brief overview of the empirical literature on evolutionary economic geography (EEG) as far as geographic clustering of industries is concerned. The dominant explanation of clustering as resulting from purely localization economies has been challenged by empirical studies in EEG. These show that there is little evidence of localization economies in a strict sense (i.e. advantages of co-location with firms in the same industry). The key contribution of these evolutionary studies on geographic clustering is that they provide an explanation of why clusters emerge even if localization economies do not operate. In addition, they have demonstrated that not all firms are evenly connected to local knowledge networks and perform equally in clusters, despite the fact that they are part of the same set of institutions. Moreover, there is now quite some evidence for economies stemming from the co-presence of firms active in related industries. In particular, there is increasing evidence that new industries branch out of related industries at the regional level. This may lead to new theorizing on regional branching, in which the existing set of industries in a region conditions the set of industries that can be expected to emerge. Studies on clusters are also starting to focus on their evolution, from the formative stage of clusters to their later stages of development, and trying to identify the ways cluster firms adapt and transform over time.

As stated earlier, this empirical literature on EEG is still very much work in progress. This also applies to the main concepts and the theoretical framework of EEG under construction (see, e.g., Boschma and Frenken, 2011; Martin and Sunley, 2011). As with every empirical study, many of the studies outlined above provide preliminary answers to basic questions but also bring up new questions and problems not yet explored. There is no doubt that the future research agenda in EEG is more than full, and we interpret this as a positive and promising sign.

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