



Relatedness as driver of regional diversification: a research agenda

Ron Boschma

To cite this article: Ron Boschma (2017) Relatedness as driver of regional diversification: a research agenda, *Regional Studies*, 51:3, 351-364, DOI: [10.1080/00343404.2016.1254767](https://doi.org/10.1080/00343404.2016.1254767)

To link to this article: <https://doi.org/10.1080/00343404.2016.1254767>



Published online: 12 Dec 2016.



Submit your article to this journal [↗](#)



Article views: 2379



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 13 View citing articles [↗](#)

ANNUAL LECTURE

Relatedness as driver of regional diversification: a research agenda

Ron Boschma

ABSTRACT

Relatedness as driver of regional diversification: a research agenda. *Regional Studies*. The regional diversification literature claims that regions diversify in new activities related to their existing activities from which new activities draw on and combine local capabilities. The paper offers a critical assessment and identifies a number of crucial issues for future research. It calls for (1) a disentanglement of the various types of capabilities that make regions diversify; (2) the inclusion of more geographical wisdom in the study of regional diversification, like a focus on the effects of territory-specific contexts, such as institutions; (3) a thorough investigation in the conditioning factors of related and unrelated diversification in regions; and (4) a micro-perspective on regional diversification that assesses the role of economic and institutional agents in a multi-scalar perspective.

KEYWORDS

regional diversification; related diversification; unrelated diversification; institutional entrepreneurship; evolutionary economic geography; institutional change

摘要

关联性作为区域多样化的驱动力: 一个研究议程。 *Regional Studies*。区域多样化的文献主张, 区域在有关其既有活动的新形态活动中产生多样化, 其中新的活动运用并结合在地能力。本文提供批判性的评估, 并指认未来研究的若干关键议题。本文呼吁(1)拆解让区域产生多样化的各种能力类别;(2)在区域多样化的研究中纳入更多地理智慧, 如同聚焦诸如制度等特定领土脉络之效应;(3)通盘检视区域内部相关和非相关多样化的条件因素; 以及(4)以多重尺度的视角评估经济和制度行动者的角色之区域多样化的微观观点。

关键词

区域多样化; 相关多样化; 非相关多样化; 制度创业精神; 演化经济地理; 制度变迁

RÉSUMÉ

La connexité comme force motrice de la diversification régionale: un calendrier des recherches. *Regional Studies*. La documentation sur la diversification régionale prétend que les régions diversifient dans de nouvelles activités liées à leurs activités actuelles, d'où les nouvelles activités font appel et se combinent aux compétences locales. Cet article fait un bilan critique et identifie quelques questions fondamentales pour de futures recherches. On demande (1) un démêlage des diverses catégories de compétence qui facilitent la diversification régionale; (2) l'inclusion de plus de sagesse géographique dans les études sur la diversification régionale, par exemple mettre l'accent sur les effets des contextes spécifiques à un territoire, tels les institutions; (3) un examen approfondi des déterminants de la diversification connexe et non connexe dans les régions; et (4) un point de vue micro-économique de la diversification régionale qui évalue le rôle des agents économiques et institutionnels dans un optique multi-scalaire.

MOTS-CLÉS

diversification régionale; diversification connexe; diversification non connexe; entrepreneuriat institutionnel; géographie économique évolutionniste; changement institutionnel

CONTACT

✉ ron.boschma@circle.lu.se; r.boschma@geo.uu.nl

Center for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University, Lund, Sweden; and Urban and Regional Research Centre Utrecht (URU), Utrecht University, Utrecht, the Netherlands.

ZUSAMMENFASSUNG

Verwandtschaft als Motor der regionalen Diversifizierung: ein Forschungsprogramm. *Regional Studies*. In der Literatur über regionale Diversifizierung wird behauptet, dass sich Regionen über neue Aktivitäten diversifizieren, die mit ihren vorhandenen Aktivitäten verwandt sind und auf denen die neuen Aktivitäten unter Kombination lokaler Fähigkeiten aufbauen. Dieser Beitrag enthält eine kritische Bewertung unter Identifizierung verschiedener wichtiger Fragen für die künftige Forschung. Gefordert werden (1) eine Entflechtung der verschiedenen Arten von Fähigkeiten, die zur Diversifizierung von Regionen führen, (2) die stärkere Berücksichtigung von geografischem Wissen in der Erforschung der regionalen Diversifizierung, wie zum Beispiel eine Konzentration auf die Effekte von gebietsspezifischen Kontexten wie Institutionen, (3) eine gründliche Untersuchung der konditionierenden Faktoren von verwandter und unverwandter Diversifizierung in Regionen und (4) eine Mikroperspektive der regionalen Diversifizierung zur Bewertung der Rolle von ökonomischen und institutionellen Akteuren in einer multiskalaren Perspektive.

SCHLÜSSELWÖRTER

regionale Diversifizierung; verwandte Diversifizierung; unverwandte Diversifizierung; institutionelles Unternehmertum; evolutionäre Wirtschaftsgeografie; institutionelle Veränderung

RESUMEN

Relación como impulsor de la diversificación regional: un programa de investigación. *Regional Studies*. En las publicaciones sobre diversificación regional se manifiesta que las regiones se diversifican en nuevas actividades relacionadas con sus actividades existentes desde donde se aprovechan y combinan las nuevas actividades con capacidades locales. Este artículo contiene una valoración crítica para identificar una serie de cuestiones fundamentales para estudios futuros. Insta a (1) una separación de los diferentes tipos de capacidades que hacen que las regiones se diversifiquen; (2) la inclusión de un juicio más geográfico en el estudio de la diversificación regional, como por ejemplo un enfoque en los efectos de los contextos específicos de los territorios, tales como las instituciones; (3) una investigación exhaustiva sobre los factores condicionantes de la diversificación relacionada e inconexa en las regiones; y (4) una micro-perspectiva sobre la diversificación regional que evalúe el papel de los agentes económicos e institucionales desde una perspectiva multiescalar.

PALABRAS CLAVES

diversificación regional; diversificación relacionada; diversificación inconexa; empresariado institucional; geografía económica evolutiva; cambio institucional

JEL O18, R0, R11

HISTORY Received 24 April 2016; in revised form 13 October 2016

INTRODUCTION

Economic diversification of regions is high on the agenda of scientists and policy-makers alike. There is increasing awareness that the existing set of local capabilities conditions which new activities will be feasible to develop in regions. Indeed, studies (e.g., Neffke, Henning, & Boschma, 2011; Rigby, 2015) show that regions tend to diversify in new activities related to their existing activities from which they draw and combine local capabilities. In policy circles in the European Union, the concept of related diversification is also increasingly regarded as highly relevant for smart specialization strategies that aim to develop new growth paths in regions (Foray, 2014; McCann & Ortega-Argilés, 2014).

These recent insights on regional diversification have also led to ongoing debates concerning a number of outstanding issues (e.g., Tanner, 2014). These concern the meaning and measurement of relatedness, the identification and relative importance of related versus unrelated diversification, the significance of local capabilities versus non-local linkages for regional diversification, the territory-specific nature of relatedness (can relatedness be

considered a global phenomenon?), and the role of micro-agents including individuals, firms, policy-makers and other institutional actors. The objective of this paper is to discuss these outstanding issues, and to set out a future research agenda on regional diversification.

First, the literature on regional diversification claims that related activities demand similar capabilities. Capabilities are often broadly defined, and empirical studies employ different measures of relatedness, such as technological relatedness (Breschi, Lissoni, & Malerba, 2003), product relatedness (Hidalgo, Klinger, Barabasi, & Hausmann, 2007) and skill relatedness (Neffke & Henning, 2013). Relatedness is often defined in terms of similarities between activities that capture the cognitive dimension of capabilities (and thus implies learning). Less attention has been focused on complementarities, that is, the need to combine different activities in order to diversify. This has led scholars to question what relatedness actually stands for (Tanner, 2014), and to be more specific about what types of capabilities matter in regional diversification.

Second, studies tend to show that related diversification is the rule, and unrelated diversification the exception. This dichotomy comes close to the distinction between new path

creation (the emergence of entirely new sectors or products) and path renewal which refers to activities switching to new but related activities (Isaksen & Trippel, 2014). It is argued here that this necessitates a discussion about how unrelated diversification is defined. Because both related and unrelated capabilities are likely to be combined in regional diversification, this paper proposes to go beyond a simple dichotomy of related and unrelated diversification and investigate what factors facilitate regional diversification of a more related and a more unrelated type.

Third, the literature on regional diversification is in need of more geographical wisdom. It tends to treat relatedness between activities as a global phenomenon (Boschma, Minondo, & Navarro, 2013; Hidalgo et al., 2007). However, the degree and nature of relatedness might differ from region to region: some activities might be related in region A, but not in region B, depending on their particular histories. Moreover, it is still unclear what type of diversification prevails in certain regions as compared with other regions (Xiao, Boschma, & Andersson, 2016). This requires comparative studies of countries and regions to determine the territory-specific nature of relatedness. Furthermore, evidence suggests that non-local capabilities, besides local capabilities, influence regional diversification (Isaksen, 2015; Trippel, Grillitsch, & Isaksen, 2015). This calls for a multi-scalar perspective to assess the relative importance of local and non-local capabilities (Binz, Truffer, & Coenen, 2014).

Fourth, the regional diversification literature needs to incorporate a micro-perspective in which the focus is on the role of agency and the identification of agents that drive the process of regional diversification. This requires a comprehensive micro-perspective that accounts for the role of and interplay between individuals (like key entrepreneurs, star scientists), firms (like start-ups, spinoffs, diversifiers, local, multi-local and non-local firms) and a set of institutional players (including policy-makers), and which types of agents are responsible for what type of (more or less related) diversification in regions (Binz et al., 2014; Dawley, 2014).

The paper is structured as follows. The next section gives a brief overview of the main quantitative studies on related diversification in regions, and how these studies have measured relatedness. The third section takes a critical stand towards the treatment of capabilities and relatedness. The fourth section discusses different forms of regional diversification. The fifth section calls for the need for comparative regional studies. The sixth section discusses the need for a comprehensive micro-perspective on regional diversification. The seventh section concludes.

REGIONAL DIVERSIFICATION AND RELATEDNESS

There is a large body of literature that refers to local capabilities¹ to explain why regions specialize, and why those specialization patterns tend to be persistent over time. Capabilities are often used as an umbrella concept for local assets that consist of a wide range of dimensions. In

a highly cited paper, Maskell and Malmberg (1999) refer to local capabilities as a combination of the region's infrastructure and built environment, natural resources, institutional endowment, and knowledge and skills. Local capabilities are depicted as the outcome of a long history that are hard to copy by other regions, due to the myopic behaviour of local agents, the tacitness of the local knowledge base (Gertler, 2003), untraded interdependencies (Storper, 1995), and their systemic nature (Asheim & Isaksen, 1997).

Recently, scholars have shifted attention from capabilities sustaining existing specializations in regions to capabilities driving the creation of new specializations in regions.² Besides providing crucial assets on which existing specializations in regions can thrive, country- and region-specific capabilities can also be considered a key source of regional diversification, as they can provide opportunities to make new combinations that give birth to new activities. However, the current set of local capabilities also sets limits to regional diversification. If a region does not possess the capabilities required for a new activity, it will be harder to develop it. Therefore, regions are expected to be more likely to diversify into new activities that are related to existing local activities, to build on their local capabilities.

This focus on regional diversification is not new in economic geography. On the contrary, since the 1980s, if not before, studies have provided key insights on how regions have managed, or not, to move into new specializations, Silicon Valley being the classic case (e.g., Markusen, Hall, & Glasmeier, 1986). The recent revived interest in the topic is new, however, in the sense that it has led to quantitative studies investigating the diversification process in many regions simultaneously, instead of focusing on particular regional cases, like the usual suspects (Silicon Valley), the perceived doomed (Detroit) or the peculiar cases (Dubai). These quantitative studies claim that new activities are not random events or historical accidents but embedded in territorial capabilities. Regional diversification is depicted as an emergent branching process (Frenken & Boschma, 2007) in which new activities draw on and combine related local activities (Fornahl & Guenther, 2010; Martin & Sunley, 2006).

This branching phenomenon has been analyzed first by Hidalgo et al. (2007) at the level of countries. Branching is here captured by building a comparative advantage in export products that are new to the country and related to existing export products in the country.³ Hidalgo et al. test whether national capabilities condition which new export products are more feasible to develop. Capabilities are taken up by the proximity concept that captures all possible dimensions that make products co-locate in the same country. Hidalgo et al. construct a 'product space' that specifies the degree of proximity between products based on the frequency of co-occurrence of products in countries' export portfolios. Two products are considered proximate if many countries have a revealed comparative advantage in both products, because that would reflect the two products demanding similar capabilities. Hausmann and Klinger (2007) demonstrate that countries

tend to develop new export products that are related in product space with existing export products, and that countries that have many related export products have more options to diversify into new export products.⁴

A similar logic has been applied to understand regions entering new product markets. Neffke et al. (2011) were the first to investigate systematically the diversification of regions in industries that are new to a region. They tested the idea that regional capabilities condition which new products are more feasible to develop. Following Teece, Pisano, and Shuen (1997), capabilities are captured by product relatedness which specifies technological relatedness between products based on the frequency of co-occurrence of products in the product portfolios of plants. Neffke et al. (2011) analyzed 2766 events of a new industry entering a Swedish region in 1969–2002 and found that an industry had a higher probability of entering a region when technologically related to pre-existing industries in that region. This finding on related industrial diversification has been replicated in follow-up studies, like Boschma et al. (2013) for 50 Spanish regions in 1988–2008 (using the proximity indicator of Hidalgo et al., 2007), Esslezbichler (2015) for 360 US metropolitan regions in 1977–97 (using a relatedness measure based on intensity of input–output linkages between 362 US manufacturing industries), and He, Yan, and Rigby (2015) for 337 Chinese prefectures in 1998–2008 (using proximity indicator of Hidalgo et al., 2007, based on co-occurrence of specializations in Chinese regions). Muneeppeerakul, Lobo, Shutter, Gomez-Lievano, and Qubbaj (2013) conducted an analysis of occupational diversification in US metropolitan regions, using a relatedness measure of 787 occupations, based on the frequency of co-location of occupational specializations in metropolitan statistical areas (MSAs). Brachert (2016) did a similar study on occupational diversification for German regions and came to the same conclusion that relatedness matters.

The same line of reasoning has been applied to technological diversification of regions. Rigby (2015) was the first to study technological diversification of regions using patent data. Capabilities are captured by technological relatedness between knowledge claims based on the frequency of co-occurrence of technology classes on patent documents. When two technology classes are mentioned on the same patent document over again, it reflects the fact that they are technologically related in ‘technology space’.⁵ Rigby found that technologies related to pre-existing technologies in a US metropolitan region had a higher probability to enter that region in 1975–2005. This finding has been replicated in other studies (Boschma, Balland, & Kogler, 2015; Kogler, Rigby, & Tucker, 2013). It has also been confirmed for the rise of eco-technologies in European regions in 1982–2005 (Van den Berge & Weterings, 2014), fuel cell technology in European regions in 1992–2007 (Tanner, 2014, 2016), nanotechnologies in European regions in 1986–2006 (Colombelli, Krafft, & Quattraro, 2014), biotechnologies in 276 world cities in 1989–2008 (Boschma, Heimeriks, & Balland, 2014; Heimeriks & Boschma, 2014), and rDNA (i.e., recombinant)

technology across US metropolitan areas in 1980–2005 (Feldman, Kogler, & Rigby, 2015).

In sum, these studies provide systematic evidence that the existing set of local capabilities conditions which new activities are more likely to develop in regions, despite differences in the dependent variable (new products, industries, technologies, professions), relatedness measures (e.g., product relatedness, technological relatedness, skill relatedness, input–output relatedness), spatial units of analysis (e.g., countries, regions, cities, labour market areas) and the time periods covered.

CAPABILITIES AND RELATEDNESS

In these studies on regional diversification, activities are considered related when they require similar capabilities. This has led to a debate about what is exactly meant by the notion of capabilities, how relatedness has been defined and measured, and what types of capabilities matter for regional diversification (Tanner, 2014).

In the regional diversification literature, capabilities are often defined in a very broad manner and embody a wide range of dimensions that can potentially make activities related. This is most pronounced in the study of Hidalgo et al. (2007) which does not specify what determines the relatedness between products, but indirectly derives a relatedness measure from the frequency of co-location of the same pairs of products. If there is a substantial and frequent presence of the same combination of two products in the same location, this is regarded as a reflection of the two products demanding similar capabilities.⁶ Here, the exact nature of local capabilities is not directly observed, but by using information on the co-location of products, scholars identify which products share similar capabilities (Neffke, Hartog, Boschma, & Henning, 2016). This principle of similar resource requirements has been applied widely at the level of organizations to determine relatedness between industries (Teece, Rumelt, Dosi, & Winter, 1994).

Studies on regional diversification have also opted for a more narrow definition of relatedness. The product relatedness measure by Neffke et al. (2011), for instance, captures technological relatedness in production between products. Co-occurrence analysis is done at the plant level, not at the firm level, as the latter would also take up product market relatedness, and also similarities in marketing and distribution capabilities (Teece et al., 1994). Products are considered related when requiring similar skills or machines in plants to produce them, reflecting economies of scope.⁷ Neffke et al. (2016) used another skill-relatedness measure that accounts for similarities in workers’ skill requirements in industries, using information on the intensity of human capital flows between industries. This focus on inter-industry labour flows takes up similar skill requirements, as workers have the incentive to move to industries where their skills are still valued highly, and firms are more willing to recruit workers from industries with relevant skills (Neffke & Henning, 2013). Esslezbichler (2015) used yet another relatedness indicator, that is, input–output relatedness between industries, that is

based on the similarities of supplier–buyer relationships between industries. This relatedness measure takes up an input–output externality that exists across industries.

Relatedness has often been treated as a symmetrical measure: product A is considered as much related to product B, as B is related to A. In reality, however, there is likely to be asymmetry: A might be related to B, but not necessarily the other way around. For example, computer hardware skills might be relevant for the software industry, but software skills may be of lesser value to the computer industry. Using this information on asymmetry in relatedness might lead to new insights on regional diversification: it might imply that the presence of a computer hardware industry in a region facilitates diversification towards software, but the presence of a software industry in a region would not necessarily increase the probability of a region diversifying in computer hardware. This application of the concept of asymmetry would bring the study of regional diversification more in line with other asymmetrical forces that have been identified in economic geography, like unequal trade, brain drain and unbalanced knowledge flows.

Relatedness is often understood in terms of both similarity and complementarity (Makri, Hitt, & Lane, 2010). Breschi et al. (2003) define relatedness as being similar when knowledge is proximate in the cognitive dimension, providing opportunities for interactive learning, and when the same knowledge is used in more than one technology. This is different from relatedness in terms of complementarities which refers to the necessity of bringing together different technologies or products and combine them (Broekel & Brachert, 2015). Some studies on regional diversification explicitly refer to relatedness in terms of similarity, focusing on the potential of knowledge spillovers between activities that share common knowledge (Neffke et al., 2011). However, most studies are less specific and refer to relatedness in terms of similarity and complementarity interchangeably. Future research should start making an effort to disentangle the two types of related capabilities in order to determine the relative importance of similarities versus complementarities for regional diversification.

In sum, there is clearly no single measure of relatedness as it encompasses many dimensions. Some studies on regional diversification have used broad measures of relatedness, while others have applied more narrowly defined relatedness measures. So far, the various relatedness measures have simply been employed in robustness analyses to check whether the finding of relatedness as a driver of regional diversification is independent of the use of the specific relatedness measure. By and large, studies show that the same finding holds, irrespective of the relatedness measure. However, the various relatedness measures are also likely to take up different types of capabilities that are not captured separately in current studies. A promising next step would therefore be to assess which types of related capabilities are drivers of regional diversification. One could, for instance, differentiate between the three Marshallian types of related

externalities (knowledge spillovers, labour skills and input–output linkages) and investigate simultaneously the effect of each type on regional diversification, as these reflect different transfer channels of resources across related activities. Such studies would contribute to an understanding of what types of capabilities cause regions to diversify.

RELATED AND UNRELATED DIVERSIFICATION

As presented in the second section, studies show that related diversification predominates. This is not unexpected, as new capabilities required for related diversification are easier to acquire when being close to existing local capabilities, while unrelated diversification requires completely new capabilities that involve high risks and costs (Saviotti & Frenken, 2008). However, the same studies show that unrelated diversification also occurs, though less frequently. This calls for clarification about how related and unrelated diversification are defined and analyzed.

Studies on regional diversification have investigated whether the entry probability of a new activity in a region is affected by the degree of relatedness with existing local activities. A positive effect of relatedness would indicate related diversification, while a negative effect implies that regions make jumps in their industrial evolution, and unrelated diversification prevails (Boschma & Capone, 2015; Zhu, He, & Zhou, 2015). Following Neffke et al. (2016), it is argued here that the more radical the transformation in the underlying local capabilities is needed to develop a new activity, the more it concerns unrelated diversification. This would be the case when a region diversifies from clothing to aerospace to pharmaceuticals, as each of these new industries requires new and very different capabilities. In contrast, if a region diversifies from motor cycles to cars to trucks, this would reflect related diversification, as the three industries are likely to draw on similar capabilities, like an engineering knowledge base. In reality, one expects related diversification in regions to be more a matter of degree (more or less related), as new activities are likely to build on and combine both local related capabilities and unrelated capabilities. This implies that one needs to leave behind the sharp distinction between related versus unrelated diversification.

The recombinant approach might be relevant here, as radical breakthroughs are considered to be the result of recombinant search processes (Fleming, 2001; Weitzman, 1998). Combining knowledge in new ways, leading to radical breakthroughs, corresponds to explorative, distant search, while combining knowledge along well-defined paths, leading to incremental change, is associated with exploitation and local search (Arts & Veugelers, 2015; March, 1991). In such a recombinant framework, related diversification can be redefined as new combinations between (local) capabilities that have been combined before, while unrelated diversification embodies new combinations of (local) capabilities that were not previously

combined (Castaldi, Frenken, & Los, 2015). However, in reality, new activities are unlikely to emerge from new combinations between either completely related or completely unrelated activities, but tend to make combinations between both types. Such a recombinant approach has been applied in studies on research collaborations and technical alliances (Boschma & Frenken, 2010; Gilsing, Nooteboom, Vanhaverbeke, Duysters, & Van den Oord, 2008), but has not yet been applied to the study of regional diversification.

The recombinant approach to regional diversification has interesting features. To start with, it would leave behind the static treatment of relatedness in studies on regional diversification. Relatedness would become dynamic itself: previously unrelated activities become related as soon as they are connected in successful new combinations (Castaldi et al., 2015; Desrochers & Leppälä, 2011). A telling example is the self-driving car that emerges out of new combinations of technology fields in automotives, sensor-based safety systems, communication and high-resolution mapping that have not been combined before. A key research question is to assess whether unrelated activities in the same location are more likely to be combined and become related, as compared with unrelated activities that do not share the same location. Moreover, local related industries might also become unrelated once they lose their combinatory potential and are not combined anymore. This has implications for the resilience of regions, as positive spillovers between local related activities will cease to exist.

Such a recombinant approach could also exploit further network properties of the product space introduced by Hidalgo et al. (2007) which is constructed on the basis of relatedness between pairs of products. What has been ignored so far are the indirect connections between products (Janssen, 2015), like two products might be related through triad closure (indirectly connected through another product) or through short paths (indirectly connected through a chain of related products). The probability of regions to diversify can be affected by these network properties.

The issue of related versus unrelated diversification needs to be taken up in future research. A promising line of research is to determine whether more related or unrelated diversification prevails in certain regions as compared with other regions. Moreover, a crucial question is whether regions can keep relying on more related diversification to sustain long-term development, or whether they need to diversify in unrelated activities to avoid lock-in in the long run, as these may open up completely new market opportunities (Saviotti & Frenken, 2008). There are no studies yet to date that have provided systematic evidence. Furthermore, there is a need to increase one's understanding of the conditioning factors that facilitate more related or more unrelated diversification in regions (Boschma & Capone, 2015; Montresor & Quatraro, 2015). This requires adding more geographical wisdom to the study of regional diversification, a topic to which the paper now turns.

THE NEED FOR MORE GEOGRAPHICAL WISDOM

There is a need to include more geographical wisdom into research on regional diversification on at least three grounds. First, one needs more understanding of the types of diversification that take place in different types of regions, and which factors, such as institutions, influence the various types of diversification. Second, relatedness tends to be treated as a global universal measure, but the degree and nature of relatedness might differ from region to region. This calls for comparisons between countries and regions to determine the territory-specific nature of relatedness. Third, studies focus primarily on local capabilities driving regional diversification, but there is little understanding about how non-local capabilities may influence regional diversification, and at what spatial scale (Isaksen, 2015).

To start with, there is yet little knowledge about which types of regions have a stronger ability to diversify, what type of diversification prevails in which types of region, and which regions contribute to radical changes in product space (Xiao et al., 2016). Are urban regions more capable of diversifying as compared with old industrial regions or peripheral regions? And do core urban regions have more of a tendency to diversify in more unrelated activities, because there are more opportunities to make new combinations between local activities? And what about the effect of related versus unrelated variety (Castaldi et al., 2015)? There is an increasing amount of single regional case studies on new path creation that provide new and important insights (e.g., Isaksen, 2015), but no studies yet exist that compare the intensity and type of diversification in many regions simultaneously in a systematic way.

Scholars are starting to investigate the conditions that make regions more likely to diversify into related or unrelated activities. An emerging research strategy is to interact the relatedness variable with conditioning factors to see whether the positive impact of relatedness on regional diversification is strengthened (more related diversification) or weakened (more unrelated diversification) by these factors. Boschma and Capone (2016) found a remarkable difference within Europe. Broadly speaking, West European countries tend to diversify in more unrelated industries, while East European countries tend to diversify into new industries that are more closely related to their existing industries. Petralia, Balland, and Morrison (2016) showed that high-income countries have a higher tendency to diversify into unrelated technologies, in contrast to lower-income countries. So, it seems that the economic level of countries influences the nature of diversification. Within advanced countries, Boschma and Capone (2015) tested whether institutions do matter for the types of diversification that prevail in countries. They found evidence that institutions associated with so-called 'liberal market economies' (i.e., institutions that regulate less tightly labour, capital and product markets) give countries more freedom to diversify in more unrelated activities. This stands in

contrast to institutions that coordinate more tightly such market relations, known as ‘coordinated market economies’, which make countries focus more on related diversification because their institutions make them stick more closely to what they have been doing in the past.

This need for more focus on institutions in the regional diversification literature opens up possibilities to connect to the international catch-up literature that focuses on the role of technological and social capabilities in countries to catch up and decrease the distance to the technology frontier (Fagerberg & Srholec, 2008; Lall, 1992). Typical of this literature is to stress that social capabilities are crucial to turn technological capabilities into economic development. Fagerberg, Feldman, and Srholec (2014) refer to technological capabilities as the ability to make effective use of knowledge to create new knowledge and innovations through innovation and finance capabilities. They take a broad definition of social capabilities that includes the public knowledge infrastructure, a well-functioning labour market, and the prevalence of norms, values and other institutions that support the functioning of society, such as income equality. This complementary role of technological and social capabilities resembles the work of Rodríguez-Pose and Crescenzi (2008) who claim that knowledge is not sufficient, but that the right institutions are needed to turn this latent capacity into economic development.

Cortinovis, Xiao, Boschma, and Van Oort (2016) have investigated the effect of regional institutions on the ability of European regions to diversify. They found no direct effect of the quality of government in regions, but found a positive effect of ‘bridging social capital’ in a region, while ‘bonding social capital’ (with more focus on intra-group interactions) had no or even a negative effect on regional diversification. This suggests that diversification requires making combinations between different activities that is facilitated by social capital that can bridge different social groups. Interestingly, in the case of low quality of government in regions, bridging social capital had an even stronger positive effect on regional diversification, while bonding social capital had a stronger negative effect. So, bridging social capital in regions seems to be a crucial enabling factor, especially when strong formal institutions are lacking.

Another enabling factor of regional diversification is the local presence of key enabling technologies (KETs) (Melicani, 2015). Montresor and Quatraro (2015) found that European regions with a strong presence of KETs had a tendency to diversify into more unrelated technologies. Based on patent application data, they found a weaker effect of relatedness (local pre-existing-related technologies) for technological diversification in regions endowed with all KETs during 1980–2010.

Isaksen and Trippel (2014) have linked different types of regional innovation systems to the question whether regions are more likely to develop new growth paths, and if so, whether regions focus on new path creation versus path renewal. Another potential application of a system approach to regional diversification is to draw a product space in every region, and then include region-specific

network variables to estimate their effect on the probability of regions to diversify. Network hypotheses developed previously can then be refined and tested, like whether networks that consist of a high number of nodes with few connections (which might give access to new and non-redundant knowledge) favour new path development, in contrast to a closely tied core in a network (Crespo, Suire, & Vicente, 2014), or whether a network structure with strong relationships within cliques and structural holes between cliques favours more unrelated diversification in regions (Balland, De Vaan, & Boschma, 2013; Fleming, King, & Juda, 2007).

Another way to include more geographical wisdom in the regional diversification literature is to be more specific about whether the product space differs from country to country, and from region to region. So far, studies have used a universal global measure of relatedness, such as studies that employed export data of both advanced and developing countries to determine product relatedness. From a geographical point of view, a relevant question is: does product space differ from country to country, and from region to region, and if so, to what extent? So, is relatedness between activities independent of their spatial context? Or is there a geographical dimension to that: are some activities related in country A, but not in country B, reflecting their own specific geographical history? This is an empirical question, but one also needs to theorize about why some industries are expected to be related in one spatial context, and not in another, to leave behind the a-contextual view of relatedness in many studies. This makes even more relevant the search for regional factors that enable more related or more unrelated diversification, as outlined above.

What is more, the literature on regional diversification has primarily focused on the role of local capabilities, showing that relatedness at the local scale is a crucial driver of diversification. Studies have also shown that industries are more closely related to one another (i.e., more coherent) at the regional than at the national scale (Neffke et al., 2011). Boschma et al. (2013) demonstrated in a study on Spain that regional capabilities are more important than national capabilities for regional diversification. However, a current weakness of this prime focus on national and regional capabilities is that it has neglected the role of extra-regional linkages and actors that might affect regional diversification (Asheim & Isaksen, 2002; Dahl Fitjar & Rodríguez-Pose, 2011; Moodysson, 2008; Trippel et al., 2015).

Recent papers have focused on the role of neighbour countries (Bahar, Hausmann, & Hidalgo, 2014) and regions (Boschma, Martin, & Minondo, 2016) to develop comparative advantage in new industries. These studies found that regions are more likely to develop new export industries in which their neighbour regions are specialized, and neighbour regions tend to have more similar export structures when they are highly connected (Boschma et al., 2016). A promising research avenue is to assess the role of extra-regional linkages more systematically, as new combinations are likely to depend on both local and non-

local inputs. Andersson, Bjerke, and Karlsson (2013) found a positive effect of high-quality imports on the introduction of new high-quality export products in regions, suggesting import spillover effects at the regional scale. The same study found that openness of a regional economy had a positive influence on such economic renewal in regions. Isaksen (2015) makes the point that peripheral regions may depend more on external investments or people, which might also favour a tendency of more unrelated diversification in peripheral regions. As this reliance on external sources may be induced by individuals (like migrated entrepreneurs) and organizations (like multinationals) coming from other regions, the next section discusses the role of agency in new path creation.

THE NEED FOR A MICRO-PERSPECTIVE ON REGIONAL DIVERSIFICATION

So far, the paper has discussed how capabilities at various spatial scales condition the nature of diversification, but little to no attention has yet been paid to the role of agency, and the different types of agents that may drive regional diversification. First, it is argued that the regional diversification literature should incorporate a micro-perspective to understand which types of firms (like non-local firms) and which types of individuals (entrepreneurs, migrants) make a difference. Second, it is argued that such a micro-perspective also requires a focus on institutional agents, besides firms, that change institutions to enable the diversification process in regions. It is argued here that this requires more understanding of why agents in some regions, and not in others, are more successful in doing so.

The work of Klepper on the emergence of new industries (Klepper, 2007; Klepper & Simons, 2000) can be regarded as a first step to a micro-foundation of the regional branching literature (Boschma, 2015). For long, a key topic is whether new start-ups or incumbents develop radical innovations and new industries. For Klepper, it were start-ups founded by entrepreneurs with experience in related industries (i.e., spinoffs from incumbents in related industries), rather than start-ups per se, and incumbents that diversified from related industries, rather than incumbents, that played a decisive role in the formative stage of an industry. His observation of spinoffs and diversifiers from related industries giving birth to new industries provided strong empirical support at the micro-scale for the process of related regional diversification.

In a study on Sweden, Neffke et al. (2016) found that new plants induce more unrelated diversification in regions. In the short run, this is especially true for new plants set up by entrepreneurs, as compared with new plants (subsidiaries) set up by incumbents. In the long-run, the difference between the two types of new plants disappears because it is harder for stand-alone entrepreneur-owned plants than for subsidiaries to survive in regions that offer little to no local related externalities, as subsidiaries can still draw on firm-internal resources.

There is increasing evidence that more unrelated diversification comes from the outside, through the inter-

regional mobility of entrepreneurs and firms. Neffke et al. (2016) showed that new plants from outside the region, and not so much local start-ups, introduce more unrelated diversification in regions. Especially new subsidiaries that are established by large firms in other regions induce structural change because the ownership link subsidiaries have with their parent in their home region allows them to develop activities that rely on resources that do not exist in the host region, and so can overcome the liability of newness. This is in line with work on multinational enterprises (MNEs) that shift specializations of regions into new directions (Crescenzi, Gagliardi, & Iammarino, 2015; Iammarino & McCann, 2013). There still is, however, a need to increase the understanding of how MNEs influence regional diversification. This is likely to depend on the investment strategies of MNEs: when they invest in a host region to exploit their technological superiority and take benefit from low local costs to produce standardized goods, more unrelated diversification is more likely to occur, with little spillovers to the local economy. Instead, when MNEs make R&D investments in activities that are related but not identical to activities in host region, with the purpose of exploiting local learning opportunities (while avoiding knowledge leakage to competitors), more related diversification occurs, with positive spillovers to the host region (Cantwell & Iammarino, 2003).

Not only the inflow of firms but also the inflow of individuals like star scientists, top managers or key employees may matter for regional diversification (Feldman, Francis, & Bercovitz, 2005; Trippi, 2013). Numerous studies have documented the importance of migrants for the development of new specializations in regions (Bahar & Rapoport, 2014). Transnational entrepreneurs, like successful return migrants (Saxenian, 2006), have played a crucial role in early industry formation in certain places (Drori, Honig, & Wright, 2009; Sonderegger & Taube, 2010), but only when they became anchored in their regional context (Binz, Truffer, & Coenen, 2016; Vale & Carvalho, 2013). Hartog (2015) found that the inflow of top managers and top technicians who possess skills that were unrelated to the plant's core activity increased the probability of a plant diversifying, but no systematic studies yet exist that have assessed the impact of new labour recruitments on regional diversification (Hausmann & Neffke, 2016). A focus on the interregional mobility of labour would also shed more light on the channels through which pre-existing (related and unrelated) industries give birth to new industries in regions.

So, the inflow of non-local firms may induce regional diversification, but local firms may also induce diversification through non-local linkages. There is a growing body of literature that focuses on innovative firms in peripheral regions that cannot draw on local resources and, therefore, rely on non-local linkages instead (Grillitsch & Nilsson, 2015; Isaksen, 2015; Isaksen & Karlsen, 2012; Shearmur, 2015). These firms have strong firm-internal capabilities, which is a prerequisite to building crucial non-local linkages. The question is whether such a combination of strong firm-internal capabilities and non-local linkages

make peripheral regions more likely to diversify in more unrelated activities. In more advanced regions, one could argue that both firm-internal capabilities and local capabilities matter for regional diversification. Studies show that local related externalities increase the export performance of more productive firms (Poncet & de Waldemar, 2012), the survival rates of high-impact firms (Borggren, Eriksson, & Lindgren, 2016), the productivity of better performing firms (Howell, He, Yang, & Fan, 2016), and the tendency of firms to conduct a related diversification strategy (Cainelli & Iacobucci, 2015). Recent studies (Hazir, Bellone, & Gaglio, 2016; Lo Turco & Maggioni, 2016) found that relatedness both at the firm and local level has a positive effect on firm diversification in new products. In advanced regions, firm diversification seems to rest more on local capabilities, possibly due to the involvement of local firms in relatively more complex products which makes them more dependent on a large diverse local knowledge base. This may imply that firms in advanced regions are more prone to related diversification and firms in peripheral regions to more unrelated diversification, but systematic evidence is lacking.

A micro-perspective on regional diversification should not be limited to economic actors (like firms and entrepreneurs) as the sole agents of change. Public agencies, like universities, can play a major role in developing new industries in regions unrelated to their existing development paths (Gilbert & Campbell, 2015; Lester, 2007; Tanner, 2014). Policy-driven change (through, for example, fundamental research and public procurement) can induce radical transformations in regions, Silicon Valley being a classic case (Mazzucato, 2013), and policy-driven change, though of a less radical nature, is also aimed for in the current design of smart specialization strategies in the European Union (Foray, 2014). Moreover, it is crucial for one's understanding of regional diversification to investigate the role of institutional agents, as embodied in collective actions by firms, interest groups, policy-makers and so forth, because early industry formation necessitates new institutions and the adaptation of existing ones (Binz et al., 2016; Nelson, 1994). This requires a deep understanding of why agents in some regions are more successful in creating, abolishing and changing institutions, as compared with other regions, which agents are responsible for such institutional change (Sine & Lee, 2009), and what regional conditions facilitate the implementation of such collective actions.

The institutional entrepreneurship literature looks at the role of agency in institutional change (Maguire, Hardy, & Lawrence, 2004). It describes how institutional entrepreneurs manipulate structures in which they are embedded (Borrás & Edler, 2014; Garud, Jain, & Kumaraswamy, 2002), and how agents engage in collective action to mobilize knowledge, resources and public opinion, as to build legitimacy and create new institutions or shape existing institutions at various spatial scales to enable new industry formation in regions (Marquis & Raynard, 2015; Sotarauta & Pulkkinen, 2011; Strambach, 2010). Saxenian (2006) has looked at successful return migrants

(or 'diasporas') as key institutional agents of change, because they are well positioned to get access to and persuade public officials and other agents in their home region to adapt and redesign local institutions. This means that the role of public actors in local industry formation cannot be studied in isolation from other agents and without taking a multiscale perspective (Dawley, MacKinnon, Cumbers, & Pike, 2015). The question is whether there are regional conditions that provide more opportunities for strategic action, make (local) actors more prone to engage in institutional entrepreneurship, and more successful in changing institutions (Battilana, Leca, & Boxenbaum, 2009).

Another promising research avenue is to link to the literature on entrepreneurial experimentation that focuses on the role that niches play for the emergence of radical new technologies in the presence of an overarching regime (Schot & Geels, 2008). Niches are incubation spaces in which new radical activities are protected against market selection and institutional pressures from a regime and allow actors to learn about novel technologies and their uses through experimentation (Coenen, Raven, & Verbong, 2010). Niches also foster empowerment through which they 'fit and conform' or 'stretch and reform' existing regimes in ways favourable to the emergence of new activities (Smith & Raven, 2012). This literature puts an emphasis on resistance and counter-forces that may block institutional change, in particular when new activities challenge others and dislodge established regimes. There is increasing understanding of how vested interests of incumbents conduct strategies that may range from a blockage of institutional change, to frustration, to collaborative attitudes (Wesseling, 2015). However, there is little understanding of the geographical aspects of niche formation (Hansen & Coenen, 2015; Sengers & Raven, 2015). Following a Darwinian logic, one could hypothesize that successful niche formation requires geographical isolation, especially in the case of unrelated diversification, or places where vested interests are not well represented or unable to dominate the design of local institutions, like in large diversified cities.

CONCLUSIONS

The paper has discussed implications for future research of a key finding in evolutionary economic geography, that is, the accumulating evidence on related diversification in regions (Kogler, 2015). It is argued here that there is a need for more clarity on concepts of capabilities and relatedness, the identification and importance of related and unrelated diversification, the territory-specific nature of relatedness, the significance of local capabilities and non-local linkages for regional diversification, and the role of economic and socio-institutional agency. This opens up a new research agenda on regional diversification that needs to combine insights from a whole range of strands in the scientific literature, including complexity theory, economic geography, institutional theory, network theory,

organizational studies, political sciences, population ecology, sociology and the sustainable transition literature.

To start with, it is argued that more clarity is needed around the claim that related activities demand similar capabilities. Scholars from diverse literatures have struggled with the question of how to define capabilities, and have come up with different proxies, including broad and indirect measures. The regional diversification literature is no exception to that rule. Having said that, it is argued here that there is a need to unravel relatedness both in terms of similarities and complementarities in studies, and to be more specific on what types of related capabilities are shared across activities and matter for regional diversification. In other words, there is a need to explore which enabling factors make some activities more likely to emerge from other specific activities in a region: is it because they share a similar knowledge base, a common network, a specific set of institutions, a particular set of skills etc?

Moreover, it is argued here that there is a need to be more precise about the distinction between related and unrelated diversification. Unrelated diversification has been associated with jumps in the industrial evolution of regions, like going from bananas to computers (Boschma & Capone, 2015), a radical shift in underlying (local) capabilities (Neffke et al., 2016), and combinations of (local) capabilities that had not been combined before (Castaldi et al., 2015). While studies found more evidence of related diversification than unrelated diversification, in reality it is argued that it will be more a matter of degree, in which related and unrelated activities are being combined. This implies there is a need to go beyond the dichotomy of related and unrelated diversification, and to investigate what types of new combinations are made between existing activities (related/unrelated, local/non-local) that lead to new activities in regions.

It is also claimed here that the study on regional diversification is in need of more geographical wisdom for four reasons. First, one needs more understanding about the types of diversification that prevail in different types of regions (Xiao et al., 2016), and which factors (at the regional scale and beyond) facilitate diversification of a more related or a more unrelated type. For instance, is more unrelated diversification more likely to be induced in regions by the inflow of non-local actors like migrants and non-local linkages, and which formal and informal institutions are more likely to generate a more unrelated type of diversification?

Second, another crucial question is which type of diversification secures long-term economic development of regions. Can regions keep relying on more related diversification, or do regions need to diversify in unrelated activities once in a while to avoid lock-in in the long run?

Third, this paper criticized the treatment of relatedness as a global and universal phenomenon that connects the same activities irrespective of their location worldwide. Instead, one calls for comparative studies between territories (countries, cities, regions) to determine the geography-specific nature of relatedness. So, does relatedness have a different meaning in different territories, because

of the path- and place-dependent nature of regional development?

Fourth, while the literature has focused primarily on local capabilities driving diversification of regions, there is a need to collect systematic evidence about how non-local capabilities influence regional diversification, and at what spatial scale. This requires a multi-scalar perspective that investigates the importance of capabilities that are tapped not only from local resources but also through network linkages at various spatial scales, from the local to the global level (Binz et al., 2014).

It was argued above that the prime focus on local capabilities may have obscured one's view about who actually is driving regional diversification, as local actors make regions diversify, not regions. This requires a micro-perspective that aims to identify the key agents that drive the process of regional diversification. In particular, there is a need to determine the role of different types of individuals, firms and institutional players including policy-makers to assess who are the key drivers of which type of (more or less related) diversification in regions, and to identify which are the regional factors that make local actors in some regions (as compared with other regions) more successful in inducing institutional change and in diversifying in new activities.

This research agenda requires a mixed-methods approach to provide a comprehensive explanation of regional diversification. Much of the regional diversification literature has employed longitudinal data and taken a quantitative approach to regional diversification in order to trace and identify regular patterns in many regions, industries and technologies over a long period of time. This had led to important insights, but these also remain partial at best. Quantitative approaches need to be complemented by insights derived from qualitative studies. This is particularly relevant for the investigation of the role of informal institutions, institutional change and the role of a range of agents (including policy-makers) in processes of diversification in regions that are very hard or impossible to grasp with a quantitative approach. The time has come to make a serious effort to apply and integrate mixed methods into the study of regional diversification (Hassink, Klaerding, & Marques, 2014).

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

NOTES

1. In the organization literature, the concept of capabilities (Dosi, Nelson, & Winter, 2000) has been widely diffused. Well-known types are combinatory capabilities (Kogut & Zander, 1992) and dynamic capabilities (Teece et al., 1997).
2. Now and then, the concepts of regional specialization and specialization in regions are used interchangeably, as if they mean the same thing. However, regional diversification means the creation and development of a new specialization in a region, which may result in regional

specialization (in the case of the absence of any other specializations in the region) or not (when other specializations in the region are already present).

3. In the regional diversification literature, new industries are often identified as new to the region, not new to the world, because these studies work with data from existing categories of industries and products.

4. Some studies account for the complexity of new export products, as it is better to develop new export products that add complexity to an economy. This is the case when the new export product is non-ubiquitous, which means there are only very few competitors in the same product (Hausmann & Hidalgo, 2011).

5. An alternative measure of relatedness is the intensity of patent citations between technology classes.

6. This broad measure of relatedness derived from the co-location of products is not unproblematic when applied to the study of diversification at the same spatial scale with the same dataset. It might lead to a bias towards related diversification when measuring relatedness and assessing the impact of relatedness on diversification with the same data at the same spatial scale, like countries.

7. A problem of using product data to measure relatedness is their prime focus on manufacturing industries, as there are less detailed product categories in services in product datasets (Janssen, 2015; Shearmur, 2015).

REFERENCES

- Andersson, M., Bjerke, L., & Karlsson, C. (2013). Import flows: Extraregional linkages stimulating renewal of regional sectors? *Environment and Planning A*, 45, 2999–3017. doi:10.1068/a45732
- Arts, S., & Veugelers, R. (2015). Technology familiarity, recombinant novelty, and breakthrough invention. *Industrial and Corporate Change*, 24(6), 1215–1246. doi:10.1093/icc/dtu029
- Asheim, B., & Isaksen, A. (1997). Location, agglomeration and innovation: Towards regional innovation systems in Norway? *European Planning Studies*, 5(3), 299–330. doi:10.1080/09654319708720402
- Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems. The integration of local 'sticky' and global 'ubiquitous' knowledge. *Journal of Technology Transfer*, 27, 77–86. doi:10.1023/A:1013100704794
- Bahar, D., Hausmann, R., & Hidalgo, C. A. (2014). Neighbors and the evolution of the comparative advantage of nations: Evidence of international knowledge diffusion? *Journal of International Economics*, 92(1), 111–123. doi:10.1016/j.jinteco.2013.11.001
- Bahar, D., & Rapoport, H. (2014). *Migration, knowledge diffusion and the comparative advantage of nations* (Working Paper). Cambridge, MA: Harvard University Press.
- Balland, P. A., De Vaan, M., & Boschma, R. (2013). The dynamics of interfirm networks along the industry life cycle: The case of the global video game industry, 1987–2007. *Journal of Economic Geography*, 13(5), 741–765. doi:10.1093/jeg/lbs023
- Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: Towards a theory of institutional entrepreneurship. *Academy of Management Annals*, 3, 65–107. doi:10.1080/19416520903053598
- Berge, M., & Weterings, A. (2014). *Relatedness in eco-technological development in European regions*. The Hague: Planbureau voor Leefomgeving.
- Binz, C., Truffer, B., & Coenen, L. (2014). Why space matters in technological innovation systems – Mapping global knowledge dynamics of membrane bioreactor technology. *Research Policy*, 43(1), 138–155. doi:10.1016/j.respol.2013.07.002
- Binz, C., Truffer, B., & Coenen, L. (2016). Path creation as a process of resource alignment and anchoring: Industry formation for on-site water recycling in Beijing. *Economic Geography*, 92(2), 172–200. doi:10.1080/00130095.2015.1103177
- Borggren, J., Eriksson, R. H., & Lindgren, U. (2016). Knowledge flows in high-impact firms: How does relatedness influence survival, acquisition and exit? *Journal of Economic Geography*, 16(3), 637–665. doi:10.1093/jeg/lbv014
- Borrás, S., & Edler, J. (Eds.). (2014). *The governance of socio-technical systems: Explaining change*. Cheltenham: Edward Elgar.
- Boschma, R. (2015). Do spinoff dynamics or agglomeration externalities drive industry clustering? A reappraisal of Steven Klepper's work. *Industrial and Corporate Change*, 24(4), 859–873. doi:10.1093/icc/dtv024
- Boschma, R. A., & Frenken, K. (2010). The spatial evolution of innovation networks. A proximity perspective. In R. A. Boschma, & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 120–135). Edward Elgar: Cheltenham.
- Boschma, R., Balland, P. A., & Kogler, D. F. (2015). Relatedness and technological change in cities: The rise and fall of technological knowledge in US metropolitan areas from 1981 to 2010. *Industrial and Corporate Change*, 24(1), 223–250. doi:10.1093/icc/dtu012
- Boschma, R., & Capone, G. (2015). Institutions and diversification: Related versus unrelated diversification in a varieties of capitalism framework. *Research Policy*, 44, 1902–1914. doi:10.1016/j.respol.2015.06.013
- Boschma, R., & Capone, G. (2016). Relatedness and diversification in the European Union (EU-27) and European neighbourhood policy countries. *Environment and Planning C: Government and Policy*, 34, 617–637. doi:10.1177/0263774X15614729
- Boschma, R., Heimeriks, G., & Balland, P. A. (2014). Scientific knowledge dynamics and relatedness in biotech cities. *Research Policy*, 43(1), 107–114. doi:10.1016/j.respol.2013.07.009
- Boschma, R., Martin, V., & Minondo, A. (2016). Neighbour regions as the source of new industries. *Papers in Regional Science*. doi:10.1111/pirs.12215
- Boschma, R., Minondo, A., & Navarro, M. (2013). The emergence of new industries at the regional level in Spain: A proximity approach based on product relatedness. *Economic Geography*, 89(1), 29–51. doi:10.1111/j.1944-8287.2012.01170.x
- Brachert, M. (2016). *The rise and fall of occupational specializations in German regions from 1992 to 2010. Relatedness as driving force of human capital dynamics* (Working Paper).
- Breschi, S., Lissoni, F., & Malerba, F. (2003). Knowledge-relatedness in firm technological diversification. *Research Policy*, 32, 69–87. doi:10.1016/S0048-7333(02)00004-5
- Broekel, T., & Brachert, M. (2015). The structure and evolution of inter-sectoral technological complementarity in R&D in Germany from 1990 to 2011. *Journal of Evolutionary Economics*, 25, 755–785. doi:10.1007/s00191-015-0415-7
- Cainelli, G., & Iacobucci, D. (2015). Local variety and firm diversification: An evolutionary economic geography perspective. *Journal of Economic Geography*. doi:10.1093/jeg/lbv040
- Cantwell, J. A., & Iammarino, S. (2003). *Multinational corporations and European regional systems of innovation*. London: Routledge.
- Castaldi, C., Frenken, K., & Los, B. (2015). Related variety, unrelated variety and technological breakthroughs: An analysis of US state-level patenting. *Regional Studies*, 49(5), 767–781. doi:10.1080/00343404.2014.940305
- Coenen, L., Raven, R., & Verbong, G. (2010). Local niche experimentation in energy transitions: A theoretical and empirical exploration of proximity advantages and disadvantages.

- Technology in Society*, 32(4), 295–302. doi:10.1016/j.techsoc.2010.10.006
- Colombelli, A., Krafft, J., & Quatraro, F. (2014). The emergence of new technology-based sectors in European regions: A proximity-based analysis of nanotechnology. *Research Policy*, 43, 1681–1696. doi:10.1016/j.respol.2014.07.008
- Cortinovis, N., Xiao, J., Boschma, R., & Van Oort, F. (2016). *Quality of government and social capital as drivers of regional diversification in Europe* (Papers in Evolutionary Economic Geography No. 16.10). Utrecht: Utrecht University.
- Crescenzi, R., Gagliardi, L., & Iammarino, S. (2015). Foreign multinationals and domestic innovation: Intra-industry effects and firm heterogeneity. *Research Policy*, 44, 596–609. doi:10.1016/j.respol.2014.12.009
- Crespo, J., Suire, R., & Vicente, J. (2014). Lock-in or lock-out? How structural properties of knowledge networks affect regional resilience. *Journal of Economic Geography*, 14(1), 199–219. doi:10.1093/jeg/lbt006
- Dahl Fitjar, R., & Rodríguez-Pose, A. (2011). When local interaction does not suffice: Sources of firm innovation in urban Norway. *Environment and Planning A*, 43(6), 1248–1267. doi:10.1068/a43516
- Dawley, S. (2014). Creating new paths? Offshore wind, policy activism, and peripheral region development. *Economic Geography*, 90(1), 91–112. doi:10.1111/ecge.12028
- Dawley, S., MacKinnon, D., Cumbers, A., & Pike, A. (2015). Policy activism and regional path creation: The promotion of offshore wind in North East England and Scotland. *Cambridge Journal of Regions, Economy and Society*, 8, 257–272. doi:10.1093/cjres/rsu036
- Desrochers, P., & Leppälä, S. (2011). Opening up the 'Jacobs spillovers' black box: Local diversity, creativity and the processes underlying new combinations. *Journal of Economic Geography*, 11, 843–863. doi:10.1093/jeg/lbq028
- Dosi, G., Nelson, R. R., & Winter, S. G. (2000). Introduction: The nature and dynamics of organizational capabilities. In G. Dosi, R. R. Nelson, & S. G. Winter (Eds.), *The nature and dynamics of organizational capabilities* (pp. 1–22). Oxford: Oxford University Press.
- Drori, I., Honig, B., & Wright, M. (2009). Transnational entrepreneurship: An emergent field of study. *Entrepreneurship Theory and Practice*, 33, 1001–1022. doi:10.1111/j.1540-6520.2009.00332.x
- Essleztbichler, J. (2015). Relatedness, industrial branching and technological cohesion in US metropolitan areas. *Regional Studies*, 49(5), 752–766. doi:10.1080/00343404.2013.806793
- Fagerberg, J., Feldman, M., & Srholec, M. (2014). Technological dynamics and social capability: US states and European nations. *Journal of Economic Geography*, 14, 313–337. doi:10.1093/jeg/lbt026
- Fagerberg, J., & Srholec, M. (2008). National innovation systems, capabilities and economic development. *Research Policy*, 37(9), 1417–1435. doi:10.1016/j.respol.2008.06.003
- Feldman, M. P., Francis, J., & Bercovitz, J. (2005). Creating a cluster while building a firm. Entrepreneurs and the formation of industrial clusters. *Regional Studies*, 39, 129–141.
- Feldman, M. P., Kogler, D. F., & Rigby, D. L. (2015). Rknowledge: The spatial diffusion and adoption of rDNA methods. *Regional Studies*, 49(5), 798–817. doi:10.1080/00343404.2014.980799
- Fleming, L. (2001). Recombinant uncertainty in technological search. *Management Science*, 47(1), 117–132. doi:10.1287/mnsc.47.1.117.10671
- Fleming, L., King, C. III, & Juda, A. I. (2007). Small worlds and regional innovation. *Organization Science*, 18(6), 938–954. doi:10.1287/orsc.1070.0289
- Foray, D. (2014). From smart specialisation to smart specialisation policy. *European Journal of Innovation Management*, 17(4), 492–507. doi:10.1108/EJIM-09-2014-0096
- Fornahl, D., & Guenther, C. (2010). Persistence and change of regional industrial activities: The impact of diversification in the German machine tool industry. *European Planning Studies*, 18(12), 1911–1936. doi:10.1080/09654313.2010.515790
- Frenken, K., & Boschma, R. A. (2007). A theoretical framework for evolutionary economic geography: Industrial dynamics and urban growth as a branching process. *Journal of Economic Geography*, 7(5), 635–649. doi:10.1093/jeg/lbm018
- Garud, R., Jain, S., & Kumaraswamy, A. (2002). Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java. *Academy of Management Journal*, 45(1), 196–214. doi:10.2307/3069292
- Gertler, M. S. (2003). Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of Economic Geography*, 3, 75–99. doi:10.1093/jeg/3.1.75
- Gilbert, B. A., & Campbell, J. T. (2015). The geographic origins of radical technological paradigms: A configurational study. *Research Policy*, 44, 311–327. doi:10.1016/j.respol.2014.08.006
- Gilsing, V., Nootboom, B., Vanhaverbeke, W., Duysters, G., & Van den Oord, A. (2008). Network embeddedness and the exploration of novel technologies. Technological distance, betweenness centrality and density. *Research Policy*, 37, 1717–1731. doi:10.1016/j.respol.2008.08.010
- Grillitsch, M., & Nilsson, M. (2015). Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers? *Annals of Regional Science*, 54(1), 299–321. doi:10.1007/s00168-014-0655-8
- Hansen, T., & Coenen, L. (2015). The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions*, 17, 92–109. doi:10.1016/j.eist.2014.11.001
- Hartog, M. (2015). *The impact of top managers and top technicians on plant diversification* (Working Paper). Utrecht: Utrecht University.
- Hassink, R., Klaering, C., & Marques, P. (2014). Advancing evolutionary economic geography by engaged pluralism. *Regional Studies*, 48(7), 1295–1307. doi:10.1080/00343404.2014.889815
- Hausmann, R., & Hidalgo, C. A. (2011). The network structure of economic output. *Journal of Economic Growth*, 16, 309–342. doi:10.1007/s10887-011-9071-4
- Hausmann, R., & Klinger, B. (2007). *The structure of the product space and the evolution of comparative advantage* (CID Working Paper No. 146). Cambridge, MA: Harvard Kennedy School, Harvard University.
- Hausmann, R., & Neffke, F. (2016). *The workforce of pioneer plants* (Papers in Evolutionary Economic Geography No. 16.03). Utrecht: Utrecht University.
- Hazir, C. S., Bellone, F., & Gaglio, C. (2016). *Product relatedness in firm export diversification. Evidence from France* (Working Paper).
- He, C., Yan, Y., & Rigby, D. (2015). *Regional industrial evolution in China: Path dependence or path creation?* (Papers in Evolutionary Economic Geography No. 15.20). Utrecht: Utrecht University.
- Heimeriks, G., & Boschma, R. (2014). The path- and place-dependent nature of scientific knowledge production in biotech 1986–2008. *Journal of Economic Geography*, 14, 339–364. doi:10.1093/jeg/lbs052
- Hidalgo, C. A., Klinger, B., Barabasi, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, 317, 482–487. doi:10.1126/science.1144581
- Howell, A., He, C., Yang, R., & Fan, C. (2016). Technological relatedness and asymmetrical firm productivity gains under market reforms in China. *Cambridge Journal of Region, Economy and Society*, 9(3), 499–515.
- Iammarino, S., & McCann, P. (2013). *Multinationals and economic geography*. Cheltenham: Edward Elgar.

- Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography*, 15, 585–600. doi:10.1093/jeg/lbu026
- Isaksen, A., & Karlsen, J. (2012). What is regional in regional clusters? The case of the globally oriented oil and gas cluster in Agder, Norway. *Industry and Innovation*, 19, 249–263. doi:10.1080/13662716.2012.669616
- Isaksen, A., & Trippel, M. (2014). *Regional industrial path development in different regional innovation systems: A conceptual analysis* (Papers in Innovation Studies No. 2014/17). Lund: Lund University, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE).
- Janssen, M. J. (2015). *Service innovation in an evolutionary perspective* (PhD thesis). Eindhoven: Eindhoven Technical University.
- Klepper, S. (2007). Disagreements, spinoffs, and the evolution of Detroit as the capital of the U.S. automobile industry. *Management Science*, 53(4), 616–631. doi:10.1287/mnsc.1060.0683
- Klepper, S., & Simons, K. L. (2000). Dominance by birthright: Entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. *Strategic Management Journal*, 21(10–11), 997–1016. doi:10.1002/1097-0266(200010/11)21:10/11<997::AID-SMJ134>3.0.CO;2-O
- Kogler, D. F. (2015). Editorial: Evolutionary economic geography – theoretical and empirical progress. *Regional Studies*, 49(5), 705–711. doi:10.1080/00343404.2015.1033178
- Kogler, D. F., Rigby, D. L., & Tucker, I. (2013). Mapping knowledge space and technological relatedness in US cities. *European Planning Studies*, 21(9), 1374–1391. doi:10.1080/09654313.2012.755832
- Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3, 383–397. doi:10.1287/orsc.3.3.383
- Lall, S. (1992). Technological capabilities and industrialization. *World Development*, 20, 165–186. doi:10.1016/0305-750X(92)90097-F
- Lester, R. K. (2007). Universities, innovation, and the competitiveness of local economies: An overview. *Technology Review*, 214, 9–30.
- Lo Turco, A., & Maggioni, D. (2016). On firms' product space evolution: The role of firm and local product relatedness. *Journal of Economic Geography*, 16(5), 975–1006. doi:10.1093/jeg/lbv024
- Maguire, S., Hardy, C., & Lawrence, T. B. (2004). Institutional entrepreneurship in emerging fields: HIV/AIDS treatment advocacy in Canada. *Academy of Management Journal*, 47(5), 657–679. doi:10.2307/20159610
- Makri, M., Hitt, M. A., & Lane, P. J. (2010). Complementary technologies, knowledge relatedness and invention outcomes in high technology mergers and acquisitions. *Strategic Management Journal*, 31, 602–628.
- March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71–87. doi:10.1287/orsc.2.1.71
- Markusen, A., Hall, P., & Glasmeier, A. (1986). *High tech America: The what, how, where and why of the sun-rise industries*. Boston: Allen & Unwin.
- Marquis, C., & Raynard, M. (2015). Institutional strategies in emerging markets. *Academy of Management Annals*, 9(1), 291–335. doi:10.1080/19416520.2015.1014661
- Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography*, 6(4), 395–437. doi:10.1093/jeg/lbl012
- Maskell, P., & Malmberg, A. (1999). Localised learning and industrial competitiveness. *Cambridge Journal of Economics*, 23(2), 167–185. doi:10.1093/cje/23.2.167
- Mazzucato, M. (2013). *The entrepreneurial state, debunking public vs. private sector myths*. London: Anthem.
- McCann, P., & Ortega-Argilés, R. (2014). Smart specialisation in European regions: Issues of strategy, institutions and implementation. *European Journal of Innovation Management*, 17(4), 409–427. doi:10.1108/EJIM-05-2014-0052
- Meliciani, V. (2015). *The specialization of EU regions in emerging and high-opportunity technologies* (Preliminary Draft Report presented June 2015). Brussels.
- Moodysson, J. (2008). Principles and practices of knowledge creation: On the organization of 'buzz' and 'pipelines' in life science communities. *Economic Geography*, 84(4), 449–69. doi:10.1111/j.1944-8287.2008.00004.x
- Montresor, S., & Quatraro, F. (2015). *Smart specialization strategies and key enabling technologies. Regional evidence from European patent data* (Papers in Evolutionary Economic Geography No. 15.25). Utrecht: Utrecht University.
- Muneepeerakul, R., Lobo, J., Shutters, S. T., Gomez-Lievano, A., & Qubbaj, M. R. (2013). Urban economies and occupation space: Can they get 'there' from 'here'? *PLoS ONE*, 8(9), e73676. doi:10.1371/journal.pone.0073676
- Neffke, F., Hartog, M., Boschma, R., & Henning, M. (2016). *Agents of structural change. The role of firms and entrepreneurs in regional diversification* (Papers in Evolutionary Economic Geography). Utrecht: Utrecht University.
- Neffke, F., & Henning, M. (2013). Skill relatedness and firm diversification. *Strategic Management Journal*, 34(3), 297–316. doi:10.1002/smj.2014
- Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography*, 87(3), 237–265. doi:10.1111/j.1944-8287.2011.01121.x
- Nelson, R. R. (1994). The co-evolution of technology, industrial structure and supporting institutions. *Industrial and Corporate Change*, 3(1), 47–63. doi:10.1093/icc/3.1.47
- Petralia, S., Balland, A., & Morrison, A. (2016). *Climbing the ladder of technological development* (Papers in Evolutionary Economic Geography No. 16.29). Utrecht: Utrecht University, Utrecht.
- Poncet, S., and de Waldemar, F. S. (2012). *Product relatedness and firm exports in China* (Working Papers No. 2012-27). Paris: Centre d'Études Prospectives et d'Informations Internationales (CEPII) Research Center.
- Rigby, D. (2015). Technological relatedness and knowledge space: Entry and exit of US cities from patent classes. *Regional Studies*, 49(11), 1922–1937. doi:10.1080/00343404.2013.854878
- Rodríguez-Pose, A., & Crescenzi, R. (2008). Research and development, spillovers, innovation systems, and the genesis of regional growth in Europe. *Regional Studies*, 42, 51–67. doi:10.1080/00343400701654186
- Saviotti, P. P., & Frenken, K. (2008). Export variety and the economic performance of countries. *Journal of Evolutionary Economics*, 18(2), 201–218. doi:10.1007/s00191-007-0081-5
- Saxenian, A. L. (2006). *The new Argonauts. Regional advantage in a global economy*. Cambridge, MA: Harvard University Press.
- Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. *Technology Analysis and Strategic Management*, 20(5), 537–554. doi:10.1080/09537320802292651
- Sengers, F., & Raven, R. P. J. M. (2015). Toward a spatial perspective on niche development: The case of bus rapid transit. *Environmental Innovation and Societal Transitions*, 17, 166–182.
- Shearmur, R. (2015). Far from the madding crowd: Slow innovators, information value, and the geography of innovation. *Growth and Change*, 46(3), 424–442. doi:10.1111/grow.12097
- Sine, W. D., & Lee, B. H. (2009). Tilting at windmills? The environmental movement and the emergence of the U.S. wind energy sector. *Administrative Science Quarterly*, 54(1), 123–155. doi:10.2189/asqu.2009.54.1.123

- Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, 41(6), 1025–1036. doi:10.1016/j.respol.2011.12.012
- Sonderegger, P., & Taube, F. (2010). Cluster life cycle and diaspora effects: Evidence from the Indian IT cluster in Bangalore. *Journal of International Management*, 16, 383–397. doi:10.1016/j.intman.2010.09.008
- Sotarauta, M., & Pulkkinen, R. (2011). Institutional entrepreneurship for knowledge regions: In search of a fresh set of questions for regional innovation studies. *Environment and Planning C: Government and Policy*, 29, 96–112. doi:10.1068/c1066r
- Storper, M. (1995). The resurgence of regional economies, ten years later: The region as a nexus of untraded interdependencies. *European Urban and Regional Studies*, 2, 191–221. doi:10.1177/096977649500200301
- Strambach, S. (2010). Path dependency and path plasticity. The co-evolution of institutions and innovation – the German customized business software industry. In R. A. Boschma, & R. Martin (Eds.), *Handbook of evolutionary economic geography* (pp. 406–431). Cheltenham: Edward Elgar.
- Tanner, A. N. (2014). Regional branching reconsidered: Emergence of the fuel cell industry in European regions. *Economic Geography*, 90(4), 403–427. doi:10.1111/ecge.12055
- Tanner, A. N. (2016). The emergence of new technology-based industries: The case of fuel cells and its technological relatedness to regional knowledge bases. *Journal of Economic Geography*, 16(3), 611–635. doi:10.1093/jeg/lbv011
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533. doi:10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z
- Teece, D. J., Rumelt, R., Dosi, G., & Winter, S. (1994). Understanding corporate coherence. *Journal of Economic Behavior and Organization*, 23, 1–30. doi:10.1016/0167-2681(94)90094-9
- Tripl, M. (2013). Scientific mobility and knowledge transfer at the interregional and intraregional level. *Regional Studies*, 47(10), 1653–1667. doi:10.1080/00343404.2010.549119
- Tripl, M., Grillitsch, M., & Isaksen, A. (2015). *External 'energy' for regional industrial change: Attraction and absorption of non-local knowledge for new path development* (Papers in Innovation Studies No. 2015/47), Lund: Lund University, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE).
- Vale, M., & Carvalho, L. (2013). Knowledge networks and processes of anchoring in Portuguese biotechnology. *Regional Studies*, 47, 1018–1033. doi:10.1080/00343404.2011.644237
- Weitzman, M. L. (1998). Recombinant growth. *Quarterly Journal of Economics*, 113(2), 331–360. doi:10.1162/003355398555595
- Wesseling, J. (2015). *Strategies of incumbent car manufacturers in sustainability transitions* (PhD thesis). Utrecht: Utrecht University.
- Xiao, J., Boschma, R., & Andersson, M. (2016). *Industrial diversification in Europe. The differentiated role of relatedness* (Papers in Evolutionary Economic Geography No. 16.27). Utrecht: Utrecht University.
- Zhu, S., He, C., & Zhou, Y. (2015). *How to jump further? Path dependent and path breaking in an uneven industry space* (Papers in Evolutionary Economic Geography No. 15.24). Utrecht: Utrecht University.