

Papers in Evolutionary Economic Geography

18.39

The geographical dimension of structural change

Ron Boschma



Utrecht University
Urban & Regional research centre Utrecht

The geographical dimension of structural change

Ron Boschma

Department of Human Geography and Planning, Utrecht University

UiS Business School, Stavanger University

19 November 2018

book chapter

Alcorta, L, N. Foster-McGregor, A. Szirmai and B. Verspagen (eds.) *New Perspectives on Structural Change: Causes and Consequences of Structural Change in the Global Economy*, forthcoming.

Abstract

This chapter explores patterns of structural change from a geographical perspective. It summarizes recent insights on the geography of structural change, and in particular on regional diversification. It shows how local capabilities and institutions impact on structural change, and why the capacity of regions to diversify differs substantially. This chapter describes how concepts like diversification and relatedness have been fruitfully combined in a rapidly expanding literature. Diversification refers to the emergence of new activities, an important feature of structural change. These new activities are often embedded in, or related to, existing activities at the national and regional scale, requiring similar capabilities. But new activities can also be unrelated to existing ones. For our understanding of structural change, the role of agency is considered crucial, as it shapes diversification at the regional level.

JEL: O18, R0, R11

Keywords: structural change, product space, regional diversification, related diversification, unrelated diversification, institutions, agency

Introduction

There is a long tradition of scientific work on structural change (Pasinetti 1981). In particular, scholars have studied the process of creative destruction induced by innovations (Schumpeter 1942). The catching up and technology gap literature has provided important insights in the conditions that hinder or facilitate innovation in countries (Abramowitz 1986; Lall 1992). However, little attention has been paid to the geographical dimension in the structural change literature (Neffke 2009; Diodato 2017). This chapter will give insights why there is a need to fill this gap. We show that capabilities, including institutions, at the national scale, but above all at the sub-national scale, have an impact on and shape the process of structural change. This makes that the capacity to develop new economic activities differs substantially across countries and regions. The objective of the chapter is to explain why one needs to adopt a geographical perspective to get a more comprehensive view on structural change.

First of all, we start describing the geographical literature that focused attention on regional dynamics due to the rise and fall of economic activities. Second, we discuss the product space and relatedness literature that is preoccupied with the question of how regions diversify over time, and how relatedness is impacting the creative destruction process (Boschma 2017; Hidalgo et al. 2018). Diversification refers to the emergence of new activities, a key feature of structural change (Saviotti and Pyka 2004). What this literature claims is that new activities are often embedded in, or related to, existing activities at the national and regional scale, requiring similar capabilities. But new activities can also be unrelated to existing activities, requiring a complete transformation of underlying capabilities at national/regional scale. This chapter discusses the interplay between structural change and geography in a systematic manner, summarizing the most recent literature in regional studies. Doing so, we also devote attention to the crucial role of agency that shapes structural change at the regional level.

Structural change and regional dynamics

There is a tradition in economic geography to investigate the geographical implications of structural change. How major shifts in the economic structure (e.g. shifts to a service-based economy, or a knowledge economy, etc.) leave their impact on productivity levels in regions has been widely documented (e.g. Andersson 1981; Daniels 1993; Hohenberg and Lees 1995; Quatraro 2009; Lambooy 2010). In the late 1970s to the 1990s, there was a revival of Schumpeterian thinking focusing on the changing geography of creative destruction. The rise and fall of economic activities was put high on the scientific agenda, and scholars became interested in how that affected centre-periphery structures at the national (Perez and Soete 1988) and regional scale (Marshall 1987; Hall and Preston 1988).

While centre-periphery structures had been regarded as being stable and persistent for many decades, centre-periphery models (Frank 1967), unchallenged for many decades, did not seem to fit empirical reality that showed turbulence in the spatial system at various geographical

scales, anymore. At the global level, the rise of the Newly Industrializing Countries (like Japan, Korea and Taiwan) and the long-lasting crisis in many Western economies leading to de-industrialization in the 1970s and 1980s was associated with a breakdown of centre-periphery structures (Perez and Soete 1988). At the sub-national scale (i.e. the regional level), the rise of the Sunbelt states in the US, and Silicon Valley in particular (Lecuyer 2006), and the simultaneous decline of manufacturing regions in the so-called Rust Belt states suggested a fundamental and unprecedented transformation in the economic landscape, heralding a new geography of innovation (Markusen et al. 1986; Hall and Preston 1988; Scott 1988). In Europe, similar regional dynamics could be observed: in countries like the UK and Belgium, the centre-periphery structure of innovation was turned upside down, with Northern regions in the UK and Southern regions in Belgium de-industrializing and falling behind, while the South East in the UK and parts of Flanders in Belgium presenting themselves as the new centers of innovation (Boschma 1997). By and large, new industries emerged in ‘new’ regions, while existing industries declined primarily in ‘old’ regions heavily specialized in mature activities (Scott 1988). In other words, the rise and fall of industries had its own peculiar geography, leading to a transformation of the geography of innovation.

When explaining the formation of new economic activities in regions, scholars tended to refer to historical accidents, as if these were built from scratch, and as if these could be developed everywhere (Arthur 1994). Silicon Valley was taken as an example, where the new electronic industry was depicted as having emerged in the ‘middle of nowhere’, despite being close to the agglomeration of San Francisco. The only impact of space highlighted in the literature was that industrial regions were unlikely places to host these new promising activities, as their structures (like competences, networks, institutions) had locked them into stagnant paths, and prevented them to move into new activities (Grabher 1993; Hassink 2005; Boschma and Lambooy 1999). In other words, space was perceived in this literature as a place of luck, as well as a place of constraints.

This has been challenged by the Window of Locational Opportunity approach that consider regions as places of opportunities that enable structural change, focusing on potentials of emergent places on the one hand, and the importance of agency that transforms local structures and turns them into supportive ones on the other hand (Perez and Soete 1988; Storper and Walker 1989; Boschma 1997). First, we will discuss the regional diversification literature that aims to identify potentials of emergent places at the national and regional scale, using longitudinal datasets and employing network techniques. Then, we discuss shortly an increasing focus on the role of agency, building on literature on transitions, institutional leadership and political sciences, that makes structural change happening (or not) in places.

Product space and related diversification in regions

In the 2000s, this interpretation of dramatic regional change shifted somewhat and became more nuanced. Empirical studies showed that some old industrial regions were able to overcome the downside of rigid specialization and reinvent themselves (Glaeser 2005), while many peripheral regions continued to be incapable of escaping from the trap of

underdevelopment. This shifted the attention to questions like: what are the potentials of regions to renew themselves, what makes regions diversify successfully in new activities, and why does this capacity differ across regions. This research agenda was boosted by the availability of longitudinal data and sophisticated network methodologies to measure and capture structural change in countries and regions.

The product space literature, building on complexity science (Hidalgo et al. 2007; Hausmann and Klinger 2007; Freire 2017) examined diversification patterns of countries. They stressed that history matters when countries move in new export products: new export products are no random events, but strongly embedded in capabilities at the national scale. Hidalgo et al. (2007) developed the ‘product space’ concept to identify the proximity between products based on their co-occurrence in countries’ export portfolios. When countries are often specialized in the same products, these are considered demanding similar capabilities. These national capabilities provide opportunities but set also limits to diversification: they condition which new export products will be feasible to develop in countries. A country is more likely to develop a comparative advantage in new products related to its existing products. New products are defined as new to the country, not to the world, because these studies work with data of existing categories of products¹. Moreover, these studies found that a diverse set of export products that are centrally positioned in the product space (i.e. related variety) provides more opportunities for countries to diversify into new products that share similar capabilities.

Simultaneously, economic geographers started to investigate more systematically the capacity of regions at the sub-national scale to develop new industries, new technologies or new jobs (Neffke et al. 2011; Boschma et al. 2013; Kogler et al. 2013; Muneeppeerakul et al. 2013; Boschma et al. 2014, 2015; Colombelli et al. 2014; Heimeriks and Boschma 2014; Van den Berge and Weterings 2014; Tanner 2014; Essletzbichler 2015; Feldman et al. 2015; Rigby 2015; Brachert 2016; Cicerone et al. 2017; Coniglio et al. 2018a). This so-called regional diversification literature built on previous work on proximity and related variety that aimed to identify which activities can be considered proximate or related to each other, and how this proximity or relatedness might affect the effect of knowledge (spillovers) on urban and regional growth (Boschma 2005; Frenken et al. 2007; Boschma and Iammarino 2009; Tavassoli and Carbonara 2014; Kuusk and Martynovich 2018).

The principle claim of the regional diversification literature is that regions are more likely to develop new activities related to their existing activities, because these provide capabilities on which new activities can build and draw resources from. Capabilities required for related diversification are easier to acquire when close to existing local capabilities. By contrast, unrelated diversification requires a complete transformation of existing capabilities, which is accompanied by huge costs and high risks of failure (Saviotti and Frenken 2008), and thus more unlikely to happen (Neffke et al. 2018). The more radical the transformation in the underlying local capabilities is, the more it concerns unrelated diversification.

¹ The ‘product space’ literature also refers to the complexity of export products. This literature claims it is better for a country to develop new export products that are rare (non-ubiquitous), with few other countries having the same specialization (Hausmann and Hidalgo 2011). Balland and Rigby (2016) have investigated the geography of complex knowledge at the regional level in the US.

This claim has found confirmation in numerous studies. Studies have used different dependent variables (new products, industries, technologies, professions), have applied it at various spatial scales (regions, cities, labor market areas), and have covered different time periods. These studies also employ different relatedness measures, such as relatedness between products sharing similar market and production capabilities (Neffke et al. 2011), technological relatedness between activities sharing similar knowledge (Kogler et al. 2013), skill-relatedness between industries sharing similar skill requirements (Neffke and Henning 2013) and input-output relatedness between industries with similar supplier-buyer relationships (Essletzbichler 2015). Despite these differences in research layout, all studies on regional diversification find that related diversification is the rule: local capabilities condition which new activities are more likely to develop in regions (Boschma 2017; Hidalgo et al. 2018)².

With respect to new products or industries, Neffke et al. (2011) found that an industry had a higher probability to enter a region in Sweden when technologically related to pre-existing industries in that region. Boschma et al. (2013) found a similar finding for entry of new export products in Spanish regions. That study also showed that regional capabilities were more important than national capabilities to predict entry of new export products. Essletzbichler (2015) demonstrated that industries are more likely to enter US metropolitan regions when related to existing industries. Similar findings have been reported for NUTS-2 regions in the EU (Cortinovis et al. 2017) and in studies on diversification in prefectures in China (Guo and He 2017; Zhu et al. 2017; He et al. 2018; He and Zhu 2019).

With respect to new technologies, studies use patent data to study technological diversification of regions, constructing a ‘technology space’ that is based either on co-occurrence of technology classes on a patent document, or on citations across technology classes. Studies find that technologies related to pre-existing technologies had a higher probability to enter that region in the US for metropolitan regions (Kogler et al. 2013; Rigby 2015; Boschma et al. 2015) and in the EU for NUTS-2 regions (Balland et al. 2018). These studies have also been done on regional diversification in particular technologies, like eco-technologies in European regions (Van den Berge and Weterings 2014), fuel cell technology in European regions (Tanner 2014, 2016), nano-technologies in European regions (Colombelli et al. 2014), bio-technologies across world cities (Boschma et al. 2014; Heimeriks and Boschma 2014), and rDNA technology across US metropolitan areas (Feldman et al. 2015).

With respect to new professions, studies use data on job classes to construct an ‘occupational space’ based on their co-occurrence in regions to investigate occupational diversification in regions (Muneepeerakul et al. 2013, Brachert 2016; Shutter et al. 2016). They all found with no exception that the entry probability of a new occupation in US metropolitan regions is higher when related to existing occupations in the region.

² While lots of scientific work on structural change has embraced the value chain approach, it is fair to say that the regional diversification literature has not yet connected to the value chain literature (Iacobucci and Guzzini 2016). This comes as a surprise, as it might be as important for regions to upgrade their economies and move into new value chains or higher segments within the same value chain as to move into new growing sectors or technologies.

Some studies on regional diversification also assessed the probability of exit of existing activities in regions (the other [down-]side of structural change next to entry of new activities), and to what extent it is affected by relatedness with existing activities in a region. All studies come to the same conclusion: the exit probability of an industry (Neffke et al. 2011), technology (Rigby 2015) or job (Muneepeerakul et al. 2013) in a region is lower when related to existing activities. Apparently, processes of decline and exit of existing activities in regions are less likely to occur when they are embedded in other local activities. Accordingly, regions tend to become more coherent over time, as they enter more related activities and exit in more unrelated activities (Quatraro 2010; Neffke et al. 2011; Neffke et al. 2018). This leads to an increase of related variety in regional structures and, in consequence, regions can become more specialized. This tendency to more coherence is more pronounced at the regional than the national scale (Neffke et al. 2011). This net effect of entry and exit has also been investigated within technologies, like nanotechnology (Colombelli et al. 2014), biotechnology (Krafft et al. 2011) and telecommunications (Krafft et al. 2014).

Structural change and unrelated diversification in regions

Thus there is a lot of evidence for related diversification. However, unrelated diversification also happens now and then, although infrequent (Coniglio et al. 2018a,b). Scholars are showing an increasing research interest in this more radical type of change and how such structural change comes about, just because it seems to be an anomaly in a world where regions show a strong tendency to do what they did before, either because they do not diversify at all, or because they diversify in activities closely related to their existing activities (Boschma et al. 2017). Some scholars have made strong claims that regions should depart radically from their past as a way to overcome an inevitable process of negative lock-in. This resonates long-standing research interest in radical change in societies, as embodied in phenomena like leapfrogging (Perez and Soete 1988), radical breakthroughs (Gordon 2016), transitions to sustainable development (Geels and Schot 2007), new path creation (Isaksen and Trippel 2014)³, and more lately, mission-oriented innovation policy (Mazzucato 2013).

In the regional diversification literature, there exists little theorizing on unrelated diversification, and why we observe it now and then. In recent years, more from a pragmatic perspective, scholars have started investigating the particular conditions that make regions more likely to diversify into unrelated activities now and then. In this context, unrelated diversification does not necessarily mean a complete break with the past, but is more defined in terms of less related, rather than completely unrelated, diversification (Boschma 2017). To explore which regional factors might enhance unrelated diversification in regions, studies often interact relatedness with regional factors to assess which conditioning factors weaken the positive effect of relatedness on regional diversification.

³ The literature on new growth paths is interested in path development, inspired by the path dependence literature (Martin 2010). However, it is not always clear what is meant by a path and how a path is defined and operationalized in studies. Therefore, it might often be more appropriate to talk about past dependence, rather than path dependence. The new growth path literature focuses on different categories of path development, like path renewal and new path creation (Isaksen and Trippel 2014).

First of all, high levels of economic development at the national scale (Petralia et al. 2017) and regional scale (Boschma and Capone 2016) tend to favor unrelated diversification. Pinheiro et al. (2018) found that more unrelated diversification (relatively speaking) happens at intermediate levels of economic development of countries. A common finding is that lower-income countries and regions are more engaged in related diversification. Periods of sustained economic growth in U.S. regions seem to favor more unrelated diversification as well, in contrast to major depression periods (Steijn et al. 2018). Second, high levels of knowledge capabilities seem to matter as well. Montresor and Quatraro (2017) found a positive effect of Key Enabling Technologies on the tendency of European regions to diversify in more unrelated technologies. That is, they found a weaker (but still significant) impact of local relatedness on technological diversification in regions with a strong presence of Key Enabling Technologies. Xiao et al. (2018) showed that a research and innovation infrastructure allows European regions to make a jump in their industrial evolution now and then. Third, unrelated variety in the techno-economic structure of regions tends to favor more unrelated diversification. Castaldi et al. (2015) found that unrelated variety enhances the occurrence of technological breakthroughs. This finding has been confirmed in a study by Barbieri et al. (2018) on new green technologies in U.S. states. They showed that unrelated variety matters more in their emergent phase and related variety more in their mature phase.

So far, we discussed national or regional capabilities that might affect unrelated diversification. However, structural change might also come from the outside. Studies (Bahar et al. 2014; Boschma et al. 2016) found that regions are more likely to develop new export sectors in which their neighbor regions are specialized. Andersson et al (2013) found high-quality imports to be crucial for the entry of new high-quality export products in regions. Case studies suggest that non-local linkages might be crucial for new path creation, especially in peripheral regions where local resources are weak (Fitjar and Rodríguez-Pose 2011; Isaksen 2015; Grillitsch and Magnuson 2015; Trippel et al. 2015). Some studies have looked at the relationship between inflow of firms and unrelated diversification in regions. Neffke et al. (2018) found that non-local entrepreneurs and firms induce structural change in regions (as opposed to incumbents), while Elekes et al. (2018) showed the strong involvement of non-local MNE's in more unrelated diversification in regions.

Scholars have suggested that unrelated diversification is crucial for long-term development of countries/regions, to avoid over-specialization in the long term. A crucial question is: can countries/regions keep relying on more related diversification to sustain long-term economic growth, or do regions need to diversify in unrelated activities now and then to avoid lock-in in the long run, and to secure long-term economic development (Boschma 2017)? Despite regular strong claims made in the literature, there is little to no systematic evidence on the long-term economic effects of more or less unrelated diversification (Coniglio et al. 2018b). Pinheiro et al. (2018) has shown at the national level that unrelated diversification might give a 'small' economic bonus to countries, especially at their intermediate stage of development.

Regional diversification and national and regional institutions

The structural change literature has long focused on the role of capabilities and which types of capabilities affect the process of structural change. This is especially prominent in the literature that examines the role of technological and social capabilities in countries to catch up (Lall 1992; Fagerberg and Srholec 2008). Social capabilities are considered crucial to turn technological capabilities into economic development. According to Fagerberg et al. (2014), social capabilities include the public knowledge infrastructure, a well-functioning labor market, and the prevalence of norms and values. Technological capabilities concern the ability to create new knowledge and innovations through innovation and finance capabilities. This complementary role of technological and social capabilities resembles a much bigger literature in innovation studies that has criticized the linear model of innovation, saying that knowledge is not sufficient for economic development, unless an appropriate and effective institutional and social context is in place (Rodríguez-Pose and Crescenzi 2008).

In the regional diversification literature, there are studies that investigated how national and regional institutions might affect the nature of diversification. Following the Varieties of Capitalism literature (Hall and Soskice 2001), Boschma and Capone (2015) tested whether institutions do matter for the type of diversification that prevail in countries. They found that institutions that regulate less tightly labor, 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, which make countries to focus more on related diversification. These institutions make them to stick closer to what they did in the past.

He and Zhu (2019) found evidence of the effects of economic liberalization and state involvement at the national and regional scale on the propensity of Chinese regions to diversify in related activities. And Cortinovis et al. (2017) investigated the effect of regional institutions on the ability of European regions to diversify. Bridging social capital in regions was a crucial enabling factor for regional diversification. This study also accounted for inter-regional variations in the quality of government, derived from surveys among citizens rating local public services in education and healthcare with respect to quality of governance, impartiality, and level of corruption (Charron et al. 2014). No direct effect of the quality of government in regions could be found. However, a combination of low quality of government and bonding social capital in a region turned out to be devastating for diversification.

Regional diversification and role of agency

So far, evidence has been collected concerning the question what makes some regions more capable of diversifying than other regions, and which capabilities at the national and regional scale contribute to what type of regional diversification. Besides the importance of national and regional capabilities, the role of agency is also considered to be crucial for diversification in regions. As noticed before, the Window of Locational Opportunity approach (Storper and Walker 1989; Boschma 1997) highlighted that actors, not regions, make regions diversify, turning local structures into supportive ones. However, this role of agency was not worked out systematically for long. This has changed recently, based on new insights in entrepreneurship

studies (Klepper 2007), transition studies (Coenen and Truffer 2012; Boschma et al. 2017) and the institutional entrepreneurship literature (Garud et al. 2002; Maguire et al. 2004).

Economic actors like entrepreneurs and firms are principal agents that make regions diversify. Work of Klepper on the rise of new industries in places like Detroit (Klepper 2007) has been crucial to develop a micro-perspective on regional diversification. What his studies showed is that new start-ups founded by entrepreneurs coming from related industries (rather than start-ups) and incumbents diversifying from related industries (rather than incumbents) played a key role in the emergent stage of an industry. This observation of spinoffs and diversifiers from related industries giving birth to new industries provides support for related diversification in regions at the micro-scale. This is in line with evidence that firms diversify in new products not only related to their own products but also related to products in their own region (Cainelli and Iacobucci 2015; Lo Turco and Maggioni 2016; Hazir et al. 2016).

Neffke et al. (2018) examined systematically who are the economic agents of structural change, and found that new plants rather than incumbents induce unrelated diversification in regions. More importantly, Neffke et al. (2018) showed that new plants from outside the region, and not so much local start-ups, are responsible for more unrelated diversification in regions. Especially new subsidiaries established by firms in other regions induce structural change, because the ownership link subsidiaries have with their parent in their home region helps them to overcome the liability of newness, allowing them to develop activities that rely on resources that do not exist in the host region. Elekes et al. (2018) found that this especially applies to plants that are established by Multi-National Enterprises (MNE's).

This resembles work on MNE's introducing new specializations in regions (Crescenzi et al. 2015). The role of MNE's in inducing structural change has been widely documented in the international trade and business literature (Iammarino and McCann 2013). The type of investment strategies of MNE's plays a crucial role: more unrelated diversification is more likely to occur, with possibly little spillovers to the local economy, when MNE's invest in a host region, exploiting their technological leadership while benefiting from low local costs to produce standard goods. Instead, more related diversification occurs, with potentially positive spillovers to the host region, when MNE's make R&D investments in activities related but not identical to activities in the host region, which allows MNE's exploiting local knowledge while avoiding leakage of their own knowledge to local competitors (Cantwell and Iammarino 2003). And besides the inflow of non-local firms, local firms may also induce diversification in a region through non-local linkages (Grillitsch and Magnuson 2015).

Besides the role of firms, there is increasing recognition that individuals can make a difference, especially individuals that come from elsewhere, like star scientists, top managers or key employees (Feldman et al. 2005; Trippel 2013). Migrants have been reported to be important for regional diversification (Bahar and Rapoport 2014). What has been referred to as transnational entrepreneurs have contributed to early industry formation in specific places (Saxenian 2006; Drori et al. 2009; Vale and Carvalho 2013).

But there are also non-economic actors that act as agents of structural change. Public agencies, like universities, play a role in developing new industries in regions unrelated to

their existing development paths (Tanner 2014; Gilbert and Campbell 2015). Public policy can induce radical transformations in regions, through fundamental research or public procurement (Mazzucato 2013). Some recent policy efforts, like smart specialization policy in the EU in particular (Foray 2014), are actually aiming for stimulating new specializations in regions, while building on their existing capabilities (Balland et al. 2018).

The institutional entrepreneurship literature looks at the role of agency in institutional change (Garud et al. 2002; Maguire et al. 2004; Battilana et al. 2009). It builds on earlier work on structural change that early industry formation necessitates new institutions and the adaptation of existing ones (Nelson 1994). It describes how institutional agents engage in collective action to mobilize knowledge, resources and public opinion, as to build legitimacy and create new or shape existing institutions at various spatial scales to enable new industry formation in regions (Strambach 2010; Sotarauta and Pulkkinen 2011; Dawley et al. 2015). This comes close to entrepreneurial experimentation in transition studies that focus on the role that niches play for the emergence of radical technologies in an established regime (Smith and Raven 2012), and on the counter-forces from vested interests and incumbents that can block institutional change when new activities challenge overarching regimes (Wesseling 2015).

Concluding remarks

We argued that little attention has been paid to the geographical dimension in the structural change literature until recently. This chapter has shown why there is need to fill this gap, and why a geographical perspective is a prerequisite to get a more comprehensive view on structural change. It has highlighted that the process of creative destruction is distributed unevenly across countries and regions. In particular, the diversification capacity of regions in countries differs to a considerable degree. We discussed recent literature showing how regional capabilities and institutions shape structural change. And processes of creation and destruction do often not coincide in the same places, generating winners and losers in the economic landscape as a consequence. In the long run, the resulting geographical pattern is persistent only to some degree, with, occasionally, shifting fortunes of regions.

In particular, we discussed the product space and relatedness literature that emerged in the last decade (Boschma 2017; Hidalgo et al. 2018). The product space literature aims to identify potentials of countries to diversify at the national scale, and the relatedness literature on regional diversification is doing more or less the same at the sub-national or regional scale, employing similar new network methods, and analyzing longitudinal data on new technologies, industries, export products and professions. Studies have found strong support for their claim that new activities are often related to, or embedded in, existing activities at the national and above all the regional scale, providing capabilities from which new activities draw resources. Unrelated diversification is less likely to happen, because it requires a complete transformation of local capabilities. In contrast, decline and exit of activities is less likely to occur in regions when related to, or embedded in, other existing activities. In consequence, regions tend to become more coherent over time: regions tend to add new activities closely related to local activities, while they exit activities unrelated to those. This

tendency is more pronounced at the regional than the national scale, which shows again why it is crucial to study structural change at the sub-national scale.

Studies have focused on what factors favor diversification. Although this body of empirical literature is relatively new and still expanding, findings tend to suggest that more unrelated diversification is more likely to occur in regions with a high level of income, unrelated variety in its economic structure, a well-developed research and innovation infrastructure, the presence of key enabling technologies, and during periods of sustained economic upswing. Institutions at the national and regional scale seem to matter as well. National institutions favoring liberal market regulations tend to give countries more freedom to diversify in more unrelated activities. In China, economic liberalization and state involvement at the regional scale increase the propensity of regions to diversify in related activities. And in Europe, bridging social capital in regions is an enabling factor, while bonding social capital and low quality of government in a region turn out to be a toxic mixture for diversification.

Besides national and regional capabilities, the literature on regional diversification stresses the importance of agency at the micro-scale. What is advocated is a micro-perspective that aims to identify key agents that drive 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 more successful in diversifying in new activities. Related diversification in regions seems to be enhanced by diversifying firms on the one hand, and entrepreneurs spinning from related activities on the other hand. Unrelated diversification in regions seems to be initiated and enhanced by non-local firms and MNE's in particular. Moreover, the regional diversification literature takes a much broader view that goes beyond the firm. It explores the role of institutional entrepreneurs and political leadership, recognizing the importance of institutional change to enable diversification in regions. What is emphasized is that institutional agents engage in collective action to mobilize resources, build legitimacy and reshape institutions at various spatial scales, to enable new industry formation in regions.

In EU regional policy circles, concepts like related diversification and related variety are being used as inputs for smart specialization policy that aims to develop new specializations in regions (Foray 2014; Montresor and Quatraro 2018). The focus of smart specialization policy is on identifying and exploiting opportunities in regions to develop new growth paths, building on the related variety and diversification literature (McCann and Ortega-Argilés 2014, 2015). It shows that structural change is more than ever part of the policy agenda, and that the regional dimension is considered to be a crucial ingredient for innovation policy.

References

Abramowitz, M.A. (1986) Catching up, forging ahead and falling behind, *Journal of Economic History* 46, 385-406.

- Andersson, A.E. (1981) Structural change and technological development, *Regional Science and Urban Economics* 11, 351-361.
- Andersson, M., L. Bjerke and C. Karlsson (2013) Import flows: extra-regional linkages stimulating renewal of regional sectors? *Environment and Planning A* 45, 2999 – 3017.
- Arthur, W.B. (1994) *Increasing returns and path dependence in the economy*, Ann Arbor, MI: University of Michigan Press.
- Bahar, D., Hausmann, R. and 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.
- Bahar, D. and H. Rapoport (2014) Migration, knowledge diffusion and the comparative advantage of nations, working paper, Harvard, Cambridge.
- Balland, P.A., R. Boschma, J. Crespo and D. Rigby (2018), Smart specialization policy in the EU: Relatedness, knowledge complexity and regional diversification, *Regional Studies*, doi: 10.1080/00343404.2018.1437900.
- Balland, P.-A. and Rigby, D. (2016) The Geography of Complex Knowledge. *Economic Geography* 93(1), 1–23.
- Barbieri, N., F. Perruchas and D. Consoli (2018), Specialization, diversification and environmental technology life-cycle, *Papers in Evolutionary Economic Geography*, no. 18.38, Utrecht University, Utrecht.
- Battilana, J., Leca, B. and Boxenbaum, E. (2009) How actors change institutions: Towards a theory of institutional entrepreneurship, *The Academy of Management Annals* 3, 65– 107.
- Berge, M. van den, and A. Weterings (2014) Relatedness in eco-technological development in European regions, The Hague: Planbureau voor Leefomgeving.
- Boschma, R.A. (1997), New industries and windows of locational opportunity. A long-term analysis of Belgium, *Erdkunde* 51, 12-22.
- Boschma, R.A. (2005), Proximity and innovation. A critical assessment, *Regional Studies* 39 (1), 61-74.
- Boschma, R. (2017) Relatedness as driver behind regional diversification: a research agenda, *Regional Studies*, 51 (3), 351-364.
- Boschma, R., P.A. Balland and D.F. Kogler (2015), Relatedness and technological change in cities: The rise and fall of technological knowledge in U.S. metropolitan areas from 1981 to 2010, *Industrial and Corporate Change* 24 (1), 223-250.
- Boschma, R. and G. Capone (2015) Institutions and diversification: Related versus unrelated diversification in a varieties of capitalism framework, *Research Policy* 44, 1902-1914.

- Boschma, R. and G. Capone (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.
- Boschma, R., L. Coenen, K. Frenken and B. Truffer (2017) Towards a theory of regional diversification: combining insights from evolutionary economic geography and transition studies, *Regional Studies* 51 (1), 31-45.
- Boschma, R., G. Heimeriks and P.A. Balland (2014) Scientific knowledge dynamics and relatedness in biotech cities, *Research Policy* 43 (1), 107-114.
- Boschma, R.A. and S. Iammarino (2009) Related Variety, Trade Linkages and Regional Growth, *Economic Geography* 85 (3), 289-311.
- Boschma, R.A. and J.G. Lambooy (1999), The prospects of an adjustment policy based on collective learning in old industrial regions, *GeoJournal* 49 (4), 391-399.
- Boschma, R., V. Martin and A. Minondo (2017) Neighbour regions as the source of new industries, *Papers in Regional Science* 96 (2), 227-245.
- Boschma, R., A. Minondo and M. Navarro (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.
- 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.
- Cainelli, G. and D. Iacobucci (2015) Local variety and firm diversification: an evolutionary economic geography perspective, *Journal of Economic Geography*, doi:10.1093/jeg/lbv040
- Cantwell, J.A. and S. Iammarino (2003) *Multinational corporations and European regional systems of innovation*, London/New York: Routledge
- Castaldi, C., K. Frenken and B. Los (2015) Related variety, unrelated variety and technological breakthroughs. An analysis of US state-level patenting, *Regional Studies* 49 (5), 767-781.
- Charron, N., L. Dijkstra and V. Lapuente (2014) Regional governance matters: quality of government within European Union member states. *Regional Studies* 48(1), 68-90.
- Cicerone, G., P. McCann and V.A. Venhorst (2017), Promoting regional growth and innovation: relatedness, revealed comparative advantage and the product space, *Papers in Evolutionary Economic Geography*, no. 17.14, Utrecht University, Utrecht.
- Colombelli, A., J. Krafft and F. Quatraro (2014) The emergence of new technology-based sectors in European regions: a proximity-based analysis of nanotechnology, *Research Policy* 43, 1681-1696.

- Coniglio, N. D., R. Lagravinese, D. Vurchio and M. Armenise (2018a) The pattern of structural change: testing the product space framework. *Industrial and Corporate Change* 27 (4), 763-785.
- Coniglio, N.D, D. Vurchio, N. Cantore and M. Clara (2018b) On the evolution of comparative advantage: path-dependent versus path-defying changes, Papers in Evolutionary Economic Geography, no. 18.18, Utrecht University, Utrecht.
- Cortinovis, N., J. Xiao, R. Boschma and F. van Oort (2017) Quality of government and social capital as drivers of regional diversification in Europe, *Journal of Economic Geography* 17 (6), 1179–1208.
- Crescenzi, R., L. Gagliardi, L., and S. Iammarino (2015) Foreign multinationals and domestic innovation: Intra-industry effects and firm heterogeneity, *Research Policy* 44(3), 596–609.
- Daniels, P. (1993) *Service industries in the world economy*, Oxford: Blackwell.
- Dawley, S., D. MacKinnon, A. Cumbers and A. Pike (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.
- Diodato, D. (2017) *Technological and structural change. Understanding economic growth in countries and regions*, PhD thesis, Utrecht: Utrecht University.
- Drori, I., B. Honig and M. Wright (2009) Transnational entrepreneurship. An emergent field of study, *Entrepreneurship: Theory and Practice* 33, 1001-102.
- Elekes, Z., R. Boschma and B. Lengyel (2018) Foreign-owned firms as agents of structural change in regions: The case of Hungary 2000-2009, Papers in Evolutionary Economic Geography no. ,Utrecht University, Utrecht.
- Essleztbichler, J. (2015) Relatedness, industrial branching and technological cohesion in US metropolitan areas, *Regional Studies* 49 (5), 752–766.
- Fagerberg, J., and Srholec, M. (2008) National innovation systems, capabilities and economic development. *Research Policy* 37(9), 1417-1435.
- Fagerberg, J., M. Feldman and M. Srholec (2014) Technological dynamics and social capability: US states and European nations, *Journal of Economic Geography* 14, 313-337.
- Feldman, M.P., J. Francis and J. Bercovitz (2005), Creating a cluster while building a firm. Entrepreneurs and the formation of industrial clusters, *Regional Studies* 39, 129-141.
- Feldman, M.P., D.F. Kogler and D.L. Rigby (2015), rKnowledge: The Spatial Diffusion and Adoption of rDNA Methods, *Regional Studies* 49 (5), 798-817.
- Fitjar R. and Rodríguez-Pose A. (2011) When local interaction does not suffice; sources of firm innovation in urban Norway. *Environment and Planning A* 43, 6: 1248–67.

- Foray, D. (2014), From smart specialisation to smart specialisation policy, *European Journal of Innovation Management* 17 (4), 492-507.
- Frank, A.G. (1967) *Capitalism and underdevelopment in Latin America*, New York: Monthly Review Press.
- Freire, C. (2017) *Diversification and structural economic dynamics*, Maastricht: Boekenplan.
- Frenken, K. Van Oort, F.G. and Verburg, T. (2007) Related variety, unrelated variety and regional economic growth, *Regional Studies* 41 (5), 685-697.
- Garud, R., S. Jain and A. Kumaraswamy (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.
- Geels, F.W. and J. Schot (2007) Typology of sociotechnical transition pathways, *Research Policy* 36 (3), 399-417.
- Gilbert, B.A. and J.T. Campbell (2015) The geographic origins of radical technological paradigms. A configurational study, *Research Policy* 44, 311-327.
- Glaeser, E.L. (2005) Reinventing Boston: 1630-2003, *Journal of Economic Geography* 5, 119-153.
- Gordon, R.J. (2016) *The rise and fall of American growth. The U.S. standard of living since the civil war*, Princeton and Oxford: Princeton University Press.
- Grabher, G. (1993) The weakness of strong ties: the lock-in of regional development in the Ruhr area. Grabher, G. (ed) *The Embedded Firm*, London: Routledge, 255-277.
- Grillitsch, M. and M. Nilsson (2015) Innovation in peripheral regions. Do collaborations compensate for a lack of local knowledge spillovers? *Annals in Regional Science* 54 (1), 299-321.
- Guo, Q. and C. He (2017), Production Space and Regional Industrial Evolution in China. *Geojournal* 82, 379-396.
- Hall, P. and P. Preston (1988) *The carrier wave. New information technology and the geography of innovation 1846-2003*, London: Unwin Hyman.
- Hall, P. and D. Soskice (eds.) (2001) *Varieties of capitalism: The institutional foundations of comparative advantage*, Oxford: Oxford University Press.
- Hassink R. (2005) How to unlock regional economies from path dependency? From learning region to learning cluster, *European Planning Studies* 13 (4), 521-535.
- Hausmann, R. and Klinger, B. (2007), The Structure of the Product Space and the Evolution of Comparative Advantage, *CID Working Paper* no. 146

- Hazir, C. S., Bellone, F., and Gaglio, C. (2016) *Product relatedness in firm export diversification. Evidence from France*, working paper.
- He, C., Y. Yan and D. Rigby (2018), Regional Industrial Evolution in China. *Papers in Regional Science* 97 (2), 173-198.
- He, C. and S. Zhu (2019) *Evolutionary economic geography in China*, Springer.
- Heimeriks, G. and R. Boschma (2014) The path- and place-dependent nature of scientific knowledge production in biotech 1986-2008, *Journal of Economic Geography* 14, 339-364.
- Hidalgo, C., Balland, P.A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., Glaeser, E., He, C., Kogler, D., Morrison, A., Neffke, F., Rigby, D., Stern, S., Zheng, S., and Zhu, S. (2018) The Principle of Relatedness, *Springer Proceedings in Complexity*, 451-457.
- Hidalgo, C.A., Klinger, B., Barabasi, A.L. and Hausmann, R. (2007) The product space and its consequences for economic growth, *Science* 317, 482–487.
- Hohenberg, P.M. and L.H. Lees (1995) *The making of urban Europe*, Cambridge (MA): Harvard University Press.
- Iacobucci, D. and E. Guzzini (2016) Relatedness and connectivity in technological domains: missing links in S3 design and implementation, *European Planning Studies* 24 (8), 1511-1526.
- Iammarino, S. and P. McCann (2013) *Multinationals and economic geography, Location, technology and innovation*, Cheltenham: Edward Elgar.
- Isaksen, A. (2015) Industrial development in thin regions: trapped in path extension? *Journal of Economic Geography* 15, 585-600.
- Isaksen, A. and M. Trippel (2014) Regional industrial path development in different regional innovation systems. A conceptual analysis, *Papers in Innovation Studies*, no. 2014/17, Lund.
- 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.
- Kogler, D.F., D.L. Rigby and I. Tucker (2013) Mapping Knowledge Space and Technological Relatedness in US Cities, *European Planning Studies* 21(9), 1374-1391.
- Krafft, J., F. Quatraro and P.P. Saviotti (2011) The knowledge-base evolution in biotechnology: a social network analysis, *Economics of Innovation and New Technology* 20(5), 445-475.
- Krafft, J., F. Quatraro and P.P. Saviotti (2014) The dynamics of knowledge-intensive sectors' knowledge base. Evidence from biotechnology and telecommunications, *Industry and Innovation* 21(3), 215-242.

- Kuusk, K. and M. Martynovich (2018) What kind of related variety for long-term regional growth?, *Papers in Evolutionary Economic Geography* no. 18.34, Utrecht University, Utrecht.
- Lall, S. (1992) Technological capabilities and industrialisation, *World Development* 20(2), 165-186.
- Lambooy, J. (2010) The evolution of spatial patterns over long-time horizons: the relation with technology and economic development, in: R. Boschma and R. Martin (Eds.) *The Handbook of Evolutionary Economic Geography*, pp. 471-486.
- Lecuyer, C. (2006) *Making Silicon Valley. Innovation and the growth of high tech, 1930-1970*, Cambridge: MIT Press.
- Lo Turco, A. and D. Maggioni (2016) On firms' product space evolution: the role of firm and local product relatedness, *Journal of Economic Geography* 16 (5), 975–1006.
- Maguire, S., Hardy, C. and Lawrence, T. B. (2004) Institutional entrepreneurship in emerging fields: HIV/AIDS treatment advocacy in Canada, *Academy of Management Journal* 47(5), 657-679.
- Markusen, A., P. Hall and A. Glasmeier (1986) *High tech America: the what, how, where and why of the sun-rise industries*, Boston: Allen & Unwin.
- Marshall, M. (1987) *Long waves of regional development*, London: MacMillan.
- Martin, R. (2010) Rethinking regional path dependence: Beyond lock-in to evolution, *Economic Geography* 86 (1), 1-27.
- Mazzucato, M. (2013) *The entrepreneurial state, debunking public vs. private sector myths*, London/New York: Anthen Press.
- 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.
- McCann P., Ortega-Argilés R. (2015), Smart Specialisation, Regional Growth and Applications to EU Cohesion Policy, *Regional Studies*, 49 (8), 1291-1302.
- Meliciani, V. (2015) The specialization of EU regions in emerging and high-opportunity technologies, Brussels, preliminary draft report presented in June 2015.
- Montesor, S. and F. Quatraro (2017), Regional branching and key enabling technologies. Evidence from European patent data, *Economic Geography* 93(4), 367-396.
- Montesor, S. and F. Quatraro (2018) Green technologies and smart specialization strategies. A European patent-based analysis of the intertwining of technological relatedness and key-enabling technologies, Department of Economics and Statistics Cognetti de Martiis, Working Papers, 201808, University of Torino.

- Muneepeerakul, R., J. Lobo, S.T. Shutter, A. Gomez-Lievano and M.R. Qubbaj (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. (2009) *Productive places. The influence of technological change and relatedness on agglomeration externalities*, Utrecht, Utrecht University.
- Neffke, F., M. Hartog, R. Boschma and M. Henning (2018) Agents of structural change. The role of firms and entrepreneurs in regional diversification, *Economic Geography* 94 (1), 23-48.
- Neffke F., Henning M. (2013) Skill-relatedness and firm diversification, *Strategic Management Journal* 34(3): 297-316
- Neffke F., Henning M. and 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.
- Nelson, R.R. (1994) The co-evolution of technology, industrial structure, and supporting institutions, *Industrial and Corporate Change* 3 (1), 47-63.
- Pasinetti L. (1981) *Structural change and economic growth. A theoretical essay on the dynamics of the wealth of nations*, Cambridge: Cambridge University Press.
- Perez, C. and L. Soete (1988) Catching up in technology: entry barriers and windows of opportunity, in: G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.) *Technical Change and Economic Theory*, London/New York: Pinter Publishers.
- Petralia, S., Balland, P.-A. and Morrison, A. (2017) Climbing the ladder of technological development. *Research Policy* 46 (5), 956–969.
- Pinheiro, F.L., A. Alshamsi, D. Hartmann, R. Boschma and C. Hidalgo (2018) Shooting Low or High: Do Countries Benefit from Entering Unrelated Activities? *Papers in Evolutionary Economic Geography*, no. 18.07, Utrecht.
- Quatraro, F. (2009), Innovation, structural change and productivity growth: evidence from Italian regions, 1980-2003, *Cambridge Journal of Economics* 33(5), 1001-1022.
- Quatraro, F. (2010) Knowledge Coherence, Variety and Productivity Growth: Manufacturing Evidence from Italian Regions, *Research Policy* 39, 1289-1302.
- Rigby, D. (2015) Technological relatedness and knowledge space. Entry and exit of US cities from patent classes, *Regional Studies* 49 (11), 1922-1937.
- Rodríguez-Pose, A. and R. Crescenzi (2008) R&D, spillovers, innovation systems and the genesis of regional growth in Europe, *Regional Studies* 41, 51-67.
- Saxenian, A.L. (2006) *The new Argonauts. Regional advantage in a global economy*, Cambridge (MA): Harvard University Press.

- Saviotti, P.P. and K. Frenken (2008) Trade variety and economic development of countries. *Journal of Evolutionary Economics* 18 (2), 201-218.
- Saviotti, P. and A. Pyka (2004) Economic development by the creation of new sectors, *Journal of Evolutionary Economics* 14, 1-35.
- Schumpeter, J. A. (1942) *Capitalism, Socialism and Democracy*, London: Unwin.
- Scott, A. (1988) *New Industrial Spaces: Flexible Production Organization and Regional Development in North America and Western Europe*, London: Pion.
- Shutters, S., Muneeppeerakul, R., and Lobo, J. (2016) Constrained pathways to a creative urban economy, *Urban Studies* 53(16), 3439-3454.
- Smith, A. and Raven, R. (2012) What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy* 41(6), 1025-1036.
- Sotarauta, M. and R. Pulkkinen (2011) Institutional entrepreneurship for knowledge regions: in search of a fresh set of questions for regional innovation studies, *Environment and Planning C*, 29, 96-112.
- Steijn, M.P.A., P.A. Balland, R. Boschma, D.L. Rigby and S.G. Petralia (2018) Technological diversification of U.S. cities during the great historical crises, *Papers in Evolutionary Economic Geography*, no., Utrecht University, Utrecht.
- Storper, M. and R. Walker (1989) *The Capitalist Imperative: Territory, Technology and Industrial Growth*, New York: Basil Blackwell.
- Strambach, S. (2010) Path dependence and path plasticity: the co-evolution of institutions and innovation—the German customized business software industry, in R.A. Boschma and R. Martin (eds.) *The Handbook of Evolutionary Economic Geography*, Cheltenham: Edward Elgar, pp. 406-431.
- Tanner, A.N. (2014) Regional branching reconsidered: Emergence of the fuel cell industry in European regions, *Economic Geography* 90 (4), 403-427.
- 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.
- Tavassoli, S. and Carbonara, N. (2014) The role of knowledge variety and intensity for regional innovation. *Small Business Economics* 43, 493–509.
- Trippel, M. (2013) Scientific mobility and knowledge transfer at the interregional and intraregional Level, *Regional Studies* 47 (10), 1653-1667.
- Trippel, M., M. Grillitsch and A. Isaksen (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, CIRCLE, Lund University. Lund.

Vale, M. and L. Carvalho (2013) Knowledge networks and processes of anchoring in Portuguese biotechnology, *Regional Studies* 47 (7), 1018-1033.

Wesseling, J. (2015) *Strategies of incumbent car manufacturers in sustainability transitions*, PhD thesis, Utrecht University, Utrecht

Xiao, J., R. Boschma and M. Andersson (2018) Industrial diversification in Europe. The differentiated role of relatedness, *Economic Geography* 94 (5), 514-549.

Zhu, S., C. He and Y. Zhou (2017), How to Jump Further and Catch Up? Path-Breaking in an Uneven Industry Space. *Journal of Economic Geography*, doi:10.1093/jeg/lbw047.