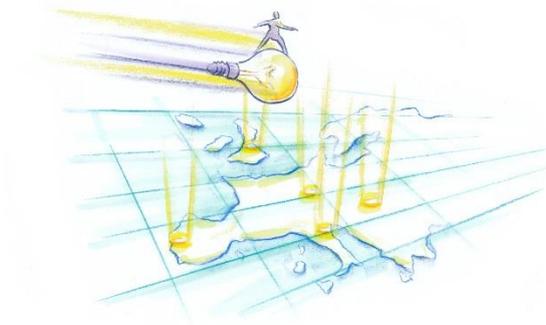


Knut Koschatzky, Thomas Stahlecker (eds.)

## **Innovation based regional change in Europe: Chances, risks and policy implications**



Karlsruhe, 2019

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### **3 Broadening perspectives: innovation outside of agglomerations**

*Martin Graffenberger, Lukas Vonnahme, Matthias Brachert, Thilo Lang*

#### **3.1 Introduction**

A central assumption in current debates on the geography of innovation is that a firm's location affects its ability to innovate (Isaksen and Karlsen 2016). Conceptualised as geographical proximity, it is argued that co-location of firms and actors such as universities and intermediaries effectively supports the emergence of innovation, especially in larger agglomerations. This assumption rests on two theoretical building blocks: localisation and urbanisation economies. The idea of localisation economies goes back to Marshall (1927) who suggested that a regional specialisation of economic activities provides pecuniary and non-pecuniary benefits to firms from related industries, for instance through eased exchange of knowledge and common use of regional resources such as a specialised labour market. Discussed in terms of urbanisation economies (Jacobs 1969), the diversity of economic activities and actors and the associated potential of cross-fertilisation provide further positive externalities. Diverse economic structures bring together heterogeneous actors and facilitate a fruitful exchange of resources.

These building blocks were integrated into contemporary conceptualisations of dynamic regional economies. Debates on territorial innovation models (TIMs), which started to emerge in the 1980s, essentially focussed on the notion of geographical proximity (Moulaert and Sekia 2003). In TIMs, innovation, competitiveness and growth are seen as endogenously induced and directly linked to the particular attributes of local and regional environments: e.g. the sectoral structure, density of actors and related network potentials and institutional arrangements (Lorentzen 2008). Following this logic, geographical proximity is not only considered a facilitating element, but often regarded as a mandatory precondition for innovation. Consequently, firms which cannot benefit from agglomeration advantages and localised knowledge exchange, i.e. firms located outside of agglomerations, are portrayed as less dynamic and innovative (Graffenberger and Vonnahme in press).

In this chapter, we argue that this perspective is outdated. And indeed, more recently, this dichotomous interpretation on the interconnection between innovation and space has increasingly been challenged (Shearmur et al. 2016). In response to critiques on the rather absolute understanding of space in TIMs in which territories are framed as self-contained entities of economic and social coordination (Moulaert and Sekia 2003; Lorentzen 2008; Crevoisier and Jeannerat 2009), studies based on relational conceptions

of space and agency illustrate that firms' social relations and networks are typically not confined to a certain region. Rather, processes of knowledge creation and circulation traverse and (re-)combine various scales (Lorentzen 2008) and thereby become territorially dynamic (Crevoisier and Jeannerat 2009). This shift in perspective provides novel insights into the geography of innovation and helps us to re-conceptualise the role of peripheral regions in the geography of innovation discourse. So far, this type of regions has not been adequately represented in wider academic debates about innovation. In quantitative approaches, innovation is often measured through indicators such as expenditures on research and development or patents that are for various reasons biased towards core and high-tech regions (Shearmur 2017). If framed and empirically measured by these indicators, innovation appears to be spatially concentrated mainly in larger city regions (e.g. Rodríguez-Pose and Wilkie 2016). However, these indicators might systematically underestimate innovation activities in peripheral regions because these regions tend to be more oriented towards traditional economic activities (Petrov 2011). Hence, a substantial part of their innovation activities remains hidden precisely because formal R&D is less relevant and the number of patents granted is lower.

The contribution of this chapter is twofold. First, it contributes to ongoing debates on a more differentiated perspective concerning the geography of innovation. We illustrate for the German context that innovative firms can also be found outside of larger agglomerations and that these firms generate outcomes that range from incremental improvements to first on the market novelties. Thereby, we oppose commonly held associations concerning the state of regions and actors outside of agglomerations as being substantially less or even non-innovative. Second, the chapter makes a contribution to existing literature by highlighting alternative pathways to innovation. In particular, we illustrate that firms outside of agglomerations seem to have lower interaction requirements and exhibit different patterns regarding their innovation-oriented collaboration partners.

In the theoretical section, we present a broad range of approaches that allows the reader to understand how firms located outside of agglomerations can mobilise their innovation potential even if geographical proximity and localised interaction do not constitute viable options. To contest common spatial associations, in the empirical section we present analyses on the spatial distribution of Hidden Champions in Germany. Furthermore, we analyse the innovation and collaboration behaviour of firms located within and outside of agglomerations in Germany and, thereby, empirically illustrate some of the alternative innovation mechanisms discussed in the theoretical section.

### **3.2 Extending perspectives on innovation activities in economic geography**

The following theoretical discussion establishes a link between the widely acknowledged understanding of innovation as knowledge-driven, interactive and multi-local processes and recent theoretical developments in the geography of innovation literature. The focus lies on theoretical arguments that help to explain the emergence of innovation outside of agglomerations – and thereby to challenge conventional perspectives which assume that innovation is less likely to occur in peripheral regions.

Contemporary conceptualisations of innovation can be associated with the 'open innovation' paradigm (Chesbrough 2003). The open innovation approach serves as an umbrella concept and integrates a number of determining features of innovation processes. Innovation typically evolves in an evolutionary and cumulative fashion (Dosi 1988; Koschatzky 2001), i.e. existing knowledge is newly combined and/or genuinely new knowledge is created as part of this process (Fagerberg 2006). Perceiving innovation openly suggests that innovating firms rely on both, their specific and specialised internal capacities (Cohen and Levinthal 1990), but also on knowledge and expertise obtained from external organisations. Purposefully and effectively linking internal resources and external expertise allows firms to expand knowledge bases and to generate innovative outcomes. Furthermore, this perspective emphasises that innovation is essentially an interactive and social process (Welz 2003; Bathelt and Glückler 2011). As a consequence, innovation activities typically rely on interactive and collaborative arrangements between actors. These collaborations are often not tied to single localities but organised in multi-scalar and territorially dynamic ways (Crevoisier and Jeannerat 2009), thereby engaging multiple localities (Schmidt et al. 2018).

However, the interactive nature of innovation has traditionally been framed as a spatially bounded phenomenon, vividly illustrated by the central position of territorial innovation models (TIMs) in economic geography. The different conceptual approaches within the TIM family such as industrial districts, innovative milieux, innovation systems and clusters, which mainly evolved throughout the 1980s and 1990s, commonly ascribe a beneficial role to geographical proximity. In fact, these concepts treat geographical proximity as a necessary condition for innovation (Moulaert and Sekia 2003) and inscribed a distinct 'core region thinking' into theoretical approaches (Isaksen and Sæther 2015). Undoubtedly, certain geographic contexts provide more conducive contexts for intense innovation activities than others. However, such prevalent theoretical positions assume a straightforward link between location and innovation, often implicitly and explicitly excluding locations and actors outside of agglomerations (Graffenberger and Vonnahme, in press). Recent theoretical developments and a growing number of empirical studies

(see Eder 2018 for a recent overview) suggest that the geography of innovation might be more diverse than conventionally assumed, resembling a complex set of multiple geographies of innovation (Gibson and Brennen-Horley 2016; Shearmur et al. 2016).

Given contemporary conceptualisations of innovation in which, apart from internal capacities, external knowledge acquisition through interaction also operates as a key mechanism, a number of conceptual approaches can be identified that qualify rather than preclude peripheral regions as contexts for innovation. We argue that these approaches can contribute to a better understanding on how firms outside of agglomerations organise innovation activities, for example regarding the way they source and implement knowledge and expertise relevant for innovation.

Given that an intense localised exchange is not a viable option due to the relative thinness of regional contexts (Tödtling and Trippel 2005), it appears that interactions and collaborations over distances might operate as valuable knowledge sourcing mechanisms. It has been emphasised that actor relations spanning beyond local settings "may lead to precisely the same benefits that arise from agglomeration" (Johansson and Quigley 2003, p. 166). Conceptually, this idea relates to the notion of global pipelines, seen as complementary to the local buzz overserved in agglomerations (Bathelt et al. 2004). In the context of firms located outside of agglomerations, purposefully and strategically established pipelines might even act as effective alternatives to local buzz. This substitution mechanism was empirically corroborated in recent studies on the innovation related interaction behaviour of firms from peripheral Sweden (Grillitsch and Nilsson 2015) and Norway (Jakobsen and Lorentzen 2015). The studies find that, within the national setting, firms from peripheral regions collaborate across larger distances and even exhibit higher collaboration frequencies than firms in agglomerations. In a similar vein, it has been shown that collaboration with international partners has the largest impact on the innovation activities of firms from peripheral regions (Fitjar and Rodríguez-Pose 2011). Firms from peripheral regions that seek access to knowledge relevant for innovation are urged to engage in collaborations that span across distances and to establish purposefully built pipelines to spatially dispersed and functionally diverse collaboration partners (Jakobsen and Lorentzen 2015; Fitjar and Rodríguez-Pose 2017; Gibson and Brennon-Horley 2016).

These findings can also be related to the multi-dimensional proximity approach (e.g. Gilly and Torre 2000; Boschma 2005; Torre and Rallet 2005). This approach emphasises that geographical proximity (and distance) constitutes only one particular dimension in collaborative arrangements. To pursue innovation activities, firms from peripheral regions can link up to geographically distant partners by building upon cognitive, social, institutional and organisational proximity. Within the debate on the geography of innovation,

this perspective highlights two relevant aspects. First, too much proximity in each dimension impedes, for various reasons, fruitful interaction (Boschma 2005), highlighting at the same time the potential productivity of relational distance (Ibert et al. 2014). Second, geographical proximity is not necessarily the most important dimension facilitating effective collaboration.

A related aspect that has so far only been insufficiently considered in innovation theory is actor mobility (Shearmur 2017). Given that mobility constitutes a central feature of contemporary globalised economies (Maskell et al. 2006) and everyday business practices (Amin and Cohendet 2004; Schmidt et al. 2018), this negligence is at odds with firms' actual behaviour – vividly summarised by Amin and Cohendet (2004, p. 108): "The everyday possibility of striking and maintaining distanced links, the everyday possibility of action at a distance, the everyday possibility of relational ties over space, the everyday possibility of mobility and circulation, the everyday organization of distributed systems, make mockery of the idea that spatial proximity and 'being there' are one and the same". Diverse mobility opportunities and the possibility to participate in the full range of temporary events can be seen as particular mechanisms through which firms from peripheral regions balance the organisational thinness of their regional contexts. Mobility allows access to information and knowledge that circulate in temporary settings and, thereby, effectively supports innovation activities (Torre 2008; Maskell 2014; Henn and Bathelt 2015). Furthermore, the notion of mobility illustrates the multi-local nature of innovation, as these processes become situated in multiple locations, sites and regions – interwoven and linked by actors being mobile within and across space. Thus, mobility can be considered a central means to overcome geographical isolation when needed and deemed productive.

However, it has also been suggested that firms outside of agglomerations might adapt to their thin regional environments by reducing their interaction requirements, compensated for by comprehensive internal capacities (Shearmur 2015). If their innovation activities do not depend on rapid acquisition and processing of the latest knowledge, innovation activities might rather build on strategic expansion of internal capacities and experience-based expertise coupled with rather few, but strategically mobilised external collaborations (Isaksen and Sæther 2015; Graffenberger 2019).

Given the focus of this chapter on firms' innovation outside of agglomerations, the conceptual approaches discussed can be considered valuable starting points to better understand the emergence of innovation beyond urban core regions. Building on widely accepted conceptualisations of innovation as knowledge-driven and interactive processes, these approaches emphasise that it is not only large agglomerations and their actors that are able to bring forward innovation. Purposefully activated collaborations can

also be established and effectively maintained over great distances. Coupled with an expanded understanding of geographical proximity, devoting relevance to the diverse possibilities of mobility and considering the potentially important role of internal capacities, this allows us to outline a geography of innovation that exceeds designated innovation hotspots.

### **3.3 The spatial distribution and innovation patterns of innovative firms in Germany**

With the empirical part, we aim at contributing to a more differentiated understanding on the link between innovation and space and challenge the dichotomous representation of innovative versus less innovative settings. Therefore, we compare firms from within and from outside larger agglomerations in Germany, paying attention to their ability to innovate and the particular strategies mobilised for innovation.

First, we present findings on the spatial distribution of so-called Hidden Champions in Germany (see 3.3.2). Hidden Champions are commonly described as extraordinarily innovative companies that successfully compete and hold a leading position in global markets. This analysis allows us to strengthen our argument that innovation is not primarily a phenomenon observed in bigger agglomerations and to take innovation activities of firms located outside of larger city regions more seriously. Second, we present results of quantitative analyses on the dispersion and use of research and development activities, the innovation endeavours and cooperation behaviour of firms in different regional settings (see 3.3.3). These analyses are based on the 2017 IAB Establishment Panel data. The analyses illustrate certain differences in the innovation behaviour of firms from within and outside of agglomerations but support our argument that innovation also frequently occurs outside of agglomerations.

#### **3.3.1 Remarks on methodological proceedings**

First, the focus of our analyses is on firm-level economic innovation with a particular consideration of innovation activities of manufacturing firms. While the service sector is usually concentrated in agglomerations (Deza and López 2014), the manufacturing sector is relevant for both regions within and outside of agglomerations.

Second, given the chapter's focus on innovation outside of agglomerations, the spatial conceptions that inform our empirical analysis need to be illustrated. It has been emphasised that spatial categorisations that build merely on geographical factors induce rather narrow spatial conceptions and essentially re-emphasise an absolute understanding of

space (Kühn and Lang 2017). Thus, we integrate both geographical and functional aspects for spatial differentiation (Kühn and Weck 2013). In the two empirical sub-sections we mobilise a functional differentiation regarding types of towns and municipalities: large cities, medium-sized towns and small towns/rural municipalities.<sup>1</sup> Given that the functional centrality of a city/town is linked to its size, this differentiation allows us to perceive small towns and rural municipalities as particular approximations of non-agglomerated locations. Furthermore, we mobilise geographical, i.e. distance-based factors to determine the spatial categorisation. This categorisation distinguishes between (very) central and (very) peripheral locations.<sup>2</sup> As centrality decreases from very central to very peripheral locations, we approximate peripheral and very peripheral locations as being outside of agglomerations.

As our empirical analyses build on different data sets, deviations regarding the spatial reference units occur. Specifically, analyses on the spatial distribution of Hidden Champions in Germany refer to both functional and geographical factors, and allow for a refined approximation of firms located outside of agglomerations. Conversely, and due to data limitations regarding the actual location of observations, analyses on the IAB Establishment Panel only refer to a functional differentiation and, accordingly, consider small towns and rural municipalities as an approximation of locations outside agglomerations.

### **3.3.2 The spatial distribution of Hidden Champions in Germany**

The term Hidden Champion (HC) was first introduced into academic discussions by Hermann Simon, as part of his research on small and mostly medium-sized companies in Germany which were found to be exceptionally successful on the world market (Simon 1990). Simon (2012) defines three criteria to determine the notion of Hidden Champions. Firms must:

- be amongst the three leading players on the world market or be market leader on one continent,
- not exceed a turnover of 5 billion euros,
- exhibit only a low level of visibility and public awareness.

---

1 Based on the classification of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR): large city:  $\geq 100,000$  inhabitants; medium-sized town: 20,000 -  $< 100,000$  inhabitants; small town and rural municipality:  $< 20,000$  inhabitants (BBSR 2012).

2 Based on the classification of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), each county/municipality in Germany can be assigned to one of these four spatial categories (BBSR 2012).

Other studies on HCs largely adopt these differentiation criteria (e.g. Rammer and Spielkamp 2015; Venohr et al. 2015; Schlepphorst et al. 2016). In his studies, Simon (2012) shows that Germany's export strength is not primarily attributable to large companies but mainly driven by these comparatively small firms. Furthermore, it has been highlighted that HCs account for increased R&D expenditures, create an above average number of jobs and exhibit, also due to their international orientation, an overall strong economic performance and are thus rather insensitive to crises. Several studies emphasise that HCs are frequent innovators (Simon 2012; Kaudela-Baum et al. 2014; Rammer and Spielkamp 2015; Venohr et al. 2015). For example, they invest twice as much as other firms in R&D activities and, on average, the number of patents granted is five times higher than for larger, well-known corporations in Germany (Simon 2012, p. 259). Due to their rather small size, HCs operate with a high degree of flexibility and are capable of swiftly adapting to technological changes and market requirements. One major feature to explain the firms' market success therefore is their excellence in innovation which often enables them to be not only the market, but also the technological leader in their respective field (e.g. Simon 2012, p. 259; Venohr et al. 2015, p. 17). Another – and in the context of this chapter central – feature is the spatial distribution of HCs headquarters in Germany as these innovative firms frequently prosper in rural areas.

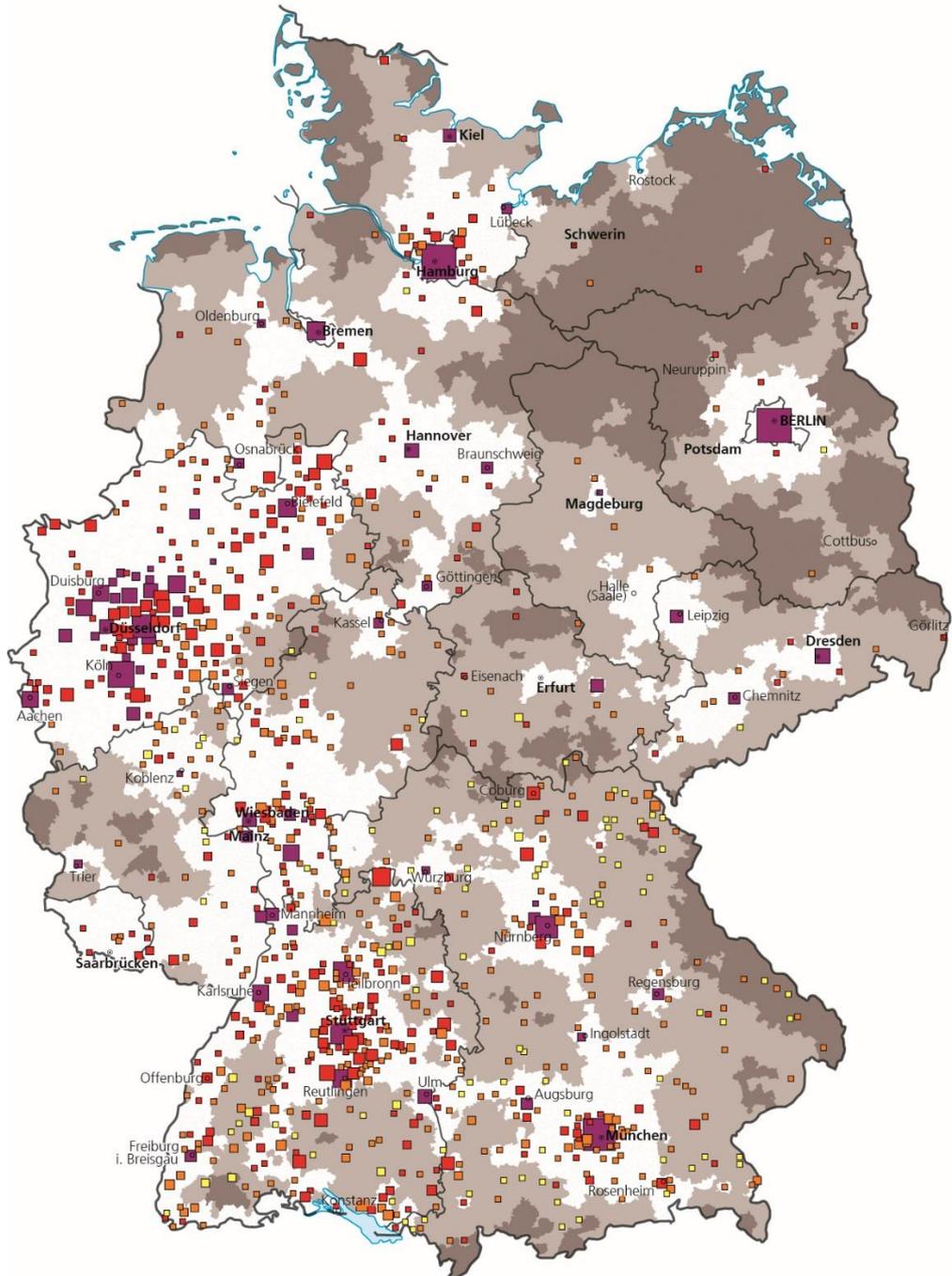
In order to identify HCs, we have merged two lists of world market leaders in Germany.<sup>1</sup> The aggregated database has been established according to the definition of Simon (2012). It contains 1,691 firms and the locations of their headquarters in Germany, including the official municipal identification code and additional company data (e.g. turnover, numbers of employees and information on economic activities according to German classification (WZ-Codes)).

The analysis of the spatial distribution of HCs across Germany highlights a number of distinct patterns (see map). Apart from major concentrations in and around metropolises such as Munich, Hamburg, Cologne and Berlin, many HCs can be observed in the federal states of North-Rhine-Westphalia, Baden-Württemberg, and Bavaria. This distribution is not unexpected, since especially Baden-Württemberg and Bavaria are known for their strong manufacturing sector (Kollewe 2012). Further concentrations of HCs can be observed in more peripheral regions such as the Black Forest in the southwest, in Franconia, a region in Northern Bavaria and Hohenlohe, a region in the northeast of Baden-Württemberg.

---

<sup>1</sup> We used and edited lists provided by Bernd Venohr (Venohr et al. 2015, <http://www.berndvenohr.de/>) and the Weissmann Gruppe für Familienunternehmen (<https://www.weissmann.de/>). Additional information has been added from the MARKUS-database, a firm database by Bureau von Dijk <https://www.bvdinfo.com/en-gb/our-products/data/national/markus>.

Figure 3-1: Locations of headquarters of German World market leaders



0 100 km

Sources:  
 Prof. Dr. Bernd Venohr  
 „Datenbank Deutscher Weltmarktführer“  
 & WeissmannGruppe für Familienunternehmen,  
 further research and supplements by the  
 Leibniz-Institute for Regional Geography,  
 Spatial Categories of the BBSR

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 Authors: T. Lang, L. Vonnahme  
 Cartography: S. Dutzmann

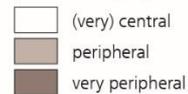
Number of firms



Type of municipality



Spatial category



Source: own elaboration

A comparison of the headquarters of HCs in Germany with types of towns and municipalities and their location demonstrates that this observation is not an exception (Table 3-1). Almost one third of the firms is located in small towns and about 20% are located in towns and municipalities outside of agglomerations (peripheral and very peripheral location). This distribution is roughly in line with the distribution of the population as well as that of the employees across the different types of towns and municipalities. Thus, a clear preference of these firms for agglomerations cannot be observed.

**Table 3-1: Spatial distribution of Hidden Champions in relation to population and employee distribution in Germany**

		Spatial location					
		very central	central	peripheral	very peripheral	total	
Types of towns and municipalities	<b>Large city</b> (=> 100,000 inhabitants)	<b>HCs</b>	23.8%	2.7%	0.0%	0.0%	<b>26.5%</b>
		<b>Population</b>	28.0%	3.4%	0.0%	0.0%	<b>31.4%</b>
		<b>Employees</b>	35.1%	5.1%	0.0%	0.0%	<b>40.2%</b>
	<b>Medium-sized town</b> (20,000- <100,000 inhabitants)	<b>HCs</b>	16.6%	14.6%	4.7%	0.1%	<b>36.0%</b>
		<b>Population</b>	13.1%	10.1%	5.1%	0.3%	<b>28.6%</b>
		<b>Employees</b>	12.5%	11.5%	6.2%	0.3%	<b>30.5%</b>
	<b>Small town and rural municipality</b> (<20,000 inhabitants)	<b>HCs</b>	7.1%	15.2%	14.1%	1.0%	<b>37.5%</b>
		<b>Population</b>	6.0%	14.6%	15.5%	3.9%	<b>40.0%</b>
		<b>Employees</b>	4.6%	10.3%	11.8%	2.6%	<b>29.3%</b>
<b>total</b>	<b>HCs</b>	<b>47.5%</b>	<b>32.5%</b>	<b>18.7%</b>	<b>1.2%</b>	<b>100%</b>	
	<b>Population</b>	<b>47.1%</b>	<b>28.2%</b>	<b>20.7%</b>	<b>4.1%</b>	<b>100%</b>	
	<b>Employees</b>	<b>52.2%</b>	<b>26.8%</b>	<b>1.0%</b>	<b>3.0%</b>	<b>100%</b>	

Source: own calculations based on data provided by Federal Statistical Office and the Statistical Offices of the Länder ([www.regionalstatistik.de](http://www.regionalstatistik.de)) for the year 2015 and BBSR (2012).

This descriptive analysis serves as a first hint towards innovative firms located outside of agglomerations. Within the scope of our research, we understand the concept of Hidden Champions as a heuristic for successful and innovative firms. As discussed in other schools of literature on so-called 'Mittelstand' firms and family firms in more general terms (Block and Spiegel 2011; Venohr et al. 2015; De Massis et al. 2018), HCs only present a sub-group of mostly medium-sized manufacturing firms in Germany which operate in international markets and ensure their competitive advantage by technological enhancement and product development. Based on the spatial distribution of HCs, we

can thus expect that the phenomenon of innovative firms outside of agglomerations is rather the rule than the exception in Germany. For these firms, geographical proximity to agglomerations is apparently less important for securing their competitive advantage and their ability to innovate. It can be assumed that they follow alternative strategies to satisfy their need for interactive innovation activities, i.e. creating and maintaining knowledge creation processes over great distances.

### **3.3.3 An analysis of R&D intensity, innovation activities and co-operation behaviour of firms across Germany**

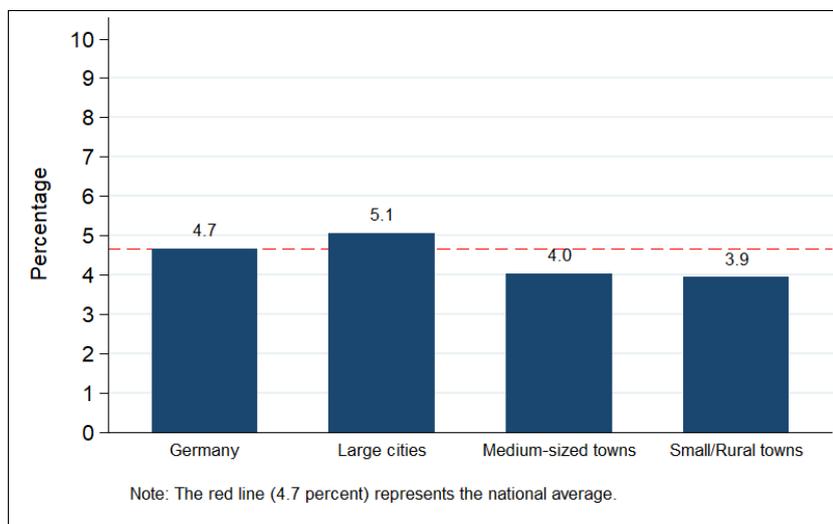
In this section we present findings that go beyond the particular, yet illustrative case of Hidden Champions. Based on analyses of the IAB Establishment Panel of the Institute for Employment Research (IAB) in Germany, we provide an overview of research and development (R&D) activities, innovation endeavours and the interaction behaviour of a representative sample of firms.<sup>1</sup> In these analyses we distinguish between panel firms located in larger agglomerations and firms located outside of agglomerations (according to types of towns and municipalities). This approach allows us to illustrate the extent to which firms, depending on their location, exhibit differences and similarities regarding their overall innovation activities and interaction behaviour.

#### **3.3.3.1 R&D activities and human capital**

The IAB Establishment Panel contains data on firms conducting and not conducting their own R&D activities. General analyses for Germany show that the proportion of firms conducting R&D activities was fairly constant in the 2007-2017 period (Müller et al. 2018). On average, 4.6 to 4.8 per cent of firms in Germany perform R&D activities. These figures are confirmed by the recent wave of the IAB Establishment Panel (see Figure 3-2). With regard to the differentiation between firms located in different types of towns and municipalities, the panel data display certain differences. The proportion of firms that perform R&D activities is the highest in large cities (5.1%) and gradually decreases with town size. 3.9 per cent of firms located in small towns and rural municipalities conduct R&D activities, which is below the German average of 4.7 per cent (see Figure 3-2).

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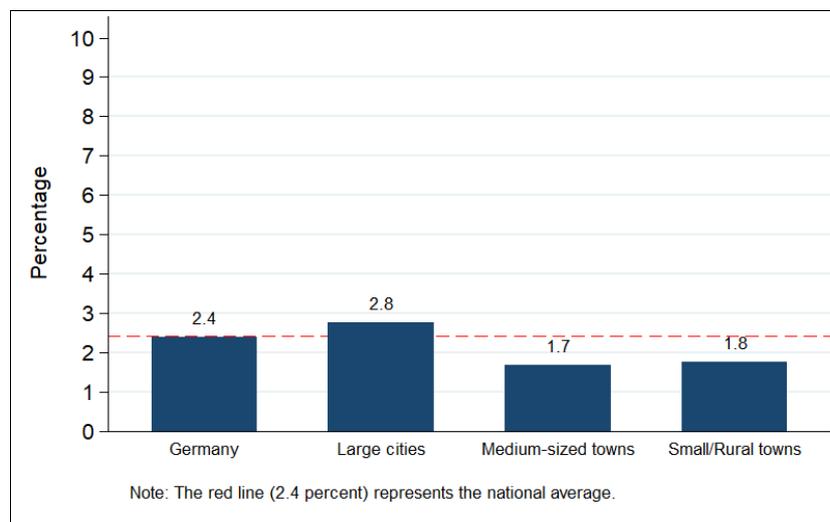
<sup>1</sup> The IAB Establishment Panel (Betriebspanel) is an annual survey of approx. 16,000 German firms active across economic activities and size categories. The survey is representative for Germany as a whole, the specified sub-regions as well as economic sectors. The survey encompasses a diverse set of questions on employment and innovation related issues. The present analysis builds on innovation relevant aspects of the survey and draws on the 2017 survey wave.

**Figure 3-2: Firms with R&D activities by types of towns and municipalities**

Source: own calculations based on IAB Establishment Panel, wave 2017

However, when differentiating between firm size, these results are not consistent across the board. Interestingly, the share of large firms (250 and more employees) which conduct R&D activities is larger for firms located in small towns and rural municipalities (30.2%) compared to firms in large cities (25.9%). While these indications require cautious interpretation due to the rather small number of observations in this firms/town size category, they are in line with the observation of Hidden Champions frequently being located outside of larger agglomerations (see section 3.3.2). Regarding the sectoral distribution of firms conducting R&D, the manufacturing sector is most important: 53.9 per cent of firms located in small towns and rural municipalities that conduct R&D activities are active within manufacturing. Conversely, most firms performing R&D in larger city regions provide business-related services (39.0%), while 34.0 per cent are active in manufacturing.

As stated previously, overall differences in the proportion of firms conducting R&D activities in different types of towns and municipalities are only moderate. However, these differences are more profound when taking into consideration the intensity with which R&D is performed. Using the share of employees with R&D related responsibilities as an approximation of overall R&D intensity at the firm level, shows that associated activities are less intensively pursued by firms in small and medium-sized towns (see Figure 3-3). Our data further reveal that this lower R&D intensity can be observed consistently across firm sizes.

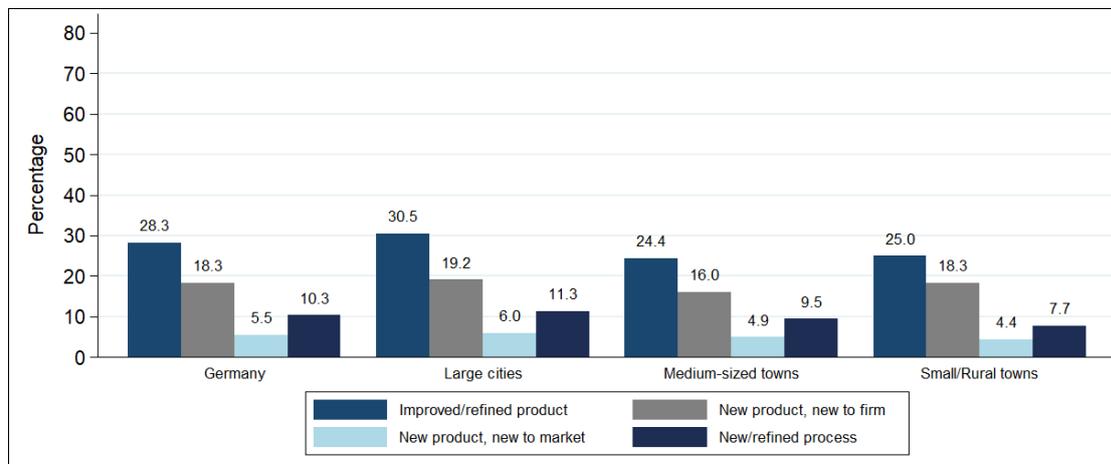
**Figure 3-3: Employees with R&D tasks by types of towns and municipalities**

Source: own calculations based on IAB Establishment Panel, wave 2017

The workforce related qualification structure of firms can be used as a further approximation of R&D intensity. In this regard, the data indicate differences regarding the proportion of roles that require higher education degrees. Specifically, 15.7 per cent of jobs provided by firms in large cities require university graduates, while this requirement can be observed for only 7.6% per cent of jobs provided by firms located in small towns and rural municipalities. Conversely, these firms provide a higher proportion of jobs for which vocational training activities suffice: 61.9 per cent compared to 55.4 per cent for firms in large cities. Overall, these indications might point towards differences regarding underlying approaches to innovation and the types of knowledge these approaches require. Collectively, these R&D related data are supportive of the view that innovation of firms located in small towns and rural municipalities rely more on practical and experience-based expertise rather than on scientific knowledge and methods.

### 3.3.3.2 Frequency and types of innovation

In the theoretical discussion we have argued that innovation is a diverse notion and that there are multiple ways for firms to innovate. Additionally, the outcomes of firms' innovation activities differ regarding the degree of novelty involved and range from incremental improvement innovations to first to market novelties. The IAB Establishment Panel collects diverse data on the implementation of firms' innovations. It distinguishes between four different types of innovation: improvement innovation (improvement of existing product/service), adaptation (integrating existing product/service into firm portfolio), radical innovation (product/service new to market) and process innovation (development/introduction of new process/method).

**Figure 3-4: Types of realized innovations by types of towns and municipalities**

Source: own calculations based on IAB Establishment Panel, wave 2017

The data reveal that improvement innovation is the most commonly implemented type of innovation, realised by 28.3 per cent of all companies in Germany. 18.3 per cent of firms have actively pursued adaptations and 10.3 per cent have implemented new processes. Due to the high degree of novelty, as well as higher levels of costs, risks and uncertainties regarding market acceptance etc., it is not surprising that radical innovations are implemented rather infrequently (5.5%).

Introducing the differentiation regarding different types of towns and municipalities into the analyses illustrates that this general pattern on different innovation types remains constant (see Figure 3-4). However, the analysis shows notable differences in the frequency of implementing certain types of innovation between firms located in larger cities and small towns. Generally, it can be observed that all types of innovation are implemented most frequently by firms located in large cities. Interestingly, the data reveal that the differences regarding firm location are not too substantial. Data for large cities only moderately exceed indications for the German average. Likewise, it is important to note that firms located in small towns and rural municipalities frequently implement innovations that range from small scale improvements to first to market novelties – despite the relative lack of agglomeration advantages. Furthermore, it can be observed that the proportion of firms from small towns and rural municipalities that generate improvement and adaptation innovation is higher than in firms located in medium-sized towns.

### 3.3.3.3 Interaction and cooperation behaviour

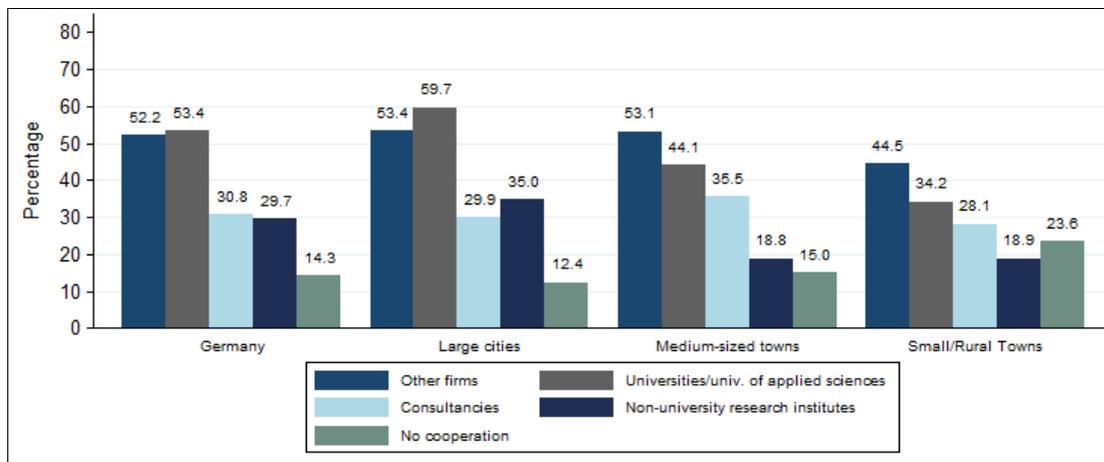
In the theoretical section we have outlined that innovation is broadly seen as an interactive process. Given the increasing (technological) complexity of innovation processes,

interaction and cooperation is ascribed an essential function in knowledge generating processes that induce successful innovation. Interaction with external actors functions as a central means to combine internal capacities with external expertise.

The IAB Establishment Panel differentiates a diverse range of potential partners firms might cooperate with in the context of R&D and innovation activities: other businesses, universities and universities of applied sciences, consultants (e.g. business consultants, engineering consultants), non-university research facilities and no cooperation (i.e. solely internal organisation of R&D and innovation).

Figure 3-5 suggests that R&D activities, treated as an approximation of innovation activities, do indeed constitute interactive processes. Data for the German average indicate that only 14.3 per cent of innovating firms have not cooperated with external partners as part of their R&D activities. Most frequently, firms have collaborated with universities (of applied sciences) (53.4%) or other commercial partners (52.2%). Collaborations with external consultants (30.8%) and non-university research facilities (29.7%) are of secondary importance.

**Figure 3-5: Types of cooperation partners in R&D activities by types of towns and municipalities**



Source: own calculations based on IAB Establishment Panel, wave 2017

Introducing the differentiation regarding types of towns and municipalities highlights that these patterns not only differ from the aggregate average, but further illustrate substantial differences on the specific cooperation patterns of firms located in large cities and small towns. Generally, the data demonstrate that the proportion of firms conducting R&D in isolation, i.e. based solely on internal capacities, is almost two times higher for firms in small towns (23.6%) than for firms in large city environments (12.4%). Furthermore, the

data illustrate differences regarding the choice of collaboration partners. While firms located in large cities prefer to engage in collaborations with university partners (59.7%) and other commercial actors (53.4%), firms located in small towns and rural municipalities most frequently liaise with commercial (44.9%) and university partners (34.2%). Interestingly, the data illustrate that the role of scientific collaboration partners gradually decreases with declining town sizes. Thus, firms located in small towns and rural municipalities collaborate less frequently with university partners and also non-university research partners such as Fraunhofer, Leibniz or Helmholtz institutes.

These indications of different collaboration patterns can be interpreted along a number of tracks. The regional economic structures between large cities and regions outside of agglomerations often differ as we mentioned earlier (Tödtling and Trippl 2005). Small towns and regions outside of agglomerations tend to be more oriented towards traditional economic activities and manufacturing, while business services and high-tech activities tend to be less important. Given these differences in economic structures, it can be supposed that collaborations with scientific institutions are less important as the demand of firms from outside larger agglomerations for scientific knowledge is lower. Also, it might be the case that firms from outside agglomerations have difficulties in mediating access to scientific partners, have a reduced awareness of the potential use of scientific knowledge for the firm's operations or generally lack experiences and, consequently, have higher reservations towards collaborations with research organisations. The latter aspect would point towards certain hurdles in the overall knowledge transfer landscape and suggest an insufficient spatial diffusion of scientific knowledge and approaches.

Besides differences regarding the role of scientific partners, Figure 3-5 further illustrates that external consultants, such as engineering offices, constitute relatively important collaboration partners for firms from small (28.1%) and especially medium-sized towns (35.5%). Assuming that due to sectoral affiliation, the demand for scientific knowledge might be lower for firms that operate outside agglomerations, external consultants that provide practical knowledge and problem-oriented (engineering) solutions appear as appropriate collaboration partners.

### **3.4 Conclusions**

The main contribution of this chapter is to challenge the general focus on core regions in the geography of innovation literature. Therein, agglomerations are usually seen as the main source of innovation and economic dynamics. Small cities and rural municipalities do typically not enter this discussion because actors are assumed to suffer from organisational thinness and a lack of public knowledge infrastructure (Shearmur 2017; Eder 2018).

We contest this confined perspective by drawing attention to firms and ways of successful innovation outside of agglomerations in Germany. First, we have shown that a good share of a particularly successful and innovative group of firms, the so-called Hidden Champions, can also be found in these types of regions. Hence, there are indeed firms able to overcome the assumed barriers to innovation in peripheral regions or which might even benefit from specific advantages these locations provide. For these firms, geographical proximity to agglomerations is apparently less important for securing their competitive advantages and their ability to innovate. Second, with the analyses of the IAB Establishment Panel we have affirmed these indications on a broader level and highlighted differences regarding the interaction requirements and interactions patterns between firms from within and outside agglomerations. The chapter shows that associating the peripheral nature of regions with less innovativeness is misleading and that innovation activities take place across different spatial categories. However, these activities seem to follow different modes of innovation, result in different outcomes and are characterised by a lower intensity of formal R&D efforts.

Our empirical analyses support some of the theoretical and empirical arguments made in previous sections of this chapter, especially given the fact that firms outside of agglomerations generate all kinds of novelties. We have shown that the level of innovative performance of firms located in small cities – across all different types of innovation – is considerable and in fact not too far from the German average. Still we see a dominance of innovation in agglomerations that might indeed provide beneficial local or regional conditions or conscious location choices of firms particularly active in the development of new products. This finding confirms spatial differentiations of innovation modes according to the types of information and knowledge needed (Shearmur 2015). However, this should not be interpreted to mean that the conditions of locations outside of these environments prohibit innovation. Firms in 'peripheral' environments find different ways and adopt different practices through which a lack of agglomeration advantages can be compensated. This especially holds true for the firms' interaction and cooperation behaviour.

One major insight of this study is that firms in small towns conduct R&D and innovation more frequently without external collaborators. This implies that these firms might, overall, have lower interaction needs and build on internal capacities to higher extents – which might act as a substitute to frequent collaborations (Shearmur 2015). A further difference regarding the choice of collaboration partners becomes obvious. The data highlight that interaction with partners that provide access to scientific knowledge (universities and non-university research facilities) plays a reduced role for firms in small towns and rural municipalities. Thus, it can be assumed that the German research sys-

tem does not reach firms equally in all parts of Germany. Conversely, external consultants seem to be relatively important external partners. Their knowledge and expertise, such as practical knowledge and engineering-based problem solving, might be more attuned to the needs of innovating firms operating outside of agglomerations. On a final note, it should be stressed that the findings of our analyses apply for manufacturing firms in the German context. More research on innovation outside of agglomerations in different geographical and institutional contexts is needed to contribute to more differentiated perspectives in the geography of innovation literature.

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