

Innovation in the periphery: How firms tackle the innovation-inhibiting impact of lacking agglomeration advantages

INTRODUCTION

Dominant theories argue that innovative firms typically locate in large cities (metropolitan areas) (Glaeser, 2011; Helsley & Strange, 2011; Glaeser & Hausman, 2019). These theories are rooted in the literature on agglomeration economies (e.g., Marshall, 1890; Krugman, 1991) and rely on the argument that large cities provide innovation-facilitating agglomeration advantages that are not present in peripheral regions such as a rich endowment of R&D facilities (e.g., universities), spatial proximity in large cities providing knowledge spillovers, abundant markets providing an efficient match of production factors, and a higher attractiveness than nonmetropolitan areas for creative people.

Despite the lack of agglomeration advantages, there is case study evidence that there can be conditions for successful innovation in the periphery (Eder, 2019). Examples are the Gnosjö region in Sweden, consisting of many different industries and known for its innovative spirit (Wigren, 2003) and the Valencia region in Spain, known for its biotechnology industry (Todt et al., 2007). Patent data across OECD countries confirm this picture (Fritsch & Wyrwich, 2021a, 2021b), showing that it is possible for peripheral regions to be as innovative as metropolitan regions. How can the success of peripheral regions such as Gnosjö and Valencia be reproduced elsewhere?

Previous research on innovation in peripheral regions identified that firms in peripheral regions reveal a stronger engagement in collaborative innovation to compensate for a lack of agglomeration advantages (e.g., Eder, 2019; Fitjar & Rodriguez-Pose, 2020). One issue with previous research is that it mostly focussed on single regions or countries which make it difficult to draw general conclusions, while a systematic assessment of innovation networking in peripheral regions is missing. This lack of knowledge hampers effective strategies to support regional development. Further research is also necessary from a practitioner standpoint, because innovation-oriented policy initiatives like the EU smart specialization strategy (Foray, 2014; McCann & Ortega Argilés, 2015) and the Green Deal (EC, 2019) require a better understanding of innovation in peripheral places that fits empirical observations. Finally, many peripheral places are particularly vulnerable to structural change and subsequent economic decline. Therefore, understanding the determinants of innovation in peripheral regions is of utmost importance to combat the backlash that many peripheral regions are facing.

THEORETICAL BACKGROUND & HYPOTHESES

We will start from the conclusion drawn by previous case-study research that innovation-facilitating network diversity also exists in small cities. This is, for example, due to connections to extra-regional actors' innovation networks that link peripheral areas to core regions (urban-rural linkages) via organizational, cognitive, and technological proximity. Hence, there may be a tendency toward more cooperation and exploitation strategies to compensate for a lack of "local buzz" (Lagendijk & Lorentzen, 2007; Grillitsch & Nilsson, 2015, Funk, 2014; Fitjar & Rodriguez-Pose, 2020; Eder & Trippel, 2019; Hervás-Oliver et al., 2021). Cooperation on innovation is an important driver of successful innovation since it allows firms to access and recombine knowledge (Ahuja, 2000; Lavie, 2007, Noseleit & de Faria, 2013).

Although agglomeration advantages of large cities provide a greater abundance of potential cooperation partners, cooperation may be less important due to other agglomeration advantages. Firms in peripheral regions, however, may rely more on cooperation because of a lack of agglomeration advantages. This also resonates with literature on regional differences in innovation activities arguing that peripheral regions that are well-connected to other regions,

particularly to metropolitan areas, may be prone to innovation activities (Crescenzi, Rodriguez-Posé & Storper, 2007). Furthermore, well-connected smaller cities and less populated areas, for example, short distances between (smaller) cities (as is the case in Germany or the Netherlands) may create an environment that stimulates innovation. This view corresponds with the discussion about the rise of city network economies (e.g., Alonso, 1973; Meijers et al., 2016; Meijers & Burger, 2017). The general idea is that connectivity between cities positively enhances the presence of metropolitan features in non-metropolitan areas. Smaller cities ‘borrow’ size and mimic agglomeration advantages. Translated to the firm level this means that firms borrow agglomeration advantages.

This leads to the following hypotheses at the firm level:

Hypothesis 1a: *Innovative firms in peripheral regions have a higher share of collaborative innovations than firms in metropolitan areas.*

Hypothesis 1b: *Innovative firms in peripheral regions cooperate with a higher share of extra-regional partners than firms in metropolitan areas.*

METHODOLOGY

Data

In order to map the innovative efforts and collaboration patterns of focal firms in metropolitan and peripheral areas, we use the OECD Regpat database (August 2023 release). We use this database as a starting point for identifying all firms that have shown an attempt to innovate by obtaining at least 1 patent. The database consists of multiple sections, including data on applicants, inventors, and patents. Each applicant, inventor, and region is assigned a share per patent, allowing us to measure collaboration as co-patenting between 2 or more applicants in line with prior work (e.g. De Noni, Orsi & Belussi, 2019). We consider both EPO and PCT patents, which we check for overlap using the EPO-PCT correspondence data. Our final sample includes firms from a variety of leading innovative countries, including Australia, Austria, Canada, China, France, Germany, Italy, Japan, Netherlands, Republic of Korea, Spain, Sweden, Switzerland, United Kingdom, and United States.

In order to identify which firms are from metropolitan and peripheral regions, we use the OECD mapping of Functional Urban Areas. In line with the definition of the OECD, we use a definition of a metropolitan area that includes more than 250,000 inhabitants. We also started the coding of large metropolitan areas (>1.5 million inhabitants) for further analysis, given the relatively broad definition of metropolitan areas. Finally, we further matched this data with firm-level data from Orbis, allowing us to distinguish individuals from firms and have a clear set of firm-level control variables.

Sampling

Our sample differs per hypothesis. In order to test the degree to which a firm’s patents are based on collaboration, we take a sample of firms with at least 1 patent in a certain year. Then, in order to measure the degree to which collaborative efforts are inter-regional, we take a subsample of firms that have at least 1 collaborative patent in a certain year. Therefore, our initial sample in model 1 contains 75,028 firm-year observations, while our subsample for testing H1b in model 2 contains 17,086 observations.

Variables

Dependent Variables

Share of collaborated innovation: we count a patent as either solo patented (the focal firm has applied for 100% of the patent) or co-patented (2 or more firms have applied for a part of

the patent). We then take the share of a firm's collaborative patents to its total number of patents that year.

Share of extra-regional collaborated innovation: Similar to the measure of collaborated innovation, we take the share of patents that is co-patented with partners from a different region than the focal firm.

Explanatory variable

Firm location in metropolitan region: we code a firm's location as either metropolitan (1) or peripheral (0), based on the number of inhabitants of the OECD region it is located in. In doing so, we follow the definition by the OECD (2019) of a metropolitan area.

Control variables

We control for a number of variables associated with both our explanatory variables and our dependent variables. These include:

Firm Size: we measure firm size through the natural log of a firm's assets.

Patents: we control for the number of patents a firm applied for in a certain year.

Country: we include focal firms' countries as dummies.

Entity Type: we control for whether a firm is part of a corporate group.

Industry: we include industry dummies according to the 2022 NAICS 4-digit classification.

Year: we include year fixed effects.

Analytical approach

Because our dependent variables are fractional measures bounded between 0 and 1, we estimated our models using a generalized linear model (GLM) with a binomial family and logit link function (Papke & Wooldridge, 1996).

RESULTS

Our initial results (Table A and B, Appendix A) show some unexpected effects. Regarding H1a, our findings counter our predictions that peripheral firms would compensate for a lack of agglomeration advantages through increased tie formation. Instead, we find a positive effect of metropolitan location on the share of collaborative to total innovations ($\beta = 0.138$, $p < 0.01$). We expect that this may be not because of motivation to partner, but rather opportunity; it is exactly the agglomeration advantages that may give access to high quality partners. However, we do find support for H1b ($\beta = -0.480$, $p < 0.01$), which shows an interesting contrast with H1a. Our findings show that while firms from the periphery tend to have a lower share of collaborative innovations, they actually have a higher share of extra-regional collaborations relative to firms from metropolitan regions. This means that while firms from metropolitan areas tend to seek knowledge within their region, firms from peripheral regions seek out knowledge further from home.

Finally, we tested the starting assumption to our paper. While the collaboration strategies between firms from metropolitan areas and the periphery may differ, does the same go for their capacity to innovate? We tested the effect of firm location on innovation performance as measured through patents, and found no significant effect in any of our model specifications. Therefore, in line with prior research, we find no systematic innovation advantages to being located in a metropolitan area – or, in other words, firms from the periphery can indeed overcome the lack of agglomeration advantages.

FUTURE ANALYSES

The current version of the manuscript purely focuses on collaboration strategies as an outcome. A possible extension could be to link these strategies to innovation performance, where a firm's collaborations mediate the relationship between a peripheral location and innovation outcomes. Moreover, not all firms are equal, and collaboration strategies for SMEs may differ from established large firms. As such, a further extension of the model could be to include Firm Size or other firm characteristics as a moderator on the relationships tested in this paper.

CONCLUSION

All in all, this paper focuses on the question of how firms in the periphery can overcome the lack of access to metropolitan resources. We argue that collaborative strategies can help firms from the periphery match innovative efforts by firms in metropolitan areas, specifically through extra-regional collaboration. Through our findings, we hope to provide new insights jointly to the fields of cooperative innovation and economic geography.

Appendix A

TABLE 1: Descriptive Statistics

	Mean	SD	Min	Max	Collaboration share	Extra-regional share	Metropolitan location	Assets (logged)	Patents
Collaboration share	0.113	0.299	0	1	1				
Extra-regional share	0.779	0.380	0	1	-0.061	1			
Metropolitan location	0.744	0.436	0	1	-0.043	-0.099	1		
Assets (logged)	8.649	3.305	-1.58	22.31	-0.377	0.021	0.161	1	
Patents	0.168	4.416	0	1576	-0.372	0.022	0.044	0.226	1

TABLE 2: GLM Regression Results

	(1)	(2)
VARIABLES	Collaboration share (H1a)	Extra-regional share (H1b)
Metropolitan location	0.138*** (0.0311)	-0.480*** (0.0612)
Assets (logged)	0.0565***	0.0287***
Patents	-0.0102*** (0.00126)	0.000457 (0.000500)
	(0.00513)	(0.00717)
Corporate entity dummies	Included	Included
Country dummies	Included	Included
Industry dummies	Included	Included
Year dummies	Included	Included
Constant	-2.822*** (0.353)	1.412*** (0.498)
Observations	75,028	17,086
Robust standard errors in parentheses		
*** p<0.01. ** p<0.05, † p<0.10		

TABLE 3: Negative Binominal Regression

	(3)
VARIABLES	Patents
Metropolitan location	-0.0164 (0.0535)

Assets (logged)	0.217***
Patents	(0.0209)
ln_profitloss3	-0.00398
	(0.0232)
ln_cashflow3	0.184***
	(0.0319)
Corporate entity dummies	included
Country dummies	included
Industry dummies	included
Year dummies	included
Constant	-6.440***
	(0.598)
Observations	524,397
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, † p<0.10	

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