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Innovating Not Only in Cities: Evidence from SMEs

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In this article, we discuss the role played by location of small and medium-sized firms on their propensity to innovate. We adopt a broad definition of innovation and set the hypothesis that SMEs' propensity to innovate is not higher in large urban areas than in rural ones. Moreover, limiting the assessment of SMEs' location to their head office tends to overestimate urban areas' innovativeness. Empirical data used in this study come from an original survey on SMEs in the French Brittany region, complemented by location data of the French National Institute of Statistics (Insee). A representative sample of 1,253 SMEs is analyzed through econometric tests. The results confirm that firms located in the largest urban areas of the region are not more innovative than those located in the most isolated areas. Results also partially validate the assumption according to which assessing the firms' location through the location of the head offices leads to overestimate the innovativeness of largest urban areas compared to less urbanized one.

Innovation stands as a "crucial factor in determining competitiveness and national progress" (OECD 2007). Investigating the factors that encourage and support innovation has a large practical and also theoretical interest. Among the factors regularly put forward are the potentialities provided by specific territories for the firms located on them. In this article, we examine the role played by firms' location on their propensity to innovate. Innovation related to location is a well-established field of research (Shearmur, Carrincazeaux, & Doloreux 2016). Firms located on innovative areas benefit from a favourable industrial environment provided either by sectoral specialization, or greater diversity. In return, firms contribute to the endogenous dynamics of innovation on their location territory (Audretsch & Feldman 2003; Autant-Bernard & Lesage 2011). Consequently, much research supports the argument that firms wanting to increase their innovation capacity prefer locating in agglomerations or cities rather than in non-urban and peripheral regions (Glaeser 2011; Hervas-Oliver *et al.* 2017). However, a growing body of research suggests that innovation is not confined to large urban areas and the theorized locational advantages of clustering do not always play out (Shearmur 2012). For example, firms located in close proximity do not necessarily cooperate; innovative firms located in cities sometimes ignore their neighbours (Freel 2003; Gordon & McCann 2005; Torre & Rallet 2005) while firms located far away from each other use digital communication tools to enhance cooperation (Aguiléra & Lethiais 2015; Aguiléra, Lethiais, & Rallet 2015). It seems that co-location is declining in importance while capacity to access distant resources is becoming more important (Echeverri-Carroll & Brennan 1999). Co-location of innovation partners in cities no longer appears to be a critical factor: less urbanized areas also support firms' innovation (Fitjar & Rodriguez-Pose 2011).

We contribute to the literature about the connections between innovative SMEs and their location. Innovation research often focuses on the high technology and/or knowledge-intensive sectors, where innovation is found to be contingent on specific human and technological resources. We adopt another view and follow a broad inter-sectoral perspective that includes all SMEs in a particular French region. SMEs are of particular interest as their characteristics differ from large firms: innovation in SMEs is challenging due to their limited internal resources (Bjerke & Johansson 2015). Moreover the size and extent of their market often let SMEs embedded within the region they are located (Freel 2003; Cooke, Clifton, & Oleaga 2005). Furthermore, research and development activities are not mandatory for SMEs that want to innovate (Moilanen, Østbye, & Woll 2014). SMEs also innovate without protection of intellectual property (Thomä & Bizer 2013). These multiple characteristics of SMEs raise questions about how to assess innovation. Empirical work relying on patent measures limits the scope of analysis to specific sectors where patents are used to protect innovations. When examining SMEs more broadly, it is important to include firms less likely to adopt innovations that require the protection of intellectual property provided by patent law (Nikzad 2015). Several studies of innovation in SMEs adopt a broad assessment of innovation and converge on the ability of SMEs located in low-density areas to access to local or distant resources in order to innovate (e.g., North & Smallbone 2000; Cooke, Clifton, & Oleaga 2005; Virkkala 2007; Doran, Jordan, & O'Leary 2012). Following these works, we adopt a broad definition of innovation to call into question, in the case of SMEs, the idea of the locational advantage of cities.

Investigating the influence of location on innovation poses a challenge of multi-located SMEs. Measuring innovation at the firm level in multi-establishment firms could favour head offices as the locus of innovation

(Shearmur 2016). Consequently, we take organizational fragmentation into account when describing the spatial profile of innovating firms. Organizational fragmentation helps in more accurately understanding the role of location on innovation performance (Magrini & Galliano 2012).

In line with these works, the main aim of this article is to examine the effects of location on the capacity of SMEs to innovate. A related secondary aim is to assess the influence of organizational fragmentation by testing the assumption that locating innovation at the head office of the firm may lead to overestimate urban areas' innovativeness. To achieve our research aims, we use data obtained from a representative regional firm-level survey conducted in 2012 for a regional observatory, on a sample of French SMEs. We complement innovation data with location data provided by the French National Institute of Statistics (Insee). Our focus is 1,235 SMEs located in Brittany, a region that is representative of French national innovation rates (Insee 2012).

This article is structured as follows. The first section presents the theoretical background of the research and the hypothesis of the paper. The data and methodology used are presented in the second section and finally, the results are analyzed and discussed with regard to existing literature.

Theoretical background and hypotheses

The body of economic literature on the link between innovation and location is vast. Since the seminal work of Marshall (1920), much of this literature is built on the idea that the propensity to innovate is increased for firms located in cities (Glaeser 2011). The main arguments put forward are the existence of local knowledge spillovers emanating from private and public research, the presence of private and public service infrastructure, the spatial concentration of human capital and its low mobility (Almeida & Kogut 1999), and the increased intensity of one-to-one collaboration and contacts (Breschi & Lissoni 2009; Hervas-Oliver *et al.* 2017). In the organization and management literature, the resource-based view of the firm offers a complementary perspective, for which firms' resources are valuable, rare, inimitable, non-tradable. Hence, firms' ability to innovate and develop a competitive advantage depends not only on their internal capacity but also on their complementarity with the external environment (Dyer & Singh 1998; Kogut & Zander 1996). Teece (2010) classifies these resources as: research and educational institutions, customer markets, government and judicial, rival firms, human capital, financial institutions, regulatory and standards bodies, suppliers and complementors. The low mobility of some of these key resources thus encourages localization within clusters or cities.

A growing literature calls into doubt the idea that innovation is limited to clusters and urban centres. Shearmur (2012) provides an exhaustive and detailed critical review of research that examines cities as the font of innovation. He puts in perspective the influence of the local buzz for innovation and contends that enhanced capacity for innovation provided by location is instead more associated with access to distant resources regardless of location. In view of this, Massard and Mehier (2010) suggest replacing an approach based on knowledge externalities with an approach based on knowledge accessibility. This approach calls upon the notion of temporary forms of spatial proximity (Bathelt & Schuldt 2008; Rychen & Zimmermann 2008) or non-spatial proximity, such as cognitive, organizational, social and institutional proximities (Boschma 2005). Fitjar and Rodriguez-Pose (2011) document the high level of innovation in the peripheral Southwest region of Norway where isolated firms compensate for their location by mobilizing regional hubs that are connected to international innovation networks and relying on multiple forms of non-spatial proximities. Shearmur (2011) supports this finding in a study of firms in the Québec region of Canada. He shows that the probability to launch some forms of innovation decreases with the distance to the metropolitan areas, but he balances this result, highlighting the low explanatory power of the distance to the metropolitan areas and the moderate role of the local context on firms' innovation capacity.

One of the main differences between research adopting a knowledge externalities perspective and research adopting resources accessibility perspective is how to measure innovation (Shearmur 2012). Most studies about the economy or geography of innovation, which contend that geographic proximity is a necessary condition for the emergence of innovation, employ patent filing as a measure of innovation and/or focus on knowledge-intensive activities (Jaffe, Trajtenberg, & Henderson 1993; Sedgley & Elmslie 2011). It is notably the knowledge-intensive nature of innovative activities that, according to us, justifies the agglomerative behaviour of firms. Even if patents are shown to be a fairly accurate measure of product innovation in large cities (Acs, Anselin, & Varga 2002), they might be a less effective measure of other innovation forms in locations outside cities (Shearmur 2016). A more applicable approach in such situations is to conduct firm-level surveys (Mairesse & Mohnen 2010). National or international institutes of statistics (e.g. Statcan, Eurostat, etc.) and academic researchers regularly conduct surveys where they define innovation as the introduction of a new product or process or an organizational change. The innovation might be "new for the firm but not necessarily for the market" and may "have been originally developed by the firm or by other firms". This approach seems to us more appropriate to analyze innovation practises of small and medium-sized firms. Numerous works focusing on innovation in SMEs adopt this approach (North & Smallbone 2000; Cooke, Clifton, & Oleaga 2005; Doran, Jordan, & O'Leary 2012).

The research evidence pertaining to SMEs tends to support the idea that locating in low-density regions is not necessarily a significant barrier to knowledge flows and thus to innovation. North and Smallbone (2000)

compare SMEs located in remote or accessible rural areas and find relatively little overall difference in the level of innovation. Cooke, Clifton, & Oleaga. (2005) points to a link between innovation capacities of SMEs in the UK and their non-local social capital. Macpherson (2008) finds, in a longitudinal study comparing firms behaviour in 1994 and 2005, that geographical location has little impact on SME's ability to mobilize knowledge, due to the diffusion of Internet-based technologies that facilitate the search, identification and sourcing of high-quality services for innovation. More recently, Doran, Jordan, & O'Leary (2012) analyze the impact of local and distant interaction frequency on the innovation performance of SMEs in the Southwest and Southeast Ireland. They find that spatially distant interaction is at least as valuable as local interaction. These findings suggest that SMEs located in non-urban areas are able to innovate if they mobilize different networks that allow them access to distant resources. We therefore test the following hypothesis:

> **Hypothesis 1**: Considering a broad definition of innovation, SMEs' propensity to innovate is not higher in large urban centres than in less urbanized areas.

Adopting a firm-level analysis implies that innovation is naturally attributed to the firm's head offices. This practical simplification raises a problem when firms have separate operations in more than one location. These multi-unit firms differ from spatially integrated firms as they are geographically dispersed operating under the control of a common head office. These firms show various degrees of organizational fragmentation (Galliano & Soulié 2012). Research suggests that organizational fragmentation affects their innovation practises. Audia, Sorenson, & Hage (2001) find that intra-firm exchanges between geographically separated units foster organizational learning and induce organizational innovation. Magrini and Galliano (2012) show that the innovation capacity of organizationally fragmented firms depends not only on the location of their head office, but also on their broader spatial distribution.

Shearmur (2016) suggests that innovation in multi-establishment firms is not easy to locate. In some cases, innovation location can be estimated through the address filed in the patent file or through the location of R&D sites. Such solutions are possible for large companies, but become more difficult to implement for SMEs as small firms have a low propensity to use patents (Thomä & Bizer 2013; Nickzad 2015) and can innovate without formal R&D (Moilanen, Østbye, & Woll 2014). To the best of our knowledge, little is known about the spatial organization of multi-unit SMEs. Studies on large firms suggest that multi-unit firms can benefit from multi-location to minimize costs and increase risk diversification (Audia, Sorenson, & Hage 2001). Large firms balance organizational fragmentation thanks to the development of communication technologies (Ota & Fujita 1993). However, such firms are headquartered separately, usually in large metropolitan areas, where they can benefit from specific services, access to transport infrastructure, and marginally from the proximity to headquarters of other businesses (Davis & Henderson 2008). As Magrini and Galliano (2012, p. 611) contend, peri-urban areas "are often areas of production and logistics, unlike urban areas that tend to house firms' head offices". Thus, if headquarters of multi-unit firms more often locate in urbanized areas and multi-unit firms have a higher propensity to innovate than single-unit firms, innovation that arises in secondary units located in all types of areas might be erroneously attributed to the headquarters located in the city. In light of this, we propose and test a second hypothesis:

> **Hypothesis 2**: Assessing the firm spatial profile only with the head office location tends to overestimate the innovativeness of urban areas.

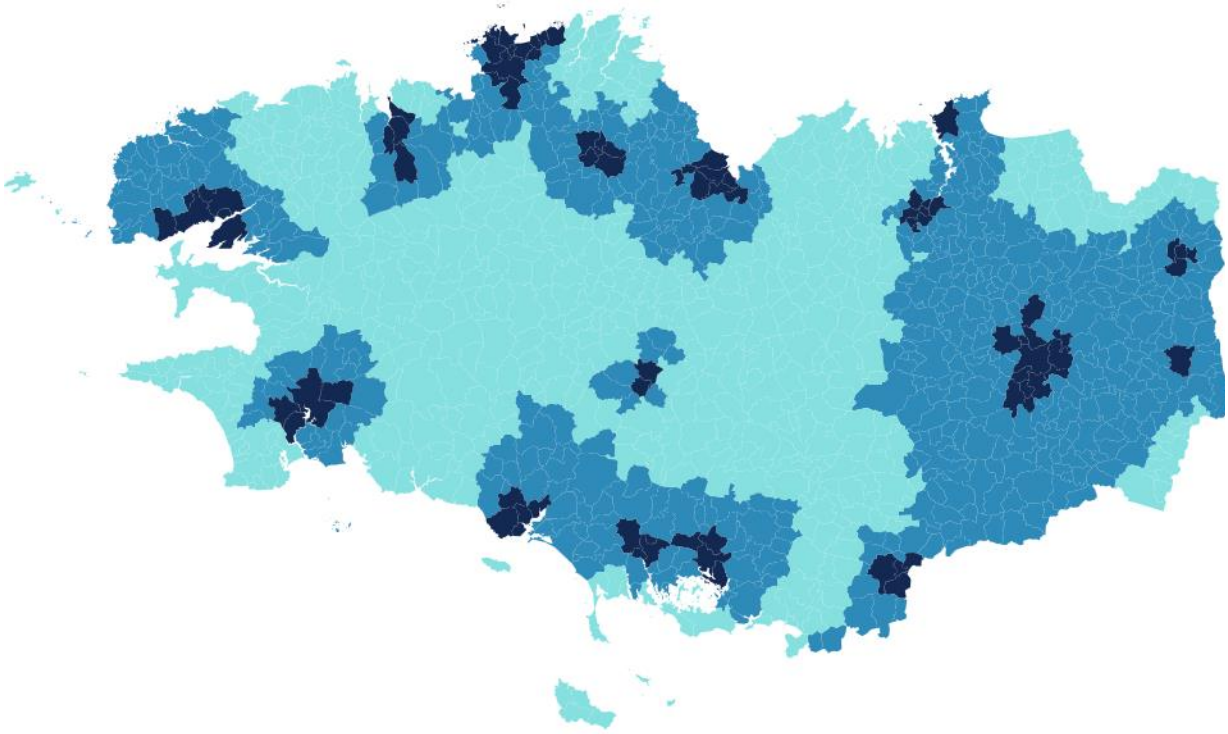
Data and method

We collected data in 2012 from SMEs located in the Brittany region of France. These firms had 10 to 250 employees and operated in the industrial, commercial and service sectors (excluding the agricultural sector and public service sector). According to the Community Innovation Survey (CIS), innovation in Brittany is similar to the average of France (Insee 2012), while France has a slightly higher innovation rate than in the European Union (Eurostat 2014). Brittany is a maritime and farming area less urbanized than the French average. But the region is under the influence of cities. This is because Brittany has a high number of small and medium-sized cities as well as the two major urban centres of Rennes and Brest. Nevertheless, Brittany has a significant rural population with 2,185 million inhabitants, out of 3.12 million (70%) living (if not working) in rural areas (Insee 2011a; Insee 2011b; Insee 2016).

Data come from a regional observatory for digital practices in Brittany (Marsouin)[1]. We contributed to the set up of the survey and provided questions on firms' innovation policy. The survey was submitted to all SMEs in the Brittany region (around 7000 firms) listed in the register of the Brittany Chamber of Commerce and Industry. Firms were solicited by email to complete the questionnaire on-line via a dedicated web site. Firms that didn't answer on-line were contacted for responding by phone. Firms were chosen so as to provide a good final representativeness in terms of location, size, and business sector compared to the regional economy (quota sampling method). Ultimately, 1,253 complete questionnaires were collected (an 18% response rate). In most cases, the firm's Chief Executive Officer (CEO) or the chief financial-administrative officer was the respondent. We collected geographical data for each of the 1,253 firms, using a database from the French National Institute of Statistics (INSEE) and we attributed an urbanization level to the location of each firm.

The dependent variable in our research is innovation propensity. The definition of innovation is close to that used in the CIS surveys: a firm is considered innovative if it launched a new

Figure 1. First classification of Brittany geographical space: 3 categories



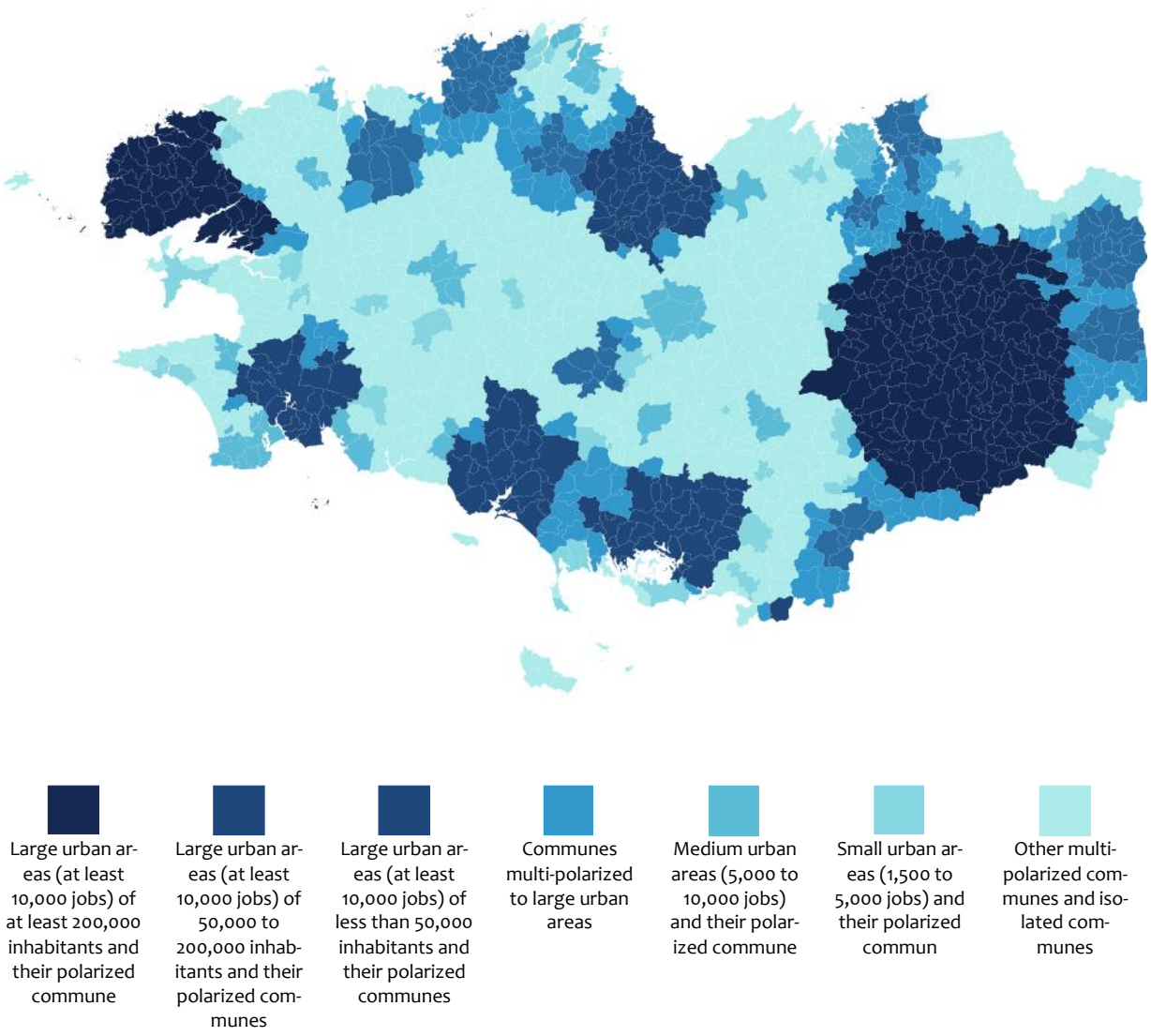
product or service or if it introduced new processes in the last two years. To better inform us on SMEs' innovation policy, the survey also provided pieces of information on the firms' collaborative R&D strategy and the protection of their innovations (particularly patent registration).

The explanatory variables of the research are the firm's geographical location and the firm's organizational fragmentation. We assess the firm's geographical location using two different variables relying on Insee regional classifications into three or seven modalities. First, in accordance with previous studies (Galliano & Soulié 2012; Magrini & Galliano 2012), areas within Brittany are classified into three modalities (Figure 1). This classification is based on concentration of employment and provides a reasonable approximation of the level of urbanization and thus the extent of resource agglomeration likely to be mobilized by the firm with potential local externalities (Magrini & Galliano 2012). However, this variable gathers in the same modality areas where economic environments might largely differ. This required us to adopt a complementary more accurate approach, based on a gathering of the cities and their suburbs. This fragmentation in a seven-categories variable combines the number of jobs and the number of inhabitants (in order to split the large urban areas category) and assigns the polarized communes[2] to the commune they are polarized to (except for communes that are multi-polarized, which cannot be assigned to a unique other commune[3]). Figure 2 describes the seven categories. Comparing the two classifications is not automatic, as they don't follow the same classification approach.

The second explanatory variable is firm organizational fragmentation. Following Magrini and Galliano (2012), we assume that the location of the head office is not sufficient to determine the location of the firm. Our survey does not identify the location of all firm units, but does provide information on the organizational fragmentation, as we know whether each firm has multiple units or not. This information is a complement to the location of the head office in order to describe the spatial profile of the firm. We measure firm's organizational fragmentation through a binomial variable indicating if the SME is a multi-unit firm or not.

We introduce five control variables in our models. The literature identifies several structural characteristics of the firm as traditional determinants of their capacity to innovate. Size, sectors, employees' qualification levels

Figure 2. Second classification of Brittany geographical space: 7 categories



and export share tend to have a significant influence on the propensity to innovate (Mairesse & Mohnen 2010; Magrini & Galliano 2012). In our study, we measure firm size through its sales revenue (less than €1 million, €1-2.5 million, €2.5-5 million, €5 million and over)[4]. Sectors of activity are integrated into the models by means of binomial variables indicating whether the firm belongs to either: 1- commerce, 2- transport, 3- hotels and restaurants, 4- finance, real estate and insurance, 5- industry (manufacturing, mining and other industries), 6- construction, 7- specialized scientific and technical activities, information communication, and finally 8- other services. We measure employee qualification level with the percentage of employees having completed higher education (i.e., less than 10%, from 10% to 49% and 50% or over). The survey does not directly inform us about firm's market extent but we inserted two proxy-indicators. The first variable indicates a mostly intra-regional clientele (over 30% of sales at local level and over 30% at regional level); the second indicates a mostly extra-regional clientele (over 30% of sales at national level and over 30% on the international markets). Numerous studies show the influence of information and communication technologies (ICTs) on capacity to innovate (e.g., Spiezia 2011; Higón 2012; Santoleri 2015). By investing in ICTs and developing their digital abilities, firms can reach remote networks or resources (Aguiléra & Lethiais 2015; Aguiléra, Lethiais, & Rallet 2015). In response to this, we have to control the effects of access to ICTs in our models. Aral and Weill (2007) suggest that two dimensions characterize firms' ICT resources: ICT assets and ICT capabilities. As these dimensions are necessarily correlated, we insert a unique

Table 1. Results of the Models "Probability to innovate"

Explanatory Variables	*Model 1-A*	*Model 1-B*	*Model 2-A*	*Model 2-B*
Spatial profile of the firm				
Firm location (head office) in 3 categories				
Large urban areas	NS	NS		
Peri-urban areas	- ** (0.72)	- ** (0.72)		
Rural areas	Ref.	Ref.		
Firm location (head office) in 7 categories				
Large urban areas of at least 200.000 inhab. and their polarized communes			NS	- * (0.71)
Large urban areas of 50.000to 200.000 inhab) and their polarized communes			NS	NS
Large urban areas of less than 50.000 inhab. and their polarized communes			NS	NS
Multi-polarized communes to large urban areas			- ** (0.53)	- ** (0.53)
Medium urban areas and their polarized communes			NS	NS
Small urban areas and their polarized communes			NS	NS
Other multi-polarized communes and isolated communes			Ref.	Ref.
Organizational fragmentation				
Multi-establishment firm		+ *** (1.43)		+ *** (1.44)
Firm Characteristics				
Size: sales revenue in 2011 (in €)				
Less than 1 million	- *** (0.53)	- *** (0.55)	- *** (0.55)	- *** (0.58)
From 1 to 2.5 millions	NS	NS	NS	NS
From 2.5 to 5 millions	NS	NS	NS	NS
5 millions and over	Ref.	Ref.	Ref.	Ref.
Sector of activity				
Commerce	- *** (0.65)	- *** (0.62)	- ** (0.68)	- *** (0.65)
Transport	- *** (0.44)	- *** (0.41)	- *** (0.45)	- *** (0.42)
Hotels and restaurants	NS	NS	NS	NS
Finance, Real Estate and Insurance	- * (0.48)	- * (0.42)	.	- * (0.45)
Industry	Ref.	Ref.	Ref.	Ref.
Construction	- *** (0.45)	- *** (0.46)	- *** (0.46)	- *** (0.46)
Specialised Scientific and Technical Activities, Information, Communication	NS	NS	NS	NS
Other services	NS	NS	NS	NS
Employee qualification				
Less than 10%	- *** (0.47)	- *** (0.48)	- *** (0.45)	- *** (0.46)
From 10 to 49%	NS	NS	NS	NS
50% and over	Ref.	Ref.	Ref.	Ref.
Market extent				
Mostly intra-regional	NS	NS	NS	NS
Mostly extra-regional	+ ** (1.87)	+ ** (1.87)	+ ** (1.92)	+ ** (1.91)
ICT resources: diversity of ICT tools used by the firm				
Very high diversity	+ *** (2.19)	+ *** (2.05)	+ *** (2.30)	+ *** (2.14)
High diversity	+ *** (1.83)	+ *** (1.76)	+ *** (1.84)	+ *** (1.77)
Medium diversity	NS	NS	NS	NS
Low diversity	NS	NS	NS	NS
Very low diversity	Ref.	Ref.	Ref.	Ref.
% of concordance	**69.5**	**70.0**	**69.6**	**70.0**
Pseudo R^2	**0.16**	**0.17**	**0.16**	**0.17**
Observations	**N=1.253**	**N=1.253**	**N=1.253**	**N=1.253**

variable in our models describing the diversity of ICT equipment deployed by the firm. We measure diversity of ICT equipment with the number of different ICT tools used[5,6] (i.e., more than 7 tools used = very high diversity; 6 or 7 tools = high; 4 or 5 tools = medium; 3 tools = low; fewer than 3 tools = very low). The descriptive statistics of all the variables (dependent, explanatory and control variables) are presented in the appendix (Table2).

We use binomial Logit models: the explanatory variable equals to 1 if the firm reports innovating in product or process in the last two years. We test our two hypothesis using four different models. First, we use alternatively the two variables of location of the firms: Models 1 for the three modalities variable and Models 2 for the seven modalities variable. Second, we use a two-step approach in order to test the impact of organizational fragmentation on the link between location and innovation. We set up each model by integrating only the location of the

head office variable (Models A). Then, we conjointly mobilize the location of the head office variable and the multi-unit variable (Models B).

Results and discussion

Our research examines the role played by location on the capacity of SMEs to innovate, and the effect of complementing the location of the head office with a measure of organizational fragmentation. Almost half (49.16%) of the 1,253 SMEs in Brittany we investigated reported innovation, whether by launching a new product or service or by adopting a process innovation (see Table 2, appendix). We compare this innovation rate to two complementary measures, also provided by the survey: collaborative R&D (15%) and protection of innovations (18%, including 6% for patenting). The comparison of the figures confirms our choice to adopt a broad definition of innovation in SMEs: an approach in terms of R&D or protection of innovations (using patent filing for example) would have masked a large number of innovative behaviours among SMEs and would poorly reflect innovation in SMEs (Thomä & Bizer 2013; Nikzad 2015).

Table 1 presents the results of the models used to test our two hypotheses. The table includes the sign of the coefficient, the level of significance (one star for 10%, two for 5% and three for 1%) and the odds ratios for the significant variables or modalities, which evaluates the influence of each explanatory and control variable[1]. For the multinomial variables, 'Ref' stands for the reference modality. 'NS' indicates a nonsignificant variable or modality. A grey box indicates that the model does not integrate this variable or modality.

The results of the models (Table 1) confirm our first hypothesis that the propensity to innovate is not systematically higher in large urban centres than in less urbanized areas. In Models 1A, 1B and 2A, the *large urban areas* modality is not significant, showing that SMEs' probability to innovate is not higher in these major urban areas than in rural ones, which include here all communes that are not subject to the influence of these large urban areas. Model 2B confirms and reinforces this result: the category "large urban areas of at least 200,000 inhabitants and their polarized communes" is significant, with a negative sign and an odds ratio of 0.71. Even if we have to carefully interpret this result, as the effect is poorly significant (only 10%), the 95% confidence interval indicates that the probability to innovate in this type of area compared to the less urbanized ones (*communes multi-polarized to medium and small urban centres and isolated communes*) varies between 0.47 and 1.08. Thus, it can be risky to conclude that SMEs located in the largest urban centres of the region are less innovative than those located in the less urbanized areas; it is therefore reasonable to infer from our results that, in the words of Shearmur (2012), cities are not the font of innovation. Indeed, the less urbanized areas of the region are at least as innovative as the largest urban areas (corresponding to the two main cities of the region and their polarized communes).

A further result of our analysis is the negative effect of peri-urban locations in Models 1A and 1B, also confirmed by the negative effect of a location in communes multi-polarized to large urban areas in Models 2A and 2B. This result is, however, difficult to interpret. It might be that control variables don't capture some specific features of firms located in these peri-urban areas and implying a lower innovative propensity. A suggestion would be to account for the role of firms' competitive strategies. The scarce literature about firms located in peri-urban areas suggests that factors such as transport costs, land prices and amenities have an impact (Hilal, Legras, & Cavailhès 2017) but they are not directly related to innovation. Nevertheless, prices and costs factors can be connected to the competitive strategies of SMEs, where low prices and low costs can provide a strategic advantage for firms following a 'defender' strategy (Miles & Snow 1978). A firm with a defender strategy is mainly focused on its current markets and customers and has a low innovation propensity. Galbraith, Rodriguez, & DeNoble (2008) studied the relation between strategic behaviours and location of firms through a survey of 44 high-technology manufacturing SMEs in Scotland. They find that a cost leadership strategy positively matches with a low-cost location, whereas focus or differentiation strategies make SMEs cluster within geographical areas that have strong surrounding intellectual capital, other technology firms and technology labour pools, often found in urban areas. Locating in peri-urban might be a way for SMEs to be next to consumer pools (Magrini & Galliano 2012) while benefiting from lower costs than in urban areas. Hence, innovation policy should be studied in light of the strategic behaviour of SMEs' location in order to better understand the link between location and innovation.

The test of our second hypothesis is directly related to the insertion of the organizational fragmentation variable in Models 1B and 2B. 27.6% of SMEs in our sample are multi-unit firms (see table 2 in the appendix). We confirm the role played by firms' organizational fragmentation on their innovative capacity: the multi-unit variable is significant with a positive coefficient in the two models, clearly indicating a positive effect of multiple locations on SMEs innovative capacity. More precisely, multi-location multiplies SMEs' probability to innovate by 1.4. This result is in line with the results of Audia, Sorenson, & Hage (2001) and Magrini and Galliano (2012) about the effects of organizational fragmentation on innovation and it provides a confirmation in the specific context of SMEs. Moreover, the comparison of the results of Models 2A and 2B suggests that taking into account the multiple locations tends to reduce the innovative capacity of firms located in larger urban areas compared to firms in the less urbanized areas. Indeed, the first modality of the location variable (*large urban areas of at least*

[1] An odds ratio equalling to x implies that a firm multiplies by x its probability to innovate for the modality taken into consideration, in relation to the reference modality.

200,000 inhabitants and their polarized communes) is not significant in Model 2A whereas it is significant with a negative coefficient in Model 2B. In Models 1A and 1B, locating in *large urban areas* has no significant effect, so we cannot conclude. We then partially validate our second hypothesis in that considering only the location of the head office of a firm tends to inflate the innovativeness of the largest urban areas. This is consistent with the results obtained by Magrini and Galliano (2012) who contend that it is important to take into account a firm's complete spatial profile and not simply the location of its head office. Even if we are not able to integrate the firm's complete spatial profile into our empirical investigation, multiple locations appear to partly modify, in our models, the role of head office location in SMEs innovative capacity.

The control variables show results consistent with the literature. The results highlight a sector effect. Firms in commerce, transport, and construction have a lower probability to innovate than those in the industry sector. Size of the firm (measured by sales revenue), level of employees' qualification, and extent of the market (mostly extra-regional versus mostly intra-regional market) all have a positive impact on innovative capacity. This supports previous empirical studies (Magrini & Galliano 2012; Mairesse & Mohnen 2010). ICT resources have a positive impact on the innovative capacity, confirming the contribution of ICTs to innovation adoption (Spiezia 2011; Santoleri 2015), notably in the case of SMEs (Higón 2012).

Conclusion

In this article, we examined the role played by location of SMEs in their propensity to innovate. Our study of a representative sample of 1,253 SMEs in Brittany suggests that the propensity to innovate is not significantly higher in large urban areas than in rural ones. More precisely, we found that firms located in the largest urban areas of the region are not more innovative than those located in the least urbanized areas. While this lends support to Shearmur's (2012) argument that innovation is not confined to cities, we must point out that our results are context-specific to the population we study (SMEs) and to the definition of innovation we adopt. Notwithstanding this, our study contributes by calling into question the idea—popular among policy makers—that innovation occurs only in cities. Our research supports the idea that agglomeration of resources and local externalities characterizing large urban areas do not necessarily lead to greater innovation capacity. Close firms don't systematically mobilize these resources and externalities, or if they do, it does not always lead to increased innovative capacities.

Our methodological choices and empirical data also allow taking into account the innovation practises of firms or territories that would be ignored with a more classical definition of innovation adopted in the literature. Our empirical data underlines that using patent or collaborative R&D to evaluate SME's innovative behaviours carries with it the problem of ignoring firm strategies that are directly related to innovation.

Another notable result of our study is the role played by multiple locations. We found that having several firm sites has a positive impact on innovation capacity. This result confirms previous studies (Audia, Sorenson, & Hage 2001; Magrini & Galliano 2012) in the particular case of SMEs. We also provide a more original result: considering multi-location in the models tends to reduce the innovative capacity of firms located in the largest urban areas, relatively to the ones located in the most rural areas. In other words, only considering firm head office location leads to overestimate the innovative capacity of the largest urban areas. However, it would be interesting to go further this result by means of complementary investigations based on the location of all firm sites as suggested by Magrini and Galliano (2012).

Our study has limitations. Our definition of innovation allows us to take into account the innovation behaviours of SMEs on a broad scale, but it does not provide an indicator of the intensity of innovation. We therefore call for complementary research on SME innovation behaviours. One potentially rich vein might be not only to identify the resources that are accessible on a territory (e.g., human capital, public and private research organizations, potential partners for cooperation, etc.) but also to examine competitive strategies, and behaviours in terms of effective resource mobilization, as firms do not necessarily use available resources (Aguiléra, Lethiais, & Rallet 2015). Continuing this research would therefore require complementary qualitative analyses, which would make it possible to better understand SMEs strategies in terms of resource mobilization in their innovative processes.

APPENDIX

TABLE 2. Descriptive statistics for the variable used in the models (N=1253)

Dependent variable : Innovation propensity (introduction of new product of new process in the last two years)

Yes	No
49.16%	50.84%

Explanatory variables : spatial profile of the firm

Head office location

Large urban areas			Peri-urban areas			Rural areas
597 (47,65%)			359 (28,65%)			297 (23,70%)
Large urban areas of at least 200.000 inhab. and their polarized communes	Large urban areas of 50.000 to 200.000 inhab. and their polarized communes	Large urban areas of less than 50.000 inhab. and their polarized communes	Communes multi-polarized to large urban areas	Medium urban areas and their polarized communes	Small urban areas and their polarized communes	Other multi-polarized communes and isolated communes
420 (33.52%)	300 (23.94%)	172 (13.73%)	64 (5.11%)	103 (8.22%)	51 (4.07%)	143 (11.41%)

Organizational fragmentation

One site firm	Multi-site firm	NR
890 (71.03%)	346 (27.61%)	17 (1.36%)

Control variables

Size: sales revenue in 2011 (in €)

Less than 1 million	From 1 to 2.5 millions	From 2.5 to 5 millions	5 millions and over	NR
211 (16,84%)	413 (32,96%)	226 (18,04%)	283 (22,59%)	120 (9,58%)

Sector of activity

Trade	Transport	Hotel and restaurants	FREA[1]	Industry	Construction	SSTAIC[2]	Other services
286 (22,83%)	70 (5,59%)	81 (6,46%)	26 (2,08%)	312 (24,90%)	293 (23,38%)	109 (8,70%)	76 (6,07%)

Employee qualification (percentage of employees having received higher education)

Less than 10%	From 10 to 49%	50% and over	NR
369 (29,45%)	507 (40,46%)	298 (23.78%)	79 (6,30%)

Market extent

Mostly intra-regional market extent		Mostly extra-regional market extent	
Yes	No	Yes	No
413 (32,96%)	840 (67,04%)	74 (5,91%)	1179 (94,09%)

ICT resources: diversity of ICT tools used by the firm

Very high diversity (more than 7 tools)	High diversity (6 or 7 tools)	Medium diversity (4 or 5 tools)	Low diversity (3 tools)	Very low diversity (less than 3 tools)	NR
223 (17,80%)	319 (25,46%)	409 (32,64%)	166 (13,25%)	131 (10,45%)	5 (0,40%)

1Finance, Real Estate and Insurance

2Specialised Scientific and Technical Activities, Information, Communication

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[1] Marsouin is both an observatory of digital practices and a network of 15 research centres.

[2] A commune is polarized to another one if over 40% of its population works in the other commune.

[3] A commune is multi-polarized if over 40% of its population works in other communes.

[4] Company size can also be estimated using the number of employees measured in three modalities (between 10 and 19 employees, between 20 and 49 employees, 50 employees or over). We set up each of the models using the two variables alternatively. Sales revenue was more often significant than the number of employees. As the other results remained unchanged, we present only the results of the models with the sales revenue variable.

[5] The 11 ICT tools taken into account in the survey are the following: EDI, Intranet, mailing lists, shared agendas, shared workspaces, planning and process management software, business-specific software, electronic certificates, Web sites, social networks, videoconferencing.

[6] We also tested the models replacing this variable by a variable measuring ICT capabilities, apprehended by the internal computer skills and measured by a three modalities variable: the existence of an internal IT department, at least one employee with a computer engineering degree or neither of the two. As results are equivalent using each of these two variables, the table presents the results of the models only including the diversity of ICT equipment.