



The importance of spatial agglomeration in product innovation: A microgeography perspective



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ABSTRACT

This study focuses on how innovation in general and product innovation in particular are influenced by firms' agglomeration in smaller local districts, the so-called microgeography of product innovation. Using spatial analytic methods on the mobile gaming industry in the Seoul Metropolitan Area, this study finds that mobile gaming firms co-locate to form sub-clusters for specializing in specific product innovation activities such as visual complexity, product price, and product upgrade. Furthermore, results show that the relationships between product innovation and sales performance differ across individual firms and sub-clusters. The findings confirm that microgeographic location plays a key role in promoting different product innovation activities within a city-level cluster. One key implication is that regional and district policy makers should consider product innovation policies based on each sub-cluster's specific product innovation potential, due to the heterogeneous agglomeration effects in product innovation activities.

1. Introduction

Product innovation is central for firms in developing and maintaining their competitive advantage (Chen, 2007), and increasing competition and accelerating product life cycles mean that product innovation becomes even more important (Slater, Mohr, & Sengupta, 2014). A firm's choice where to geographically locate its product innovation efforts is based on specific circumstances and other contributing factors (Demirbag & Glaister, 2010). Although information and communication technologies improve interaction among people, especially in virtual teams of global firms (Sole & Edmondson, 2002), geographic distance as well as geopolitical borders restrict the flow of knowledge between firms (Singh & Marx, 2013) and deteriorate both quality and quantity of knowledge transfer (Boschma, 2005; Malmberg & Maskell, 2006). Therefore, substantial research has focused on how innovation in general is influenced by the spatial positioning of firms and industries from a macro perspective (e.g., at the country-, state-, or metropolitan-level).

However, less attention has been paid to how innovation generally and product innovation in particular, is configured and effective in smaller local districts within a cluster, from a micro perspective (e.g., at the district- or firm-level within a city), the so-called "microgeography of innovation." The microgeography of innovation deals with detailing

the spatial delimitation of clusters based on firm-based micro-data (Boix, Hervás-Oliver, & Miguel-Molina, 2015). This view can be extended to the spatial distribution of firm-level product innovation within a single cluster. Local presence enables firms to participate in and benefit from localized and highly specialized knowledge exchanges that occur only in face-to-face interactions and unanticipated encounters (Storper & Venables, 2004). Although a firm's internal factors are important for its innovation efforts, a firm's external environment, its collaboration network and internal capabilities to exploit the network externalities, also influence its innovation performance (Chiu & Lee, 2012).

Furthermore, agglomeration benefits are not always equally distributed. Specifically, firms do not benefit symmetrically from agglomeration because of unique characteristics that enable them to obtain greater benefits from specialized inputs (McCann & Folta, 2011) or because some clusters have different labor market structures from other clusters (Agrawal, Cockburn, Galasso, & Oettl, 2014). Recently, Boix et al. (2015) found that creative industries are highly clustered and co-locate to form smaller clusters that are predominantly metropolitan, cross-border, and heterogeneous. Despite a growing literature in asymmetric agglomeration effects, researchers have mainly focused on 'macro-heterogeneity' across locations but with less attention to 'micro-heterogeneity' across people and firms (Ottaviano, 2011).

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The objectives of this study are to explore empirically (1) if individual firms co-locate to form smaller local clusters, henceforth referred to as sub-clusters and (2) if they asymmetrically benefit from product innovation agglomerations individually and in sub-clusters, based on geospatial data of firm-level product innovation and the related sales performance. Specifically, we aim to explore how micro-geographic proximity shapes firms' product innovation behaviors ("spatial dependence") and to what extent relationships between product innovation and sales performance vary across firms and sub-clusters ("spatial heterogeneity"). If such microgeographic effects exist, both incumbent and newly-entering firms will be interested in allocating their limited R & D budgets more efficiently and policy makers may facilitate firms and their product innovation activities more effectively. Thus, by focusing on the role of the microgeography of product innovation, this paper contributes to the study of geography of innovation under simultaneous consideration of spatial dependence and spatial heterogeneity.

This paper continues with a literature review and the development of research hypotheses. Spatial effects on the effectiveness of product innovation are tested and discussed using a data set of 72 mobile game developers, with 355 commercialized mobile gaming products, across 30 local districts in the Seoul Metropolitan Area in South Korea. This paper concludes with implications for academic research and management practice.

2. Literature review and research hypotheses

2.1. Knowledge externalities in product innovation

Agglomeration theory argues that innovation depends on the nature of local knowledge (Tallman, Jenkins, Henry, & Pinch, 2004) and the variety of knowledge in the region (Frenken, Van, & Verburg, 2007). Such variety of knowledge consists of related variety and unrelated variety. The related variety denotes the balance between cognitive proximity and distance across sectors in a region and provides a basis for knowledge spillovers among sectors (Nooteboom, 2000), causing specialization externalities (Audretsch & Feldman, 2004). The unrelated variety denotes that the higher number of technologically related sectors in a region results in the higher inter-sectorial knowledge spillovers between those related sectors (Frenken et al., 2007), eventually enhancing diversification of regional innovation.

According to Audretsch and Feldman (2004), a firm's innovation activity should take place in those locations where the direct knowledge-generating inputs are the greatest and where knowledge spillovers are the most prevalent. The related variety enhances innovation as related technologies are more easily recombined into new technology both at the firm level (Breschi, Lissoni, & Malerba, 2003) and the regional level (Castaldi, Frenken, & Los, 2015). Although both types of knowledge variety are beneficial for innovation, related variety seems to be more important than unrelated variety in regional innovation (Castaldi et al., 2015). Applying the agglomeration theory to the product innovation context, firms benefit from specialized knowledge of product innovation spilled over in local sub-clusters. Location-specific advantages provide firms with opportunities to optimize activities along the value chain across different metropolitan areas (McCann & Folta, 2011). But due to firm-specific and site-specific factors, not all innovating firms benefit equally from their participation within micro- or macro-level clusters. Specifically, asymmetry in the learning capability of firms leads to asymmetric benefits of knowledge spillovers in clusters (McCann & Folta, 2011).

Recent research on the geography of innovation has begun to

address micro-level locations of firms and sub-clusters in an industrial cluster (Arbia, Cella, Espa, & Giuliani, 2015). Using a geo-statistical algorithm and firm-based micro-data, Boix et al. (2015), identified clusters in creative industries in Europe. Taking a micro-level view on the geography of knowledge dynamics, Strambach and Klement (2012) found that space and place shape cumulative and combinatorial knowledge dynamics by proximity economies and the institutional embeddedness of actors. Arbia et al. (2015) analyzed the demographic dynamics of Italian retail food stores (i.e., their birth, growth, and survival) based on micro-geographic data and uncovered the relative importance of competitive and cooperative interactions in determining the spatial distribution of economic activities. But while these studies explore the spatial distribution or clustering of micro-level firms or economic activities, they pay little attention to the analysis of asymmetric sales performances of product innovations across individual firms or sub-clusters.

These considerations give rise to two types of microgeographic effects in product innovation and sales performance: spatial dependence and spatial heterogeneity. The concept of spatial dependence is determined both "by similarities in position, and by similarities in attributes" (Longley, Goodchild, Maguire, & Rhind, 2005, p. 517), representing the extent to which neighboring firms specialize in certain aspects of product innovation. In contrast, spatial heterogeneity refers to the tendency for the relationships among variables to vary across locations, or the unevenness of a trait, event or relationship across a region (Anselin, 2001). As these effects are likely to be strong even for firms in close proximity, the product innovation activities of a firm and its sales performance are likely to be associated with other firms and/or sub-clusters heterogeneously.

2.2. Spatial dependence in product innovation

According to the knowledge production function model (Griliches, 1979), incumbent firms engage in the pursuit of new economic knowledge as an input into the process of innovation. By shifting the unit of observation from a firm to geography, Feldman and Florida (1994) confirmed that the knowledge production function was robust at the geographic level of analysis: the output of innovation is a function of the innovative inputs in that location. The importance of geographic proximity for knowledge spillovers is dependent on the propensity of similar industrial activity to agglomerate geographically (Autant-Bernard, 2001). While long distances require more complementary proximities to achieve closeness, short distances favor interaction, networking, collaboration and innovation (Boschma, 2005). Lazzarotti and Capone (2016) found that whereas the influence of social proximity diminishes as the cluster evolves and matures, geographical proximity continues to play a significant role along the cluster evolution.

Therefore, firms choose the location of their product innovation efforts based on specific local circumstances (Demirbag & Glaister, 2010). The collocation of related innovating firms generates knowledge spillovers and facilitates product innovation (Malmberg, Sölvell, & Zander, 1996). According to Malmberg and Power (2006), true clusters have a spatial agglomeration of similar and related economic activity, and the activities are interlinked by relations and interactions of local collaboration and competition. Darchen (2016) found that video game developers located in the Central Business District in Melbourne mainly specialize in complex games which require more face-to-face meetings and collaborative work than less complex games. As such, if the tenets of microgeography hold up for innovation, we should also expect product innovation activities to be spatially dependent upon neighboring innovating firms in smaller local

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