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Localization of knowledge-creating establishments[☆]

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ABSTRACT

This study investigates the localization of establishment-level knowledge creation using data from a Japanese patent database. Using distance-based methods, we obtain the following results. First, Japanese knowledge-creating establishments defined by patenting experience are significantly localized at the 5% level, with a localization range of approximately 80 km. Second, localization is observed for all patent technology classes, and the extent of localization has a positive relationship with the level of technology measured by R&D investment. Finally, the extent of localization is stronger for establishments that are more productive in terms of both the number of patents and the number of citations received, i.e., quantitatively and qualitatively. These results indicate that geographical proximity is important for knowledge spillover, particularly for establishments that demand external knowledge intensively.

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1. Introduction

Knowledge spillovers are crucial for innovation and productivity growth. Beginning with Marshall (1890), it has been widely recognized that geographical proximity enhances knowledge spillovers, which cause industrial agglomeration. Several prior studies have examined the localization of knowledge spillovers using patent citations (Jaffe et al., 1993; Thompson and Fox-Thompson and Fox-Kean, 2005; Murata et al., 2014) and inter-organizational collaborations (Inoue et al., 2013) as proxies for knowledge spillovers. This implies that knowledge-demanding establishments agglomerate more than do other types of establishments.

The role of knowledge spillover as an agglomeration force has long been empirically examined. Rosenthal and Strange (2001) find that the intensity of R&D investment is positively related to the extent of industrial agglomeration. Ellison et al., 2010 find that the intensity of citation relationships between industries positively relates to the extent of co-agglomeration between pair industries. These studies, however, identify agglomeration determinants with

industry-level estimations. Thus, establishment-level heterogeneity within an industry disappears due to aggregation. The role of knowledge spillovers, however, may differ across establishments within an industry, depending on the extent of their demand for knowledge spillovers. Thus, the location pattern may also differ across establishments within an industry.

A seminal paper by Carlino et al. (2012) examines the localization of R&D laboratories that demand external knowledge intensively. They use the address information of R&D laboratories from the Directory of American Research and Technology and find that R&D laboratories are significantly localized for most industries. They also identify core clusters of R&D laboratories in the U.S. and localized spillovers within the identified clusters. However, their focus is revealing the local structure of R&D laboratories' localization rather than the overall location pattern of knowledge-creating activities across a country.

With this background, this study investigates the localization of Japanese knowledge-creating activities by constructing an establishment-level database drawn from the entire patent database in Japan. A convention in the Japanese patent application allows us to

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construct an establishment-level database. That is, inventors in Japan register the address of the establishments to which they belong as the “inventor’s address”. We can detect 74,452 patent-creating establishments, which covers establishments in all regions. We recognize these patent-creating establishments as knowledge-creating establishments and investigate the pattern of localization of knowledge-creating activities across the entire country.

In addition to the global pattern of localization across Japan, our sample encompasses all industries. The industrial agglomeration literature mainly focuses on manufacturing industries. As we will show, establishments of non-manufacturing industries also intensively create knowledge. However, the role of knowledge spillovers in industrial agglomeration in non-manufacturing industries has been scarcely investigated. This study covers both manufacturing and non-manufacturing industries in the analysis.

Furthermore, using a patent database enables us to address differences in localization patterns within patent-creating establishments, depending on the heterogeneity of their demand for knowledge spillovers. If knowledge spillovers are determinant of agglomeration, establishments that demand more knowledge spillovers should be more localized. The technology level of patents that establishments apply for represents the extent of their demand for knowledge spillovers. High-technology invention ought to require more knowledge spillovers. From another perspective, establishments that create more patents or higher-quality patents require more knowledge spillovers. We examine differences in localization patterns depending on the above-mentioned heterogeneity.

To investigate the localization of patent-creating establishments, we conduct a distance-based analysis, as developed by [Duranton and Overman \(2005\)](#). This approach focuses on the distribution of bilateral distance between all pairs of patent-creating establishments and is therefore free from the problems of administrative boundaries. The critical idea is to compare the distribution of bilateral distances with the counterfactual distribution generated by a random allocation of patent-creating establishments’ locations to all potential sites. For the potential sites of patent-creating establishments, we use all establishments of all industries in Japan from micro-data in the Establishment and Enterprise Census.

We obtain the following results. First, the locations of patent-creating establishments are significantly localized at the 5% level, with a localization range of approximately 80 km. Furthermore, by the industry-level analysis, we find that patent-creating establishments are significantly localized relative to the all the establishments in the same industry. Second, localization is found for all patent technology classes, and the extent of localization has a positive relationship with the level of technology, as measured by R&D investment. Finally, the extent of localization is stronger for more productive establishments in terms of both the number of patents created and the number of citations, i.e., quantitatively and qualitatively. This implies that productive establishments require more external knowledge from other establishments. These findings suggest that knowledge spillovers are important determinants of economic agglomeration, particularly for establishments that demand external knowledge intensively.

The remainder of this paper is organized as follows. In the next section, we introduce the dataset and the identification of patent-creating establishments. Section 3 describes the empirical strategy based on the micro-geographic information of each establishment. Section 4 presents our baseline results and robustness checks. Section 5 focuses on the differences in the extent of demand for knowledge spillovers across patent-creating establishments. Finally, Section 6 concludes.

2. Data

We utilize the Institute of Intellectual Property (IIP) patent database ([Goto and Motohashi, 2007](#)), which includes Japanese patent publications (the Patent Gazette). This database includes basic patent information, such as patent IDs, publication dates, names and addresses of applicants, and names and addresses of inventors. The database also includes citation information on each patent, such as the number of times the patent has been cited. From this database, we construct an establishment-level database of all patents published from 1993 to 2008.

This study focuses on the localization of patent-creating establishments. We identify the patent-creating establishments from the patent database, taking advantage of a convention in the Japanese patent application where inventors register the address of the establishments to which they belong as the “inventor’s address” ([Inoue et al., 2013](#)).

Here, we describe the algorithm used to identify the patent-creating establishments from our patent database, following [Inoue et al. \(2013\)](#). First, firms are identified by the name and address of the applicants. Here, we define the firm as an applicant whose name includes the term “company limited,” or “*kabushikigaisha*” in Japanese. This definition simultaneously excludes relatively small firms, such as private limited companies. Second, the patent-creating establishments are identified as follows. We check whether the firm’s name is included in the inventor’s address. Then, we consider the inventor’s address with the firm name as the address of the establishment owned by the firm.

Using this identification method, we obtain the following information. [Table 1](#) provides the summary of the dataset, which includes 1,967,361 patents. A total of 1,189,262 patents are applied for by the firms with identified patent-creating establishments. The number of firm applicants is 56,592, and the total number of patent-creating establishments is 74,452.

[Fig. 1](#) shows the map of patent-creating establishments identified by our methodology. As the map shows, the identified patent-creating establishments span Japan.

Furthermore, our analysis requires the potential sites of patent-creating establishments. We assume that patent-creating establishments can be located at any site where the establishments of all industries are located. To obtain information on the locations of establishments of all industries, we use micro-data from the Establishment and Enterprise Census. This database includes the address, the number of employees, and the industry code information of each establishment. Then, we convert the establishments’ address into a latitude-and-longitude format.¹ The number of establishments in the data is 5,722,559.

Table 1
Data summary.

Number of patents	1,967,361
Number of patents applied for by firms with identified establishments	1,189,262
Number of applicants (firms)	56,592
Number of patent-creating establishments	74,452
Number of overall establishments (census)	5,722,559

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