

Spatial Transition of Innovation Focused on Railway Stations: A Case Study of Patent Applications in Japan from 1980 to 2019

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In recent years, many regions have been seeking to revitalize their local economies through generating innovations in order to overcome the economic decline in rural areas. In generating innovations, it is known that face-to-face propagation of technology and knowledge play important roles. Therefore, in the sense of reducing the time for people's interactions, railway developments and proximity to railway services are considered to be significant factors in generating innovations. There have been several studies that have identified the relationship between the development of railway networks, representing the flow of people, and the innovations produced by these networks. However, few studies have examined the relationship between railways on a national scale and over an extended period of time.

Therefore, to clarify the relationship between railway systems and innovations, this paper analyzes the spatial transition of innovations focusing on the distance from the nearest station using patent data covering Japanese patent applications from 1980 to 2019. The first approach focuses on spatial transitions at the small spatial scale of a 1 km² grid and analyzes spatial autocorrelation to gain detailed insights into the trends. The second approach tries to evaluate the relationship between patent applications and new railway openings by utilizing histograms classified by distances from the nearest station. Furthermore, we categorize patent applications into increase/ decrease or emergence/ loss to identify the breakdown of the fluctuations in this approach.

The former analysis uncovered the following results by utilizing local Moran's I and distances from the mean. In terms of High-high, where the number of patent applications is relatively high in both the subject region and the surrounding region, tends to include grids in the metropolis. As for High-low, where the number of patent applications is relatively high for the subject region, but relatively low for the surrounding region, tends to encompass grids near a station in rural areas. The results suggest that the distance from a railway station may have a significant impact on generating innovation.

The latter analysis yielded the following new findings. First, the frequency of grids increased as the distance from the nearest conventional station gets long with the peak of 300 to 700 meters, converting to a gradual decrease after the peak. This result was commonly achieved regardless of the categories of increase/ decrease or emergence/ loss. Second, especially from 1980 to 2000, patent applications increased significantly near stations. Third, the trend turns opposite from 2000 to 2010, a significant decrease near stations especially in metropolis. Fourth, some areas with newly opened High-speed Rail (HSR) lines have the relatively large increase of patent applications. These trends are continuing in until 2019, but the tendency was relatively modest.

These results suggest that the relationship between places of innovation generation and the distance from its nearest station is getting modest, but still plays a significant role. Especially, the result suggests that developments of HSR may be greatly effective for generating innovation in rural areas.

Keywords: Innovation, Railway station, Spatial transition, Patent application, Local Moran's I