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Transportation infrastructure investment and the location of new manufacturing around South Korea's West Coast Expressway

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ABSTRACT

This study analyzes the impact of the opening of the West Coast Expressway in Korea on the location of new manufacturing establishments near the road. The expressway opened in December 2001 and connects the Seoul Metropolitan area with Jeolla province. Major construction goals were to stimulate the industrial development of nearby regions and improve the traffic flow around existing industrial complexes. The analysis used panel data for the ten years of 1997 through 2006. The database was developed from the annual Korea Mining and Manufacturing Survey and other sources.

The analysis used a fine spatial resolution based on three non-overlapping, small spatial administrative units: city *wards* (Korean: *dong*), *towns* (K. *eup*), and rural *districts* (K. *myeon*). This led to 2029 observations (one for each spatial unit) per year, or a total of 20,290 observations for the 10-year panel. The analysis was performed with a fixed-effect negative binomial panel regression. The analysis modeled the formation of new manufacturing establishments, both in total and classified by technology level and establishment size.

The results found that the opening of the West Coast Expressway had a significant positive impact on the decision of the location of new manufacturing establishments. The average wage of employed workers in local manufacturing establishments was also an important location determinant for new manufacturing establishments, especially for establishments based on lower technology levels which pay lower wages. Land price was found to produce a negative effect, regardless of technology level or size. The number of employed workers in existing manufacturing establishments in the local area was a highly significant positive determinant of location for new manufacturing establishments, indicating agglomeration effects.

1. Introduction

Given the immense expenditure of major transport infrastructure construction, it is important to investigate impacts on economic development. The importance of transportation cost in the decision to locate a firm has been emphasized since Weber (1929) established a model for cost minimization or profit maximization. The accessibility provided by transport infrastructure in relation to the transportation needs of firms, which vary by sector, is also of importance (Vickerman, 1996).

Generally, transportation infrastructure investment is positively correlated with economic growth, although the effect can vary considerably in size or significance, though in some cases it has little or no effect. For instance, Song and van Geenhuizen (2014) show that investment in port infrastructure in China has contributed to increased regional economic growth. Li et al. (2018) found that road infrastructure in China has varied effects by region; in one region it enhanced overseas investment and local real estate development, whereas in another region they note that road infrastructure stimulated market openness. A nationwide study in China also found that transport investment had positive economic impacts and spillover effects, but that they varied by province and for the nation (Jiang et al., 2017).

Studies at the national level in the U.S. have shown a positive correlation between infrastructure capital, specifically expressways, and productivity (Aschauer, 1989; Fernald, 1999). A positive correlation has been found to exist between transport infrastructure and output (Conrad and Seitz, 1994; Boarnet, 1998; Ozbay et al., 2007). Coughlin and Segev

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(2000) found that the level of transport infrastructure has a positive correlation with the number of new foreign-owned manufacturing establishments. The time-series analyses of Holl (2004a, 2004b) show that the expansion of transport infrastructure has a statistically meaningful correlation with the new entry of manufacturing establishments.

These types of results provide support for political decisions to carry out large-scale transport infrastructure investment, although there are cases where projects have not had the expected effects. For example, in China it has been found that, in general, motorways are linked to concentration of economic activity, but that improved road transport could lead to spatial dispersal of economic activity if the transport cost was low (Yu et al., 2016).

High-speed rail investment has been found to improve local budgets, although on the national scale the investment may not pay off and can require subsidies (Hernández and Jiménez, 2014). A positive effect of railway stations has been found for the stations' vicinity, based on UK and Spanish data (Mejia-Dorantes and Lucas, 2014).

Among studies dealing with the relationship between transport infrastructure and employment growth through geographically disaggregate data, Luce (1994) and Singletary et al. (1995) found a positive correlation, whereas Bollinger and Ihlanfeldt (1997) suggest a negative correlation.

In this way, preceding studies on aggregate economic effects have produced conflicting results, some showing positive and some showing negative effects. Overall it can be interpreted that most transportation investments are likely to have both positive and negative effects (Laird and Venables, 2017).

Taken together, most regional-level studies focusing on the aggregate effect of transport infrastructure show positive impacts, but inter-metropolitan analysis does not accurately measure the impact of transport infrastructure without using geographically disaggregate data. A meta-analysis of 33 transportation investment studies found that the positive effect is generally larger for sectors such as manufacturing and that the effect varies between the U.S.A. and Europe (Melo et al., 2013). In a comparison of numerous models of and investigations of wider economic impacts of transport infrastructure, Rothengatter (2017) points out that new infrastructure in a developing area can have an important effect, whereas an infrastructure rehabilitation project in an already developed area may work mostly to avoid negative effects of deteriorating infrastructure.

A limited number of studies on this topic have been conducted in Korea due to the difficulty in gathering data and a huge volume of unsorted data. Among the studies on transport infrastructure, Lee and Lee (2002) analyzed location determinants of manufacturing establishments which were moving to a new location. Lee and Lee (2002) used a cross-sectional analysis (as opposed to a multi-year panel data analysis) based on discrete choice modeling. Lee and Kim (2005) investigated location determinants of new manufacturing establishments in cities, also using a cross-sectional analysis with a discrete choice modeling framework.

Theoretical models of economic geography suggest that the development of large-scale transport infrastructure significantly affects the spatial distribution of economic activities (Krugman, 1991; Fujita et al., 2001). The expansion of transport infrastructure is important because it reduces transport expenses required to reach markets and thereby can affect the spatial distribution of economic activity. For instance, in the case of a rise in transportation costs, economic activity tends to disperse, whereas in the case of a decrease in transportation expenses and an increase in the regional accessibility, establishments tend to pursue economic benefits through agglomeration. These important and sometimes conflicting effects suggest the importance of planning and policy tools that are based on research into these impacts of projects (Short and Kopp, 2005).

It is necessary to conduct a systematic analysis of how the location of new manufacturing sites has been impacted by investment in transport infrastructure to make more effective regional development policies and improve transportation infrastructure planning. Despite Korea's considerable fiscal investment in major transport infrastructure, such as expressways, there are few studies of economic spillover effects. Studies on the spatial changes of economic activity caused by the construction of expressways are particularly lacking.

It is now rare that complete, large-scale expressways are built from scratch, connecting distant areas of a nation. Most of these projects in the U.S. and Europe were done decades ago. Korea has, in recent decades, undertaken large-scale investment in transportation infrastructure. Such projects therefore give the opportunity to study the effects of new construction; an opportunity rarely available for study in the U.S. and Europe.

This study analyzes the impact of the opening of the West Coast Expressway in Korea, which was completed in December 2001, on the location of new manufacturing establishments by technological level and size. Analyzing the West Coast Expressway is useful because it is one of the newest and largest transport infrastructure investments in Korea.

The major construction goals of the West Coast Expressway were to stimulate industrial development of nearby regions and to improve traffic flow around existing industrial complexes. This paper, therefore, studies the effect of the expressway on new manufacturing establishments, which is also important due to their significant spillover effect on local economies.

The results are intended to contribute to helping establish effective regional development policies and support transportation infrastructure planning by identifying the impacts of expressway construction on changes in the spatial distribution of economic activity.

This research has methodological significance as it used a 10-year panel of data for small spatial units on a time-series basis, which was analyzed with a sophisticated multivariate statistical model that handles panel data and count data. This is also the first location-related study in Korea covering the location pattern of new manufacturing establishments with a small spatial unit and panel data.

2. Data

The West Coast Expressway (see Fig. 1)—the largest project among newly opened expressways—is now the second longest expressway in Korea. It is also known as the North-South axis of the national trunk road. This study takes as its geographic scope the entire western half of the nation. This covers four provinces (the four provinces on the east side of the nation and the island province of Jeju are omitted) and four metropolitan cities, which are administratively separate from the provinces. The provinces and cities included are (listed from north to south): Gyeonggi province, the Seoul Metropolitan city, Incheon Metropolitan city, Southern Chuncheong province, Daejeon Metropolitan city, Northern Jeolla province, Gwangju Metropolitan city, and Southern Jeolla province. The geographic reach of the study therefore includes areas that are quite far from the expressway and unlikely to benefit directly from it. Having areas that are both affected and not affected by the expressway in the models allows the estimation of the effect of the road against the backdrop of the overall national economy.

This study built a panel dataset for the years 1997 through 2006, a 10-year period. The road opened in sections from July 1994 through December 2001. Observations from each year during the construction are only available for sections that were open to traffic. The primary source dataset is the Korea Mining and Manufacturing Survey conducted every year by Statistics Korea. Additional information on data development and study background are available in Korean in a project report (Kim and Ahn, 2009).

It is of key interest in this study to investigate the effect of accessibility to both the previously existing freeway network and the new West Coast Expressway on the number of new manufacturing establishments. The spatial resolution of a location study is of importance. If the spatial unit is large, it becomes impossible or meaningless to use local effects, such as the distance to the nearest expressway interchange (IC). Kim et al.