



Highways and firm performance in the logistics industry[☆]

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ABSTRACT

Using detailed geo-referenced data we analyse the effects of highway development on firm level performance in the Spanish logistics sector. To address potential endogeneity issues we carry out panel data analysis together with instrumental variable estimation. Results show that highways have significant implications for logistics' firm performance, although with important spatial heterogeneity. For urban logistics firms, a reduction in the distance to their nearest highway increases their productivity performance. In contrast, for rural logistics firms, improvements in highway access show a positive impact on employment growth but have also led to a reduction in productivity growth for those rural logistics firms that remained outside highway corridors.

1. Introduction

Over the last decades there have been important changes in the nature of competition. Time is becoming a highly competitive issue and speed-to-market has become a critical factor in many industries. Markets are ever more global, as is competition. At the same time, the organisation of production has also changed towards more complex production networks and towards an increasing reliance on transport and logistics¹ that substitute for traditional inventory holding (Hesse and Rodrigue, 2004).

As production and distribution systems have reorganized, so has their spatial structure (Giuliano et al., 2016). Nevertheless, while the changes in the management of physical distribution² have been well documented, its spatial reorganization has not (Hesse and Rodrigue, 2004). Restructuring of distribution activities can be attributed to the so-called “logistics revolution”, which started in the 1950s, and can be explained with five interrelated phenomena (see, among the others Vahrenkamp, 2010; Mariotti, 2015): (i) the consumer-oriented

economy, e-commerce, and consumer preference changes; (ii) internet-based information systems; (iii) the substantial reductions of trade barriers, tariffs and transportation costs; (iv) increased competition due to 1970s and 1980s deregulation and liberalization in the US, and integration of European markets in the 1990s (Hesse and Rodrigue, 2004); and (v) the globalized market that has increased the amount of goods flows to be moved around the globe (Yieming et al., 2002; Mariotti, 2015).

The role of logistics has therefore changed, and over the last decades, a remarkable increase in logistics activities has been observed. Logistics is now gaining a strategic role in the successful implementation of time based competitive strategies and for facilitating the managing of complex and increasingly global supply chains. The literature has also documented a bidirectional link between economic development and logistics performance (see Arvis et al., 2007; Ferrari et al., 2011; Benassi et al.; 2015). Indeed, several countries have undertaken concerted efforts for improving their logistics sector, upgrading their infrastructure and technology to get a bigger slice of the

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¹ According to Ballou (1999, p.6): “Logistics is the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information flow from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements”.

² Physical distribution is the collective term for the range of activities involved in the movement of goods from points of production to final points of sale and consumption (McKinnon, 1988, p. 33).

market (Tongzon, 2007; Bolumole et al., 2015).³

Transport is an essential input in the provision of logistics services and this provision depends crucially on transportation infrastructure networks. The recent UK Logistics Report clearly emphasises infrastructure as key for the productivity and competitiveness of the sector (FTA, 2016). Yet, surprisingly, the role of transportation infrastructure investment on the performance of logistics firms has remained largely unexplored in the academic literature.

The logistics sector is clearly one with a high reliance on the highway network, particularly in Spain where the proportion of road usage in total inland freight transport has grown steadily over the last decades and today roads account for well over 90%.⁴ Spain is also the country with the highest number of logistics service providers among European Member States (European Commission, 2015). Highways can lead to shorter distribution times and reduce the operating costs of logistics firms, improve delivery times, and reliability. This can allow logistics firms to improve their performance. However, transport infrastructure improvements also open up local markets, which may expose local logistics operators to greater competition.

We are not aware of research relating directly logistics performance to improvements in transportation networks. To the best of our knowledge this is the first study to examine the effects of a major highway development program on firm level performance in a sector which has not yet received much attention in this respect.

We contribute to the still small but growing empirical literature on the firm-level productivity impacts of transportation infrastructure improvements in various respects. First, the literature on local productivity advantages has mainly focused on the role of urbanization and localisation economies. However, the empirical evidence on the spatial heterogeneity of productivity impacts of transportation investment is still limited. Yet productivity impacts of transportation infrastructure may depend on the environment in which the infrastructure is placed. We distinguish between the effects on firms in urban and rural areas, as some earlier evidence suggests that indeed impacts of transportation infrastructure improvements may differ between the two types of locations (Rephann and Isserman, 1994; Funderburg et al., 2010; Holl, 2016; Holl and Mariotti, 2017). This way we aim to contribute to a more nuanced understanding on the spatial heterogeneity of effects of transportation infrastructure improvements. Second, most of the productivity literature as well as the literature on transportation infrastructure impacts has studied the manufacturing sector. Much less is still known about the service sector and, when it has been included in previous analyses, it has been at rather aggregated levels. We provide novel evidence for a specific service sector. Third, focusing on a narrowly defined sector such as logistics allows us to demonstrate that spatial heterogeneity in impacts not only happens across sectors, but also within individual sectors.

Fourth, for identification we rely on panel data and explore variation over time within firms of distance to highways that is based on the exact location of logistics firms and not on municipality, ward, or district distances as in most previous studies. Furthermore, using fixed-effects combined with Instrumental Variables (IV) techniques allows us to provide evidence on causal effects of transportation investment on firm level performance. Finally, we study a range of firm performance measures which allows checking robustness of results to alternative methods for estimating firm performance.

Our results show that highway improvements have significantly

³ The Logistics Performance Index has been developed to provide a cross country and in-depth evaluation of the logistics gap that exists among countries (see Arvis et al., 2007).

⁴ For international freight movements, maritime transport accounts for the biggest slice when measured in tons transported but still roads are an important mode for Spanish exports (Transportation and Logistics Observatory, Ministry of Transportation).

enhanced productivity in urban logistics firms but not so in rural logistics firms. In fact, highway improvements have contributed to productivity decline of rural logistics firms that are not located in close proximity to the highway network. Further estimations indicate that highways have nevertheless contributed to employment growth of rural logistics firms. Thus, rural firms seem to have increased factor inputs in response to highway improvements but not their efficiency with which they convert inputs to outputs. This suggests important spatial variations in the impacts of transportation investment even within a narrowly defined sector. The impacts of transportation infrastructure improvements clearly depend on the spatial environment where they take place. The findings of the present study are expected to be highly transferrable into policy because of the frequency of policies to attract logistics firms and invest into transport infrastructures.

The paper is organised as follows. Section 2 is dedicated to the literature review. Section 3 presents data and descriptive statistics. The estimation approach is described in Section 4. Section 5 presents the results of the empirical estimations. Conclusions, policy implications, and indications for further research follow in Section 6.

2. Literature review

Most studies on the impact of transportation infrastructure investment have been carried out at an aggregate level (for a recent review see Melo et al., 2013). Vickerman (1996) describes the way in which transport infrastructure affects accessibility, industrial location and hence regions' growth and development. Specifically, the author states that transport infrastructures can have two main effects on economic growth: non-spatial and spatial effects. Non-spatial effects are the effects of infrastructure investment on the aggregate level of economic activity, productivity and competitiveness in an economy, while spatial effects consider the way in which infrastructure can lead to differential performance in different locations, either between regions or within regions. The paper, therefore, improves the appraisal framework for new transport infrastructure and concludes underlying the need for a more specific policy of matching transport provision to regional needs. Banister and Berechman (2001), explored whether, in developed countries, transport infrastructure investments promote economic growth mainly at the urban and regional level. The authors argue that while transport investments produce benefits such as travel time reduction, other "economic development benefits" can take place if the following three conditions occur simultaneously: (i) economic conditions (i.e. agglomeration and labour market economies, high skilled labour force); (ii) investment conditions (availability of funds, the scale of investment and its location, the network effects and the actual timing of the investment); (iii) political conditions (the broader policy environment with which transport decisions must be taken) (see also Banister and Berechman, 2000). According to a recent study by Laird, Venables (2017), transport can raise productivity by fostering intense economic interaction, shaping the level and location of private investment, and affecting the labour market, potentially allowing more workers to access jobs.

Less work has been done at the firm and plant level and specifically the literature on the effects of transportation infrastructure investments on firm level performance is still relatively scant (some notable example are, Lall et al., 2004 and Ghani et al., 2016, 2017 for India; Graham, 2007a, 2007b and Gibbons et al., 2017 for the UK; Holl, 2012, 2016 and Martin-Barroso et al., 2015 for Spain). These studies show that highways positively affect firm level performance, but most of these studies have focused on manufacturing and those that have considered services have used rather broad sectors.

To date, there is no direct available evidence on the impacts of transportation infrastructure investment on firm level performance in the logistics industry. Yet, there is some indirect evidence that highlights the importance of highway for the logistics sector. Shirley and Winston (2004), Datta (2012), and Li and Li (2013) for example,

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