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Influence of the geographical pattern of foreign trade on the inland distribution of maritime traffic

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ABSTRACT

Many papers analyse the role of transport infrastructure in the economic development and competitiveness of regions. However, the literature has paid little attention to the impact of the changing patterns of international trade on the use of the infrastructure. The hypothesis of this work is that the evolution of the geographical pattern of countries' foreign trade influences the inland distribution of maritime traffic and, consequently, the use of the infrastructure. The inter-port distribution of the Spanish exports in 2000 and 2015 was analysed in order to confirm the validity of this hypothesis. To that end, the Spatial Interaction Models approach was adopted. The results suggest that the final destination of the flows does influence the inland distribution of the Spanish container flows and, consequently, that the use of the inland transport infrastructure has evolved in line with the geographical pattern of foreign trade.

1. Introduction

There is ample literature on the role of the transport sector in trade and competitiveness, both at regional and national levels. Recent relevant examples can be found in Bensassi et al. (2015), Bottasso et al. (2018), Brodzicki et al. (2018), Tiller and Thill (2017) or Tsekeris (2016). The relationship between the transport sector and foreign trade is also studied here, but the perspective of analysis has been reversed. It is well known that the activity of ports depends on the dynamism of their geographical surroundings, as well as on the international relevance of the sea routes in which their facilities are included (Ducruet et al., 2013; Notteboom and Rodrigue, 2007). However, the question addressed here is whether changes in the geographical links of such surroundings with the rest of the world have an impact on the inland distribution of the maritime traffic and, consequently, on the use of the transport infrastructure.

Over the past two decades, Asian economies have been gaining prominence. China and India lead this process, but other neighbouring countries, such Korea or Indonesia, are also increasing their relevance (see Hanson, 2012; O' Neill and Terzim, 2014). Using data from the World Bank (2017), the share of the Asian countries in world GDP (in current dollars) went from 7.2% in 2000 to 20.7% in 2015. At the same time, the relative weight of America in world GDP fell from 30.6 to 24.3% (hereafter, America refers to both North and South America). According to the basic logic of the gravity equation (see, e.g., Head and Mayer, 2014), exports rise in proportion to the economic size of the destination and imports rise in proportion to the economic size of the origin. Thus, the global shift in economic size should be reflected in trade flows. The European Union (EU) foreign trade confirms this eastward shift in trade flows: EU trade with America fell from 33.2 to 26.1%, whereas trade with Asia grew from 38.6 to 47.2% (Eurostat, 2017).

Seaborne trade is heavily dependent on prevailing economic trends (Valentine et al., 2013). In this sense, the Review of Maritime Transport (UNCTAD, 2017) underlines that the demand for maritime transport services is closely linked to the evolution of the world economy, with Chinese import demand being particularly important for maritime trade. Certainly, the global shipping network has its own configuration rules (Ducruet and Notteboom, 2012) and it tends to maintain stability of its overall architecture (Ducruet, 2017). However, the economic conditions and trade flows between world regions remain key factors in the deployment of shipping lines (Mengqiao et al., 2015).

With these considerations in mind, our hypothesis is that the considerable changes in international trade and maritime routes may have consequences for the inland distribution of the maritime traffic, which in turn should be reflected in the evolution of the inland corridors of flows. This is in line with Blauwens and Van de Voorde (1988), who analysed the evolution of inland transport as a result of changes in port

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choice for the Belgian case, and with Cantillo et al. (2018) and Veldman et al. (2013), who concluded that the port choice depends, among others factors, on the port location regarding the flow destination. This is of particular interest to countries (or regions) bordering two seas, as is the case of Spain. Hence, the case study presented in this paper focuses on this country.

A Spatial Interaction Model (SIM) was employed to assess whether the port hinterland configuration does actually vary according to the final destination of the shipments. As repulsion and attraction factors, the province-port travel time and the container throughput of the ports were considered respectively, two variables previously identified as determinant to delimit the scope of the hinterland of the Spanish ports (see Moura et al., 2017). The results show that the proposed approach contributes to explain properly the inland distribution of the maritime traffic and confirms that the final destination of flows is relevant for the hinterland configuration of the seaports.

The conclusions of the paper could be useful for public policy and planning. Our results show that the configuration of hinterlands is influenced by the final destination of the traffic. Therefore, the evolution of the use of the inland transport infrastructure is linked to the evolution of the geographical pattern of foreign trade. This is a factor beyond the control of policy makers, but it can be tracked and, to some extent, predicted.

The remainder of the paper is structured as follows: Section 2 provides a short review of the literature. Section 3 presents a descriptive analysis of the case study. Section 4 shows the model proposed to test the validity of the hypothesis stated. Section 5 gathers together the data sources and the obtained results. Some additional considerations are highlighted in Section 6, and a brief discussion is introduced in Section 7. Section 8, finally, summarises the main conclusions.

2. Literature review

The analysis of the port choice is not the aim of this paper. However, this is a closely linked issue, as the configuration (and the evolution) of hinterlands relies on the inland distribution of the maritime traffic, which in turn results from the port choice. In this sense, Talley and Ng (2018) underline that the determinants of port choice will also settle the choice of the hinterland transport chain.

In general, port choice is considered to be influenced by cost,[1] location, port operations quality and reputation, handling speed and time, facilities, efficiency/frequency of shipping services and hinterland accessibility. The relevance of these variables differs according to the different port players (shippers, forwarders, shipping companies and terminal operators), although the most cited as determinant of port choice both by shippers and shipping companies are costs, port location and reputation, while frequency of shipping services and intermodal connections are among the least cited (Aronietis et al., 2010). However, Halim et al. (2016) highlighted the port hinterland connectivity as a key determinant for port choice by shippers.[2]

Nowadays, ports are considered as pieces in value-driven logistic chains (Robinson, 2002), thus the determinants of the port choice are now considered to be related to the entire logistic chain in which the port is included as a node (Magala and Sammons, 2008). Ports became *pawns in a game* (Slack, 1993), and their bargaining power and their influence has been reduced (Meersman et al., 2010) because of the mergers and alliances between large shipping lines, which in some cases also integrate vertically (Notteboom et al., 2017; OECD, International Transport Forum, 2008). Nevertheless, ports continue to play the role of interface between sea and land transportation. Their success depends on their ability to attract traffic from the major economic centres and their inclusion in the main shipping routes (hinterland and foreland connections, respectively). According to Fleming and Hayuth (1994), seaports are still characterised by two spatial qualities with complementary dynamics, *centrality* and *intermediacy*,[3] which continue to stand out as factors responsible for the heterogeneity of maritime services and port traffic in recent articles (see, for instance, Guerrero et al., 2015 or Ducruet and Itoh, 2015).

All of the above reinforces the interest of the debate about whether "the ship follows the cargo" or "the cargo follows the ship" (see Notteboom, 2009). Such debate is still on-going, and Berli et al. (2018) highlighted that is still not clear whether the sea-land connectivity determines or is determined by port activity. It can be said that the services of the shipping companies contribute to attract traffic from the inland side to the port facilities and, simultaneously, port choice by shipping companies is influenced by the availability of cargo, which is directly determined by the hinterland. In this sense, Hayuth (2007) observed that port choice is increasingly being influenced by landside factors and, more recently, Guerrero et al. (2016) found that the impact of shipping services on the geographical pattern of trade is much less important than that of distance. However, as Lee et al. (2008) illustratively stated, ships can move and ports cannot. From this perspective, ports would depend on shipping companies, which is in line with Ducruet and Itoh (2015), who found that port activity is increasingly explained by shipping routes where the ports are included. In addition, Wilmsmeier et al. (2011) noted that corridors now depend more on strategies of vertical cooperation than on the location of the infrastructure.

It is important to note that the activity of transport service providers (both on the sea and land sides) exists because of the trade demand, i.e. transport demand is a derived demand that reacts to changes in trade looking for a rational integration of sea and land segments of traffic flows (Robinson, 2002). According to this, Guerrero et al. (2015) found that maritime transport supply depends to a large extent on the hinterland and highlighted that the maritime services vary as a function of the foreland.

The aim of this paper is not to delve deeper into the analysis of the relevance of the determining variables of port choice, but to study whether the final destination of flows influences the inland distribution of maritime traffic (which certainly results from the port choice). For this purpose, the following case study has been carried out.

3. Descriptive analysis

The geographical pattern of the Spanish foreign trade follows the same trends observed internationally, i.e. Spanish flows have experienced an eastward shift. Fig. 1 shows the evolution of the Asian and American shares of the Spanish trade (imports plus exports) for the period 2000–2015.[4] The Asian share was already higher than the American share at the beginning of the study period (42 vs. 40.3%), but at the end of the period the difference between both shares was 28.4 percentage points.

To appreciate whether this evolution in the geographical pattern of the Spanish trade has had consequences for the inland distribution of the freight flows, it is necessary to observe what has happened at the provincial level (NUTS 3).[5] For this purpose, Fig. 2 shows the change in

[1] Inland transport costs are often the most significant part of the total transport cost (Notteboom and Rodrigue, 2005).

[2] A recent synthesis of the most influential factors for shippers can also be found in Shi and Li (2016).

[3] *Centrality* is related to the location of ports regarding the traffic generation centres, whereas *intermediacy* refers to their inclusion in the main maritime routes.

[4] So long as the analysis is focused on deep-sea traffic, intra-EU maritime traffic is excluded. Moreover, more than three-quarters of the Spanish containerised deep-sea traffic is linked with Asia and America, this share remaining quite stable during the period of the sample. In the rest of the paper containerised flows with Asia and America will be analysed.

[5] The Balearic and Canary Islands, as well as the autonomous cities of Ceuta