Spatial competition and complementarity in European port regions

Axel Merkel[1]

Faculty of Logistics, Molde University College - Specialized University in Logistics, Norway

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ABSTRACT

The purpose of this study is to investigate whether inter-port relationships in European container shipping are characterized primarily by competition or complementarity, and to what extent this differs between major port regions. Utilizing a set of spatial dependence model specifications and quarterly container throughput data for 92 European ports in five regions between 2000 and 2014, it is found that the nature of inter-port relationships tend to differ between major port regions. While the Hamburg-Le Havre region is characterized mostly by competition, ports in the Mediterranean region are found to be complementary with regard to demand.

1. Introduction

Competition between ports is nested in broader concepts of competition. A decision maker's choice of calling at a particular port from a set of feasible alternatives is conditioned on the higher order choice of maritime over alternative modes of transportation. Not only other ports, but also other modes of traffic, other routes, and combinations of the two, are relevant substitutes. Choice of port is also subject to certain restrictions such as port capacity, availability, location, cargo handling specialization and accommodation of certain vessel sizes. Such restrictions, along with high entry barriers in the port market, dampen the intensity of competition between maritime ports. However, the development of intermodal logistics chains has tended to add flexibility to some of these restrictions.

Inter-port relationships are likely to be complex, and may not always be characterized only by competition. One reason for lacking or low degrees of competition is that ports are generally considered to possess a significant degree of natural market power (Goss, 1999; Verhoeff, 1981). The tendency for ports to exploit market power in pricing practices has led to strong arguments for creating competition within ports (De Langen and Pallis, 2006). Another reason for lacking competition is that ports may rather be incentivized by co-operation than by competition. In terms of demand analysis, one might characterize a set of ports as either substitutory (in a situation where inter-port relationships are characterized by competition), or as complementary (in the case of co-operation).[2]

To illustrate the two types of relationship features in a simple example, consider a scenario where two ports X and Y are able to separately serve the same hinterlands. Standard economic reasoning says that a decrease in the generalized cost of using port X (be this the effect of an efficiency improvement, a reduced charge or something else) is likely to lead to an increase in demand for port X and a decrease in demand for port Y. A counteracting effect would be one of complementarity; a lower generalized user cost for port X results in a lower total cost for a vessel calling at both ports X and Y, increasing demand for both X and Y. This can be termed a spillover effect or a positive externality. Naturally, the example can be generalized to a large network of ports. A change in user cost for one port will affect other parts of the transportation network, and the size of this effect is related to the intensity of the relationship between the ports.[3]

There is a rather wide body of research concerning the changing role of inter-port competition in the face of increased supply chain integration (Juhel, 2001; Notteboom, 2008; Song and Panayides, 2008). Previous research has approached the analysis of competition in the port sector from a variety of methodological approaches, including microeconomic indifference analysis (Yap and Lam, 2004), measures of industry concentration (Figueiredo et al., 2015; Hoyle and Charlier, 1995), revealed preferences of port-calling patterns (Notteboom, 2009a) and various qualitative indicators of competition (Fleming and Baird, 1999). The incentives for ports to engage in competitive or cooperative behavior has also been analyzed using game-theoretical approaches (Anderson et al., 2008; Ishii et al., 2013; Wang et al., 2012). Following a large volume on literature on estimates and determinants of operational efficiency in ports, several contributions have also studied the relationship between port efficiency, performance and competition (Figueiredo et al., 2015; Simões and Marques, 2010; Yuen et al., 2013). The spatial characteristics and

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development of port systems has been recognized as vital to the understanding of port regions (Ng and Gujar, 2009; Notteboom and Rodrigue, 2005). There has however been no attempt to model port competition using spatial dependence models, a field that has garnered an increasing amount of attention in applied economics (Anselin, 2001).

Spatial analytical tools are well suited for studying port competition for a few key reasons. Ports represent fixed areas of interconnected infrastructure interfacing seaborne and land-based modes of transportation. The market structure facing ports is widely taken to resemble monopolistic competition, though this is subject to political and economic factors. The tendency for a set of container ports to be regarded by a shipper as substitutory within a supply chain is likely determined (or rather approximated) by the distance that separates them. In other words, distance can be used as a measure for characterizing the intensity of the relationship between any set of ports. For a large set of ports, spatial econometric tools provide a variety of convenient methods for modeling relationships based on geographical data. In addition, the governance structures of European ports tend to be classifiable by region (Verhoeven, 2011).

This study estimates spatial dependence in inter-port relationships as a measure of competition within five major container port regions. It provides a theoretical contribution to the port economics literature by extending the much-researched topic of inter-port competition to a spatial econometric framework, as well as an empirical contribution by applying this methodology to well-defined segments of the European container market. As this paper is the first to treat port competition as a case of spatial dependence, it represents a novel contribution to the literature. The European port system comprises the highest concentration of ports in the world (Chlomoudis and Pallis, 2002), and the historical lack of a pan-European policy for governance of ports in the single market of the European Union poses the interesting question of how various national and regional policies governed by different interests affect the maritime transportation system. In light of recent and previous proposed frameworks for a harmonized European Union ports policy (Chlomoudis and Pallis, 2005; European Commission, 2013), it is vital to understand differences in the European port system in order to establish a desirable way to move forward.

The structure is as follows: Section 2 reviews previous research on port competition and port governance in various regions of Europe. Section 3 introduces the methodological framework, the data and the empirical model applied. Section 4 presents and interprets the results of the study, while Section 5 is dedicated to a discussion regarding the results and some limitations of the method. Finally, Section 6 summarizes the conclusions of the study.

2. Inter-port competition: theoretical concepts and institutional enablers

The term port competition is by itself very imprecise, as it may refer to a wide number of things. Verhoeff (1981) was perhaps the first to identify the complex structure of the market in which ports and terminal businesses compete, recognizing that there is competition between ports in a confined area, between ports within a larger region, and between entire regions of ports.[4] Competition among ports within regions is, according to Verhoeff, especially complex because public authorities tend to support and seek to strengthen national ports through subsidization. If a port region is then stretched over several countries, such policies may have a catalyzing impact on competition.

The literature that followed Verhoeff and other early works in port economics has tended to focus on two subtopics, inter-port competition and intra-port competition. Previous research in the former is briefly

reviewed in the next section, followed by a look at country-specific governance and regulations in Europe.

2.1. Inter-port competition

Competition between individual ports has been a subject of discussion since the early works in port economics. Verhoeff (1981) observes that ports tend to operate in a market structure that is monopolistic. Jansson and Schneerson (1982) note that demand for the services of an individual port cannot be taken as inelastic with regard to queuing times and port charges, since some shippers will call at other ports when these costs increase. For a system of ports, Jansson and Schneerson regard total demand as inelastic, which can only be the case if there is no competition from other modes of traffic (perhaps a reasonable assumption for ocean haulage, but less so for short-sea shipping). In a study of shippers' criteria for port selection in the North Atlantic, Slack (1985) finds that port infrastructure and service characteristics do not play a large role in routing decisions. Fleming and Baird (1999) note that port competition is often used as an undefined term by researchers to characterize any rivalry between ports. The authors find that competition is not necessarily an accurate characterization of inter-port relationships; some heavily invested ports may rather be interested in co-operation. In line with this, Song (2003) conceptualizes a mixed strategy of competition and cooperation (termed "co-opetition") and argues that finding a balance between these elements is crucial for ports. Hinterland contestability, structure and access are considered important factors in assessing inter-port competition (Notteboom, 2008; Notteboom and Rodrigue, 2005). In evaluating structural changes in hinterland access, Homosombat et al. (2016) show that structural changes in the location of hinterland producers are likely to have significant impact on the competitive balance between regional ports. Notteboom (2002) finds that European container ports, despite high barriers to entry, do face competitive pressures from structural changes in logistics chains, which prevent the extraction of monopolistic profits. A potential concern for policy makers with regard to port competition is that competitive incentives may lead to excessive infrastructure investments, yielding overcapacity in a port system. Treating strategic investment decisions in ports as a game theoretical problem and applying this approach to large East Asian ports, Anderson et al. (2008) find that large observed levels of investment may not be consistent with strategic evaluation. Game theoretical applications in previous research have also focused on pricing competition (Ishii et al., 2013), and it has been suggested that cooperation strategies between ports serving overlapping hinterlands may be in conflict with institutional and political factors of port governance (Wang et al., 2012). While most of the above cited research is concerned with the strategies and incentives which induce competitive behavior of ports through pricing and investment, a significant amount of related research has also focused on identifying, describing or quantifying sources of port competitiveness (Fleming and Baird, 1999; Lee and Lam, 2015).

In a theoretical examination of inter-port relationships, Yap and Lam (2004) apply indifference analysis to show that a pair of ports may be complementary or substitutory in terms of demand. To illustrate the principle of indifference analysis, it might be useful to revisit the example stated in the introductory section of this paper. For a decreased cost of calling at Port X, there will be an effect on demand for calling at Port X and the neighboring port Y. This is illustrated using a simple framework in Fig. 1, where the decrease in cost causes a change in the slope of the budget line. The effect on demand for X can be grouped into the substitution effect (SE), which is (always) negatively related to the change in the cost of X, and is shown by the increase in demand $X_0 \rightarrow X_1$. The income effect (IE), which is shown by an increase in demand $X_1 \rightarrow X_2$, is positive under the assumption that port services are not inferior "goods". The subsequent total effect on demand for Y (shown by $Y_0 \rightarrow Y_1$ and $Y_1 \rightarrow Y_2$), is positive in the case of complementarity (as shown in Fig. 1), but negative in the case of competition. In general terms, the substitutability of X for Y and vice versa will depend on the slope of the indifference curve, which is the marginal rate of substitution.

Yap and Lam exemplify the concept of complementarity in port

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[4] The terms 'range', 'region' and sometimes 'cluster' are to a certain extent used interchangeably in the literature to describe a geographical area comprising a system of ports providing access to adjacent or overlapping hinterlands. For consistency, the term 'region' is used throughout this paper.