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Deep-sea hinterlands: Some empirical evidence of the spatial impact of containerization

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ABSTRACT

Two distinct types of ports handle the French deep-sea cargo. Global ports of Northern Range and Marseilles serve a large number of overseas regions (forelands) and secondary ports mainly serve niche markets. In this paper we demonstrate that global ports serve also larger hinterlands, but their prominence over secondary ports depends on the types of cargo handled. The results of our spatial interaction model demonstrate that most of types of cargo flows are strongly constrained by distance. This indicates that, despite a deep transformation on forelands, the secondary ports subsist because they partly depend on niche markets and largely on local economies generating substantial amounts of non-containerized cargo flows. Some implications of this finding are explained.

1. Introduction: the concept of hinterland is it still relevant?

An attempt has been made to elucidate the spatial structure of French hinterlands after four decades of containerization in this study. The detailed hinterland analysis developed by Charlier (1981, 1991) is updated by extending it to the period 1995–2005 and to 95 inland regions.

We first define "hinterland" as it is central to this paper. The concept of hinterland and its overseas equivalent term "foreland" were mainly explained before containerization in the middle of 20th century (Sargent, 1938; Amphoux, 1950). Both refer to the inland areas served by ports (Weigend, 1956). As seen in Fig. 1, the hinterland of the port [|a] is an inland area [A] that delimits the points of origin and destination of maritime shipments handled by the port [a] Conversely, the foreland of the same port [a] is the set of inland areas served by the port [a] by means of maritime transportation [B, C]. By this definition, a single area [A] acts as the hinterland of one port [a] and also forms part of the forelands of other ports [b and c]. In this schematic context, the hinterland is a spatially continuous area and the foreland is a discontinuous set of land areas interconnected by maritime links. This scheme also postulates exclusive hinterlands that are spatially concentrated around ports. However, this is not always the reality. As early as 1918, Demangeon observed substantial overlap between the hinterlands of the ports of Antwerp, Amsterdam, and Rotterdam (Demangeon, 1918).

Containerization has challenged the hypothesis of captive hinterlands that are spatially concentrated around ports. Between 1960s and 2000s, container has brought important changes in liner shipping. In containers, many kinds of cargo can be transported on the same ship, and each container can be easily transferred from one means of transport to another without unpacking. Containerization leads to significant economies in handling and maritime transport (De Neufville and Tsunokawa, 1981). However, the high capital cost of container ships and handling tools necessitate a push for its maximum utilization. This push predisposes spatial concentration of freight flows at one or two big ports by region, marginalizing all other ports, as demonstrated by Mayer (1978). He observed that the combined effect of development of container shipping and the completion of interstate highway network increases the competitive advantages of main ports, also called "load centers". These ports are usually located close to large markets and/or to main maritime routes. The spatial impact of containerization has been an ongoing area of study for transportation geographers. Hayuth (1981) was the first to formalize the load center concept by developing a spatial model inspired by Taaffe et al. (1963) and Rimmer (1967). The concept explains how the development of a hub-and-spokes network leads to concentration of cargo flows in a few ports, inland centers, and transport routes. The further evolution of the port system might lead to deconcentration, when cargo shifts from large ports to smaller or new ports (Hayuth, 1981; Notteboom, 2005; Frémont and Soppé, 2007).

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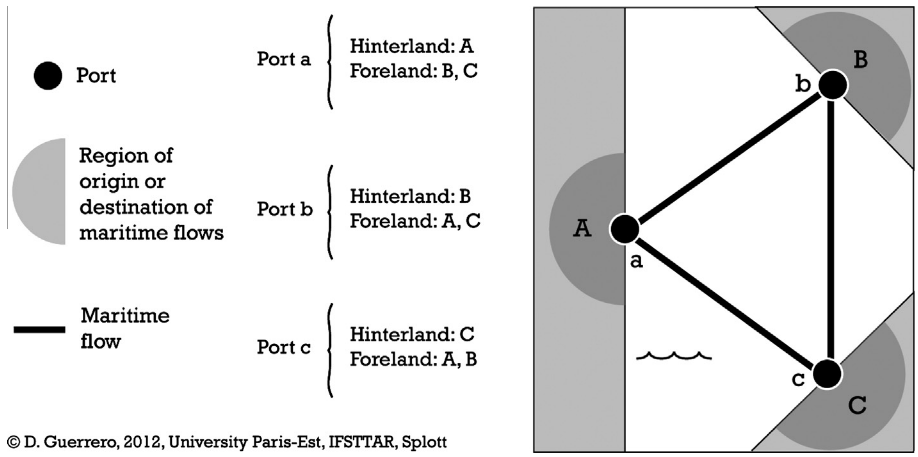

Fig. 1. Schematic representation of hinterlands and forelands.

Several regional studies provided empirical evidence for the consequences of containerization on hinterlands and forelands. Hoare (1986) found a large overlapping of hinterlands of British ports. He argued that containerization results in shippers preferring to concentrate trade and services to particular overseas destinations at particular ports. Similarly, Slack (1990) found, in a continental context of the United States, that the development of rail services across the country contributed to the concentration of an increasing share of Far Eastern Trade on the ports of the West Coast to the detriment of those of the East Coast. In both the cases, shippers attempted to minimize the maritime segment of their exports, even if it implied longer inland haulages. They reasoned that the increase of inland haulage can be compensated by overall cost saving achieved by speed of flow and through inland handling costs (Hoare, 1986). The geographic configuration of mainland Europe is different, and the distance between ports and markets is generally short, even if it were be increased by the development railway corridors to the hinterland (Van Klink and Van den Berg, 1998).

The developments discussed above clearly demonstrate that the development of containerization has transformed port hinterlands. Some scholars even go so far as to say that hinterlands "no longer matter[s]" (Hoare, 1986). Although the increase in inter-port competition as a result of containerization has been largely proved (Veldman and Bückmann, 2003; Ng and Yu, 2006), empirical investigation on the changes of hinterlands due to containerization remains scarce, largely because of lack of data. Therefore, the purpose of this paper is to study the containerization impact on port hinterlands by providing empirical evidence.

The rest of this article is structured as follows. Our hypotheses are explained in Section 2 and an overview of the data and methods used are provided. Section 3 examines how French hinterlands are shared between global and secondary ports. Section 4 introduces a spatial interaction model to measure the differences between hinterlands for different types of cargo. Section 5 explores the link between hinterland and foreland for the two main French container ports, Le Havre and Marseilles, for trade with United States and East Asia. Section 6 presents the conclusions and some implications for policymakers.

2. Analyzing French hinterlands: data and methods

When studying maritime flows at a national level, delineating hinterlands proves to be difficult. Even only if the ports located inside France are taken into account, some big ports such as Le Havre and Marseilles obviously serve wider territories. In addition, other ports located outside France (like Antwerp and Rotterdam) also handle French cargo flows.

Unfortunately, in Western Europe a large-scale geographic database of freight flows is not available as in the United States (PIERS). Empirical evidence on freight flows can be gathered only from enquiries (shippers' survey), which are not comprehensive on a EU-wide basis. For these reasons, we decided to make use of national data, although we know it is an imperfect proxy of a much wider phenomenon.

Information about freight flows is available from databases generated by French Foreign Trade Statistics Bureau, providing disaggregated and exhaustive data of the value and weight of trade (in euros and tonnes). We collected data of Foreign Trade Flows for 1995, 1999, 2003, and 2005. The advent of an internal European Union market on the January 1, 1993 that led to removal of customs formalities (the traditional source of statistical data on international trade) between Member States enforced the adoption of a new data collection system, Intrastat, as the basis for statistics on intra-EU trade. The introduction of Intrastat involved a methodological break with the past and reduced the quality of statistics. But these changes have not affected much of the customs formalities for EU trade outside EU (imports and exports). For these reasons, we made use of data available for French maritime trade outside EU. This narrows the focus of this paper to deep-sea freight flows.

The year 2005 was chosen for this study. Since 2007, with new simplifications of Customs declarations, trade data in tonnes is no more available. This development implied a lowering of data quality after 2007, since goods having the same value can have very different weights, and then be carried in a very different manner. The authors are aware that change happens in hinterlands rather slowly and therefore have decided to adopt 2005 data in euros and tonnes instead of more recent data only in euros.

The spatial units used are the *départements*, French equivalent of Chinese "*xiàn*", US counties, Japanese "*ken*", or European NUTS-3. We selected 94 mainland *départements*, excluding those of Corsica and Overseas French Territories.

Customs offices located in French ports were aggregated into ports (Fig. 2). Information about ports of foreign countries that handle French foreign trade is only available at the country level. Then, we have divided the ports into two types of entities: (a) 16 individual ports located in France and (b) 5 foreign country port sets, which handle together 98% of the value and 97% of the tonnes of French foreign trade.