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The adaptive capacity of container ports in an era of mega vessels: The case of upstream seaports Antwerp and Hamburg

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ABSTRACT

Port system development is a key theme in port geography literature. Recent decades have brought a rise in container terminal development at estuarine, coastal and offshore port locations, in part driven by scale increases in vessel size. This paper examines how container ports located upstream on rivers use processes of adaptive capacity building in an attempt to remain competitive in port systems. We link the development path of upstream seaports to a range of economic, technological, social and political factors. When combined, these factors shape the willingness and capacity of an upstream seaport to adapt to changing conditions such as an increasing demand for nautical accessibility. The case study results on Antwerp and Hamburg show that the discussion on the future of these upstream seaports cannot be detached from broader public policy and stakeholder management concerns and the influences of retention mechanisms, power, politics and collective action by the port community.

1. Introduction

A seaport is a logistic and industrial node accommodating seagoing vessels and characterised by a functional and spatial clustering of cargo transport, storage and transformation processes linked to global supply chains. The handling of maritime cargo at specialised terminals remains a core function of seaports. Seaports and their maritime freight terminals can be located on an island or an offshore location, along a coastline, in a natural bay, a delta or a river estuary, or upstream along a river. Antwerp in Belgium and Hamburg in Germany can be categorized as upstream seaports. Their terminal infrastructures have been developed entirely alongside a river, at docks directly accessible from a river and, in the case of Antwerp, also partly at dock systems connected to a river via large sea locks. Furthermore, they are located inland with a one-way diversion distance from the main coastline of 40 and 60 nautical miles respectively (1 nm equals 1.852 km). Reaching these ports by seagoing vessel requires the use of pilots to navigate long and narrow tide-dependent access channels on the rivers Scheldt and Elbe respectively. Despite their inland locations, Antwerp and Hamburg are seaports as they receive a large number of seagoing vessels and are home to a large logistic and industrial cluster focused on maritime cargo flows. Container ships are handled at state-of-the-art container terminal facilities spread out in the port area and operated by global terminal operating companies DP World and PSA in Antwerp and Eurogate and HHLA in Hamburg. Both seaports differ from river ports located further upstream along major European rivers (e.g. Rhine, Scheldt, Rhône, Elbe, Danube or Weser) as the latter only receive inland barges and occasionally small coasters.

Baird (1996) argued that scale increases in vessel size negatively affect the competitive position of upstream seaports Antwerp and Hamburg compared to neighbouring seaports located along the coastline or in river estuaries. In a reaction, Notteboom et al. (1997) pointed out that the container market shares of these ports in the so-called Hamburg-Le Havre seaport range actually increased throughout the 1980s and 1990s at the expense of coastal and estuarine rivals. In a rejoinder, Baird (1997) added that political motivation and local forces have artificially extended the lifecycle of these upstream urban seaports, thereby suggesting that the competitive position of these ports cannot be explained by looking at market logic only: “there is now less need for the largest container ships to continue to transit long and narrow inland waterways in order to call at an upstream urban port […] such vessels are unlikely to continue this practice in the long term” (Baird, 1997, p. 301).

The mentioned papers were published some 20 years ago at a time when Maersk Line introduced the Regina Maersk, the first post-Panamax container vessel with a capacity of about 7500 TEU. Ship sizes now reach about 20,000 TEU while alliance formation among shipping lines and the strong development of coastal and estuarine ports in northern but also southern Europe intensified competition.

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This paper focuses on the adaptive capacity of upstream container ports in dealing with the stress resulting from the increase in container ship size. We apply conceptual insights on adaptive capacity building by port authorities to Antwerp and Hamburg. The central proposition in this paper is that in the past decades these two upstream container ports have been able to remain competitive vis-à-vis rival ports (despite the significant nautical access challenges both ports are exposed to) by developing strong adaptive capacities combining technological, financial and human resources and a strong political and institutional setting.

The paper is structured as follows. In the first section, we analyse the evolution of container port systems through the lens of the extant traditional port development literature and more recent conceptualizations in economic geography. Then, we discuss the process of adaptive capacity building by port authorities which in the third section is applied to Antwerp and Hamburg. The last part presents conclusions and avenues for further research.

2. Insights from port system development literature

2.1. Forces of port migration away from upstream urban port/terminal locations

A port system is a system of two or more ports, located in proximity within a given area (Ducruet, 2009). They can relate to a complete coastline (e.g. the West coast of North America), a 'range' (Vigarié, 1964) such as the Hamburg-Le Havre range, and a 'multi-port gateway region' such as the Rhine-Scheldt Delta or the Yangtze River Delta (Notteboom, 2010). The development of port systems is a key theme in port geography literature (Ng et al., 2014). Early works on port system development, such as Taaffe et al. (1963), mainly focused on hinterland network development as major forces of port concentration and the degradation of minor ports. Later works pointed to processes of cargo deconcentration resulting from port activities leaving the urban core for less congested suburban or peripheral port sites (Barke, 1986). For urban ports this typically implied a development away from the obsolete facilities near the urban core to less urban locations with ample space and a better nautical accessibility (see the Anyport-model of Bird, 1971). In a number of cases the development took place further down a river as was the case in Antwerp and Hamburg. In other cases, port development moved from river sections to the coastline.

In a more extreme form, Hayuth (1981) introduced a trend towards deconcentration in port systems as a result of the 'challenge of the periphery', a concept which was empirically tested by Notteboom (2005) for Europe and Slack and Wang (2002) for Asia.

The traditional port system development literature discussed above points to underlying reasons that support a spatial shift of container port and terminal development from urban river locations to less urban locations in an estuary or along the coast:

Nautical accessibility (C1). The need for deepwater access to accommodate ever larger vessels is one of the prime reasons to look for deepwater locations, typically in an estuary or along a coastline, bay or deepwater inlet. While also many coastal and estuarine ports are challenged to dredge access channels, investments in the nautical accessibility of upstream seaports typically require larger budgets and come with more complex issues revolving around river morphology and ecology, flood protection and the disposal of (contaminated) dredged material. Puig et al. (2015) concluded that compared to coastal seaports and locations at inlets and bays, European ports located on rivers and in river estuaries rank dredging challenges (e.g. operations, disposal of sediments and sediment contamination) very high on the environmental priority list.

Location vis-à-vis maritime networks (C2). The need for locations that offer a better 'intermediacy' in liner shipping networks (Fleming and Hayuth, 1994) can push port development to estuarine and coastal locations, or even offshore. The growing sea-sea transhipment markets (hub-feeder) put additional pressure on ports. De Monie (1997) and Baird (2003) argued that the largest vessels would primarily serve offshore transhipment mega-hubs, avoiding many physically constrained traditional container ports. Much-quoted requirements for transhipment terminals include short diversion distances and costs for mainline vessels, fast turnaround times, low feeder ship cost and a smooth and easy nautical access (see e.g. Lirn et al., 2004; Baird, 2006).

Diseconomies of scale and land availability issues at established ports (C3). These concerns are echoed in the work of Bird (1971). In more recent times, the discussions also revolve around finding enough space to create new large-scale logistics zones in the framework of port-centric logistics (Mangan et al., 2008; Monios and Wilmsmeier, 2012) and free trade and economic development zones (Tiefenbrun, 2012). Moreover, port development away from urban areas might facilitate the creation of (new) congestion-free intermodal corridors to the hinterland which, particularly in the start-up phase, typically face difficulties in finding the necessary base cargo.

Port/city dynamics (C4). In an urban setting, strong tensions between port development and urban/city development can result in a move away from upstream urban locations. The matrix on port-city relations as presented by Ducruet (2005) and modified in Ducruet and Lee (2006) provides a framework to assess the risk of incurring increasing tensions between city and port. Wiegmans and Louw (2011) present a model that adds to the Anyport-model of Bird by referring to zones where conflicts between the existing land use as a port and proposed city land uses takes place. Such city-port tensions can eventually result in port migration.

Cost differentials in production factors capital, labour and or land (C5). This argument is related to C3 and C4, but specifically focuses on the role of production factors in location behaviour. High factor costs at more urban upstream locations can drive port developers and market players to look for new less urban estuarine or coastal locations.

Stronger environmental restrictions (C6) at established ports, particularly those located in urban areas or near vulnerable ecological systems, can trigger a search for other terminal locations. Given the proximity of urban cores and the associated local communities, issues of noise, air quality, energy consumption, waste management and dredging are typically scrutinized much more than in remote offshore or coastal port sites.

2.2. Forces favouring port/terminal development at upstream urban port/terminal locations

The list of forces presented in the previous section points to a decreasing attractiveness of urban container ports located in upstream river locations. Traditional port system development literature provides less clues on the processes that might favour a further development of ports in upstream urban locations. We present five forces that help to explain why upstream seaports can still have a significant role to play in port systems. These forces are based on the application of economic geography concepts to port systems and insights on market-related dynamics.

First, market players typically value some of the supply chain related characteristics of upstream urban ports, such as a closer proximity and better connectivity to inland markets provided by road, rail and or barge networks, high cluster and scale effects in cargo generation and savings in environmental costs of land transport. Port economics literature captures some of these factors driving port competiveness and port selection through port competition models, efficiency analysis, multi-criteria analysis, factor analysis and other qualitative and quantitative methods (see Pallis et al., 2011 for an extensive literature overview). Many of these studies point to generalized transport costs, transit times and service quality elements of ports in a supply chain perspective as key determinants of port competitiveness, see e.g. the Logit model results in Veldman and Bückmann (2003) and Nir et al. (2003). As seaports have evolved towards nodes in value-driven supply chains, their