Foreland-based regionalization: Integrating intermediate hubs with port hinterlands

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ABSTRACT

Development and changes in port hinterlands have received considerable attention as they represent substantial opportunities to improve the efficiency of global freight distributions. Port regionalization was a concept brought forward by Notteboom and Rodrigue (2005) to articulate the emerging port hinterland dynamics in light of containerization, supply chain management and the setting of inland terminals. This paper expands this concept by focusing on a particular dimension of the regionalization paradigm concerning the evolving role of intermediate hubs. It is argued that, in addition to hinterland-based regionalization, there is also a foreland-based regionalization where intermediate hubs capture a maritime hinterland. This intensity and viability of processes of foreland-based regionalization depend on multiple geographical, technical and market-related factors, and this paper identifies and analyzes these underlying parameters. By doing so, it assesses whether foreland-based regionalization is simply a transitional phase in port development or, alternatively, represents emerging functional characteristics of contemporary freight distributions.

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1. Introduction: the port regionalization thesis revisited

A seaport (hereinafter known as ‘port’) is defined as a transit area through which goods and people move from and to the sea. As such, ports are places of contact between land and maritime spaces, nodes where ocean and inland transport lines meet and intertwine, intermodal places of convergence (Hayuth, 1985). Ports are part of a larger system with specific spatial and functional characteristics. The concept of the foreland-port-hinterland triptych accentuates the spatial and functional ties of its seaborne leg and land leg (Charlier 1982; Vigarie 1979). While geographers have not generally agreed upon the definition of hinterland (or even upon its meaning), the hinterland of a port in early works has been defined as the area of which the greater part of the trade passes through the port (Barke, 1986; Blumenhagen, 1981; Sargent, 1938; Weigend, 1958). Hinterland, as part of the port triptych, is only defined by a group of locations connected to the port through related goods flows. In this respect, Hilling and Hoyle (1984) rightly stated that initially well-defined, even discrete, port hinterlands had become blurred, as each port generated its own momentum as competitive forces created intervening opportunities and new linkage possibilities.

Hence, a shift from captive to shared or contestable hinterlands is the result of this process. The first definition of ‘foreland’ appeared about 50 years ago, where Weigend (1958) defined it as the land area which lied on the seaward side of a port, beyond maritime space, and with which the port was connected by ocean carriers. Also, later definitions treated foreland as overseas area with which the port carried out trade (see, for instance, Barke, 1986). The strong interdependency between a port’s foreland and hinterland is very apparent when considering the rise of containerization and intermodality. Increased supply chain integration has made that the separation of foreland and hinterland relationships of a port into two neatly labeled packages representing dichotomy that is been questioned. The limits of the hinterland and the characteristics of the foreland are in effect interdependent variables which cannot be separated. The traditional approach of the port triptych has therefore been complemented in the last decades by a renewed approach viewing seaports as turntables in extensive logistics networks and as crossroads of a multitude of commodity chains (Notteboom & Rodrigue, 2008; Notteboom & Winkelmans, 2001; Robinson, 2002; Rodrigue (1999); Wang, Olivier, Notteboom, & Slack, 2007). Lee, Song, and Ducruet (2008) argued such changes had inevitably influenced the spatial structure of hub port cities, not only in Europe and North America, but also in Asia.
Since then, the development and changes in port hinterlands in relation to wider logistics networks have received a lot of attention, as they represent substantial opportunities to improve the efficiency of global freight distribution by improving its most costly segment. In this respect, port regionalization was a concept brought forward by Notteboom and Rodrigue (2005) to articulate the emerging port hinterland dynamics in light of containerization, supply chain management and the setting of inland terminals. The phase of regionalization brings the perspective of port development to a higher geographical scale, which is beyond the port’s perimeter. In discussing the functional development of the port of Rotterdam, Van Klink (1995) used the term ‘borderless mainport’ to describe the functional development from port city to port network.

Two main forces have triggered regionalization, one global and the other local. The first force concerns globalization, where regionalization enables the development of a distribution network that corresponds more closely to fragmented production and consumption systems. Supply chain management can be accommodated on the maritime side with economies of scale and frequency of service along major pendulum routes linking gateways and hubs. On the inland side, freight has to find its way to (and from) a variety of locations, which requires spatial deconsolidation (or consolidation). The second force concerns local constraints such as congestion and limited amount of land that impact port growth and expansion and which can partially be circumscribed by regionalization. Many freight activities, such as storage, that used to take place in proximity of port terminal facilities can take place further inland with the establishment of a network of inland terminals.\(^1\) Jointly, these forces are part of two phases that have transformed port systems in recent decades – the insertion of intermediate hubs and regionalization.

The port system development model as presented by Notteboom and Rodrigue (2005) can be depicted in Fig. 1. The first phases (1–4) are well evidenced by the traditional port growth theories (Barke, 1986; Hayuth, 1981; Taaffe, Morrill, & Gould, 1963). The subsequent two phases have seen noticeable transformations in the port-hinterland relationships.

Phase 5 depicts decentralization and the insertion of intermediate hubs. The growth in the volume of containerized traffic since the 1980s permitted many ports to participate as load centres, through competing over extended hinterlands when a critical mass was reached. The outcome was a relative level of decentralization along several maritime ranges. Additionally, intermediate hubs were constructed to accommodate modern containerization draughts on sites having lands for future expansions, with lower labor costs and terminals owned, in whole or in part, by carriers or port operators. In some cases, intermediate hubs were developed within offshore location – often on small islands with an implicit local cargo base. Initially, these terminals solely focused on accommodating transshipment flows, but in time, other freight distribution activities started to locate in vicinity. Nevertheless, the development of offshore hubs did not exclude transshipment activities at traditional gateway ports, where an important outcome of such development was that the amount of cargoes handled by a port was no longer strictly proportional to the number of clients within the area surrounding it.

Phase 6 consists of a regionalization phase, i.e., the integration of inland freight distribution centres and terminals with gateway ports. The outcome is the formation of a regional load centre network with an improved efficiency of inland freight distribution. Gateways achieve a higher level of synchronization with their hinterlands through specialized high capacity corridors of circulation serviced by rail or barges. Within this phase, the port system consequently adapts to the imperatives of distribution systems and global production networks while mitigating local constraints. Also, this phase is characterized by a strong functional interdependency and even joint development of a specific load centre and (selected) multimodal logistics platforms in its hinterland, ultimately leading to the formation of a regional network of load centres aimed to meet the requirements of global logistics and production networks.

In the meantime, the port regionalization model has been applied to concrete cases (see, for instance, Notteboom, 2006 for an application to the port of Antwerp). The models on port development portray a high degree of path dependency in the development of ports at a regional scale. Path dependency implies that port systems evolve by building on previous phases and ‘memory effects’, meaning that there is a level of inertia conveyed by existing infrastructure accumulation and hinterlands. In other words, port systems follow a similar evolutionary development path. This view was supported by Ng and Pallis (2007) who noted that, even within a similar generic solution, variations of political traditions and culture could result in the embeddedness of strategies within the institutional frameworks concerned. Apart from path dependency, Notteboom (2009b) also argued that port development processes showed certain degrees of contingency, where strategies and actions of market players and other stakeholders might deviate from existing development paths. Both path dependency and contingency explain why port systems around the world do not develop along similar lines or follow the same sequence of stages as suggested in the models on port system development. The result is some level of disparity among port system developments around the world.

Although Rimmer and Comtois (2009) stated there is no need for an additional sixth phase, regarding regionalization as nothing more than decentralization, we hereby argue that the regionalization phase is more than just simple decentralization which involves the expansion of the hinterland reach through a number of strategies linking the port more closely to inland freight distribution centres in a functional way. However, we do agree with Rimmer and Comtois (2009) that there is a danger of becoming too pre-occupied with the land-based network, without incorporating the realities in the maritime space. Thus, the port regionalization phase focuses strongly on the hinterland side of the spectrum, i.e., the changing dynamics between ports and inland centres towards the formation of regional load centre networks, while the issue of maritime networks and, in particular, the role of intermediate hubs in the port regionalization phase have not been thoroughly developed.

Concomitantly with the regionalization phase, transport terminals have witnessed higher level of integration within freight distribution systems, either as a buffer where they can be used for temporary storage or as a constraint inciting various forms of satellite/inland terminal use and inventory in transit practices (Rodrique & Notteboom, 2009). This emerging practice of higher integration of intermodal terminals in supply chain management reinforces the regionalization thesis, but also underlines that it looks at only one side of the maritime/land interface, with the actual role of intermediate hubs still being unclear.

For understanding this deficiency, this paper extends the concept of regionalization by looking at a particular dimension of the paradigm concerning the evolving role of intermediate hubs that are capturing maritime forelands to create added value. A distinction is made between hinterland- and foreland-based regionalization, as suggested in phase 6 of Fig. 1. After this introductory section, the next section discusses the role and

\(^1\) Within the literature, inland terminals are sometimes known as ‘inland ports’ or ‘dry ports’. For further details, see Ng and Gujar (2009), Notteboom and Rodrigue (2009a) and Rodrigue, Debreie, Fremont, and Gouvrinal (2010).
vulnerability of intermediate hubs as part of global shipping networks. After then, the foreland-based regionalization concept is introduced as a way for intermediate hubs to acquire a more sustainable position in supply chains and vis-à-vis partner ports in the networks they serve.

2. The role and function of intermediate hubs

2.1. General discussion

With globalization, the function of intermediacy has become increasingly prevalent for long distance transportation, particularly freight distributions (Fleming & Hayuth, 1994). Intermediate hubs had emerged since the mid-1990s within many global port systems: Freeport (Bahamas), Salalah (Oman), Tanjung Pelepas (Malaysia), Gioia Tauro, Algeciras, Taranto, Cagliari, Damietta and Malta in the Mediterranean, to name but a few (Fig. 2). In this regard, an abundant literature exists on the role of intermediate hubs in maritime hub-and-spoke systems (see, for instance, Baird, 2006; Fagerholt, 2004; Guy, 2003; McCalla, Slack, & Comtois, 2005; Wijnolst & Wergeland, 2008). These hubs tend to possess excellent nautical accessibilities, are located in proximities of major liner shipping routes, with some at the intersection of longitudinal and latitudinal routes to accommodate interlining/relay flows, and often possess lands for future expansions. Terminals are typically owned, in whole or in part, by carriers or multinational terminal operators which efficiently use these facilities.

Yet, the creation of intermediate hubs does not occur in all port systems, but around specific regions ideally suited for maritime hub-and-spoke distribution patterns, thanks to geographical, nautical and market-related advantages (Fig. 3). Some markets seem to offer the right conditions for the emergence of more than one transshipment hub (like the central Mediterranean), while other port systems do not feature any offshore hubs. In the US, for example, many impediments in American shipping regulations gravitating around the Jones Act have favored a process of port system development with limited (feeder) services between American ports and the absence of US-based transshipment hubs (Freeport and other ports in the Caribbean to a limited extent take up this role). In this regard, Brooks (2009) provides a good overview
of the current status of regulation on maritime cabotage in the world and its implications on domestic shipping activities. Also, Northern Europe up to now does not count any real transshipment hub, let alone an ‘offshore’ hub. Hamburg, the North-European leader in terms of sea–sea flows, has a transshipment incidence of 45.8%, far below the high transshipment shares in the main south European hubs (85%–95%, see Fig. 4). It is generally expected that the transshipment shares in newcomer ports Flushing and Wilhelmshaven might slightly exceed 40%. The only concrete plan for a real North-European offshore hub relates to a proposed transshipment facility at the natural deep-water harbor at Scapa Flow in the Orkney Islands, where Baird (2006) argued that alternative port sites (such as Scapa Flow) could provide a superior and more competitive location supporting the fast expanding transshipment markets of northern Europe. Nevertheless, other benefits of intermediate hubs, such as linking gateways, improving the connectivity of maritime shipping and acting as intermediary locations within global systems of circulation, tend to be underestimated. It is the hubbing function of intermediate terminals that requires clarification in light of their role within regional port systems. It thus appears that the regionalization thesis needs to be expanded further to better reflect the distribution strategies of the hinterland and the foreland that are connected to a port gateway.

2.2. The role of intermediate hubs in global shipping networks

Intermediate hubs emerge in places where the hub-and-spoke and interlining/relay solutions offer clear advantages over direct port calls at mainland ports. They are particularly located along the equatorial round-the-world route (Ashar, 2002; De Monie, 1997). The global beltway pattern focuses on a hub-and-spoke system that allows shipping lines to provide a global grid of east/west, north/south and regional services. The large ships on the east/west routes will call mainly at transshipment hubs, where containers can be shifted to multi-layered feeder subsystems serving north/south, diagonal and regional routes. Indeed, some containers within such a system can undergo as many as four transshipments before reaching the final port of discharge. Much of the discussion on the

![Fig. 3. World's Main Transshipment Markets, 2007.](image)

![Fig. 4. Transshipment incidence in some major container ports on the European mainland, 2007.](image)
hub port system (and consequently on regional container distribu-
tion) has focused on the deployment of large mainline vessels. Less attention has been paid to feeder vessels and to the hinterland transport modes, and yet both are fundamental in the dynamics of intermediate hubs. Part of the problem is that some ports, particu-
larly those which serve as direct port of call, or even cater for some transshipment traffic, feel that serving feeder vessels means a loss of status.

Carriers have some feeder options available: direct feeders between hub and feeder port or indirect feeders via line-bundling loops including more than one feeder port. The first strategy has the lowest transit time but typically requires more feeders and smaller feeder vessels. Alternatively, indirect feeders benefit from economies of feeder vessel size, but incur longer distances and longer transit times. Carrier’s choice between one or more direct calls at mainland load centres with the mother vessel or an indirect call via a feeder vessel is determined by factors such as the diver-
sion distance, nautical conditions (such as water draught), the volumes of containers involved, the possibility to combine trans-
shipment activities with strong cargo-generating power of the port’s regional hinterland, the related costs, port productivity and the strength of the individual carrier in the markets served (see, for instance, Zohil & Prijon, 1999).

When point-to-point markets cannot support a direct service in the container trade, shipping lines need to make decisions about transshipment locations. A wide range of literature discusses the location and selection of optimal transshipment locations (see, for instance, Aversa, Botter, Haralambides, & Yoshizaki, 2005; Baird, 2006; Fleming, 2000; Hayuth & Fleming, 1994; Lim, Thanopoulou, Beynon, & Beresford, 2004; McCalla, 2008; McCalla et al., 2005; Ng, 2006; Tai, 2005; Waals & Wijnolst, 2001) and related hub opera-
tions (see e.g. Henesey 2006). Hub-and-spoke networks would allow considerable economies of scale of equipment, but the cost efficiency of larger ships might be not sufficient to offset the extra feeder costs and container lift charges involved.

In referring to the Asian hub/feeder restructuring, Robinson (1998) argues that a system of hub ports as main articulation points between mainline and feeder nets is being replaced by a hierar-
chical set of networks reflecting differing cost/efficiency levels in the market. High-order service networks will have fewer ports of call and bigger vessels than lower order networks. Increasing volumes as such can lead to an increasing segmentation in liner service networks and a hierarchy in hubs.

2.3. The vulnerability of intermediate hubs

Intermediate hubs, as part of elaborate hub-and-spoke networks, are often vulnerable to market fluctuations. Two develop-
ments undermine the position of intermediate hubs as trans-
shipment facilities, namely: (i) container growth or decline, and (ii) new entrants to the transshipment market.

2.3.1. Container growth and decline

Port systems typically observe an increasing container volume as a result of worldwide growth in containerization. Particularly, the Asian and European container port systems have witnessed strong growth in the last decade, although volumes have plum-
meted from mid-2008 onwards thanks to the negative impacts caused by the financial tsunami (since September 2008). Container port systems typically have to cope with higher volumes on specific routes, thereby supporting the development of direct end-to-end or line-bundling services that bypass transshipment hubs. In other words, the insertion of hubs can turn out to be just an intermediate stage in connecting a region to the global liner shipping networks. Once volumes for the gateway ports are sufficient, the utility of hubs diminishes. In extreme cases, a hub can even become a redundant node in the network.

The Mediterranean Sea provides a good example where inter-
mediate hubs have contributed to the repositioning of the region within global trade flows. In the West Mediterranean, extensive hub-feeder container systems and short sea shipping networks emerged since the mid-1990s to cope with the increasing volumes and to connect to other European port regions (see Fig. 5). Termi-

nals are typically owned, in whole or in part, by carriers which are efficiently using these facilities. Here Marsaxlokk on Malta, Gioia Tauro, Cagliari and Taranto in Italy and Algeciras in Spain act as turntables in a growing sea–sea transshipment business within the Mediterranean. These sites were selected to serve continents, not regions, for transshipping at the crossing points of trade lanes, and for potential productivity and cost control. They were typically located far away from the immediate hinterland that historically guided port selection.

The market share of the transshipment hubs in total container throughput in the West Mediterranean peaked in 2004 (48.2%) but since then started to decline to 44.1% as volume growth in main-
land ports allowed shipping lines to shift to direct calls (Fig. 6). While certain shipping lines still rely on the hub-and-spoke configura-
tion in the Mediterranean, others decided to add new line-bundling services calling at mainland ports directly. Maersk Line, MSC and CMA-CGM are modifying their service patterns, giving increasing priority to gateway ports. In reaction, mainly Italian transshipment hubs are re-orienting their focus, now serving Central and East Mediterranean regions. Algeciras (stronghold of APM Terminals of the AP Moller Group) relies much on east-west and north-south interlinking and is facing competition from newcomer Tanger Med where APM Terminals has also established business recently. The net result of the above develop-
ments explains the slight decline in the market share of the West Mediterranean hubs in recent years.

2.3.2. New entrants

The transshipment business remains a highly ‘footloose’ busi-
ness mainly because along long distance shipping lanes there are several site options for intermediate hubs. Commonly, new entrants beget more competition, which promotes effectiveness, fair pricing and provides customers with more routing options. New entrants in the market also inevitably lead to a distribution of transshipment volumes over more players and nodes. There are two ways of entry with implications on existing transshipment facilities. First of all, competing shipping lines may decide, once volume has reached a certain threshold, to introduce direct services to gateway ports in the region on those links that support direct services. Such a cherry-picking strategy can pose negative effects on cargo volumes on the spokes within the existing transshipment network which may even lead to the collapse of the whole hub-and-spoke system. Secondly, new transshipment facilities may be established in the vicinity of existing hubs by competing terminal operators, shipping lines or port authorities. The introduction of a competing network solution undermines established hub-and-
spoke networks of incumbents in the region.

Consequently, bundling networks, such as hub-and-spoke systems, are vulnerable to changes in traffic volumes caused by new entrants in one or more of the spokes. The conversion of one link out of the hub-and-spoke network to a direct service due to cherry-picking by newcomers or volume increases within the network, thus negatively affects the profitability and operational efficiency within the bundling system. As a consequence, once a hub-and-spoke network is installed, shipping lines involved are continuously challenged to shifting to a (downsized) system of direct calls or line-bundling systems.
Recent developments in the liner shipping industry have revealed the weaknesses of pure hub-and-spoke systems versus multi-port itineraries. As the feasibility of a hub-and-spoke system using intermediate hubs only bears fruits at a specific level of cargo volume, the system lacks flexibility to cope with strong increases in cargo volumes or a sudden collapse in volumes (due to market entry or changes in demand). A system of more loops with smaller vessels can provide an answer to these challenges. Carriers

![Map of Mediterranean Route Deviation]

Fig. 5. Gateway ports and transshipment hubs in the Mediterranean.

![Bar chart of market shares in TEU throughput West-Mediterranean ports]

Fig. 6. The market shares of ports in the West Mediterranean. Ports grouped according to the diversion distance from the main shipping route, 1975–2008.
continuously review their strategy with respect to liner shipping networks, and this can very well introduce a tendency towards less transshipment and more direct ports-of-call even for the bigger vessels. Gilman (1999) rightly stated that the networks operated by large vessels will continue to be based on end-to-end services. Hub-and-spoke systems are just a part of the overall scene.

3. Foreland-based regionalization: in search of competitive advantages

The vulnerability of intermediate hubs is partly the result of the narrow focus of these nodes on transshipment of containers only. The terminal operators in hubs mainly compete on basic resources such as location, nautical accessibility and terminal infrastructure (post-panamax cranes) and on the terminal productivity they can offer in terms of short vessel turnaround times. These competitive sources can rather easily be imitated by competitors in neighbouring locations, thus making it very difficult to create sustainable competitive advantages. Considering that terminals are capital-intensive assets, being a hub conveys a high level of risk. Basic terminal handling activities no longer constitute the basis for competitive advantage as terminals have access to similar terminal technology (60% of the world’s gantry cranes are provided by ZPMC in Shanghai, NAVIS is a world leader in IT system for terminal operations) which makes imitation more feasible. While investigating the container transshipment market in North Europe, Ng (2006) demonstrated that the opinions of shipping lines in assessing port attractiveness seemed to be in accordance to their decisions on transshipment hub choices. By means of a Likert-style questionnaire, the study revealed that shipping lines did not just look at revenues when assessing the attractiveness of transshipment facilities, with other attributes, notably, time efficiency, geographical location and service quality also taken into considerations. In between, the importance of qualitative factors on top of infrastructure/equipment and pure cost factors was also echoed in recent studies on port selection criteria (see, for instance, Chang et al., 2008; Linn et al., 2004; Wiegmans, Van Der Hoest, & Notteboom, 2008 and Notteboom, 2009a).

Thus, we hereby argue that intermediate hubs have better chances of consolidating their positions in liner service networks if they can offer value-added services that go beyond mere transshipment activities. These services should be based on attributes which are difficult to imitate by competitors, as they rely on complex processes of continuous improvements and enhancements strongly embedded within supply chain networks. Among the activities that can be involved, container transloading and customization offer opportunities to adapt products to regional market characteristics, while keeping the advantage of mass production upstream. Depending on the concerned supply chains, certain intermediate locations may be able to integrate global production networks more effectively. For instance, a location such as Algeciras would be able to integrate supply chains having Asian, African and South American components. The hub or relay transshipment functions are thus multiplied with their closer integration within supply chain management. Also, there is an opportunity, particularly if transloading is already taking place, to interface different container leasing markets, enabling better usage of containerized assets. Hence, shipping companies can maintain their assets in constant circulation within their networks, while at the same time regional leasing companies can maintain their assets within a more bounded, but also more flexible (like demurrage) market. By doing so, repositioning costs are also consequently reduced. Another multiplier can be the possibility to custom-clear cargo bound to a regional market at the intermediate hub, particularly if the hub is within the same trading block such as the EU, NAFTA or ASEAN.

If a core competence is based on a complexity of technologies and skills, it will be difficult for competitors to imitate. Therefore, it will have a higher probability of generating competitive advantages and less vulnerable position for the intermediate hub concerned. Depending of regional geographical characteristics, namely deviation from shipping lanes, there are several reasons why intermediate hubs are likely to play more important roles that go beyond conventional hub-feeder, interlining and relay functions. First of all, economies of scale in shipping have reached a level seriously undermining the serviceability of some ports, even those with significant hinterlands. Hubs offer advantages of consolidation, while the consolidation of flows in a hub allows the development of artery routes served by large mainline vessels. In fact, the recent economic downturn due to the financial tsunami can actually help hubs, in the sense that shipping lines are looking for considerable savings (given the nearly-immediate drop in freight rates, so they have strong incentives for savings through route optimization.

Secondly, intermediate hubs are increasingly aware of the vulnerability of the transshipment business since bound to the strategies of shipping lines (cf. Ng, 2009). In essence, transshipment and relay/interlining traffic are linked to the decisions of shipping lines with regard to liner service network optimization. In principle do not take place due to shippers’ requirements. However, the development of transshipment activities can give incentive to shippers to re-design their own distribution networks. This leads to strategies at extracting more values from cargo passing through stronger anchoring within the regional port system. For example, the development of distribution networks centered on main distribution facilities near the hub (value-added logistical activities) generates additional cargo flows to shipping lines. Hubs with a local cargo base can have additional edges here when compared to ‘offshore’ locations, as the former are in a position to combine the transshipment/relay/interlining functions with gateway functions.

On the maritime segment, economies of scale and regional hinterland access need to be better reconciled. The concept of foreland-based regionalization refers to the integration of intermediate hubs in regional shipping networks, where the maritime foreland of the intermediate hub is functionally acting as a hinterland (Fig. 7). For various reasons, for instance, deviation, small volume and niche hinterland, some ports are not that well-connected to the global long distance shipping network and show limited opportunities to improve this connectivity, as shipping companies must consider effective configurations of the networks that tend to focus on major gateways and intermediate hubs. The intermediate hub enables a level of accessibility and such accessibility incites them to look beyond their conventional transshipment role. This includes actions to extract more values of cargo passing through and, as such, get more economic rents out of transshipment facilities. Such strategies have led to some transshipment hubs, such as Gioia Tauro and Algeciras, to develop inland rail services to capture and serve the economic centres in the distant hinterlands directly, while at the same time trying to attract logistics sites to the ports. The multiplying effects of being an intermediate hub in terms of frequency of port calls and connectivity to the global economy can thus be leveraged for developing hinterland activities.

Theys, Ryoo, and Notteboom (2008) developed a model for determining seaport-located logistics activities. Their empirical application to the port of Busan demonstrated that, in case ports were involved in providing logistics services to transshipment cargo, hinterland characteristics remained fundamentally important in terms of logistics attractiveness. First of all, if ports were serving both their own hinterland as overseas markets, the extent
to which a corridor was developed would influence the number of logistics facilities in the port that served their own hinterland markets. For poorly developed hinterland corridors, the port would ideally be located for logistics facilities targeted to the hinterland, on top of the logistics centres that were already based in the port area for serving overseas markets. On the other hand, in case of well-developed corridors, logistics facilities for import/export cargo might move closer to consumption and production areas in the hinterland. Secondly, the hinterland connections of (smaller) ports that were served by feeder connections also affected the location possibilities that companies had for logistics facilities. When a port transshipped cargoes to smaller ports with a poorly developed hinterland, economies of scale and scope would make this port particularly attractive for locating logistics facilities targeted to those overseas areas. Thus, the overseas port and their hinterlands would likely have relatively few logistics facilities. In contrast, when the overseas port had strongly developed corridors serving larger parts of its own hinterland, that port actually reduced the logistics attractiveness of the port through which it was feeding. Logistics facilities would then be located either in the area surrounding the overseas port, or in its hinterland. Over time, when cargo throughputs in such ports increased, they might be directly served.

However, ports often tend to prefer direct ship calls within long distance pendulum networks. Hence, unsurprisingly, some smaller gateway ports are not eager to become part of foreland-based regionalization strategies, given the risk of confirming their secondary or minor role within the global shipping network. However, it is not always logistically feasible since port volumes may not justify sufficient frequencies. The positive outcome of foreland-based regionalization is that it enables the system to support a level of traffic which otherwise would not be feasible, considering the network configuration of shipping companies. Shippers must provide a network structure to cope with economies of scale and intermediate locations minimizing deviation from major shipping lanes, with geography playing significant roles in combination with liner network dynamics. Hence, foreland-based regionalization is a step forward in reconciling the operational characteristics of forelands and hinterlands.

4. Foreland-based regionalization: reconciling forelands and hinterlands

Shipping and inland freight distribution have evolved at two different momentums, both improving the level of functional and geographical integration of the global economy. Containerization has attained a large diffusion within supply chains and several niche markets, namely commodities, still have potentials for development. Still, the role of shipping in global supply chains remains to be further considered within the economic and transport literatures, with the design of liner shipping networks and hinterland networks are strongly intertwined (Notteboom, 2004). In the past, shipping lines were able to limit ports-of-call partly due to advances in large-scale intermodal transportation combined with absorption pricing systems, but the load centres were only as competitive as the inland and relay links that connected to it. The optimal network design is not only function of carrier-specific operational factors, but also of shippers’ needs (in terms of transit time and other service elements) and of shippers’ willingness to pay for a better service. The more cost efficient the network becomes from a carrier’s perspective, the less convenient that network could be for the shippers’ needs in terms of frequency and flexibility. As indicated by Fig. 8, there is a growing disparity between the maritime and inland sides of the freight distribution equation as traffic volumes reach a certain level. Economies of scale of shipping are a logical process, particularly as volumes increase, leading to larger loads between ports of call. Such a process is less clear for inland transportation as containerized freight must be broken into much small loads due to geographical fragmentation of production/consumption and supply chain management. At some traffic levels, diseconomies of scale have resulted in congestion, difficulties to meet expected levels of service and higher costs.

Any change, let it be market or technical, challenges the balance in terms of capacity and level of service between forelands and hinterlands. It also forces additional strategies to reconcile them, particularly if a change has impacted one system more than the other and thus led to additional imbalances. Over this, the full
impact of a new class of containerships above the 10,000 TEUs threshold is subject to much speculation, notably their impacts on the reducing number of ports-of-call and on the configuration of shipping networks, certainly not helped by the economic downturn since mid-2008. While hinterland-based regionalization has allowed inland freight distribution to keep up with volume and network configuration changes within shipping, the new imbalances brought by new mega containerships may reinforce foreland-based regionalization.

At a regional level, several small or medium-sized ports may realize that it is in their long-term interests to have a higher level of integration with an intermediate hub, even if it comes at the expense of shorter distance pendulum services calls. Foreland-based regionalization can support export-oriented strategies with a better connectivity of more marginal (or in their early stage of growth) ports to global shipping networks and thus international trade. There are also site constraints, environmental factors or simple market potentials that may limit the volumes generated by the hinterlands of some ports.

On the intermediate hub side, the volatile long distance transshipment traffic would be complemented with a more stable and secure regional traffic. Both the foreland and the hinterland are mutually self-reinforcing, as hinterland stability can anchor the volatility of the transshipment function, particularly in light of footloose operators. A better reconciliation between forelands and hinterlands would help to insure that returns on investments are higher; subject to less fluctuation and improving competitiveness of maritime ranges.

The reinforcement of regional economic integration through trade agreements could lead to a better recognition of intermediate hubs within a common international trade and transport policy. The intermediate hub, through foreland-based regionalization, could become a functional gateway (port of entry) where shipments are cleared through customs before reaching its final ports of destination by a feeder service. Such a strategy would also help anchoring added-value activities at intermediate hubs, such as free trade zones, at a traffic level that would promote the cost effectiveness of regional distributions.

While foreland-based and hinterland-based regionalization can co-exist in the same region, each port system shows a dominance of one of the two approaches. A few examples can be discussed:

- The container ports in the Baltic Sea in Europe rely on a foreland-based regionalization model to get access to major trade routes. The major container ports along the Hamburg-Le Havre range, i.e., Hamburg, Bremerhaven, Rotterdam, and to a lesser extent, Antwerp, Zeebrugge and Le Havre serve as intermediate hubs. Mainline vessels call at these main ports while the Baltic ports receive the connecting feeder services. The observed routing practices are a result of the long diversion distance to Baltic ports for mainline vessels and the limited nautical accessibility of the Baltic Sea (Baltimax vessels). As container volumes within the region grow strongly, major Baltic ports such as St. Petersburg in Russia (1.66 million TEUs in 2007), Kotka in Finland (570,000 TEUs) and Gdynia in Poland (614,000 TEUs) are among the ports aiming for direct calls of deep sea vessels. Up to now, the market continues to rely on the hub-and-spoke solution centered on the intermediate hubs in the Hamburg-Le Havre range. The existing model goes hand-in-hand with the establishment of major European Distribution Centers (EDC) in the Benelux countries (near the main ports Rotterdam, Antwerp and Zeebrugge) and in the northern part of Germany. These EDCs also serve the Scandinavian and Baltic markets, mainly via the existing feeder networks. The port of Aarhus in Denmark and Gothenburg in Sweden, both situated near the entrance of the Baltic, have ambitions to increase their intermediacy role, both in maritime services and logistic activities, between the overseas markets and the Baltic;

- Next to their intermediacy vis-à-vis the Baltic port system, the main ports in the Hamburg-Le Havre range rely heavily on hinterland-based port regionalization strategies to serve the hinterland regions in Western-Europe and Central- and Eastern-Europe. Respective port authorities have established task forces together with various stakeholders (carriers, shippers, transport operators, labor and government bodies) to identify and address issues affecting logistics performance and
to enhance collective actions and coordination (see also Van der Horst and De Langen 2008; De Langen and Chouly 2004; Notteboom 2006, 2008) with port authorities acting as facilitators. Apart from port authorities, other organizations are also adopting facilitating roles in port regionalization issues (cf. representative bodies such as Alfaport in Antwerp and Deltalinqs in Rotterdam);

- Among the major trade gateways of Pacific Asia (Fig. 9), two major port clusters are dominated by hinterland-based regionalization where transshipment traffic is more limited: Hong Kong and Shanghai. This conventionally fits the export-oriented strategies of the major manufacturing clusters along China’s coastline, with facilities located in proximity to port terminals to insure an efficient access to global shipping networks, as hinterland’s access tends to be poor. There is also the emergence of a foreland-based regionalization with three major intermediary hubs linked to an array of smaller ports—Busan, Kaohsiung and Singapore. The intermediary roles of Busan and Singapore are reinforced by a detour index that the Yellow Sea and the Gulf of Thailand respectively impose on pendulum services. Supply chain integration set in place by FDIs (e.g. Korea/Northern China and Taiwan/Central China) also favors the use of the national intermediary hub. Also of significance are the prospects of economic integration, which can lead to the reconfiguration within certain regional shipping networks, such as ASEAN. Last but not least, it remains to be seen if the re-establishment of direct shipping links between Taiwan and Mainland China (since December 2008) will favor a foreland-based regionalization with Kaohsiung being the main hub, but this seems a likely possibility considering the existing high level of economic integration and the importance of Taiwanese shipping lines (like Evergreen).

5. Conclusions: an unfolding paradigm?

The evolution of the role and function of intermediary hubs has resulted in a process that has been defined as foreland-based regionalization, which is the integration of intermediate hubs in regional shipping networks, where the maritime foreland of the intermediate hub functionally acts as a hinterland. Doing so insures greater traffic stability at the intermediate hub and enables smaller port to have access to global shipping networks.

In addition to the conventional risk of footloose operators switching traffic to another intermediate hub, market change risks (such as lower volumes) underline the need for intermediate hubs to mitigate these risks through a higher integration with their feeder ports. Concomitantly, there is growing evidence that containerization is entering a phase of maturity (Notteboom & Rodrigue 2009b), where future volumes are likely to grow at a lower rate than previously observed, a trend reinforced by global recessionary forces that have been unfolding since 2008, forcing carriers to re-consider their shipping networks. Reducing shipping rates, as well as lower cargo volumes along several pendulum routes, serve as strong incentives to drop some lower volume ports-of-call and place greater emphasis on a hub-feeder structure for regional freight markets. By doing so, service frequency can be maintained through fewer assets. In this context, foreland-based regionalization can become a more important strategy of regional competition within global freight distribution systems than it currently is.

Several issues remain to be addressed to substantiate the foreland-based regionalization thesis. In particular, smaller ports may be reluctant players in such a system, as it can be perceived that it would limit their growth opportunities and capacities. Ports, whatever their size, aim at direct calls and some could attempt to also become an intermediary hub. In the present port competitive framework, smaller, notably container, ports are also frequently tempted to making speculative investment decisions without any degree of assurance that traffic will increase and shipping lines will retain their loyalties. Their only belief is that a lack of investments will certainly not increase traffic (Slack, 1993). Such supply-driven strategies could lead to overcapacity and a more vulnerable intermediate hub, since regional competition is more acute to secure this role. Thus, a good strategy for smaller ports is to link to more than one hub, providing more robustness in the network with improved flexibility in freight distribution, as well as a better synchronization between regional and global traffic flows.

Finally, there is also the question pertaining to if foreland-based regionalization is simply a transition phase in port system development. There is evidence that it may not be the case and that foreland-based regionalization would be a distinct phase on its own. The massification of flows linked to vessel sizes leaves limited options outside major gateways and hubs and the prospects of higher energy prices would also favor intermediate locations, as higher capacity and lower speed would be a characteristic of long distance shipping. Since shipping companies and port operators are likely to continue making sound investment management decisions, the emergence of intermediary hubs and the foreland-based regionalization they entail appears to be a conscious decision to establish, when suitable, such a network configuration linking regional and global shipping networks. Thus, further research should be done to measure the performance and efficiency of foreland-based regionalization. Network-related indicators, such as transshipment percentage and connectivity via relay/interlining operations, obviously provide first indications of the reliability of a port system on intermediate hubs. However, empirical work on the foreland-based regionalization concept demands more and new indicators to measure the vulnerability of intermediate hubs in the network and the capacity of the hubs to extract economic rent through the development of value-added logistics services. The ideas and concepts proposed in this paper can thus be pivotal in shaping the direction of port evolution and development patterns in the post-2008 world.

References
