

# Ports, peripherality and concentration – deconcentration factors: a review

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## Abstract

**Purpose** – The purpose of this paper is to review the literature on peripheral ports, hub ports and concentration – deconcentration factors. This is an issue, as investments in port development in more peripheral locations are challenging due to the difficult financial situation currently faced by the maritime industry.

**Design/methodology/approach** – This paper presents a narrative literature review focusing on peripherality in the context of seaports and transport. Moreover, it gathers the reasons why ports concentrate–deconcentrate, and how these factors evolve over time.

**Findings** – This paper develops a future research agenda for peripheral ports.

**Practical implications** – The paper provides insights for ports in developing countries in their efforts to upgrade their port facilities and infrastructure.

**Originality/value** – This paper contributes to the research on ports in peripheral locations which have been under studied compared to larger hub ports.

**Keywords** Concentration, Hub, Deconcentration, Peripheral, Peripheral port challenge

**Paper type** Literature review

## Introduction

In the twenty-first century, developing countries and emerging markets are becoming more involved in global trade. They have become both major exporters and importers of raw materials, are global manufacturers and are a growing source of demand for finished products. This has further driven increases in seaborne trade and an increased demand for maritime transport (UNCTAD, 2015). Moreover, developing economies are contributing to greater port competition. China, as a leading manufacturer and influencer of world maritime markets (Lee and Rodrigue, 2006), had 11 ports in the top 30 world container ports in 2014 (Containerisation International, 2015). Other emerging economies have not only expanded their ports to meet demand but have also tried to improve their opportunities for becoming hubs for their region by increasing transshipment activities. Examples include emerging ports in Mexico (Nelson, 2005), South American countries (Wilmsmeier *et al.*, 2010; McCalla, 2008), Turkey (Bloem *et al.*, 2013), Western African countries (Van Dyck, 2015, Gohomene *et al.*, 2016), South African countries (Fraser *et al.*, 2016; Notteboom, 2011), ASEAN countries



(Talib, 2008, Wiradanti *et al.*, 2016) and other ports in the Asia-Pacific region (Unescap, 2007).

However, the maritime transport industry is also currently facing a difficult situation. The continued recovery from the 2008 economic crisis, the slowdown of global economic growth as a consequence of China's slowdown, changing trends in the use of fossil fuel and an oversupply in container shipping capacity have resulted in continued downward pressure on container freight rates (Thanopoulou and Strandenes, 2015, UNCTAD, 2015, Porter, 2016). Therefore, investing in the development of ports in more peripheral locations in developing economies needs to be considered in more depth.

The development of hub ports and their relationship with peripheral ports has been discussed, as the "Peripheral Port Challenge" concept proposed by Hayuth (1981). This study looked at containerisation in the ports of the USA in the 1970s, and argued that eventually a "peripheral port challenge" will happen as a result of "maturity" in the port system.

Hayuth stated that:

The port system structure reaches a greater "maturity," marked by more established ocean trade route networks and inland distribution systems and by a fairly stable hierarchical port structure. The load centres continue to dominate the container traffic; however, the challenge of the dominant ports by some of the smaller ports intensifies. (Hayuth, 1981, p. 165).

Hayuth's (1981) work triggered further studies on deconcentration, confirming the peripheral port challenge existed in other regions of the world. Concentration and deconcentration factors were identified by port researchers to understand the reasons why agglomeration or dispersion of cargo volume happens between hub and peripheral ports. Ducruet *et al.* (2009b) explains concentration as a result of path-dependency of large agglomeration from port cities, e.g. New York and efficient load centres e.g. Hong Kong, while deconcentration is the consequence of new port development, carrier selection, global operational strategies, governmental policies, congestion and lack of space at main load centres. Analysing studies from 1963 to 2008, Ducruet *et al.* (2009b) compiled these factors and argued that there was a shift from concentration to deconcentration studies. Even so, literature written from the point of view of the periphery is still under-studied. Considering the aforementioned situation in maritime transport and the need to update recent studies, a comprehensive review is therefore necessary. Thus this paper reviews literature on peripheral ports and its relation to container hub ports. In updating the concentration and deconcentration factors compiled by Ducruet *et al.* (2009b), the aim is to understand how these factors evolve over time and identify a future research agenda in respect of peripheral ports. This paper is divided into four sections. First, definitions of peripherality are provided, second, concentration and deconcentration factors relating to container hub ports are discussed. In the third section, issues regarding both peripheral and hub ports are assessed. The final sections details the conclusions and agenda for future research.

### Methodology

A narrative literature review was conducted which is useful for obtaining a broader perspective of the issues, appropriate for describing the history or development of a problem and its management, and identifying future research areas from identified gaps in the existing literature (Baumeister and Leary, 1997, Cook *et al.*, 1997, Green *et al.*, 2006, Cronin *et al.*, 2008). This fits with the aim of this paper, especially concerning peripheral ports, as peripherality in a wider context beyond seaport and transport studies also needs to be considered, for example in geography, transport policy or economics.

To present the findings of a literature review in a clear and consistent way, the review should be framed into categories such as themes, methodological categories, theoretical/empirical type or in chronological order (Cronin *et al.*, 2008, Carnwell and Daly, 2001). In port literature, examples of a chronological review are Beresford *et al.* (2004) describing transition process and development of European ports from the 1960s to 2000s, and Lee *et al.* (2008) describing evolution of port issues in Western and developing countries. In this paper, concentration and deconcentration factors are divided into a time continuum for the periods 1970-1990, 1990-2008 and after 2008. These periods are important in the maritime industry, as they reflect respectively the period of early container adoption, the growth of containerisation and improvements in shipping technology, globalisation and after the 2008 economic crisis.

### Peripherality

The Oxford Dictionary (2016) defines peripheral as relating to or situated on “the edge”. In economic development literature, the periphery is seen as the other extreme of the core, while in “Dependency Theory”, the whole world is seen as series of “constellations” which consist of metropolises and satellites cities (Frank, 1967, pp. 146-7 cited in Knox and Agnew, 1998; MacKinnon and Cumbers, 2011). Metropolitan areas at the core exploit their “satellites” which were established historically; hence, development in one place requires underdevelopment somewhere else (MacKinnon and Cumbers, 2011; Knox and Agnew, 1998).

In “World-System Theory”, the world economy is an evolving market system in a form of a three-level hierarchy: core, semi-periphery and periphery (Wallerstein, 1984 cited in Knox and Agnew, 1998). The “core” are countries who have capital, operate processes involving relatively high wages, advanced technology and a diversified production mix, while the “periphery” involves the opposite of that and “semi-periphery” involves a mix of the two extremes (Wallerstein, 1984 cited in Knox and Agnew, 1998). This point of view claims the gap between the core and the periphery is increasing, both in developed and developing countries (Erkut and Özgen, 2003; Hopkins and Wallerstein, 1996). However, Friedmann’s core-periphery model representing regional urban and transport systems, argues that spatial inequalities eventually reduce, and a functionally integrated urban system will emerge (Friedmann, 1966 cited in Rodrigue, 1998).

In the context of geography, Langholm (1971) expressed “centrality-peripherality” as a denomination of remoteness and accessibility. Ball (1996) constructed peripherality as limited access to transport networks and to the market. Copus (2001) explained periphery as remoteness from the main centres of economic activity and population. Meanwhile, Bickerstaff *et al.* (2006) mentioned that both peripherality and marginality means remoteness, with a clear distinction that “peripherality” relates more to political-economic issues and “marginality” more to sociocultural issues.

In economic geography, the New Economic Geography concept uses core/centre and periphery terms to differentiate locations into the manufacturing role (the core) and agricultural role (the periphery) (Krugman, 1991b; Krugman, 1991a; Krugman, 1998). It also explains that the core-periphery pattern is a result of economies of scale, transportation costs and manufacturing’s share in a national income (Krugman, 1991b). Moreover, in economics, Swyngedouw (1992) analysed the work of Marx (1977) and argued that space or location is a pattern of spatial configuration which should be taken account of in the political-economic processes. Erkut and Özgen (2003) argue that economic peripherality leads to spatial peripherality. However, the concept of peripherality not only relates to spatial-economic aspects. Copus (2001, p. 543) argued that traditional indicators of

peripherality in economic gravity models are not enough (e.g. GDP, employment and economic structure). Other reasons less related to location such as advancing information technology, business, institutional networks, etc., are aspatial aspects which affects peripherality (Copus, 2001).

*Peripherality in transport and maritime transport contexts*

From a transport perspective, Knowles (2006) argues that peripherality has been increasing through innovations in transport such as the development of hub and spoke systems and shipping technology. Hubs are “special nodes that are part of a network, located in such a way as to facilitate connectivity between interacting places” (O’Kelly, 1998, p. 171). Hubs are “articulation points” or connections (Robinson, 1998). A location holds the role of a “transportation hub” if the problem consists of three locations, or in other words, having a hub in between two locations is not reasonable (Krugman, 1993).

The hub–spoke terminology was first used in the airline service, particularly in the USA, emerging from deregulation in the late 1970s, with players having the freedom to determine their own route structure and prices (Borenstein, 1992, Hendricks *et al.*, 1997). Since the 1980s, “hubbing” operations have been established by all modes of transport, using, for example, post-Panamax ships, wide-bodied airplanes and double stack rail, to take advantage of economies of scale (Slack, 1999). The impact of hubs is the “bundling” of flows (Bryan and O’Kelly, 1999), higher traffic/freight concentration from more market areas compared to point-to-point services and larger facilities that needs to be provided by terminal operators such as seaports, airports and rail yards (Slack, 1999). “Centrality” and “intermediacy” are spatial qualities of transportation hub location (Fleming and Hayuth, 1994), hence being peripheral is the opposite of the aforementioned.

Besides being affected by the hub system, peripheral could also be seen to mean an unfavourable location. Ports in more peripheral locations have less bargaining power in the market because ports in prime location have options in negotiating with a variety of shipping lines (Heaver *et al.*, 2005). Wilmsmeier and Monios (2013) brought the work of Swyngedouw (1992) to the port context, showing that peripheral ports are the opposite of ports having a “favourable location”. The “unfavourable location” could be compounded by political-institutional factors, as in the case of Scottish ports suggested as having double peripherality (Monios and Wilmsmeier, 2012) where ports are becoming more peripheral and less important because the UK Government favours developing south-eastern ports, relying on land transport rather than supporting the development of infrastructure and policy for Scottish ports (Monios and Wilmsmeier, 2012).

Another way to consider peripheral ports is their position compared to large hub ports in a hierarchy. Hayuth (1981) describes a “port hierarchy” as level of difference between larger and smaller ports during the initial adoption of containerisation. The larger ports in the hierarchy are those with superior physical infrastructure, open to outside information, having large cargo handling and having capital for investment, hence having the ability to develop new container handling facilities (Hayuth, 1981). Smaller ports, being more peripheral, are those “desperate” for cargoes and trying to improve their position in this port hierarchy (Hayuth, 1981). Meanwhile, Robinson (1998) argue that the hierarchy is based on efficiency and cost. Increasing container volumes trigger ports to invest in more capacity and ships to invest in larger capacity for reduced per unit costs, hence the network becomes more pressured and restructured into a hierarchy or order (Robinson, 1998). At higher levels in the hierarchy are port–shipping networks with high efficiency/high cost operators which turns into “mega-terminals”, while at lower levels are a mix of hub and direct-call ports focusing on different market segments. The lowest level of ports in the hierarchy act as

feeder ports (Robinson, 1998). Moreover, Ducruet (2008) argued that the port hierarchy is divided into three categories: ports having a low degree of peripherality are load centre ports, a medium degree of peripherality secondary ports and the highest degree of peripherality are the peripheral ports. This high degree of dependence means that peripheral ports are connected to the rest of the world through a main hub, and unable to handle their own traffic which is carried by smaller vessels through feeder services.

Peripheral ports can also be identified generally by their size. Remoteness itself leads to low volumes for carriers or shipping companies, resulting in increasing costs of liner calls arising from an imbalance of cargo (Dunbar-Nobes, 1984). There is no exact threshold in volume or distance from existing hubs determining peripheral status. However, being small means ports are likely to have a range of problem to deal with. They have to make sure investments to develop and modernise infrastructure and facilities are justified with their low volume (Dunbar-Nobes, 1984, Notteboom, 2005). They have their own roles as “local terminals” which are just as important as large hub ports (Notteboom, 2005). While they are not considered important for the maritime network and international trade, they are important in terms of trade and economic benefits for their own region and hinterland (Bryan *et al.*, 2006, Wang and Slack, 2004, Mangan and Cunningham, 2000).

#### *Potential change in the peripheral status of ports*

Ports being peripheral does not mean that they will necessary stay peripheral permanently. A region's economic development depends on its port's facilities; however, the fortune of the port itself in the long term is determined by its hinterland's trade (Sargent, 1938, cited in Hilling and Hoyle, 1984). Therefore, a port grows as trade in its region grows, as stated by Sargent (1938) that “in the beginning the harbour made the trade; but soon the trade began to make the harbour” (cited in Hilling and Hoyle, 1984). Ports are “a dynamic phenomenon” because their character, functions or status in a hierarchy is likely to be altered by a variety of factors (Hoyle, 2000). Pettit and Beresford (2008) shows that the UK's western ports such as Cardiff, Newport and Liverpool, declined from the 1960s and were perceived as geographically disadvantaged as the fortunes of the southeast ports increased. Eventually after the 1990s, throughput in these ports started to grow by securing individual contracts and managing their business well (Pettit and Beresford, 2008). Another example is the rise of Chinese ports with increasing direct calls as a result of infrastructure expansion and hinterland penetration from inland cities (Ducruet *et al.*, 2010).

Definitions of peripherality and peripheral ports are summarised in Table I, and the larger picture is that there is an underlying hierarchy describing a structure of interrelated ports. Therefore, this study proposes a definition of peripheral ports as follows: *Ports which handle small cargo volumes, which have limited economies of scale, which are distant from major markets, and which have limited access to economic centres, markets or production centres, hence becoming non-preferred ports of call by large shipping companies and dependent on larger hub ports by feeder services.*

#### **Concentration and deconcentration factors**

Concentration and deconcentration factors explain why ports across the world agglomerate in a particular location. This section identifies additional factors to those described in Ducruet *et al.* (2009b), and also categorises the factors in order to identify patterns and explain how they evolve over time. Concentration itself can be seen in terms of both a general perspective and transshipment-base perspective. From a general perspective concentration describes the agglomeration of ships and cargoes moving through a particular gateway, load centre or hub port. Thus concentration can be seen in the port's general

| Context                                    | No | Definition of peripheral  | Source   |
|--|----|---|--|
| General, development, geography, economics | 1  | Situated on the edge  | Oxford Dictionary (2016)   |
|  | 2  | Less developed, the edge of a constellation or bottom of a market hierarchy, where the peripheral is supporting the core      | Frank (1967 cited in Knox and Agnew, 1998); Wallerstein (1984 cited in Knox and Agnew, 1998) |
|  | 3  | Core–periphery representing regional urban systems which is equal to regional transport systems                               | Friedmann (1966 cited in Rodrigue, 1998)   |
|  | 4  | Gap between core–periphery increasing   | Hopkins and Wallerstein (1996)   |
|  | 5  | Remoteness and inaccessibility to transport network, market, economic, population centre                                      | Langholm (1971); Ball (1996); Copus (2001); Bickerstaff <i>et al.</i> (2006)                 |
|  | 6  | Core–periphery pattern is a result of economies of scale, transportation costs and manufacturing's share in a national income | Krugman (1991b)  |
|  | 7  | Aspect of location to be considered in political–economic processes   | Swyngedouw (1992)  |
|  | 8  | Economical peripherality leads to spatial peripherality   | Erkut and Özgen (2003)   |
|  | 9  | Aspatial aspects related to peripherality   | Copus (2001)   |
| Transport, maritime transport              | 1  | Peripherality becomes worse with the advancement of innovations in transport  | Knowles (2006)   |
|  | 2  | The opposite of centrality and intermediacy, not strategic  | Hayuth (1981); Fleming and Hayuth (1994)   |
|  | 3  | Unlike prime locations, peripheral ports have less bargaining power   | Heaver <i>et al.</i> (2005)  |
|  | 4  | Unfavourable location, ports competing with other transport modes or other ports  | Monios and Wilmsmeier (2012); Wilmsmeier and Monios (2013)                                   |
|  | 5  | Being feeders at the lowest port hierarchy based on efficiency and cost   | Robinson (1998)  |
|  | 6  | The degree of being hub dependence in the maritime network  | Ducruet (2008)   |
| Seaports                                   | 1  | Small in size, desperate for cargo  | Hayuth (1981)  |
|  | 2  | Low volume or throughput  | Dunbar-Nobes (1984)  |
|  | 3  | Should focus on their own role  | Notteboom (2005)   |
|  | 4  | Less importance for the maritime network but important for their region or hinterland   | Bryan <i>et al.</i> (2006), Wang and Slack (2004), Mangan and Cunningham (2000)              |
|  | 5  | Peripherality status could change   | Sargent (1938 cited in Hilling and Hoyle, 1984); Hoyle (2000), Pettit and Beresford (2008)   |

**Table I.**  
Definitions of peripherality and peripheral port

**Source:** Author

throughput without considering their transshipment activities. Detailed measurements can be used to identify issues such as inequality (using the Gini index), Concentration Ratios (Herfindahl–Hirschman index) and Shift–Share analysis (Notteboom, 2006b, Kuby and Reid, 1992, Wang and Ducruet, 2013, Pham *et al.*, 2016).

Meanwhile from a transshipment-based perspective, agglomeration can be calculated by measuring factors such as the transshipment cargo rate (Huang *et al.*, 2008), the percentage of transshipment on total throughput (Notteboom *et al.*, 2014), where ports are categorised into pure transshipment hubs (transshipment incidence above 75 per cent per cent), mixed ports (between 50 per cent per cent-75 per cent per cent) and gateway ports (below 50 per cent per cent). Figures 1 and 2 detail concentration and

Ports,  
peripherality and  
concentration

| Period-1: 1970-1990  | Period-2: 1990-2008  | Period-3: After 2008  |
|--|--|---|
| <ul style="list-style-type: none"> <li>Development of load centres, consolidation, intermodal facilities<br/>Hilling (1977), Hayuth (1981), Hayuth (1982), Slack (1985), Slack (1990)</li> </ul> |  |   |
| <ul style="list-style-type: none"> <li>Port city dominance<br/>Kenyon (1970), Ogundana (1971)</li> </ul>   | <ul style="list-style-type: none"> <li>Port city dominance and existing hub dominance<br/>Hoyle (1999), Brunt (2000), Ducruet (2008)</li> </ul>  | <ul style="list-style-type: none"> <li>Hub port cities, reputation of large existing hubs, market power<br/>Lee and Ducruet (2009), Notteboom (2009), Yang and Chen (2016)</li> </ul>   |
| <ul style="list-style-type: none"> <li>Stable structure port hierarchy<br/>Charlier (1988)</li> </ul>  | <ul style="list-style-type: none"> <li>Economies of scale and stable traffic concentration<br/>Starr (1994), Notteboom (2006b), Fremont and Soppe (2007)</li> </ul>  | <ul style="list-style-type: none"> <li>Stable hierarchical positions<br/>Cullinane and Wang (2012), Ducruet and Notteboom (2012)</li> </ul>   |
| <ul style="list-style-type: none"> <li>Regional integration and hinterland penetration<br/>Hoare (1986), Airriess (1989)</li> </ul>  |  | <ul style="list-style-type: none"> <li>Regional integration, cross border integration, commercial diversification, expansion of foreland, overlapping hinterland<br/>Lee and Ducruet (2009), Lemarchand and Joly (2009), Laxe <i>et al.</i> (2012), Wilmsmeier and Monios (2013)</li> </ul>   |
|  | <ul style="list-style-type: none"> <li>Technological innovation<br/>Kuby and Reid (1992), Wang (1998), Lee <i>et al.</i> (2008)</li> <li>Concentration of investment and export-led policy<br/>Todd (1993), Hoyle and Charlier (1995)</li> </ul> | <ul style="list-style-type: none"> <li>Government support, regulations, political stability<br/>Ducruet <i>et al.</i> (2009b), Wang and Ducruet (2012), Wang and Ducruet (2013), Van Dyck (2015)</li> <li>Increasing need for container transshipment and varying levels of productivity and efficiency<br/>McCalla (2008), Notteboom (2010), Wilmsmeier and Notteboom (2011), Notteboom <i>et al.</i> (2014), Van Dyck (2015), Suarez-Aleman <i>et al.</i> (2016)</li> </ul> |

**Figure 1.**  
Concentration  
Factors in Literature  
Since 1970

Source: Author, modified and updated from Ducruet *et al.* (2009b)

| Period-1: 1970-1990  | Period-2: 1990-2008  | Period-3: After 2008  |
|--|--|---|
| <ul style="list-style-type: none"> <li>Hinterland–foreland changes and traffic specialisation<br/>Kenyon (1970), Charlier (1988)</li> </ul>  |  | <ul style="list-style-type: none"> <li>Hinterland–foreland changes, emerging regions, traffic specialization, direct connections,<br/>Notteboom (2010), Feng and Notteboom (2013), Xu <i>et al.</i> (2015), Yang <i>et al.</i> (2016)</li> </ul>  |
| <ul style="list-style-type: none"> <li>Congestion, lack of space for development, diseconomies of scale<br/>Ogundana (1971), Hayuth (1981), Hayuth (1982), Barke (1986)</li> </ul> | <ul style="list-style-type: none"> <li>Congestion and diseconomies of scale<br/>Notteboom (1997), Wang (1998), Lee <i>et al.</i> (2008)</li> </ul>   |   |
|  | <ul style="list-style-type: none"> <li>New port development, modal shift, strategy of transnational operators<br/>Hoyle (1999), Slack and Wang (2002), Notteboom and Rodrigue (2005), Notteboom (2006a)</li> </ul> | <ul style="list-style-type: none"> <li>Increasing need for container transshipment, rise of secondary port, strategies of transnational operator, institutional adaptations<br/>McCalla (2008), Notteboom (2009), Wang and Ng (2011), Wilmsmeier and Notteboom (2011), Monios and Wilmsmeier (2012), Wilmsmeier and Monios (2013), Wilmsmeier <i>et al.</i> (2014)</li> </ul> |
|  | <ul style="list-style-type: none"> <li>Port selection and shipping line concentration<br/>Charlier (1998), Wang and Slack (2000), Notteboom (2005), Fremont and Soppe (2007)</li> </ul>                            | <ul style="list-style-type: none"> <li>Port selection, flexibility and accessibility<br/>Notteboom (2009), Notteboom (2010), Ducruet and Zaidi (2012)</li> </ul>  |
|  | <ul style="list-style-type: none"> <li>Port competition and urban growth<br/>De and Park (2003), Ducruet and Lee (2006)</li> </ul>   | <ul style="list-style-type: none"> <li>Port competition, changing port hierarchy<br/>Ducruet <i>et al.</i> (2009b), Lee and Kim (2009), Wang <i>et al.</i> (2012), Wang and Cullinane (2014), Fraser <i>et al.</i> (2016), Pham <i>et al.</i> (2016)</li> </ul>   |
|  | <ul style="list-style-type: none"> <li>National/government and regional development plans<br/>Brunt (2000), Ducruet (2008)</li> </ul>  | <ul style="list-style-type: none"> <li>Government plans and policy, Port Devolution<br/>Ducruet <i>et al.</i> (2009b), Lemarchand and Joly (2009), Shimohara (2009), Parola <i>et al.</i> (2013), Wilmsmeier and Monios (2016)</li> </ul>   |

**Figure 2.**  
Deconcentration  
Factors in Literature  
Since 1970

Source: Author, modified and updated from Ducruet *et al.* (2009b)

deconcentration factors and how these factors emerge in certain periods across the three time periods 1970-1990, 1990-2008 and post-2008.

#### *Factors emerging from 1970*

Prior to 1970, ports concentrated in locations with established inland transport corridors (Taafe *et al.*, 1963; Rimmer, 1967b; Rimmer, 1967a). Subsequently, the development of load centres, consolidation and intermodal facilities were reasons offered as to why concentration occurs (Hilling, 1977; Hayuth, 1981; Hayuth, 1982; Slack, 1985; Slack, 1990). These issues were not discussed further in the later periods, however three concentration factors were, being: port city dominance; economies of scale, stable structure and port hierarchy and regional integration and hinterland penetration.

#### *Port city dominance*

In the period from 1970 ports which were prepared to handle increasing volumes of containers were large port cities such as New York (Kenyon, 1970) and historically important ports, such as those in Nigeria (Ogundana, 1971). These port cities had large-scale transshipment operations, wholesale distribution and efficient handling of containerised cargo (Kenyon, 1970). In the period after 1990, the concentration was based in both port city dominance and existing hub dominance (Hoyle, 1999; Brunt, 2000; Ducruet, 2008), and after 2008, they are identified as large hub port cities with reputation and market power (Lee and Ducruet, 2009; Notteboom, 2009; Yang and Chen, 2016). Reputation was built and maintained with stakeholder relations management (Notteboom, 2009). Moreover, criteria to become these global hub ports did not only relate to the costs of transport and stevedoring, but also the convenience of customs clearance, land costs and investment systems and incentives (Yang and Chen, 2016).

#### *Economies of scale, stable structures and port hierarchy*

Prior to 1990 structural change is considered to have been a slow process (Charlier, 1988). However, in the subsequent period, decreased ports of call by shipping lines were more pronounced, which imposed increasing economies of scale and stable traffic concentration (Starr, 1994, Notteboom, 2005; Fremont and Soppe, 2007; Notteboom, 2006b). After 2008 multiple linkage analysis confirms that ports having the most inflow and outflow cemented their position in the top hierarchy, for example Shanghai, Hong Kong, Singapore and Shenzhen (Cullinane and Wang, 2012). A stable structure now existed in the global network, and they are too large to be missed as a port of call (Ducruet and Notteboom, 2012).

#### *Regional integration and hinterland penetration*

As containerisation and associated technology developed in the 1970s and 1980s the trend of regional integration based around pre-existing transport conditions resulted in concentration at particular ports (Hoare, 1986, Airriess, 1989). Some ports could not depend on particular origin regions as their hinterland, while some ports, as in the case of the UK, successfully broadened their hinterlands (Hoare, 1986). Furthermore, after 2008, globalisation brought more mixed hinterlands, across “maritime ranges” (Lemarchand and Joly, 2009). The same pattern occurs with cross border integration (e.g. Hong Kong), commercial diversification, expansion of forelands, overlapping hinterlands (Lee and Ducruet, 2009, Wilmsmeier and Monios, 2013). During crisis periods, commercial diversification and the expansion of forelands help to offset falls in demand (Laxe *et al.*, 2012).

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Two deconcentration factors in this period that continued to be discussed in subsequent periods were: hinterland–foreland changes and congestion, lack of space and diseconomies of scale.

#### *Hinterland–foreland changes*

Deconcentration in ports occurs because the origin of the cargo itself changes. Prior to 1990 these changes were related more to new infrastructure developed in the hinterland, for example the St. Lawrence Seaway and railways in the USA (Kenyon, 1970), as well as traffic specialisation (Charlier, 1988). Subsequently, research related to hinterland–foreland changes focused more on emerging trade regions and their connections to their trading partners (Notteboom, 2010; Feng and Notteboom, 2013; Xu *et al.*, 2015; Yang *et al.*, 2016). In the global shipping network, Xu *et al.* (2015) identified that East Asia remained a powerful trade region in the period 2001–2012, arguing that this is more important than being a central or intermediate region. Regions with the most decline were the North American West Coast, North American East Coast and Australasia; meanwhile, emerging areas were the South American North Coast, West Africa, Southern Africa, South American East Coast and West Asia, shown by their growth rates in total traffic volume and connectivity.

#### *Congestion, lack of space and diseconomies of scale*

In the initial conceptualisation of peripheral port challenges the primary issue was congestion at large load centres and a lack of space for expansion (Hayuth, 1981; Hayuth, 1982; Barke, 1986). Later, after 1990 there was a shift of cargo to medium-sized ports (Notteboom, 1997) and from congested roads to river transport in China (Wang, 1998). Hong Kong and Singapore successfully overcame these problems in the late 1980s and remained as prominent hub port cities, by adapting a port – urban city growth model, improving port productivity and efficiency and increasing urban attractiveness (Lee *et al.*, 2008). However, congestion became less of an issue for discussion since deconcentration to new locations is perceived to relate to the strategies of transnational port operators.

*Factors emerging from 1990.* New concentration factors occurring in this period were: technological innovations; concentration of investments; and export-led policies and growth poles.

#### *Technological innovation*

Concentration occurs in ports that are technologically more advanced. In contrast to deconcentration in the 1980's US port system (Hayuth, 1981), Kuby and Reid (1992) argue that these advances include containerisation, larger ships and trains, and information technology for freight tracking and billing. This was also reflected in the development of Hong Kong, which compared to Chinese ports which were not well developed, reflected the different levels of economic development (Wang, 1998). Moreover, other advances took place in planning and developing Asian global hub port cities which “consolidate” port and urban development to increase productivity (Lee *et al.*, 2008). Technology declined as an area of consideration after this period as in the following years the emphasis became more focused on the different levels of implementation.

#### *Concentration of investment and export-led policy*

Concentration of investment is actually another form of technological innovation which applies to developing economies that have less access to technology. An example is the implementation of steamship and railway technology to establish colonial control in the

East African (Hoyle and Charlier, 1995). Investment could also form part of trade enhancement such as in Taiwan where their port system was developed in parallel with industrialisation and export-led policies (Todd, 1993). In the next period, further research showed the support of foreign investment and modernisation (Ducruet *et al.*, 2009b), the support of government by regulations and the importance of political stability which influences concentration on investment (Wang and Ducruet, 2012; Wang and Ducruet, 2013; Van Dyck, 2015).

Deconcentration factors which emerged in this period were related to: new port development; port selection; port competition, new technologies and urban growth; and national/government and regional development plans.

#### *New port development*

New developments in this period were not generally located in existing dominant city-ports, but at new urban and industrial growth poles (Hoyle, 1999), with the strategies of transnational operators being to seek more business opportunities and port regionalisation (Slack and Wang, 2002; Notteboom and Rodrigue, 2005; Notteboom, 2006a). This issue intensified after 2008 due to the increasing need for container transshipment, the rise of secondary ports, the changing strategies of transnational operators and institutional adaptations (McCalla, 2008; Notteboom, 2009; Wang and Ng, 2011; Wilmsmeier and Notteboom, 2011; Monios and Wilmsmeier, 2012; Wilmsmeier and Monios, 2013; Wilmsmeier *et al.*, 2014).

#### *Port selection and shipping line concentration*

This factor developed from the shipping line's need to choose which port becomes their dedicated hub to secure port services, reduce costs and gain efficiency in operations (Charlier, 1998; Fremont and Soppe, 2007; Wang and Slack, 2000). A further example were the transshipment hubs formed in the Mediterranean due to low diversion distances (Notteboom, 2005). The same logic continued into the following period for shipping lines in order for them to gain more flexibility and increase accessibility to markets (Notteboom, 2009; Notteboom, 2010; Ducruet and Zaidi, 2012).

#### *Port competition and urban growth*

This factor underlines the outcome of the two previous factors. Having new ports and port selection challenges in the region creates port competition. The competition also intensified among the long-standing hub ports with increasing urban populations (De and Park, 2003, Ducruet and Lee, 2006). Furthermore, in the following period, port competition was discussed in the context of changing shipping routes and the likelihood for a changing port hierarchy (Ducruet *et al.*, 2009a; Lee and Kim, 2009; Wang *et al.*, 2012; Wang and Cullinane, 2014; Fraser *et al.*, 2016; Pham *et al.*, 2016).

#### *National/government and regional development plans*

Besides transnational port operators' strategies, national governments also have a say in deconcentration. Governments have agenda to look after their peripheral regions and reduce dependency on existing hubs (Todd, 1993, Brunt, 2000; Ducruet, 2008; Lemarchand and Joly, 2009). Such issues are expressed in government policies, port reforms or devolution (Ducruet *et al.*, 2009b; Shinohara, 2009; Parola *et al.*, 2013; Wilmsmeier and Monios, 2016).

*Factors emerging from 2008.* New factors occurring in this period were related to the increasing need for container transshipment and varying levels of productivity and efficiency

(McCalla, 2008; Notteboom, 2010; Wilmsmeier and Notteboom, 2011; Notteboom *et al.*, 2014; Van Dyck, 2015; Suarez-Aleman *et al.*, 2016). It is unclear whether the increasing need for transshipment resulted in concentration or deconcentration. However, the literature suggests that concentration still occurred despite deconcentration trends. Different levels of port productivity and efficiency exist, especially in developing economies, as a result of private sector participation, corruption in the public sector and improvements in intermodal facilities (Suarez-Aleman *et al.*, 2016). Shipping lines avoid unreliable ports and use hub ports as buffer zones to protect them from the negative impacts of inefficiency (Wilmsmeier and Notteboom, 2011).

## Discussion

Several critical questions arise when considering the development of ports in more peripheral locations. The first is: How is concentration and deconcentration managed? Second: What are the dominant factor driving both concentration and deconcentration? And third: Are there changes which need to be identified in order to determine which peripheral ports have potential? Therefore, this section suggests that there is a concentration–deconcentration cycle relating to shipping line’s behaviour in operating transshipment and direct calls. It also attempts to confirm the existing literature that institutional factors are important as enablers and suggests changing criteria in respect of peripheral port potential.

### *Transshipment vs direct call: managing concentration and deconcentration*

Although Ducruet *et al.* (2009b) argued that there is a shift from concentration to deconcentration studies, both concentration and deconcentration are still occurring. These two processes are recurring, which eventually leads to the creation of a cycle. The increasing need for transshipment is the result of direct calls having higher volumes. Later, the rise of secondary ports indicating deconcentration result from concentration itself, but in an expanding network. Hence, it can be argued that port location patterns are derived from the configuration of liner shipping networks. This is supported by Fremont and Soppe (2007), stating that there is an imitation of strategies by other actors in the chain to preserve equilibrium. Liner shipping network configuration, argued by Wilmsmeier and Notteboom (2011), fits this pattern (Table II). Their four-phase model described how the network evolves. It starts with “point-to-point” direct services, then higher connectivity to international trade is gained by consolidating cargo in an intermediate hub, which then results in a secondary network. Finally shipping lines offer new direct services connecting the emerging ports with overseas as volumes continue to grow (Wilmsmeier and Notteboom, 2011).

### *Importance of institutional factors*

No specific new factors emerged after 2008. However, it is recognised from literature that the existence of medium-sized emerging secondary ports mainly relates to institutional factors. Slack and Wang (2002, p. 164) defined institutional factors as “the roles of the port authorities and terminal operators and their relationship with the shipping lines”. They argue that it emerges because of the recent trend in global/international terminal port operations, especially in Asia where regional traffic growth and port development opportunities exist compared to the stable market in Europe and North America. Nowadays, path dependency in port development is affected by strategies and the actions of the players or stakeholders, whereby even multi-port gateways and multi-port operators exist in a port system (Notteboom, 2009).

| Shipping lines                   | Phase 1   | Phase 2  | Phase 3   | Phase 4   |
|----------------------------------|---|--|---|---|
| (Wilmsmeier and Notteboom, 2011) | Point-to-point direct services with a strong local or regional orientation. Regional orientation and inter-connectivity to the overseas markets is poor | Higher connectivity to overseas markets by consolidating cargo in an intermediate hub. Increasing dependency to the hub. Direct regional services start to lose their importance. Growing connectivity of the port system to overseas markets increases the region's attractiveness to shipping lines and international port operators | Port traffic growth leads to a further outreach of the hub-and-spoke network. The inclusion of new ports. International port operators further penetrate into the market and state intervention in ports is strongly reduced. Main lines are growing, smaller regional services start to develop again in a secondary network | Market size of specific ports has grown. Shipping lines started to offer direct services from these ports to overseas regions. The hub's functional position undermined. The hub seeks liner service connections to smaller ports which still lack connectivity to overseas market to maintain its role |
| <i>Ports</i>                     | <i>Deconcentration</i><br>Development of load centres, consolidation and intermodal facilities  | <i>Concentration</i><br>Become dominant hub port cities, Economies of scale, Establishing a port hierarchy   | <i>Deconcentration</i><br>Increasing need for transshipment, Rise of secondary ports, Strategies of transnational operators, Institutional adaptations  | <i>Concentration</i><br>Commercial diversification, expansion of foreland, and overlapping hinterland. Varying levels of productivity and efficiency  |

**Table II.**  
Pattern of liner shipping network configuration with port concentration and deconcentration

**Source:** Author, modified from Wilmsmeier and Notteboom (2011)

For peripheral ports to be more involved in international trade, managing concentration and deconcentration becomes important. Ports must engage with shipping lines, offering dedicated terminals or incentives to become “sub-hubs” or intermediate hubs which adds more nodes in the expanding network. After the stage of hub dependency to existing hubs, these ports need to ensure that meet the requirements to upgrade traffic volumes and network positioning in the long-run (Ducruet *et al.*, 2010). Ports also need to negotiate so that shipping lines adjust their ship size to gain route specialisation and first-mover advantage. Delayed action might no longer become suitable, consequently the first-mover advantage is significant (Wilmsmeier and Monios, 2016).

Further, consideration needs to be given to whether institutional factors undermine locational factors? Ducruet *et al.* (2009a) argued that location nearby core economic regions is less important than in the past, as regional integration and port competition intensifies. However, changes in hinterland–foreland relationships and emerging markets are also affecting deconcentration (Table II) which cannot be ignored. It could be claimed that institutional factors are not more important than locational factors; however, it is an enabler to deconcentration when all factors are fulfilled. The manufacturing of strategic locations is feasible as in Latin America, the Caribbean (Wilmsmeier *et al.*, 2014), China (Wang and Ng, 2011) and the UK (Wilmsmeier and Monios, 2013). Hence, the market power of peripheral

regions still needs to be addressed, to make direct calls feasible for shipping liners and secure sufficient volumes.

#### *Changing criteria of potential peripheral port*

Concentration–deconcentration factors which emerge in specific periods mostly carry their importance into later periods. Earlier criteria placed more stress on locational factors such as nautical accessibility and port efficiency, which still continue to be important. Furthermore, more recent deconcentration factors are becoming new criteria which need to be fulfilled by potential peripheral ports to become sub-hubs. Recent criteria emphasise identifying peripheral markets to create changes in hinterland-foreland relationships and addressing institutional factors identified from earlier phases of secondary port growth. There is also a need for risk assessment taking account of the dynamics of port selection, port competition, and path dependency in order to prevent overinvestment.

#### **Conclusions**

It has been shown that emerging markets influence the peripheral port challenge and that concentration–deconcentration needs to be managed. Institutional factors, identified in the literature in the form of the strategic actions of operators, are becoming more dominant and considered as enablers to deconcentration. However, other deconcentration factors still need to be fulfilled. Ports need to push to become sub-hubs and need encouragement to develop to accommodate to ship size changes and shipping routes. It can be seen that potential port developments in more peripheral locations will require the fulfilment of a wider range of criteria.

This paper contributes to the research on port development in peripheral locations which have been under-studied compared to large hub ports. It also provides insights for ports in developing countries in their efforts to upgrade their port facilities and infrastructure. The future research agenda concerning peripheral ports is to explore further how peripheral ports are perceived by relevant stakeholders in the context of maritime transport and logistics, to identify different levels of peripherality, find ways to manage concentration and deconcentration, identify detailed criteria and characteristics of potential peripheral ports, and the potential benefits for stakeholders: not only transnational port operators but also global shipping lines, governments and regional bodies. Related fields such as marketing and business development should be embraced and related to economics issues, in order to better understand the complex behaviour of players in maritime transport.

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