



Port System evolution – the case of Latin America and the Caribbean

Gordon Wilmsmeier

UN-ECLAC

P.O. Box 147-D, Santiago, Chile, +56 (2) 2210 2640

Gordon.Wilmsmeier@CEPAL.org

Jason Monios

Transport Research Institute, Edinburgh Napier University, Scotland

j.monios@napier.ac.uk

Gabriel Pérez

UN-ECLAC

P.O. Box 147-D, Santiago, Chile

Gabriel.perez@CEPAL.org

Abstract

The explosion of the container trade has significantly influenced the port geography and maritime logistics system in the Latin America & Caribbean (LAC). Paired with and in response to liner shipping strategies this has led to a concentration of container traffic at selected ports. In recent years, the attempt to manufacture strategic locations by engendering centrality and intermediacy has emerged as a recurring issue in region's port development process.

Emerging research questions are thus what effect these developments will have on infrastructure demand and in particular how will they influence and be influenced by the actions of those ports currently occupying a secondary rank in the LAC port hierarchy? This paper aims to understand the evolution of maritime networks and the autopoietic nature of port development. The paper analyses time series data on container movements to examine patterns of cargo flows and transshipment location choices. From a theoretical perspective, this analysis is situated within the context of recent institutional approaches by considering port development and infrastructure investment strategies at primary and secondary LAC ports.

The discussion of these findings raises questions about port policy and both public and private sector responses to a changing port geography and an extended understanding of connectivity. The findings deepen understanding of the recursive relationship between shipping lines and port development strategies, as well as their effect on wider maritime network developments.

Keywords: container port development, concentration, peripherality, Latin America, liner, shipping

1. Introduction

This paper examines the drivers for peripheral ports to counteract the concentration of container traffic at a few large gateways, seeking ways to overcome their peripheral status and increase their access to global trade routes. It builds on previous work by Wilmsmeier and Monios (2013), Wilmsmeier and Notteboom (2011) and Sanchez and Wilmsmeier (2010) by applying the theoretical approach to liner networks connecting Latin America.

The geographical focus of the paper is on Latin American & Caribbean ports and analyses time series data on container port throughput to examine patterns of growth and transshipment location choices. From a theoretical perspective, this analysis is situated within the context of recent institutional approaches by considering port development and infrastructure investment strategies at primary and secondary LAC ports. The paper aims to understand the evolution of maritime networks and the autopoietic nature of port development as secondary ports seek to reposition themselves within emerging feeder markets through a variety of proactive and reactive strategies that involve different actors within a complex institutional environment.

The approach taken in this paper builds on previous work in the field by providing insights on the constraining factors of maritime networks and the associated implications for trade development. The discussion of these findings raises questions about port policy and both public and private sector responses to a changing port geography, requiring an extended understanding of connectivity. The findings deepen understanding of the recursive relationship between shipping lines and port development strategies, as well as their effect on wider maritime network developments.

This conceptualisation of port development underlines the necessity for decision makers to develop a clear understanding of its complexity; such knowledge can potentially reduce risks and enable a view of port development and the wider impacts on the economic, social and transport systems. At the same time such a conceptualisation enables decision makers to reflect critically on their own role as a factor for port development.

This paper does not attempt to develop a comprehensive theory to explain or predict port development. Rather, the quantitative and qualitative analysis in this paper presents a more multidimensional view, which offers new insights to port development and indicates challenges in a variety of contexts.

The following two sections examine peripherality, the role of concentration of container service provision at hub ports, port development strategies and the importance of liner network connectivity. A discussion on the port's ability to act develops the concept of "autopoiesis" in the context of recent institutional literature. The LAC port system and evolution are analysed in section five. Discussion of the results follows and section seven concludes.

2. Peripherality and concentration

Issues faced by peripheral regions include high transport costs and an inability to generate economies of scale and density (Nijkamp, 1998). Furthermore, a distinction may be drawn between peripheral regions within a country and peripheral countries. In the context of maritime trade peripherality is particularly driven not by geographic but by economic distance, connectivity and market structures (Wilmsmeier, 2010, Sanchez and Wilmsmeier 2011). This is relevant in the context of increasing integration and reduction of economic, legal and practical barriers between countries within supranational trading blocs and in the Latin American case related to the physical integration initiatives that aim at increasing regional integration based on infrastructure development. Nijkamp (1998) noted that “a system of regions is much more an open trade system without customs or institutional barriers. Thus, competitiveness plays a crucial role in regional development [and] ... factor mobility tends to be much higher between regions” (p.8). The reduction of internal barriers can lead to a concentration of container traffic at fewer, larger gateway ports, but also to a diversification and decentralisation of port traffic through a extension of port hinterland as a result of infrastructure development. This paper aims to understand the drivers for a multiple gateway approach that would lead to decentralisation and provide secondary ports with a greater role, while simultaneously providing increased opportunities for peripheral trade.

Numerous studies on port system development exist, evolving from the traditional spatial analyses of port expansion and upgrading of berthing and handling facilities (Bird, 1963; Taaffe et al., 1963; Rimmer, 1967; Hoyle, 1968; Hayuth, 1981; Barke, 1986; Van Klink, 1998) to the more recent focus on port competition through hinterland accessibility, such as the concept of port regionalization as one possible pathway in port system evolution (Notteboom and Rodrigue, 2005; Monios and Wilmsmeier, 2012). Discussions that include the competition in the maritime foreland (as argued by Sanchez and Wilmsmeier, 2006), focusing on intermediate transshipment hubs and the structure of maritime services have recently been appearing (Rodrigue and Notteboom, 2010).

As a port system moves towards concentration, particularly for unitised cargo, significant challenges to hinterland infrastructure become apparent. Ducruet et al. (2009) argued that “concentration stems from the path-dependency of large agglomerations”, while drivers of deconcentration include “new port development, carrier selection, global operation strategies, governmental policies, congestion, and lack of space at main load centres” (p.359). According to Barke (1986) and Hayuth (1981), port system concentration will eventually reach its limits and invert, leading to a process of deconcentration, a phenomenon discussed more recently by Slack and Wang (2002), Notteboom (2005), Frémont and Soppé (2007) and Wilmsmeier and Monios (2013). However, existing theory falls short of differentiating between deconcentration that emerges upon failure of a system in a reactive manner, deconcentration that materializes from proactive port development strategies, and deconcentration that

emerges from new economic and industrial development. Thus the drivers of deconcentration processes can be related not only to the port system, but also to the transport system (i.e. hinterland infrastructure and carrier strategy) and the economic system (e.g. logistics strategies, economic development) (Wilmsmeier and Monios, 2013; Wilmsmeier and Sanchez, 2010; Robinson, 2002).

3. Liner shipping networks and port system evolution

Port operators and shipping lines have both exhibited strong concentration processes and increasing vertical integration. In 2011 the top 4 operator moved 26.5 per cent of the global container throughput. Strategic alliances between them have exerted a profound influence on maritime network structure and also on a region's integration in the global maritime transport network. These developments have to a certain extent made port development dependent on network strategies of global players. The location of a port within the network influences the competitiveness of trade through that port and subsequently raises important questions of what determinants lead to the configuration of current networks and how these could be influenced.

The development of liner shipping networks is primarily driven by the demand for containerised transport, depending on the strategies of shipping companies and the demand of the shippers for specific service characteristics. As such, the location of a port or a region within the global liner shipping network is determined by the density of trade flows to and from a specific port or region. These factors then become the determinants of the service frequency, loading capacity, number of port calls per roundtrip and transshipment or relay strategies (Fagerholt, 2004).

Port selection can be based on several criteria, from physical characteristics and geographical location to port efficiency, strategic carrier considerations and hinterland access (Wilmsmeier and Notteboom, 2011). Magala and Sammons (2008) argued that port choice is a by-product of the choice of logistics pathway. Thus port choice becomes more a function of the overall network cost and performance. From the carrier's perspective, the economies of scale, scope and density in shipping, port operations and inland operations would favour a very limited number of load centres in a region (Cullinane and Khanna, 2000; Frémont and Soppé, 2007). Wilmsmeier and Notteboom (2011) propose an evolutionary four phase generic model for port system development:

First phase. The liner shipping network is determined by point-to-point direct services with a strong local or regional orientation. The liner service network is highly regional in orientation and interconnectivity to the overseas markets is poor. Government involvement in the port sector is typically high while at the same time international market players (shipping lines and terminal operators) face limited possibilities to enter the region;

Second phase. The region and the market players seek a higher connectivity to overseas markets by consolidating cargo in an intermediate hub. The first tendencies towards a hub-and-spoke network emerge. The evolving liner service network configuration increases the dependency of the port system on indirect services via the hub, while direct regional services start to lose their importance. The growing connectivity of the port system to overseas markets increases the region's attractiveness to shipping lines and international port operators. The rising pressure on port infrastructures and the need for a professional and commercial approach to market dynamics urges government bodies to revise their port policy. Often, the local/regional/national government will seek the start-up of a port devolution process to face the mounting infrastructural and operational port challenges linked to the opening up of the region to the world market. The resulting changes in the port governance and policy framework enable international stevedoring groups and shipping lines to access key assets in the local ports and to seek control over terminal operations.

Third phase. Port traffic growth leads to a further outreach of the hub-and-spoke network and the inclusion of new ports in this pattern. International port operators further penetrate into the market and state intervention in ports is strongly reduced. Main lines are growing and smaller regional services start to develop again in a secondary network.

Fourth phase. The market size of specific ports has grown to such an extent that shipping lines can now offer direct services from these ports to overseas regions. The hub sees its functional position undermined. In view of maintaining its role in the network, the hub will seek liner service connections to smaller ports in the region which still lack connectivity to overseas market. Consequently, the terminal activity in the hub shifts in geographical terms and a new secondary hub-and-spoke network emerges involving other gateway ports.

Following Wilmsmeier and Notteboom's (2011) four-stage model of the evolution of liner shipping networks, it may be that networks in the LAC region and its sub-regions are between stage two and stage three, where a hub-and-spoke pattern is mature and smaller regional services start to develop again in a secondary network, to stage four, where shipping lines can now offer direct services from these ports to overseas regions, and in order to combat this undermining process, existing hubs seek liner service connections to other ports in the region that still lack connectivity to overseas markets.

While network development and port choice are based on many factors, the port's ability to "steer their own future" (Olivier and Slack, 2006; p.1414) can exert some influence. Ports can take on "the challenge of the periphery" (Barke, 1986; Hayuth, 1981; Slack and Wang, 2002); in particular, secondary ports can take advantage of wider trends such as the limits of concentration and reposition themselves to take advantage of a network that may be changing from an outdated system of hubs to new structures. In order to understand how secondary ports act under such conditions, a more complex and nuanced understanding of the port's ability to act is required.

4. The port's ability to act

One basis for distinguishing between the shipping and port subsystems remains the fact that the constituent elements of the latter are composed of physical characteristics in space, while the former comprises mobile elements. The economic and the shipping system together generate pressure on the port system in the form of ever-evolving specific requirements with respect to infrastructure, superstructure, equipment, efficiency and organisation. This prompts a process of time-lagged reaction within the port system to satisfy this changing demand and it is this reactive process that actually constitutes the port development process, determined by and reflected in its physical (infrastructure and superstructure), economic, social/environmental, and institutional arrangements.

Changes in the port system occur in an almost completely discrete manner, since variations in port infrastructure and superstructure, as well as organisational changes, do not occur in a continuous fashion; investment in the port sector is often characterised as 'lumpy' (Sanchez and Wilmsmeier, 2010). Moreover, port development is very often dependent upon and determined by the degree to which a specific port in question is embedded within local and regional institutional considerations and, therefore, beyond the direct sphere of influence of the port system itself. This is critically important not only to the port but also to the economy it serves as it is this that ultimately defines the degree of connectivity enjoyed by the economic system that prevails within a port's hinterland.

Due to the fact that the port system development cycle advances in a discrete manner, its adjustment to the continuous evolution of freight transport demand will inevitably lead to alternating situations of either infrastructural insufficiency and scarcity of supply on the one hand (i.e. excess demand), or to a surfeit of port infrastructure (i.e. surplus supply). In addition to such natural cycles, there is the long-term lifecycle of the port, through development, introduction, growth, maturity and decline (Cullinane and Wilmsmeier, 2011). It has been suggested that the early spatial port development models such as Bird (1963) or even the more recent UNCTAD generational model (UNCTAD, 1992) are unable to capture the complexity of port infrastructure, operations and services (Bichou and Gray, 2005). Beresford et al. (2004) developed the WORKPORT model as a response to the need to conceptualise the complexity of this operational environment.

Institutional approaches to port development have argued that the port authority has constraints on its ability to act, stemming from its specific nature. The key distinction is that port development is path dependent, heavily constrained by past actions and institutional design, but also contingent, in relation to private investment and public planning. Ng and Pallis (2010) showed how port governance is largely determined by local/regional institutional characteristics, despite attempts to implement generic governance solutions. Notteboom et al. (2012) applied the concept of institutional plasticity (Strambach, 2010) to port development, arguing that, while port development is path dependent, a port authority

can achieve governance reform by a process of adding layers to existing arrangements. In this way, the port authority does not break from the existing path of development, but develops new capabilities and activities via a process of “institutional stretching”. An example is given of port authorities investing in load centres in the hinterland, beyond their traditional jurisdiction, and the particular importance of informal networking is noted (see also Monios and Wilmsmeier, 2012). Jacobs and Notteboom (2011) asserted the need for an evolutionary perspective, drawing upon the economic geography literature to define the movement from critical moments to critical junctures, concluding that port authorities have windows of opportunity in which collective action is possible. The authors concluded that “the question of to what extent critical moments require institutional adaptations in order to materialise into critical junctures needs further thought” (p.1690).

In this paper it is argued that, in order to make use of previous work, a more sophisticated institutional appreciation of the port is required, as the entity normally considered a unified port is not only created by numerous actors but is endlessly being recreated with each new relationship or network in which the port is embedded. The port’s connectivity is always changing and creating itself anew. Marx said that “the capitalist system carries within itself the seeds of its own destruction.” Maybe that is also true for ports as they move through their life cycle, which includes an inevitable decline after concentration, as noted above. The aim of this paper is to understand this process in a more active and flexible manner, in particular the role of secondary ports in managing the transition from stage three to stage four of Wilmsmeier and Notteboom’s (2011) four-stage model.

The concept of “autopoiesis” was introduced by Maturana and Varela (1980), who defined it as follows:

An autopoietic machine is a machine organised (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components which: (i) through their interactions and transformations continuously regenerate and realise the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realisation as such a network. (Maturana and Varela 1980; pp.78-79)

The concept was first applied to port geography by Sanchez and Wilmsmeier (2010), who observed that transport systems exhibit a self-organising structure that can be viewed through the lens of autopoiesis. A transport system may adjust itself while developing its identity and defining its limits, however, transport autopoiesis is likely to have an especially high inertia when it comes to changing system variables (see Mingers, 1994, p.77; Jantsch, 1982, p.64).

Under pressure from an uncertain environment, a transport system takes actions in order to tackle existential situations (otherwise market forces will deconstruct the organisation of the

transport system). When feedback loops are missing, parts of the system may grow in an uncontrollable manner, and, through the limitations of its physical characteristics, it may lead to overshooting and collapse of the system. In developing countries, autopoiesis may be particularly challenged. This is because, even though the transport system steers and organises itself, the global tendencies of the system are defined by its environment and not itself.

As the facilitators of flows, ports represent a bridge between the outputs of the economic system and the movement of these outputs within globalised trade. Ports have grown to be a key component of competitiveness, and their structure is intrinsic to its ability to facilitate trade. Yet with each transformation of the inputs, the system changes its state (Schober, 1991, p.3520).

This paper will describe the changes in the LAC port system evolution and based on the findings will discuss the drivers of these changes as the port is placed right in the interplay between supply (liner shipping industry) and demand (container traffic). While this discussion cannot be conclusive in the context of this paper it aims to place arguments for a more systemic view on port development (a discussion that usually only focuses on main ports) and to identify arguments which support secondary and emerging ports in their striving to develop their facilities and strategies and the governing institutional structures.

5. The Latin American & Caribbean port system

The container throughput in the Latin American and Caribbean port system grew from 10.4 million twenty-foot equivalent units (TEUs) in 1997 to 41.3 million (TEUs) in 2011. The movement in 2011 was equivalent to 7 per cent of all global port movements. One fifth of all containers in LAC are moved in Brazil (ECLAC, 2012) followed by Panama (16 per cent), Mexico (10.23 per cent), Chile (8.21 per cent) and Colombia (5.16 per cent). However the port throughput at regional and country level is only a very crude reference of the current state of the port system. In order to understand the port system evolution it is necessary to take a spatio-temporal perspective, looking at disaggregated figures at country and sub-regional level and at an extended time period. The LAC port system can be categorized into 3 sub-regions and seven coastal areas. The following analysis includes data for 131 ports with container activity in the region

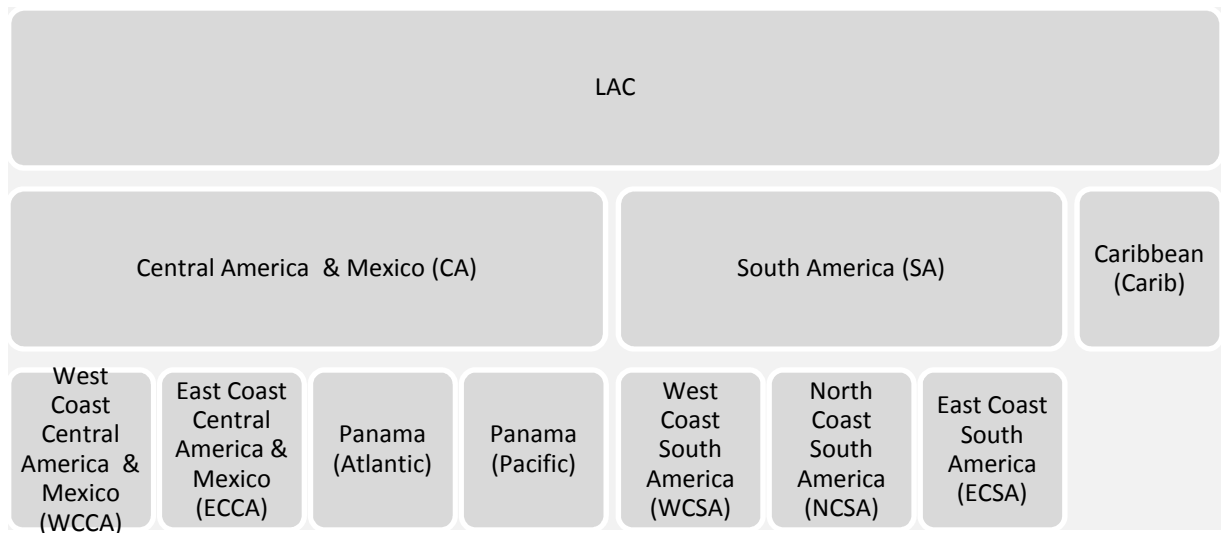


Figure 1: Latin America and the Caribbean shipping and port system categories (Source: Authors)

The analysis of the port activity shares in the region at subregional level reveals that Panama has gained the greatest market share and growth figures over the last 15 years. As port activity growth in Panama is particularly related to transshipment traffic, it might be argued that this is a first indicator for the changes in the port system towards the third stage hub-and-spoke structure as indicated by Wilmsmeier and Notteboom (2011) and thus leading to a concentration in the port system towards transshipment hubs; a development that is rather driven by liner shipping strategies than economic development.

The Caribbean a key market for transshipment however, has been losing market participation over the last years; indicating a shift from the traditional transshipment hubs (e.g. Kingston, Jamaica and Freeport, Bahamas) towards Panama and Cartagena, Colombia.

A further development is an activity shift in Central America and Mexico from ECCA to WCCA. For the case of Central America (including Mexico) the share of container activities have transformed from an 80:20 ECCA-WCCA relation to a 52:48 relation in a market that in 2011 was almost five time bigger than 1997.

In order to get a more in depth understanding, if the role of transshipment hubs has lead to a concentration and/or if transshipment activity has shifted geographically, the specific evolution of throughput of the identified transshipment hubs in the Caribbean and on LAC's Pacific coast is analysed in the following.

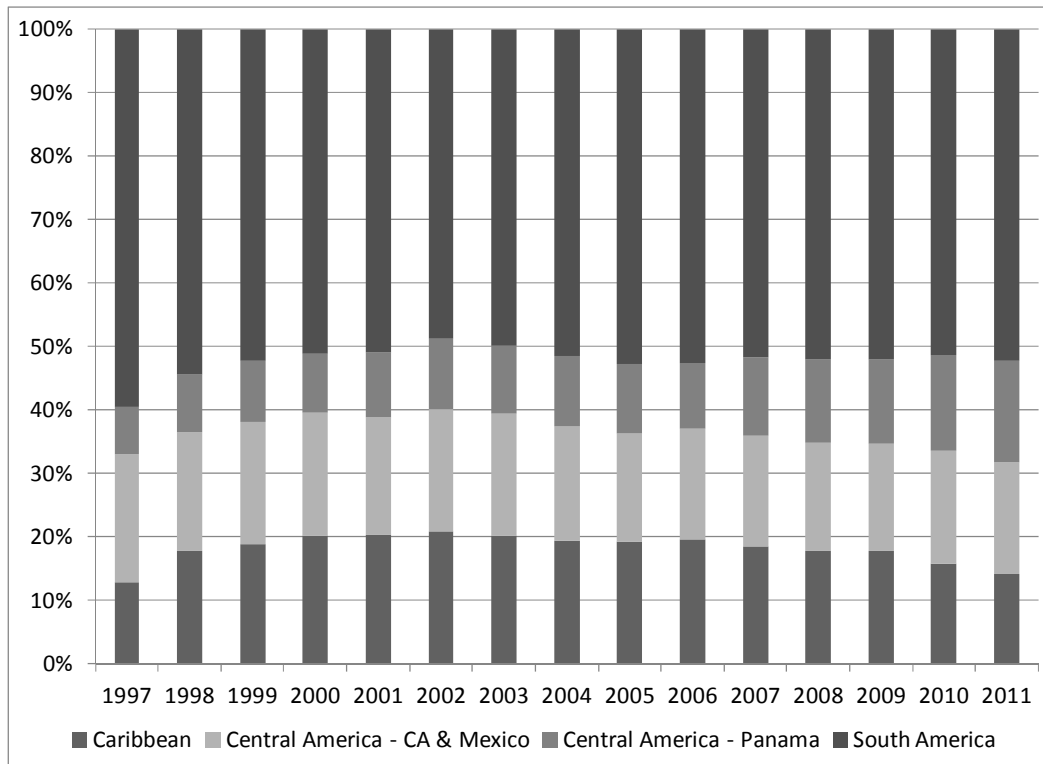


Figure 2: Sub-region's shares in container throughput in LAC, 1997 to 2011
 (Source Authors, based on ECLAC)

A comparison of growth rates of Pacific coast ports for the periods 2000-2005 and 2005-2011 reveals that the growth rates of the two leading transshipment ports: Balboa, Panama and Lazaro Cardenas, Mexico, are the greatest for the first period, and are among the leading growth rates also for the period 2005-2011. Further, four secondary ports (Arica, San Vicente and Puerto Angamos in Chile; and Corinto, Nicaragua) evolve the fastest. There is also a notion that the ports with the greater growth rates between 2000 and 2005 depict slower growth in the following period, probably indicating a conversion from take-off phase towards more maturity after they have reached a certain size. Ports like Callao, Peru and San Antonio, Chile display relatively lower growth rates in comparison to other traditional gateway ports. The findings deliver arguments for two trends a) exponential growth rates of transshipment ports and b) exponential growth rates in emerging of secondary ports between 2005 and 2011 partly combined with the entrance of new players in the port system such as in the case of San Vicente (SVTI), Chile.

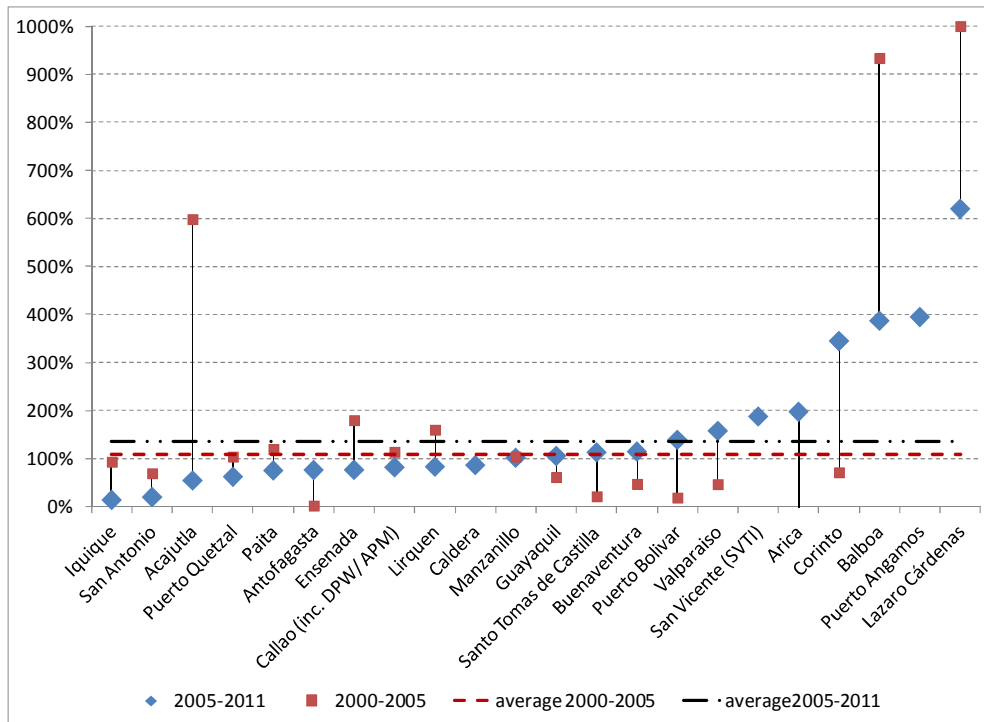


Figure 3: WCSA and WCCA growth rates of container ports, 2000 to 2011
 (Source Authors, based on ECLAC)

The emergence of secondary ports is particularly notable for the case of Chile, which leads to a greater geographical spread of ports towards the South of the country. As mentioned above the appearance of San Vicente (SVTI) in 2005, as a new player and the growth of the co-located Talcahuano, appear to be “pioneers” in the emerging relevance of secondary ports in the region and the transformation of the port system. The analysis also reveals that the two traditional main ports effectively lost over six per cent market share between 2005 and 2011. However, the pure numerical analysis by port does not reveal the systemic relationships in the port system created by the privatisation efforts over the last two decades and the internationalisation of container port operations. In the case of Chile this is particularly interesting as the operator of San Antonio is the same as in San Vicente. Thus, while the individual port San Antonio, was not able to increase its weight in the port system, the private operator’s relevance and share in port activity grew strongly as this would consider the ports of San Antonio, San Vicente and the other Chilean ports operated by that company.

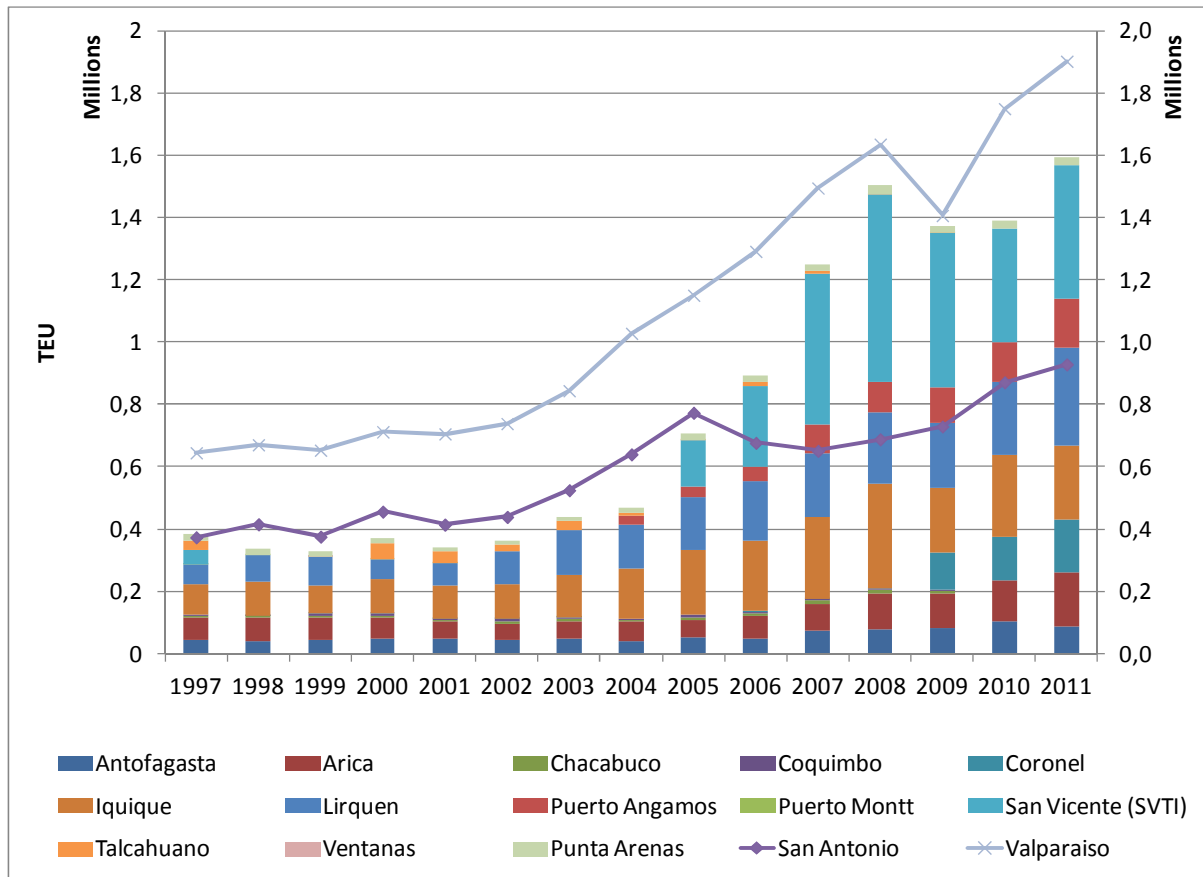


Figure 4: Shares in container throughput in WCSA, 1997 to 2011
 (Source Authors, based on ECLAC)

Shifting the focus of analysis to the ECSA a somewhat similar picture emerges. In the period between 1997 and 2011 overall container throughput more than tripled to almost 11 million TEU in 2011. This was accompanied by a significant shift in the market participation of the ECSA countries. Brazil's market participation expanded from 60 per cent to 72 per cent, Argentina lost one third of its market share and in 2011 generated only 20 per cent of all container traffic in the ECSA. This shift is principally originating from the expansion of Brazil's economy, paired with its population size. By way of example Brazil today is one of the world's largest exporters of chicken and beef; a trade that has only recently emerged as a response to the growing demand in the emerging Asian economies. Uruguay, the smallest economy on the ECSA, however was able to grow its market share to almost 8 per cent. The latter is not only driven by the economic development of the country, but also by the ports strategy to act as a transshipment hub and gateway for Paraguayan cargo but also for southern Argentinean cargoes (see also Wilmsmeier, Martinez-Zarzoso and Fiess, 2010).

Adjunct to the shift in market participation at country level the traditional concentration in the national container port systems is being diluted by the entrance and emergence of new players. In the case of Argentina the deconcentration process is still in its infancy, but it is noteworthy that the container terminals in Buenos Aires have lost about 6 per cent of national

market share over the last 7 years, showing the fast expansion of new container ports (e.g. Zarate) in the country.

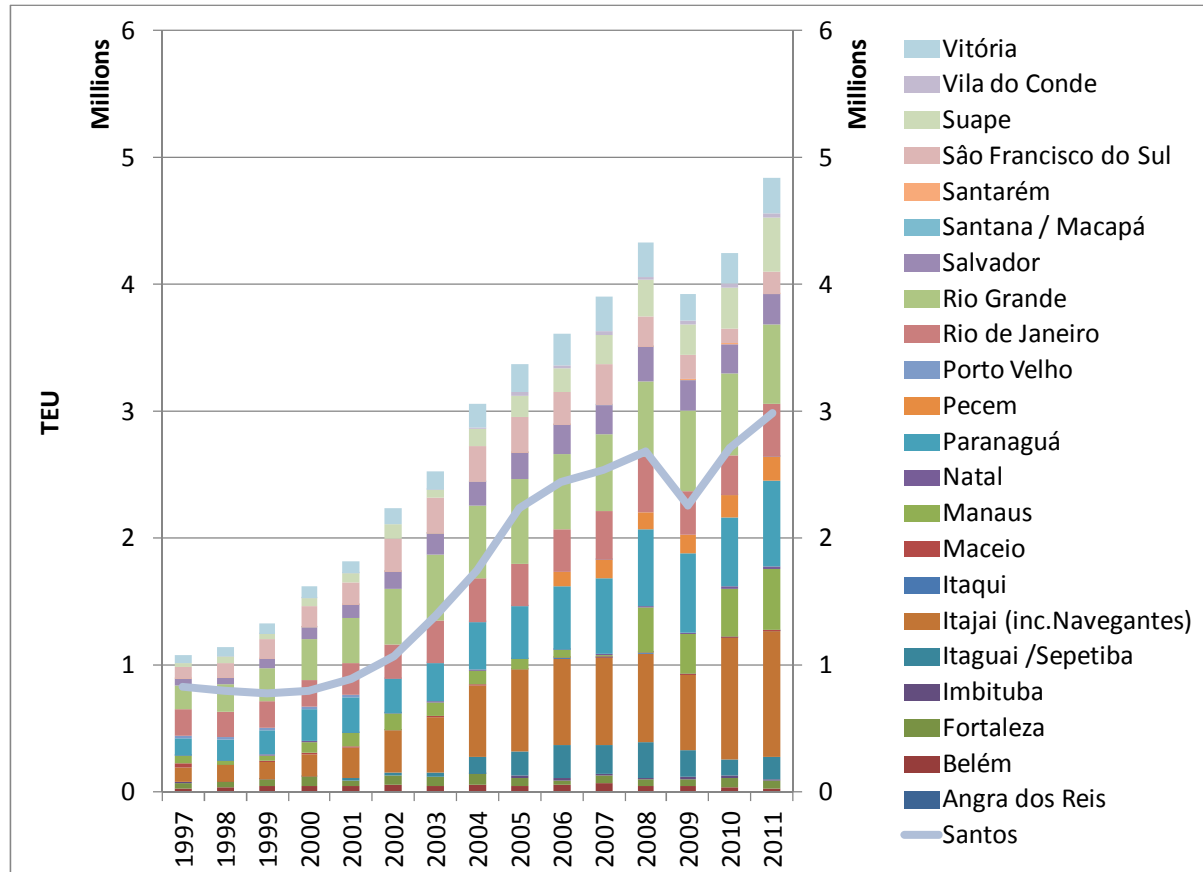


Figure 5: Shares in container throughput in ECSA, 1997 to 2011
 (Source Authors, based on ECLAC)

Traditionally, Santos has been the principal container port in Brazil and 38 per cent of Brazil’s container throughput was handled in the terminals of Santos in 2011. Nevertheless, its market decreased in comparison to 1997, when the port was responsible for over 43 per cent of Brazil’s container movements. Rio de Janeiro as the second biggest container port in Brazil in 1997 lost 50 per cent of its market participation over the last 15 years. A number of secondary ports and greenfield projects emerged over the last 15 years that a) lead to a geographic spread of container activity and b) initiated a deconcentration process of container activity. Rio Grande held an important market participation of 10 per cent in 1997 and was discussed to evolve as a competitor to Montevideo and Buenos Aires in the south of Brazil as its infrastructural conditions and draft of 15m favoured the handling of post-panamax vessels. The port expanded and increased its market share to over 13 per cent in 2003, benefitting from the repercussion of the economic crisis in the port of Buenos Aires (see Sanchez and Wilmsmeier 2008). However, since then its shares in the Brazilian container throughput have been decreasing to almost 8 per cent in 2011. Thus, the continued growth was not sufficient for keeping up with the speed of expansion of the overall national container activity. The port

of Itajai (including the new Navegantes terminal) doubled its market participation to 13 per cent in 2011, Manaus also doubled its share to 6 per cent. Suape more than tripled its participation to over 5 per cent in 2011.

The ports in the Caribbean/ECCA/NCSA port system can be categorized as follows: pure transshipment hub (minimum of 70 per cent transshipment cargo), hybrid port (between 30 and 70 per cent transshipment cargo), gateway port (less than 30 per cent transshipment cargo) and local and inter-islands transshipment port. Port throughput in these sub-regions grew from 4.6 million TEU in 1997 to 15.9 million TEU in 2011. The authors estimate that the share of transshipment cargo increased from 38 per cent (1999) to around 50 per cent of total traffic in 2011. Thus, the incidence of transshipment traffic in the region is significantly above global average of 28 per cent in 2008 (Rodrigue, 2012).

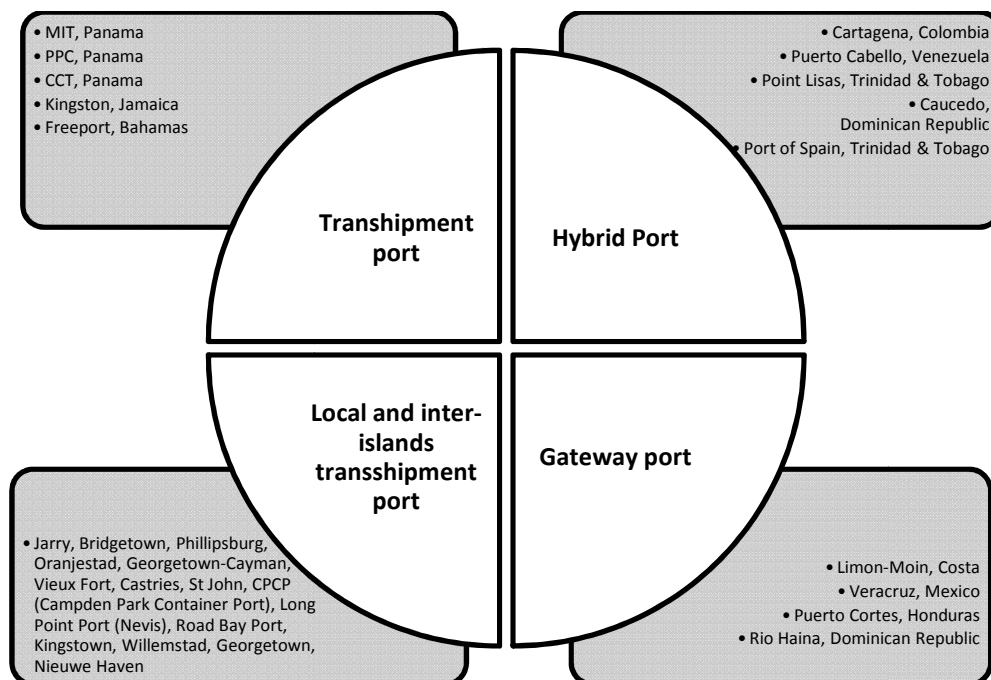


Figure 6: categorization of ports in the Caribbean/ECCA/NCSA port system
 (Source: Authors)

The market participation of the transshipment ports grew from 33 per cent in 1997 to 45 per cent in 2011. The development of the hybrid ports is more diversified. Cartagena, Colombia being the most successful one, by increasing its market share from 5.8 to 11.6 per cent in the same period, while other hybrid ports like Port of Spain, Puerto Cabello or Point Lisas are not able to gain market share. Cartagena’s transshipment share in total container movements increased significantly since 2005 when Hamburg Sued decided to make the port its strategic transshipment hub for Latin America and the Caribbean connecting to seven of the carrier’s services between North and South America, the Caribbean, the Mediterranean and North Europe. Hamburg Sued’s transshipment volume through the Cartagena has increased fivefold between 2006 and 2012 (Port Strategy, 2012). A particular case in this category is Caucedo,

Dominican Republic. The port appeared in 2003 based on a greenfield development and operated by a the global terminal operator DP World with the aim to become a new transshipment port in the region. Since then the port has evolved from to a hybrid port by capturing significant amounts of the increase in local destination cargo and at the same time pursuing the goal to attract transshipment cargo. The latter reaching a share of above 50 per cent of all container movements in 2011

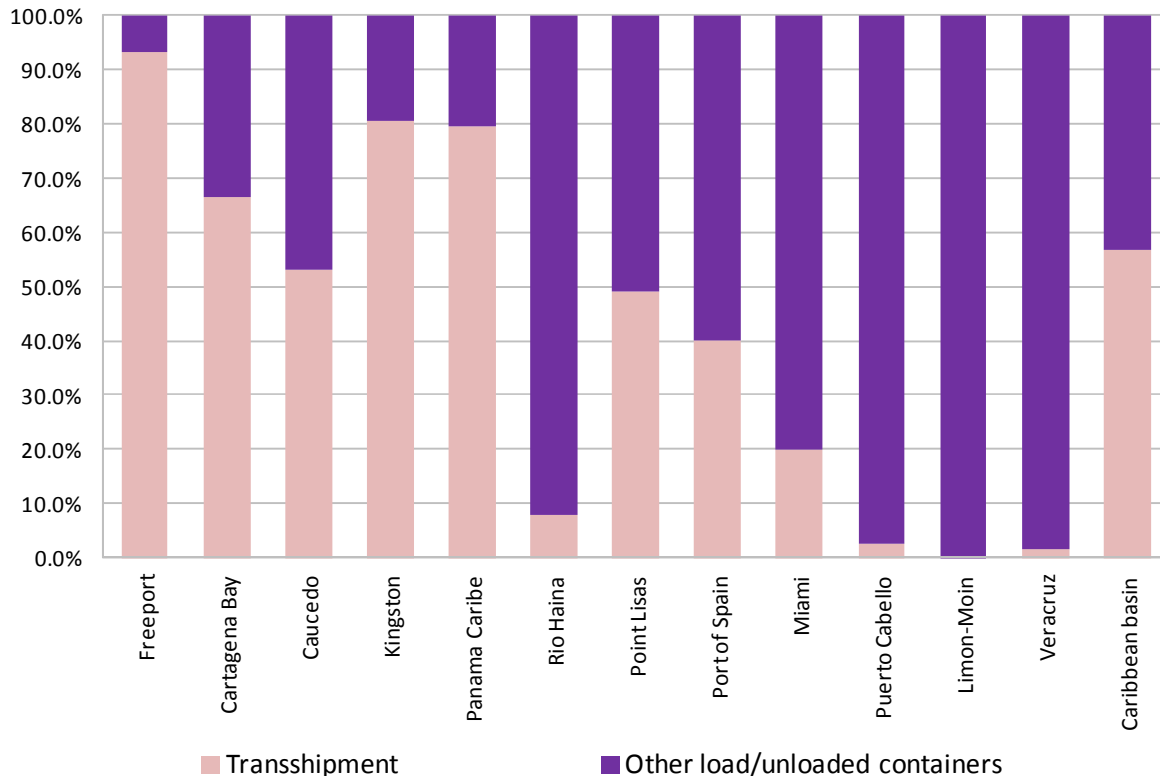


Figure 7: Share of transshipment and origin/destination cargoes for selected ports in the Caribbean/ECCA/NCSA port system (Source: Sanchez, 2012)

The gateway ports were not able maintain their market participation, despite their growth in container throughput. Sanchez (2012) observes a significant geographical shift in the Caribbean/ECCA/NCSA port system driven by changes in the evolution of traditional transshipment ports and the emergence of new players as well as the expectation in the logistics system resulting from the Panama Canal widening.

Beyond the changes in throughput volumes the appearance and evolution of port devolution processes in the region since the beginning of the 1990s has marked critical moments for those countries and ports involved. This development is closely linked to the appearance of international port terminal operators from the region and also global terminal operator groups (see also Sanchez and Wilmsmeier, 2006). The comparison of the presence of international terminal operators in the region in 2006 and 2012 reveals how the influence of these actors

increases. By 2006, 35 container terminals were being operated by international and global terminal operators in 12 countries of the region. This number increased to 51 by the beginning of 2012.

While the pure presence of private port operators is not a guarantee for success in port and terminal development it can be argued that these operators changed the level of competition in the different sub-regions. Until 2006 intra-port competition was restricted to the port of Buenos Aires, the Caribbean coast in Panama and to the competition between Valparaiso and San Antonio in Chile as they serve a congruent hinterland. Since then the further influx of international terminal operators has brought a new level of intra-port competition to Callao, Peru (APMT and DPW), Panama's Pacific coast (PSA and HPH), Buenaventura, Colombia (TCB and ICTSI), Lazaro Cardenas (APMT and HPH), Manzanillo, Mexico (SSA, HPH, ICTSI), Santos (DPW, APMT and Santos Brazil). It is interesting to observe that each international operator shows specific geographic specialisation strategies. In the first phase during the influx of international operators the interest concentrated on the countries' main ports of which many in the 1990 did not have sufficient scale (except Buenos Aires and Panama Caribbean coast) to make operation viable for two competing operators. The continued growth in demand has changed this situation and since 2005 we the increase in competition can be observed as describe above. HPH has a clear dominance in the Central American market (i.e. Mexican market). APMT has been focussing on new terminal developments strong interest not only in transshipment cargoes but lately rather gateway ports with potential to develop towards hybrid ports. DPW has a more equilibrated presence in each sub-region. These findings underline the advances in the evolution of the port system as proclaimed by Wilmsmeier and Notteboom (2011).

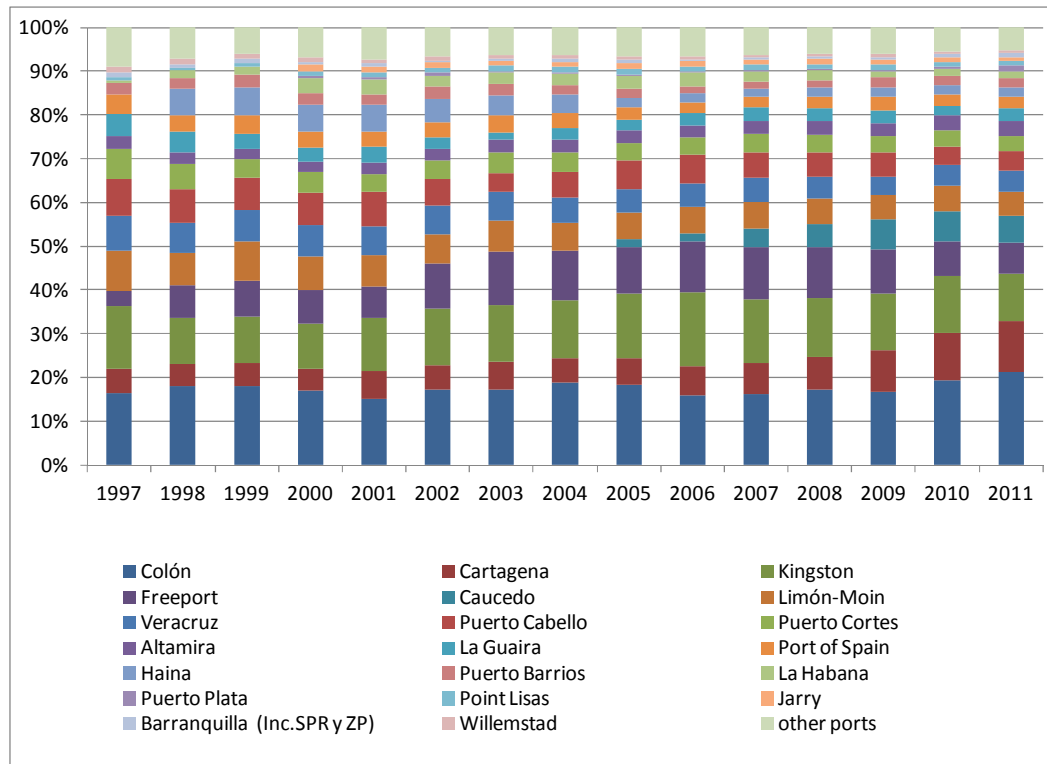


Figure 8: Shares in container throughput in Caribbean/ECCA/NCSA, 1997 to 2011
 (Source Authors, based on ECLAC)

A number of questions emerge from the descriptive analysis regarding the evolution of the region’s port system and sub-systems. What were the critical moments and what were the criteria of success that some ports converted these moments into critical junctures for the port system development in LAC? If the LAC port system is evolving from concentration to deconcentration, what implications does this have for the region’s and countries’ strategies and policies? What is the role of shipping lines in driving the emergence of new and secondary ports? What are the reasons that traditional ports fall start to lose their position in the system? Has the influx of global and international port operators contributed to the shifts in the port system? In how far does the economic development not only contribute to growth, but also to geographically diverse growth of container ports? Are other economic or institutional variables playing a role for the emergence of these ports? Which ports have been successful in taking on the “the challenge of the periphery”?

6. Discussion

The advances in port devolution and deregulation of port infrastructure and transport services in general opened new scales for development in the region. Port devolution brought a significant change to the region transforming the structure of actors and their relationships and

thus creating new drivers and strategies in port development and asking for an institutional adaptation process.

Until today the focus has been almost exclusively on the development of main container ports, leaving only residual attention to secondary port development in the region. Therefore many of the previously described changes and transformation in the different sub-regions have happened almost unnoticed or at least not been part of a contextual debate of port system development challenges and opportunities.

These new developments offer opportunities and needs for policy implementation that reaches beyond the physical development of single port infrastructures and traditional port operations in main ports and as it requires addressing more strategic and integrated possibilities of system developments. Success in an increasingly competitive environment can only be achieved, if the institutions and private sector actors are able to identify the crucial moments and are enabled to convert these into crucial junctures.

Based on the analysis the following main critical moments can be identified to have influenced the port system development in Latin America & the Caribbean. These did neither appear in sequence nor simultaneously but rather in a diversified spatio-temporal manner.

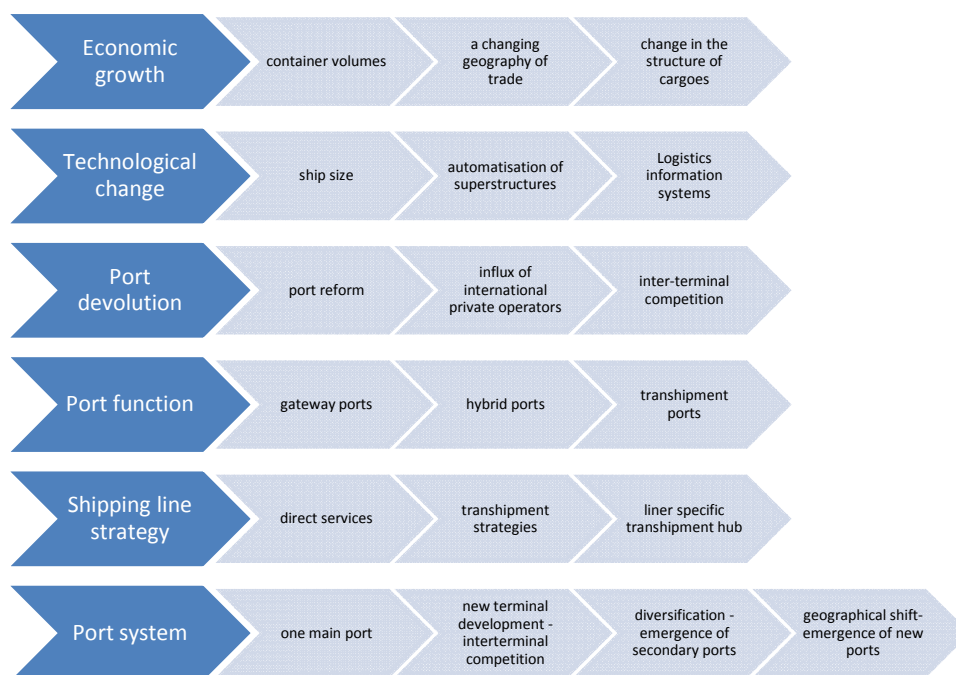


Figure 9: Critical Moments in LAC port development between 1990 and 2011 (Source: Authors)

The analysis of the port system in this paper hints that countries and also individual ports (represented by their actors, either public or private) were able to make use of critical moments in more and less successful manners. Given the historic need for infrastructure development in the region most attention was given to the main ports and the development

and role of secondary ports at national and regional level was frequently forgotten in the analysis. However, secondary port are starting to engage in more integrated development strategies strategy that also include the consideration of logistics development connected to the port (e.g. Manaus, Brazil, Puerto Angamos, Chile).

The introduction of bigger vessels on the world's mainline routes can be expected to initiate a process whereby vessels cascade down to the secondary LAC routes and creating requirements for new infrastructure not only in the region's main ports but also the secondary ones. A recent study expects that 13,000 TEU ships will start to call regularly on the coasts of South America between 2016 and 2020 (Sánchez and Perrotti, 2012), which will have direct implication on the liner shipping networks and port infrastructure in the region. If some of the secondary ports will not be able to handle bigger size ships due to insufficient handling capacity to accommodate them, this would support the growth of regional second-tier hubs, which can then serve the smaller ports either by smaller feeders or even land transport (thus raising issues relating to the quality and capacity of hinterland infrastructure links).

Additionally, the introduction of ever-larger vessels on mainline routes may be attractive for shipping lines but will strain ports severely. Ports invest large sums upgrading their facilities and competing to receive vessel calls, but handling such demand spikes is difficult. Large container drops can result in inefficient crane utilisation, as the numerous large cranes required to service large ships are not all required between calls; furthermore, such numbers of containers cannot always be moved in and out of the port in a smooth manner. Second, shipping lines already cannot meet their own schedules; current average reliability across the industry is below 70 per cent. The larger the vessel and the larger the drop of containers at each call, the larger the knock-on effect of such poor reliability on the rest of the container system.

The use of the first mover advantage for greenport development like in Caucedo is already showing repercussion in the market participation of ports. The advantages gained by these ports in the "battle" for a position particularly in the transshipment market, will be difficult to replicate by the competitors that have only recently started to develop their strategy in this directions.

When analysing port evolution of a port system and its sub-systems, it is important to be aware of the effects of path dependence and the contingency of port development upon port devolution, competition and public planning approval. The work in this paper underscores the temporal aspect of path dependence. For inverting peripheral status, the first mover advantage is of considerable importance because when fighting for a small market, coming in against an incumbent is an unattractive business proposition in a sector with large upfront investment, large sunk costs and a long payback period. However, proactive strategies such as those by Caucedo and Cartagena seem to be challenging traditional path dependence. With the devolution process many countries have left port development in the hand of the private

sector , but this position ignores the realities of, as Swyngedouw puts it, ‘the production of locational effects as a result of capital investment in space’ (p. 424). Fleming and Hayuth have also noted how the virtues of centrality and intermediacy that create strategic locations can be manufactured. But how will future private investment and institutional capacities current development, particular in a region where government investment in ports is almost absent. There seems certain evidence from the above analysis that the manufacturing of strategic locations can be successful and may have initiated the emergence of secondary ports in LAC.

The available data suggest some evidence for a deconcentration of container traffic within the LAC port system, related to a shift both in gateway regions and a shift from a gateway role to a transshipment role, thus supporting the movement of cargo through secondary LAC ports. More research is required, but these identified shifts have potential benefit for secondary ports, many of which are pursuing significant port expansions to take advantage of this expected trend. These ports seek to reposition themselves within an emerging feeder market that could reduce their peripherality that has been embedded by the traditional LAC port and infrastructure system. The paper thus raises questions about port policy and both public and private sector responses to a changing LAC port geography.

7. Conclusion

Port development in LAC has been driven by significant and continued growth of container traffic. Strategies of liner shipping companies have evolved towards a wide implementation of hub-and-spoke networks, while the effects of path dependence and the contingency of both private investment and public planning approval have been found to play an important role in port development, further embedding emergent port hierarchies. The work in this paper takes these notions forward by underscoring the spatio-temporal aspects in port system evolution and relates to the importance of a systemic view and analysis of port system development in order to identify critical moments and junctures.

References

- Barke, M. 1986. *Transport and Trade; Conceptual Frameworks in Geography*, Edinburgh: Oliver & Boyd.
- Bird, J. 1963. *The Major Seaports of the United Kingdom*, 33 London: Hutchinson & Co.
- Cullinana, KPB and Khanna, M. 2000. Economies of scale in large containerships: optimal size and geographical implications, *Journal of Transport Geography*, 8, p181-195

- Cullinane, KPB and Wilmsmeier, G. 2011. The Contribution of the Dry Port Concept to the Extension of Port Life Cycles. In: Böse, J. W., ed., 2011. *Handbook of Terminal Planning*. New York: Springer.
- Ducruet, C, Notteboom, TE and de Langen, PW. 2009. Revisiting inter-port relationships under the New Economic Geography research framework. In *Ports in Proximity*, Edited by: Notteboom, TE, Ducruet, C and de Langen, PW. 11–28. Farnham: Ashgate.
- Fagerholt K. 2004. A computer-based decision support system for vessel fleet scheduling – Experience and future research. *Decision Support Systems* 37(1), 35-47.
- Fremont, A and Soppe, M. 2007. Northern European range: Shipping line concentration and port hierarchy. In *Ports, Cities and Global Supply Chains*, Edited by: Wang, J, Olivier, D, Notteboom, T and Slack, B. 105–120. Aldershot: Ashgate.
- Hayuth, Y. 1981. Containerization and the load center concept. *Economic Geography*, 57: 160–176.
- Hoyle, BS. 1968. East African seaports: an application of the concept of ‘anyport’. *Transactions & Papers of the Institute of British Geographers*, 44 pp.163-183.
- Jacobs, W and Notteboom, TE. 2011. An evolutionary perspective on regional systems: The role of windows of opportunity in shaping seaport competition, *Environment & Planning A*, 43(7), pp.1674-1692.
- Magala, M and Sammons, A. 2008. A new approach to port choice modelling. *Maritime Economics & Logistics*, 10, (1-2), pp. 9-34
- Maturana, H and Varela, F. 1980. *Autopoiesis and Cognition: the Realization of the Living*. Robert S. Cohen and Marx W. Wartofsky (Eds.), *Boston Studies in the Philosophy of Science* 42. Reidel Publishing Co.
- Mingers, J. 1994. *Self-Producing Systems*. Kluwer Academic/Plenum Publishers
- Monios, J and Wilmsmeier, G. 2012. Giving a direction to port regionalisation. *Transportation Research Part A: Policy and Practice*, 46: 1551–1561. [CrossRef]
- Monios, J and Wilmsmeier, G. 2012. Port-centric logistics, dry ports and offshore logistics hubs: Strategies to overcome double peripherality?. *Maritime Policy & Management*, 39: 207–226.
- Ng, AKY. and Pallis, AA. 2010. Port governance reforms in diversified institutional frameworks: generic solutions, implementation asymmetries. *Environment & Planning A*, 42 (9) pp.2147-2167.

- Nijkamp, P. 1998, European Regional Development Policies and Foreign Direct Investments. Seier Research Memoranda. The Netherlands
- Notteboom, TE and Rodrigue, J. 2005. Port regionalization: Towards a new phase in port development. *Maritime Policy & Management*, 32: 297–313.
- Notteboom, TE. 2005. The peripheral port challenge in container port systems. In *International Maritime Transport: Perspectives*, Edited by: Leggate, H, McConville, J and Morvillo, A. 173–188. London: Routledge.
- Olivier, D. and Slack, B. 2006. Rethinking the port. *Environment & Planning A*, 38 (8) pp.1409-1427.
- Rimmer, PJ. 1967. The search for spatial regularities in the development of Australian seaports 1861 – 1961/2. *Geografiska Annaler*, 49 pp.42-54.
- Robinson, R. 2002. Ports as elements in value-driven chain systems: The new paradigm. *Maritime Policy & Management*, 29: 241–255. [Taylor & Francis Online], [CSA]
- Rodrigue, J-P and Notteboom, TE 2010. Foreland-based regionalization: Integrating intermediate hubs with port hinterlands. *Research in Transportation Economics*, 27: 19–29.
- Sánchez RJ and Perrotti DE. 2012. Looking into the future: big full containerships and their arrival to South American ports. *Maritime Policy and Management*, Volume 39, Issue 6, 2012.
- Sanchez, RJ and Wilmsmeier, G. 2006. The river plate basin – A comparison of port devolution processes on the East Coast of South America. *Research in Transportation Economics*, 17: 185–205.
- Slack, B and Wang, JJ. 2002. The challenge of peripheral ports: An Asian perspective. *Geojournal*, 56: 159–166.
- Strambach S. 2010, Path dependency, path plasticity – the co-evolution of institutions and innovation. The German business software industry. In: Boschm, RA and Martin, R (eds). *Handbook for Evolutionary Economic Geography*, p 406-431. Cheltenham. Edgar Elgar
- Swyngedouw, E. 1992. Territorial organization and the space/technology nexus. *Transactions of the Institute of British Geographers*, 17: 417–433.
- Taaffe, EJ, Morrill, RL & Gould, PR. 1963. Transport expansion in underdeveloped countries: a comparative analysis. *Geographical Review*, 53 (4) pp.503-529.
- UNCTAD, 1992. Development and improvement of ports: the principles of modern port management and organisation. Geneva, Switzerland: UNCTAD.

Wilmsmeier, G and Sanchez, R. 2010. Evolution of shipping networks: Current challenges in emerging markets. *Zeitschrift fuer Wirtschaftsgeographie*, 3/4: 180–193.

Wilmsmeier, G; Martinez-Zarzoso, I; Fiess, N. 2011 Regional hub port development - the case of Montevideo, Uruguay. *International Journal of Shipping and Transport Logistics*, Volume 3, Number 4, pp. 475-493(19)

Wilmsmeier, G. and Monios, J. 2013. Counterbalancing peripherality and concentration: an analysis of the UK container port system, *Maritime Policy & Management*, 40(2), pp. 116-132.