

Port Investment and Container Shipping Markets

Roundtable Summary and Conclusions

03

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Avril 2014

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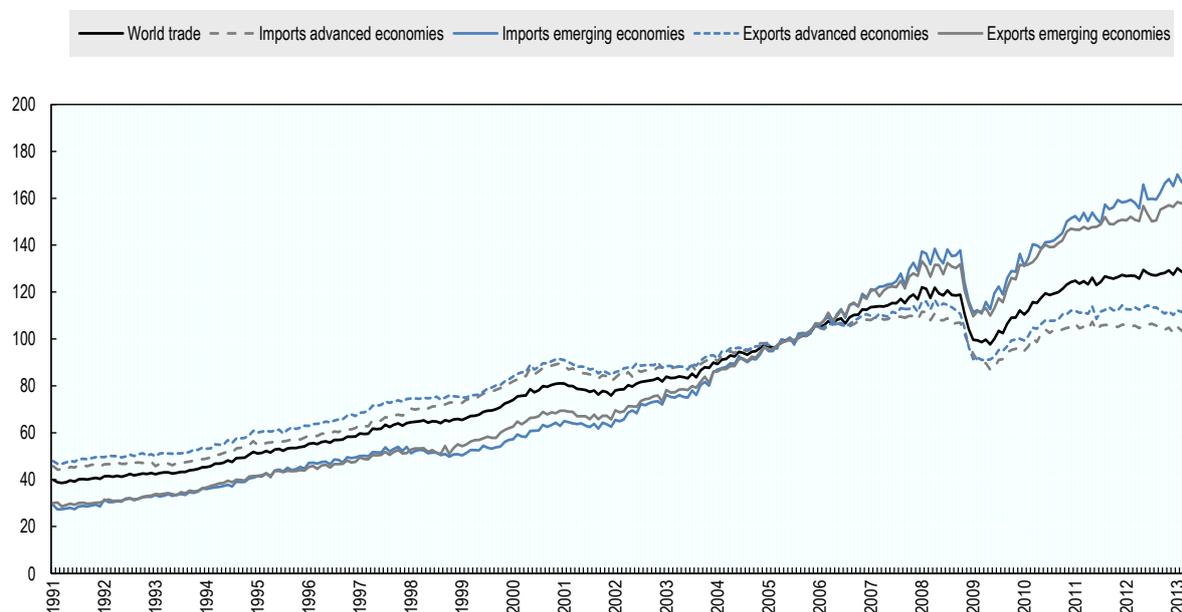
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1. INTRODUCTION

1.1. The Context for Container Port Planning

Ports around the globe are planning expansions to respond to the growth of containerised maritime trade and to the development needs of their hinterland economies. Following the dip in trade induced by the 2007-2008 financial crisis, global volumes are on the rise again (Figure 1), driven by growth in the emerging economies. Growth in trade will be supported by the WTO Trade Facilitation Agreement signed in Bali in December 2013 and expanding container port capacity is again a pressing issue in many locations. Inadequate container port infrastructure can be a severe logistics bottleneck and a constraint on growth. Efficiency and capacity need to increase in step with demand. At the same time port policy makers and container terminal operators have to match capacity to demand carefully to avoid costly overinvestment, a task complicated by rapid technological change in liner shipping markets with the introduction of larger vessels, rising fuel prices and restructuring through mergers and alliances.

Figure 1. **Monthly index of world trade**
Advanced and emerging economies, 2005=100



Source: CPB Trade Monitor, June 2013.

Large-scale port projects have irreversible effects on land use and multiple impacts on the local economy and local community. They affect the way that the regional and national economy operates as a whole, not just in the vicinity of the port, with major impacts on regional transport systems. Port planners make better decisions when these broad impacts are examined as part of the development of a national freight transport and logistics

strategy. Private investment in port terminals is also facilitated by the certainty engendered by development of such a national freight transport and logistics strategy. Decisions to invest in new container ports need in particular to take careful account of forecasts of hinterland demand for containerized trade, the broader context of evolving maritime transport markets, competition between ports, the development of port hinterland transport infrastructure, community attitudes towards port traffic and environmental issues.

This report summarises a roundtable on Port Investment and Container Shipping Markets held in Santiago, Chile in November 2013 that examined the issues that need to be considered before the decision to proceed to costly expansions with long-life spans and a structural influence on the local and national economy. The report benefits from a case study of Chile, where plans for a major expansion of port capacity in the central part of the country are well advanced. Chile provides the detail for an examination of factors critical to decisions on container port investments everywhere:

- demand forecasts;
- change in liner shipping markets;
- hinterland transport capacity;
- competition between container terminals; and
- financing of investment.

The report is organised in 5 sections that address these issues in turn.

1.2. Case Study: Chile

Geographical location and physical geography make Chile more dependent on maritime trade infrastructure than many other economies. Chile's exports account for 38% of GDP compared to an average of 27% in OECD countries. Approximately 95% of Chile's foreign trade is transferred through its ports, with 75% of the total tonnage transferred by three ports – Valparaiso, San Antonio, and San Vicente – located in the central-south part of the country, close to the centre of economic activity around Santiago and some of the country's main agricultural areas. Ports in the north and south account, respectively, for the major part of mine and forest products. Container transport is concentrated in the three central ports.

The national port system uses a landlord model of port governance, widely applied around the globe. Following reform of the national port sector in the 1990s, responsibilities for port development was devolved in 1997 to 10 autonomous local Port Authorities (Empresas Portuarias), the mandate of which is to ensure good quality infrastructure and efficient port operations whilst maintaining sound finances¹. There are also 14 privately owned public-use ports, carrying various cargoes as well as smaller amounts of container traffic (Wilmsmeier 2013).

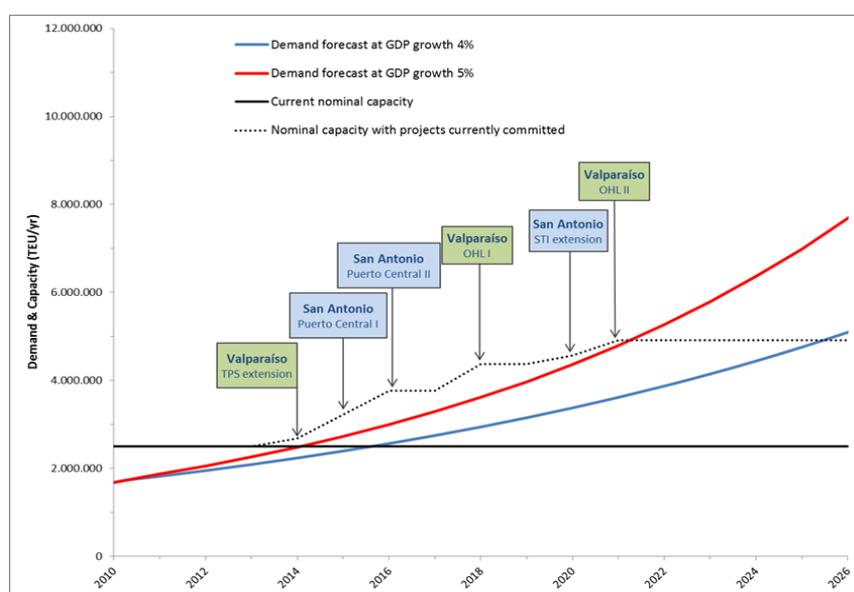
The Chilean landlord port model differs from that typical in Europe and North America in two ways. Terminal operators rather than port authorities are responsible for investment in piers and quays and port authorities are explicitly excluded from performing cargo handling operations. While port authorities in Chile purchase land for port development, they must concession freight transfer operations and pier infrastructure development to private operators. Sixteen years after the reform, seven out of 10 Port Authorities had concessioned at least one terminal.

Chile's rapid economic development is reflected in container traffic growth and investments are underway to meet forecast demand through extensions to terminals and new concessions

1. Modernisation of State Ports Act (Law 19.542).

in the existing ports (Figure 2). Whether planned investment might be delayed, and for how long, by enhancing productivity at the two terminals are questions to be considered. Additional productivity enhancements might delay the need for investment, but with San Antonio's current berth productivity already the best in South America, the delay may be of short duration². With committed facilities potentially reaching saturation in a decade, a major expansion of port capacity is planned. In this context the Ministry of Transport began work on a National Ports Development Plan in 2012 to provide long-range vision on port capacity needs and a strategy for landside infrastructure development so that private investments in port terminals are able to deliver the services needed by the national economy. Following an initial examination of four potential locations in the central region – Ritoque, La Ligua, San Antonio and Valparaíso – the two latter ports were identified as potential sites for a large new container port with several terminals. Both sites might be developed in sequence. The options for expansion under consideration by the government and the process of project selection and development of a national port and freight transport development strategy are set out in an accompanying paper (Michea 2013).

Figure 2. **Demand & capacity - existing and projected container terminals in the Santiago region**



Source: Michea (2013).

In a nutshell, Chile presents a case of proactive port planning as a key to sustained economic growth. Examination of how it might proceed in establishing new capacity, via which type of projects and which aspects of shipping markets and hinterland transport and logistics are most crucial to the decision is instructive. Many countries face the need to advance major port expansions and the case of Chile offers lessons for a wider audience.

2. In the top 20 ports in the Americas for berth productivity, San Antonio is currently rated as having a berth productivity index of 43, above that of Manzanillo in Mexico (42) but below that of Lazaro Cardenas, Mexico at 65 (page 9, Journal of Commerce (2013). The best practice port in the Americas is Long Beach at 74, showing that there is always room to improve productivity by benchmarking business processes against best in class.

2. DEMAND FOR PORT CAPACITY

2.1. Forecasting Demand

Forecasting demand for port services to align container handling capacity with the prospects for economic development requires disaggregation of global container shipping trends from regional and local economic factors. Local drivers of container traffic can be identified to a greater level of detail. It is useful to examine port regions, incorporating capacity present in the entire region rather than focusing on capacity limits at single ports. Projections of demand need to be compared with actual, rather than designed port capacity as capacity is a function of terminal operating efficiency as well as physical dimensions. Performance measurement and monitoring is essential to making informed investment decisions. Development of port capacity and performance indicators is deficient in many parts of the world and should be given priority by all port stakeholders.

Port productivity improvements can often reduce the pressure for expansion in the short to medium term; there are numerous methods by which higher utilization can be extracted from existing facilities including relatively small investments in container yard handling equipment, investment in new business processes and information technology systems, introducing port gate arrival reservation systems, introducing financial incentives to reduce port dwell time, extending the number of gang shifts or adding cranes, and so on. The potential for such productivity improvements can be overlooked in demand projections based on past performance and future economic growth but as noted Chile's main ports appear to have little margin to improve productivity without expansion.

The prospects for terminals of any size depend on productivity and utilization rates. The existing container terminals in Chile are intensively utilized, with dense operations and high levels of productivity. In the case of Valparaiso, the operational area is 14.62 hectares with an annual yard operation rate of 58.13 k TEU/Hectare. This is achieved via a container handling productivity that averages 70 moves per hour, twice the average in 2005. Valparaiso averages 2.1 movements per container and 2.6 days dwell time, with 30 minutes average truck waiting time. The port handles approximately 1 600 TEUs per meter of quay annually; the average figure is more than 1 200 in South-East Asia, approximately 1 000 in Latin America, and less than 800 in Europe and North America (Caprile 2013). This makes Valparaiso an extremely efficient operation and the prospect of accommodating more throughput at current capacity is remote. In the 2013 *Journal of Commerce* port productivity exercise, San Antonio was the only port south of the Panama Canal included in the list of the 20 most productive ports in the Americas (Journal of Commerce 2013). The room for improvement here is thus also comparatively limited. Accommodating more traffic in either port requires new capacity.

The difficulty of predicting future demand for ports is widely acknowledged and all long-term projections face uncertainty. Forecasts therefore need to examine alternate scenarios, at the very least to test different overall rates of economic and trade growth. Often more detailed, plausible scenarios can be identified to gauge the potential impact of specific risks.

Producing a range of credible scenarios will identify the period over which capacity limits are likely to become critical (Figure 2) and can give an idea of how robust different projects and development schedules are to change.

Scenario testing tended to be ignored in the bubble economy at the turn of the century, with globalization driving trade on top of economic expansion and consequent strong sustained growth in container shipping. Linear, even exponential, growth was expected by many to continue for years. The financial crisis of 2007 and subsequent economic recession exposed the deficiencies in this mind set. This problem is not of course unique to the port sector and optimism bias in demand forecasts frequently characterises major transport infrastructure projects (ITF 2013). The lumpy nature of new port development (large units of capacity brought into service at irregular intervals) makes it particularly difficult to match capacity to demand and can result in prolonged periods of over-capacity. This is a recurrent issue in northern European ports, exacerbated by long planning and approval procedures. The opening in 2012 of a 2.7 M TEU capacity terminal in the new Jade Weser Port in Wilhelmshaven is the most recent major increase in capacity and for the moment has limited throughput (Acciaro and McKinnon, 2013). Sometimes demand never materialises. In ten years of operation the Ceres-Paragon 1 M TEU terminal in the port of Amsterdam never handled more than 0,3 M TEU and is now disused. Competition to attract traffic between port authorities that provide quays and piers with public finance may exacerbate the trend in this range.

Chile belongs more closely to the emerging economies in Figure 1 than the advanced economies in terms of trends in trade growth. It is experiencing rapid economic expansion and has a great deal of potential for further expansion of exports, depending on sustained growth in the economies of its trading partners. Chile has 22 trade agreements with 59 countries – among them Canada, Mexico, the United States, the European Union, China, and Japan – representing 86% of world GDP and 62% of world population. More free trade agreements are in negotiation. 93% of Chilean exports are covered by these agreements. Container traffic in the central region of Chile is forecast to outstrip port capacity as early as 2021. The diversity of Chile's markets reduces vulnerability to possible prolonged economic stagnation in Europe but calibration of trade forecasts with scenarios for economic growth in key trading partners might be a useful refinement to current forecasts.

Forecasts of demand for maritime transportation services are commonly produced with the use of econometric models based on correlations and regression analysis that often produces exponential projections. Disaggregated econometric analysis is valuable for understanding the current drivers of growth, product category by product category. It is also valuable for calibrating alternative scenarios. Clearly the potential time over which exponential growth can continue varies greatly by market and commodity. Many markets will show signs of saturation over the timeframe for project planning, with demand following an S shaped curve. In aggregate, Chilean container shipping markets are likely to be on the steep part of the curve for some time to come. Moreover, import consumption patterns could change sharply as average incomes rise with potentially large increases in imports of consumer durables and electronics. Potential limiting factors for some key commodities should nevertheless be investigated; for example, the availability of irrigation water has the potential to limit expansion of fruit production for export in the central belt of Chile. Imports and exports of non-containerised goods also need to be forecast as container terminals often share port space with bulk goods and both absorb hinterland transport capacity; in central Chile this includes significant quantities of copper plate for export and imports of milled steel.

Other variables that might determine the demand for container trade include productivity growth in the domestic economy (which has been sluggish) and transport and economic integration with neighbouring countries. Some specific developments are worth modelling,

including plans for a new railway crossing the Andes from Mendoza in Argentina north of Santiago and a new highway link located about 100 km south of Santiago, which will provide a faster route through a lower pass than the existing route north of Santiago and will be less prone to closure by snow.

2.2 Specific market segments

Specialised container markets have their own dynamics and deserve close attention as they provide opportunities for growth and could compete for capacity with existing traffic. Demand for refrigerated containerised (reefer) cargo exports is increasing globally and particularly strongly in South America (Vagle 2013). Vessel capacity for reefers has increased correspondingly, with ships serving Brazilian ports holding the record for the number of plugs for refrigerated containers. Demand from cargo owners and shipping lines for shore-side reefer plugs is similarly increasing. Growth in this demand has been notable in Chile as its exports of fruit and seafood have tripled over the last decade (Wilmsmeier 2013). Seasonal produce like fruit is particularly vulnerable to delay from port congestion. For ports that export large quantities of seasonal produce it is also the critical driver of congestion. Capacity and reliability at peak demand periods are the relevant congestion indicators rather than average utilisation rates.

Reefer cargo in increasing volumes is moved using transshipment as port operations in transshipment ports in the region have significantly improved their efficiency (e.g. in Panama and Cartagena, Colombia). Still, reefer trade pays a significant premium, and reefer cargo owners prefer to avoid transshipment services.

Another issue worth exploring is the potential of demand from underdeveloped segments of the container shipping market. Expansion of the range of goods transported in containers might shift traffic from the non-container segment of the market, i.e. bulkers, to container ports. Chile's primary export of copper is not particularly suited to containers but there may be other cargoes that will benefit from container port expansion. Assessment of the scope for such modal segment shift is worthy of investigation including review of recent trends in containerisation of commodities on other trade routes.

2.3 Congestion

Commonly, congestion problems appear in ports when the average terminal utilization of a heavily used facility passes the 70% mark. This may be the result at certain times of the year of seasonality in trade flows. Extended gate opening hours can provide some response to seasonal peaks but, where this traffic represents a large part of the total volume of trade, peak demand is the relevant planning criteria. In Chile, Valparaíso and San Antonio ports already show symptoms of congestion. In 2011, a ratio of waiting time/service time of 16.8% was reported as average for the STI San Antonio and TPS Valparaiso terminals, 10% being a broad 'best practice' reference figure for the ports. Congestion could clearly become a problem before the capacity and demand curves cross in Figure 2, i.e. before 2021. The emergence of congestion problems has intensified the efforts of planning at both port and national level as it will have increased overall logistics costs for container trades.

The cost of congestion and resulting inefficiencies experienced at the yard and along the logistics chain differ according to type of cargo, as does the extent that increased logistics costs are associated with increased manufacturing costs. However, in all cases these costs are significant and have a vital impact on the decisions of port users. Congestion may lead cargo owners, logistics service companies or shipping companies to relocate or completely reorganize transportation activities. If Chile's central ports were to suffer chronic congestion,

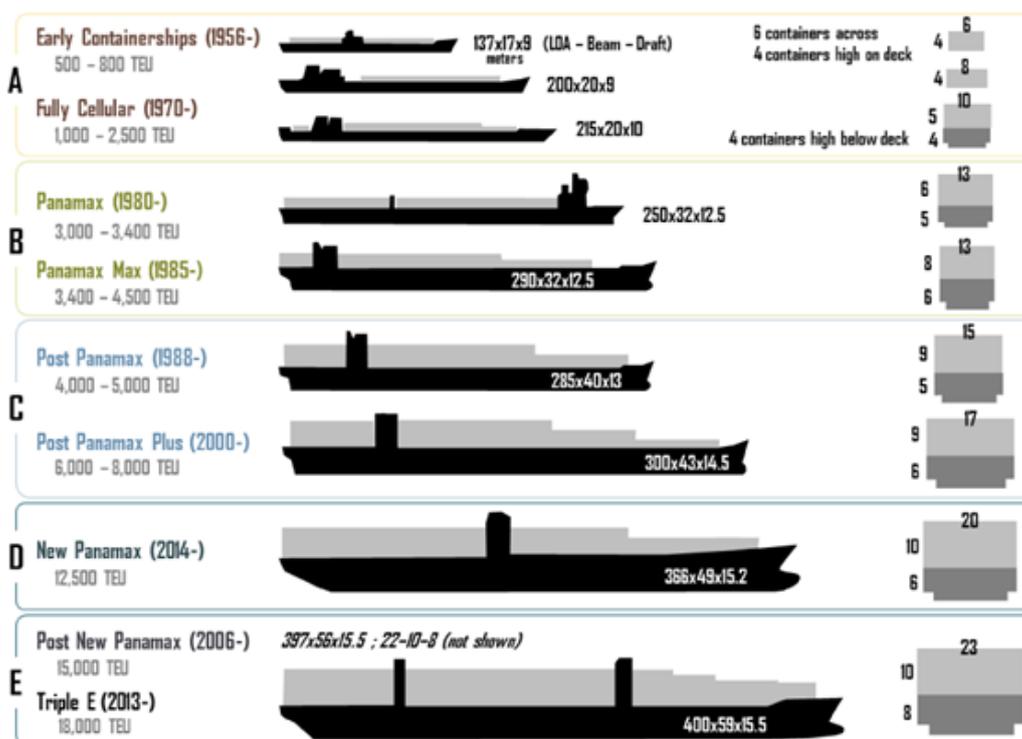
traffic would divert to the Concepción Region, 500 kilometres south. This would change landside costs and depending on origin/destination result in longer journeys by truck for some traffic and potentially higher costs, implying a loss in competitiveness for Chilean trade.

Port planners need to act well in advance of anticipated congestion. Due to the scale and complexity of major port developments and site-specific engineering challenges, environment permit approvals and maintenance of good port-city relations often require lengthy deliberations.

3. CONTAINER SHIPPING MARKETS

The configuration of shipping networks is an important factor in decisions about port infrastructure and port system development. One impact of the introduction of very large vessels (Figure 3) on high volume trade lanes has been a cascade of large vessels to other routes. General overcapacity of the container fleet in the wake of the financial crisis is also tending to increase vessel size on lower volume routes as older, smaller vessels are retired to make use of newer, more productive and fuel efficient vessels. As a result, larger ships are appearing in ports on lower volume routes. Very large 10 000 TEU capacity, 16 m draft ships already operate on the relatively low volume North-South trades serving the east coast of South America.

Figure 3. Evolution of New Generation Container Ships



Note: All dimensions are in metres. LOA: Length overall.

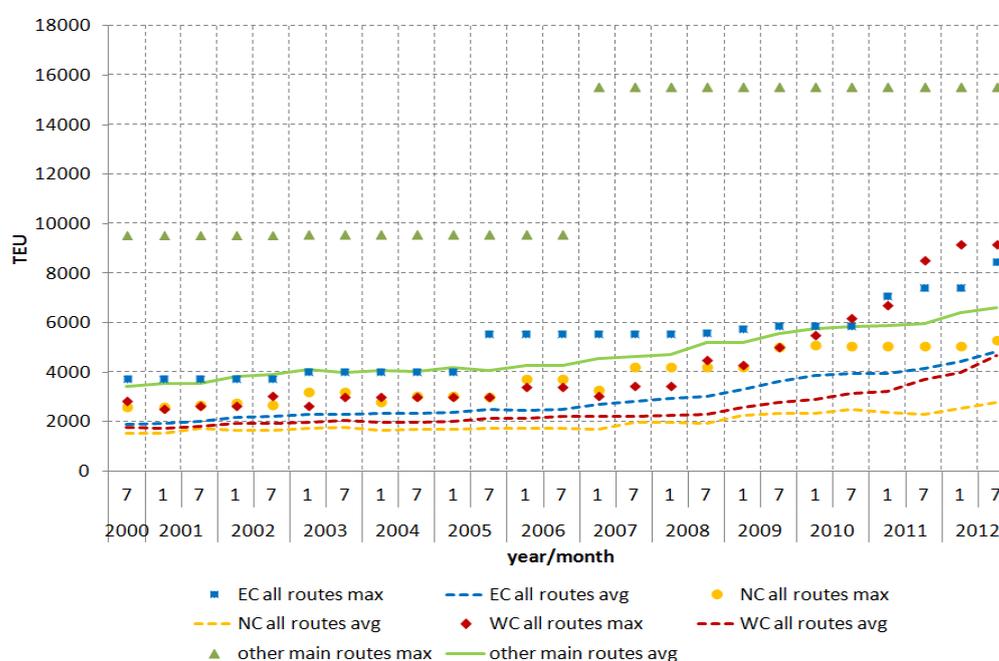
Source: Ashar and Rodrigue, 2012. Copyright Dr. Jean-Paul Rodrigue, Dept. of Global Studies & Geography, Hofstra University, New York, USA.

3.1. Overcapacity and Deployment Patterns

There is currently overcapacity in the global container shipping market, due mainly to two factors: (1) delivery of large ships ordered before the 2007 financial crisis and (2)

technological change, with the introduction of a new generation of even larger ships offering significant increases in productivity. The capacity of the top 20 carriers alone increased by 29% over the period 2010-12 (Slanderbroek 2013). The ultra-large containership, the biggest for the moment being the triple-E design, 18 000 TEU vessel has arrived. In the absence of strong growth in container volumes transported, their introduction has resulted in freight rates that are lower than experienced in the past in spite of a general recovery in seaborne trade in 2010-2012. Low freight rates, cash flow constraints imposed by banks restricting lending as they recapitalize in the wake of the financial crisis, and more expensive bunkering costs as oil prices stay high and fuel quality regulations require more use of high grade fuels³ have all contributed to the deterioration of liner shipping company accounts and negative financial results for the sector since 2010. As a result, shipping lines revisited their strategies for vessel deployment and network configuration, restructuring routes and services.

Figure 4. **Evolution of vessel capacity on main trade routes and in South America, 2000-2012**



Note: main trade routes include transpacific, transatlantic and Europe-Asia.

Source: Wilmsmeier (2013).

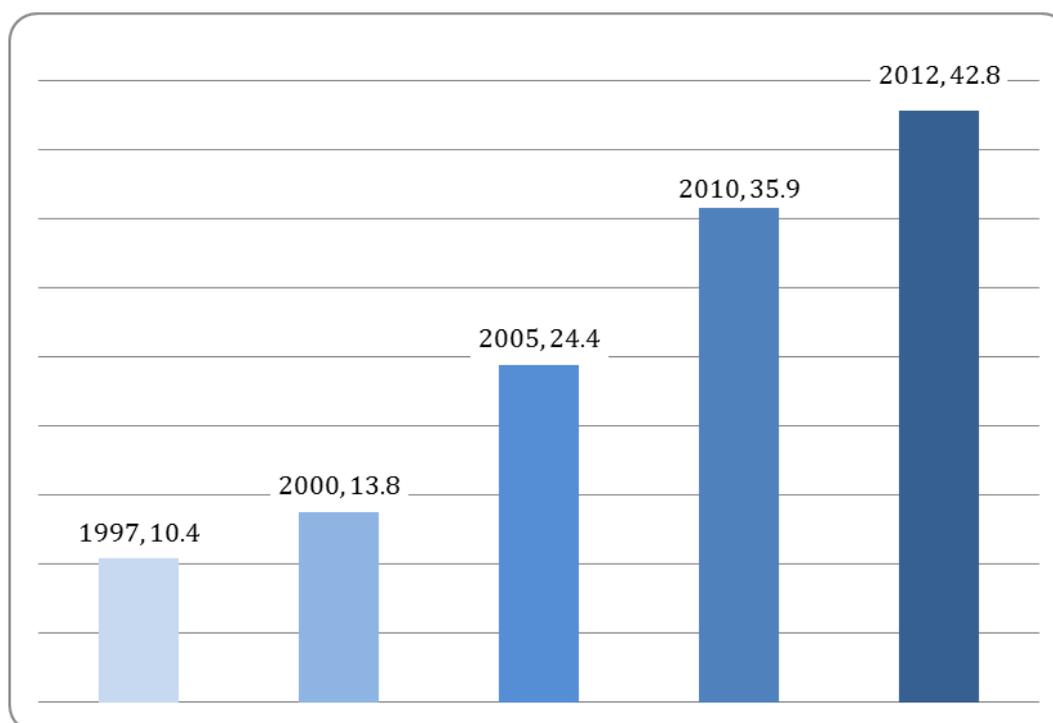
Since 2008 there has been an acceleration in the increase in the size of vessels deployed in all regions of the world (Figure 4). Since early 2013, ships of 18 000 TEU capacity have been introduced on the busy Asia-Europe routes, displacing post-Panamax size vessels (5 000-13 000 TEUs) onto routes operated by smaller vessels. South America is among the regions that has felt the impact of this cascading effect and has seen the deployment of larger container vessels. In recent times, the region saw vessels grow to 9 000 TEU on West Coast routes and 11 000 TEUs on routes to ports in Argentina. These bigger vessels serve a continuously increasing demand, based more on the dynamics of the Latin America and

3. In 2013 bunkering costs are on average six times more the bunkering costs of 2000; *ibid*.

Caribbean (LAC) economies (Figure 5) rather than the global seaborne trade development trends (Wilmsmeier 2013).

A worldwide order book of 110 vessels of between 10 000 and 18 000 TEUs to be delivered by 2016⁴ suggests that the cascade will continue. This may be a temporary phenomenon and large vessels might be redeployed to the main trade routes if growth picks up. Port policy makers need to anticipate both local and external factors that determine the size of vessels deployed on routes serving their market. In short, major new port developments in most regions will need to be designed to be able to accept very large vessels in terms of draft, quay length, turning basins and crane reach.

Figure 5. **Total Container Throughput in LAC ports** (MTEU)



Source: Wilmsmeier (2013).

3.2. Port Draft

Due to continuing increases in vessel size, existing container terminals with draught restrictions might face a degree of obsolescence. The international standard of 12 meters draught of a decade ago is obsolete; the new post-Panamax requirement is 13.2 meters plus and many international ports consider 15 meters the minimum to offer customers. In addition to deeper waters, container ports also need longer berths. Dredging capacity and adequate turning circles will become increasingly important to port access. In Chile, the current draft in Valparaíso is 12.5 meters and that of San Antonio 12.4 meters. Both ports have access to deep water with minimal dredging. Plans for new container ports at either location are based on a navigational depth of 16 m.

4. Source: www.alphaliner.com.

3.3 Consolidation and cargo-sharing agreements

Inextricably linked with these trends is a development of a different kind, consolidation of the liner shipping market and the presence of fewer but larger shipping lines. Horizontal integration affects competition, even when it takes the form of cargo sharing agreements rather than formal consolidation.

The most recent major cargo-sharing arrangement is the P3 Alliance involving three major carriers (Maersk, MSC, and CMA-GM) together representing 38% of the world's container fleet capacity. Together these three shipping lines operate a reported 255 vessels. The second major alliance is the G6 Alliance involving 6 carriers — Hapag-Lloyd, NYK, OOCL, Hyundai Merchant Marine, APL and MOL — that deploy 240 container ships serving 66 ports in Asia, America and Europe.⁵ If cleared by competition authorities in Europe and the USA, the formation of the P3 Alliance has the potential to be a game-changer. This might happen not only because of the success of this alliance *per se*, but also because of its influence on how other shipping lines decide to align their strategies. This will not only have operational implications for terminal operators but will also change the balance of negotiating power between ports and carriers, as well as between carriers and shippers. For the moment, the P3 Alliance is an agreement to be implemented on the Asia-to-Europe route where its partners are estimated to command a market share of 42%. If it is successful on that route, it is likely to expand to other parts of the world, including trans-Pacific trades.

3.4. The Panama Canal

The Panama Canal is currently being expanded to allow passage of larger ships. For container ships, the newly constructed facilities are expected to accommodate vessels up to 13 000 TEU by 2015, compared with a maximum size today of approximately 5 000 TEUs. This increase in capacity to handle larger vessels is expected to significantly reduce the cost of transoceanic shipping on a per container basis. Canal expansion could see large vessels operating West Coast South America—Europe trades. Accelerated development of transshipment hubs around the Canal might have an opposite effect; with shipping lines reconfiguring routes to serve South American ports through feeder services although the volumes currently being handled on both South American coasts suggest this is unlikely to be a dominant trend. Of the cargoes transported from/to Chile, 60% are traded with Asia and therefore little affected by Panama Canal considerations. On these Asian routes vessels of 9 000 TEU are already in service (Figure 4). Widening of the Panama Canal is not expected to significantly affect Chile's maritime container transport system; rather than creating a break in trend, recent trends towards larger vessels will be reinforced.

Similarly for North America, a major study by the U.S. Maritime Administration of the impact of the expansion on U.S. ports concluded that, beyond the immediate ports near the Canal, which can be expected to see significant growth, the expansion will only have major effects on specific trade routes (those providing East-West services between the Far East and U.S. East and Gulf Coast ports), and particular trades (agricultural and energy exports to Asia from U.S. East Coast ports will be able to move through the Panama Canal on larger bulk vessels operating at deeper drafts than current Panamax vessels). The study foresees no significant impact on West Coast U.S. ports (US DoT 2013).

Panama Canal expansion has been accompanied by significant investment in container terminals in the regions close to the Canal as well as in the Caribbean. Development has

5. Source: www.alphaliner.com

been notable at Cartagena in Colombia as well as further afield at Lázaro Cárdenas on the Pacific coast of Mexico. Further development of container capacity in Panama is expected, particularly on the Pacific coast. The Panama container terminals principally aim to attract transshipment cargo, inter-connecting Asia–East Coast South America and Europe–West Coast South America trades and exploiting scale economies. Lázaro Cárdenas in Mexico also has the potential to become a transshipment hub, given its location on east-west routes through the Canal and the size of its hinterland market, including Mexico City, with hinterland rail services stretching as far as Kansas City.

3.5. Port Policy and Efficient Scale

The configuration of shipping networks shapes port development rather more than ports shape shipping networks. In the 1990s for example, new shipping lines entered the Latin America and Caribbean (LAC) market, one example being the arrival of MSC in 2000 followed by a number of mergers and acquisitions of shipping companies in the region. This changed the pattern of port throughput in a range of ports and the pattern continues to evolve. Nevertheless, decisions on the configuration of liner shipping networks are influenced by land-side factors including port development plans, port and terminal operator's policies towards shipping lines, hinterland size, market specifics and institutional governance issues (Wilmsmeier 2013).

Scale is important. Without the prospect of scale economies it is difficult to attract the interest of terminal operators to invest in, or even operate, a terminal. As there are no limits on the absolute size of terminals, apart from physical constraints imposed by the site, the question of terminal/port size is one of demand, competition, and efficient operation. In some circumstances there may be a choice between opting for increasing capacity via one mega-project or planning two or more separate port expansion projects. There is no standard methodology for determining the technologically efficient size of ports and the size of efficient terminal handling capacity evolves with the ships to be served. Local and international terminal operators may have different views on the size of unit required to serve the market competitively. Modeling needs to be accompanied by observation of the market and discussions with potential port users on the optimal scale of development. Large container ports currently under development across the world typically comprise a number of 1.5 M TEU per annum capacity terminals, similar in scale to the two port developments under consideration in Chile. San Antonio would comprise four terminals of 1.5 M TEU capacity constructed in stages, totaling 6 M TEU when complete. Valparaiso would consist of two 1.5 M TEU terminals constructed in stages, totaling 3 M TEU).⁶ The level of intra- and inter-port competition, the specific geography of the port hinterland and the volume of the cargo base all influence decisions about inter-port competition and phasing of multi-port services. The scale at which a terminal can operate is also dependent, to some extent, on the size of the land site available for terminal development.

Evidence suggests that container terminals show a tendency towards an ever-larger scale. In Europe, the average scale of new terminals in the ports of the Rhine-Scheldt Delta increased from 0.5-1 million TEUs in the 1990s to two million TEUs and above in the second part of the 2000s. At throughputs of 300 000 TEUs per annum, it is viable for a port to commercially support two or more common user container terminals. However, the choices vary and there is no correlation between market size and number of terminals. At any specific throughput

6. Examples of new terminals within this range are found in Asia (i.e. Jebel Ali new Container Terminal 3, due to open next year, has an annual capacity of 4 MTEU; Port of Ennore, India 1.5 MTEUs), Europe (COSCO terminal in Piraeus increases to 3.7 MTEU in 2015) and America (Puerto Cortes, Honduras, 1.8 MTEUs)

above one million TEUs, there are from one to seven terminals, but in some cases the numbers are into double-digits. The benchmarks are strongly influenced by Asian ports, where there is a tradition of providing shipping lines with their own dedicated terminals and it is rare for landlord ports to support more than four common user operators. In Europe, the maximum number of terminals is five with the median size varying from 363 000 to 683 000 TEU per annum with the exception of Rotterdam. In North America, the maximum number of terminals is eight with the median size of terminals ranging from 300 000 to 746 000 TEU. Some South American ports like Rio de Janeiro have been deliberately subdivided at relatively low throughputs. On the other hand, around 23% of the large ports with container throughput above two MTEU in 2007 and about half of the ports with a throughput level between 1.5 and two million TEU have only one container terminal (Kaselimi et al., 2012). Roundtable participants agreed that for an anticipated long-term throughput growth to 6 million TEUs, a terminal offering 1.0-1.5 million designed capacity would be of interest to potential bidders and be efficient. Competition is well served with three terminal operators competing for the business in the port region.

Table 1. **Throughput scale of container terminals in ports for a sample of 423 ports around the world in 1000 TEU - figures for 2007**

| TERMINALS | AVERAGE | MEDIAN | MAX | MIN | ST. DEVIATION |
|-------------------------------|---------|--------|--------|-----|---------------|
| 1 (all ports) | 320 | 144 | 5.550 | 1 | 547 |
| 1 (throughput > 150.000 TEUs) | 609 | 400 | 9.269 | 117 | 988 |
| 2 | 1.033 | 299 | 13.550 | 59 | 2.280 |
| 3 | 809 | 566 | 3.154 | 114 | 795 |
| 4 | 687 | 505 | 2.300 | 153 | 598 |
| 5 | 454 | 507 | 588 | 312 | 120 |
| 6 | 1.613 | 1.066 | 4.000 | 321 | 1.698 |
| 7 | 863 | 901 | 1.194 | 353 | 331 |
| 8 | 1.784 | 1.784 | 3.269 | 299 | 2.100 |
| 9 | 928 | 928 | 1.474 | 381 | 773 |
| 10 | 532 | 287 | 1.079 | 231 | 474 |
| 11 | 375 | 375 | 375 | 375 | |
| 12 | 877 | 877 | 877 | 877 | |
| Total | 485 | 220 | 13550 | 1 | 1032 |

Source: Kaselimi et al. (2012), based on data of Containerisation International Yearbook 2009

3.6. Vertical Integration and Port Terminal Competition

The container terminals in Chile are at present all operated by domestic companies. International terminal operators have made preliminary preparations for bidding for terminal concessions in Chile in the past but withdrawn. The roundtable discussed the potential merits of investment in Chile by one of the international liner shipping companies operating its own terminal. This might have the advantage anchoring liner services to a Chilean port and stimulate shore-side investment in ancillary businesses. This, however, is already happening with, for example, recent investment by Maersk and MSC in manufacturing reefers at San Antonio.

Vertical integration of activities along the supply chain can yield economies of coordination, reducing costs, but can also reduce competition along the supply chain. Vertical integration combined with horizontal mergers and coordination agreements between shipping lines could affect competition significantly. Competition authorities in large jurisdictions such as the European Union and USA have far reaching effects on global shipping interests and existing

competition law provides adequate powers to maintain efficient markets (ITF 2010). Relatively thin markets distant from powerful competition jurisdictions, like Chile, are more vulnerable to monopolistic behaviour, and a foreign-based monopoly has the disadvantage compared to a local monopoly of being likely to repatriate rents abroad. The effective remedy is to minimise rents through adequate horizontal competition, between terminals. The view of the roundtable participants was that three competing terminal operators in the region served by San Antonio and Valparaíso are adequate and sufficient to ensure efficient prices and levels of service (Jara-Díaz, Tovar and Trujillo, 2008 and Tovar and Wall, 2012). With the establishment of larger terminals in a new port it will, however, be important to ensure that in time there are two competing terminal operators in first of the new ports, as the new terminals can be expected to enjoy economies of scale. As noted above, it is not obvious what the most efficient terminal size is. Assuming for a moment that larger yards with multiple berths do have advantages, the port project at San Antonio provides the possibility of concessioning the first and second terminals to different operators and, when terminals three and four are leased, allowing the operators of terminals one and two to compete for their adjacent units (see figure 7).

3.7. Cabotage and Short Sea Shipping

Transshipment is a significant part of container port expansion plans in many places. Chile, however, is located far from the main maritime shipping routes and far from zones propitious for transshipment where routes cross. Chile's ports are at the end of the line rather than at the gateway to a region of potential feeder ports. Transshipment does not therefore figure in the development plans of the country's ports. Plans for a large expansion of the port of Callao in Peru could have an impact on Chile but for similar reasons Callao is not well placed to develop transshipment. Liberalisation of cabotage in Chile could have a more significant effect, permitting efficiencies in the use of ships (reducing costs) and potentially substituting for some long distance road traffic (reducing the external costs of pollution, congestion and crashes on the roads) and increasing port activity in Chile overall.

Countries with long coastlines – Chile among them – may be able to attract cargoes to move by short sea shipping rather than roads but current regulatory barriers may restrict this potential. A tradition of protected trades limited to vessels flying the national flag exists in many nations, including in North and South America. Cabotage services represent an opportunity when considered under the prism of spare capacity on ships that could be utilised. This is particularly important if the long coastline is at the end of a pendulum service as in Chile; the liner company is more likely to drop the last port on a pendulum if a port is to be dropped from the string in a re-design of its networks. Adding cabotage traffic can make a difference to the economics of maintaining service on the last leg.

Regulatory changes may be needed to take advantage of cabotage opportunities. In the Chilean case, these were identified to be the need to expand the waiver of the condition to use Chilean-flag vessels (currently only available to up to 400 tonnes cargo per shipment) or even provide unlimited permission to transport cargo without using Chilean-flag vessels. The second option may not be politically palatable but has not been studied and so is at least worthy of investigation.

Developing short sea services is also about examining the potential of cooperation with the trucking industry. This was the backbone of developing intermodal rail service in the U.S. in the 1990s. The desire is to serve cargo owners (exporters and importers) efficiently and effectively, thereby ultimately reducing prices and the cost for the cargo to reach its final destination; exports can be grown if end-market prices are more competitive. Establishing the potential for short sea shipping to compete with road, and the efficient equilibrium between the modes in a barrier free market in Chile is a research gap to be addressed.

4. Hinterland Strategies

Ports are an integral part of the overall transport and logistics system. For an efficient system, transport infrastructure capacity in the hinterland must be matched seamlessly to the development of ports. Port development also needs to be planned to maximise the potential for value creation in the supply chain and depends therefore on the organisation of logistics services in the hinterland. Planning for port expansion needs to take a logistics business perspective in determining the optimal development of terminals, customs and inspection, vehicle management, warehousing and other landside capacities. Fostering the establishment of networks of logistics activities at the landside of the port can create value for the port itself. The reach of the port, and its competitiveness with other ports in its range, is determined largely by the quality of its connections with road, rail and, where they exist, inland waterway networks.

Large-scale port projects require particularly careful planning of landside connections. A core element is assessment of the options associated with each mode of landside transportation and the development of a strategy for optimal integration with each mode, given the constraints of physical and economic geography and the regulatory environment for road and rail transport. Responsibilities for investment and regulation vary by jurisdiction. Port authorities usually provide essential coordination of access to essential facilities, either providing rail access to terminals in the port or brokering equitable access agreements to infrastructure owned by one of the stakeholders. Port authorities in a few locations, for example Rotterdam, play a major, pro-active role in developing seamless hinterland transport, making joint investments in hinterland infrastructure and promoting effective use of all modes available through conditions negotiated in concession agreements (De Langen 2008). The role of the central government in investment in hinterland transport links also varies by jurisdiction but even where infrastructure is privately owned, grants or other forms of financial support (loans, bond guarantees) are often available for capital investment to upgrade infrastructure as ports expand (Acciaro and McKinnon 2013). Designating land for adequate hinterland transport infrastructure is fundamental to planning for new port development. This has to be done well upstream of investment in order to avoid speculative land acquisition complicating the process of infrastructure development and increasing its cost.

Logistics costs in key sectors of the Chilean economy have reached 19-20% of the total costs when one would expect such costs not to exceed 8-9% (Guasch 2011). Seasonal congestion is one factor, as noted above, but as port operations are among the most efficient elements of the supply chain in Chile, weaknesses also lie elsewhere. They may lie in the organisation of the logistics industry itself; but also in hinterland transport services. While there has been from major highway investments, rail investment has been limited. The Ministry of Transport is also examining the potential to reduce lighthouse dues, which are higher than in neighbouring countries.

Costs may also be driven by the performance of customs and sanitary inspection services. Significant economies could be achieved through organising joint customs and sanitary

inspections. Performance indicators would be useful for reducing costs. The quality and capacity of customs and inspection services is integral to trade performance and needs to be planned from a business perspective, providing services where they are most effective – including away from ports when space limits capacity in the port – and more generally functioning as a service to exporters and importers rather than an administrative barrier. 24/7 operation might ease congestion in the seasonal peak.

In other OECD countries with trade shares of GDP similar to Chile, such as New Zealand and Australia, customs services have a clear mission to facilitate trade, backed by performance indicators. More than 20 aspects of service quality are monitored in Australia, for example, with performance against headline targets published regularly (table 2).

Table 2. **Performance against trade facilitation targets in 2010–11, for the Australian**

| Key performance indicators | Target* | Actual |
|---|---------|--------|
| Availability of electronic cargo systems to Customs and Border Protection clients (excluding scheduled outages) | 99.7% | 99.7% |
| Proportion of electronically lodged cargo documents where a response message is transmitted within five minutes | 98% | 97.9% |

Customs and Border Protection Service

Source: Australian Customs and Border Protection Service, Annual Report 2010-11.

4.1. Road

The truck is usually the least expensive means of reaching destinations close to the port and its flexibility in terms of frequency and providing last mile access makes it the principal mode of transport in many markets. The major negative impacts of truck traffic are road congestion and pollutant emissions. Both can become a constraint on port development. Santiago has a major air pollution problem with recurrent episodes of particulate and NOx levels exceeding air quality standards during periods of winter temperature inversions. Port expansion is largely frozen in Los Angeles/Long Beach, for example, until levels of particulate pollution from trucks are significantly reduced and air quality improves in the city because of the risk to health from pollution and the perceived contribution of port activity to the problem (Giuliano and O'Brien 2009). Port city residents are almost always unhappy with the growth in road transport that port expansion produces, and naturally become vocal if landside investment and traffic management does not keep pace with port expansion.

Managing road connections starts with the organisation of trucks at the terminal gate. Different options exist, including replacing the traditional first-come-first-served system, where trucks are served and containers are loaded as they become available, with an appointment system for loading and unloading. This is widely used on both sides of the Atlantic. An alternative is the 'window' system, with pre-determined slots established when trucks are allowed to collect/deliver cargo, used in some Chinese ports. The applicability of each option will depend on local factors, such as the regularity of containerships arrivals and the location and reliability of customs and sanitary inspections.

Appointment systems (even the simplest, one day advanced notification systems) provide significant benefits on the port side of the gate, allowing containers to be marshalled in advance into small lots for rapid handling at collection. They provide for load spreading, reducing peak traffic and making use of off-peak periods to sort containers. On the other side of the gate they also have the potential for reducing peak traffic and cutting truck waiting

times. The benefits can be substantial but there can be additional costs for trucking companies. If windows are tight and inflexible, more trucks or drivers will be required to guarantee availability.

The near universal availability of mobile phones makes it possible to provide a great deal of flexibility for ports with suitable gate management IT systems, minimising the costs imposed on trucking. In the case of Southampton container port, for example, appointments can be amended or rescheduled up to 15 minutes before pick up, with (modest) penalties applied for missing appointments only when this limit is passed (Davies 2009). All port gate management systems require adequate parking and waiting areas on routes approaching the port.

Innovative gate management systems are driven by necessity. In Southampton very little land-side space is available because of the location in a heavily urbanised area. Rapid growth in container traffic in the early years of the century created severe yard congestion that prompted introduction first of an optional appointments system, with limited success, then a mandatory but highly flexible system that has worked well. The Los Angeles Pier Pass system provides for extended gate opening in a similarly constrained environment (Giuliano 2009).

The site of Valparaiso container port is even more constrained geographically, at the foot of a steep hill and adjacent to a UNESCO World Heritage site. The response has been to move customs and inspection to a location 5 km from the port, where parking space is available, with a new link road providing direct access to the port and to the Santiago highway. Trucks are dispatched from the parking area to the port when containers are ready for collection. San Antonio port experienced a number of severe congestion episodes on the approach roads to the port in recent years, and in response invested in off road parking areas and a traffic monitoring and alert system, in cooperation with the highway concession and police force, to prevent repeat incidents. Development of a large new container port/terminal in either city will require investment in high capacity link roads and capacity enhancements to the national road network. Freight transport demand forecasts for the ports need to be coordinated with highway traffic forecasts and the demand and revenue projections of the highway concessions as discussed in Section 2 above. Capital investments to increase the capacity and reliability of connecting highways will be essential to ensuring that port investments achieve their expected financial returns.

4.2. Rail

Rail connectivity is often of strategic importance to potential new port terminals. Opportunities for rail transport are to a large extent subsidiary to historical development of the national rail system and to national policy towards rail freight. The economic geography of the USA, for example, with a large integrated market and widely spaced industrial centres, favours rail transport and deregulation of the railways in 1980 reversed a long term decline in the share of freight carried and restored profitability. Trucks are the preferred mode of transporting containerized goods inland from US ports for routes of less than 750 km⁷ but rail has traditionally carried a relatively high share of US commodities flowing outward. On long distance trunk routes in both Canada and the US rail is dominant.

7. The road: rail trade-off in terms of cost efficiency is between 500 and 750 kms according to Resor et al. (2004); in Canada, the distance is considered to be one-half day's driving distance by truck.

The national rail system in Chile has more in common with rail in Great Britain than the USA (although rail carries much larger volumes of passengers in the UK than Chile and, if mine railways are excluded a larger share of freight traffic). Both UK and Chilean freight rail systems were privatised and vertically separated in the 1990s and in both systems passenger trains take priority over freight on the general-purpose network. In both, infrastructure is owned and managed separately from freight train operations (Thompson and Kohon 2012).

In Chile the rail freight task was 4 billion t-km in 2011. The domestic freight transport market in 2009 (in tons) was split 3% rail, 84% road and 13% coastal shipping (EU 2010). In Great Britain rail carries 9% of freight t-kms (21 billion t-km in 2011), road 60% and short sea shipping 26% (UK DfT 2011).

Containers account for only a third of the rail freight in the UK nevertheless, rail provides good access from the country's main ports to key centres of population and industry and 25% of containers entering the country are carried by rail⁸. At the two main container ports, Felixstowe and Southampton, rail accounts for 20 to 30% of inland container transport (GHK and Royal Haskoning, 2008). The share has grown over the last decade in response to congestion on the roads, investment by train operators and infrastructure capacity enhancements supported by capital grants from government.

In Great Britain rail freight pays track access charges on the basis of avoidable costs. These usually cover only wear and tear and operational management costs. They do not currently reflect capital investment costs as freight is rarely the prime user of rail tracks in the UK, although the rail regulator is considering introducing contributions to capital investment costs for some categories of freight as volumes grow on some routes. Capital investment therefore can be a barrier to expanding rail freight service to ports, although in recent years containerized rail freight services have benefited from the enlargement of the loading gauge on strategic routes to the main deep-sea ports of Southampton and Felixstowe, permitting the movement of 9'6" boxes. The Southampton link was jointly funded by government and industry. The largest share of funding was provided by the Department for Transport (£43m). Other contributors included Associated British Ports, the South East England Development Agency and the European Regional Development Fund. In the year following gauge enhancement on the line from Southampton to the West Coast Main Line, the main spinal rail route in the UK, rail's share of container movements to / from this port rose from 29% to 36% (Freightliner, 2013). The gauge enhancement to Felixstowe was financed out of the Department for Transport's Transport Innovation Fund.

In competing with more flexible road transport, rail has to overcome the "double lift penalty" involved in transferring containers to trucks for final delivery. The labour and fuel economy advantages of rail overcome this penalty beyond distances of around 350km in UK conditions; the competitiveness of rail is determined by factors including maximum train capacity/length, loading gauge (single stack in the UK), infrastructure charges (only avoidable costs are charged in the UK) and road congestion. The major plus of rail is the potential of transporting larger volumes of containers in a more reliable (depending on rail network quality, freight train priority, management quality and labour relations etc.) and environmentally-friendly way and without impinging on the car-driving public.

Stakeholder coordination is critical to policies to prioritise rail transport. Hamburg port has achieved a modal split of 30% for rail in a system with 92 different railway operators moving

8. Freightliner <http://www.portoffelixstowe.co.uk/partner-directory/rail-companies/freightliner/>

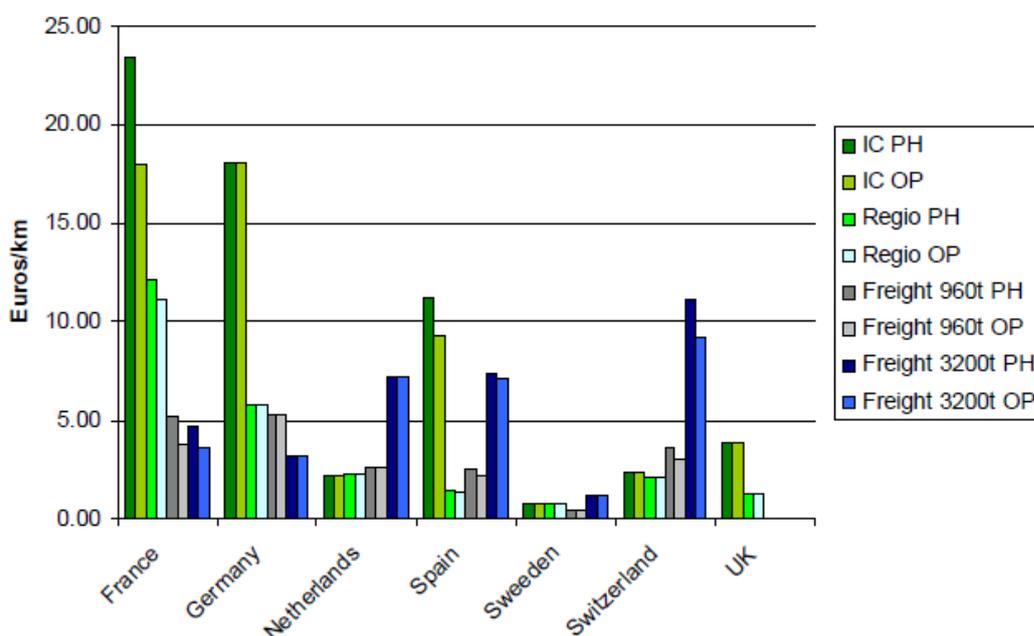
more than 230 freight trains per day. 36% of container transport was carried on rail in 2010 and the share is planned to exceed 40% by 2025 (HPA 2012). The main terminal operator, HHLA, is one of the few terminal operators that runs its own trains and accounts for a large share of rail carriage. The port authority ensures train operators serving terminals have equitable access to track infrastructure.

Voluntary agreements for sharing essential facilities are widespread in both Europe and North America (partly because regulatory intervention would risk discouraging investment). As noted in ITF (2009), the Port Authority of Antwerp brokered a large reduction in SNCB's prices for locomotives hauling trains within the port in 2008; SNCB, the incumbent national train operator, was the only company with locomotives authorised to run on the intra-port network. In Rotterdam a neutral company, Rail Feeder, was created at the instigation of the Port Authority in 2008 and now runs 80% of intra port rail operations with published tariffs following several years of complaints that the incumbent national infrastructure manager was unable to offer slots to new entrants. These coordination efforts have raised rail shares in Antwerp and Rotterdam although road and inland waterways dominate hinterland traffic (both ports are located at the mouths of large rivers connected to extensive canal networks). (ITF 2008). In Rotterdam 57% of container throughput was carried by road in 2008, 30% by inland waterways and 13% by rail. Target shares for 2035 are inland waterway 45%, road 35% and rail 20% (OECD 2010).

Northern European ports achieve these relatively high rail modal shares despite an unfavourable economic and political geography that makes European railways very different from US freight railways: short average distances for hinterland carriage and fragmented railway operations, both the result of the relatively recent integration of Europe into a single market. National boundaries leave a legacy of railways with small markets, poor technical interoperability and different charging systems and uneven regulatory environments. Like Great Britain, railways in Belgium and the Netherlands are vertically separated and freight trains are charged only the avoidable costs they impose on the network, usually only marginal costs. This has the advantage of keeping tariffs low but is a disincentive for investment. Governments therefore make capital grants where policy seeks to shift trucks from road to rail.

Reconciling modal shift policies with financial sustainability for rail and sustainable fiscal policy (containing accumulation of public rail debt) is not always easy. This is illustrated by the Dutch government's €4.7 billion investment in the Betuwe rail freight line opened in 2007 to link the port of Rotterdam with key industrial markets in Germany. The government was unable to attract private investment in the line (Koppenjan 2007), costs escalated and traffic has proved to be much lower than forecast despite charging only marginal costs for use of the line. The Dutch rail regulator determines the charges for using national infrastructure following principles set out by law requiring them to cover, inter alia, the marginal costs of track wear. Heavy trains hauled by powerful locomotives pay the highest charges as they account for the largest part of maintenance and renewal costs (Figure 6). Steel mills in the hinterland were one of the industries the Betuwe line was designed to serve but were unable to pay the infrastructure charges prescribed. Lowering the charges would have rapidly "bankrupted" the line. In the end the government felt obliged to provide operating subsidies to close the gap.

Figure 6. Rail infrastructure use charges in Europe



Note: For each country, the two columns to the left indicate high speed train charges (IC PH and IC OP), the central bars are for conventional passenger trains and the bars to the right are for freight.

Source : Vidaud M. & de Tilière G., 2010.

The Rotterdam Port authority also promotes rail development through specific modal split targets included in concession agreements, for example in the case of the Masvlaakte II terminals (De Langen 2009). Rotterdam is Europe's biggest port and it is not clear that all port authorities have the power to copy it. Such requirements might eliminate bidders from concessions opened for terminals in smaller ports. It also remains to be demonstrated that the modal split clause will be enforced.

In more favourable circumstances, rail operations are an area where private investment can be attracted to bid for concessions, and there is a solid literature on rail development by private interests (Resor and Laird 2013). One example is the Bombay Jawaharlal Port project where 30% of the 4.5 M TEU transported travel by rail following development of a dedicated freight corridor part financed with equity from users that allows double stacking and thus the transportation of 300 TEUs per train. "Favourable circumstances" in India include grossly inadequate road capacity. Nevertheless, national policies that cross subsidise passenger traffic with freight profits make it difficult to attract private investment away from the dedicated freight corridors. There have, nevertheless, been a few public private partnerships where industrial plants close to ports have financed dedicated rail access.

At the roundtable, there was considerable discussion about the need for detailed assessment of the capacity for the rail route to San Antonio to take additional container traffic. To be sufficient to achieve an environmentally and socially acceptable rail/road distribution of container traffic from a much larger port, significant investment in track and signalling is likely to be required. The rail network serving San Antonio is for freight but volumes are currently limited on the line by the quality of the infrastructure. There are plans to introduce passenger services on part of the line. Containers are not the only freight carried; bulk products including sulphuric acid for copper mines in central Chile consume significant

capacity. A detailed appraisal of long term road and rail hinterland transport options and investment requirements is essential. Appraisal should include the potential to carry double-stacked containers, subject to the constraints of tunnel gauges. At Valparaiso, expansion of rail freight is almost impossible as the tracks are shared with the local metro/suburban train system. The existing rail link was converted to largely metropolitan passenger train use with an upgrade of the line that enclosed it in a tunnel with limited loading gauge. Major rail investment would appear necessary to serve a large new port development. Broad appraisal of hinterland transport options and impacts is essential.

4.3. Dry ports (inland ports)

Dry ports (inland ports) and extended gateways are being developed in many parts of the world in response to land-side port capacity constraints. As noted, Valparaiso has already developed a short range extended gateway with relocation of custom and sanitary inspection and a truck holding facility 5 km from the port. The 'ZEAL' project was developed to overcome capacity shortage in the port terminal and resulted in an increase in productivity of 20%.

In Spain, the dry port of Madrid (Coslada) and Terminal Marítima de Zaragoza have extended the gateways of the major container ports of Barcelona, Valencia, Bilbao and Algeciras (Monios 2011). In France, the inland Port of Lyon, a partnership initiated between the port of Marseille and the river port Edouard Herriot in Lyon provides handling, storage, packing, and inland transportation leasing and repair of containers, having a throughput of over 100 000 TEUs per year. European Container Terminals (ECT), the main terminal operator in the port of Rotterdam and a subsidiary of Hutchinson Port Holdings (HPH), has been actively involved in the setting up of Venlo in the Netherlands, Duisburg in Germany and Willebroek in Belgium all served by rail, to mitigate truck volumes creating congestion issues (Wilmsmeier et al. 2013). In North America, there are many inland port examples. One example, the Savannah Port Authority Industrial Park (SPAIP), is a site specializing in satellite activities removing pressures from the container terminals of the dynamic port of Savannah, such as container and chassis storage and repair. About 10 km from the port terminals are two large logistics zones owned, like the port, by Georgia Port Authority. The Virginia Inland Port is served primarily by rail from the Hampton Roads port 350 km away and provides customs services, reloading and cross docking services. BNSF Logistics Park Chicago is another; it is a major inland port 60 km southwest of Chicago linked by transcontinental rail to various ports, including Los Angeles/Long Beach to the Chicago hub (Rodrigue et al., 2010).

The dry port is a cargo consolidation center located away from the seaport but serving the cargo transported through it, providing sufficient economies of traffic density for viable shuttle services. As well as providing the space needed for land-side port processing tasks, it embeds the port more effectively in the supply chain, providing dedicated space for the development of integrated warehousing and distribution centres and ancillary value adding services. Location is important; proximity to major centres of demand is an advantage and siting at nodes in transport networks suited to extension or development of greenfield logistic centres essential. Coordination of container movements needs to be managed in the same way as at the port, with integrated information exchanges. Customs and sanitary inspections need to be transferred to the dry port or greatly simplified administrative and customs procedures introduced. There might be potential for establishing a dry port and logistics centre in the vicinity of Santiago, connected to the new port by rail.

4.4. Strategic Issues

Development of a major new port, tripling container handling capacity, on the central coast of Chile will stress hinterland transport infrastructure and result in congestion unless capital investment in road and rail links keeps pace with container traffic. Supply chains currently rely heavily on road transport and port development will require a long-term vision for highway investment. Plans for a new highway to Argentina need to be taken into account as this could generate significant port transit traffic. Trade facilitation measures could further increase traffic, such as joint customs and sanitary inspection at the border (single inspectors by joint teams from both countries; also single inspections covering both customs and sanitary dimensions). Bilateral agreements to allow back-hauls can at the same time facilitate trade and reduce traffic and congestion.

Certain steps can be taken to counter potential hinterland congestion problems. Performance monitoring on the highways and railways will identify where bottlenecks develop. Cargo origins and destinations should be identified as a basis for planning development of the transport system. A strategic approach, covering road, rail and short sea shipping, should be taken rather than ad hoc responses to demand, and mechanisms for coordinating investments with other industrial policy initiatives are valuable. These include transport impact assessment as part of planning procedures for commercial and industrial development and mobility plans for large municipal planning authorities. Central government requires such plans of city administrations in many countries. The logistics dimension of port capacity expansion is not a purely sectoral issue but requires coordination across government.

The Ministry of Transport is aware that more detailed assessment of landside transport infrastructure demand and investment requirements deep into the hinterland of the prospective new ports is needed and has begun consultations with the Ministry of Public Works to ensure the necessary capacity is developed in time. It also recognizes the need for regulatory changes to existing cabotage law and customs procedures to enable inspections inland.

5. DEVELOPING CONTAINER TERMINALS THROUGH CONCESSIONS

This section reviews a number of the issues that arise when concessioning new terminals. Concession contracts have become the dominant model for private participation in providing port services around the globe. Chile adopted the model in the 1990's and has successfully attracted significant private capital investment to expand and renew its ports. As already discussed, operations in the container terminals developed through these concessions are efficient and productivity compares well with leading ports elsewhere. The general landlord port concession model was refined in Chile to assign pier and quay infrastructure provision as well as cargo transfer operations to concessionaires. The Port Authorities can only step in to construct piers when the bidding process fails to award a concession. Some bidding rounds have stalled, but no authority has stepped in as bidding is seen as the critical market testing stage in planning port expansion. The Port Authorities and Ministry of Transport carry out forecasting and strategic planning to determine the general schedule of demand for new capacity but the ultimate decision of when to invest is left to the market. Concessionaires take the demand and revenue risk. Public funds for capital investment are not exposed to this risk. The existing bidding system has proven to work well in Chile and appears generally well suited to concessioning terminals in a new large port.

5.1. How many terminals?

Expansion of container port capacity can be delivered through one terminal or multiple terminals, and in the latter case these can be located in a single port or distributed across two or more ports, depending on local circumstances. For expansion projects of one M TEU per annum or more there is a potential to split facilities between two or more terminals, subject to the scale sufficient to generate interest of potential terminal operators in bidding for the concession. A site that exceeds one million TEU with a quay length of 950 meters is likely to attract global operators. This size is also big enough to attract a diverse array of ancillary services that create local added value around the port. Smaller scale terminals, e.g. around 500 000 TEU, tend to attract local rather than global operators. For efficiency, terminals should be structured so that two vessels can be handled simultaneously. Accommodating large vessels implies larger concessions.

The size of the projects under consideration in Chile allows for multiple large terminals. At San Antonio, the project would accommodate four 1.5 M TEU terminals. The Valparaiso project would accommodate two 1.5 M TEU terminals.

5.2. Who is eligible to bid?

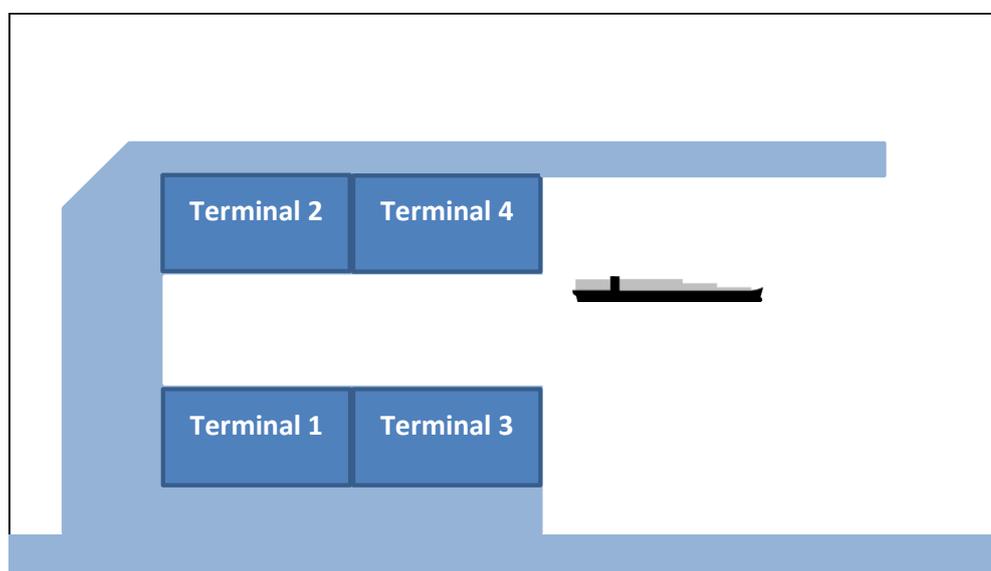
Explicit port competition policy and general antitrust competition policy will determine if existing terminal operators are eligible to bid for a new concession and whether acquisition of the new concession would require divestment of some existing interests. Competition is important to avoid the development of monopoly rents and to drive efficiency, creating pressure on prices and service quality. Competition can take place between separate terminal operators within a single port or between ports serving overlapping hinterlands. Both forms of competition exist in the ports serving the Santiago region and competition is evident with examples of shipping lines switching operations between San Antonio and Valparaiso and between terminals in San Antonio.

There was a consensus among participants that the presence of three different terminal operators competing in a port or in overlapping hinterlands secures adequate competition. More competitors are desirable only if this doesn't compromise economies of scale. Two or more operators also provides for resilience should one suffer a natural disaster, strike or other interruption to operations. San Antonio and Valparaiso each have one consolidated terminal operator plus one new entrant, awarded a construction and operation concession within the last three years.

The new terminals might be larger than existing concessions, each of which amounts to an approximate capacity of 1.0 million TEU per annum. They may therefore offer economies of scale, and may attract an international terminal operator vertically integrated with a shipping line. Issues and opportunities for coordination with existing concessions therefore arise. Opening a new large terminal may reduce the value of existing concessions.;

If the new terminals have a significant technical potential to be more efficient than the existing terminals, ensuring competition between terminals in the new port will be as important as overall levels of competition in the region if maximum benefits are to be passed on to users of the new terminals and to the economy as a whole. As noted, the size and configuration of the San Antonio project is particularly well adapted to promoting competition and economies of scale. Terminals should be opened successively. Terminals 1 and 2 should be let to different operators. When terminals 3 and 4 are concessioned (Figure 7), the operators of 1 and 2 could be eligible to bid with a view to extending integrated operations into terminals 3 and 4 respectively. The Antitrust Authority would have to approve such extensions. In many configurations the holders of today's concessions at both ports could be eligible to bid without undermining the three operator minimum for adequate competition in the region.

Figure 7. **Schematic Representation of New Large Port at San Antonio**



Issues of market exit are an integral part of concessioning. While privatisation increases efficiency in the short-term, one needs to secure conditions for the long-term as well. In the case that operators decide to leave the market before the end of the concession, governments that have not foreseen this possibility might find themselves spending

significant public funds and renegotiating from a disadvantageous position.⁹ Thus exit clauses need to be considered when structuring the project.

5.3. Quay and breakwater construction

Ports require large capital investments in infrastructure – quays, piers, breakwaters – that take many years to recoup. The lumpiness of these sunk investments has led to many jurisdictions to develop systems of concessions where government funds basic infrastructure. There is, however, no universal model and in the United Kingdom, for example, investment in some ports is purely private. Moreover, different parts of the infrastructure have different life-spans (measured in decades for quays, centuries for breakwaters).

In Chile, the terminal operator invests in piers and quays. As noted, port authorities are allowed to develop pier and quay infrastructure only when the bidding process fails to deliver a concession. No port authority has so far invested in piers in Chile as a failure of the bidding process is taken as a signal that there is no business case for the project. Landlord port models elsewhere in the world generally assign investment in quay and pier construction to the port authority. The Chilean approach may increase the cost of port infrastructure to the extent that the cost of private finance exceeds public finance and transaction costs tend to be higher with concessions and public private partnerships but this appears to be outweighed by incentives to complete construction on time and to budget. Prior to the introduction of concessioning the public sector had a poor record of delivery, with long delays and consequent cost overruns. Guasch (2013) reports that on average 75% of publicly financed infrastructure projects in Latin America experience cost overruns with the mean overrun about 35%. The bidding process for port concessions in Chile has so far escaped problems of grossly over-optimistic revenue forecasts associated with many concessions and public private partnerships for transport infrastructure elsewhere. The assignment of responsibility for financing piers to concessions also has the advantage of countering any tendency to over-invest taxpayer resources in port infrastructure in order to compete with rival neighbouring ports.

Constructing breakwaters is an integral part of many port capacity expansion projects. This fundamental part of the port infrastructure has a life span that extends well beyond that of a container terminal concession. Concessioning breakwater construction jointly with a terminal concession would be complicated with more than one terminal operator. It creates risks that are difficult to price when terminals are built sequentially: one terminal operator would set the charges for the breakwater to be paid by the other. Therefore, breakwater projects are commonly unbundled from terminal construction and the bidders for financing the breakwater are excluded from bidding on the terminals.

Unbundling allows port authorities to finance breakwaters and charge terminal concessions for its use on an equal basis. Construction might be financed directly or via a separate concession. Technically, because of the simple structure of the project, either option can be used. The interest in opting for direct investment is to minimize the cost of finance. The interest in private finance for the breakwater would be to transfer construction risk to a

9. The case of Busan in Korea is illustrative. The two then congested terminals were concessioned to two global terminal operators (Hutchinson and PSA respectively). This was the first foreign investment allowed in the sector. After 5 years, however, these operators left for various reasons. It took another five years for local market operators to develop competitive services. Meanwhile the national administration had to assume responsibility and the expense of keeping the terminals open.

company with a recent track record in construction of similar projects (the last major breakwater built in the central region of Chile dates from the early 1900s). A concession would also take the burden of paying for construction in the short term with repayment over a very extended period off the books of the Port Authority (although the liability still resides ultimately with government).

The cost for building a breakwater for one of the major ports under consideration is small compared to the substantial gain of economic prosperity foregone if the project were not to be built. There was consensus among roundtable participants that unbundling breakwater construction from terminal concessions would facilitate timely development of a new port and is compatible with the objectives of competition policy.

6. CONCLUDING COMMENTS

6.1. Key points for strategic port development planning

Summarising much of what precedes, public policy makers and port authorities need to undertake the following strategic analysis in support of cost-benefit assessment and decision-making on container port investment.

1. Conduct a disaggregate analysis of prospective demand as a basis for forecasts that cover a realistic range of scenarios. This includes:
 - Evaluating existing terminal offerings, with benchmarking on the basis of recognised performance measures, to determine if there is congestion and if productivity improvements and/or investment in cargo handling technologies and information technology are likely to increase capacity over the longer-term.
 - Estimating project demand using scenarios to evaluate potential trends beyond 10 or 20 years, calibrating forecasts with historical data but also identifying potential shifts in population, economic growth, location of activity and new business opportunities in sectors where the country has solid competitive prospects and including potential constraints on the further developing of existing trade. Identifying potential breaks in consumption patterns beyond the incremental effects of growth in population and per capita incomes is included here.
2. Understand the container shipping market. This includes:
 - Identifying the captive part of the container market.
 - Analysing which cargoes the container terminals will serve so that hinterlands are understood and opportunities for local value creation are to be identified.
 - Assessing the ability of expanding the shipping market, through changes to regulations (e.g. cabotage, removal of non-tariff barriers) and through modal shift from truck or rail to short sea shipping.
3. Consult with shippers, carriers, logistics businesses, current port concessions and other cargo interests to understand their perspectives on the best way of expanding container port capacity. Identify critical issues that must be addressed for success. This includes:
 - Developing an integrated approach of infrastructure planning for both hard infrastructure and logistics services.
 - Including social and environmental issues in planning (impact on the quality of life, emissions, congestion, etc.).
4. Clarify of what kind of port and/or port terminal is envisaged. This includes:
 - Making decisions on port type: Gateway, hub, or feeder? Common user or dedicated terminal? Is the goal economies of scope or economies of scale?
 - Finalizing which of the broad possibilities remain, e.g., expansion of capacity by (a) modernising existing facilities, (b) adding to existing facilities or (c) developing a greenfield project?
5. Reserve land to be used for land side port operations, rail and road access, warehousing, logistics and distribution services and hinterland transport infrastructure.

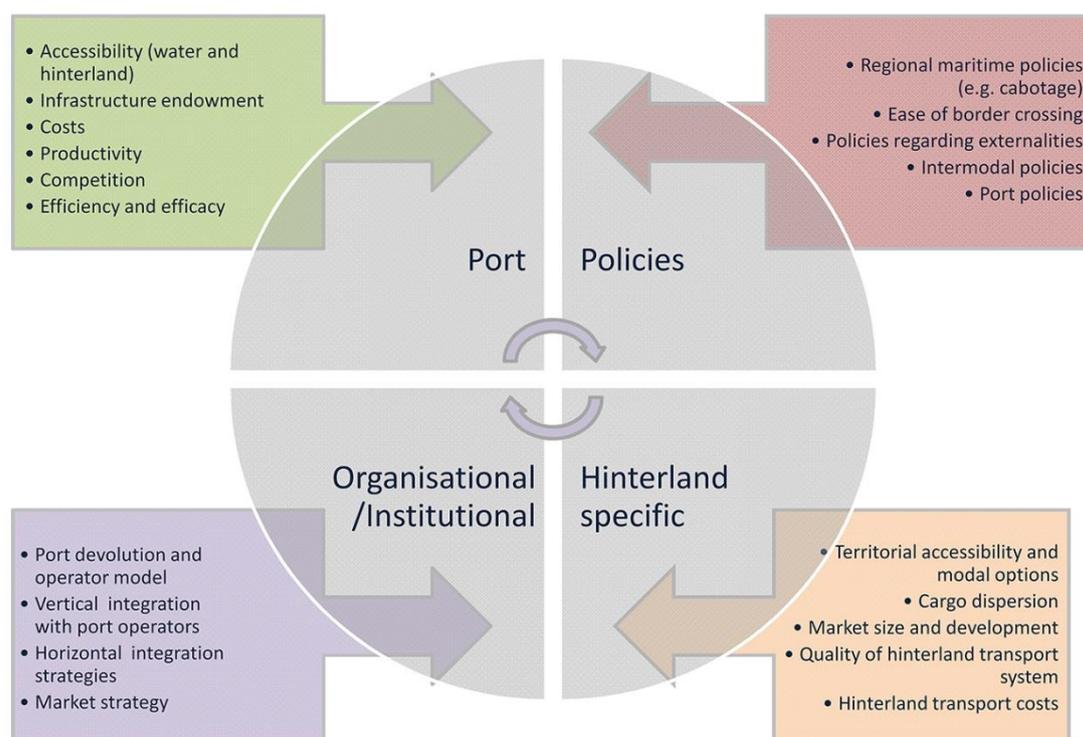
Roundtable discussions underscored the importance of forecasting demand for port services that examines the potential drivers of growth and goes beyond extrapolation of trends or focusing on aggregate GDP as a basis for long-term forecasts. Past performance is often a poor indicator of the future; global shipping markets, export markets, domestic consumption and import markets are all undergoing change. This creates uncertainty that forecasting can only address through the development of scenarios to test plausible changes in the markets most relevant to the region served by the port.

For central Chile the Roundtable discussion highlighted three considerations of particular relevance to making forecasts of demand for container port services more robust:

1. As average household incomes rise in middle income countries and a middle class with more discretionary disposable income expands, there can be rapid change in the structure of demand with a shift from export-dominated traffic to a greater share of imported consumer goods.
2. Refrigerated exports of fruit and vegetables are a staple of current container traffic with great potential to grow. The preference of shippers of these goods for direct services is a significant factor in the decisions of shipping lines on network configuration. There are potentially external limits to the growth of this sector, availability of irrigation water for example, that are worth examining to make forecasts more robust.
3. Maritime container traffic can also be generated by modal shift from truck to sea and internal growth of short sea shipping. Both would be stimulated by a relaxation of restrictions on cabotage. As well as increasing port traffic, resulting feeder opportunities would make operation of large container vessels in Chilean ports more economic.

It is never too early to bring in stakeholders, particularly cargo owners (not just exporters but also retailers and agricultural producers), to get a market-based sense of the reality of the forecasts. Understanding the requirements of cargo interests grows more important as value creation for the participants in the supply chain becomes the primary factor in network redesign. This means cargo interest requirements need to be studied (to identify market-specific requirements), and both shipping lines and cargo interests need to be involved in the port expansion and hinterland infrastructure planning. Demand forecasts tend to be buffeted by unanticipated game-changers and those who pay for transport are often aware of them ahead of government.

There is an important role for developing Key Performance Indicators (KPIs) in relation to congestion designed to monitor the development of capacity constraints and also identify opportunities to improve the productivity of existing facilities. Port productivity benchmarks can be used to identify whether the existing berth and yard productivity meet international standards, or could be increased with smaller scale investments than construction of new berths. In the Chilean case, it was clear that both San Antonio and Valparaiso have reached a high level of productivity, confirming that capital investment in additional terminals is the only way to expand container services. New terminals will be constructed to accommodate the largest ships expected to enter service on the West Coast of South America, which exceed current maximum berth depths.

Figure 8. **Relevant factors in liner network configurations**

Source: Wilmsmeier (2013), roundtable presentation.

The key factors that determine which ports shipping lines call at are summarized in figure 8. Beginning in the upper right corner of the figure, the roundtable focused on the importance of aligning regulatory policies, both landside and maritime, to remove impediments to growing trade, such as inefficient border controls, restrictive cabotage policies and weakly defined strategies for development of the logistics industry, a factor that is particularly important where ports compete for business as hinterland access has become the focus for global supply chain competition.

All four quadrants of the figure require monitoring and the development of a small set of key performance indicators to monitor quality of service from both port and government perspectives is recommended. For example, baseline highway statistics might be used to monitor the quality and capacity of the hinterland transport systems. These can identify the extent to which bottlenecks in existing highway infrastructure will be exacerbated by putting additional port traffic on the roads. The indicators developed can also be used to measure improvement by port investment but also hinterland investment and policy initiatives.

Measuring the performance of a logistics system is a considerable challenge and very much a product of what data a country already collects, and what data it chooses to collect in future. Thinking about ideal KPIs from a government perspective is best done through community consultations with relevant supply chain partners. Many port businesses already measure KPIs to track continuous improvement, but consider sharing their KPIs in public as divulging competitive strategies. That said, there are already efforts underway by ports and individual partners to develop KPIs that are useful in measuring some parts of the performance of a logistics system, and some KPIs that are already collected globally. In addition to the Journal of Commerce Port Productivity KPIs previously discussed that demonstrate port productivity (upper left quadrant in figure 8) at San Antonio and Valparaiso, many ports evaluate their

infrastructure endowments as adequate for existing vessel sizes, collect data on changes in port traffic as a ratio to economic growth, and so on. For the upper right quadrant, many governments rely on the indicators provided by the World Bank Doing Business (Trading Across Borders) database¹⁰ or the Logistics Performance Index database¹¹ and select comparable countries to benchmark against. These indicators are problematic as small countries and large ones are not necessarily good equivalents and a country like Chile, given its geographical features, may not find reasonable comparators. There are very few appropriate benchmarks for the lower left quadrant, as this is mostly about developing appropriate policies and institutions, while those in the lower right are quite country-specific. The development of appropriate KPIs is an area Chile may consider exploring via stakeholder consultation in the process of developing its logistics and freight policies. There are many examples to draw on, and this could be an area for future research on options suitable for Chile's specific hinterland configuration.

Roundtable participants agreed that hinterland investment may be as important to the competitiveness of a terminal as on-port investments, given the inter-relationships between port capacity, congestion and reliability. This reinforces the earlier discussion about alignment of regulation and hinterland infrastructure so as to optimise the whole supply chain not just the port-specific infrastructure. Failure to consider the whole supply chain risks port investments by simply moving reliability issues and bottlenecks outside the gate rather than addressing them as part of the whole project.

The four quadrants in figure 8 are interconnected and the weak links need to be identified, establishing which factors are a brake on business development: logistics policy, competition policy, restriction of cabotage, trade restrictions, customs, sanitary inspections, IT systems, and so on.

6.2. Advancing container port terminal capacity in Chile

To meet growing demand in a dynamic economy, the Chilean Ministry of Transport and Telecommunications is planning for large-scale container port capacity expansion. The Ministry's analysis of demand and options for the location and design of the port are thorough and in line with the steps set out in this report for robust assessment of the economic case for investment. Some additions to the consultations and analysis undertaken would reinforce the quality of the preparations. These could include a more detailed look at the requirements of cargo interests in the region, particularly with respect to their assessments of the realistic growth potential of their businesses over the life span of the project. Discussions with the Antitrust Commission would be useful for developing a common view on the minimum number of concessions and operators for adequate competition in the market at a relatively early stage, to allow time for reflection in parallel with the other work preliminary to launching concessions.

Consultations with shippers, logistics companies rail and road concession operators would be valuable in developing a national/regional freight and logistics plan that integrates port expansion with hinterland infrastructure development. Hinterland infrastructure will require investment in step with port expansion if it is not to become a bottleneck in supply chains and if road congestion is to be contained. There might be potential for establishing a dry port and logistics centre in the vicinity of Santiago, connected to the new port by rail.

10. <http://www.doingbusiness.org>

11. <http://lpi.worldbank.org>

Completion of the national freight transport and logistics strategy will be important in providing the confidence required for private investment in infrastructure, in the hinterland as well as in the ports. Consultations with local communities affected by port development on managing environmental and other external costs should begin at the earliest stage possible. The approach adopted by the Port Authorities of planning expansion in phases that minimise demand/revenue risk and facilitates competition by providing for two or more terminal operators in each port is eminently appropriate. Chile's port concession model has proved successful and is suited to the larger scale investments planned. The port concession law also appears to allow for breakwater infrastructure to be financed separately from terminals and quays, which would simplify concessions for terminals in a major new port.

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