# Dynamic Shipping and Port Development in the Globalized Economy

## Volume 2: Emerging Trends in Ports

Edited by

Paul Tae-Woo Lee

Kevin Cullinane

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Edited by

Paul Tae-Woo Lee
*Institute for Supply Chain and Logistics, College of Business*
*Victoria University, Australia*

Kevin Cullinane
*Department of Business Administration*
*University of Gothenburg, Sweden*

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*To the parents in the world who devoted their lives to educating their children*

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# Contents

# Figures and Tables

## Figures

## Tables

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# Editors and Contributors

## Editors

**Kevin Cullinane** is Professor of International Logistics and Transport Economics at the University of Gothenburg, Sweden. He has been an adviser to the World Bank and governments of Scotland, Ireland, Hong Kong, Egypt, Chile, and United Kingdom. He holds an honorary professorship at Hong Kong University and numerous visiting professorships at several universities. He is a chartered fellow of the Chartered Institute of Logistics and Transport, UK. He has published 10 books and more than 200 refereed journal papers and is an associate editor of both *Transportation Research* (Parts A and D) and *International Journal of Applied Logistics*. He was a member of the Civil and Construction Engineering sub-panel for Research Excellence Framework in 2014 (REF 2014).

**Paul Tae-Woo Lee** is Professor of International Logistics and Maritime Transportation and Associate Director Research at the Institute for Supply Chain and Logistics, College of Business, Victoria University in Melbourne, Australia. He holds a PhD from Cardiff University, UK. He has extensive academic and field experiences in maritime transportation and logistics as academic researcher, consultant, economic adviser, and policymaker for several governments as well as public and private sectors. He has published 4 books and edited 15 special issues of international journals as guest editor and guest co-editor. He is an associate editor of the *Journal of Shipping and Trade* and editorial board member of *Transportation Research Part E: Logistics and Transportation Review*, *International Journal of Logistics Management*, *Journal of Korea Trade*, and *Journal of International Logistics and Trade*.

## Contributors

**Mary R. Brooks** is Professor Emerita at Dalhousie University, Canada. She is the editor of Elsevier's *Research in Transportation Business and Management*. She was appointed to the Marine Board of the U.S. National Academy of Sciences in 2008 and now serves as its vice-chair. She is also the founder and chair of the Port Performance Research Network (PPRN), a network of more than 50 scholars interested in

port governance and port performance issues. Her latest publication is *Classics in Port Policy and Management* (with Thanos Pallis, May 2012).

**Sharon Cullinane** is an Associate Professor at the School of Business, Economics and Law, University of Gothenburg, Sweden. Previously, she was a senior lecturer at Heriot-Watt University in Edinburgh, UK. Prior to that she was employed at the University of Hong Kong, Oxford University, Egyptian National Institute of Transport, Ecole Supérieur de Commerce in Rennes, and the University of Plymouth in Devon. She holds a PhD in Logistics from the University of Plymouth. She has lectured, researched, and published in the field of transport policy and the environment around the world.

**Darren Fraser** is Senior Corporate Strategy Manager at the corporate head office of a major port operator in South Africa. He holds a PhD from the University of Antwerp, Belgium, and his PhD research and publications focus on the port sector with particular emphasis on southern African port development. He holds a Bachelor of Commerce degree in Economics and Accounting from the University of South Africa in Pretoria, an Honours degree in Accounting from the University of KwaZulu-Natal in Durban, and an advanced Master's degree in Transport and Maritime Economics from the University of Antwerp.

**Jasmine Siu Lee Lam** is an assistant professor at Nanyang Technological University, Singapore. Her research areas include maritime logistics, port economics, and sustainable development. Her various publications have appeared in leading international journals such as *Industrial Marketing Management*, *Journal of Cleaner Production*, *Journal of Transport Geography*, *Transportation Research* (parts *A* and *E*), and *Transportation Science*. She is an associate editor of *Maritime Policy & Management* and a member of the editorial review board of the *Journal of Supply Chain Management*. She is a recipient of many awards, including Best Paper Award and Erasmus Mundus Scholars Award from the European Commission.

**Tsung-Chen Lee** is Professor at the Department of Economics, National Taipei University, Taiwan. She holds a PhD from the Department of Applied Economics and Management, Cornell University, USA. During 2008–2011, she participated in the projects on port development policies in South Africa. Her recent research interests include, among others, economic and environmental impact analysis

of port-related activities, and the impacts of trade liberalization on the seaborne cargo volumes and maritime carbon emissions.

**Enrique Martín-Alcalde** is a project manager of the maritime transport and port logistics area at the Center for Innovation in Transport (CENIT) in Barcelona, Spain. He holds a Master's in Shipping Business and a PhD in Civil Engineering from UPC-BarcelonaTech, Spain. His PhD has focused on the improvement of the yard performance of container terminals by introducing efficient storage strategies. In 2013, he was a visiting researcher at the Pusan National University, Republic of Korea.

**Jason Monios** is a senior research fellow and Head of the Freight Transport and Logistics Group at the Transport Research Institute, Edinburgh Napier University, UK. His research focuses primarily on intermodal transport planning and the geography of port systems, with a specific interest in how these two subjects intersect in the port hinterland. He has more than 40 peer-reviewed academic publications in addition to numerous research and consultancy reports, covering Europe, North and South America, Asia, and Africa. He has co-authored technical reports with the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC) and been an expert adviser to the Scottish Parliament. His book *Institutional Challenges to Intermodal Transport and Logistics* was published in 2014.

**Adolf K.Y. Ng** is Professor of Transportation and Supply Chain Management at the Asper School of Business of the University of Manitoba, Canada. He holds a DPhil in Geography from the University of Oxford, UK, and excels in the research and teaching of port management, transport geography, intermodal transportation, climate change and transport infrastructure planning, port-focal logistics, and global supply chains. His productive research culminates in publication of 3 scholarly books, more than 40 journal papers, and several other forms of publications. He has received numerous accolades, such as Fulbright Scholar Program (USA), Endeavour Research Fellowship (Australia), Universités Parisiennes Fellowship (France), Rh Award for Outstanding Contributions to Scholarship and Research (Canada), and Associates' Achievement Award for Outstanding Research (Canada). He is a council member of the International Association of Maritime Economists (IAME), a co-editor of the *Journal of Transport Literature*, an associate editor of *The*

*Maritime Economist*, and an editorial board member of several reputable transportation and logistics journals.

**Theo Notteboom** is a foreign expert/professor at Dalian Maritime University, China; a part-time professor at the University of Antwerp and the Antwerp Maritime Academy in Belgium; and a visiting professor at World Maritime University/Shanghai Maritime University and Nanyang Technological University, Singapore. He has widely published on port and maritime economics. He is Emeritus President and a council member of IAME, co-director of PortEconomics.eu, and member of the editorial boards of several journals in the field of maritime and transport studies.

**Sergi Saurí** is Assistant Professor of Transportation at UPC-BarcelonaTech, Spain, since 2004. He holds a PhD in Civil Engineering from UPC-BarcelonaTech, a Master's in Shipping Business from UPC-BarcelonaTech, and a Bachelor's in Economics from the University of Barcelona. Since 2013, he has been the Director of the Center for Innovation in Transportation, where he has been responsible for maritime transport and port logistics research. He has also been the coordinator of the Master in Supply Chain, Transportation and Mobility program at UPC-BarcelonaTech, since 2013. He serves as a member of the board committee of the Association of Civil Engineers of Catalonia and as a member of several scientific committees.

**Tengfei Wang** is Economic Affairs Officer at the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), since February 2008. He has worked in the areas of trade and transport facilitation, logistics policy, freight forwarding, and multimodal transport. Prior to joining the ESCAP, he was Senior Lecturer in Port and Supply Chain Management at the University of Plymouth, UK. His articles have appeared widely in internationally renowned journals. He holds a PhD from the Hong Kong Polytechnic University and, for the period 2002–2005, was the winner of the Palgrave Macmillan PhD competition.

**Gordon Wilmsmeier** works in the Infrastructure Services Unit at UN-ECLAC. He is also Professor of Maritime Geography (honorary) at the University of Applied Sciences, Germany, and a visiting lecturer at the University of Gothenburg, Sweden, and Universidad Nacional de San Martín, Argentina. His research primarily focuses on transport

geography, port development, shipping networks, competition, and energy efficiency. He has published more than 100 book chapters, journal articles, institutional publications, and working papers. He is a council member of IAME and member of the Port Performance Research Network, the Sustainability Working Group of the European Freight and Logistics Leaders Forum, and PortEconomics.

# 1
# Introduction

*Paul Tae-Woo Lee and Kevin Cullinane*

The global maritime network underpinning the world economy is currently facing critical challenges. These include, inter alia, relatively stagnant economic and trade activity, China's growing impact on international trade, changes in the structural pattern of international trade as a consequence of emerging free trade agreements, the need to further integrate maritime logistics systems, fierce port competition and the influence of mega carriers, terrorist attacks and other security issues, natural disasters and the need for enhanced resilience, and global warming and other environmental concerns. Within the context of a globalized world economy, the continued emergence of new developments which fundamentally affect it (such as China's growing engagement in Africa and South America) and aspects such as the pursuit of an integrated logistics environment, the competitiveness of alternative production bases, the potential for the relocation of production lines, and the associated establishment of new supply chains have all attracted the attention of manufacturers, maritime logistics providers, academics, and policymakers. This is the context which has prompted the production of this book entitled *Dynamic Shipping and Port Development in the Globalized Economy.* Consisting of two volumes, the first concentrates on aspects of maritime economics and logistics which revolve around *Applying Theory to Practice in Maritime Logistics*. The second volume is entitled *Emerging Trends in Ports*. As the name suggests, it brings into sharp focus the impact on ports of the contemporary practices in maritime logistics that have been discussed and analyzed within Volume 1. The two volumes encompass a total of 15 contributions from 23 visionary scholars of international repute, which together provide a truly comprehensive scientific, practical, and contemporary perspective on the developments and challenges that have

necessitated *Dynamic Shipping and Port Development in the Globalized Economy*.

As exhibited in Volume 1 of this book, maritime logistics plays a pivotal role in underpinning world trade. The connectivity of nations is also critical to the benefits derived from engaging in international trade. Lying at the heart of international transport and supply chain systems, ports play a significant role as an interface between the various available transport modes. They also constitute nodes embedded within value-driven chain systems (Robinson, 2002) or value constellations (Normann and Ramírez, 1993). Ultimately, it is the efficiency and effectiveness of ports that determines the degree of connectivity between port hinterlands and international markets. Enhancing this level of connectivity, therefore, often revolves around attempts by ports to optimize the interface between hinterlands and the maritime logistics network. Core aspects of these efforts include the coordination of transport operators; improving communication among key players so as to connect the transport chain or constellation; the sharing of best practices among stakeholders; improving physical linkages into the hinterland; continuous process improvement; and the development of innovative business models that enhance both shipping and port operations. The ongoing developments in relation to these issues, as well as other *Emerging Trends in Ports* are addressed within this Volume 2 of *Dynamic Shipping and Port Development in the Globalized Economy*.

Considering Latin America and the Caribbean (LAC) as an emerging region on the global map of container trades, Gordon Wilmsmeier and Jason Monios (Chapter 2) analyze the current challenges faced by container ports in the region from three perspectives: the implications of a changing geography of trade; the challenges arising from a port life-cycle perspective on infrastructure and technical efficiency; and the restrictions of the current institutional framework. In so doing, they analyze the intersection of clear trends in the evolution of port systems – the decentralization of port governance; a greater concentration of power; and the simultaneous deconcentration of port traffic. In so doing, their intention is to identify how the institutional setting governing the spatial diversification of container port activity has changed as a result of the intersection of these three trends and whether it is suited to dealing with new challenges as they arise. An additional question is whether the new institutional settings created by port reform in developing countries are suited to supporting the successful application of port devolution policies imported from developed countries with different political and institutional histories. The authors provide

some interesting observations on the LAC context: an increase in Brazil's share of container throughput from 60 to 74 per cent between 2000 and 2013 was ascribed to the nation's economic development and a strategy to act as transshipment hub and gateway for Paraguayan, as well as southern Argentinian, cargoes; a spatio-temporal diversification process, driven in particular by the emergence and expansion of secondary ports, with Brazil, Chile, Mexico, and Panama providing good examples of these processes; and the emergence of different categories of ports in the region – namely, pure transshipment hubs (with a minimum of 70 per cent transshipment cargo), hybrid ports (between 30 and 70 per cent transshipment cargo), gateway ports (with less than 30 per cent transshipment cargo), and local and inter-island transshipment ports. The authors also point out that port development in LAC, as in other port systems, has been driven first by significant and continued growth of container traffic. The strategies of liner shipping companies have evolved toward a wide implementation of hub-and-spoke networks, leading to patterns of concentration which exhibit significant effects of path dependence. However, private investment, public policy, and planning practices have been found to play an important role in port development, supporting newly emergent port hierarchies. Globalization has contributed to the reconfiguration of the container shipping networks within the region, as has China's growing engagement in LAC. This chapter illustrates the developments taking place, and the challenges faced, within the LAC port system since the turn of the millennium, and it graphically portrays the fact that port development is no longer a local or regional discussion, given the process of internationalization that has taken place over the last 20 years.

As far as the container port sector is concerned, South Africa (SA) can be considered to be an emerging country within the sub-Saharan region. In Chapter 3, Darren Fraser and Theo Notteboom identify the funding options available to SA's container ports given their institutional position and need for port capacity. The authors comment on the merits of each funding option from the perspective of SA's ports and the port authority, in particular Transnet. The timing of capacity expansion and a positive assessment of future demand are crucial not only to positioning SA's ports in readiness for sustainable growth, but also to secure the appropriate sources of funding for the financing of capacity expansion. The authors elaborate generic sources of funding and financing for the port sector and build up a theoretical framework of funding and financing options as a function of the extent of public port ownership, referring basically to the World Bank port reform toolkit typology

of ports. Based on the above framework, the authors propose that "pure public ports from developing countries have limited investment funding sources, compromising the execution of capital investment expansion programs" and test this hypothesis by utilizing a case study of SA's container ports. As long as Transnet Soc Ltd (the group holding company, henceforth Transnet) maintains its 100 per cent shareholding, funding sources are in effect limited to shareholder investment capital, general reserves, and debt. The authors describe the choices available for each option and address both the theoretical financial benefits arising from the choice identified and the potential financial pitfalls for the company.

The authors' investigation is particularly relevant given the proposed "Dig-Out Port" to be constructed on the site of the old Durban International Airport; Transnet are currently investigating the business rationale of alternative funding and financing arrangements. In 2013, Transnet concluded a series of stakeholder meetings with local organizations about the proposed Durban "Dig-Out Port" project, as part of the project's concept phase that includes the development of the Sustainable Port Development Framework that will inform all future designs as well as operations. The authors highlight the port institutional framework of SA in order to present various funding alternatives available to the organization. These range from full or partial privatization of the port operators and partial privatization of the port authority, quite apart from retaining the current status quo. The authors conclude that Transnet is in a good position to review recent port reform programs within the region and to assess whether the investment track record of these public–private partnership ports (with their profit maximization imperative) have any similarity to the capital expansion ambitions of the Transnet group. Even though there are definite implications for the reform decision, the authors have eschewed other more qualitative and practical implications of the various options, such as potential labor opposition to privatization or the potential positive impact of outsider expertise.

In Chapter 4, Kevin Cullinane, Sharon Cullinane, and Tengfei Wang analyze the development of mainland China's container ports over a period in which China has seen an explosion in its containerized trade. The authors adapt and apply a taxonomy, originally developed by Robinson (1998), which is based upon the position of a container port within a hierarchy of the type of liner shipping services that make most use of the port. This concept is utilized for explaining the phases in the development of the container port sector in mainland China and

also for analyzing the three geographical centers (in southern, central, and northern China) where container port competition is most intense. The influence of other factors is also considered. In this respect, the combined impact of China's port privatization policy, foreign direct investment in China's transport and logistics industry, the globalization policies of the world's major container terminal operators, planned transport infrastructure improvements, and China's accession to the World Trade Organization (see Li et al., 2003) are all critical to the future development of the sector.

Observing that production has moved from being "firm-focal" to "port-focal", and recognizing the consolidation of shipping routes, the globalization of shipping lines and increasing cooperation among port operators, port authorities have evolved from focusing only on port infrastructure to playing active roles in their hinterlands. In Chapter 5, Enrique Martin, Sergi Saurí, and Adolf K.Y. Ng review the changing roles of ports and the evolution of ports in a globalized world, with a focus on identifying the key drivers that have prompted this process. In this chapter, the term "ports" refers to a seaport as well as (parts of) any other nodal point with facilities and personnel which can facilitate the contemporary development of global supply chains (river port, inland port, airport, and other types of logistics terminal). The authors identify six key drivers at a dimension level: demography and social changes, energy and environment, technology, economy, finance, and policy (see Table 5.3). Each key driver has sub-drivers at a criterion level. Noting that the topology of the shipping network (from one-to-one to hub-and-spoke with several levels of complexity), shipping companies, terminal operators, port region, and port governance are the main elements of a four-phase model of shipping line development by Wilmsmeier and Notteboom (2011), the authors ask the question: How can these elements explain the dynamics involved in the four phases? Their answer is that the demands on both the shipping side and the land side of a port constitute a self-reinforcing loop. As a result of both self-reinforcing loops, a key conclusion is that "the rich get richer" in terms of port development. They conclude that the main drivers governing port devolution are the alliances and vertical integration of shipping companies, the expansion of international trade, the concentration of cargoes around the closest part of port hinterlands, and institutional aspects, most often such aspects as port development and port governance.

In Chapter 6, Mary R. Brooks questions whether a government's objective that ports be commercially driven organizations that reimburse

taxpayers for prior investment is compatible with a local port community's objective of enhancing its own economic development. This chapter focuses on identifying the principles of good governance and how they can be translated into the organizational structure and processes of devolved entities. In seeking a solution to this problem, the first thorny issue to grapple with is to provide a definition of "governance" that yields a common understanding. Once this is achieved, the author moves on to focus specifically on the Canadian corporate governance code as providing a benchmark set of "best practice" principles in governance and to analyze how best these could be implemented within any form of organization. In addressing the specific literature on port devolution, the author berates the emphasis placed on full privatization and reminds us that this represents merely one end of a continuum of private sector participation in governance and only one of a whole range of possible characteristics that could be embodied within any given governance structure. Brooks concludes that because a wide variety of governance models exist and they are often very complex, governments are unlikely to agree on a globally harmonized approach to port governance. She also outlines some of the issues governments need to contemplate in their quest for both good governance practices and the alignment of the commercial objectives of the board of a port authority with community economic development objectives. This particular focus is missing from recent port governance research. Over the past decade since the publication of Brooks (2005), there have been further literature on port reform/restructuring efforts in several countries (e.g., Brooks and Cullinane, 2007; Brooks and Pallis, 2011, 2013; Debrie et al., 2013; Galvao et al., 2013). Brooks identifies future governance challenges in three critical areas: concessions as a governance mechanism for terminal operations; strategies to coordinate or capture hinterlands; and port community (i.e., IT) systems and other stakeholder engagement strategies. The author observes that there has been very little research on how well port devolution initiatives have worked and even less evaluation of whether port reform has been compatible with local community economic development initiatives. The majority of the research reported in academic outlets examines corporate governance as it relates to public or private entities from the American/Anglo-Saxon market-based perspective. Having reviewed the principles critical to good, community-responsive port governance and analyzed what has changed over the last decade, Brooks concludes that ports have not reached the goal of being successful engines of economic development.

Based on the work reported in Lee et al. (2012), Tsung-Chen Lee and Paul Tae-Woo Lee (Chapter 7) claim that even though there have been several studies of South African ports, they are mostly descriptive and do not provide a quantitative analysis of the economic impact of port development on the national economy. The authors argue that the stakeholders in South African ports not only need to understand how current and planned operations and capital investments in the port sector might affect economic activity, but also need to develop a robust economic impact model to quantify and determine the contribution of ports to the national economy. To fill this gap, the authors propose the application of the computable general equilibrium (CGE) model, namely the Global Trade Analysis Project (GTAP), in port impact studies (PIS). By taking both an investment perspective and an operational perspective, this approach explicitly and comprehensively elaborates the channels through which port development can affect the macroeconomy of a nation. This quantitative analysis of port development in South Africa is conducted from two perspectives: one focuses on the one-off impact of port investment during the construction phase and the other focuses on the ensuing effect of a reduction in freight rates due to improved capacity. The key findings of the authors are that port development generates growth and employment and is beneficial to the South African economy as a whole; port investment brings significant benefit to the port-related sector (particularly to those activities related to water transport, transport equipment, and construction); and a reduction in freight rates as a result of a saving in waiting time for vessels will cause an asymmetric impact on shipping costs across the region, and, as a consequence, this will lead to a shift toward closer trading partners, particularly in sub-Saharan Africa and the Middle East. The results highlight the significance of the port sector for the South African economy and reveal that port development, as a means of promoting trade and employment, is an important dimension for promoting economic growth in South Africa. The authors point to the potential significance of the global CGE model, the GTAP, in port-related analysis. In particular, the international dimension of the global CGE model enables the exploration and identification of the impact of port development, not only in terms of the level of total trade, but also at a disaggregate level, by major export and import commodities and by major international trading routes.

Paul Tae-Woo Lee and Jasmine Siu Lee Lam (Chapter 8) attempt to elaborate the first revised version of the "fifth generation port" (5GP), focusing on container ports and maritime logistics, and to propose a

second revised version of the 5GP. The United Nations Conference on Trade and Development (UNCTAD, 1999) coined the term "fourth generation port" (4GP) in relation to eight items: that is, service quality, information technology (IT), community environmental impact, port cluster, maritime cluster, logistics hub, inland, and waterside, as well as referring to vertical and horizontal integration port strategies. Flynn and Lee (2010) and Flynn et al. (2011) proposed the concept of the 5GP on the basis of 4GP. Lee and Lam argue that the description of the eight items in Flynn et al. (2011) is to some extent vague and does not provide a sharp demarcation line among some items which form the basis for the comparison and evaluation of a port's generation. In a previous work, Lee and Lam (2013, 2015) modified the 5GP concept and tested it empirically by applying descriptive and quantitative methods to four major international ports, namely Shanghai, Singapore, Hong Kong, and Busan. In this chapter, the authors identify some shortcomings and omissions with their previously espoused concept for the first 5GP on the basis of their empirical test results and the feedback received in respect of their previous research. In an effort to resolve these issues, the authors go on to describe the second 5GP concept, consisting of 5 aspects, 8 features, and 12 criteria (as shown in Table 8.4 in Chapter 8). The key differences between the first 5GP concept and the second version lies with (a) the level of "service quality" as reflected in a customer's satisfaction with the regulations and general standards which underpin and ensure the reliability and resilience of the system; (b) the second 5GP considers information flows in maritime logistics, taking into account high-end IT solutions such as single window systems (SWS) and radio-frequency identification (RFID); (c) the level of "sustainability" provided, with the symbiotic nature of the port and city and the "green port" concept being specifically addressed in the second 5GP concept; and (d) in contrast to the first version of the 5GP concept, because they are closely related to meeting port users' multifaceted requirements and needs, the port cluster, and maritime cluster concepts are grouped under the same clustering subgroup in the second version of the 5GP. The authors emphasize that their modifications are intended to more clearly distinguish a 5GP from a 4GP by making these characteristics more specific. This is graphically illustrated through the application of the second 5GP concept to empirical case studies of four major container ports in Asia. This comparative case analysis evaluates whether the four ports have advanced to the 5GP stage and demonstrates the feasibility of the second 5GP. The authors conclude that the second 5GP concept is both more comprehensive and more quantifiable

than its antecedents, thus facilitating its application to diverse ports for quantitative empirical testing. In addition, the authors point out that because the second 5GP consists of aspects, features, and criteria, this enables the use of multi-criteria decision-making techniques or hybrids thereof (Lee et al., 2014).

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# 2

# Container Ports in Latin America: Challenges in a Changing Global Economy

*Gordon Wilmsmeier and Jason Monios*

## Introduction

"The only way to change one's relative location on the network is to change the geographic area covered by the network" (Black, 2001, p. 1). Consequently, analyzing how ports work and interact with their environment and identifying the determinants of its performance are key to understanding the challenges currently faced by the port system in a globalized economy.

Economic development has traditionally come with a transformation of material mobility. Mobility constitutes an ontological absolute in today's society, which "exploded" in the wake of containerization in the second half of the twentieth century. The globalization of trade grew exponentially, facilitated by the container that revolutionized the global maritime logistics system. Economic development in emerging economies changed the geography and structure of international trade and has shifted the relations of industrial production and regional integration.

The very raison d'être of ports is to provide and facilitate intermodal interlinkages in terms of transport and trade. Thus fundamental questions surrounding ports concern relative accessibility, transport system characteristics (Taaffe and Gauthier, 1973), operational efficiency, and institutional environments. A port is thus a dynamic phenomenon, changing its morphology, functions, and organization, as well as its role within the port system over time. As the container has been a key element in globalization, container ports as interfaces between the shipping (maritime) and economic systems (Cullinane and Wilmsmeier,

2011) have been fully exposed to the growth of container trade over the last decades.

Latin America and the Caribbean (LAC) can still be considered an emerging region on the global container trade map. From a global perspective, the 7.2 percent share (2013) of world container trade seems like a relatively small portion; however, from a regional viewpoint, the threefold growth of container traffic since the turn of the millennium has posed significant challenges to the ports and governments in the region in terms of infrastructure development, institutional frameworks, and policy strategies and has significantly transformed the port sector (ECLAC, 2012; OECD, 2011; Perrotti and Sánchez, 2011; Rozas and Sánchez, 2004).

Ports have evolved from being traditional interfaces between land and sea to providers of complete logistics networks. Accordingly, the roles of the traditional actors in a port have changed and new actors have emerged. Port authorities have become intermediaries and facilitators of development driven by trade development, global shipping lines, and international terminal operators. Ports are being increasingly differentiated not only by their ability to handle the latest generation of container ships, but also by their institutional efficiency and effectiveness to respond to market developments. Recently, however, discussions on port infrastructure capacity limitations in LAC (Perrotti and Sánchez, 2011) and the need for a new approach to port governance have resurfaced (Monios and Wilmsmeier, 2015). From momentum of current economic changes and maritime and port industry sector trends, the need emerges to reflect on the current state of the port system, to evaluate emerging challenges and to question current institutional frameworks and governance strategies in the region.

This chapter reviews the changes over the last 15 years and analyses the current challenges of container ports in the region from three perspectives: (a) the changes implied by the changing geography of trade, (b) the arising challenges from a port life-cycle perspective regarding infrastructure and technical efficiency, and (c) the restrictions of the current institutional framework.

## The LAC container port system

The LAC port system can be categorized first by territory and second by coastline: Central America[1] (split by east and west coast), South America (split by east, west, and north coast) and the Caribbean. Container throughput in the LAC port system grew from 14.6 million TEU

(20-foot equivalent units) in 2000 to 44.9 million TEU in 2013 (ECLAC, 2014). Throughput in 2013 was equivalent to 7.2 percent of all global port movements. Figure 2.1 shows all LAC ports handling more than 100,000 TEU in 2013.

Figure 2.1 shows what at first appears to be a relatively even spread across the coastlines of each country. However, container throughput within each country or coastal range is not spread evenly across all ports (see Wilmsmeier et al., 2014 for full analysis).

Figure 2.2 reveals the evolution of container throughput in the region and sub-regions. While all regions grew steadily until 2008, the region experienced a negative growth in 2009 due to the global financial crisis, and since 2010 the speed of container activity expansion has slowed down leading up to a reduction of throughput in 2013 (see Figure 2.3). The diminishing growth rates over the last years stand in clear contrast to the period prior to the financial crisis and mark the beginning of new challenges.

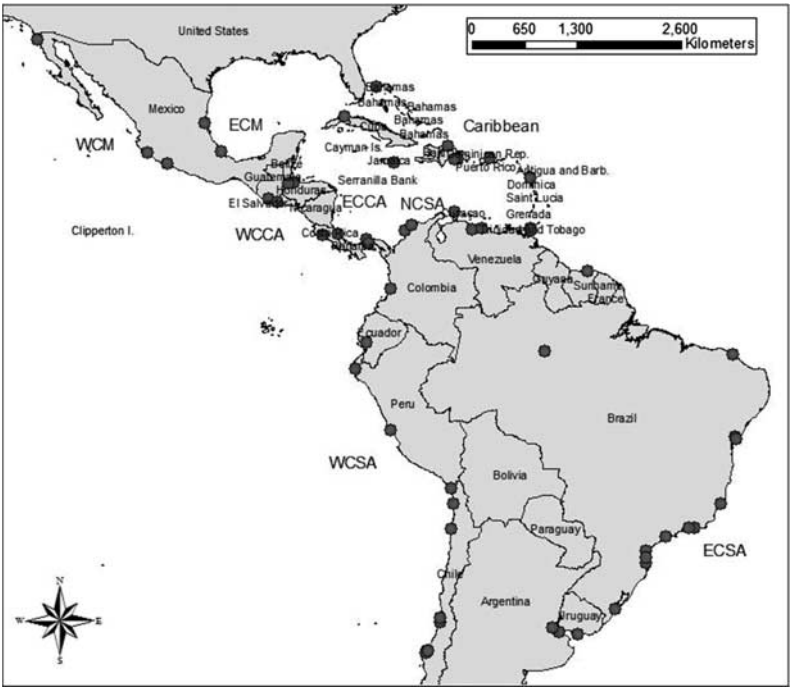


*Figure 2.1* LAC ports with throughput over 100,000 TEU in 2012

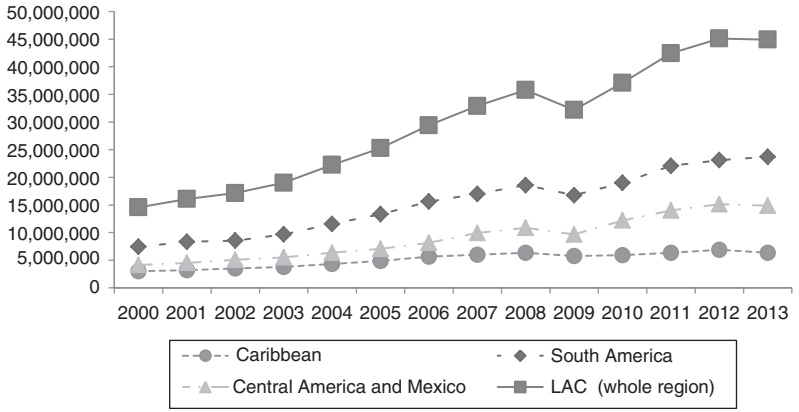


*Figure 2.2* Port throughput (2000–2013)
*Source*: Based on ECLAC (2014).

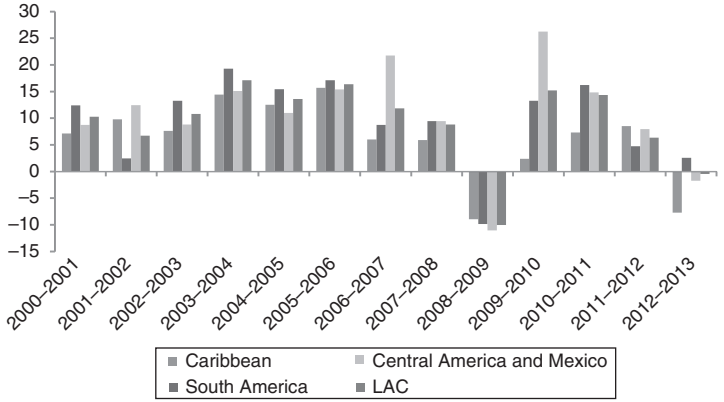


*Figure 2.3* Year-on-year growth rates (2000–2013)
*Source*: Based on ECLAC (2014).

Furthermore the shares of container activity have shifted. The Caribbean has lost a significant share of activity in the region, while Mexico and Central America (especially Panama) have expanded their market shares. Central America (mostly Panama) has recorded the most impressive growth figures over the last 14 years. Port activity growth in Panama is particularly related to transshipment traffic, which reflects the changes in liner service strategies that build on hub-and-spoke structures as indicated by Wilmsmeier and Notteboom (2011), thus leading

to a concentration in the port system toward transshipment hubs, a development that is driven by liner shipping strategies rather than economic development. The Caribbean continues to be a key market for transshipment; however, it has been losing market participation to the coastal regions (NCSA and Panama) over recent years, indicating a shift from the traditional transshipment hubs (e.g., Kingston, Jamaica, and Freeport, Bahamas) toward Panama and Cartagena, Colombia.

Wilmsmeier et al. (2014) also observe a shift in Central America and Mexico from the Caribbean coast toward the Pacific coast. In 2013, 50 percent of container throughput in Central America and Mexico was handled in Pacific coast ports. By way of comparison, the ports on this coast did not even reach a 20 percent share in 2000. In contrast, the three coasts of South America have remained in balance, maintaining throughput in the time period at a proportion of 50:35:15 between east, west, and north coasts, respectively. The shift of activity in Central America and Mexico is a result of not only the increased trade with Asia, but also the expansion of transshipment activity, especially in Balboa, Panama, and Lazaro Cardenas, Mexico.

Analyzing port activity by country reveals that in 2013 one-fifth of all containers in LAC were moved in Brazil (19.3 percent), followed by Panama (14.6 percent), Mexico (10.9 percent), Chile (8.5 percent), and Colombia (7 percent). However, the port throughput at regional and country level is only a very crude reference of the current state of the port system. In order to understand the evolution of a port system, it is necessary to take a spatio-temporal perspective, investigating disaggregated figures at country and sub-regional level over an extended time period.

On the ECSA, Brazil's share of container throughput expanded from 60 to 74 percent between 2000 and 2013, Argentina's share dropped from 51 percent in 2000 to 17 percent in 2013, in a market that reached total volume of 11.7 million TEU in 2013. This shift originates primarily from the expansion of Brazil's economy, its further insertion into the global economy and its population size. By way of example, currently Brazil is one of the world's largest exporters of chicken and beef, a trade that has only recently developed as a response to the growing demand in the emerging Asian economies. Uruguay, the smallest economy on the ECSA, was able to grow its market share to almost 8 percent. This achievement is driven not solely by the economic development of the country, but also by its strategy to act as transshipment hub and gateway for Paraguayan as well as southern Argentinean cargoes (see also Wilmsmeier, Martínez-Zarzoso, and Fiess, 2011).

Wilmsmeier et al. (2014) observe a spatio-temporal diversification process, which is particularly driven by the emergence and expansion of secondary ports. Brazil, Chile, Mexico, and Panama are good examples of these processes. In Brazil, Santos' traditional dominance has been eroded by emerging ports. Furthermore, Rio de Janeiro, which has traditionally been the second biggest container port in Brazil in 2000, lost 50 percent of its market participation over the last 14 years. A number of secondary ports and greenfield projects have emerged that not only led to a geographic spread of container activity but also initiated a spatial deconcentration process. Rio Grande held an important market participation of 10 percent in 1997 and was expected to evolve as a competitor to Montevideo and Buenos Aires (Sánchez and Wilmsmeier, 2006) in the south of Brazil as its infrastructural conditions and draft of 15 meter favored the handling of Post-Panamax vessels. The port expanded and increased its market share to over 13 percent in 2003, benefitting from the repercussions of the economic crisis in the port of Buenos Aires (see Sanchez and Wilmsmeier, 2006). However, since then its share in Brazilian container throughput has decreased to almost 8 percent in 2013. Despite its continued growth, the port could not keep up with the speed of expansion of overall national container activity. Looking at other ports, the port of Itajai (including the new Navegantes terminal) doubled its market share to 13 percent in 2013, Manaus also doubled its share to 6 percent, while Suape more than tripled its participation to over 5 percent in 2013.

Balboa, located on the Pacific coast of Panama, has taken half the country's throughput from the previously dominant port of Colón on the Caribbean coast. Mexico's port activity in 2013 was less concentrated than in 2000, due to the shift of activity to the Pacific coast, with Veracruz losing share to Manzanillo and the emerging Lazaro Cárdenas. In the Chilean market, the emergence of secondary ports is particularly notable, which has led to a greater geographical spread of port activity toward the south of the country (Wilmsmeier et al., 2014) based on the appearance of San Vicente (SVTI) as a new player in 2005 and the growth of the co-located Lirquen. These developments effectively reduced the market share of the two traditional main ports, Valparaiso and San Antonio, by more than 6 percent market share between 2005 and 2013. However, the pure numerical analysis by port does not reveal the systemic relationships in the port system created by the privatization efforts over the last two decades and the internationalization of container port operations. In the case of Chile, this is particularly interesting as San Antonio and San Vicente share the same operator. Thus,

while the port of San Antonio was not able to increase its market share of the port system (but it did grow in absolute terms), the private operator's relevance and share in port activity grew strongly when one considers the ports of San Antonio, San Vicente, and the other Chilean ports operated by the same company.

Colombia's port system contrasts this development as the port of Cartagena concentrates the greatest share of port throughput in the country. This results from the changed function of the port from a traditional gateway port for national cargo to a hybrid port with a significant share of transshipment. In a regional context, these developments reveal the different stages of maturity of the port system in the LAC countries, where the spatial deconcentration of activity is also an expression of geographical shifts in the economic activities of the countries and in the case of transshipment and hybrid ports might reflect changes in the strategies of shipping lines and terminal operators. Wilmsmeier et al. (2014) identified three categories of ports in LAC: pure transshipment hubs (minimum of 70 percent transshipment cargo), hybrid ports (between 30 and 70 percent transshipment cargo), gateway ports (less than 30 percent transshipment cargo), and local and inter-islands transshipment ports.

Analysis reveals that the share of transshipment cargo in the Caribbean basin (ECCA, East Coast of Mexico, Caribbean, and NCSA) decreased slightly from 48 percent (1997) to 40 percent of total traffic in 2013. However, the incidence of transshipment traffic in the region is significantly above the 2011 global average of 31 percent (Drewry, 2013). Colón, Panama, recorded the most significant growth in absolute terms, it has retained its approximately 50 percent market share. Freeport has taken some market share from Kingston, but importantly, Colón has been able to maintain its upward trend of container throughput while both of the other transshipment ports have dipped in the last few years. The share taken by local ports has declined, while gateway traffic has remained stable. What is most interesting about the data is that hybrid ports have significantly increased their market participation from 12 to 23 percent. Cartagena in Colombia was the most successful hybrid port by increasing its market share from 5.5 to 11.6 percent in the same period, while other hybrid ports such as Port of Spain and Point Lisas were not able to increase their market share, despite overall traffic growth. Cartagena's transshipment share in total container movements increased significantly since 2005 when Hamburg Sud decided to make the port its strategic transshipment hub for LAC connecting to seven of the carrier's services between North and

South America, the Caribbean, the Mediterranean, and North Europe. Hamburg Sud's transshipment volume through Cartagena has increased fivefold between 2006 and 2012.

Other points of interest are the emergence of new ports such as Caucedo, Dominican Republic, opening in 2005 and reaching almost 1 million TEU by 2011. The port of Caucedo is a greenfield development and is operated by the global terminal operator DP World with the aim to become a new transshipment port in the region. Since then the port has evolved to a hybrid port by capturing significant amounts of the increase in local destination cargo and, at the same time, pursuing the goal of attracting more transshipment cargo, which reached a share of above 50 percent of all container movements in 2011. The success of hybrid ports suggest the growth of secondary ports as second-tier regional hubs, similar to the findings in the Chinese port system by Wang and Ng (2011). Such ports have managed to insert themselves in between global and local flows, providing transshipment to intermediate services as well as serving local and regional gateway traffic.

Gateway traffic is more complex, as due to the difficult geography of the regions, many gateway ports are not competing for an overlapping hinterland. Therefore, traffic counts are related more directly to the increase of global trade rather than the changes in the port system. Most gateway ports experienced a similarly steady increase in total throughput across the time period.

Ducruet et al. (2009, p. 359) argued that "concentration stems from the path-dependency of large agglomerations", while drivers of deconcentration include "new port development, carrier selection, global operation strategies, governmental policies, congestion, and lack of space at main load centres". According to Ogundana (1972), Barke (1986), and Hayuth (1981), port system concentration will eventually reach its limits and invert, leading to a process of deconcentration, a phenomenon discussed by Slack and Wang (2002), Notteboom (2005), and Frémont and Soppé (2007). Wilmsmeier and Monios (2013) argued that existing theory falls short of differentiating between deconcentration that emerges upon failure of a system in a reactive manner, deconcentration that materializes from proactive port development strategies, and deconcentration that emerges from new economic and industrial development. Thus, the drivers of deconcentration processes can be related to the port system, the transport system (i.e., hinterland infrastructure and carrier strategy) and as well as the economic system (e.g., logistics strategies, economic development).

The rise of secondary ports has already been identified in recent research (e.g., Wang and Ng, 2011, in China; Wilmsmeier and Monios, 2013, in the United Kingdom; Wilmsmeier et al., 2014, in LAC). However, unlike previously dominant ports, the emergence and location of such ports has not been explained satisfactorily by natural location advantages, suggesting that such developments are driven to a large degree by other factors, such as the planning and regulatory regimes in each country. It is recognized that to some extent these factors will be unique to each port system; nevertheless, some of these key influences, such as port devolution policy, the introduction of the private sector to port operations, the ongoing relation between the private operators and the changing regulatory system (Wilmsmeier et al., 2014), and the conclusion of a ports life cycle (Cullinane and Wilmsmeier, 2011), have been hypothesized to be key factors in any such critique.

The previous descriptive analysis gives an overview of the state of the LAC container port system, but in order to understand the drivers of these developments a more detailed look at the complexity and critical factors of port system evolution is necessary.

> One major difficulty lies in the fact that the integration of phenomena which we must study in areas is an integration of a large number of independent, or semi-independent factors. Consequently, we seldom have to do with simple relationships .... Theoretically we might follow the logic of the systematic sciences by assuming that all other conditions remain the same ... Even if we knew the theoretical principles governing the relation of each individual factor to the total result ... the sum total of all relationships would be far too complicated for us to be able to use. This is a general difficulty that applies not only to all the more complicate aspects of the social sciences, but also to many phenomena in the natural science.
>
> (Hartshorne, 1939, p. 203)

Wilmsmeier et al. (2014) identify critical moments in port development in the region (see Figure 2.4). These critical moments do not appear either in sequence or simultaneously but rather in a diversified spatio-temporal manner, suggesting the influence of local and regional institutional and global industry specificities. Their framework contextualizes, systematizes, and identifies the spatio-temporal instances of such key influences on port development.

Critical moments exert a determinative impact on whether it is productive or unproductive mobility. The moments when investment

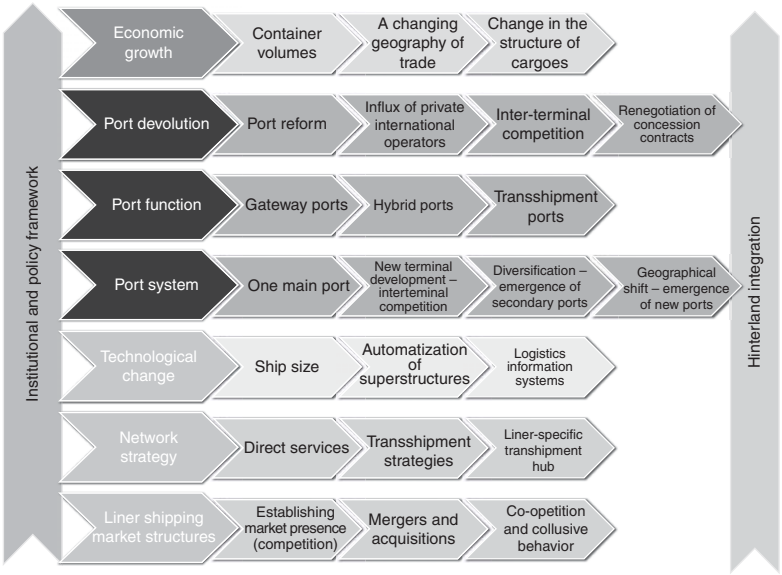


*Figure 2.4* Critical moments in LAC port development

comes online (or the industry changes) must be capitalized on by key stakeholders. Global replication of identical strategies will not work unless the correct mix of critical moments are arrayed in a suitable spatio-temporal pattern. When analyzing the evolution of a port system and its sub-systems, it is important to be aware not only of path dependence exerted by previously dominant ports but the contingency of port development upon port devolution, competition, and public policy and strategies. The work contained herein underscores the temporal aspect of path dependence supporting the view of Jacobs and Notteboom (2011) that the "window of opportunity" has to be open long enough to achieve the institutional transformation at the critical juncture, otherwise the window closes again.

A number of questions requiring disaggregated research emerge from the descriptive analysis. What implications does current development have for the policies of individual countries within the region? What is the role of shipping lines in driving the emergence of new and secondary ports as well as the expansion of existing port? How far does economic development contribute not just to throughput growth but also to a geographical diversification of the growth of container ports? Are other economic or institutional variables playing a role in the

emergence of these ports? What has been the effect port devolution and international terminal operators?

The following section will discuss specific critical factors of port development in more detail and try to show the interconnections and interdependencies between these factors.

## A changing geography of trade

The continued expansion of the demand for material mobility, thus container trade and related logistics comes at a cost, particularly in rapidly developing economies. It raises demand for infrastructure, initiates land-use debates, drives increased energy consumption and emissions, and exploits natural resources.

The traditional geography of production and consumption is changing. By 2025 the portion of the world population belonging to the consuming class will be – for the first time in history – greater than the group living in conditions below consuming class, and the global consuming class will be growing by 75 percent between 2010 and 2025. Additionally, most of the population belonging to the consuming class in 2025 will be living in the countries today considered as emerging markets (Figure 2.5).

The economies in LAC have been part of the expansion of economic development and trade. Since 2000, the region has experienced a continued growth in GDP per capita. This development has been significantly driven by trade liberalization has increased the high demand for natural resources from the Asian economies (especially China and India) and the overall growth of the global economy in terms of exports. At the same time, the increase in purchasing power from growing GDP has had a positive influence on imports in terms of volumes and value.

Figure 2.6 illustrates the increase in the volume of international maritime trade between 2000 and 2012, which grew more than fourfold in this time span and underlines the growth in container trade, as described in the previous section.

Beyond expansion in the volume of trade, the changes in the geography of this trade over the last 14 years is of high relevance as it reflects the emerging importance of new trade lanes and trade relations. Figure 2.7 depicts the expanding relevance of South American trade with Asia, which in terms of volume made up more than half of international maritime trade in 2012 and was accompanied by a doubling of its share in terms of value to above 36 percent. At the same time, the relevance of the traditional markets of the region (Europe and

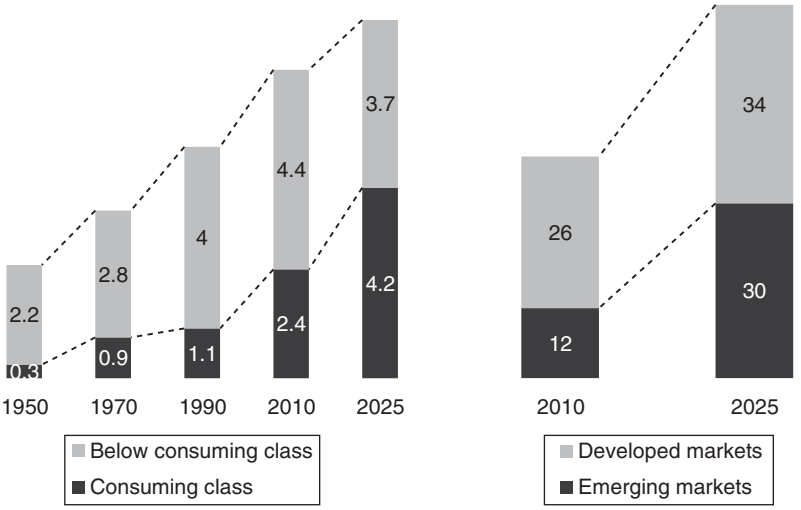


*Figure 2.5* Evolution of world population and consumption until 2025
*Note*: 1. Consuming class: Daily disposable income is equal to or greater than USD 10; below consuming class: less than USD 10; incomes adjusted for purchasing power parity. 2025 projected data.
2. Estimate based on 2010 private-consumption share of GDP/country and GDP estimates for 2010 and 2025, assumes private consumption will remain constant. 2025 projected data.
*Source*: Based on the Maddison-Project, http://www.ggdc.net/maddison/maddison-project/home.htm, 2013 version (accessed October 2014).

North America) has decreased. Further intra-regional trade has suffered a significant loss in relevance to the region as it has not increased in terms of volume or value in the period between 2000 and 2012. In terms of value, 87 percent of the import cargo and 54 percent of the export cargo is containerized.

How do these developments influence the LAC port system? The shift in trade relations has led to an increased demand for liner services between LAC and Asia. The LAC–Asia routes, in contrast to some of the traditional main routes (WCSA–Europe, WCSA–US East Coast), do not have size restrictions as they do not pass the Panama Canal. In consequence, the increases in ship size on the Asia routes have been faster and thus have been the driver for infrastructure and superstructure demands in the ports of the region. Wilmsmeier (2013) demonstrates this for the case of South America. He is also able to identify the cascading effect that emerges as a repercussion of the economic crisis and the oversupply of vessel capacity at the global level (cf. Yeo, 2014) (Figure 2.8).

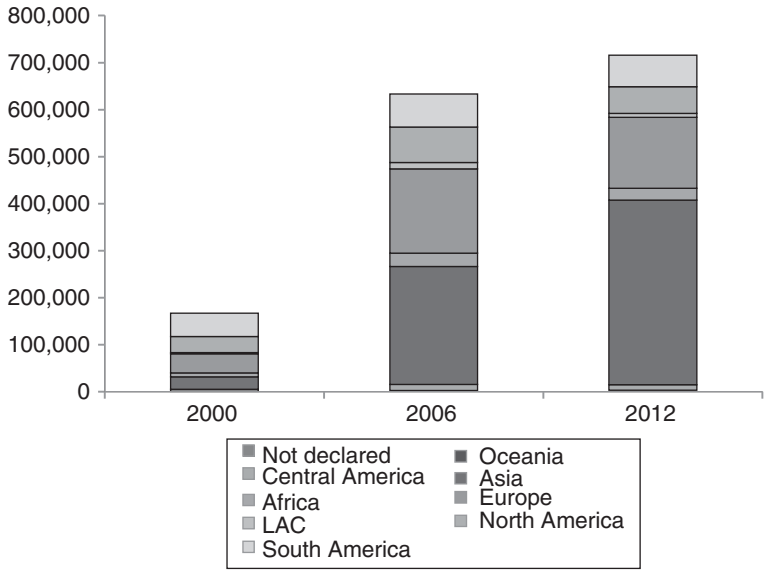


*Figure 2.6* Evolution of volume (thousand metric tons) of South American international maritime trade (2000–2012)
*Source*: Based on International Transport Database, ECLAC, various years.

Wilmsmeier (2013) shows in detail how the changing characteristics of vessels deployed in the region impact the port system in various dimensions of infrastructure and superstructure development. Beyond vessel draught, increased length and breadth of vessels determines the minimum required infrastructure and superstructures in ports. The latter characteristic, by way of example, is a key indicator for superstructure requirements in ports, especially the reach of ship-to-shore cranes. Additionally, the breadth of vessels serving the sub-region increased from 32.5 meter (in 2000) to more than 45 meter (in 2012).

In consequence, the changing volume and geography of trade creates a multiplicity of pressures to adjust port infrastructure, as well as emerging pressure for new and planned port development. A recent study expects 13,000-TEU ships to start calling regularly on the coasts of South America between 2016 and 2020 (Sánchez and Perrotti, 2012). This would have direct implications for the liner shipping networks and port infrastructure in the region. If some secondary ports have insufficient handling capacity to accommodate bigger ships, this would support the growth of regional second-tier hubs, which would be able to

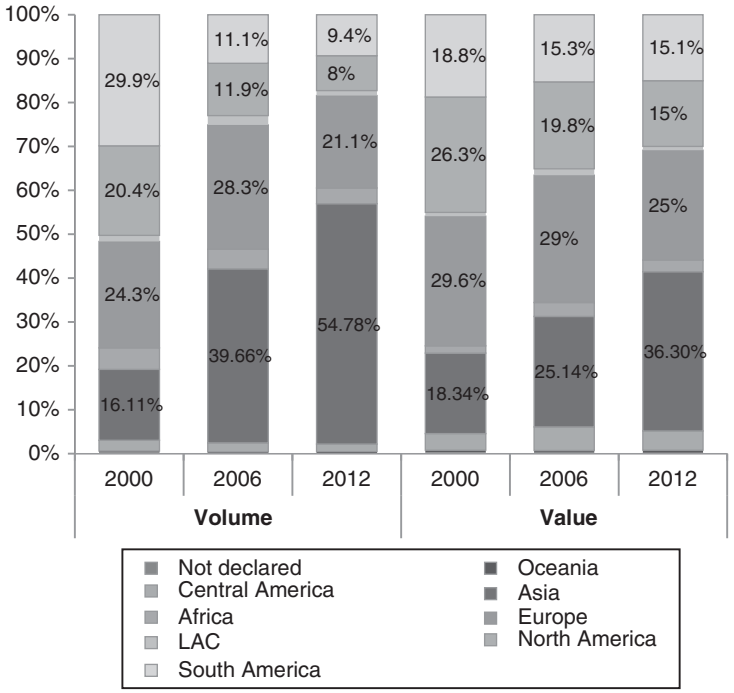


*Figure 2.7* Share in South American international trade by region in terms of volume and value (2000–2012)
*Note*: Volume in metric tons; value in current USD.
*Source*: Based on International Transport Database, ECLAC, various years.

serve the smaller ports either by smaller feeders or even land transport (thus raising issues relating to the quality and capacity of hinterland infrastructure links).

The introduction of ever-larger vessels on mainline routes may be attractive for shipping lines but will strain ports severely. Ports invest large sums in upgrading their facilities and competing to receive vessel calls, but handling demand spikes is difficult. Large container drops can result in inefficient crane utilization as the numerous large cranes required to service large ships are not all required between calls; furthermore, large numbers of containers cannot always be moved in and out of ports smoothly. Moreover, shipping lines already have trouble meeting their own schedules; current average reliability across the industry is below 70 percent. The larger the vessel and the greater the volume of

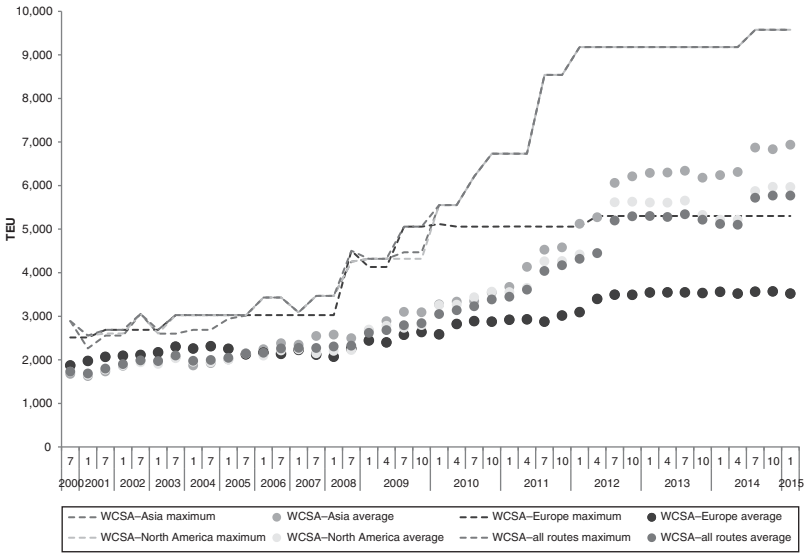


*Figure 2.8* Evolution of vessel capacity on West Coast South America main trade routes (2000–2012)
*Note*: The main trade routes are transpacific, transatlantic, and Europe–Asia.
*Source*: Wilmsmeier, 2013, based on ComPairData, Lloyd's List, and Marine Traffic, various years.

transferred containers at each call, the larger the knock-on effect of poor reliability on the rest of the container system (Figure 2.9).

A further dimension of technological change in ports is driven by the rapid expansion of reefer cargo (Vagle, 2012). The global demand for perishable products, especially fruit, has grown substantially, increasing the need for refrigerated seaborne transport capacity. The associated trade flows mainly originate in the southern hemisphere and are directed toward the industrialized countries in the northern hemisphere. Total seaborne reefer trade was around 95 million tons in 2013 (seaborne) and is expected to reach 112 million tons by 2016 (Drewry, 2014). The seaborne reefer trade in 2013 was equivalent to 3.1 million 40 feet full High Cube Reefer containers or 2.5 percent of the worldwide seaborne trade of dry cargoes of all kinds.

In general, containerized reefer trade has been one of the fastest growing market segments in the liner shipping industry to and from LAC (BTI, 2014). Reefer cargo requires constant refrigeration to maintain

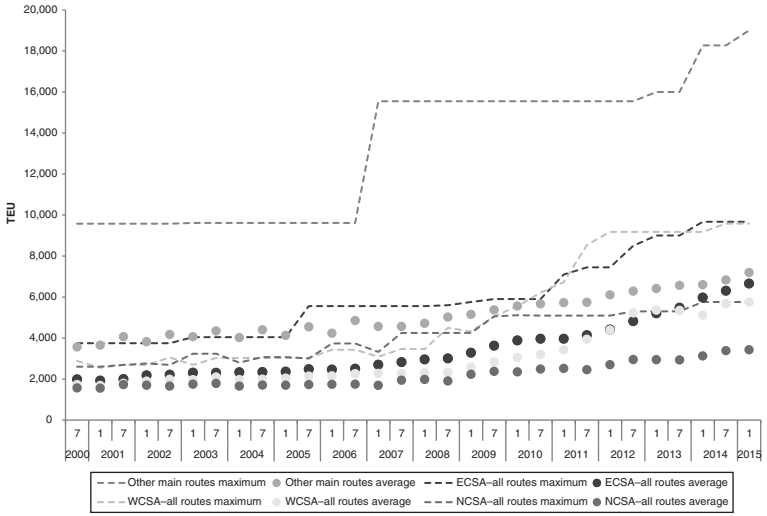


*Figure 2.9* Evolution of vessel capacity on South American and other main trade routes (2000–2012)
*Note*: EC = east coast; WC = west coast; NC = north coast; the main trade routes are transpacific, transatlantic and Europe–Asia.
*Source*: Based on ComPairData, Lloyd's List, and Marine Traffic, various years.

the quality of the product and thus consumes a significant amount of energy while moving in the supply chain. Hence, reefer trade poses an additional pressure on efficient energy consumption besides the energy required for regular port activities and operations.

The deployed weekly capacity of TEU and reefer plugs on the SA main routes more than tripled between 2000 and 2012. This shift is also reflected in the number of reefer slots per ship deployed in the region – up to 1,500 per vessel. WCSA and ECSA are the regions in the world where ships with the highest number of reefer plugs are being deployed (Figure 2.10).

This structural change in trade also has significant repercussions on ports, as the handling of reefer cargo requires not only additional installations for cooling and specific services to manage the units, but also has significant impact on the energy consumption of the ports in the region.

Consequently, these changes are accompanied by a shift in industrial production, and thus economic growth and development will lead to a new configuration and scale of supply chains and sustainability

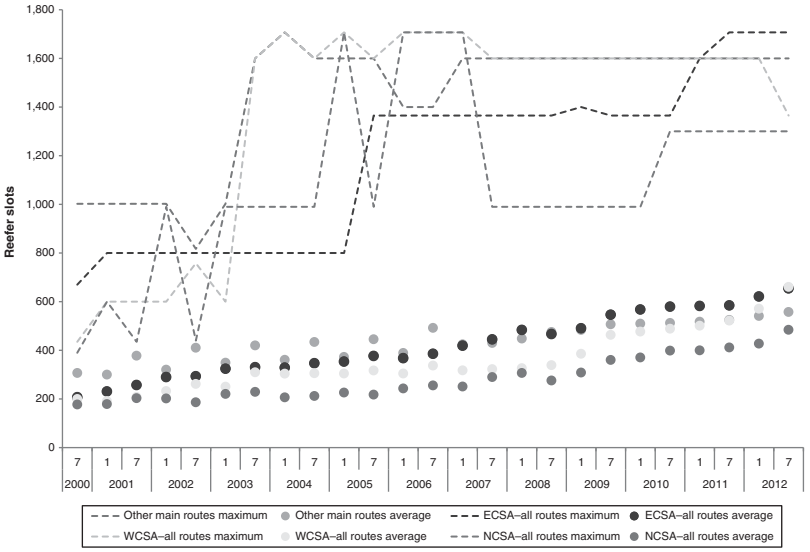


*Figure 2.10* Reefer capacity of vessels deployed on WCSA main routes (2000–2012)

*Note*: The main trade routes are transpacific, transatlantic, and Europe–Asia.
*Source*: Based on ComPairData, Lloyd's List, and Marine Traffic, various years.

challenges for ports. Given the current paradigm of growth, the question is: to what extent current port location and institutional frameworks are prepared to handle the emerging changes and challenges.

Based on the recognition of the changing geography and structure of trade, new challenges are emerging to synchronize port development, maritime networks, and demand further complicated by emerging structural changes and geographical shifts in manufacturing, distribution, and consumption. An emerging question is how the public and private sector response and existing strategies in terms of operation and institutional frameworks have and will be delivering results in this structurally changing and geographically shifting maritime geography of trade.

## Port devolution and productivity

Beyond the changes in throughput volumes, the appearance and geographical spread of port devolution processes in the region since the beginning of the 1990s have marked critical moments for the ports and port system (Wilmsmeier et al., 2014). Ports have undergone, and some

are still in, the process of implementing structural reforms in many countries, involving private capital in specialized terminal operation through the landlord scheme. Main container ports are now operated by international companies, and the competition among these to win concessions and within the market has been increasing.

In LAC, the intention of devolution was to "secure the benefits for commercially driven decision making organization previously run by government" (Baltazar and Brooks, 2007, p. 380) and to solve existing problems in ports such as excess of work force and regulation, inefficiency of port operations and deficits in the provision and maintenance of infrastructure and port superstructure investment, and security challenges (cf. ECLAC, 1992; Sánchez and Wilmsmeier, 2005).

Thus, port reform beyond its initial objectives of devolution of power, improved competitiveness, and technological efficiency has facilitated the corporatization of the port system as well as horizontal and vertical integration. The question that emerges is whether the results from port reform have been sufficient to respond to demand growth, infrastructure needs, and the changing expectations in the related private sectors such as the integration of port infrastructure with their hinterland.

This process facilitated the appearance of international port terminal operators in the region (see also Sánchez and Wilmsmeier, 2006). In 2006, 35 container terminals were being operated by international terminal operators in 12 countries of the region (Wilmsmeier et al., 2014). This number increased to 51 by the beginning of 2012. Along with the global terminal operators the emergence and progressive development of Latin American capital owned port operators can be witnessed (e.g., Brazilian, Chilean, or Colombian companies) with technical performances similar to the aforementioned companies.

While the simple presence of private port operators is not a guarantor of success in port and terminal development, it can be argued that these operators changed the level of competition, productivity, and efficiency in the region. Until 2006, intra-port competition was restricted to the port of Buenos Aires, the Caribbean coast in Panama, and between Valparaiso and San Antonio in Chile as they serve a congruent hinterland (Sánchez, Wilmsmeier, and Doerr, 2008). Since then the further influx of international terminal operators has brought a new level of intra-port competition to Callao, Peru (APMT and DPW); Panama's Pacific coast (PSA and HPH); Buenaventura, Colombia (TCB and ICTSI); Lazaro Cárdenas (APMT and HPH); Manzanillo, Mexico (SSA, HPH, ICTSI); and Santos, Brazil (DPW, APMT, and Santos Brazil).

It is interesting to observe that each international operator shows specific specialization strategies. In the first phase, during the influx of international operators, the interest concentrated on the countries' main ports of which many in the 1990s did not have sufficient scale to make operation viable for two competing operators (except Buenos Aires and Panama's Caribbean coast). The continued growth in demand has changed this situation and, since 2005, the increase in competition can be observed, as described above. HPH has a clear dominance in the Central American market (i.e., Mexico). APMT has been focusing on new terminal developments with a strong interest not only in transshipment cargoes but lately in gateway ports with potential to develop toward hybrid ports (e.g., recent development in Costa Rica). DPW has a more presence only in key ports in the region in each sub-region.

Given the historic need for infrastructure development in the region (Sánchez and Wilmsmeier, 2006), most development initially took place in the main ports. However, in more recent years, secondary port started to engage in more integrated development strategies that also included the consideration of logistics development connected to the port (e.g., Manaus, Brazil, and Puerto Angamos, Chile) (cf. Wilmsmeier et al., 2014).

The influx of private companies is not only a mere shift from public to private in the process of devolution, but further included a diversification of private operators. Notteboom and Rodrigue (2012) differentiate between (i) port authorities; (ii) private port terminal operating companies; and (iii) the shipping lines. Today, more than 80 percent of container port throughput are controlled by private operators (see Figures 2.11 and 2.12).

In this respect, LAC has been catching up in comparison to Asia or other regions, where global port operators had strong portfolios much earlier than in this region. This has converted ports from isolated localized entities to parts of global networks, global horizontal integration and parts of global corporate strategies. In consequence container terminals now are part of more ample network strategies that reach far the local embeddedness of these entities.

As the Latin American economies have become increasingly integrated with the global economy (Rozas and Sánchez, 2004; ECLAC, 2012; Rodrigue, 2012), productivity, and efficiency of ports in changing environments (i.e., strong changes in demand) are a key factor to strengthening economic development. In the current environment and given the continuous increases in ship size (Cullinane and Khanna, 2000), the technological evolution of container handling is and has


*Figure 2.11* Private port operators in Latin America and the Caribbean (2006)

been a prerequisite in successful port development (UNCTAD, 2012). The discrete characteristics of advances and the ports' adjustment to the continuous evolution of freight transport demand will inevitably lead to alternating situations of either infrastructural insufficiency and scarcity of supply on the one hand (i.e., excess demand) or to a surfeit of port infrastructure (i.e., surplus supply) on the other (Cullinane and Wilmsmeier, 2011). Thus, an interesting question is how this natural characteristic of a virtually constant harmonic mismatch of port infrastructure supply and demand is reflected in port productivity and port efficiency in dynamic market conditions. Consequently, it


*Figure 2.12* Private port operators in Latin America and the Caribbean (2012)

might be expected that demand excess as well as supply surplus will negatively affect the efficiency and performance of a port (Sánchez and Wilmsmeier, 2010).

Port planners feel pressure to invest in infrastructure and superstructure as they know that underinvestment and a lack of capacity will lead to a loss of port traffic. However, these investments lead to significant financial burdens without guarantee of customers. The economics of liner shipping have contributed to some negative effects for ports; on the one hand, the downward pressure on market prices triggers an increase in the supply of terminal capacity, and on the other hand,

an improvement in terminal productivity is accompanied by a decline in profitability. These paradoxical developments lead to a common belief that cost leadership and economies of scale provide competitive advantages.

This belief is highly questionable as the requirements for port development go beyond pure efficiency and economies of scale. The important necessity of efficacy in port development is often neglected and is a definite option for confronting the increasing power of shipping lines.

The devolution processes shifted the responsibility and management of productivity and efficiency of port infra and superstructure toward the private sector. The above mentioned port reform and increased private sector participation led to significant changes in port operation in the region during the 1990s and the first decade of this millennium. Numerous studies have discussed the success of the port reforms in the region (Estache et al., 2002; Hoffmann, 2001; Kent and Hochstein, 1998; Tongzon and Heng, 2005; Wilmsmeier and Monios, 2015). Efficiency gains from port reform in the Latin American Caribbean port system have been widely studied (Barros et al., 2012; Estache et al., 2004; Morales-Sarriera et al., 2013; Rios and Maçada, 2006; Sánchez et al., 2003; Wilmsmeier et al., 2006). While these studies identify advances and improvements in port efficiency through private sector involvement, results in the global literature on the relationship between port efficiency and private sector involvement vary and are sometimes even contradictory as recently discussed by Gong et al. (2012) and Bichou (2013).

Port reform undoubtedly led the terminals in the region to catch up in terms of quay productivity, reduced port charges, the attraction of new investment to modernize existing port infrastructure and an overall reduction in labor issues (although still with occasional disputes).

Sustained positive market development in the past decade has made efficiency and productivity gains in ports relatively "easy" to achieve as demand was continuously outgrowing supply (Wilmsmeier et al., 2013). Expansion of infrastructure and technology deployment was the preferred response in LAC as in other regions. The influx of international and global container terminal operators was seen as a panacea to solve these challenges and to provide the necessary capital to rapidly expand infrastructure and deploy technology. Certainly, port infrastructure development advanced, but nevertheless by 2005 it became obvious that the gap in infrastructure development, a condition that had also triggered port devolution processes in the 1990s, was rather increasing than decreasing (Perrotti and Sánchez, 2011).

Measuring changes in productivity during a period of changing market conditions allows measuring the success or failure achieved by production units as well as getting a deeper understanding of the drivers and sources of efficiency and productivity differentials (Cullinane and Wang, 2005; Lovell, 1993).

From a pure infrastructure perspective, container port infrastructure expanded 76 percent between 2000 and 2013. This increase in capacity has been paired with quay productivity which has been estimated to have increased more than twofold in the same period (Table 2.1).

In general terms, container terminals in LAC have reached productivity levels comparable to other regions in the world. The figure below depicts the average moves of ship-to-shore cranes per operating hour in different regions. Main ports in Central America (especially Mexico, Panama, and the main transshipment ports in the Caribbean) reached globally comparable productivity levels by 2005. For the case of South America it becomes evident how crane productivity increased with the advancing of the implementation of new superstructures in the subregion (cf. Wilmsmeier et al., 2013). The ports in the region have still not reached productivity levels of Asia, but the gap has been closing. The reason for this development relates that container terminals across the world which are operated by main container terminal operators are more and more operating similar equipment.

In the current volatile economic climate, it may be the adequate time to reflect on and analyze the evolution of container port productivity and efficiency in dynamic market conditions and over a longer period

*Table 2.1* Infrastructure expansion and berth productivity in selected LAC ports (2000–2013)

| | **2000** | **2005** | **2007** | **2009** | **2011** | **2013** | **2000–2013 percentage change** |
|---|---|---|---|---|---|---|---|
| Throughput (million TEU) | 4.4 | 11.9 | 15.4 | 16.0 | 22.7 | 24.6 | 177 |
| Berth length (thousand meters) | 13.0 | 27.0 | 34.6 | 33.9 | 44.0 | 46.3 | 76 |
| Ship-to-shore cranes (numbers) | 60 | 92 | 119 | 161 | 187 | 204 | 238 |
| Berth productivity (TEU/meter) | 338 | 792 | 923 | 829 | 1,019 | 1,077 | 219 |

*Source*: Based on ECLAC surveys and ECLAC's Maritime and Logistics Profile.

of time. Productivity and efficiency are related but different concepts. Productivity is the ratio between the obtained products and the factors used in its production. On the other hand, technical efficiency is the capacity of obtaining maximum amount of output from certain inputs (output orientation) or, alternatively, as the capacity of obtaining a given output level using the minimum amount of inputs (input orientation). Also, a company presents scale efficiency if it reaches the maximum productivity by means of the current technology. From the previous definitions, it is possible to deduce that technical efficiency is only one of the determining factors of productivity (see also Kao et al., 1995).

Wilmsmeier et al. (2014) analyze the changes in productivity and efficiency in LAC from 2005 to 2011 and reveal the complexity of efficiency measures and underlines a necessary wider perspective on port productivity and efficiency. Their results in line with Cheon et al. (2010) clearly show that infrastructure and/or superstructure expansion as single measures will not necessarily and directly increase technical productivity and efficiency of a terminal, but it requires an integrated management and organization of the different components to obtain the desired results.

Most existing studies find advances in port efficiency and productivity independent of the region of study, but many of those were conducted during periods of uninterrupted sustained growth. Given the changing dynamics of economic development in 2008 and 2009 and the slowdown of container throughput growth since 2010 new questions arise. How big is the time lag of infrastructure and superstructure investment (and availability)? Do the existing governance frameworks enable the public and private sectors to respond effectively and act with real agency in a changing and dynamic environment?

Wilmsmeier et al. (2013) analyze container terminals at the top 16 ports in Latin America aiming (a) to document the harmonic mismatch in the evolution of port infrastructure and superstructure endowment, and container demand and (b) to quantify the effect of the financial crisis and the posterior changing economic development on container port productivity applying non-parametric Data Envelopment Analysis (DEA).

The results clearly demonstrate the changes in productivity when comparing the pre-crisis, crisis, and post-crisis periods, showing first significant productivity and efficiency losses provoked through the economic crisis followed by a strong rebound of the same. Further, the impact of the crisis overcompensates the productivity gains in the

pre-crisis period. This happens as the investments in new infrastructure and superstructures only materialize during the crisis, thus increasing input capacity by technological change in a period of regressing or even negative demand growth. The terminals are not able to compensate these losses by the improvement in pure technical and scale efficiency.

The increase in crane capacity has particular impact on the potential container handling capacity and productivity, and in the case of the ports on the west coast of South America the appearance of new crane capacity, especially in Ecuador and Peru, was an adjustment to external pressure from shipping lines thus implying technological progress, or better said "technological catch-up" as it eliminated the requirement to use geared vessels when calling in these ports (see Figure 2.13).

In this context, it should be noted that capital intensive industries with increasing returns to scale are particularly exposed to demand shocks and will have difficulties to react effectively. Major shocks and demand decreases in international trade are out of the control of port operators and thus are likely to have severe effects on port productivity and efficiency.

Further, the differentiation of terminals into transshipment, gateway, and hybrid is a necessary step in any planned evaluation, as ports form part of different strategies and serve varied functions within the regional port system. Especially, terminals dedicated to transshipment traffic are not only exposed to changes in the economic environment, but also

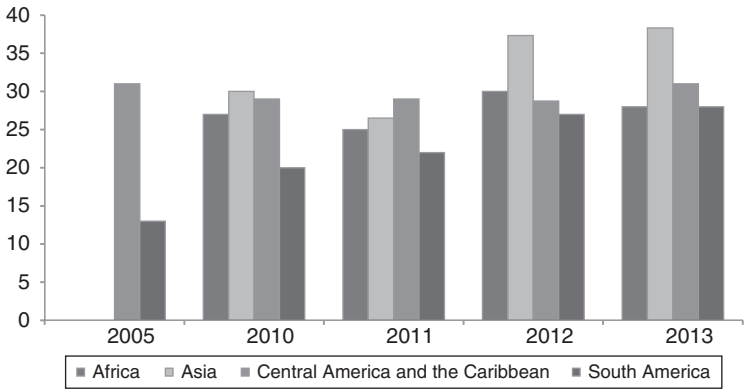


*Figure 2.13* Average ship-to-shore crane productivity in selected regions (2005–2013)

*Note*: Average numbers reflect performance a 42 container terminals across the regions.
*Source*: Based on container terminal survey in 2014.

to alterations and changes in the strategies of shipping companies, which can result in immediate and high volume changes in demand, independent of a terminal's performance. For example, a shipping line might have guaranteed a minimum throughput in a specific terminal. In case of a sharp drop in demand, the line could deviate services from other terminals to satisfy the given guarantees to the specific terminal, independent of the other terminals' performance.

Thus, it might be argued that, in dynamic economic environments, the ability of the industry to respond in terms of proactive measures to counteract losses in scale such as engaging in port promotion or adopting equivalent policies to stimulate demand or improving somewhat the relative competitive position in the country, is at least of equal relevance as improving productivity. While adjustments in efficiency or effectiveness in adjusting management strategies by itself tend to be insufficient to quickly mitigate major demand shocks a combination of both might deliver more positive results.

Wilmsmeier et al. (2013) demonstrate how external effects (e.g., changes in shipping lines strategies as response to changes in demand) on the already given harmonic mismatch of demand and supply in the port industry should be taken into account by decision makers when planning port development. Hence, new questions arise from the findings in relation to the timeliness and timing of infrastructure and superstructure investments and particularly the governance of this situation.

In consequence, while the results of devolution have responded to solve some challenges existing in the 1990s, recent studies have shown that the devolution processes in LAC were not able to resolve underinvestment in container port infrastructure and port infrastructure expansion in line with growth of demand, despite a significant expansion of infrastructure and productivity. Thus as in other regions the results of port reform are mixed and substantially weak in governance (Wilmsmeier and Monios, 2015).

## The institutional dimension

The devolution of port management and operations and, more generally, the deregulation of transport services, have opened new opportunities for development in the region. Port devolution not only facilitated the influx of international terminal operators, but also transformed the institutional structure in which actors and their relationships were embedded; this transformation spurred new strategies that required,

at least on behalf of the successful ports, an identifiable process of institutional adaptation.

Global trends toward political decentralization and devolution have been identified in the literature (Peck, 2001; Rodríguez-Pose and Gill, 2003). Devolution, however, is not necessarily an actual transfer of power but can be more of a qualitative restructuring (Brenner, 2004), characterized as uneven processes of hollowing out (Rhodes, 1994) and filling in (Jones et al., 2004; Goodwin et al., 2005), often resulting in asymmetrical acting capacity.

MacKinnon et al. (2010) argue that any consideration of the role of actors requires an approach that can assess structure and agency, and they note that Jessop (2001) is critical of Giddens's (1984, p. 274) structuration theory for "assuming that a particular structure is equally constraining or enabling for all actors". Of particular relevance for this paper, MacKinnon et al. (2010, p. 274) stress "the contingent nature of state strategies, requiring concrete research to examine the interaction of structure and agency in particular temporal and spatial contexts". This process is facilitated by considering the path dependent nature of state restructuring. According to Peck (1998, p. 29), "Geographies of governance are made at the point of interaction between the unfolding layer of regulatory processes/apparatuses and the inherited institutional landscape." The new geographies of governance created in the port sector at the intersection of an applied process of devolution and the legacy of current and previous institutional regimes have not yet been fully understood.

Jones et al. (2004) identify a recursive relationship between state personnel and institutions. MacKinnon et al. (2010, p. 275) use the terminology of Duncan and Goodwin (1988) to assert that state personnel are both agents and objects of reform: "Devolution has not only created new organizational forms, strategies and relations which have changed the role of state personnel, it has also been ultimately interpreted and delivered through the actions of such personnel." This viewpoint can be transferred to port actors and even port institutions such as port authorities. These institutions have in many ways been both the agents and objects of reform, with a high degree of regulatory capture evident in port sector actors through their relationships with terminal operators and shipping lines.

In LAC, reforms also lacked reform and continuous evolution. Deregulation and privatization had a major impact on the availability of more reliable and lower-cost services to the economy as a whole. These reforms in the port sector also complemented trade liberalization efforts.

However, in LAC in many cases reform fell short in creating institutional frameworks and policies to respond to the changing environment and merely focused on advances of productivity and technical efficiency.

Research on the perceived success of port privatization in 2000 revealed some of the early successes (Hoffmann, 2001). The experiences in Panama, Colombia, and Chile were seen as the greatest achievements at that time. Today the cases identified by Hoffmann (2001) are much larger, but the emerging question is, if the reforms would be perceived equally successful in a long-term perspective and if considering current economic change.

A major feature of the reform process in all countries was the elimination of state-run public monopolies (Estache et al., 2002), the decentralization of port governance from the national level by the creation of local or regional port authorities and the involvement of the private sector to realize delayed investment in infrastructure and superstructure (Wilmsmeier and Monios, 2015).

Thus the national governments engaged in a strategy to push responsibilities into different spatial scales (local or regional) and to the private sector, based on the principal-agent theory under the assumption that this transformation will improve efficiency (Hartley et al., 1991; Parker, 1994). A main challenge today is that the objectives of public sector governance today follow principles defined almost a century ago (Sánchez and Pinto, 2014).

As stated above, the main drivers for port reform were the relief of financial public burden and to improve port efficiency gains through new labor arrangements and driven by standardization of port services. The current framework for intensive port devolution and port reform beyond scale increases is weak in many countries in the region. Moreover, past challenges of infrastructure shortage (Perrotti and Sánchez, 2011) have returned and LAC countries infrastructure investment would need to average 5 percent of GDP over the next decade to catch up to international standards (Whitefield, 2014). With these new/old challenges for ports the mismatch between the institutional framework under which ports operate and economic and social reality is expanding. In this context, a new role for institutions and new forms of governance are emerging.

One might argue that Fordism has reached structural boundaries, as economies of scale eventually reach their limit and current market requirements are more commonly ruled by post-Fordist principles. This changes the source of competitiveness for ports from economics of scale, based on basic production factors (capital, land, labor) to economies of

scope based on advanced production (service) factors know-how, procedures. The service demands transform from standard services, with long life cycles to large differentiated service requirements, with short life cycles. Moreover as stated already the economic environment is highly dynamic with greater insecurity and risk.

The requirements for organization are being modified. Standard processes and procedures need to be complemented to work in flexible, decentralized organizations with incident management needs. A further point of discussion is the role of the port as discussed above. This role has to be discussed and often is not clear. If the role of the port is to generate employment different measures and development potentials have to be considered. The same rule has to be applied if ports are thought to strengthen economic development or if ports are operated under private profit principles. The match between these different roles and the market requirements will have to be discussed in depth in further research.

A strong nexus exists between port system development and existing infrastructure capacity challenges. Governance is defined as the institutions, mechanisms, and processes through which economic, political, and administrative authority is exercised. This definition builds on an extensive literature arguing that governance has gone beyond government (e.g., Hooghe and Marks, 2001; Imrie and Raco, 1999), and acknowledges the important roles that private actors and civil society play in policymaking. Importantly, governance as an analytical concept allows a focus on the arrangements that are non-hierarchical, multi-level, or network based, and it acknowledges the high degree of complexity facing modern policy problems.

Institutional approaches to port development have argued that the port authority has constraints on its ability to act, stemming from its specific nature. The key distinction is that port development is not only path dependent, heavily constrained by past actions and institutional design, but also contingent, in relation to private investment and public planning (Notteboom, 2009). Ng and Pallis (2010) showed how port governance is largely determined by local/regional institutional characteristics, despite attempts to implement generic governance solutions. Notteboom et al. (2012) applied the concept of institutional plasticity (Strambach, 2010) to port development, arguing that, while port development is path dependent, a port authority can achieve governance reform by a process of adding layers to existing arrangements. In this way, the port authority does not break from the existing path of development, but develops new capabilities and activities via a process

of "institutional stretching". An example is given of port authorities investing in load centers in the hinterland, beyond their traditional jurisdiction, and the particular importance of informal networking is noted (see also Monios and Wilmsmeier, 2012). Jacobs and Notteboom (2011) asserted the need for an evolutionary perspective, drawing upon the economic geography literature to define the movement from critical moments to critical junctures, concluding that port authorities have windows of opportunity in which collective action is possible. The authors concluded that "the question of to what extent critical moments require institutional adaptations in order to materialize into critical junctures needs further thought" (p. 1690).

A more sophisticated institutional appreciation of the port is required, as the entity normally considered a unified port is not only created by numerous actors but is endlessly being recreated with each new relationship or network in which the port is embedded. Thus the port's connectivity is always changing and being recreated. Marx believed that the capitalist system carries "within it the seeds of its own destruction" (Marx and Engels, 1850, n.p.). Perhaps the same logic could be applied to ports as they move through their life cycle, as the symptoms of success (concentration of container flows at a single port) are themselves the cause of congestion, stagnation, and decline, if not addressed.

Port development in LAC, as in other port systems, has been driven first by significant and continued growth of container traffic. Strategies of liner shipping companies have evolved toward a wide implementation of hub-and-spoke networks, leading to patterns of concentration exhibiting significant effects of path dependence. However, the contingency of both private investment, public policy, and planning approval have been found to play an important role in port development, supporting newly emergent port hierarchies.

## Maritime sector dependency

> Globalisation has contributed to the remaking of the container shipping networks.
>
> (Slack et al., 2001)

In the maritime system, convergence is a main principle. This conformity can be seen best in the extension of services to all markets and a shift in direct port calls. At the same time, the shipping industry (maritime sector) is developing toward a stage of maturation based on the life-cycle theory. A strong tendency toward concentration can

be observed throughout the last years, and recently gaining velocity through mergers and acquisitions. While earlier bigger companies tended to buy small competitors to increase the geographical coverage of their services, recent mergers took place between global operators striving for market power (Wilmsmeier and Sánchez, 2010, 2011; Yeo, 2014). This process reaches beyond the earlier development and implies a strong rationalization trend among shipping companies. This trend is fostered trough appearing intentions of shipping companies not only to gain horizontal market power but also to reach for vertical integration and control of transport chains (dedicated terminals). The increasing concentration has been a trigger for similar developments in the port system.

The current structure of the liner shipping services provided in LAC is rather oligopolistic (Sánchez and Wilmsmeier, 2010). During the last years, a drastic reshuffle of the services provided and in result an inherent change in the maritime services network can be observed and a hierarchic services network has been developing. A further observation is that shipping services have become more and more "footloose".

The interplay between the investment intensive port industry and the changing structure of the shipping sector makes ports portray a subordinate role. With many international shipping and logistics market players undertaking vertical and horizontal integration strategies, involving ports either directly or indirectly, the conventional taxonomy of port institutional players should be fundamentally reviewed. Strategies of vertical integration include ocean carriers and other multimodal providers (e.g., rail operators) engaging in terminal leasing and ownership. Shippers are also sometimes perceived as port owners, such as through dedicated oil or car terminals. Horizontal integration strategies were less common in the past but are gaining more support in recent years, such as through port cooperation and mergers (e.g., Copenhagen and Malmö Ports – CMP) and, more particularly, the expansion of certain ports beyond their initial spatial bases (e.g., the Port of Singapore Authority shortening its name to PSA and owning and managing ports and terminals in other countries). The impacts of such changes on the traditional perception of the port industry are dramatically significant in the sense that today's ports can be owned and managed by many types of institutions (both within and outside international shipping and logistics markets), and that the long-established perception of ports as non-moveable assets no longer holds so much validity. The process of vertical integration implicates further changes leading to new challenges in transport network development and a restructuring of hinterlands.

Port operators and shipping lines have both exhibited strong concentration processes as well as increasing vertical integration. In 2012, the top ten carriers controlled approximately 63 percent of the world container shipping capacity (Alphaliner, 2012), while the top ten port terminal operators handled approximately 36 percent of total container throughput (of which 26.5 percent was just the top four), measured in "equity TEU" (Drewry, 2012).[2] Strategic alliances between them have exerted a profound influence on maritime network structure and also on a region's integration in the global maritime transport network. These developments have, to a certain extent, made port development dependent on network strategies of global players. The location of a port within the network influences the competitiveness of trade through that port and subsequently raises important questions regarding what determinants lead to the configuration of current networks and how these could be influenced.

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

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

## Reflections and emerging challenges

A functioning port infrastructure – more precisely, the services it provides – is essential to economic welfare in modern societies. Port infrastructure facilitates trade, integrates transport modes, and connects producers and consumers in different markets. The performance of ports

is essential for the functioning of the economy and for developing welfare. LAC have experienced a significant and continuous economic growth. However, the past environment is changing, and while expansion of infrastructure reached important levels, the "past ghosts" of lack of infrastructure investment and labor issues have returned. Port infrastructure also forms a significant part of a country's capital stock, in the case of container ports a great share is now held by international private companies. In order to catch up, maintain, and expand existing port infrastructure, the public and private sectors are now in a position where considerable investments are required. Given the economic relevance of port infrastructure within a country's logistics system, its governance is a critical factor.

This chapter illustrates the development and challenges in the LAC port system since the turn of the millennium and portrays that port development is no longer a local or regional discussion given the internationalization process that has taken place over the last 20 years. Such a perspective will inevitably fall short in analysis.

Port in many parts of LAC are still seen and dealt with by decision makers as isolated phenomena and lack the perception that they belong to a port group, hierarchy or complex which is functionally interrelated on a local, national, and international scale. The development of ports as a dynamic phenomenon has for a long time been impeded. And the lengthy period of port reforms since the 1990s has not yet fully eliminated the sclerosis of port morphologies. If the ports situated along the coasts are imagined as spinal cords, the delay of development has created fixtures and fractures in different parts, which today obstruct the dynamic movement of the whole.

The main deficit in LAC is institutional, as none of the reforms managed to close the infrastructure gap from the 1990s. The reforms remained at a first level and have not managed to transform the new port authorities into institutions with real agency (Wilmsmeier and Monios, 2015). An important focus of the reforms was on creating intra-port competition, many times leaving aside issues such as minimum scale efficiency (e.g., Buenos Aires – see Sánchez and Wilmsmeier, 2006), inter-port competition and port functions within a national or sub-regional port system.

Undoubtedly, differences exist between countries, but it is a common feature that the institutional structure and agency has not evolved in parallel to the port system, even as a reaction to changes in the environment. Rather than governing ports in the region, the institutions in charge of governing are merely reacting in a firefighting manner to

shortages of infrastructure. Institutions have not developed the capacity to adjust their governance model to a changing economic and market environment. The life cycle of the ports and port system in the region are getting advanced, but not their public sector management. The absences of advanced and integrated hinterland connections are another common issue across LAC, and a lack of an integrated transport and logistics policy means that even after ports and terminals are upgraded, insufficient landside infrastructure or fragmentation and bureaucracy in the rail sector lead to congestion, delays, and increased costs for port users. Such issues are often not part of the port development process and are not integrated with other governance regimes such as rail regulation (Wilmsmeier et al., 2015).

While institutional structures and settings are somewhat different within LAC countries, all share the strategy of devolution and decentralization, while mostly sharing the lack of port infrastructure (except Mexico), absence or non-implementation of national port system development plans, or an integrated transport and logistics policy. The capacity limit and timely provision of port infrastructure continues to be one of the main challenges in the region. Port reform in the region extended the life cycle of the existing port infrastructure through technical efficiency; however, the limits of port capacity are inevitably reached again, and now expansion is required outside the existing footprints. The lack of port capacity has already created in some cases a geographical shift of activity due to congestion (e.g., Santos, Brazil), leading to a reactive deconcentration to secondary locations. Thus, besides the emergence of new secondary ports driven by regional economic development, a certain level of growth can also be attributed to negative spillover effects from congestion in other ports or the hinterland of those ports (Wilmsmeier et al., 2014).

The efficacy of these national efforts has been hindered by the lack of agency in the institutional settings that have developed in the two decades since the initial reforms, suggesting that the temporal element and the autopoietic nature of the system are inhibiting new attempts at reform.

The operation of container terminals is now primarily in the hands of the private sector. The institutional structure of private investors has undergone significant changes in the last decade and today global and international terminal operators control the greatest share of container throughput in the region (Notteboom and Rodrigue, 2012). This influx of global groups raises a contradiction in the devolution process. The reform aimed to create smaller, more active, local, or regional entities,

but these decentralized entities are facing global players when negotiating concession contracts, thus creating a new incongruence of power. The situation now obtains where local, regional, and even national institutions in the region lack the institutional knowledge to critically reflect, analyze, and negotiate the wider impact and repercussions when passing the "power" of their ports to these global conglomerates.

The decentralization process was successful in creating more local input in port development, but the steering, governing, and coordinating roles of the state at a higher level was generally missed, or in some cases was created but not developed. A decentralized structure of port governance without a national framework or strategy remains a development of individual unarticulated entities where the system is not able to capture economies of either scale, scope, or density. Thus the mentality of reform has once again been overtaken by reality (lack of infrastructure, poor performance).

Rather than a structural reform in order to improve management and flexibility to respond to changes in the industry, a lack of decision making remains evident – it is just that the power has shifted to different organizations. Indeed, in many cases, it is the same personnel in the same positions, only in superficially different organizations. So institutions have changed but governance, particularly the aspect of agency, has not been reformed in any real sense. As a result, a question to consider in future research is whether the region is perhaps pending reforms once again?

## Conclusions and outlook

The chapter analyses the intersection of clear trends in the evolution of port systems (decentralization of port governance, concentration of power, and deconcentration of port traffic) in order to identify how the institutional setting governing the spatial diversification of container port activity has changed as a result of this intersection and whether it is suitable to deal with new challenges as they arise. An additional question was whether the new institutional settings created by port reform in developing countries are suitable to support the successful application of port devolution policies imported from developed countries with different political and institutional histories.

In the 1990s, policymakers in LAC initiated what was intended to be a virtuous cycle to promote technical efficiency and expansion of the container port system. However, neither the role of political traditions in deciding the structure and agency of reformed organizations was part of

the political discourse, nor has it been comprehensively assessed since. The case findings show that port reform has simply replaced an old path dependency with a new one, involving, critically, a loss of power from the public to the private sector. For example, when poor management by a private operator leads to congestion or labor strikes that close the port and threaten the national economy, government actors have few levers to address the problem. Devolving to the local level in hopes of achieving a more active and informed local governance, it rather created institutional weakness vis-à-vis global terminal operators. Moreover, the reform failed to produce an integrated policy framework. It is open to question whether the short-term gains of technical efficiency in individual terminals make up for such long-term losses of control. Some recent attempts to regain national influence have been inhibited by the evolution of the institutional setting since the initial reforms, in which the required agency to disrupt the new path dependency is lacking.

Previous analysis (Gong et al., 2012) showed that port devolution works in a context of well-developed institutional infrastructure and capacities, such as integrated transport policy frameworks, investment strategies and plans, transparent disclosure, pricing competition, and regulatory policy. These institutional conditions tend to be in place in developed countries, among developing countries, Latin America being no exception, the institutional capacity to proactively administer change is limited. This lack of institutional capacity becomes even more evident if an existing development path needs to be altered, as this inevitably requires agency to effect the necessary change of institutional structure.

A narrative is required that addresses new reforms of port governance, reforms that emphasize the spatial politics of port development and the "social/corporate" production of place. Corporatization, commercialization, internationalization, devolution, and privatization of port operations are now global phenomena. The motives for ownership, devolution, and institutional restructuring are manifold, but principally, access to financing and investment and, recently, market strategies (global players) have been the driving forces. As such the geography of port operations has transformed over the last three decades in parallel to and driven by globalization and at the same time on the back of changing geographies of trade, the firm, and power.

While a broad discussion and analysis exists on power and globalization of the industry, no works exist that discuss the spatio-temporal development of power in the port industry. So far there is no work that

discusses the institutional and governance implications of the changing geography in the port operator industry.[3]

The current economic system tries to evade crisis through the spatial expansion of activity (shipping, port operation, etc.). The expansion of port operators is, therefore, not specific to the sector but a general indicator of capitalist development. The effects of path dependence and the contingency of both private investment and public planning approval have been found to play important roles in this process, further embedding emergent port hierarchies.

Several questions raised in the above analysis could therefore benefit from close analysis of individual port reform trajectories. It is therefore hoped that the findings from this chapter regarding lack of national system planning and proactive site development can provide the starting point for much-needed disaggregated research in the LAC region.

## Notes

1. West Coast Central America (WCCA), East Coast Central America (ECCA), North Coast South America (NCSA), East Coast South America (ECSA), and West Coast South America (WCSA).
2. The "equity TEU" concept was devised by Drewry as a more accurate way than simple TEU throughput to account for the fact that some terminal operators have shares in each other.
3. The authors took the first steps toward such a critique in their contribution "The operation of ports" in Ng et al. (2014).

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# 3

# Port Development in Sub-Saharan Africa: Competitive Forces, Port Reform, and Investment Challenges

*Darren Fraser and Theo Notteboom*

## Introduction

From as early as the seventeenth century, Southern Africa served as an important maritime space in the global network. The ports in this region have transformed from colonial halfway refreshment stations to viable container and bulk ports following various port investment initiatives. Today, however, due to greater social and economic stability, regional integration, and globalization, Southern African container ports in particular face increased pressure to provide sufficient port capacity. This growing misalignment between container demand and container port capacity impacts the quality of service experienced at the ports and leads to port congestion. Chang et al. (2008) cite an important attribute affecting service quality and port performance as port congestion. Port user costs rise sharply once the port traffic approaches the existing effective port capacity limits. To alleviate the problem of congestion, ports increase capacity by investing in port infrastructure such as canal enhancements, additional berths, or additional port handling equipment. Ceteris paribus, increasing port capacity should help to enhance service quality and reduce time costs for ships and cargoes and should therefore attract and accommodate more traffic to the port (Xiao et al., 2012).

Port capacity investments, however, are very costly given their capital intense nature (Baird, 2004; Haralambides, 2002). Because of the costs involved, port managers and terminal operators typically are inclined to first stretch existing capacity via measures leading to a better terminal

planning and more optimized port operations. Only when capacity stretching has been exhausted, additional capacity should be made available to the market. In practice, matching demand and supply is not an easy task given the long lead time to plan, construct, and start up new port and terminal infrastructure. Finding the perfect timing to initiate the planning and implementation phases of new port infrastructure is therefore not easy. A more than proportional growth in port traffic volumes will only be feasible within optimal commercial capacity circumstances. Moreover, there is always the imminent danger of creating overcapacity in cases where a port extension project does not induce a growth in port demand. The timing of a capacity expansion and a good assessment of future demand are crucial not only to position the port for sustained growth, but also to secure the right funding sources for capacity extensions.

Funding strategies for costly port investments are constrained largely by a port's institutional position. Pure public or tool ports (World Bank, 2005) for example are limited to funding sources obtained from the national fiscal revenues. Developing countries, in particular, are facing increased constraints on the level of public funding sources available to develop port infrastructure due to the existence of other national infrastructural and social priorities. This constraint gives rise to the need for alternative funding strategies which meet port infrastructure investment objectives. The scope of available funding alternatives can, however, be achieved through institutional port reform or "stretching" the port's existing institutional position, also referred to as "institutional plasticity" (Notteboom et al., 2013; Strambach, 2010).

This chapter will disclose the funding options available to South African container ports, given their respective institutional position and port capacity needs, and also comment on the merits of each funding option. Port investment in the South African container sector will be observed, with a focus on the sources of funding available to each given existing institutional constraints. In addition, the analysis will verify if each port's funding strategy selected is suitable and sustainable for the investment and capacity goals put forward. Ultimately, this study tests the relation between port institutional frameworks and sources of port funding in a developing country context.

This chapter is structured as follows. The second section provides the literature background as well as the theoretical framework and methodology underlying the more empirical sections in this study. The third section applies the analytical framework to the case, addressing our theoretical inference to the case study in question. The final section

discusses and evaluates the results of the preceding section, finding cross-case patterns where applicable and incrementally building theory from the findings of the case studies.

## Theoretical background and framework

### Port institutions, port legislation, and port funding mechanisms

Notteboom et al. (2013) describe institutions as the humanly devised and or socially constructed sets of rules that constrain and enable human interaction. Aligned to this definition, Roland (2004) defines institutions as constraints on behavior imposed by "rules of the game". Gertler (2004) characterizes institutions as having formal regulations, legislation, economic systems as well as informal societal norms that regulate the behavior of economic actors. Port institutions are classified albeit narrowly, for example, by the World Bank port reform toolkit (WBRTK) typology of ports. In a comparative case study of port governance in the United States, United Kingdom, Australia, India, and Canada, Brooks (2004) finds the WBRTK typology of ports too simple an approach. The main criticism relates to the fact that the WBPRTK's functional (infrastructure, superstructure, port labor, and other function) categorization of port types does not provide guidance to a government faced with pressure to devolve port administration in terms of the application of each approach given the country specific (or local) situation.

Similarly with regard to financing or funding options, the WBPRTK does not capture the localized financing situation given the hybrid financing possibilities and port legislation. While the government typically is the major infrastructure supplier and funder, many governments are facing challenges related to the level of national borrowing thresholds, the coverage of their investments via taxes and other revenues, and an overall shortage of public funds. Therefore, governments around the world are urged to consider private sector involvement for the development of infrastructure, also when it comes to port infrastructure. The financing combinations which exist for ports today could dilute public ownership structures such that the simple private or public categorizations of the WBRTK (see Table 3.1) become an oversimplification of reality. Indeed, the wide array of financing combinations give rise to port authority or port operator structures which could lie anywhere on the spectrum between total, high, medium, low, or zero public ownership. The ultimate position would depend primarily on the type of financing options/combinations utilized. For the purpose of this

*Table 3.1* World Bank port reform toolkit ownership interest categories

| Port type | Infrastructure port authority | Public ownership | Superstructure operator | Public ownership |
|---|---|---|---|---|
| Public service port | Public | High | Public | High |
| Tool port | Public | High | Public | High |
| Landlord port | Public | High | Private | Medium |
| Private service port | Private | Low | Private | Low |

*Source*: Adapted from the World Bank port reform toolkit.

research, a port's institutional position will be categorized by the extent to which public interest is held in the ownership of the port authority or port operator. Essentially, a port can be positioned institutionally anywhere on a scale of low or high public involvement and each position unleashes or limits different funding possibilities.

### Port legislation

Prior to understanding which finance options are available to ports, it is necessary to understand the governance structures guiding port institutions. Corporate governance is defined by the OECD as procedures and processes according to which an organization is directed and controlled (OECD, 2005). For ports, at the highest level this is exercised by the promulgation of port legislation. Broadly defined, port legislation provides for the establishment of the port authority to undertake the management and control of ports as well as the provision (and possibly regulation) of facilities and services related thereto (adapted from the Namibian ports act, 1994 and South African ports act, 2005). Funding sources available to ports are consequently determined by the legislated ownership/port structure provisions governing ports (at a national or more regional state or provincial level). For example, if port legislation provides that a port entity be established as an institutional monopoly (i.e., a state-owned enterprise or a corporation in a planned economy) port finance is then limited largely to state funds and debt. Port legislation provisions permitting the conversion of a public port authority into a publicly listed corporation (in terms of shareholding) would then broaden the spectrum of available funding sources. At the other end of the spectrum, fully privatized ports cannot rely on funding sources which require the receiving port to have some sort of public status.

## Sources of port finance and funding

Prior to drawing any parallels between port types and port funding and financing options, it is useful to understand the salient sources of port financing available to port authorities and port operators in general. Figure 3.1 refers to essentially five major sources of funding and finance available for port infrastructure development. A clear distinction should be made between funding and financing. Funding entails the provision of money at no interest for the development of the port project (e.g., state grants, from internal reserves). Financing implies that the money lent is regarded as investment and thus comes at an interest rate (e.g., commercial and investment banks, bond financing) or required rate of return for the investor.

First, there is debt which can comprise conventional loans, debentures/bonds, convertible preference shares or development finance aid (i.e., loans at a lower than market related rate to recipients of developing countries unable to afford debt funding through commercial means). Debt does not dilute the ownership structure; however, interest payments (the cost of debt) are expensive and defaulting on contractual repayment obligations can result in the forfeiture of assets (depending

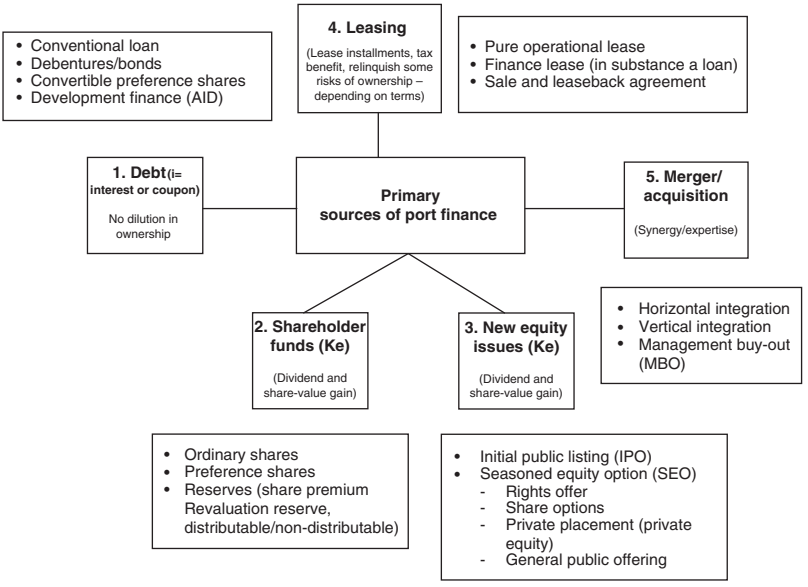


*Figure 3.1* Generic sources of funding and financing
*Source*: Author elaboration based on Ogilvie (2009).

on the terms of the debt agreement). In general, banks or other lenders are very sensitive about the project assets. In evaluating an investment project they assess the extent to which the project assets remain within the operating authority or company. Banks and other lenders are also strict when it comes to the risk distribution: they favor a setting where all risks associated with the port infrastructure project are assumed and passed on to the appropriate actor. For example, lenders might insist on passing risk to the other project participants through contracts, such as a construction contract, an operation and maintenance contract.

A second group includes shareholder funds in the form of ordinary shares or preference shares (the latter similar to debt, but with equity characteristics) or shareholder reserves (re-invested retained earnings). A diverse shareholding dilutes ownership relinquishing control for majority shareholders. The cost of a share is essentially measured as the required rate of return on the investment from shareholders. Note however that in the case of retained earnings, these funds are not a free source of finance and the required rate of return is essentially the cost of equity, because funds "belong" to equity investors, not the firm.

Third are new equity issues, in the form of initial public offering (IPO) or a seasoned public offering (SPO) or a general public offering (GPO). Methods of issuing seasoned equity include the private placement of shares to a single or small group of investors; employee options; or a rights offering (a right to purchase shares with a price concession). A GPO is similar to an IPO, but with generally lower underwriting costs. A most noteworthy feature of a GPO is that generally the market identifies a GPO as a signal that management thinks the firm is overvalued – that is, the market's required rate of return is lower than the correct rate of return, implying a cheap source of funds, or the market has overestimated the firm's future free cash flows. Risks for shareholders associated with shares as a source of finance reside on how the value of a share is affected (gain/loss value) on the share trading market.

The second and third options can be project-based, but could also lead to a fully-fledged divestiture meaning that an equity stake of a state-owned port authority or enterprise is sold to the private sector, through either a trade sale or public listing of the company in the stock market. A trade sale results in the selling off of a public asset/corporation to the private sector entirely or in part, usually via a public tender. An alternative approach is share flotation through the issuing of shares and the trading of the capital of a public company in the stock market. The capital raised by share flotation may be used to fund future investments or to capitalize the governmental accounts. Divestiture may

be a solution to raise capital for the development of new port infrastructure projects without jeopardizing the public budget. Next to capital needs, these operations might also aim to bring management expertise to the port authority or company, so as to implement a more innovative and dynamic managing approach.

Fourth are lease agreements which comprise of pure operating leases, finance leases (in substance a loan) or sale and leaseback agreements. Terminal operation concession agreements are essentially long-term operational leases used extensively for private participation in ports. The government or a public authority holds the property rights of the facilities throughout the concession period and receives lease payments on the assets. The private partner bears the production and commercial risks, so it has an incentive to innovate, optimize, and improve its services. Terminal concession and lease-operate arrangements are common in landlord ports around the world and have been extensively discussed in academic literature (see, e.g., Notteboom, 2007; Pallis et al., 2008; Theys et al., 2010). The financial side of a concession agreement remains a balancing act. High concession fees, royalty payments and/or revenue sharing stipulations are detrimental to the terminal operator's return on investment and could as such decrease the investment potential of the incumbent terminal operator and scare away future investors. Low payments could negatively affect the revenue base of the public (port) authority in a way it can no longer guarantee the proper execution of its landlord functions. Finance leases are becoming more and more difficult to justify, due to an increase in focus on substance over form accounting treatment and vigilance against tax avoidance. The accounting treatment and favorable tax concessions are less evident with the adoption of International financial reporting standards.

Fifth are mergers and or acquisitions. These comprise broadly as (1) horizontal integration mergers with firm in same line of business and (2) vertical integration mergers with firm higher or lower in value chain – for example, supplier/customer. In addition there are also conglomerate mergers whereby a merger occurs with a completely unrelated firm to realize diversification benefits and management buy outs. Wright et al. (1995) describe management buy outs (MBOs) as the acquisition by incumbent management of a significant, if not majority equity stake in the company for which they work. This refers to a transaction whereby executive managers of a business individually or jointly with financing institutions (mostly private equity or venture capital firms) buy the business from the entity which currently owns it. MBOs are an extreme form of divestiture. The overriding objective of a merger is to create

synergy (the sum of the merged firm is greater the sum of the individual (firm) parts) in which economic value is generated through efficiencies, increased expertise, greater access to funding, and so on. Notably, mergers and acquisitions have come under increased scrutiny in view of anti-competitive/anti-trust legislation.

Excluded from the five sources of port finance are fiscal/government funds.

**Literature framework and methodology**

Merging the fundamental components of the WBRTK (essentially how the extent of public involvement defines generic port types) and the salient sources of finance for ports we can derive a qualitative framework which illustrates how a port's institutional position influences the diversity of accessible funding available to a port. Figure 3.2 and Table 3.2, demonstrate how first, a 100% publicly held port is limited to only two (apart from government funds) of the five sources of port funding namely debt or shareholder (in this case the government) reserves.

As public ownership is relinquished and private sector involvement increased, the port funding source possibilities are immediately extended from two to five (from the primary funding source categories). Apart from funding costs, the selection of a suitable funding option by a port authority hinges on the extent to which a port authority

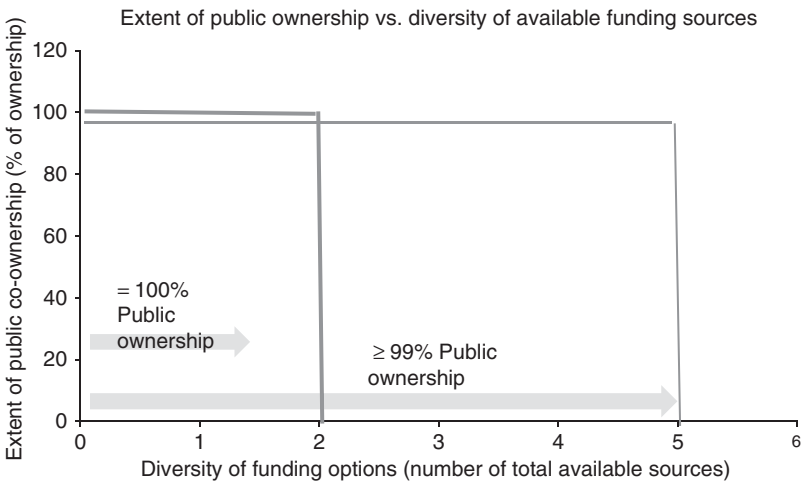


*Figure 3.2* Port ownership versus funding options

*Table 3.2* Funding and financing options as a function of the extent of public port ownership

| Extent of public ownership | Funding sources |
|---|---|
| 100% | 1. Debt (all)<br>2. Equity reserves |
| Less than 100% | 1. Debt<br>2. Shareholder funds<br>3. New equity issues<br>4. Leases<br>5. Mergers and acquisitions |

is willing to dilute its controlling interest and distribute financial risk exposure. This becomes an increasingly difficult trade-off in countries which regard their ports as a national interest asset. From this theoretical framework, we can infer that *pure public ports from developing countries have limited investment funding sources, compromising the execution of capital investment expansion programs*.

We test this proposition by following a case study approach from a selection of important South African container ports. These selected ports have varying capacities, the same dedicated cargo operation (containers) and are located along one country coastline. Case study research is a useful research method for a thorough analysis of a specific situation (Van den Berg and De Langen, 2011). Yin (1994) advocates case study research for the purpose of testing existing theory. Lee (1999) proposes that case study research is best suited for the examination of why and how real-life (organizational) phenomena occur, but under conditions where researchers have minimum control. Mouton (2001) describes case research as being best suited for a small number of cases and also cites business and regional studies as typically applicable. Eisenhardt (1989) advocates theory developed from case study research as having important strengths like novelty, testability, and empirical validity. Data used in this study was primarily limited to secondary sources which consisted of archival/documentary sources such as official annual reports (primarily the balance sheets), official port authority memoranda and port strategic plans.

In view of the changing port competitive dynamics and increased governance issues in the region of South Africa, our theoretical framework will form the basis of analysis used to interrogate the funding methods applied by the ports in our case study. Importantly, our analysis will assess if the ports' institutional position inhibits or enables investment

funding requirements for capital expansion programs. This assessment will be conducted, first, by unpacking the level of public involvement at each of the ports and disclosing the sources of funding used to advance their respective capital investment programs. Second, we will then determine other possible funding sources given the existing institutional arrangements and identify given the benefits associated with each funding source identified. Finally from our analysis we will verify if the implementation and sustainability of each of the port's capital investment plan can be sustained given the respective funding strategies selected.

## Application of port funding framework

### Case background

Following a theoretical review on port institutions, port legislation, port funding mechanisms, and a discussion on the research methodology applied, this section provides background into the South African ports and port authority analyzed in this study.

South African ports have essentially evolved in three phases: (1) colonial, (2) independence, and (3) regional global integration phase. From as early as the late seventeenth century (the colonial phase), Southern Africa served as an important maritime space, primarily a halfway refreshment station to service Dutch vessels en route to the east. The second (independence) phase was a period of ports being managed by newly independent states establishing their authority in the management of port-related state assets. Finally, there comes the current regional and global integration phase (phase 3). In this phase, ports face increased pressure on port capacity arising from the impact which globalization has had on trade. Alleviating this pressure exerted on existing port capacity is achieved mainly through port expansion projects. At some ports, this necessitated port institutional changes (ownership structure changes) as a precursor for alternative (non-government) funding or private partner port investment.

In this current phase of port development, the Southern African ports collectively constituted a significant 40 percent market share of all container traffic through the African continent in 2005. Durban, the largest port in the region and the busiest on the continent, is positioned as one of the top 50 ports in the world. The region although remote is endowed with viable east–west trade hubs and presents a potential alternative sailing route to the Suez Canal for north–east trade.


*Figure 3.3* The Southern African container port system
*Note*: Map not drawn to scale; corridors and ports are approximations for illustrative purposes.

The South African container port system is competing with ports in Mozambique, Namibia and the islands of Madagascar and Mauritius. Notwithstanding the remoteness of the region to the main maritime network, these ports are served by global container carriers such as Maersk Line, MSC, MOL, Evergreen, and CMA CGM. Figure 3.3 provides the locations of each Southern African country together with the seaports. In addition, approximations of the major freight corridors connecting these ports to the hinterland are provided. Central to the corridors is Johannesburg situated in the Gauteng province of South Africa. It is considered the main consumption and production zone of the region. This small region generates 10 percent of the entire continent's GDP (GCIS, 2013). Given this fact, and the location of the largest inland container depot in this region, Gauteng is positioned as a critical node in the container logistics chain.

There are no hub-and-spoke and relay/interlining operations in the region comparable to the ones found along the global beltway (Notteboom, 2012). Various internal and external factors, however, are driving traffic to the region. Internally, these factors include increased investments in port accessibility and port terminal infrastructure, improved shipping links with Asia and increased terminal productivity.

Externally, the strong GDP growth outlook, integration of regional economies with Asian suppliers, greater regional political stability and the increase/emergence of the urbanized African middle class (Ncube et al., 2011) have also spurred on maritime traffic growth to Southern Africa. Positioned at the tip of the African continent, Southern African ports are ideally situated to serve as economically viable commercial ports for both the western and eastern seaboards of Southern African Development Community (SADC) and the landlocked countries in between (Notteboom, 2010, 2012). The region has seen fast port development in the last 15 years with new ports entering the market or existing ports expanding their supply.

Competitive dynamics in the Southern African container port system are getting stronger, and this is impacting on South African ports. Both the ports of Durban and Maputo are nodal points each linked to corridors with Gauteng, the central production and consumption zone in the region, as the end node in the supply chain. Given that cargo is transported from these two ports onto continental areas inland effectively defines Durban and Maputo both as gateways. The two north–east range corridors are orientated toward Gauteng: Natcor – Durban to Gauteng, and Maputo Corridor – Maputo to Gauteng. The Maputo Corridor is well positioned along one of the most industrialized and productive regions of Southern Africa. Two gateways in such close proximity, however, results in intense rivalry for market share. Comparatively, from both a rail and road perspective, Maputo is at a shorter distance to Johannesburg and Pretoria. This has both cost and time implications for freight customers. The shorter distances from Gauteng to Maputo (compared to Durban) clearly illustrates the competitive advantage the Maputo corridor has over the Natcor (Durban corridor). However, Durban remains by far the biggest container port maintaining a regional market share of 53 percent at 2010 while Maputo held 3 percent. Any further gains for Maputo will be limited to the ports increased capacity to handle any further incremental volumes. Given the port of Maputo's ambitious capacity expansion plans for the future, Durban will need to find initiatives to defend its status as the primary gateway port into Southern Africa. In addition to capacity improvements, the port needs increased focus on improved operational efficiencies, more competitive tariffs and a more reliable service offering.

Competition between Cape Town and Walvis Bay also largely focuses on gateway cargo. Despite its distance from Cape Town (the most southern point in the region), the port of Walvis Bay stated its strategic intent

as a natural gateway for international trade with the ability to reach the Gauteng market via the Trans-Kalahari Corridor instead of going via Durban or Cape Town, saving 7 to 11 days of transit time. In addition to serving the geographic hinterland in close proximity to the port of Walvis Bay, the container terminal also seeks to serve the economic hinterland namely Gauteng.

The islands of Madagascar and Port Louis service for captive cargo is limited to the size of the islands (population served) and productive capacity to export commodities. The Indian Ocean range is therefore seen more as a hub region than a gateway port region. The port of Ncqura has been positioned strategically by Transnet as the transshipment hub port for Southern Africa and thus faces head-on-head competition with the two island ports for what the transshipment business is concerned.

Next to competitive pressures from neighboring ports, South African ports are also heavily affected by governance issues at a national and supranational level. Tupy and Rohac (2014) indicate that some of the most significant bottlenecks to Africa's economic and infrastructural development are in fact internal to Africa. These include poor governance, inefficient bureaucracies and corruption. Political stability, transparency and an effective government administration are some pillars toward achieving credible improvements in policies and government institutions, thereby increasing confidence to foster investment and drive economic growth. Table 3.3 provides a selection of World Bank governance indicators which influence trade, foreign direct investment and the ease of doing business in the region for the years 2007 and 2012. These indicators include political stability and the absence of violence, government effectiveness and the control of corruption in the region. The addition of a base figure (the average value of each indicator of world lower- to middle-income countries) is included for comparative purposes. Mauritius leads with the highest scores in all three governance indicators compared with the rest of the region. This is followed by Namibia and, to some extent, South Africa. Notably, South Africa had a considerably low score of 44.08 (2012, the second lowest in the region among the Southern African port range) in the area of political stability. The most risky Southern African port range country in the region during the two periods was Madagascar with all three indicators lower than the average figures for lower- to middle-income countries worldwide. With reference to the landlocked SADC countries, Botswana leads with the highest governance indicators for all selected. This is particularly important given the country's location

*Table 3.3* World Bank governance indicators (presented in percentile rank 0 to 100)

| | | Political stability and absence of violence | | Government effectiveness | | Control of corruption | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2012 | 2007 | 2012 | 2007 | 2012 |
| | **Average lower- to middle-income countries worldwide** | **38** | **40** | **33** | **33** | **33** | **35** |
| Southern African port range | South Africa | 50.96 | 44.08 | 69.90 | 63.64 | 61.65 | 53.59 |
| | Mozambique | 54.81 | 58.77 | 37.38 | 29.67 | 37.86 | 33.01 |
| | Namibia | 84.13 | 78.67 | 58.25 | 59.33 | 65.05 | 66.51 |
| | Madagascar | 43.75 | 27.96 | 40.29 | 14.83 | 56.31 | 31.10 |
| | Mauritius | 75.96 | 79.15 | 77.18 | 77.03 | 71.84 | 66.99 |
| Landlocked SADC countries | Botswana | 82.21 | 88.62 | 72.81 | 66.50 | 79.12 | 78.94 |
| | Zambia | 56.73 | 65.40 | 26.21 | 37.79 | 34.46 | 45.93 |
| | Zimbabwe | 15.38 | 21.80 | 7.76 | 11.00 | 3.39 | 5.36 |
| | Malawi | 44.71 | 43.60 | 32.03 | 38.27 | 35.92 | 39.72 |
| | Swaziland | 44.23 | 34.12 | 20.38 | 32.05 | 51.94 | 47.36 |
| | Lesotho | 32.25 | 56.39 | 41.26 | 42.10 | 54.85 | 61.72 |
| Other coastal countries | Angola | 23.55 | 35.5 | 8.7 | 15.31 | 4.36 | 4.78 |
| | DRC | 2.88 | 2.84 | 0.97 | 0.95 | 4.85 | 4.30 |

*Source*: Date obtained from World Bank governance indicators, year 2013; average lower- to middle-income countries worldwide.

and consequently the potential it has to become the major inland port player in the region. Zimbabwe ranks lowest on every indicator compared to all the other landlocked countries, with a significantly lower score in the area of the control of corruption. Among the "other coastal" SADC grouping, Angola and the Democratic Republic of Congo (DRC) rank well below the average percentile rank indicators for lower- to middle-income countries. Both are highly endowed with natural recourses but remain low-income states plagued with corruption and instability.

Overall, from the governance indicators, we observe that countries with high governance indicator percentile rankings also have ports which perform better than those with lower rankings. For port infrastructure development, trade and growth within the SADC region (landlocked and coastal) to be sustained, its governments need to simplify bureaucratic procedures, seek solutions to the political conflicts impacting on regional stability and have the will to root out corruption.

**Port governance and institutions in South Africa**

The Transnet National Ports Authority (TNPA) is the managing organization established and incorporated in Chapter 2 (3) of Act 12, 2005 (the National Ports Act of South Africa). Currently, TNPA is structured as a division of a large cargo logistics public enterprise of the South African government, Transnet Soc Ltd. In addition to holding the national port authority, some other Transnet divisions include all of the dedicated container port operators nationally, Transnet Port Terminals (TPT) as well as Transnet Freight Rail (the rail operator). In terms of the narrow ownership structural categorization of the World Bank port reform toolkit, the TNPA can be categorized as a service port–tool port hybrid. The state-owned TNPA serves as the landlord and is also responsible for marine services, port control and marine engineering. The container operations of the country's four dedicated container terminals are leased to TNPA's "sister division" TPT at Durban, Cape Town, Port Elisabeth, and Ncqura as presented in Figure 3.3.

Each of the ports currently (in 2014) have varying annual capacity limitations ranging from the largest and busiest port of Durban (3.6 million TEU), the Eastern Cape transshipment hub Ncqura (400,000 TEU[1]), Port Elizabeth (400,000 TEU), and Cape Town (1 million TEU). TNPA and TPT have, in the last 15 years, initiated significant capital investment programs at each of the ports. These include, at (1) Durban, the widening and dredging of the harbor channel and the construction of the first rubber-tired gantry (RTG) terminal in the Southern Hemisphere (Pier 1); at (2) Ncqura, the development of a greenfield deep-water transshipment port; and at (3) Cape Town, the extension of quay walls and conversion of the operation from a straddle to RTG facility. In the past decade, Transnet, together with South African policymakers, have approached the issue of port investments within wider nation-wide targets of lowering the (logistics) cost of doing business, the development of the sea–sea transshipment business in relation to sub-Saharan countries and inland corridor development (see, e.g., Fraser and Notteboom, 2014; Notteboom, 2010, 2012 for a more detailed discussion on these issues).

Although TNPA and TPT exist as ring-fenced divisions of Transnet, providing each with a certain level of autonomy in decision making with respect to business and operational decisions, the funding strategy (source and use of funds) ultimately resides in the hands of the holding corporate office, Transnet. Effectively, "mega projects" are defined outside of the delegation of authority of the two port divisions and require

group board project and funding approval. The future capital endeavors of TNPA and TPT (the 2014 to 2043 capital expansion plan[2]) position the organizations container expansion projects as having the largest capital requirement compared with all the other cargo handling facility projects nationally (i.e., cars, bulk). According to the 30 year expansion capital requirements of Transnet, Transnet Long-Term Capital Planning Framework (LTPF) (Transnet, 2014, p. 349):

- Ports Authority investment requirements are significantly more than that of port terminals.
- An analysis of the capital requirements per port highlights the ports of Durban (ZAR 79 billion) and Ngqura (ZAR 39 billion) as the main capital investment destinations.
- Durban will attract more than a third (35 percent) of the port investments to cater for consistently strong demand for its services.
- Investments required for Phase 1 of the Durban airport site port development feature strongly during the first few years and capacity of the port will be required by 2023. The Phase 2 capacity will be required by 2035.

Notably, while some competition with respect to cargo handling operators exists in the break-bulk and bulk-port facilities, TPT holds more than 90 percent of the market and operates all the dedicated container facilities in the country. The current institutional position of the container sector in terms of funding sources for the container expansion endeavors of Transnet, thus implies a self-funding (balance sheet) strategy for the capital investment endeavors of TNPA and TPT.

**Analysis**

Having reviewed the institutional positioning of the South African container ports in terms of the ownership structure and divisional separation, we will now assess the extent to which this inhibits or enables the financial (and consequently) investment possibilities, given the available sources of funding its institutional positioning permits.

Table 3.4 discloses the generic funding sources available to TNPA and TPT given its structure as a wholly owned state enterprise. In so far as Transnet (holding company) maintains its 100 percent shareholding, funding sources are in effect limited to shareholder investment capital, general reserves and debt. The organization has, however, expanded the type of debt procured by including funding sources from

*Table 3.4* Current port financing sources available for TPT and TNPA

| Port | Public sector involvement | Port financing sources | |
|---|---|---|---|
| | | **Potential funding sources** | **Merits for the port** |
| South Africa | 100% | Public shareholder investment capital | Required for corporatization of the port |
| Transnet National Ports Authority (TNPA) | | General reserves | Total control |
| Transnet Port Terminals (TPT) | | Debts, loans, and sovereign bond | Tax shield, no control relinquished |

the sovereign debt market. In addition to simply sourcing this foreign lending, bond issuance was listed as a local currency-denominated bond on the international capital markets (a first from an African company).

While Table 3.4 discloses the current actual ownership structure and consequential funding sources of the container port divisions held by Transnet, the institutional framework of the South African port system (the National Ports Act, 2005) does permit other potential structural arrangements for the sector. While a number of potential options or "choices" exist, we identify and discuss a few critical options (A to D),[3] summarized in Table 3.5. For each option, the choice is described, the theoretical financial benefits arising from the choice are identified, the potential financial pitfalls for the group holding company are addressed and the overall choice trade-off dilemma for the group is presented.

*Transnet retaining 100 percent state shareholding of port authority and operator*

The first choice is for the holding company to do nothing. Transnet maintains the current port authority and port operator divisional structure and in doing so retain full control of both port divisions within the group. The major pitfall of this choice results in the primary problem of funding source limitations. Effectively, funding sources are restricted narrowly to only two broad alternatives (as per Figure 3.2). At option A, the trade-off for the holding company is full shareholder control of all port divisions versus limitations to other funding source possibilities and total financial risk exposure for the group.

*Privatization: Cargo handling port operator*

This would entail retaining the port authority within the Transnet group while completely outsourcing the container handling facility (one, all or a few terminals) in a private concession agreement with a private sector partner (PSP). Doing so would reduce the investment requirements of the group by the value of the planned investment in the container handling facilities (terminals) being concessioned. In terms of port legislation, provisions of the National Ports Act already permit private participation of port operators (currently already in effect in the beak-bulk sector of South Africa, for example), subject to the approval of a port operations and services license and a successful awarding of an operator bid. The financial benefits of a PSP would result in a reduction in debt for the group and an improvement to the organizations gearing ratio. The main pitfall of this approach for the group, however, would be a loss of management control of the terminal handling facility concessioned. The ultimate trade-off dilemma is a loss of control versus improved gearing and the potential elimination of financial risk exposure to the group by terminal operator capital investments funding.

The privatization/concessioning of one or a few terminals would have an impact on the competitive situation of the remaining TPT terminals. When properly applied, such a privatization would result in the entry of a highly competent and efficient (global) terminal operator to the market. In case such a terminal operator has a large terminal facility at its disposal and no large capacity shortages persist in the market, the new entrant is in a good position to have an impact on the traffic distribution among terminals in the South African port system, thereby potentially negatively affecting the volume base for the remaining TPT terminals and undermining the financial position and investment potential for TPT as part of Transnet. One means to obviate this is to ensure that there is a level playing field for competition among terminals. Creating a level playing field when two terminal governance systems coexist is not easy, but feasible. With respect to port tariffs, the port regulator of South Africa has a mandate to review the annual tariff increase proposals of TNPA and the discretion to approve or reject them. The regulator has been successful in curtailing port authority tariffs in the past (refer to port regulator decisions 2011/2012, 2012/2013); however, there is concern that the "regulatory rejected increases" could be implicitly passed onto the port operator TPT in the form of higher terminal handling charges as a means of recovering such "losses" given that the operator and authority are one company. This is also possible as the port regulator

has no jurisdiction over the regulation of tariff/pricing decisions of terminal operators in terms of the National Ports Act. A new port operator entrant into the market would potentially have a greater degree of flexibility in their tariff pricing policies. This new terminal operator entrant (outside of Transnet) would therefore not be required to pass on the authority's "regulator imposed tariff losses" onto consumers for the benefit of the group. On the contrary, the benefit of lower TNPA charges to a private operator could be passed onto users (theoretically following a more market-related approach to pricing).

As such, we further expect that the privatization of one or more terminals in South Africa will lead to the end of the current uniform pricing arrangements in South African ports. At present, there is little differentiation in terminal pricing among the terminals and ports (i.e., only at the level of storage charges for import containers, which is much higher in Durban than in other ports). The entry of a newcomer in the market would likely create an impetus toward more price differentiation at the level of terminals, traffic/vessel types, and customers.

*Partial private sector partner: Port operator*

In this option, the port operator would be retained as a division within the holding company; however, a PSP could be solicited broadly in two forms. The first broad PSP agreement (PSP1) would involve a shareholding partnership between the port operator and PSP in a deal structured as a type of business consortium. The extent of the loss of ownership share by the operator (and consequential financial funding source gain) would be guided by the investment funding requirements of the operator and the permissible management control losses allowed by the holding company. By way of example, a 40 percent stake in the port operator could be sold to a PSP partner, with the proceeds from the sale used to fund a portion of the business's long-term capital expansion program. The second broad PSP agreement (PSP2) could exist whereby a private investor co-invests in specific port handling infrastructure within the operator's expansion projects, in exchange for either exclusive use of the facility in which the PSP2 invested or reduced tariffs on services at the facility. On the one hand, such an agreement would eliminate explicit structural management control dilution fears from the holding company and operator, but this could have an impact on the pricing strategy and the operational flexibility of the operator on the other. As stipulated in B, the National Ports Act does permit private operators at the country's ports. The extent to which the two forms of private participation can legally exist within the provisions/framework of Chapter 5

of the National Ports Act (Port Regulator) needs further evaluation. The independent port regulator of South Africa is established under the port act to exercise jurisdiction over economic, regulatory, equity of access to port facilities and the monitoring of activities of the port authority. Terms of a PSP2 agreement between port customers and the port operator (for example) could stipulate "favorable" financial (i.e., lower tariffs) and/or preferential operational benefits (i.e., exclusive facility use rights) for a PSP2 customer. This would be ostensibly unfair to other port users and as such may invoke intervention from the port regulator. Such PSP2 agreements are extremely complex and would require thorough review within the regulatory framework of South African ports prior to consideration of this as a funding mechanism (outside the scope of this work).

The benefits of both PSP1 and PSP2 agreements have the positive impact on the balance sheet (lower gearing), diversification of funding sources and shared financial risk on the investments with the PSP. The potential pitfalls include the partial loss of management control by the holding company and operator and a potential for recourse from the regulator if the behavior of the PSP and the operator is perceived to be unfair and anti-competitive.

*Privatization: Port authority (complete or partial)*

Comprehensive port privatization entails port reform programs such as those completed in the United Kingdom and New Zealand involving the outright sale of port land in conjunction with a transfer of traditional public port tasks. According to the World Bank (2005) comprehensive port privatization often requires the enactment of new laws, to regulate the transfer of both ownership and functions from the public to the private sector. Chapter 2 of the National Ports Act has provisions for the conversion of the authority into a public company theoretically permitting the sale of a "National Ports Authority Ltd" to private investors. The act, however, stipulates that "the States rights as a shareholder of the Authority are to be exercised by the shareholding minister and, where required by this Act, with the concurrence of the minister" (National Ports Act, 2005, p. 14). In addition to ministerial concurrence, conversion of the authority into a public company is also possible only after the execution of Chapter 2, section 3(3), of the Act – namely, the separation of TNPA as a division outside of the Transnet group and incorporation of the authority as the National Ports Authority Ltd (a private company) with Transnet as the sole member and shareholder. Given that the scope of this work seeks to explore funding source possibilities, we assume[4]

that the execution of all the actions necessary to convert the TNPA into a privatized National Ports Authority Ltd (in terms of the act) would result in a range of alternative funding sources including equity from the sale of shares to the private sector for the purposes of funding expansion projects. We also assume that the sale could be wholly or partially executed, depending on the extent of control which the majority holding entity (Transnet) would be willing to relinquish. We also recognize that fully privatizing the port authority may be counterproductive with respect to achieving the LTPF 2014–2043 investment expansion targets of Transnet. Typically, private companies exist to maximize shareholder value, a motivation in conflict with that of a public good such as a port. If for example, the LTPF 2014–2043 investment targets do not achieve this goal (for private investors), then they would be abandoned. This rationale is also aligned to the work of Vining and Boardman (2008) on ports as public goods which highlights the notion that private firms acting in their (profit-maximizing) interest have (their own) correct incentives to make optimal investments. We therefore view total privatization of the authority as a funding source possibility for Transnet, but we do not advocate total privatizations as being in the best interest for the group in terms of its cargo infrastructure LTPF. As such, we see more potential in partial privatization as a funding source possibility in this context.

The potential financial benefits of the (partial privatization) option include the sharing of risk, improved gearing ratios for the group and potentially high gains from the stock market (in the event of a public listing). The potential trade-offs include the dilution of control from the holding company, increased risk exposure (share market), potentially high transaction costs and potential share price discovery disputes prior to the initial public offer (Table 3.5).

## Discussion and conclusions

The analysis in the previous section identified the potential funding opportunities which exist for the port operator and port authority divisions of the Transnet group. Currently, the organization funds its capital expansion program for the ports, mainly through self-funded means and debt. Notwithstanding this fact, the organization has had a tremendous investment track record over the last 15 years based on the number of port projects commissioned to date. Pursing the expansion goals of the port component within the Long-Term Planning Framework (a series of interventions to increase infrastructure capacity to match projected

*Table 3.5* Summary of funding choices for Transnet's long-term planning framework

| **Choices for Transnet, TNPA and TPT** | **(A) Retaining 100% state shareholding** | **(B) Full private partner: cargo handling port operator** | **(C) Partial private partner: port operator** | **(D) Partial private partner: port authority** |
|---|---|---|---|---|
| Choice description | Retaining the current divisional structure | Retaining the port authority within the group with a complete concession of the handling facility/ies to private sector (all or some terminals) | Port operator permitting a private partner to invest in specific/components of expansion projects | Conversion of state port authority into a publicly listed company or private consortium with some shareholding reaming within Transnet |
| Financial benefits to Transnet | Full control remains within the group | Reduction of investment requirements (by the value of the planned handling facility concessioned)<br>Improved gearing ratio | Risk of project failure shared with partner<br>Additional source of outside funding improved gearing ratio | Diversified funding sources (all available options as per Figure 3.2)<br>Financial risk in respect of largest investment (PA) shared with partner<br>Improved gearing |
| Potential Pitfalls for Transnet | Funding option limitations (as per Figure 3.2) | Loss of control of the terminal handling facility by group holding<br>Level playing field between privately operated and TPT operated terminals<br>Reassessment of role of port regulator might be needed | Loss of some control (depending on the extent of private partnership)<br>Potential anti-competitive behavior (if partner is a customer)<br>Reassessment of role port regulator might be needed. | Loss of some control (depending on the extent of private partnership).<br>Potential anti-competitive behavior (if partner is a customer) share market risk exposure |
| Trade-offs | Complete control vs. funding limitations and total financial risk exposure | Loss of control vs. improved gearing reduced risk exposure (on account of operator investments) | Partial loss of control for improved gearing ratio and shared financial risk exposure | Loss of control of authority vs. diversified funding and shared risk |

demand to 2043) comes at a significant cost, with the ports requiring 25 percent of the total (ZAR 909 billion) capital requirements spend (Transnet, 2014, p. 344). Although alternative debt funding mechanisms have already successfully been pursued such as the oversubscribed sovereign market bond issuances by Transnet in 2013, alternative funding strategies will be necessary to alleviate pressure on the organizations balance sheet.

The discussion on alternative funding and financing options to Transnet is particularly vivid when considering the planned port expansion in Durban. Transnet investigates the business rationale of alternative funding and financing arrangements for the proposed dig-out port to be constructed on the old Durban International Airport site. It concerns a large-scale port project following Transnet's purchase of the old Durban International Airport site, south of the city and existing port area of Durban in KwaZulu-Natal. The site would be developed in phases comprising container berths, automotive berths and liquid bulk berths. Transnet commenced with high-level technical and environmental studies in 2012. In 2013, Transnet concluded a series of stakeholder meetings with local organizations about the proposed Durban Dig-Out Port project, as part of the project's concept phase which includes the development of a Sustainable Port Development Framework that will inform all future designs as well as operations. The process of moving from the concept phase through the pre-feasibility and feasibility phases, and finally to actual implementation, is anticipated to take approximately four years. The proposed port forms a key pillar of Government's Strategic Integrated Projects (SIPs) to upgrade the Durban–Free State–Gauteng Freight Corridor (also known as SIP2 in the National Infrastructure Plan), thereby unlocking South Africa's trade opportunities in order to boost the country's long-term economic prospects. Transnet has indicated that it is considering alternative funding and financing options as a way to carry the heavy investment burden (estimated at ZAR 75 billion) of such a major port infrastructure development. This may even include the opening up of the container terminal business in South Africa to outsiders.

Our analysis looked to the port institutional framework of South Africa in order to present various funding alternatives available to the organization. These options (apart from retaining the current status quo) ranged from full to partial privatization of the port operators and partial privatization of the port authority. Each, presenting various risk and benefit trade-offs for the organization. We inferred that pure public ports from developing countries, such as South African ports, have

limited investment funding sources, compromising the execution of capital investment expansion programs. Indeed, the analysis provided in Figure 3.2 and Table 3.2 demonstrated that a 100 percent publicly held port is limited to only two (apart from government funds) of the five sources of port funding namely debt or shareholder (in this case the government) reserves. In other words, a change to the port institutional path of South African ports could broaden the options available in the pursuit of alternative funding. Other Southern African ports such as Toamasina (Madagascar) and Maputo (Mozambique) have undergone various port reform programs for the purposes of port expansion in the last ten years. Both ports have combinations of the options we presented in this chapter. Toamasina, for example, has a private partnerships agreement at the port authority (SPAT) and a totally concessioned container terminal operator (Madagascar International Container Terminal Services, MICTS). Maputo has a majority privatized port authority, the Maputo Development Company (MPDC), and a private container operator (DP World Maputo). In both cases, however, state involvement/shareholding is still prevalent. As such, Transnet is in a good position to review recent port reform programs within the region and assess if investment track record of these public private partnership ports (with their profit maximization imperative) have relative similarity to the capital expansion ambitions of the Transnet group. Confirmation of such a similarity would strengthen the case for the exploration of such partnerships. Notably, the analysis did not consider other, more qualitative and practical implications of the various options such as labor opposition to privatization, the potential positive impact of outsider expertise to the divisions, and so on. These were outside the scope of this work but have implications on the reform decision.

Finally, a change to the port institutional path, by an authority arising from the pursuit of alternative funding (for example), is largely dependent on the policy position of the government (the main shareholder of Transnet) in which the authority operates. The political will of a government to maintain its controlling stake in the ports as both authority and operator, despite the legal framework permitting outside involvement, will perpetuate service port–tool port hybrid and limit funding possibilities in the port environment of South Africa.

## Notes

1. Phase two to double this capacity currently underway.
2. Refer Transnet (2014, p. 351).

3. Options A to D are presented solely in consideration of funding alternatives available. Port operational and qualitative aspects which may have widened the spectrum were not considered due to this work's focus and limitation to port funding.
4. We refer to this without delving into the complexities associated with separating TNPA from Transnet and the ministerial concurrence requirement.

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# 4

# A Hierarchical Taxonomy of Container Ports in China and the Implications for Their Development

*Kevin Cullinane, Sharon Cullinane, and Tengfei Wang*

## Introduction

Prompted by a phenomenal growth in trade over the last decade, China's container ports have been increasing in both number and importance. Within the Asian market sector, container ports in the Chinese mainland now threaten to undermine the dominance of both Hong Kong and Singapore. This chapter describes the development of China's container ports to this point in time and, by applying a classification system based on a hierarchy of ports, seeks to deduce likely scenarios for the sector's future development.

Robinson (1998) has divided the development of Asian hub/feeder networks into three phases by. These phases are differentiated by the degree of complexity in the structure of the port hierarchy within the region. Specifically, from 1970 to the mid-1980s, there were only a few,

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The chapter was prepared before Dr Wang joined the United Nations Economic and Social Commission for Asia and the Pacific. The views expressed in this publication do not necessarily reflect those of the United Nations. The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country or territory or of its authorities, or concerning the delimitations of its frontiers.

very important hub ports which existed within a single hierarchical level and which dominated the trade in a liner service network configuration that stretched from Singapore to Japan.

With the transition into the next phase, identified by Robinson (1998) as taking place over the period from the mid-1980s to the mid-1990s, a second tier of regionally significant feeder ports came into being and added a new dimension to Asia's liner service networks. From the mid-1990s to the 2000s, the third phase was characterized by the expansion of what had hitherto been classified as feeder ports. These became potential mainline ports of call and/or hub ports in a secondary network containing feeder services to a fast-expanding third tier of feeder ports in the region.

While this analysis of Robinson (1998) did include some consideration of the Chinese mainland container ports, the main focus was very much on the whole of the Asian region in toto. As such, his conceptualization of the development of container ports may not be wholly applicable to the very special situation of China. A similar approach, however, can be found in the China Shipping Development Annual Report (Department of Water Transport, 1998) and is based on dividing the development of China's ports into three phases. Because the analysis presented in the report does not focus on the development of dedicated container ports or terminals, but deals instead with the general development of China's ports, irrespective of their particular specialization, it too does not provide a wholly appropriate analysis of China's container ports sector.

The development of container ports in China is divided into four distinct phases in line with the conceptual framework presented in Figure 4.1, one which is itself based closely on the conceptualization due to Robinson (1998).

This chapter goes on to identify the way that port policies have influenced the development of China's major ports and the shuttle lines which serve them. Finally, a hierarchy of ports is developed. This latter is especially important since it is this which exerts a major influence over cargo flows, and thus the whole structure of the liner shipping network which services China's trade.

## Phases in the development of China's container ports

### Phase 1: 1978–1986

In 1978, China's state-owned shipping company (China Ocean Shipping Company – COSCO) inaugurated China's first venture into the container transport business with a maiden voyage from Shanghai to

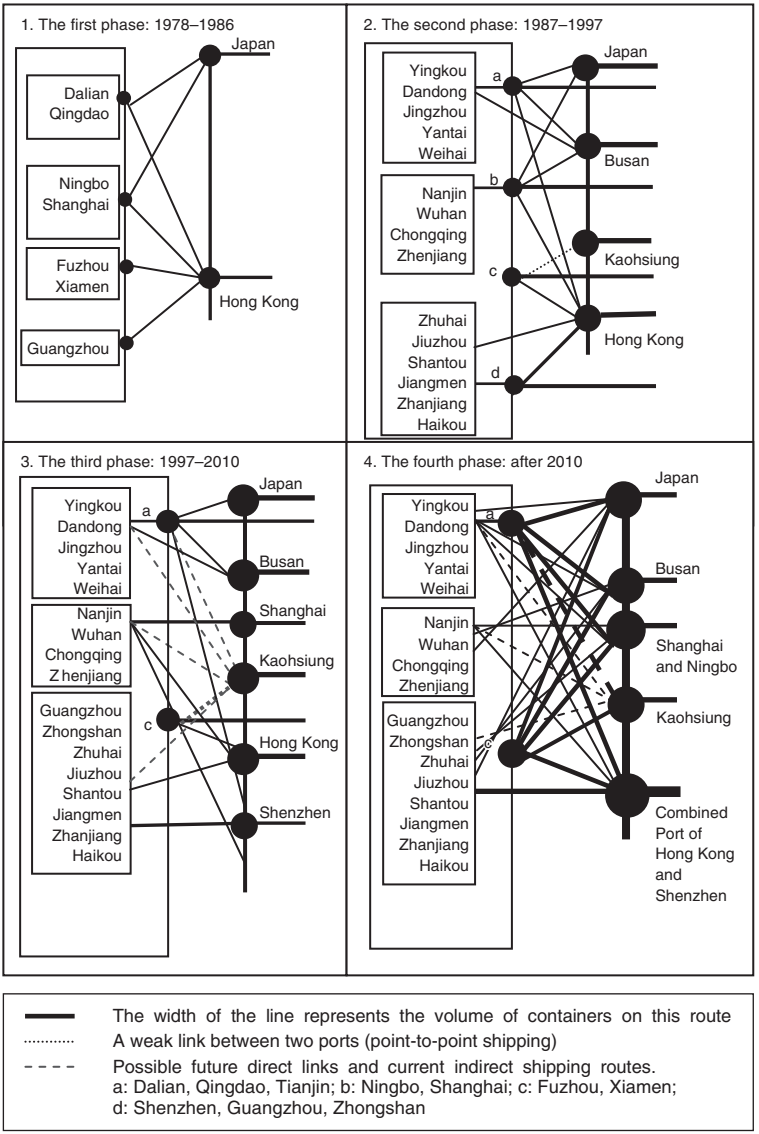


*Figure 4.1* Phases in the development of container ports in China

Australia (Department of Water Transport, 1998). This marked the true start of container port development in China despite the fact that over the whole of this phase, from 1978 to 1986, almost no *dedicated* container terminals were established. Instead, emphasis was placed on

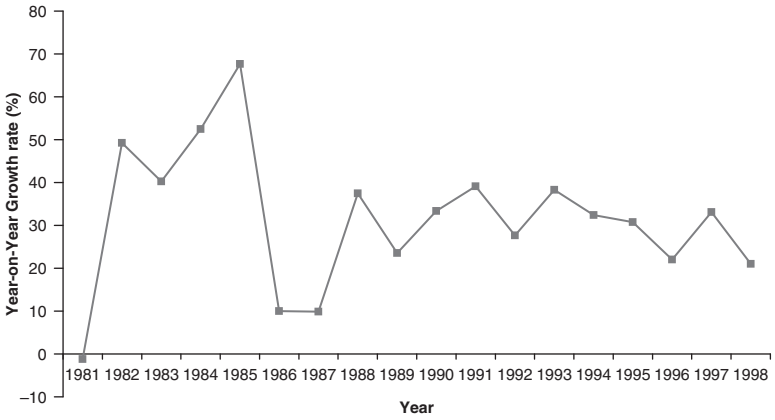


*Figure 4.2* Growth rates of container throughput (1981–1998)
*Source*: Department of Water Transport (1998).

the use of bulk or general cargo quays for the berthing of container ships.

The capacity and quality of service of these ad hoc "container ports" could not meet the burgeoning demand for the transport of containerized cargoes. The problem became acute when serious port congestion occurred in 1981, 1983, and 1985. The inadequacy of container handling capabilities in ports had effectively become a major bottleneck, thus restricting foreign trade and the further economic development of the Chinese mainland. Despite these problems and albeit from a low base, the growth rate in container throughput over this period, as shown in Figure 4.2, was rather impressive. Perhaps, however, the adverse impact of poor container handling facilities can be witnessed in the dampened growth rate that applied toward the end of this phase.

The growing importance of containerized cargoes to the ports sector, shown in Figure 4.3, reflects the degree of acceptance that the containerized transport of international cargoes was slowly but surely to achieve in the Chinese mainland over this period and later. According to Yeung (1996), however, since there were no real regional container ports or international liner services, during this phase most containers were shipped to either Hong Kong or Japan for transshipment onto mainline services.

### Phase 2: 1987–1997

As early as 1985, China's state council promulgated the provisional rules for the "Favourable Treatment for Construction of Terminals by Sino-Foreign Joint Ventures".

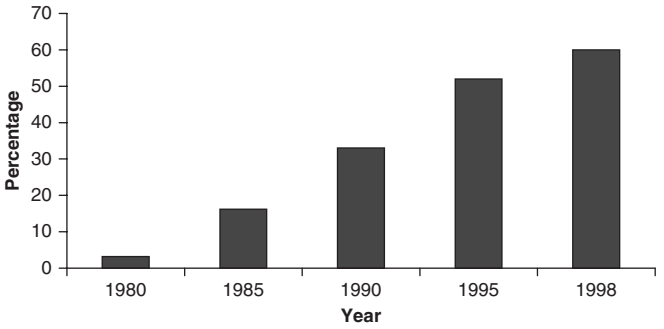


*Figure 4.3* Importance of containerized cargoes to China's main ports (1980–1998; percentage of total tons handled)
*Source*: Department of Water Transport (1998).

*Table 4.1* Developments of dedicated container terminals and container throughput in the Chinese mainland (1987–1997)

| Year | Number of dedicated terminals | Designed container throughput (thousand TEU) | Actual throughput (thousand TEU) | Growth rate (%) | Proportion of containerized cargoes in coastal ports (%) |
|---|---|---|---|---|---|
| 1987 | 14 | 1,100 | 689 | 9.89 | 20.0 |
| 1988 | 15 | 1,200 | 947 | 37.45 | 23.0 |
| 1989 | 18 | 1,330 | 1,170 | 23.55 | 26.0 |
| 1990 | 19 | 1,450 | 1,560 | 33.33 | 33.0 |
| 1991 | 23 | 1,950 | 2,170 | 39.10 | 42.0 |
| 1992 | 34 | 3,120 | 2,770 | 27.65 | 43.0 |
| 1993 | 36 | 3,540 | 3,830 | 38.27 | 44.0 |
| 1994 | 42 | 4,340 | 5,070 | 32.38 | 46.0 |
| 1995 | 52 | 5,330 | 6,630 | 30.77 | 52.0 |
| 1996 | 57 | 6,380 | 8,090 | 22.02 | 57.0 |
| 1997 | 65 | 10,030 | 10,770 | 33.13 | NA |

*Source*: Department of Water Transport (1998).

Under this set of rules, the construction of terminals by joint ventures involving Chinese mainland and overseas collaboration was not only permitted but positively encouraged. In effect, this set of rules provided a policy guarantee which underpinned the rapid development of container ports in the Chinese mainland. Table 4.1 shows the development of dedicated container terminal and container throughput in the Chinese mainland during 1987–1997.

The beginning of the second phase in the development of container ports in the Chinese mainland began in earnest in 1987 with

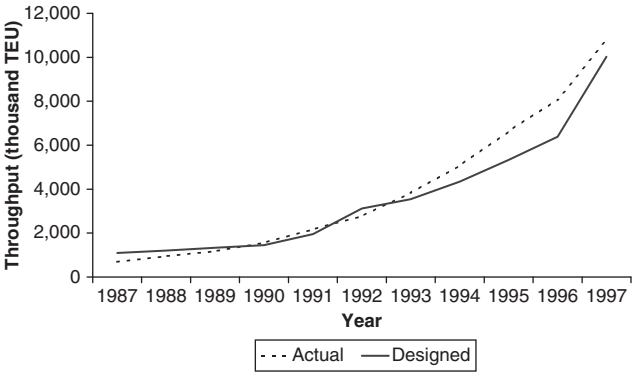


*Figure 4.4* A comparison of designed and actual container throughput
*Source*: Department of Water Transport (1998).

the establishment of the Nanjing International Container Terminal Company Ltd. This was the first Sino-foreign container handling enterprise in the Chinese mainland and involved a joint venture between Nanjing Port Authority and US-based Encinal Terminals. The main characteristics of this phase in container port development can be described as follows:

- *The Construction of New Container Ports*. During this phase of development, there was a good match between the designed capacity of the main container ports and actual container throughput. Even though from 1993, overall designed capacity lagged behind actual throughput, this problem of insufficient capacity had been largely rectified by 1997. Clearly, during this phase, great attention was paid to the planning and the construction of dedicated container terminals to meet the needs of the Chinese mainland's international trade. A comparison of designed and actual container throughput in the main container ports can be found in Figure 4.4.
- *Privatization and commercialization of China's container ports*. Since 1985, China has invested more in its port development than the rest of the world combined (Frankel, 1998). To attract more capital, China has moved rapidly toward the privatization of its ports and, particularly, its container terminals. In fact, over the last 20 years, China's port system has experienced a shift from a policy of centralized control to one, which is much more decentralized (Department of Water Transport, 1998). In addition, since the setting up of the first Sino-foreign International Container Terminal Company Ltd in Nanjing in 1987, an increasing amount of overseas capital has been invested in the development of container terminals (Frankel, 1998).

- *Upgrading of certain feeder ports to regional hub ports*. Prevailing market conditions and the vigorous competition between liner shipping companies during this period has meant that the container shipping industry has emerged as only a marginally profitable business. As a result, carriers have focused their energies on pursuing market share through cost-cutting. In addition, mergers, takeovers and alliances among the larger liner shipping organizations have consolidated the market domination of a few large companies (Ryoo and Thanopoulou, 1999). These alliances have redeployed their fleets and reconfigured and rescheduled their services and, by so doing, have led to a worldwide rationalization of container transport so that fewer and fewer container ports are called at directly by mainline vessels (Cullinane and Khanna, 1999).

  In stark contrast to the hub concentration which has resulted from this worldwide process of fleet and schedule rationalization, certain container feeder ports in China (e.g., Shanghai, Shenzhen) have gradually emerged as regional hub ports. In part, this reflects China's increasing market orientation, its adoption of economic liberalization policies and the ending of its economic and political isolation. From a more pragmatic and transport-oriented perspective, however, it also reflects its emergence as the world's manufacturing powerhouse and, concomitant with this, as the world's largest potential consumer market.
- *The development of China–Korea and China–Taiwan shipping services*. The Chinese and South Korean governments established diplomatic relations in 1992. At that time, some large container ports in South Korea (but most notably Busan) had become international hub ports (Cullinane and Song, 1998). The increasing trade between China and South Korea, with Busan container port acting as the international transshipment center, greatly stimulated the development of China's container ports, especially Qingdao, Tianjin, Dalian, and Shanghai, as well as many medium and small ports in Shangdong and Liaoning provinces.

  In 1997, following protracted negotiation between the governments of both China and Taiwan, experimental direct sailing was introduced across the Taiwan Strait by ten Chinese and Taiwanese shipping companies. The potential for container transport between China and Taiwan is extremely promising. This is not only because of Kaohsiung's existing position as a major international hub port but also because of the forecast growth of Xiamen and Fuzhou container ports which lie across the Taiwan strait in the Chinese mainland.

**Phase 3: 1997–2010**

Two policies promulgated by the Ministry of Communications in 1997 marked the beginning of the third phase. The first of these was the imposition of cabotage restrictions, which reserved market entry onto coastal shipping routes solely for vessels flying the flag of the Chinese mainland. The avowed intention of this policy was to encourage the initiation of coastal feeders and, thereby, to provide support to the development of major ocean liner routes. The second policy, which might appear to contradict the first, was to impose a generally applicable 20 percent increase in port charges for vessels engaged in coastal shipping services. This could be somewhat cynically viewed, however, as the price which local operators had to pay for the protection from overseas competition, which the first of these policies rendered them.

During this phase and taking many years for their construction, several large container terminals have been established in the Chinese mainland. Plans for their further development to 2010 are already in place and construction activities, especially with respect to the provision of appropriate transport infrastructure to serve these container terminals, also have a long planning horizon. Figure 4.1 has already shown the large coastal ports and main liner services extant during this period (phase 3) and alludes to the future expectations, which are embodied in the currently planned infrastructure investment (phase 4). Table 4.2 shows the throughput of the top ten container ports from 1981 to 2000 and, in so doing, highlights the progress, which is being made not only in economic development but also in meeting the logistics needs for facilitating this development.

According to Table 4.2, in 2000 the market share (of the Chinese mainland's total throughput) of the top five and top ten container ports accounts for 63 percent and 79 percent, respectively. In effect, three major regional groupings of container ports have taken shape in the Chinese mainland over this period according to their geographic location and container throughput at ports. They are:

- Southern China: Shenzhen, Guangzhou, and Zhongshan;
- Central China: Shanghai and Ningbo; and
- Northern China: Qingdao, Tianjin, and Dalian.

The geography of these three important container port groupings within the Chinese mainland is depicted in Figure 4.5.

*Table 4.2* Throughput of the Chinese mainland's top ten container ports (thousand TEUs)

| Port | 1981 | 1985 | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | Growth rate (compared with 1999) |
|---|---|---|---|---|---|---|---|---|---|---|
| China | 104* | 503* | 1,560 | 6,630 | 8090 | 10,765 | 13,124 | 18,059 | 23,480 | 30% |
| Shanghai | 49 | 202 | 456 | 1,527 | 1,971 | 2,527 | 3,066 | 4,216 | 5,612 | 33% |
| Shenzhen | 0 | 0 | 33 | 284 | 589 | 1,147 | 1,952 | 2,986 | 3,994 | 34% |
| Qingdao | 12 | 33 | 135 | 603 | 810 | 1,033 | 1,213 | 1,542 | 2,120 | 37% |
| Tianjin | 26 | 190 | 286 | 702 | 823 | 936 | 1,018 | 1,302 | 1,708 | 31% |
| Guangzhou | 11 | 47 | 110 | 515 | 558 | 687 | 841 | 1,177 | 1,431 | 22% |
| Xiamen | 0 | 0 | 36 | 310 | 400 | 546 | 654 | 848 | 1,085 | 28% |
| Dalian | 6 | 30 | 131 | 374 | 421 | 453 | 526 | 736 | 1,011 | 37% |
| Ningbo | 0 | 1 | 22 | 160 | 202 | 257 | 353 | 601 | 902 | 50% |
| Fuzhou | 0 | 0 | 29 | 151 | 177 | 225 | 252 | 318 | 400 | 26% |
| Zhuhai | 0 | 0 | 0 | 275 | 270 | 264 | 262 | 291 | 314 | 8% |

*Note*: *Estimated by the authors.
*Source*: Department of Water Transport (2000).

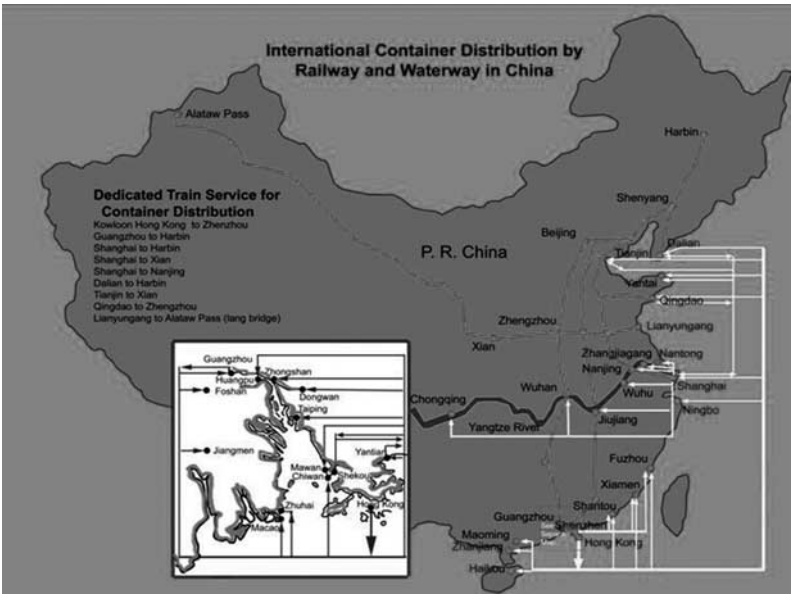


*Figure 4.5* The three major geographical port groupings in mainland China

## Regional analysis of Chinese mainland container ports

### The container ports of southern China: Shenzhen container port

The port of Guangzhou (formerly known as Canton) has traditionally been the largest port in southern China. However, it is now Shenzhen container port, which attracts the main attention of industry commentators in the region. This is because of both its exceptional rate of growth and its intriguing relationship with the port of Hong Kong in terms of an overlapping ownership structure and its position as Hong Kong's main competitor and major potential collaborator (Cullinane, 2000).

Shenzhen container port comprises the container terminals of Yantian, Shekou, Kaifeng, and Chiwan, the details of which are shown in Table 4.3.

Generally speaking, the terminals of Shenzhen container port used to fulfill a feeder function for the port of Hong Kong, as shown in Figure 4.1. This situation, however, is changing rapidly as they develop still further. As argued by Slack (1998), Hong Kong's pre-eminent position as China's most important hub port is due to the competitive weakness of other ports, rather than to any inherent characteristics of containerization. The hinterland of Shenzhen container port will

*Table 4.3* Container terminals in Shenzhen port

| Container terminal | Container berths | New or under construction Berths | Designed berthing capacity (thousand tons) | Designed throughput volume per annum (thousand TEU) |
|---|---|---|---|---|
| Shenzhen Container Terminal | 2 | 0 | 50 | 500 |
| Kai Feng | 2 | 1 | 50 | 500 |
| Chi Wan | 0.5 | 0 | 75 | 150 |
| Yan Tian | 2 | 3 | 50 | 500 |
| Shekou | 0 | 3 | NA | NA |
| Ma Wan | 0 | 0 | NA | NA |
| Da Pen Bay | 0 | 0 | NA | NA |
| Total | 6.5 | 7 | | 1,650 |

*Source*: Department of Water Transport (2000).

expand with its continued growth and eventual maturity. As at the time of writing, there are altogether 156 container ships calling at Shenzhen container port, including 73 which are over 4,000 TEUs, 61 of 3,000–4,000 TEUs and 22 less than 3,000 TEUs. Table 4.4 illustrates the international liner services calling at Shenzhen container port.

An official forecast of the development of the future hinterland of Shenzhen container port (prepared by Wang, 1998) is presented in Table 4.5.

### Coastal container ports in southern China

The Pearl River Delta (PRD), which includes Guangdong and Hainan provinces and the Guangxi Zhuang Autonomous Region, has always been regarded as the area of the Chinese mainland which is at the forefront of implementing China's policies for economic reform. In 1998, 60 percent of the Chinese mainland's total container throughput either originated from, or was destined for, this area. Following Hong Kong's return to China on 1 July 1997, the relocation of Hong Kong's manufacturing industry across the border to the PRD area has accelerated, and this has unquestionably stimulated a significant growth in demand for container transportation, and thus the development of the region's ports and container terminals.

Since 1990, there has been a rapid increase in the volume of containers moved to and from the provinces of Guangdong and Hainan and to and from the Guangxi Zhuang Autonomous Region. This new

*Table 4.4* Liner services calling at Shenzhen container port as of October 1999

| Route | Frequency | Liner | Ship slots |
|---|---|---|---|
| America | Once a week | Global Alliance | 4,300 |
| | Once a week | | 4,832 |
| | Once a week | Grant Alliance | 3,600 |
| | Once a week | | 4,830 |
| | Once a week | K-line/ COSCO/Yangming | 3,720 |
| | Once a week | Evergreen | 5,364 |
| | Once a week | | 6,000 |
| | Once a week | Maersk-Sealand | 2,408 |
| | Once a week | | 6,600 |
| | Once a week | | 1,800 |
| | Once a week | Pan Pacific | 1,728 |
| | Once a week | North Europe-Asia/CMA(CGM) | 900 |
| | Once a week | Mediterranean | 2,206 |
| | Once a week | HKSQ | 900 |
| | Once a week | COSCO | 5,250 |
| | Once a week | Zim | 3,416 |
| | Twice a week | Pacific | 1,986 |
| Europe | Once a week | Maersk-Sealand | 4,300 |
| | Once a week | Grant | 4,600 |
| | Once a week | Alliance | 4,200 |
| | Once a week | Global Alliance | 3,980 |
| | Once a week | Mediterranean | 4,000 |
| | Once a week | North Europe-Asia/CMA(CGM) | 4,000 |
| | Once a week | China Shipping Co. | 2,097 |
| Mediterranean | Once a week | Zim | 3,016 |
| Southeast Asia | Once a week | Grant Alliance | 4,960 |
| | Once a week | Global Alliance | 4,481 |
| | Once a week | Pacific | 1,650 |
| | Once a week | Zim | 670 |
| | Once a week | | 568 |
| | Once a week | COSCO | 1,200 |
| | Once a week | China Shipping Co. | 1,000 |
| Australia | Once a week | Russo-Orient | 1,748 |
| | Twice a week | ANL | 2,825 |

*Source*: Department of Water Transport (1999).

volume has been fed into the container terminals of Shenzhen and the rest of southern China, largely via coastal feeder services. Meanwhile, Yunnan, Guizhou and Sichuan provinces and the southern region of the Yangtze River are fast becoming new economic hinterlands for these ports. Table 4.6 shows the development of the container ports in southern China.

*Table 4.5* Forecast changes in the hinterland of Shenzhen container port

| 1995 | | 2010 | |
|---|---|---|---|
| Hinterland | %* | Hinterland | %* |
| Shenzhen city | 60% | Shenzhen city | 42% |
| Pearl River delta (except Shenzhen) | 40% | Most regions in Guangdong province | 58% |
| Coastal cities and regions along Guangdong province | | Regions along the railway of Beijing–Guangzhou, Beijing–Kowloon | |
| Regions along east-north coast | | Regions along southeast coast | |
| Guangxi autonomous region | | Hong Kong and some East | |
| Jiangxi province | | Asian areas | |
| Regions along Beijing-Guangzhou, etc. | | | |

*Note*: *The percentage share of the total containers moving through the container ports of Shenzhen that are generated in a region.

*Table 4.6* Throughput of the main southern China container ports (1995–2000; in TEUs)

| Port | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| Shenzhen | 283,681 | 589,057 | 1,147,347 | 1,951,746 | 2,824,000 | 3,994,000 |
| Guangzhou | 514,987 | 557,528 | 687,303 | 840,000 | 1,120,000 | 1,431,000 |
| Zhongshan | 178,176 | 221,781 | 315,530 | 378,636 | 415,000 | 506,000 |
| Zhuhai | 274,637 | 270,095 | 261,985 | 257,570 | 291,000 | 314,000 |
| Shantou | 69,742 | 90,016 | 74,228 | 63,223 | 117,000 | 114,000 |
| Jiangmen | 36,622 | 33,735 | 42,349 | 50,819 | NA | NA |
| Zhanjiang | 29,944 | 29,465 | 43,672 | 33,089 | 49,000 | 75,000 |
| Huicheng | 16,363 | 25,093 | 27,832 | NA | NA | NA |
| Haikou | 20,702 | 16,637 | 26,047 | 28,694 | 38,000 | 49,000 |
| Total | 1,470,574 | 2,074,151 | 2,781,281 | 3,603,777 | NA | NA |

*Source*: Department of Water Transport (1998, 2000).

### Ports along the Pearl River

The Pearl River mainly comprises Xijiang, Beijiang, and Dongjiang. It flows across Guangdong province and the Guangxi Zhuang Autonomous Region and constitutes the main inland waterway in southern China. There are altogether 57 ports along the river, most of which are extremely small (Wong, 1996).

Containerized river transport between these small ports (including Shekou, Ma Wan, Chi Wan, and Zhuhai) comprises a fleet of river boats ranging 10–200-box capacity. This transport mainly acts as a

feeder service for the regional large container ports. In fact, according to Tai-Yuen and Beresford (1995) the Pearl River has not been made full use of for inland water transportation.

### The container ports of central China: Shanghai container port

As mainland China's traditional industrial center, Shanghai is often the focus of worldwide attention. As shown in Table 4.7, the throughput of Shanghai container port has developed dramatically since the reform of the Chinese economy.

In 1998, the port of Shanghai included 13 dedicated container berths distributed within Baoshan Terminal, Jun Gong Lu Terminal, Zhang Hua Bang Terminal, and Wai Gaoqiao terminal. The total designed annual throughput capacity was 2.3 million TEUs and encompassed the deployment of 22 gantry cranes. The details are shown in Table 4.8.

However, a maximum draft restriction of 11 meters greatly impedes the further development of Shanghai container terminal as a truly international container hub port. Table 4.9 shows the details of containerships calling at Shanghai container terminal. According to this table, in sharp contrast with Shenzhen container port which is called at by most large containerships, it is clear that the largest ship only has a slot capacity of about 1,800 TEUs.

Table 4.10 shows the new projects underway or being planned in the Yangtze River estuary to solve this problem. It is of great significance to note that a new purpose-built deep-water container terminal with a maximum draft restriction of 15 meters in Yang Shan, as shown in

*Table 4.7* Throughput of the Shanghai container terminals (1980–1998; thousand TEUs)

| Year | Imports | Exports | Throughput | Growth rate (%) |
|---|---|---|---|---|
| 1980 | 15.9 | 14.5 | 30.4 | – |
| 1985 | 106.9 | 94.8 | 201.7 | 46.0 |
| 1990 | 224.3 | 231.8 | 456.1 | 17.7 |
| 1991 | 281.3 | 295.4 | 576.7 | 26.4 |
| 1992 | 339.4 | 391.1 | 730.5 | 26.7 |
| 1993 | 448.3 | 486.4 | 934.8 | 28.0 |
| 1994 | 555.7 | 643.5 | 1,199.2 | 28.3 |
| 1995 | 693.0 | 833.5 | 1,526.5 | 27.3 |
| 1996 | 924.1 | 1,047.3 | 1,971.4 | 29.1 |
| 1997 | 1,146.6 | 1,380.7 | 2,527.3 | 28.2 |
| 1998 | 1,411.0 | 1,655.0 | 3,066.0 | 21.3 |

*Source*: Guo (1999).

*Table 4.8* Container terminals in the port of Shanghai

| Terminal | Berths | Length (meters) | Designed capacity (TEU) | Throughput in 1998 (TEU) |
|---|---|---|---|---|
| Zhang Hua Bang Terminal | 3 | 784 | 800,000 | 910,000 |
| Jun Gong Lu terminal | 4 | 857 | 650,000 | 844,000 |
| Baoshan terminal | 3 | 640 | 250,000 | 273,000 |
| Wai Gaoqiao (first phase) | 3 | 900 | 600,000 | 675,000 |
| Others | | | | 358,000 |
| Total | 13 | | | 3,060,000 |

*Source*: Guo (1999).

*Table 4.9* Liner services calling at Shanghai container port as of the end of December 1999

| Route | Frequency | Liner | Ship slots |
|---|---|---|---|
| America (West Coast) | Once a week | COSCO | 1,000 |
| | Once a week | Yangming | 1,000 |
| | Once a week | Maersk/Sea-land | 1,000 |
| | Once a week | CMA (CGM) | 600 |
| | Once a week | Mediterranean | 600 |
| | Once a week | NYK | 900 |
| | Once a week | MOSK | 1,000 |
| | Once a week | P&O N | 900 |
| | Once a week | Zim | 300 |
| | Once a week | Hanjin | 1,200 |
| America (East Coast) | Once a week | COSCO | 1,000 |
| | Once every two weeks | HKSQ | 1,100 |
| Hong Kong | Once a week | Ever Green | 600 |
| | Once a week | Haihua | 288 |
| | Once a week | Xinhai | 327 |
| | Once a week | HK Orient Transportation | 380 |
| Europe | Once a week | American President | 1,000 |
| | Once a week | Hapag-Lloyd | 1,800 |
| | Once a week | CMA(CGM) | 400 |
| | Once a week | Hyundai | 1,000 |
| | Once a week | MOSK | 1,000 |
| | Once a week | OOCL | 1,800 |
| | Once a week | Mediterranean | 600 |
| | Once a week | COSCO/K-line | 1,050 |
| | Once every two weeks | Lloyd Triestino | 600 |
| | Once every two weeks | China Shipping Co. | 700 |
| | Once a month | Hanjin/Sino-Trans | 700 |
| | Once a month | Maersk/Sealand | 1,000 |
| Mediterranean | Once a week | Zim | 800 |
| | Once a week | COSCO | 670 |
| | | China Shipping Co. | 400 |
| Southeast Asia | Twice a week | Global Alliance | 400 |
| Australia | Once a week | COSCO | 350 |
| | Once a week | China Shipping Co. | 200 |
| | Twice a week | ANL | 300 |

*Table 4.9* (Continued)

| Route | Frequency | Liner | Ship slots |
|---|---|---|---|
| Japan | Once a week | COSCO | 400 |
| | Once a week | China–Japan International Ferry Co. | 224 |
| | Once a week | China Shipping Co. | 200 |
| | Once a week | Shanghai International Ferry Co. | 229 |
| | Once a week | Xinhai | 480 |
| | Once a week | Tianhai | 617 |
| | Once a week | K-line | 450 |
| | Twice a week | Central Asian Shipping | 20 |
| | Twice a week | Jinjiang | 443 |
| | Twice a week | Yantai Shipping Co. | 310 |
| | Four times a week | Sino-trans | 310 |
| | Once every ten days | Haihua | 552 |
| | Five times a week | Minsheng Kambara Marine Shipping | 150 |
| | Once a week | Korea Marine Transport Co. | 500 |
| | Once a week | China Shipping Co. | 200 |
| | Once a week | Jinjiang | 300 |
| Korea | Once a week | Xindong | 762 |
| | Once a week | COSCO | 672 |
| | Once a week | Changjin | 380 |
| | Twice a week | Dongying | 475 |
| East and | Once every 10 days | MOSK | 88 |
| west of | Once a week | P&O N | 65 |
| Africa | Once a week | Delmas | 50 |

*Source*: Department of Water Transport (1999).

*Table 4.10* Committed and planned container port projects in Shanghai

| Project | Quay length (meters) | Annual capacity (million TEUs/year) | Completion by end |
|---|---|---|---|
| Waigaoqiao: 5 spp QCCs | | 0.5 | 2000 |
| 4 spp QCCs | | 0.4 | 2001 |
| Phase III | 665 | 0.6 | 2001 |
| Phase IV | 665 | 0.6 | 2002 |
| Wahaogou: new terminal | 600 | 0.4 | 2003 |
| | 600 | 0.4 | 2003 |
| Jinshanzui: new terminal | 600 | 0.4 | 2006 |
| | 600 | 0.4 | 2008 |
| Xiaoyangshan/Dayangshan | 2,000 | 2.5 | 2007–2010 |
| | | 12.5 | After 2010 |

*Source*: OSCL (2001, p. 80).

Table 4.10, is under construction. This new project, scheduled to be used after 2010, will fundamentally overcome the drawback with Shanghai container port and restructure the worldwide container transportation network. This restructuring is also illustrated in Figure 4.1.

### Ningbo container port

Beilun container terminal constitutes the main part of Ningbo container port. It comprises two dedicated container berths with designed annual throughput capacity of 0.5 million TEUs. The water depth is 13.5 meters, which means that a Panamax containership of 80,000 deadweight tons is the maximum size of vessel, which is capable of berthing here.

Because of the comparatively short distance between the container ports of Shanghai and Ningbo (204 kilometers by rail), their close cooperation is encouraged by the Chinese government. In September 1997, a cross-regional container terminal administrative organization, the Shanghai Port Group, was established to regulate competition and to maintain and promote the pace of development of container ports in Shanghai, Zhejiang, and Jiangsu provinces. However, because China's current port policies are characterized by a decentralized approach, which stimulates competition, the management of ports and terminals have appeared to pay much more attention to establishing themselves as regional hub ports. Hence, the feasibility of this form of cooperation proving successful is rather dubious.

### Container transport along the Yangtze River

The Yangtze is the longest river in China. It flows for 2,815 kilometers and, altogether, there are 26 ports along it, including some relatively large ports such as Nanjing. In 1998, the containers transported along this east–west corridor accounted for 80 percent of total containers transported by inland waterway. The container throughputs of the main ports along the Yangtze River are shown in Table 4.11.

The main shipping companies involved in moving cargoes through the Yangtze River are the China Changjiang National Shipping Corporation (China's largest inland shipping group) and the COSCO (the national carrier) with over 40 barges deployed in an extensive network of barge/river ship services.

Fossey (1998) highlights the importance of the Yangtze River by pointing out that the government intends it to become the intermodal corridor which links such inland cities as Chongqing, Changsha, Wuhan and Wuhu. Following the completion of the much-heralded, controversial, and extremely expensive "Three Gorges Dam" project, the flow of the river will be much more controllable and average water depth up to the city of Chongqing (the largest city in China with more than 15 million people) will be raised by approximately three meters. This will allow barges and coastal ships up to a maximum of 10,000

*Table 4.11* Container throughputs of the main ports on the Yangtze River (1986–2000; in TEUs)

| Year | Nantong | Zhangjiagang | Nanjing | Wuhan |
|---|---|---|---|---|
| 1986 | 5,188 | 33,034 | 379 | 238 |
| 1987 | 11,451 | 35,891 | 1,016 | 1,370 |
| 1988 | 17,271 | 38,786 | 4,525 | 3,263 |
| 1989 | 9,435 | 47,985 | 23,946 | 2,552 |
| 1990 | 10,907 | 49,990 | 42,021 | 1,605 |
| 1991 | 19,999 | 60,375 | 51,797 | 2,548 |
| 1992 | 30,046 | 67,017 | 73,303 | 6,205 |
| 1993 | 46,534 | 81,964 | 109,098 | 14,120 |
| 1994 | 65 899 | 94,587 | 126,213 | 16,343 |
| 1995 | 87,179 | 108,063 | 144,657 | 13,766 |
| 1996 | 93,082 | 118,224 | 130,287 | 16,932 |
| 1997 | 71,591 | 119,132 | 130,266 | 18,568 |
| 1998 | 120,362 | 105,051 | 123,218 | 18,659 |
| 1999 | 158,000 | 113,000 | 157,000 | 25,000 |
| 2000 | 182,000 | 137,000 | 203,000 | 30,000 |

*Source*: Department of Water Transport (2000).

dwt to sail from the seaports to Chongqing for the first time. This is the keystone element in the Chinese government's long-term objective to industrialize and open up the country's interior, while simultaneously transforming Shanghai into an international shipping center.

Because of the importance of the Yangtze River corridor and China's obvious determination to develop it as one of its main economic arteries, ports and other facilities along the Yangtze River have attracted much investment and their number and sophistication has increased accordingly.

### The container ports of northern China: Qingdao, Tianjin, and Dalian

The container throughput of Qingdao is greater than that of Tianjin, Dalian and other northern container ports. This is mainly due to: the rapid development of its hinterland economy, especially within the city of Qingdao itself; its natural geographically advantageous situation; the 14.5-meter water depth in Qingdao container port can be utilized for berthing fifth generation container ships over 5,250 TEUs (Chadzynski, 1997); the fact that port users regard the management of the port as highly efficient and effective (Anon, 1997).

The container throughputs of Tianjin and Dalian container ports rank second and third respectively in Northern China. The designed throughput capacity in Tianjin is 1.4 million TEUs and the water depth is

12–14 meters. Dalian Container Terminal is a joint venture between the Port of Singapore Authority (PSA) and Dalian port authority. Its designed annual throughput capacity is 1.15 million TEUs and with a water depth of 12.1–14 meters, it is capable of berthing fifth generation container ships.

Despite highly efficient management in both Tianjin and Dalian container ports, the economic development of their most proximate and main hinterlands has progressed only comparatively slowly in recent years and it is difficult to envisage how it can improve further. This is especially the case for Liaoning province, one of the former centers of heavy industry in the Chinese mainland. Aside from the major portions of each of their hinterlands, these three container ports also access cargoes sourced from or bound for some regions where the hinterlands of the three ports are overlapping. This means that there will be vigorous competition between the three of them, at least for some time into the near future.

### Medium and small container ports in northern China

There are many medium or small ports such as Yingkou and Yantai around Bohai Bay and along the coast of the Yellow Sea. In terms of container transport, they mainly serve as feeder ports for Qingdao, Dalian and Tianjin. They also possess some direct services to South Korea and Japan, although their market share is small (Anon, 1999).

## Discussion

A continuation of the Chinese mainland's policies of economic and political liberalization will mean that the same trends which are now impacting upon the global ports sector will inevitably emerge within the context of the Chinese ports sector.

Indeed, the foregoing analysis suggests that the early stages of some of these trends have already appeared. In particular, having recognized the benefits of private sector participation in the ports and container terminals industry, the Chinese authorities have stimulated what is now a significant financial and managerial commitment to the sector from both China's own commercial private-sector enterprises and from global port owner-operators such as Hutchinson Port Holdings, PSA, P&O Ports and Modern Terminals Ltd. The attraction of foreign finance has even extended to international logistics companies, such as Maersk and Kerry, who have also involved themselves in either or both of the ownership or management of Chinese mainland container ports and terminals (Song, 2001).

Closely associated with the increased participation of private sector interests in the container ports of the Chinese mainland, there is also a burgeoning demand for, and provision of, dedicated container terminals. This also reflects a trend which is taking place worldwide.

It will be extremely interesting to see whether the explosion in China's international trade and the greater liberalization of its trading environment, that are both anticipated to follow China's accession to the World Trade Organization, will provide a simultaneous boost to foreign direct investment in the Chinese mainland's ports sector. Potential investors will surely be attracted by the prospect of booming trade in an economically and politically more liberal and secure business environment where both bureaucracy and inefficiency have been greatly reduced.

Although covering a very large geographically diverse area, it has already become apparent that there is much greater competition at the regional level than was previously the case in the Chinese mainland's ports sector. The further inculcation of competition into the ports sector, which overseas private-sector participation will bring, is likely to further intensify competition. Initially, this is likely to be most acutely felt within each of the three major regional clusters of port activity. However, as time progresses and as extant plans for transport infrastructure improvements come to fruition, this will lead inevitably to a situation where competition within China's ports and terminals sector becomes transnational in scope.

The resolution of the competitive forces at play in the marketplace will be greatly complicated by the fact that many of the new private-sector actors involved in the Chinese market have investments in numerous different ports and terminals, some of which are in direct competition with each other. It will be complicated still further if the growing worldwide tendency toward the strategic alliance of container ports and terminals is adopted and applied within China. Were such a situation of co-opetition (Brandenburger and Nalebuff, 1996; Jorde and Teece, 1989) to emerge within China and elsewhere, it implies a borderless port community with little or no national responsibility and accountability; a phenomenon which starkly contradicts the traditional view of ports as the gateways for a nation's trade and of ports policies as instruments for maximizing national welfare.

Within the wider context of China as a whole, it is the current situation of Hong Kong, which is particularly intriguing. Focusing on China's container ports sector from a purely national perspective, it is clearly the case that Hong Kong's cost-competitiveness is severely

undermined by any comparison to the container ports and terminals of the Chinese mainland, especially those within its own hinterland of Shenzhen (Cullinane, 2000). At the same time, the advantage that Hong Kong possesses in terms of service quality is being rapidly eroded. What may ultimately prove to be the savior of Hong Kong is the role which it plays in allowing China to compete internationally in the ports sector. At least in the short term to medium term, its geographical characteristics, including its physical location, are such that it is has major advantages in seeking to maintain its international status as a major hub port for Asia (see Cullinane and Khanna, 2000).

Attempts by other ports in the Chinese mainland (but particularly those located in the central and northern port clusters) to establish themselves as major hub ports for Asia or, eventually, even to maintain their positions as regional hubs for China's trade, are likely to be severely undermined by the enormous and unyielding competition which they will face from Kaohsiung and Busan.

If the Chinese mainland ports are to compete internationally, efficiency must continue to improve by leaps and bounds. In line with the economic theories of public choice and property rights (Hart and Holmstrom, 1987; Martin and Parker, 1997; Shapiro and Willig, 1990), it is to be expected that greater private-sector participation will improve productivity levels within China's ports. However, there is also a very clear-cut relationship between the scale of operation and productivity (Tabernacle, 1995) and it may well be the case that, with the exception of Hong Kong, China's container ports have left it rather too late to mount a concerted effort to compete in the international market for hub port status. In this context, the market domination of Hong Kong, Kaohsiung and Busan are already too ingrained. In particular, should some political reconciliation be reached between Taiwan and the Chinese mainland, simply the geographical position of Kaohsiung relative to the major internal trade flows of China (Cullinane et al., 2002) will place it in an enviable and dominant market position.

## Conclusions

On the basis of existing policy in the Chinese mainland, this chapter has tentatively proposed a third phase of container port development to continue until 2010. It remains to be seen whether the conditions negotiated for China to become a member of the WTO will bring about such a radical change in China's ports policies that a new phase in container terminal development will be the result.

Irrespective of WTO membership, as things stand and if current trends continue, there is no doubt that container ports and terminals in the Chinese mainland will benefit still further from the injection of overseas investment and expertise. There remains plenty of scope for this to occur. As a result, one can expect to see productivity levels continue to increase and the container operations in ports to become more seamlessly integrated with an ever-improving land-based freight transportation infrastructure.

There are a number of potential influences, which might deflect this extrapolation of the development of China's container ports and terminals, all of which provide a fertile ground for further research. With the focus being the broad outcome of the competition between the different container ports within China, the ultimate aim must be to predict the market share of individual ports. On the basis of the arguments presented herein, it is clear that this is not going to be an easy task. A number of potential influences have been identified which, although capable of being analyzed independently, are also interrelated and, therefore, have a combined effect. In particular, the individual and combined impact of WTO membership on the volume and nature of trade and industrial location; improvements to the transport infrastructure and the level of cooperation between ports would also seem to be areas where further work would prove especially beneficial.

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# 5

# Port-Focal Logistics and the Evolution of Port Regions in a Globalized World

*Enrique Martín-Alcalde, Sergi Saurí, and Adolf K.Y. Ng*

## Introduction

Globalization and the changes in international trade pattern have significant influences on port and shipping industries, leading to alliances and competitions at the regional and international levels. Recently, we have witnessed the consolidation of shipping routes, globalization of shipping lines and cooperation of port operators. In addition, production has moved from being "firm-focal" to "port-focal" (Ng and Liu, 2014), in which the port region plays an increasingly important role. Such a process has comprehensively transformed the port system, and many proximate ports that initially competed with each other have started to cooperate in various aspects and/or establish a more complementary relationship. Such a process has led to the formation of port regions around the world.

Having understood such change, the aim of this chapter is to review the evolving roles of ports in a globalized world, with a focus on identifying the key drivers that prompt this process. The chapter is structured as follows. The second section describes the development of port-focal logistics and its implication to the establishment of port regions. In the third section, the concept of port regions and port strategies in the global market is discussed, followed by an introduction on a general approach of the port evolution, including the logistics needs. The fourth section contains an explanation of the drivers and trends governing the evolution of the port role. Finally, in the conclusion, some important research questions requiring further research will be raised.

## The development of port-focal logistics and its implications on the evolution of port regions

Ports' roles have experienced an important evolution: from being locally focused infrastructure to gateway ports, including the concept of port region. In the past, supply chain was very much a "firm-based" system. Nearly, all the raw materials were obtained from local/nearby suppliers/sources, while the finished products were produced and led within a single firm (i.e., production plant). After then, they were transported to the (largely local or nearby) market for consumption. Under this situation, the process of production within a production unit (e.g., a factory situated at a particular location) was often the most important factor in deciding the price, quality and thus competitiveness of particular products in the market. In this regard, many firm-based theories related to supply chain systems have been proposed in the past decades, such as the just-in-time (JIT) and just-in-case (JIC) concepts. In this case, there was hardly any surprise that the traditional study of logistics and supply chain management had come through an analytical path evolving as an intrinsic domain of the optimization-based disciplines (e.g., operations research, operations management). The study of ports was no exception, where there were substantial research works on ports focusing on port's internal cargo handling capacity and efficiency, and thus its competitiveness against other nearby ports. Of course, here is not to deny that there were some research describing how ports and logistics have evolved, such as port's infiltration in its hinterlands (e.g., Panayides, 2006), and the relationship between ports, logistics and supply chains (e.g., Wilmsmeier et al., 2014). However, until now, there is still a very strong presence of research works that are rather piecemeal or based on the experiences of individual (or even segregated) cases embedded in certain geographical areas strongly influenced by local characteristics and situation (Ng, 2013; Pallis et al., 2010).

The fact is that, however, the supply chain system has become much more diversified in the contemporary world. Technological innovation, the rise of international trade and the global division of labors have ensured that the production and distribution processes have become much more diversified. For instance, the raw materials (in some cases, semi-finished products) could come from sources/regions that were different from where the production plant was located. Moreover, nowadays, it is not a *fait accompli* that all the processes within a production would take place within a single production unit. For example, in the automobile industry, it is quite common that the location of production

of different components of the vehicles (such as engines) is different from where the vehicles are actually assembled. Simultaneously, the final destinations of the finished products have become more diversified. Rather than just local/proximate markets, many finished products are now exported to countries and regions in different continents, notably emerging markets, such as China, India, and Latin America.

Such a change has posed significant implications to supply chains. First, the existence of multi-production plants imply that JIT will take place only if different production plants are coherent to each other and not to disrupt the smooth flow of production (and distribution) of products. However, under the initial setting, ports (or distribution hubs and their facilities) are not under the control of the firms that operate the production plants, and thus uncertainties inevitably occur. This is not helped by the fact that the markets of the products are often more geographically diversified nowadays (as mentioned earlier). With the current and foreseeable future movement of internationally traded cargoes still dominated by maritime transportation, the distribution of finished products will involve the use of ports much more frequently. Finally, the separation between different functions (e.g., production, assembly) imply the need for the stocking of raw materials and semi-finished products[1] so as to absorb certain shocks and uncertainties, that is, the transactions costs, during the production and distribution process, and this would involve costs for the storage of raw materials and/or semi-finished products.

As supported by Liu (2009), all these have prompted producers and shippers to call for the development of more resilient and disruption-robust supply chain systems. Indeed, the above leads to the inadequacy of only concentrating on the efficiency of production units, and "chain efficiency" has become more pivotal. Although transportation and logistics are traditionally separate economic entities, they need to become much more integrated nowadays. In this case, being the interaction points between transport modes and logistics stakeholders, the criticality of ports is becoming more explicit, with global logistics and supply chains gradually moving away from being "firm-focal" to "port-focal". In this regard, it is important to note that "port" does not necessarily only mean seaport (i.e., the interaction point between land and sea), it also can imply (parts of) any nodal point with facilities and personnel which can facilitate the contemporary development of global supply chains (river port, inland port, airport and other types of logistics terminals). Nowadays, it is common knowledge that the competitiveness of particular products in the international market is largely based on

the competitive dynamics between different "chains", and any research works which continue to treat port as an individual, separate entity are clearly becoming obsolete.

Nevertheless, one should not forget that in a segregated supply chain it is far from easy to establish the so-called "chain awareness" among different supply chain stakeholders, and that they may even compete with each other due to diversified interests. This is especially true for countries and regions that have strong institutional frameworks, as exemplified by major emerging economies around the world (Ng and Tongzon, 2010). Needless to say, this may negatively affect the efficiency and integration of supply chains. Given such risks, under a port-focal system, production firms may attempt to exert more control on (parts of) the ports so as to minimize the costs and uncertainties during the production and distribution process, and this is especially true with capital-intensive products involving a high-level technological innovation. They would possess more incentives to acquire/invest (parts of) ports, and transforming them into dedicated facilities so as to facilitate their production and distribution.[2] Simultaneously, these facilities would lower their costs in stocking which was essential to sustain JIT. Quoting Ng and Liu (2014), the port-focal system allows a production firm to be treated as a governance structure, so as to attain its organizational efficiency, notably the minimization of transaction costs. The control of logistics and supply chains by container shipping lines (i.e., transport operators) has previously been widely researched by scholars (e.g., Heaver, 2002; Panayides, 2006). However, the increasing control of logistics and supply chains by production units (i.e., shippers), and their implications, has yet to be widely addressed. This is perhaps unsurprising, given that much of the attention on logistics and supply chains in the past decades has been concentrated on the movement of containers (Lau et al., 2013). Moreover, from the geographical perspective, this transformation implies that ports gradually move away from simply acting as the bridge between one particular geographical region and another. Instead, they start to play more pivotal roles in sustaining the well-being of global productions and distributions. In other words, the "locality" of ports is being challenged.

In this regard, Ng and Liu (2014) has provided a very comprehensive discussion on this topic, notably the development of "port-focal logistics", and its implications on global supply chains. Readers are strongly encouraged to refer to their work for further interest on this topic. Their main focuses are on the "vertical" aspect of evolution (e.g., the changing relationship between ports and other supply chain stakeholders), and

the impacts of such an evolutionary trend on the reconsideration of efficiency (e.g., port benchmarking) and the changing governance structure of ports (e.g., public–private partnership, the corporatization of port authorities, the impacts of public institutions). Nevertheless, the impacts of the development of port-focal logistics are more than what Ng and Liu (2014) have illustrated. The rise of the port-focal trend implies that the production process has become much more diversified. As mentioned, different production units can now be located in different regions and continents around the world. More than that, in many cases, even the production unit itself can be broken up into several components, and re-located to different locations. For instance, in the automobile industry, the production of engines, other parts and the assembling process are often done in different manufacturing plants located in different locations (Guerrero et al., 2014).

The "breaking up" of traditionally unified production units implies the substantial increase of transportation, logistical and supply chain services, including ports. The immediate question is that, given its capital-intensive nature and huge sunk cost of capacity investment nowadays, whether a port can often successfully play the "catch-up" game and build up their capacities (e.g., cargo handling, inventory, transportation, even professional personnel) to absorb such an increase quickly. If not, then an (sensible) alternative solution would be looking at the possibility of horizontal integration, that is, cooperating with nearby ports, including direct rivals, in various aspects, and to develop a more complementary "regional" port system. No matter what, given the rapid development of port terminal facilities (facilitated by the neoliberal ideology on economic policies that directly contributes to substantial devolution and privatization of port infrastructures, management and governance) since the end of the last century, such a changing relationship might be necessary as many ports around the world are already suffering from overcapacity due to (sometimes insensible) speculative investments on facilities in the past decade. An illustrative example took place in the Pearl River Delta (PRD) in southern China, where intensified competition between PRD ports (notably Hong Kong, Shenzhen and Guangzhou), coupled with the de-industrialization of the region, has accelerated the urgency in establishing a more complementary regional port system (Wang et al., 2012). Together with the ever-increasing sizes of container ships, such as the MSC Oscar and Magleby Maersk with maximum container capacities of 19,224 (Lloyd's List, 2014) and 18,270 TEUs (Maersk Line website), respectively, which pose even greater pressure on reducing port calls, the establishment of "port regions" seems inevitable.

Also, one should note that despite being more and more integrated into global supply chains, ports still remain deeply embedded within a particular geographical setting. As stated earlier, port-focal logistics implies a much closer relationship between ports and supply chains, and this often implies that the former gets more integrated into the global economic system. At the same time, however, it means that they are (perceived to be) becoming more and more segregated from the cities and regions in which they are situated. Such a process of segregation is further strengthened by the rise of multinational port terminal operators – in many countries and regions, port terminal operation nowadays is becoming more a "pure business", and managed under a business model dominated by strategic, financial and operational considerations, and this further loosens the already crumbling traditionally close port–city linkage. In this regard, the port of Hong Kong serves as a good example, where Hutchison Port Holdings (initially a Hong Kong-based company) increasingly diminishes its "Hong Kong" label as the firm expands to nearly every corner around the world (Wang et al., 2012). Perhaps inevitably, this may create more potential conflict between supply chains and the regions where ports are located, because while much of the positive externalities of port operations (e.g., cargoes and thus wealth) has been transferred from ports' surroundings to other places (via the supply chains), most of the negative externalities (e.g., pollution, competition of land use) have remained intact, if not increased due to more intensified operations, to the surrounding population (a good example is the competing use of roads leading to the port of Vancouver in Canada by container trucks). In many cases, these problems have intensified, as being "port-focal" sometimes also attracts the agglomeration of economic activities (e.g., industrial parks, logistics parks) – causing considerable spillover effects that do affect not only a single port but also the whole region nearby (including proximate ports). The "vertical" and "horizontal" relationships of ports have created substantial challenges that have become "trans-regional", and naturally, such challenges require a more "regional" approach to address. In fact, the development of port-focal logistics and the evolution of port regions are closely knitted with each other.

## The major port regions in a globalized economy

### Definition and typologies

A port region can be considered as a port system or a system of two or more ports located in proximity within a given area. A port range, such

as the "Hamburg-Le Havre range" in North Europe, can be considered a port region in which, aside from geographical proximity, there is a functional interdependence through sharing sea and land services (Ducruet, 2009).

Port regions vary in function and importance according to the continental context and traffic specialization, which is highly related to regional skills. According to Ducruet et al. (2012), eight types of port regions can be identified through a non-hierarchical clustering analysis (based on port throughput, population, unemployment, GDP, cargo specialization, employment sectors) – namely, deprived, peripheral, metropolitan, industrial, productive, bulky, transit and traditional port regions.

The most relevant characteristics of each typology of port region are briefly introduced as follows:

- Deprived port regions: This type of port region has poor economic performance and higher specialization in primary activities.
- Peripheral port regions: Different from the previous one and tend to be richer and rely dominantly on imports and services suggesting a dominance of local consumption.

Both types of port regions are specialized in liquid bulk traffic with smaller share in total world port throughputs and lack of industrial activities.

- Metropolitan port regions are richer, more densely populated and more service-oriented with lesser production activities, but handling more general cargo.
- Industrial port regions typically resemble maritime industrial development areas which are dominated by production and transformation activities as well as by liquid bulks.

Metropolitan and industrial port regions concentrate noticeable shares of world port throughputs and liquid bulks and share certain features such as economic and demographic characteristics.

- Productive port regions are richer and more industrialized than average while handling more imports and liquid bulks.
- Bulky port regions are better defined by a large share of world port throughputs, specialization in solid bulk traffics, and population density.

This cluster is characterized by being large regions with high GDP with lower international and general cargo traffics than world average.

Finally, the last cluster is particularized by a smaller size and lower liquid bulk traffics than average. In particular:

- Transit port regions are specialized in higher valued goods and industrial activities.
- Traditional port regions are specialized in solid bulk traffics and the primary sector such as the agricultural and mining sectors.

As regards to the above classification, the main port regions per type of cluster are shown in detail in Table 5.1.

*Table 5.1* Main port regions globally per typology

| **Typology of port region** | **Main port regions** |
|---|---|
| Deprived port regions | California and Florida, Hokkaido, Nova Scotia, Hainan, and Sabah |
| Peripheral port regions | Insular and territories separated from mainland such as Hawaii, Alaska, Okinawa, Baleares, Corsica, Ceuta and Melilla, and some states in the United States (Maine, Rhode Island, and Delaware) |
| Metropolitan port regions | Zuid Holland, Hamburg, Provence (Marseilles), Liguria (Genoa), Hampshire (Southampton), Pomorskie (Gdansk), Skane (Malmö), Cape Town, Mumbai, Yokohama, Valparaiso-Santiago, New York, Selangor-Kuala Lumpur, Taipei, Seoul-Incheon, Auckland, and Tokyo |
| Industrial port regions | Barcelona, Bilbao, Nantes, Antwerp, Bremen, Goteborg, Bergen (all in Europe); Houston (in Texas in the United States), Veracruz (in Mexico), Western Australia; and many regions in Korea (e.g., Busan) |
| Productive port regions | Northern Italy, many regions in the United States, and Japan |
| Bulky port regions | Chinese, Indian, Australian, North American regions; Kwazulu-Natal (in South Africa); and southern Brazil |
| Transit port regions | Valencia, East Anglia/Felixstowe and Kent for London; Tangier or Johor in Malaysia; Algeciras (Spain) |
| Traditional port regions | Various regions in Mexico, Chile, Morocco, and Turkey (Ducret et al., 2012) |

According to Ducruet et al. (2012), bulky port regions are the first cluster of ports occupying about 50 percent of world traffic, concentrating about 70 percent of solid bulk traffics and more than 45 percent of general cargoes. At the second place, metropolitan port regions own the 15 percent of world traffic shares, but in terms of liquid bulk and general cargo the share is 23 percent and 20 percent, respectively. Third, industrial port regions which are mainly placed in Europe, Western Australia and Korea share the 12 percent of world traffic, being specialized in liquid bulk (18 percent) and general cargo (11 percent). Thus, it can be observed that deprived and productive port regions have 11 percent and 8 percent of world traffic shares, respectively, being specialized in liquid bulk traffics.

An additional important issue to be highlighted is the fact spatial distribution patterns have been found in terms of recurrences in the location of types of port regions within countries. That is, the specialization and spatial distribution of port traffics is far from being randomly distributed over space.

**Cooperation and competitiveness of ports**

Shipping companies have heightened a greater negotiating power and market share through alliances; on the contrary, cooperation of adjacent ports has been adopted as a counter-strategic option in order to survive on the ever-increasing competitive business environment. In such context, Wang and Slack (2004) point out that in view of the competition, the constituents of a regional port system need to be organically integrated so as to achieve a win–win solution for all the parties concerned.

Port competition can be divided into three levels: intra-port competition between operators; competition between operators from different ports within the same range serving more or less the same hinterland; and competition between port authorities at different levels (local, regional, or national).

Far from reducing competition, many ports recognize that some degrees of coordination with other ports (including competitors) can enhance efficiency and facilitate supply chain integration. In fact, cooperation may help to strengthen competition and to increase the competitiveness of partner ports against outsiders (UNCTAD, 1996). Regional ports become involved in partnership arrangements in order to achieve cost savings (e.g., economies of scale), pooling of resources, risk and investment sharing, uncertainty reducing and trading different complementary resources to achieve mutual gains and eliminate

the high cost of duplication (Barlett and Ghoshal, 2000). In summary, cooperation will lead to better use of assets in terms of efficiency, scale and scope, and to improve competencies and gain positional advantages.

The idea of port networking was also raised by Notteboom and Winkelmans (2001), who recommended that segmentation of markets and coordination of functions can prevent port authorities from wasting scarce resources on inter-port competition. In such context, more and more practical cases in port cooperation have recently been found since the turn of the twenty-first century. The findings shown in Chiang and Hwang (2010) indicate that cooperation between proximate ports positively influences the overall competitiveness of ports located within a particular region. Moreover, competitive intensity and innovation of ports are associated with cooperation and integration of ports in a region.

Unlike the complete absence of port cooperation that may lead to direct and intensified inter-port competition, there are different types of approaches that allow ports to cooperate and reap the benefits of scale economies, even under a competitive landscape. Cooperation has taken several forms, indicating the absence of one best approach. The most important types of cooperation are introduced as follows:

- Port collaboration develops synergies between ports that are competing in the same region. This is often based on ad hoc arrangements that endure for the life of given projects (e.g., joint ventures, temporary initiatives).
- Port integration can be treated as mergers. This usually takes place at a metropolitan scale, where cities with multiple ports merge port authorities under one umbrella (sometimes in terms of a mega structure), but it can also take place across national borders. In this kind of partnership, the minimization of competition can be mandatory (e.g., obligatory strategic plans, nationally imposed), or voluntary (e.g., port boards, port organizations, joint ventures).
- Port co-opetition (Song, 2003) is a mixture of competition and cooperation, thus having a strategic implication that those who engage in the same or similar market(s) should "collaborate to compete" as a win–win strategy, rather than a win–lose one. It takes place when ports work together for parts of their business that they do not have competitive advantages, and they can share common costs while remaining competitive in other areas.

In such context, and according to UNCTAD, highly suggested areas for port cooperation are technical training, harmonization or exchange of tariffs and information for common service (Li and Oh, 2010).

In order to provide some examples, Table 5.2 illustrates most relevant cases of different types of port cooperation around the world. It should be note that this list is not exclusive.

The examples in Table 5.2 reveal that any cooperation between ports in a proper area can be beneficial to all the ports concerned. Cooperation can lead to advantageous results, such as risk reduction, economies of scale, rationalization, technological exchanges co-opting or blocking competition, and overcoming government mandated trade or investment barriers (Song, 2003).

*Table 5.2* Illustrative cases on port collaboration, integration, and co-opetition during the early 2000s

| **Collaboration** | |
|---|---|
| Ports of Shanghai and Ningbo (China) | Shanghai and Ningbo are having mutual benefits. Ningbo port has an advantage of cost, natural deep-water berth and major bulk handling service. Shanghai port enjoys an advantage of management, financing, and container handling service.<br>Shanghai did not have sufficient water depth, so Ningbo was arranged as a complementary port, which helped Ningbo to gain awareness from the shipping companies.<br>Therefore, these ports set up a joint venture (each side holds 50 percent of the shares) in 2010, supported by financial participations and institutional coordination, to invest in transport, shipping and ports, energy and related areas. In fact, the two ports have started to discuss cooperation for future investments and operations (Merk, 2010). |
| Ports of Amsterdam and Rotterdam (the Netherlands) | These ports that compete in the field of break-bulk began collaboration on the port base project as of 2009 in order to become the national platform for all ports and airports within the foreseeable future and facilitate information exchange between companies and authorities. |
| Ports of Los Angeles and Long Beach (United States) | These ports signed a joint regulation for the Clean Air Action Plan for both ports. |
| Ports of Koper (Slovenia) and Trieste (Italy) | These ports were discussing cooperation on joint bids for EU funds, navigational safety, and possibilities of enhancing hinterland coordination by linking the two ports by railway to create a common entry point in the northern Adriatic region (Brooks et al., 2010). |

*Table 5.2* (Continued)

| | |
|---|---|
| **Integration** | |
| Port of Vancouver (Canada) | Single entity which would become the second largest port in North America. After merging, each port has a specialized area, although there is overlap between them.<br>The main target was to attract higher volumes from the fast-expanding Asian markets and be able to compete more effectively with US gateways. |
| Yangtze River Delta (YRD) (China) | The YRD International Shipping Center by the China government, in order to group container terminals and allocate its capacities properly to prevent duplicated constructions, as well as raise the international competitiveness of Chinese ports as a whole (Wang and Slack, 2004).<br>In 2010, the national government developed a regional port system strategy in which Shanghai is the international shipping center and Ningbo-Zhoushan is the regional hub supported by other feeder ports in the YRD.<br>The Ningbo-Zhoushan port is the result of a merge between Ningbo port and Zhoushan port in 2006. |
| Ports of Normandy Authority (France) | The ports of Caen-Ouistreham and Cherbourg merged in 2007. |
| Ports of Osaka, Kobe, Sakai-Senboku and Amagasaki-Nishinomiya-Ashiya (Japan) | The Japanese government decided to merge the three ports into one (Hanshin Port) in order to improving international competitiveness and luring liner services (Chiang and Hwang, 2010).<br>The aim of the merger is to win business by having one port tariff to cover several calls at separate terminals. |
| Copenhagen Malmö Port AB (Denmark and Sweden) | Voluntarily merge across borders between Denmark and Sweden in 2001 in order to realize economies of scale and improve land use planning, marketing, financial resources, operational efficiencies and interactions with the shipping industry. |
| **Co-opetition** | |
| Ports of Seattle and Tacoma (United States) | They did cooperate on infrastructure, transportation, regional promotion and environmental issues. The joint planning and cooperation was vital and increasing competition from Canada's western ports. |
| Pearl River Delta (PRD) (China) | The PRD port system has clearly evolved from a one-gateway hub to two-gateway port and then to a three-port competition among Hong Kong, Shenzhen and Guangzhou ports. The overall effect is a regionalization with specialization.<br>In this new context, the three ports have particular roles, but will retain their interdependencies (Liu et al., 2013). |

On the other hand, integrating transshipment hubs in regional shipping networks may lead to increase the focus of market players on logistics integration. Shipping companies used to consider effective network configurations that tend to focus on major gateways and intermediate hubs (Rodrigue and Notteboom, 2010). Therefore, small or medium-sized ports may realize that at long term it would be more beneficial for them to improve their integration level with an intermediate hub.

**Multi-port gateway regions**

Notteboom and Rodrigue (2005) was a pioneer in proposing the concept of port cooperation through their port regionalization concept. It consists of grouping ports within the same gateway region to form multi-port gateway regions, where the locational relationship to nearby identical traffic hinterlands is major criteria to cluster adjacent ports (Notteboom, 2009). A gateway represent the maritime/land interface in which significant logistical clusters have become with the accumulation of terminal infrastructures, such as ports, rail terminals and freight distribution centers, with the aim to ensure continuity along supply chains around the world.

From previous analysis and desk review, the major multi-port gateway regions in the current major economic powerhouses can be summarized as follows:

- *Western Europe*: The main multi-port gateway regions are placed within the Le Havre-Hamburg range, being the Rhine-Scheldt Delta (Rotterdam, Antwerp, and Zeebrugge ports) and the Helgoland Bay (north German ports) the most important regions. The market share of the Rhine-Scheldt Delta represents 44.3 percent of the total European container throughput, whereas the Helgoland Bay represents about 18 percent in 2008. Alternatively, Spanish Mediterranean ports represent about 7–8 percent of container cargo within Europe.
- *East Asia*: Particularly in China, multiple port gateway regions have been developed in recent years, largely imposed by the "Chinese Coastal port layout plan" imposed by the Chinese Ministry of Transport in 2006. Based on economic development and features of different regions, the relationship of ports with the same region and economic rationality of major cargo transportation, the coastal ports can be divided into five major port ranges, namely the Bohai Rim, Yangtze River Delta (YRD), southeast coast, Pearl River Delta (PRD), and southwest coast (Wang and Ng, 2011).

  Ports within each port region were expected to carry out functions which were complementary to each other. But, only the YRD

(Shanghai, Ningbo and Lianyungang ports) and PRD (Hong Kong, Shenzhen and Guangzhou ports) can be categorized as multi-gateway ports regions due to their trade development, government guidance and peripheral challenge because of the decentralization of the container system and the service network expansion of the shipping liners (Liu et al., 2013; Pan et al., 2014).

- *North America*: There are fewer gateways, while port ranges are comparatively less developed. There is a certain cargo concentration level in the container port system emanated from the increasing dominance of Long Beach/Los Angeles as the major gateways along the Pacific coastline, mainly catering for Asian import cargo. In 2006, the shares of the Los Angeles/Long Beach and New York/New Jersey port clusters were about 38 percent and 14 percent, respectively (Rodrigue and Notteboom, 2010). In addition, we can characterize four major port ranges along the Atlantic coastline: the upper range (Halifax and Boston ports) handles a low containerized volume; the mid-range shows a complex and rich hinterland (Boston–Washington corridor); the New York/New Jersey and Hampton are the two leaders of this region. Finally, the lower range is an emerging port range with a fairly uncongested access to hinterland, centering on the Savannah/Charleston port cluster.
- *South America*: Particularly in Brazil, four distinct ranges or multi-port gateway regions can be categorized. From north to south, the main regions are Amazon Basin (from Belém to Manaus and Porto Velho), Northeast Basin (from Itaquí to Salvador), Southeast Basin (servicing the Belo Horizonte, Rio de Janeiro, Sao Paulo, Curitiba, and so on) and the Far South Basin (Santa Catarina/Rio Grande do Sul). The largest container ports in Brazil are located in the most urbanized economic core regions in the southeast and in the far south, which are dominated by the port of Santos in Sao Paulo.

In addition, the River Plate Basin comprises a large geographical region of four countries with a concentration of three important ports: Buenos Aires (the biggest one), Rio Grande and Montevideo. However, this port range takes an intermediate position in the global shipping network.

## The main drivers of port evolution and the trends governing port dynamics

The evolution from firm-focal production to port-focal logistics, and the rise of port region, can be explained basically as a result of some

major drivers and trends. To make clearer and more precise analysis, the description is focused on container sector. The majority of conclusions can be easily extended to the rest of the shipping sectors, but introducing some changes from the idiosyncrasy of each of them. For that, the starting point is the fact that the shipping network has shaped port systems (e.g., Lui et al., 2013), and so the drivers governing the shipping networks can provide part of the answer. The other parts come from the hinterland side and the ports in themselves.

Following Rodrigue (2010), there are six main types of drivers acting on transportation: demography and social changes, energy and environment, technology, economy, finance and policy. The impacts of these drivers are indicated in Table 5.3. In general terms, the demographic drivers will still keep increasing the international trade. The economic situation is increasing the short-term risk of the shipping business, making higher the investment cost and making then easier the consolidation of the sector, as a reaction. The energetic cost will play an important role in any modal shift, due to its importance in the transport cost. Finally, regarding policy measures, the most important impacts are allocated in the efficiency of the transport system, reduction of the administrative efforts and climate change.

A global view of port's evolution will help to particularize these drivers and trends to the specific case of the container sector. Wilmsmeier and Notteboom (2011) develop a four-phase model of shipping line development, which can be used to explain the port evolution (Wilmsmeier et al., 2014). In the first phase, shipping service is one-to-one with local or regional cargo and high government involvement in the port sector. In the second phase, the region gets better overseas markets. A first hub-and-spoke structure appears and the connectivity to overseas markets makes the region more attractive to international shipping and port operators, process in which there is a change of port regulation and governance model to make this entrance easier. In the third stage, there is more traffic growth consolidating the hub-and-spoke network and an inclusion of other ports into the system. In many cases, in this stage, the role of government has been substantially reduced. Finally, in the fourth phase, the market size allows shipping lines to offer services from these ports to the overseas and the hub seeks more connectivity to ports without access to overseas regions. It is noted that the main elements describing each phase are as follows: the topology of the shipping network (from one-to-one to hub-and-spoke with several levels of complexity), shipping companies, terminals operators, port regions, and port governance.

*Table 5.3* The major drivers of port evolution and their impacts on transportation

| Type of driver | Driver | Main impact on transportation | Main affected variables of shipping sector | Long-/medium-/ short-term impact |
|---|---|---|---|---|
| Demography and social changes | Growth in population | Growth in transport demand | More frequency, reduction of ship cost (economies of scale) and less incentive for consolidation | Long |
| | Ageing of population | Demand, with not clear the direction<br>Changes in mobility | Frequency and ship cost | Long |
| | Urbanization | Higher transport demand, long distance and optimization of transport chains | Changes in transportation chains since longer distances are expected; better port connections and efficiency of infrastructures are required | Long |
| | Change in work patterns | More international trade and movement of freight | Larger ships and higher frequency | Long |
| Energy and environment | Fuel cost | Change in transportation cost | Higher incentive for cost saving and consolidation | Long |
| | Climate change | Policy support for environmental friendly transportation modes | Increase support of the maritime sector against other transportation modes | Short and long |
| | Biofuels | Environmental advantages and more cost-effective | More cost-effective | Medium |
| Technology | Information and communication technologies (ICT) | Application to improve transportation operations and to reduce administrative procedures | Improve reliability, time turnaround and flexibility | Short and long |

*Table 5.3* (Continued)

| Type of driver | Driver | Main impact on transportation | Main affected variables of shipping sector | Long-/medium-/short-term impact |
|---|---|---|---|---|
| Economy | Economic growth | Increase transportation demands | Higher frequency, reduction of ship cost (economies of scale) and less incentive for consolidation | Medium and long |
| | Globalization of production and consumption | Increase transportation demand and distances (where maritime transportation is more competitive) | Frequency, reduction of ship cost (economies of scale) and less incentive for | Short and Long |
| | Uncertainty growth | Demand becomes more risky and increases the risk of the business and the investment | Incentive for consolidation and increase of the investment cost | Short and long |
| Finance | Financial instruments | Fewer financing possibilities and more expensive | Incentive for consolidation and increase of investment cost | Short and medium |
| Policy | Regulation | Safety<br>Environmental<br>Security | Increase average cost<br>Increase average cost<br>Increase average cost | Short and long<br>Short and long<br>Short and long |
| | | Market | Increase competition in the shipping market, encouraging consolidations and efficiency | Short and long |
| | Geostrategic interest | Investment locations and trade agreements | New markets for shipping and port sector | Short and long |

*Source*: Based on Rodrigue (2010).

How can these elements explain the dynamics involved in the four phases? Figure 5.1 can help to answer this question, where the relationships among the main variables involved in the port development are represented. For the shipping side, a complementary reaction of shipping lines against competition at the international market is more efficiency (reduction of the average cost), as well as a consolidation of the market (alliances, mergers, etc.). Improvement in efficiency has been possible through larger ships and hub-and-spoke shipping network (Ng, 2006). More cargo volume (from more demands or/and more sector consolidation), the better use of these both factors. As a result, the shipping sector has defined a self-reinforcing loop with demands: more demands allow a better competitiveness of the sector through efficiency and consolidation. On the landside, there is a similar self-reinforcing behavior. Once a port is able to improve the shipping connectivity, mostly because of some significant volume of cargoes in the port's hinterland, the port becomes more attractive for international terminal operators and shipping companies. There is an increase of the logistical services in the hinterland (e.g., distribution centers, railway services), making possible a growth of the volume of cargo and, hence, making possible a better use of the economies of scale and density. As a result of both self-reinforcing loops, a key conclusion from Figure 5.1 is that "the richer gets richer" in terms of port development.

Following Figure 5.1, the trends in the shipping and port sector are governed by the dynamics of four main variables, namely consolidation of the shipping and port industry; economies of scale in container vessels; evolution of shipping network; and port regionalization.

Regarding the consolidation of the shipping sector, during the last two decades, an important consolidation tendency has been occurred in different formats, such as consortia and strategic alliances. Currently, the three largest shipping lines – Maersk, MSC and CMA-CMG – concentrate nearly 40 percent of the world's container capacity (in terms of TEUs) (Alphaliner, 2015). The use of large container ships as a result of the growing market and a decrease of economic and financial risk from cooperation serve as the main reasons for such a tendency (Evangelista and Morvillo, 2000; Ferrari et al., 2008).

The same factors governing the dynamics of the shipping sector help to explain the consolidation process in the port sector. Here three stakeholders play the major roles: stevedores companies, shipping lines and financial holdings. According to Nottebom and Rodrigue (2010), with market growth, stevedores companies expand their business to other ports (from local to regional/international levels) but

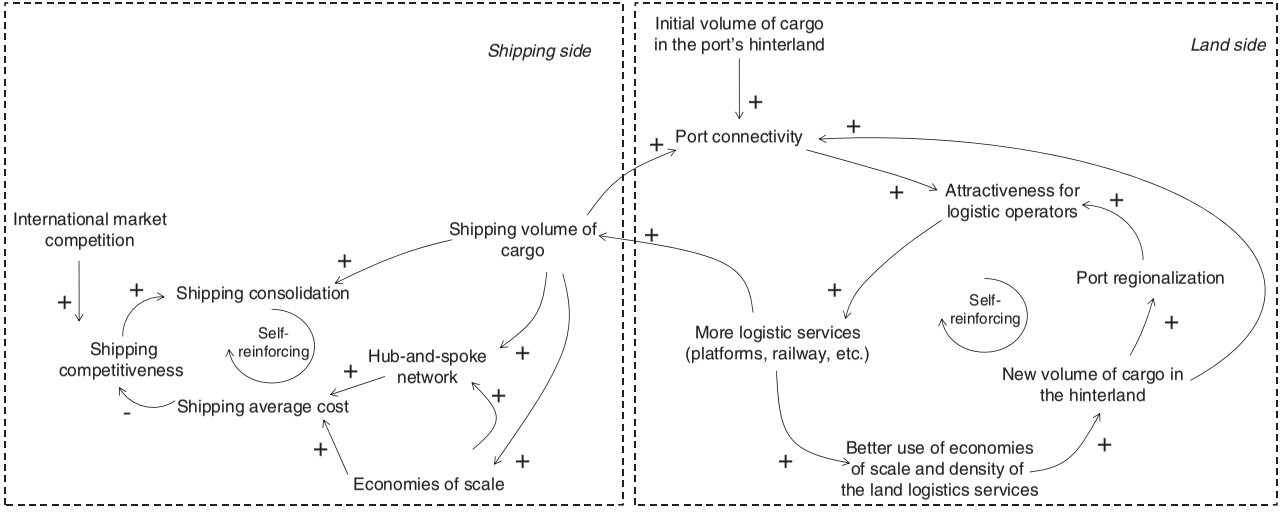


*Figure 5.1* Dynamics of the port and shipping container industries

*Note:* The positive signs imply that there are position correlations between connected variables.

keeping themselves as port terminal operator (horizontal integration). Illustrative examples include Hutchinson Port Holdings (HPH), Port of Singapore Corporation (PSA), and Dubai Ports World (DPW). This is not the case of some shipping lines, of which they have extended their activities to the port sector (both public and dedicated terminals), such as Maersk (and its APM Terminals). This vertical integration allows shipping lines to ensure their port performance need, key element for shipping business, especially with the mega vessels, and to take over the market expansion. In the last decades, the competition for cargoes has transformed the competitive framework: from the port perspective to the logistics corridors, making a vertical integration (investing in the port and the hinterland) necessary for the maritime shippers in order to take over the market. Of course, this has also facilitated the globalization of production and accelerated the process of developing port-focal logistics as stated earlier. All these important port expansions required huge investments, not just because of the increase in the number of terminals, but also the fact that terminals are becoming more automated, that is, more capital-intensive. In addition, the long-term expected revenues have made attractive the shipping and port sectors. Both factors explain the entrance of the financial holdings, through acquisitions, mergers and reorganization of assets, to shipping and port industries. Morgan Stanley Infrastructure serves as an illustrative example. The horizontal and vertical integration in the shipping and port sector have been reflected in the shipping network. Hence, port selection is based not only on the physical characteristics and location of ports, but also on their efficiency, hinterland access and the market strategies of shipping lines (Wilmsmeier and Notteboom, 2011).

Another element involved in port evolution is the shipping network. An interesting perspective comes from the topological analysis, which has become a relevant issue in the literature. In Tran and Hassis (2014), we can find an extensive recompilation of the main references on the shipping network analysis, such as Ducruet and Notteboom (2012), Ducruet and Zaidi (2012), and Kaluza et al. (2010), for instance. Within the four-phase model of port development, shipping network evolves from one-to-one maritime services to different level of complexity within a hub-and-spoke network. Through the empirical analysis of the container shipping network, two properties can be observed, namely small word and scale-free (e.g., Ducruet and Zaidi, 2012). "Small word" refers to the fact that, in most networks, there is a short path between any two nodes, including large-size networks. This property is often associated with the existence of clustering, which is the case

of the shipping network sector (see, for instance, Pais et al., 2012) and allows an easy diffusion of connection among the nodes. On the other hand, "scale-free" property appears in network in which all possible links have the same probability. In such a network, the degree of distribution (a degree of a node is the number of links connecting this node to others), conceiving each port as a node and the maritime connections the links, follows a power-law. For instance, In Hu and Zhu (2009), an interesting empirical analysis of the shipping container cargo can be found. The authors shown that the degree distribution of the container network, $P(k)$, follows a power-law distribution with exponents of –1.7 and –2.95 (depending on the number of nodes included in the analysis), that is, $P(k) \sim k^{-1.7 \text{ or } -2.95}$. The concept "scale-free" comes from the fact that this type of functions has the property to keep its functional form within the scales. In practical terms, power-law implies that a few ports dominate transcontinental connections (usually known as the "hubs"); for instance, the results in Hu and Zhu (2009).

One of the key aspects to understand the dynamics in the shipping and port industries is the economies of scale of the container vessels. The vessel technology (including ship architecture) in itself can explain why the average cost reduced when the ship size increases. The exponential evolution of the vessel capacity during the past four decades is more than enough to explain the intensity of this economical property: from 3,430 TEU (L "lica" class) in 1981 to 18,000 TEU ("Triple E" class) nowadays. Despite such growth, some factors can limit the economies of scale, notably the fact that fewer ports manage to operate with such mega vessels, as well as the need for more port timing and the need for highly capital-intensive terminal infrastructure and superstructures.

Regarding the landside, a key trend is the regionalization of the ports. Port competition has experienced an evolution of its framework as indicated above: from being strictly among ports to at logistics corridors level, in which several ports can be involved in the same corridor – for instance, the Asia–Europe trade through the northern European ports or through the Mediterranean Sea. This has necessitated ports to go beyond their own facilities and, hence, to integrate the port to the rest of the logistical chain by using logistical platforms, providing rail and waterways services, improving port connectivity and so on. Ports have to work to become an integral part of a logistical corridor, as indicated in the first section of the chapter, becoming port-focal logistics. In this regard, Hayuth (1981) defines a five-phase port development model: namely conventional port; container port; port concentration and inland penetration; load center; and port decentralization (when port congestion can result the relocation of port traffic to smaller ports).

Later, Notteboom and Rodrigue (2005) added port regionalization as the sixth phase (as explained in the previous sections). This last step goes in the direction of desegregating the port-focal logistics of their closes hinterland, as indicated earlier.

Based on literatures Notteboom (2010), Liu et al. (2013), Tran and Haasis (2014), Heaver at al. (2000), Wang and Ng (2011), and Wilmsmeier et al. (2014), the main drivers governing the port evolution can be identified:

- The alliances of shipping companies e.g., M2, O3, CKYHE and G6 make possible to become decisions makers on call ports and force ports to play an active role on the landside to have more influence on the logistics corridors and, therefore, on shipping lines' port selection.
- The vertical integration of the shipping companies, expanding their business in some cases to the port and landside.
- Expansion of the international trade.
- The concentration of cargo around the closer hinterland of ports, such as the existence of important manufacturing clusters. This is the case of the most of the ports located in East Asia, where strong manufacturing bases are located.
- Institutional aspects: often port development is dependent on how the port is embedded in the local and regional institutions, influencing on the port investment and port governance.
- Port governance: for instance, around Europe, important changes have been taking place in making port becoming more autonomous.

## Conclusion

The chapter has reviewed the development of port-focal logistics, and its implications on the evolution of port regions in a globalized world. However, a number of research questions are yet to be satisfactorily addressed. First, what will be the transformation pattern of port networks? Until the past decade, as mentioned earlier, many port terminal facilities have been privatized (or corporatized) and are operated by terminal operators (e.g., HPH, PSA, and DPW) or by shipping lines (like Hanjin, Evergreen and Maersk) as dedicated terminals. How do the increasing participation of shippers on port facilities would affect port, and indeed shipping, networks? Specifically, will it (and if so, in what ways) affect the established port hierarchy as we have witnessed nowadays? Will it lead to a new wave of port growth (Guerrero and Rodrigue, 2014), or even the evolution of a completely new port system? Second,

what are the implications of port-focal logistics on the geographical setting of ports? As mentioned earlier, while the "locality" of ports is being challenged (to become more "chain-oriented"), ports would remain firmly embedded within a particular region, and this might create some conflicting issues on the dynamics and relationship between ports and cities/regions (e.g., urban congestion). Inevitably, this leads us to the third question: To what extent does such a system sustainable? The establishment of facilities dedicated to particular industries and productions might lead to the ports to become more reliant on the production and supply chains. Given the rather diversified nature of productions, of which many firms often tend to identify alternative locations for productions in the future,[3] how would ports be able to absorb such shocks, in case the production plants move to alternative locations (and so the facilities established in the ports become obsolete)? This chapter serves as an ideal platform for further research on these queries.

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## Notes

1. Most production nowadays involve a mixture of both JIT and JIC (Ng and Liu, 2014).
2. This is facilitated by the global trend of privatization and the establishment of public–private partnership in port terminal operations.
3. This is mainly due to the minimization of costs, as well as other institutional factors, such as the desire to stay away from organized labor unions. For further details, see Kaneko and Nojiri (2008).

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# 6

# Port Governance as a Tool of Economic Development: Revisiting the Question

*Mary R. Brooks*

## Introduction

There was a trend toward the devolution of government-owned entities like ports during the 1980s and 1990s. Governments purposely devolved responsibility to the private sector in the belief that social welfare would be improved. Types of reform efforts spanned the spectrum. For instance, the United Kingdom essentially privatized its key port infrastructure while in the United States governance changed only in a few ports. In Canada, port reform was accomplished via Canada's National Marine Policy of 1995. The intention in Canada was to secure the benefits of commercially driven business decision making in organizations previously run by governments while securing compensation for prior taxpayer investments. The Government of Canada had already begun the process of devolution for airports in 1987, and ports were the next logical step.

For any devolution program to be successful, the government must create appropriate governance structures and processes for the devolved entity. The Board of that devolved entity then responds to the new governance regime and, over time, implements its strategy for growth and development. If successful, there is little incentive for governments to make wholesale changes to the regulatory structure it has set in place for ports; if not, governments are tempted to make incremental or substantive changes to the imposed governance structure in which ports operate (Brooks and Pallis, 2008).

It has been argued (Parr, 1981) that airports and ports are "growth poles" that can serve as economic catalysts to attract industry to locate and/or invest in their vicinity. Goss (1990) concluded that ports drive

economic development as they increase their market area and that drives prices down for their users. On the other hand, Ferrari et al. (2010) noted that increasing the overlaps in port hinterlands diminishes the impact on economic development. Clearly, this area of research is still being debated.

For many communities, the shift of governance to locally controlled entities is viewed as a progressive policy step to empowering local community economic development. Whether that economic development does, in fact, materialize is a secondary question but not one addressed here. The focus of this chapter is to review the changes in port governance over the past decade as well as to determine whether the concept of community-focused governance has found support in the setting of conditions by government. The chapter begins by defining the terms "governance" and "stakeholder".

Free-market economists use the term "governance" to capture the adoption and enforcement of rules governing conduct and property rights, but the reality is that governance is often confused with "government". Governance may be imposed by governments or adopted voluntarily by businesses, groups or associations or even informally by citizens organizing themselves for change when they adopt systems, structures, and processes for a common purpose. Governance is a notion that can be applied to more than just corporations. While governance principles are applicable to all relationships between businesses and their shareholders, they are also suitable to relationships between governments and their voters and taxpayers, between public/private agencies and their stakeholders, and between organizations and those who establish them to undertake activities on their behalf. In the case of ports, and this chapter, the legislation and regulations imposed by government on a port define its governance.

Each port is subject not only to the governance imposed by government, but also to whatever governance systems, structures and processes it chooses when it establishes managerial practices and policies. Of course, the members of the port's governing body may change these over time in accordance with the thinking of the day. This is its corporate governance.

In corporate governance, the port organization has a fiduciary responsibility to serve the objectives of the corporation in the interests of its shareholders (or members, if established as a not-for-profit organization). As may be imagined, there are as many variations in port governance as there are ports. Brooks and Cullinane (2007), in a study of the objectives, activities, and structure of 42 ports found 34 combinations

or models of governance and argued that the use of "public", "private", and "mixed" to describe port governance was an over-simplification.

Sternberg (1998) argued that it is a mistake to criticize corporations for failure to achieve public policy objectives or to accord greater importance to their stakeholders on the assumption that stakeholder participation will provide for better governance. This raises a question: What is a stakeholder?

Stakeholders are organizations or groups of individuals affected by the decisions of the corporation and include, for example, employees, customers, and the greater local community of citizens as well as advocates for the environment or for product safety. When an organization like a port is devolved from government ownership and control to a governance model that involves more local and more private sector participation, stakeholders (including citizens/taxpayers) raise concerns that their interests will no longer be considered, and that society's interests will be ignored in the pursuit of greater efficiency and profits. It is argued that stakeholders enjoy greater protection when government manages an organization than when it is managed by a private sector entity.

In the traditional private sector model, corporate governance is the structure, roles, and responsibilities that provide the means by which the organization is managed as an economic entity, based on the objectives of the corporation. In devolution, each devolved entity faces an identity crisis: does it co-opt the objectives of government, or identify its own in keeping with the views of the newly created Board, or co-opt those of community stakeholders? The decision about which path to follow might depend on what the devolving government establishes as governing principles in legislation or regulations or what the newly established Board chooses to set as objectives, if its goals are not identified in the governance principles set out in such legislation/regulations. A particular organization may choose to incorporate broader social responsibilities as part of its vision, or may opt to serve only its owners. The driving force is one of strategic intent on the part of the Board or those with the authority to govern the organization.

The World Bank Institute's (2014) definition of governance reflects this broader applicability:

> *Governance consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of*

*citizens and the state for the institutions that govern economic and social interactions among them.*

There is no shortage of material for debate on corporate governance in the private sector. An early compilation by Keasey et al. (1999) provides comprehensive coverage. Its content is entirely appropriate and applicable to private sector ports. In fact, corporate governance principles for ports that have been fully privatized (e.g., British Associated Ports) are quite clear. In private sector Boards, management serves at the pleasure of the Board, and the Board is "confirmed" by shareholders at the Annual Meeting but management "tenure" in the position is never assured. For ports that follow a public port model only (like US ports), there is also little ambiguity; here the port's management is mandated to act in the best interests of those who appoint management, be they politicians or local councils. For example, the ports of Los Angeles and Long Beach, which together controlled 40.6 percent of the import TEUs handled at US ports in 2012 and 28.0 percent of the export ones (Maritime Administration, 2014), are managed by Boards responsible to their respective municipalities and serve the objectives their local political masters establish. If management does not execute strategies as expected, or the political situation changes, port managers can be replaced as was seen in 2013 when newly elected Mayor Garcetti of Los Angeles asked all general managers to reapply for their jobs when he took over as mayor; the Executive Director of the Port of Los Angeles "chose" to retire (Press-Telegram, 2013).

This chapter examines the Canadian corporate governance code, applicable to Canadian publicly traded companies, to illustrate a potential set of principles of good governance that a devolved port might adopt or that a government might incorporate into its devolution policies. It then explores how these have changed since their introduction in 1994. The compatibility of governance codes with the achievement of economic development objectives a port might have is then discussed. This is followed by a discussion of the more recent literature on port governance and on stakeholder involvement in port activities and the critical governance issues faced by port boards today, in order to advance our understanding of improved port economic development outcomes.

## What are the principles of good governance?

Recognizing that good governance practices are essential in delivering value to shareholders, the Toronto Stock Exchange (TSE) developed a set of 14 governance principles in its landmark 1994 study (also known as

the Dey Report) on corporate governance practices in publicly traded companies in Canada. The Dey Report was certainly not the first, or the only, investigation into corporate practices. Subsequent to its release, there was a fruitful discussion of governance issues in publicly traded companies (Conference Board of Canada, 1998; OECD, 1999) and in government (World Bank Institute, 2014). The Securities and Exchange Commission in the United States focused considerable energy on establishing standards of reporting practice and disclosure by Boards and management. Carver (1990) examined governance in non-profit boards and the Cadbury Commission (1992) explored governance issues in UK publicly traded companies.

In the early 2000s, corporate governance came under pressure with the catastrophic failure of Enron, resulting in a major overhaul of US corporate governance legislation with the introduction of the Sarbanes–Oxley Act of 2002 (Public Law 107–204, 116 Stat. 745), with its particular focus on disclosure, corporate financial audits, and rules governing their performance, among other things (Brancato and Plath, 2003). In Europe, there was significant examination of governance practices for publicly traded companies as well, documented by Plath and Wilde (2004). While many countries re-examined their corporate governance regulations for private corporations, in Canada there were adjustments to regulations and more careful oversight by authorities but no substantive changes with respect to either corporations or ports. The Dey Report guidelines were, however, embraced.

Codes of Governance, as guidelines of this type are known, have been widely implemented to protect the rights of shareholders (Aguilera and Cuero-Cazurra, 2000), and stakeholder theorists argued in the strategic management literature that their scope should be broadened to include greater social responsibility content. In publicly traded companies, shareholder voices seeking improved rights have become louder but do not always succeed in getting any change.

This chapter primarily examines the 14 principles established by the Toronto Stock Exchange (TSE-14) as voluntary guidelines to Boards as these form the basis for good corporate governance practice for many Canadian companies and non-profit organizations. It is assumed that these principles are broadly applicable to other jurisdictions but that each jurisdiction will, as part of its due diligence in devolution implementation, examine those it may wish to incorporate into the regulatory environment in which the devolved entity will operate.

The most important word in the above paragraph is “voluntary”. In developing the TSE-14, the Toronto Stock Exchange recognized that not

all guidelines would be deemed appropriate by the Boards of the companies on the exchange. Suggested practice is to incorporate into the Annual Report a list of the guidelines and the Board's acceptance or rejection of each. This acceptance or rejection must be accompanied by a discussion of actual performance in the case of the former or rationale in the case of the latter; in other words, the company should explain how its practice complies with or differs from each guideline, or why the guideline does not apply. The guidelines provide examples of good disclosure, using the names of fictitious companies and individuals to provide tips on how to communicate with the company's shareholders and potential investors (TSE, 2014). This part of the Annual Report is viewed as a means by which shareholders can evaluate the philosophy of management and make an informed decision about investing in the corporation. The TSE-14 principles have been adopted in Canada by many non-profit Boards as well and therefore provide a focal point for the discussion below. Furthermore, there is the added benefit that the TSE conducted a review of corporate practice in Canada five years after the publication of the guidelines (TSE, 1999), and the principles as they exist at the end of 2014 are also published (TSE, 2014). The Appendix provides a summary of the principles, their rationale, and the 1999 findings on the extent of their adoption by Canadian publicly traded companies. It was reviewed against the current principles in December 2014.

A review of the Appendix highlights that relatedness is a key theme embodied in the TSE-14. Basically, an inside director is one who is an officer or employee of the corporation and, therefore, is related. Outside directors are usually unrelated, but if they have material interests, provide services to the corporation or otherwise benefit from the activities of the corporation, they are deemed to be related. A conclusion that should be drawn is that independence of directors from management is a basic tenet of transparent corporate governance in Canada, and one intended to serve the interests of the shareholders as opposed to the interests of management.

As is evident from the Appendix, for-profit corporations in Canada in 1999 were having difficulty meeting the ideals established by the Dey Report (the final column of the Appendix shows incomplete uptake of the principles). Kazanjian (2000) noted that TSE Guideline 5, the requirement to assess Board effectiveness as a whole, the effectiveness of its committees, and the contribution of individual directors, was ranked last in terms of compliance in a survey of more than 600 TSE-listed companies; less than 20 percent of corporations had any formal processes in place to evaluate performance on this guideline.

Furthermore, benchmarking against the TSE-14 did not happen to the extent anticipated. The Dey Report provided an ideal, as well as a Code of Governance Practice respected by many shareholders, but it did not instill the discipline that many had expected. For our purposes, it did, however, provide a yardstick for discussion of good governance practice for both private and not-for-profit companies.

Perhaps most interesting is that column 1 in the Appendix indicates that these same 14 principles are still the cornerstone of Canadian corporate governance today (TSE, 2014). Furthermore, the TSE has better explained to publicly traded companies what it considers to be good governance disclosure by producing a communication guide (TSE, 2014). In a related vein, since the Dey Report, the Institute of Corporate Directors (2014) has developed an educational and professional development program to enhance the professionalism of corporate governance and underline the behaviors expected of Directors. Osler Hoskin & Harcourt and the Institute of Corporate Directors (2014) note that the original Dey Report guidelines could be made more effective if Boards would consider adding two more guidelines – first, that Boards focus on ensuring the sustainability of the organization and, second, that Boards become leaders in establishing the ethical culture of the organization.

One critical aspect of governance systems is the identification of the role played, or to be played, by each of the parties involved. As governments proceed to devolve ports from being government-owned and government-controlled bodies to more business-like models, it is necessary for them to examine why private governance models work; the role to be played by each of the parties needs to be understood. If the new governance model includes only some elements of the private sector model, who does what in the new corporation will not be the same as in the old. What is particularly important about changing governance models is the redefinition of roles to be played and responsibility for activities to be conducted. For a typical for-profit corporation, these are defined in Table 6.1.

In implementing port devolution policies, it is critical for governments not moving all the way along the continuum toward private ownership to carefully predetermine how "owner" functions will be handled to ensure that their approaches have integrity. In sum, the critical question for those implementing the not-for-profit model becomes: who fills the owner (shareholder) role in a non-share capital corporation? Many governments fail to define their answer to this question in planning port reform.

*Table 6.1* Typical responsibilities in for-profit corporations

| Activity | Owner functions | Board functions |
|---|---|---|
| Leadership and stewardship | Elect/appoint Directors<br>Appoint auditors | Play central role in strategic leadership and stewardship<br>Select, recruit, oversee, evaluate, and compensate CEO/senior management<br>Be involved in Board composition, diversity, and nomination |
| Empowerment and accountability | Empower Board<br>As institutional investors, they are accountable to individual savers (e.g., mutual and pension funds) | Delegate sufficient authority to CEO (and committees)<br>Be accountable to owners at annual general meeting and special meetings |
| Communication and transparency | Communicate expectations to Board and CEO<br>Receive corporate and auditor reports | Have central role in ensuring comprehensive corporate communications plan<br>Speak with one voice<br>Evaluate and share information needs of Board |
| Service and fairness | As investors, support efficient and transparent capital markets<br>Make social and ethical investments to promote corporate social responsibility | Balance diverse expectations of shareholders and other stakeholders<br>Champion integrated social responsibility as part of overall mission of company |
| Accomplishment and measurement | Allocate resources (especially capital) among competing corporations<br>Approve fundamental changes affecting corporation<br>Use corporate performance results | Oversee corporate performance<br>Approve certain important decisions of management or executive<br>Use performance measures and verify their integrity |
| Learning and growth | Reward learning cultures with investment<br>Contribute to growth through the workings of capital markets | Foster climate of continuous learning and growth<br>Be committed to director development |

*Source*: Adapted from Conference Board of Canada (1998), part of Exhibit 8, p. 8.

## Are codes of governance appropriate in port reform?

What are the overarching Codes of Governance imposed by governments that are needed to ensure the success of the devolution process? Why should good governance practices be adopted by organizations that are not publicly traded? That is: Are such codes relevant for public ports?

Sachs et al. (2000) examined the relationship between privatization, institutional reforms, and overall economic performance in transition economies, distinguishing between "change-of-title" privatization and "agency-related" reform. They argued that not only is the former insufficient to generate economic performance improvements without the latter, but also that privatization may even have negative economic performance impacts. Agency-related reforms include improving the performance and regulation of capital markets, and laying the foundation for appropriate corporate governance. They concluded that the implementation of Codes of Good Governance is a necessary condition for maximizing of benefits of devolution. Aguilera and Cuero-Cazurra (2000) maintained that increasing privatization resulted in the development of Codes of Good Governance, such as the TSE-14 discussed above.

While governance principles can provide guidance to the Board of any transport entity, the outcome of good governance practices is dependent on the implementation structures and systems and on their effectiveness in achieving the desired outcome. This is easier said than done.

First, it is necessary that the Board come to some agreement on what principles are applicable to the organization, whether it is a public or private entity. Clearly, this must be undertaken in the context of the mission of the organization, its goals and objectives. Board Members should be active participants in the process; this is not solely an activity for management divorced from the Board.

Second, once consensus has been achieved, that agreement must be articulated and processes to facilitate effective decision making determined. The most common approach is to develop a reference manual for Board Members. It should address a number of areas important to good governance practice, including appropriate Board composition, selection of directors, processes for such selection and appointment, appropriate Board compensation, and terms of appointment. As part of good governance practice, it should include appropriate guidance for committee structure, size, and activities as well as guidelines for committee reporting and decision making. Other necessary elements include

processes for director removal, replacement or re-appointment, and processes for stakeholder input; the resulting documentation should clearly delineate the responsibilities and obligations of directors contrasted with those of management.

Finally, governance decisions should be transparent and Directors accountable for outcomes. Without transparency and accountability, Boards will fail to be responsible for their actions and hence the outcomes.

Given the competitive nature of the port industry, with almost all ports seeking to be industry leaders, the quality of governance must come into play. Verhoeven and Vanoutrive (2012) identified four port types using factor analysis on a database of 116 port authorities containing 72 variables. Corporate governance variables played a role in the allocation of ports to groupings by autonomy, port proactiveness, transparency in financial accounting and contracting out, and public versus private funding. In other words, they found four port types and concluded that governance matters.

In conclusion, this section of the chapter has found that (1) the implementation of a Code of Governance Practice is a necessary step for a government to take to maximize the benefits of devolution; (2) if a pure private sector model is not to be followed, the government must be clear in its structuring of the devolved entity to identify how the owner (shareholder) role is to be undertaken; and (3) governance matters in the port industry. The next section then asks: how can government ensure appropriate economic development outcomes once ports are devolved?

## Ensuring appropriate economic development outcomes

The key issue in the economic development equation is how to ensure that appropriate value-added activities take place within the boundaries of the local community rather than at another geographic location. This is really an issue of aligning the port's strategy and goals to those of the local community. It is possible to secure such alignment in part through the structuring of the organization by government in the devolution process; for more on appropriate organization structure for ports, see Baltazar and Brooks (2007). A fully satisfactory outcome lies in a combination of good planning, good timing, and good luck. The decisions are not guaranteed to be the best ones as the players are human and subject to all the potential frailties implied. Brooks (2005) proposed several issues to be addressed in ensuring that the Board meets local community

objectives (of economic development). This section re-examines these in the light of more recent experience.

**Development of an effective, independent Board, and avoidance of political patronage**

The role of the Board is to set the vision and policy of the organization, while the role of management is to execute the strategic plan established by the Board. What makes an effective Board?

Brooks (2005) concluded, based on the research of Leighton and Thain (1997), that an effective Board begins with an effective chairman, and that the quality of the Chairman can only be as good as the quality of the Board from which he or she is recruited. Furthermore, Leighton and Thain (1997) argued that Boards must be empowered, responsible, effective, and involved, or the outcome will not meet the desired standard.

Brooks (2005) noted that one particular feature of devolution is that a government often establishes Boards with a membership, structure, and mix that it thinks is appropriate from a public policy perspective, and therefore that governments, by the way they establish Boards, set them up for success or failure. To quote:

> If a board appointment is seen as a plum or reward, as happens in cases of political patronage (government-appointed boards), effectiveness will be compromised. The Board Member who is more interested in fees than outcomes, in ego than results, and in political gain than community service or improving shareholder value can derail a community-driven board quite effectively. There is no place for political patronage if boards are to be truly effective.
>
> (Brooks, 2005, pp. 116–17)

The importance of independent directors is often noted in the literature as critical to Board success. The Brooks and Pallis (2011) study of 69 of the world's largest ports reported that independent directors are not common practice in the port industry; this is in sharp contrast to the practices of good corporate governance in North America and Australia (Kang, Chen, and Gray, 2007).

**Removal of the profit motive while retaining efficiency incentives**

Both Saundry and Turnbull (1997) and Baird (1995) provided compelling evidence that privatized entities, finding themselves in a

monopoly position, may not actually pass the benefits achieved to customers in the form of reduced charges or improved services. Gellman Research Associates' (1990) study of the distribution of airport "profits" concluded that US airports, because of their municipal ownership, pass their profits onto airlines in the form of below-market prices, and therefore governments should limit excess profits through tax policy, rather than regulating the "explicit profits" seen in for-profit airports.

When the Government of Canada faced the decision to implement the devolution of airports, and chose to do so via non-share capital corporations as this was considered by the government to be preferable, Brooks (2005) noted that the not-for-profit non-share capital corporation model encourages corporations to follow one of three paths: (1) allocating positive operating returns to capital projects, which may or may not be necessary; (2) allocating positive operating returns to reduced services fees; or (3) expending positive operating returns by enlarging the administrative bureaucracy (because it adds to local employment). She concluded that the path chosen is a function of the philosophy of Board Members and what they deem to be their objectives.

In a private sector operation, efficiency gains are driven by the prospect of profit. Therefore, the second element of the governance structure decision is how to retain or improve efficiency without the existence of a profit motive in the governance design. Unless articulated by government as part of the devolution policy (and its implementing legislation) or by the community as part of its vision, the outcome of devolution or port reform may not be the option that best supports economic development.

### Alignment of board vision and objectives with community objectives

In the process of devolution, each devolved entity faces an identity crisis: does its Board co-opt the objectives of government, or identify its own in keeping with the views of the Directors of the newly created Board, or those of its community's stakeholders? Brooks (2005) concluded that the outcome will very much depend on how Directors are chosen; it is highly likely that those inserted by government, be it national or local, will co-opt the objectives of the appointing government if in the majority. Those chosen by the community will more likely reflect the concerns of local entities, while those chosen by stakeholders have yet again different objectives. Early experiences no doubt play a role in influencing whether a particular Board will

co-opt the objectives of those its members represent or whether Members feel sufficiently independent to adopt objectives of the Board's own choosing.

The Board of Directors is the steward of the port's assets; its Directors must exercise due diligence, meet fiduciary obligations, and understand community economic development objectives. A good Board needs an orientation to community objectives, a solid reporting system to its community, guidelines on transparency in tendering, and collegiality within and between the Board and management. Before managers can make decisions that take into account stakeholder relationships, they must know what interests stakeholders consider important. The rise of community consultation mechanisms reflects the need for this impact to Board decision making. The challenge is that in many parts of the world, Canada particularly, ports lag airports in adopting community consultation organizations. While Hoyle (2000) notes the importance of community in imaging the future of the Canadian port-city, the involvement of community in port planning has been slow to be adopted. This chapter returns to this issue later.

As noted by Verhoeven (2010, p. 254), land-use policies have risen to greater levels of importance over the last decade. Local citizens see port lands as ripe for development and yet might not see the long-term need to bank land for future port growth. Likewise, tourism authorities or developers may eye port lands as ready for development of housing, marinas or uses other than the management of freight.

Furthermore, he notes the traditional roles played by landlord ports have expanded, and points to the new role of "cluster manager", a concept we return to in next section, a role sandwiched between the economic development aspirations of the local business community and the port's social license granted taxpaying citizens seeking perhaps to see the port, with its accompanying air and water pollution, disappear.

**Development of mechanisms for board accountability**

Most devolution models require Boards to produce annual reports as a mechanism of accountability. Is this really adequate? Brooks (2005) concluded that, given the poor track record of Canadian for-profit corporations found by TSE (1999) and noted in the Appendix, the answer must be no. The Government of Canada, in its devolution of airports, introduced a set of public accountability principles that was mandatory for airports to follow (Auditor General of Canada, 2000). These were that (1) all carriers have equitable access; (2) all

user charges be reasonable; (3) the airports engage in activities consistent with their purpose; (4) contracts be tendered; (5) the airports declare business activities to avoid real or perceived conflicts of interest; and (6) the airports engage in community consultations. Of these, Brooks (2005) concluded that the most important is the requirement for community consultations (defined as twice-yearly meetings with a formal community consultation committee representing specific interests). As non-profit, community-based organizations, airports were viewed as being accountable to the local community. We will return to the issue of community consultation later in the chapter. In the next section, we look at the port devolution research of the past decade to see what new contributions have occurred since Brooks (2005) was published.

## Latest advances in port devolution: The literature

Brooks and Cullinane (2007) presented 14 country case studies on port reform and port devolution, but only one of those countries truly embraced privatization of ports – the United Kingdom, as examined by Baird and Valentine (2007). Belief in the privatization model was initially encouraged by findings, like those of Boardman and Vining (1989), that in terms of profitability public sector firms perform substantially worse than private sector firms. While port privatization was believed to encourage and improve efficiency by making industry more responsive to the demands of customers and by reducing public debt, it was also argued that it forces management (and unions) to face the realities of the marketplace (Gillen and Cooper, 1995).

The reality that has emerged from port reform programs has not been such a rosy picture. Thomas (1994), Baird (1995), and Saundry and Turnbull (1997) all illustrated the pitfalls of such thinking. Saundry and Turnbull (1997), for example, attributed improvements in economic performance in UK ports to the abolition of the National Dock Labour Scheme and not the privatization of the ports.

Over the years, numerous authors including Goss (1990) and Everett and Robinson (1997) explored non-privatization models. Many of these also noted the failure of reform efforts to deliver the benefits sought. Baltazar and Brooks (2001) concluded that what is necessary in port reform and the chosen port governance model is internal consistency (called "fit") between the environment, a government's goals, a port's strategy, and the structure and systems put in place at the time of devolution, a model they called the Matching Framework.

They attributed the poor outcome of Canada's 1990s' reform efforts to a misalignment of the strategy–structure–environment configuration. Neither of the non-privatization port reform cases they presented, Canada and the Philippines, was predicted to be successful because fit was missing. It remains so today.

Since the publication of Brooks (2005), there has been further research on port governance but not any major revolutions in port governance reform, although Brooks and Pallis (2008) predicted such revolution in the longer term. In spite of the best practice guidance that governments revisit policy decisions on a regular basis, say every five or ten years, port reform efforts undertaken in the 1990s have not, for the most part, been revisited either by governments or by scholars as was expected. As noted by Brooks and Pallis (2013, p. 5):

> The assessment, however, of the existing governance structures and their influence on the evolution of effective strategy formulation and performance measurement is somewhat lacking. . . . It appears to have been too easy for port scholars to focus on describing the reform agenda and too difficult to design a study to assess whether that reform has been successful. . . . We need to move beyond reform to assessing governance effectiveness.

Over the past decade (since Brooks [2005] was written), there have been further port reform/restructuring efforts in Libya (Gheshat and Cullinane, 2013), Brazil (Galvao et al., 2013), and South Africa (Gumede and Chasomeris, 2012) to name a few. There has not been a major rethinking of port governance in most countries, including Canada (a major review of the Canada Marine Act in 2002–2003 resulted in minor adjustments in 2008 [Parliament of Canada, 2008]), although there have been substantive revisions to port policy in Europe, mostly related to state aid, access, port services, and the awarding of concessions (EC, 2011; Official Journal of the European Union, 2014).

Debrie et al. (2013) noted that local forces often influence port reform trajectories, and so it is not surprising that there has been a divergence in governance approaches. While port reform over the past ten years has not led to a consolidation of the myriad of governance models for ports, it might have led some governments to consolidate a number of ports under a single port authority umbrella, moving the ports away from local communities and recentralizing them, as has happened with the Government of South Africa. Here a single port authority – the South African National Ports Authority – was created and charged with

the management of eight major seaports without local port community mechanisms (Gumede and Chasomeris, 2012).

To provide a Canadian illustration of this consolidation of authorities, a single entity was created from competing ports in Port Metro Vancouver (three separate ports merged into one). In this case, external competitive pressures and the potential benefits of improved services were at the core of the decision. The Canadian federal Minister of Transport invited the three authorities – Fraser River Port Authority, North Fraser Port Authority, and Vancouver Port Authority – to consider port amalgamation and the research conducted persuaded the authorities that the merger was of considerable local benefit as noted by port management (Port Metro Vancouver, 2008):

> The amalgamated port will be well positioned to better coordinate port planning and develop new investment opportunities that will facilitate the circulation of goods to and from foreign markets. The VFPA will also have greater resources for land acquisition, river management and strategic infrastructure investments.
>
> "With a broader scope and more influence, the Vancouver Fraser Port Authority will be able to further enrich our community partnerships and better commit to improving our levels of customer service," said Gordon Houston, Chair, Lower Mainland Port Amalgamation Steering Committee.

A second illustration is one of greater cooperation and the situation has yet to fully unfold; the ports of Seattle and Tacoma are not merging but creating an alliance (*The Seattle Times*, 2014). Unlike Vancouver, the political will to merge was not there but it too was a response to external competitive pressure. With all 10 commissioners managing the alliance, while the individual port commissions retain their existing governance structure and assets, this governance structure is weaker and therefore less likely to succeed than one that had a complete commitment by the two to forming a joint entity with a broader but single community focus.

Brooks and Pallis (2011) noted that while most US ports are publicly owned, the public port authority is often not involved in operating the port but in planning and, in some cases, not even that. A notable exception is the Port of Virginia, which has a strong role in port operations. That said, many US ports primarily act as landlords, with terminal activities delivered through leases with private sector operating companies.

Over the past ten years there has been a trend toward the development of regional governance structures to address hinterland issues facing port authorities. While port-led community management models have developed (de Langen, 2007), regional governance models have also evolved, not unlike the long-existing multimodal models exemplified by the Port of New York New Jersey and Massport (in Boston). Here a single entity controls the operations of many different modes of transport, often including the port, the airport, the local transit system, and so on.

## Future governance challenges

While there has not been substantive change in port governance over the past decade (outside of the reforms in Europe), there have been new strategic developments at the individual port level and these have been explored in detail by port researchers. They occur in three critical areas: (1) concessions as a governance mechanism for terminal operations; (2) strategies to coordinate or capture hinterlands; and (3) port community (IT) systems and other stakeholder engagement strategies.

### Concessions as a governance mechanism for terminal operations

In the last decade, there has been considerable interest in the role of concession agreements by landlord ports as a governance mechanism to serve the needs of the government, the port authority or even the economic development needs of the broader community in which the port operates. Notteboom (2007) identified that port authorities set the conditions that lead to economic development by the way they design the concession agreement; the specific terms and conditions of the agreement, the peculiarities of its tariff regime, the process by which the concession is awarded, and the sanctions and penalties included, all reveal the priorities of port authorities as well as those of their political masters (if they are public or hybrid authorities). Through the setting of concession policy or the regulations that apply to concessions, port authorities and governments, respectively, can retain some control over the recipients granted concessions as well as encourage them to optimize the use of scarce resources like land (Notteboom, 2007).

Since 2007, the growth in concessions has continued unabated, not even halted by the Global Economic Crisis, and is now expanding to

many types of stevedoring operations, more than just container terminals where the concept first flourished, and today cruise terminal concessions are also common. As already noted, in 2014, the European Commission finalized its guidance on concession policy (Official Journal, 2014).

**Strategies to coordinate or capture hinterlands**

The second of these includes the attempt by ports to engage in cluster governance and any other mechanisms by which they can engage supply chain partners and manage the activities along the supply chain in favor of port economic development. This stream of research began with the seminal work of de Langen (2004). In a continuation of this research, de Langen (2007, p. 458), using the example of Rotterdam, evaluates whether port authorities should expand their activities to incorporate a port-centric cluster governance role:

> The concept of cluster governance differs substantially from the frequently used concept of corporate governance because, unlike a corporate hierarchy, a cluster consists of independent organizations with few formal control relations to govern their interactions.

Should the port authority decide to expand its focus, de Langen (2007) identifies five areas where port authority management (and its governance) rubs against (or with) the community in the case of economic development – environmental protection, urban development versus port development, labor conditions versus port development, resident interests (safety, quality of life) versus port development, and overall economic development versus port development. It is the last that is the nexus of this chapter. Can a port board serve its own objectives and, at the same time, serve the local community by achieving the overall economic objectives of the region and cluster? The conflict often is evident.

De Langen (2007) concludes that the performance of the port cluster is directly related to the quality of its governance, its ability to manage stakeholder conflict as well as its investments in innovation and education. Furthermore, to quote his conclusions (de Langen, 2007, p. 469):

> The development trajectories of different ports may be explained to a large extent by the quality of accommodations. Especially interesting [...] is the question of how the governance model of the PA [port

> authority] influences the power of the different stakeholders, and consequently the development path of a port change over time. How do changes in the governance model (for instance, a transfer of responsibilities from public organizations to private firms, or the appointment of a non-political board of directors instead of a political one) affect accommodations for important conflicts like land use?

De Langen concludes, based on his analysis of the port cluster at the Port of Rotterdam, that the port must safeguard its support from city government by focusing on the benefits of local economic development. In other words, that there is an active role for the port in protecting gains and retaining its social license to operate in the community.

After de Langen wrote these two initial pieces of research, he contributed to the 2008 International Transport Forum Roundtable on Seaport Competition and Hinterland Connections. Here he noted that ports can enhance their attractiveness to shipping lines by exploiting their complementarities with other supply chain components, like inland distribution centers, and build positive economic development prospects for port communities through supply chain coordination (de Langen, 2008). This thinking was incorporated into the final report of the Joint Transport Research Centre (2008) report on the Roundtable.

In Canada, the federal government has taken the concept of coordination and support of Canadian gateway ports to heart, providing funding for infrastructure (in the case of the Pacific coast) and marketing (in the case of the Atlantic Gateway); the approach is one of improving access and fluidity to/from Canadian manufacturers/markets in the interests of Canada as a trading nation. Brooks et al. (2010) concluded that in Eastern Canada the port gateway governance has been informal rather than formal because ports have only cooperated in the marketing of Canadian ports as part of a cruise network, leaving supply chain coordination to private sector firms like Canadian National (rail), the large trucking firms, and major retailers.

Today, the European Commission is focusing on integrating ports and their future port plans into transport networks, as part of article 46 implementation of the TEN-T guidelines; the Commission aims to provide grants and financial support for infrastructure projects through the Connecting Europe Facility (a financial program) (European Commission, 2014). How well they will succeed in achieving that integration will be determined by governance mechanisms they

establish to ensure that economic development occurs along the TEN-T corridors.

**Port community (IT) systems and other stakeholder engagement strategies**

The third area is that of port community systems. Brooks and Pallis (2011) identified, as a "top four" current issue in governance, the challenge of how to best engage local stakeholders in efforts to improve port hinterland access. To quote Brooks and Pallis (2011, pp. 495–96):

> A content analysis of these [72 collected mission statements and objectives] reveals that ports are still as much interested in economic development as they are in serving commercial and trading interests, confirming the findings of Baltazar and Brooks (2007). The full gamut of objectives from commercial profitability and customer satisfaction to strategic national interest to sustainable, local economic development can be found. . . . [I]t is surprising when even private ports consider the "economic value" they may generate for their local community.

In the four years since their research into port governance and activities was conducted, the issue has only become more critical. In particular, port–city relationships have become a focal issue, particularly where there are multiple jurisdictions providing funding and citizens who are active (for more on joint governance processes, please see Daamen and Vries, 2013).

Stories of gain or loss of social license abound. Two recent examples provide insights into success and failure of the relationships between ports and their communities. In the case of Jacksonville (Florida), the port is at the forefront of promoting LNG bunkering capability by encouraging the development of an LNG facility on port lands abutting the St John's River and an industrial park, and working with the US Coast Guard on standards for safe bunkering. The port authority has been open with the local community about the ability of this investment to grow Jacksonville's trade with Puerto Rico and the Caribbean and develop new business opportunities that will lead to growth (for more, see Szakonyi, 2014). On the other hand, in the Port of Baltimore (Maryland), the blame game has erupted as Ports America Chesapeake has made a significant investment in Post-Panamax crane handling capabilities, and the US Army Corps of Engineers in dredging, only to have the landside development of a new intermodal container yard

facility fail to get citizen support, resulting in the withdrawal of state funds for its development to the chagrin of the city's mayor (Reutter, 2014). Both landside and portside investments were needed to grow new business for Baltimore.

Other issues demonstrated to be of significance to community groups include environmental management, waste management, carbon footprint analysis, and water consumption monitoring. European Commission (2012) demonstrates that in the areas of port community systems, more than 50 percent of port authorities are engaged in assisting the port community with the implementation of regulations, operating a port community IT system, promoting and marketing the port, and managing and promoting cruise traffic. This will become even more relevant as cybersecurity becomes a dominant issue for port security in future. The rise of the third force, the local citizen, who may be encouraged into action via social media, adds complexity to the governance pressures ports face.

**Other thoughts on governance mechanisms**

The most significant contributions of the research of Brooks and Pallis (2011) were: (1) They noted that 63 of 69 ports studied had "Boards of Directors" but what those Boards did, how they were directed and what their priorities were differed. They called this "The Myth of the Perfect Model". (2) They posited that many Boards had prominent local politicians and former bureaucrats; the limited number of independent directors is discouraging as it is the independent director who is most likely to reflect local concerns.

On the other hand, the alliance of Boards with their political masters might mean more subsidy funding could be gained; in an era when investment dollars are scarce, such relationships may make the difference in being ready to compete. Menozzi and Vannoni (2014, p. 10) note:

> It is common wisdom that SOEs [state-owned enterprises] are affected by the presence of multiple and potentially conflicting objectives. In SOEs, board directors are called to pursue a social mission and are subject to social control. If politically connected, they might go after goals other than profit maximization, like increasing the level of employment at a local level or offering low prices to consumers. These practices have commonly been used in many network industries, such as local public utilities, so that clear and good corporate

> governance practices are strongly required. Reforms have been introduced in order to improve the performance of SOEs but their effects could be neutralized by the activity of self-interested CEOs and by the presence of weak board of directors.

Whether political connection or independence in public or hybrid ports is most effective in driving economic development remains an area of research yet to be conclusive.

Finally, Grossmann (2008) reminds us that it is important to consider economic development in the context of the changing economy in the local situation. In Hamburg's case, he noted that there are competing pressures particularly for inner city port land to be used for everything from waterfront housing to recreation and tourism. He also concludes that, in this case, technology enables economic development relocation away from the port's physical location. In this case, economic development may not occur in the same location as the physical port as value-creation shifts to service- and information-based sectors. Even if throughput growth projections are realized, job creation may not occur as planned as new technologies replace labour. Hamburg is not an isolated case, as such pressures have become common in many port cities around the world, and in some cases such pressures have led to the relocation of the port to new lands outside the inner city as seen with the relocation of Sydney Australia's container facilities to Port Botany.

## Conclusions

As noted by Brooks and Pallis (2013), there has been very little research on how well port devolution initiatives have worked and even less evaluation of whether port reform has been compatible with local community economic development initiatives. Over the past decade, the importance of the port as an economic engine has come to the fore in the face of the global economic crisis and increased scarcity of funding for economic development projects. Added to this has been the rise in community action and, in some cases, the withdrawal or diminishment of social license.

The majority of the research reported in the academic press examines corporate governance as it relates to public or private entities from the American/Anglo-Saxon market-based perspective. In the last decade, the governance practices of ports in Europe have been more closely examined and other models discussed (see Verhoeven, 2010).

Brooks (2005) concluded that because a wide variety of governance models exists, and that they are often very complex, governments are unlikely to agree on a globally harmonized approach to port governance. What is needed, however, is an assessment of whether port reforms have met the government's objectives and whether port authority governance has been successful, and neither of these has been done.

Brooks (2005) also outlined some of the issues governments need to contemplate in their quest for both good governance practices and the alignment of Board commercial objectives with community economic development objectives. This particular focus is missing from recent port governance research.

Good corporate governance at the port authority level, whether within a non-share capital port or a private port, is not incompatible with the ability of the corporation to deliver positive economic development outcomes. It is the mechanisms of accountability and transparency, including a good stakeholder communication policy, coupled with the commitment of Board Directors to serve the public interest, that secures the success of a port economic development agenda under non-government owned and controlled models. Ensuring that an annual meeting is held, that the accounts of the entity are properly audited to regulated or generally accepted standards of practice, and that it meets its fiduciary responsibilities in areas of transparency, disclosure, compliance, and risk mitigation are critical elements to successful port governance. Boards also play a strategy-setting approval role and monitor that management meets the goals of the strategy and the organization. As port Boards have evolved, their ability to harness growth in the post–Global Economic Crisis world has often been determined by their ability to play forward-thinking strategy-formulation roles, find the right talent, and play the politics in their favor (Casal and Caspar, 2014). This mandates that port Boards work harder than before and have greater focus. It is no longer acceptable to have Board Members who are on too many Boards to be effective on any. Board education is more than ever an important factor in positive outcomes.

In conclusion, as production and distribution supply chains evolved over the last decade, and the performance of the entire end-to-end logistics chain became more important to the competitiveness of port customers, community economic development has been side-lined by the growing importance of and increasing difficulty in gaining social

license. This situation has been influenced by the ability of those who do not grant social license to engage in hactivism (hacking information systems for a cause), use social media in a deleterious way, and exploit cybersecurity gaps, all of which can prevent ports from enhancing community economic development outcomes. The findings of Dooms et al. (2013) seem particularly relevant; they conclude that stakeholder interests need to be understood by port managers in terms of which ones are location-dependent and which are not location bound so as to better manage stakeholder activities in favour of desired port development.

## The author's notes

This chapter was originally planned as an update of Brooks (2005), which was very much a product of its time. It was a state-of-the-art review for ports and port reform was underway in a number of countries. Since the original chapter was written, there have been major advances in governance education and principles in publicly traded companies, and new developments in the governance of third-sector (non-profit) enterprises, but most of these changes have not filtered down to ports or been implemented via regulatory reform to influence port governance and management, particularly in North America. Therefore, the author apologizes for the repetition of earlier work in the course of building this update; there has not been enough progress or revolution in the port industry to report real change or a new direction. Governments have much to be held accountable for this state of the art. On the other hand, there have been exciting new developments in the area of port strategies and community relationships, and so this area has been supplemented. The author accepts responsibility for any errors or omissions in this chapter.

## Appendix

*Table 6A.1* The TSE 14 principles

| **Table of principles 1994 (status 2014)** | **The good governance perspective** | **Adoption rate 1999** |
|---|---|---|
| 1. The Board should assume responsibility for the stewardship of the corporation. (✓) | This includes strategic planning, risk management, succession planning, communications policy, and internal control and management information systems. A board needs to set policy, not become involved in micro-management, and approve all significant decisions before implementation. | Good (strategic planning, risk management, and controls) to poor (succession and communications) |
| 2. The majority of Directors should be unrelated. (✓) | Independence of management is a key element in the ability of the Director to monitor results. | Good |
| 3. The Board should provide disclosure of measures to determine relatedness. (✓) | Full disclosure of a Director's relationships and interests ensures that relatedness is transparent. | Good |
| 4. A committee of independent Directors should be responsible for the appointment and assessment of Directors. (✓) | Usually called the Governance Committee, it ensures that Board appointments are not unduly influenced by management and the Director performance is evaluated. | Poor |
| 5. There should be a process for assessing Board effectiveness, as well as the effectiveness of its committees and individual Directors. (✓) | Such processes should measure performance against benchmarks so that the Board can engage in continuous improvement in its stewardship. | Poor |
| 6. The Board should provide orientation and education for new Directors. (✓) | Without orientation and education, it is unlikely that the full potential contribution of Directors can be realized. | Fair |
| 7. The Board should consider reducing its size to improve its effectiveness. (✓ Now reworded to examine the issue of size.) | Overly large boards are considered to be less effective in decision making. Not noted here, but of considerable importance in the literature, is the issue of board skill set and mix, which should reflect the range of skills needed, and the diversity of interests. | Excellent |
| 8. The Board should review Director compensation in light of risks and responsibilities. (✓) | Fees should be commensurate with Director's duties, responsibilities, and risks. | Good |

| | | |
|---|---|---|
| 9. Committees of Boards should be composed of a majority of unrelated non-management Directors. (✓) | The ability of a board to address management shortfalls in execution of Board policy is hampered when committees are controlled by management. | Good |
| 10. The Board should appoint a committee responsible for governance issues. (✓) | Without a committee of the Board taking responsibility for governance, governance practices will likely fail to be adequately reviewed by the corporation. | Fair |
| 11. The Board should define the limits of responsibilities by establishing mandates for the Board and the CEO in line with objectives. (✓) | It is difficult to measure performance if objectives and mandates have not been determined. It is the Board's responsibility to clarify these within, and with the CEO. | Fair |
| 12. The Board should establish structures and procedures for the Board to operate independent of management. (✓) | In keeping with maintaining Board independence of management, appropriate structures often include such elements as a Chair who is an unrelated Director and the ability of the Board to hold meetings without management present. | Good (unrelated chair) to poor (independent meetings). |
| 13. The Board should establish an Audit Committee, with a defined mandate, and independent of management. (✓) | Adequate oversight of management dictates the existence of an Audit Committee composed only of outside directors and with responsibility and authority independent of management. | Good |
| 14. The Board should implement a system whereby individual Directors can engage independent advisors at the corporation's expense. (✓) | Such ability is seen as essential to the protection of independence. It is often suggested that a committee of unrelated Directors should approve such expenditures. | Poor |

*Note*: The Governance Perspective is a lay interpretation of the key issues. The Adoption Rate 1999 is based on results from TSE (1999, p. 3) where the author has concluded that excellent = above 80 percent, good = above 60 percent, fair = above 40 percent and poor = below 40 percent. The Status (2014) TSX: ✓ = substantially similar; X = principle changed.
*Source:* The principles are a paraphrase of TSE (1994) as reported in Brooks (2005, Appendix 1).

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# 7

# Economic Impact Analysis of Port Development

*Tsung-Chen Lee and Paul Tae-Woo Lee*

## Introduction

Ports are often recognized as a public good and/or social infrastructure given their important roles in many supply chains and distribution channels related to international commodity trade. In this regard, their values are assessed from the perspective of the contribution to regional or national development. As suggested by Lee et al. (2008) and Bennathan and Walters (1979), in a country with a less mature port system, developing ports should be considered in the context of national economic security and the fundamental infrastructure of the national economy rather than commercial entities required for a recovery of their full costs from users.[1]

In the literature on port economics, quite a few studies have adopted scientific approaches to evaluate the impact of port development on the economy. The studies are generally referred to as the port impact studies (PIS). The purpose of PIS is to quantify the magnitude of economic impacts, such as added value and employment, which can be attributed to port activities. PIS constitute an important part of the evaluation process for port development and investment, and in particular show the significance of port sector to the national and/or regional economy from a macroeconomic perspective.

From a methodological viewpoint, input–output (I-O) models and the computable general equilibrium (CGE) models are frequently adopted in the quantitative analysis of economic impacts associated with public investment or policies.[2] The two approaches are similar in terms of the questions addressed, data requirements, and the range of applications (Rose, 1995). However, most recent studies have undergone a

paradigm shift away from the I-O analysis and toward the use of CGE models (Burnett et al., 2007). Such a paradigm shift could be attributed to the following reasons. First, CGE models have an explicit economic structure that captures the interactions among institutions (i.e., the government, household, and production sectors), while the interactions are usually neglected in the I-O models. Second, CGE models adopt nonlinear functional forms and allow for factor substitution in production sectors. In contrast, I-O models usually specify rigid production technology using fixed input coefficients. Third, I-O models only allow for either quantity or price to be endogenous but not both as in the case of CGE models, hence it is incapable of capturing the responses of individual institutions to market signals. Last but not least, I-O models implicitly assume a perfectly elastic supply of primary factors, which may lead to an overestimation of economy-wide impacts. As noted in McGregor et al. (1996), the associated results from the I-O analysis are similar to the long-run impacts in the CGE analysis under neo-classical assumptions. This is of special concern in a short- to medium-run timeframe (Gillespie et al., 2001). There is also evidence from the literature showing that I-O models perform poorly under a short- to medium-run time frame (e.g., Rickman and Treyz, 1993).

In port sector, the associated studies seem not catch up the paradigm shift. There are relatively more applications of I-O models, as compared with those of CGE models. Examples of I-O models include, among others, Chang et al. (2014), Kwak et al. (2005), Moon (1995), Van der Linden (2001), and Warf and Cox (1989). Warf and Cox (1989) explore the economic effects of maritime trade through the Port of New York on the New York metropolis. Moon (1995) suggests that port I-O model is an appropriate tool to provide information for the future planning of ports in Korea. Van der Linden (2001) argues that some extensions (i.e., an accurate cost structure, an inter-country framework, a macroeconomic module determining the expenditure effects, and company-level responses) should be considered in the conventional I-O analysis so that the flexibility, completeness, and accurateness of the outcomes can be achieved. Kwak et al. (2005) examine the significance of the maritime industry in the Korean national economy from both short-run and long-run perspectives. Chang et al. (2014) explore the extent to which port sectors can affect an economy using South Africa as a case study.

However, relevant applications of the CGE models to port sector are relatively sparse. We survey various sources of literature, but find only three studies: Doi et al. (2001) investigate the system-wide impact of an

improvement in port efficiency on the Japanese economy using a CGE model; Kent and Fox (2004) derive the cost of port inefficiency and use a global CGE model, named the Global Trade Analysis Project (GTAP), to estimate the impact of port inefficiency on trade and welfare; and Lee et al. (2012) make quantitative contributions to the understanding of the economic impacts associated with port investment and changes in freight costs on the national economy of South Africa using the GTAP model.

This chapter aims at advancing the applications of CGE models in PIS by presenting a comprehensive analysis on how port development can affect a concerned economy. To achieve such a goal, we first elucidate the channels through which port development can affect macro-economy. A quantitative analysis for the South African economy using the GTAP model by Lee et al. (2012) is then introduced. The conclusions are provided at the end of this chapter.

## How can port development affect macro-economy?

According to Lee et al. (2012), the economic impacts of port development can be classified into two categories. One is the once-off impact of port investment stimulus to improve port capacity during the construction phase, and the other is the effect of a reduction in freight rates as a result of the improved capacity after the completion of construction. The once-off impacts of port investment can be attributed to the exogenous increase in the capital stock of the port-related sectors (e.g., construction, transport equipment, transport service, water transport, etc.). As a consequence, the port-related sectors have higher production capacity, and their expansions in turn affect other sectors through inter-industry linkages. On the other hand, the channels through which an increase in the port capacity can affect the economy (through sea freight rate) are illustrated in Figure 7.1, and the explanation is provided as follows.

A higher port capacity will promote international trade, leading to an increase in trade volume. On one hand, there is an increase in import, which leads to an increase in the supply of foreign product for the domestic market. Consequently, two effects that might affect the domestic economy yield:

- *The supply effect* that captures the negative impact of the increase in supply of foreign product on its price.
- *The substitution effect* arising from the fact that the relative price of the foreign product becomes lower.

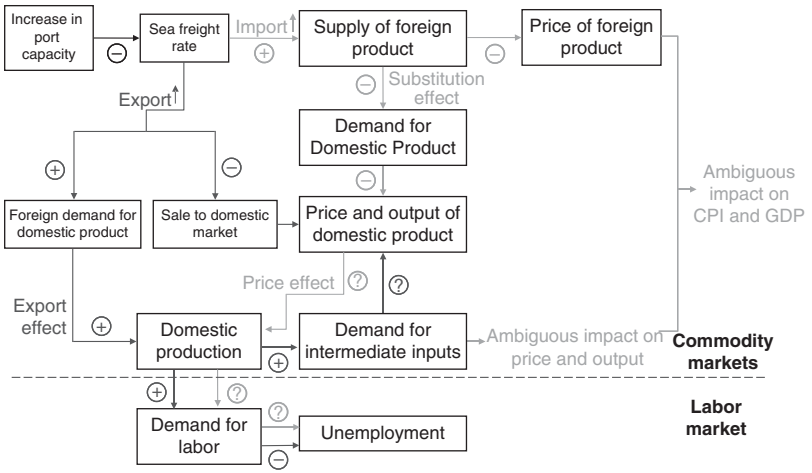


*Figure 7.1* The impact of increase in port capacity on the economy
*Source:* Lee et al. (2008).

Accordingly, the foreign product is used in substitution for domestic product, causing a decrease in the demand for domestic product and hence a lower price and output.

Moreover, a higher port capacity has a positive impact on the export, among others, by contributing to reducing port congestion with lower berth utilization rate and as a result, lowering sea freight rates. It is, therefore, an increase in the foreign demand for domestic product and a decrease in the sale to domestic market. A higher level of export will lead to a positive effect on domestic production but a lower level of sale to domestic market. The effects of export side, together with those of the import side, lead to an ambiguous impact on domestic production and price. Furthermore, these effects on production sectors will change the producers' demand for labor force, which in turn leading to an impact on the labor market as well as on unemployment. Given the ambiguous effects on production sectors, the effect of an increase in port capacity on unemployment is also uncertain. In sum, the impact of port development on national economy depends on the relative magnitudes of the above mentioned effects and is essentially an empirical question.

## Case study of South African economy

This section introduces a case study concerning port development in South Africa by Lee et al. (2012). The goal is to demonstrate how to apply the CGE model in the economic impact analysis of port development

in the two phases introduced in last section, namely, the construction phase and the operation phase after completing the construction. In what follows, the background of port development in South African is first introduced. Then the adopted CGE model and design of simulation scenarios regarding the South African port development are presented. Finally, the numerical results are analyzed.

**Literature concerning port development in South Africa**

In the current literature, there are several studies analyzing the empirical and economic significance of public infrastructural investment in South Africa. Among others, the Development Bank of Southern Africa (1998) provides a summary of the elasticities of output with respect to infrastructure in South Africa. The elasticities range from 0.15 to 0.33, indicating a significantly positive relationship between the capital in the public sector and output. Perkins et al. (2005) and Fedderke et al. (2006) make a comprehensive description of economic infrastructural development in South Africa starting from the year of 1875. They also suggest a bi-directional causality between infrastructural investment and economic growth, that is, infrastructure leads growth, and vice versa, output (GDP) leads infrastructural development.

In addition to the studies on general public infrastructure, there are also studies focusing on ports in South Africa. Table 7.1 summarizes a chronology of key research reference points for each item. These studies include those submitted by commissioned consultants to Transnet Group, government policy papers and independent scholarly researches.

Based on Table 7.1, there is a wide range of methodologies deployed to quantify the impacts of port activity on various segments of the South African economy. Among these are several of the most useful and informative studies employing simple methodologies such as descriptive statistical analyses (see Chasomeris, 2007a, 2007b; Department of Transport, 1998; Jones, 2002a). In general, South African and foreign researchers have been impeded by a lack of reliable and consistent statistical resources over various years. In an attempt to estimate the effect of a changing port traffic based on the Durban metropolitan economy, Jones (2002b, p. 95) states, "This exercise should be seen as an impressionistic indication rather than as a precise snapshot of economic activity." The study by Fund for Research into Industrial Development, Growth and Equity (FRIDGE) (2007) is also limited because Transnet declined to provide commercially sensitive pricing data. The study by CPCS Transcom (2003, p. 13) explains that "[e]xact information needed to calculate cargo charges in Richards Bay was sought but has not yet been received".

*Table 7.1* Studies on port development in South Africa

| Authors (year) | Title | Methodology | Findings and conclusions |
|---|---|---|---|
| Maritime Education Research and Information Technology (MERIT) (Pty) Ltd. (2001) | "Report on the Economic Evaluation of the Proposed Port of Ngqura and Development of a Container Terminal" | Descriptive and quantitative | Capacities of the three existing terminals are insufficient to meet the predicted demand in the year of 2020. Their expansion is limited; hence, there is a need for new terminal in Richards Bay or Ngqura. According to National Port Authority, Ngqura is the best option. Diversion of existing cargo through the subsidization of inland transport is not preferred. Containers will reach Gauteng sooner than from Durban (but enduring a distance and cost disadvantage); will handle traffic from Gauteng; and will not divert traffic from other ports or relocate functions from Port Elizabeth to Ngqura. |
| Fourie (2006) | "Structuring South African Maritime Supply Chains for Higher Efficiency", PhD thesis, University of Johannesburg | Descriptive | To improve the efficiency of the South African maritime supply chain (MSC), liner shipping has to lead the structural integration of container supply chains. Transnet does not allow structural development of MSC under the leadership of the private sector, thus restraining efficiency improvement. MSC development should be done through private–public partnerships, given that the role of Transnet is changed to permit the private sector to lead the development. |
| Jones (1988) | "A General Overview of Harbour Tariff Principles" | Descriptive statistics | Shows inefficient port pricing, particularly ad valorem wharfage. |
| Portia Management Services Ltd. (1998) | "Eastern Region Ports of Durban and RB Container Capacity Study" | Strategic port capacity study | Undertakes an analysis on strategic capacity for container berth development at Durban and Richards Bay to enable the two ports to handle 5 million TEUs by 2020 and suggests the schedule of port developments. |

*Table 7.1* (Continued)

| Authors (year) | Title | Methodology | Findings and conclusions |
|---|---|---|---|
| Chasomeris (2005) | "Assessing South Africa's Shipping Costs" | Descriptive statistics | Shows post sanctions South Africa has increased trade, reduced tariffs, increased ad valorem shipping costs (c.i.f./f.o.b. ratio) but reduced real liner freight rates and reduced real port charges. |
| Chasomeris (2007a) | "South Africa's Port Performance: Policy, Pricing and Growth" | Descriptive statistics | Shows the impact of improved pricing principles and reduced real charges in South Africa's ports; indicates several challenges for South Africa's ports. |
| Bell (2007) | "Port Policy in South Africa: Emergence of a Global Terminal Operating Company" | Descriptive | South Africa needs an injection of competition into terminal operation. Suggests joint ventures between Transnet Port Terminals and global terminal operators in Durban and Ngqura; Singapore cited as a good example. |
| Fund for Research into Industrial Development, Growth and Equity, FRIDGE (2007) | "Administered Prices Study on Economic Inputs: Ports Sector: Final Report" | Descriptive statistics | The South Africa Transport Services Act (1989) provides a price and service guide only for commuter rail. It is silent on freight rail and port services, but Transnet is not to behave in a way that damages the economy. Transnet's key role is to assist in lowering the costs of transport in South Africa. The study is limited as Transnet refused to provide pricing data. Prices criticized from 2000 to 2007. South Africa's port pricing is strategic and includes non-port financing objectives. |
| Competition Commission of South Africa (2004) | "Competition Policy and Regulation: Transport" | Descriptive | Overview of models of port ownership; reasons for port reform. Raises concerns on slow progress in leasing Durban Container Terminal. |
| Department of Transport (1998) | "Moving South Africa: A Transport Strategy for 2020" | Descriptive and forecasts | Freight customers saw biases toward import substitution and against export competitiveness of value-added products, a failing rail service, an inefficient port system, and, uniquely, world-class bulk freight systems. Destructive competition between road and rail; underinvestment in capital replacement. Develops a 20-year strategy. |

| | | | |
|---|---|---|---|
| Jones (2002a) | "The South African Freight Transport Sector" | Descriptive | Overview of South Africa's freight transport – comprising ports, road, and rail. |
| Barrett (2003) | "A Third Way to Competitive Ports: An Alternative to Privatising the Key Economic Service of South Africa's Ports Authorities" | Descriptive | Labor representative view. Because South Africa's ports are already segmented and there is overcapacity in most terminals, new terminals to enhance competition are not desirable. Inter-port competition would cut across the corridor strategy. Give National Port Authority time to realign skewed tariffs. Permit Transnet Port Terminals to continue operating the terminals that it currently operates. |
| Stellenbosch University and Graham Muller Associates (2007) | "Results: Transnet Container Alignment 2007" | Descriptive and econometric modeling of container volumes and I-O model used for a gravity flow model | The Graham Muller Associates and University of Stellenbosch forecast results appeared to be significantly different, but the study shows the results work well together and provides answers to each study's aims. Improved understanding of container weights and contents will facilitate future researches. Research into Sub-Saharan container market is recommended. |
| CPCS Transcom (2003) | "Economic Impact and Port Asset Packaging Study" | Social Accounting Matrix model (using I-O and Supply and Use Tables) | An economy-wide analysis of restructuring within the Durban Container Terminal (DCT) and Richards Bay, which finds that export production shipped through DCT generated ZAR 98 billion or 6.3% of South Africa's production (4.8% of GDP at factor costs); terminal users directly and indirectly created 435,791 jobs. Richards Bay Multi-Purpose Terminal generated 1.93% of GDP and 183,294 jobs. |
| HMG JV (2008) | "Comparison between Bayhead and Richards Bay Container Terminals: Technical Report" | Comparative study based on cost estimate alignment and financial model | Conducts a comparison between the Bayhead and Richards Bay Container Terminal in terms of scope of works, port and rail layouts, assumptions, and costs in order to facilitate decision making. |

*Source*: Complied and analyzed by Lee et al. (2008).

Therefore, an estimate was based on data from the Durban Container Terminal (DCT) and adapted to the composition and tonnage of cargo in the Richards Bay Multi-Purpose Terminal (RBMPT).

In conclusion, the above literature survey shows that even though the studies on the South African ports have been conducted by cities, universities, and various public and private organizations, they are mainly descriptive and do not provide quantitative analysis on the economic impacts of port development on the national economy. Accordingly, the stakeholders in South Africa need not only to understand how current and planned operations and capital investments in the port sector may affect economic activity, but they should also develop a robust economic impact model to quantify and understand the contribution of ports to the national economy. The following study by Lee et al. (2012) fills the gap by providing a quantitative evaluation of economy-wide impacts for port development in South Africa.

**Background of port development in South Africa**

Ports are one of the oldest forms of infrastructure in South Africa. In the 1970s, there was a substantial expansion in bulk port capacity (specifically at Richards Bay and Saldanha). Currently there are three major container ports in South Africa, consisting of Port of Durban, Port of Cape Town and Port Elizabeth. In the past years, the total container throughputs of these container ports increase significantly. However, because of insufficient capacity to handle the ever increasing container traffic, the waiting time for vessels called at the two largest ports, Durban and Cape Town, has become longer. As shown in Table 7.2, the average waiting hours in Port of Durban increase from 26.14 hours in 2001 to 55.14 hours in 2007, and those in Cape Town increase from 12.23 hours in 2001 to 40.98 hours in 2007. The increase in waiting time signifies the situation of high demand for very limited port services and capacity. In order to resolve the port congestion problem and foster economic growth, the country plans to develop a new hub port in Ngqura. As a result, port development has drawn considerable attention in South Africa.

**The CGE model: The GTAP model**

Lee et al. (2012) estimate the quantitative effects of port development from an investment perspective and an operational (freight cost) perspective. Because the distance of different trading routes is an important factor that affects the (changes in) freight costs and trade patterns, the quantitative model has to explicitly account for the commodity trade

*Table 7.2* Average utilization rate, average working and waiting hours at Durban and Cape Town container terminals

| Port | Year | Average utilization rate (%) | Average working hours | Average waiting hours |
|---|---|---|---|---|
| Durban | 2001 | 89 | 39.00 | 26.14 |
| (Berths 108, 109, 200, 202, | 2002 | 92 | 37.95 | 38.31 |
| 203, 204, 205) | 2003 | 86 | 42.70 | 34.55 |
| | 2004 | 80 | 41.31 | 39.60 |
| | 2005 | 80 | 41.48 | 31.17 |
| | 2006 | 82 | 41.53 | 47.25 |
| | 2007 | 92 | 37.29 | 55.14 |
| | Average | 86 | 40.18 | 38.88 |
| Cape Town | 2001 | 71 | 24.42 | 12.23 |
| (berths 601–04) | 2002 | 76 | 23.06 | 18.94 |
| average | 2003 | 78 | 31.24 | 22.06 |
| | 2004 | 68 | 30.44 | 10.77 |
| | 2005 | 70 | 31.01 | 15.08 |
| | 2006 | 73 | 31.38 | 19.79 |
| | 2007 | 68 | 30.70 | 40.98 |
| | Average | 72 | 28.89 | 19.98 |

*Source*: Transnet Port Terminals (2011).

on different trade routes. Accordingly, the adopted CGE model should not only capture the mechanisms linking the economy, the port sector and international trade, but it should also have an explicit treatment of commodity trade on different sea freight routes between South Africa and the rest of the world. Hence this study adopts a global CGE model, namely, the Global Trade Analysis Project (GTAP) in the quantitative analysis. In what follows, a brief introduction to the GTAP model is provided. For the details of the GTAP model, the reader is referred to Hertel (1997) and the GTAP website.[3]

The GTAP model is a comparative-static, multi-region, multi-sector CGE model, which assumes perfectly competitive markets, that is, price taking behavior for all economic agents, and constant-returns-to-scale technology. The nested production structure in the GTAP model is shown in Figure 7.2. For each production sector, commodity supplies are based on single-output production functions. Substitution between inputs is modeled using two-level nested production functions. Demand for land, capital, natural resources, unskilled labor and skilled labor are determined at the lower level of the nests based on constant elasticity of substitution (CES) production functions. Land is employed in the

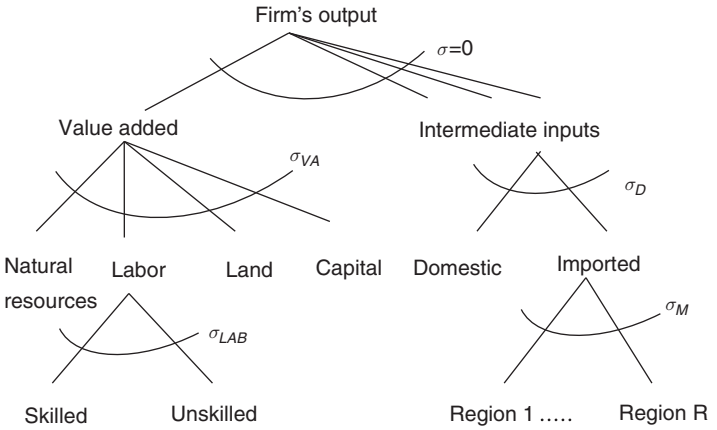


*Figure 7.2* Nested production structure in the GTAP model

agricultural sector only and is imperfectly mobile across sectors. Labor and capital are perfectly mobile across sectors within regions, but are internationally immobile. At the top of the nests, Leontief functions are specified to determine the demands for intermediate inputs and the primary factor composite. The intermediate inputs are classified into domestic and foreign inputs. To model the intermediate import demands, the "Armington approach" (Armington, 1969) is adopted to determine the optimal mix of imported and domestic goods, with each commodity being differentiated by its place of origin.

Domestic demand for market goods is composed of intermediate demand and final demand. Intermediate demand is the firms' demand for production inputs that are produced by other firms. As for the final demand, it is assumed that there is a representative household for each region which maximizes utility derived from consumption of market goods by private household and government and savings subject to regional income, a variable that consists of primary factor payments and net tax collections. The regional household's utility function is of the Cobb–Douglas form, implying that the expenditure shares for the private household, government and savings are constant. The nested consumption structure for the regional household is shown in Figure 7.3. The private household consumption is modeled based on the constant difference of elasticity (CDE) utility function while the government consumption is modeled based on the Cobb–Douglas utility function. The final import demands are again modeled according to the "Armington approach". Regional production of new capital goods is financed by domestic savings and net capital inflow.

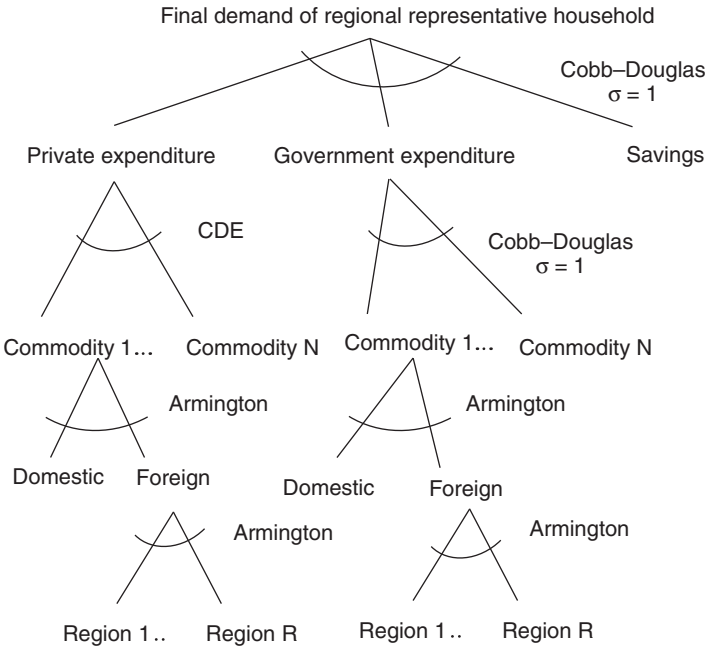


*Figure 7.3* Nested consumption structure in the GTAP model

The database adopted in this study is a publicly available, global database released by the center of the GTAP – the version 6 database with the base year of 2001 (Dimaranan, 2006). In this database, there are 5 primary factors, 87 regions and 57 production sectors. The 5 primary factors consist of land, capital, natural resources (forestry, fisheries, fossil fuels and mining), unskilled labor, and skilled labor. Among the 87 regions, regions 1–3 are located in Oceania; regions 4–20 in Asia; regions 21–36 in America; regions 37–70 in Europe; regions 71–72 in the Middle East; regions 73–87 in Africa; and South Africa has been listed as the 77th region. The production sectors in the GTAP database are composed of the agricultural and food processing sectors (sectors 1–22), the mining sectors (sectors 23–26), the manufacturing sectors (sectors 27–42) and the service sectors (sectors 43–57).

In this chapter, the trading partners of South Africa are grouped into the trade lanes used as industry practice by the global container lines and the commodities are divided into the shipping industry's ship type segmentations. The GTAP Version 6 database containing 87 regions and 57 sectors is aggregated to a much higher level of

8 regions and 9 sectors. The 8 regions are South Africa, sub-Saharan Africa (SSA), Northern Europe, the Asian Countries, the Middle East, North America, the Mediterranean, and the Rest of the World. The 9 sectors are water (sea) transport, containerized general, containerized agriculture, major bulk, break bulk and minor bulk, liquid, crude oil, automobile, and others. In the port investment scenario, the port-related sectors are further separated from the above 9 sectors. The port-related sectors are composed of (1) transport equipment (motor vehicles and other transport equipment), (2) transport service (land transport), (3) trade, (4) construction, and (5) water transport. Table 7.3 and Table 7.4 respectively provide the detailed descriptions of the regional and sectoral aggregation.

*Table 7.3* Regional aggregation

| **Regional description** | **Countries/regions covered in the GTAP Version 6 database** |
|---|---|
| South Africa | South Africa |
| Sub-Saharan Africa (SSA) | Botswana, rest of South African Customs Union, Malawi, Mozambique, Tanzania, Zambia, Zimbabwe, rest of Southern African Development Community, Madagascar, Uganda, and rest of SSA |
| Northern Europe | Austria, Belgium, Denmark, Finland, France, Germany, the United Kingdom, Ireland, Luxembourg, the Netherlands, Sweden, Switzerland, rest of European Free Trade Area, Estonia, Latvia, and Lithuania |
| The Asian Countries | China, Hong Kong, Japan, Korea, Taiwan, rest of East Asia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Viet Nam, and rest of Southeast Asia |
| Middle East | rest of Middle East |
| North America | Canada, the United States, Mexico, and rest of North America |
| Mediterranean | Greece, Italy, Portugal, Spain, rest of Europe, Albania, Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Malta, Poland, Romania, Slovakia, Slovenia, Turkey, Morocco, Tunisia, and rest of North Africa |
| rest of the world | Australia, New Zealand, rest of Oceania, Bangladesh, India, Sri Lanka, rest of South Asia, Colombia, Peru, Venezuela, rest of Andean Pact, Argentina, Brazil, Chile, Uruguay, rest of South America, Central America, rest of Free Trade Area of the Americas, rest of the Caribbean, Russian Federation, and rest of former Soviet Union |

*Source*: Lee et al. (2012).

*Table 7.4* Sectoral aggregation

| **Sectoral description** | **Sectors covered in the GTAP Version 6 database** |
|---|---|
| Water transport | Water transport |
| Containerized general | Gas, textiles, apparel, leather, wood products, paper and paper products, other transport equipment, computing machinery and communication equipment, electricity machinery, and manufacturing and recycling |
| Containerized agriculture | Vegetables and fruits, oil seeds, sugar plants, textiles materials, plants and flowers, livestock, poultry, raw milk, wool, fishing, meat of livestock, meat of poultry, oil material, dairy products, milled rice, food processing, and beverage and tobacco |
| Major bulk | Paddy rice, wheat, cereals, coal, and mining |
| Break bulk and minor bulk | Forestry, sugar, non-metallic mineral products, iron and steel, non-ferrous metals, and fabricated metal products |
| Liquid | Refined petroleum products, and chemicals and plastic products |
| Crude oil | Oil |
| Automobile | Motor vehicles |
| Others | Electricity, gas distribution, water, construction, trade, land transport, air transport, telecommunication, financial intermediation, insurance, real estate and renting, recreational, sporting and other service, public administration, and other sectors |

*Source*: Lee et al. (2012).

Similar to most comparative static CGE models, the GTAP model does not take macroeconomic and monetary policies into consideration. Moreover, because the model is not an inter-temporal model, investment will only affect production and trade through its effects on the profile of final demand. Following Dewatripont and Michel (1987), there are solutions to the fundamental indeterminacy of investment in comparative static models. One follows the non-neoclassical closures[4] in which investment is simply fixed, and the other allows investment to adjust. In our simulations, the investment is assumed to be fixed (i.e., *cgdslack* is assumed to be exogenous).[5]

The requirement for external balance for a national economy can be expressed as follows:

$$s - 1 = \textit{Trade Balance} = X - M \tag{7.1}$$

where $S$ is saving, $I$ is investment, $X$ is exports and $M$ is imports. In the GTAP model, saving is a fixed share of regional income. Investment is governed by the global bank, which seeks to equate expected rates of returns across regions, and is assumed to be exogenous. Therefore, without any changes in the macro-economic variables, the right-hand side of Equation (7.1) must adjust to maintain the identity. This is accomplished in the GTAP model by adjusting the "real exchange rate", which can be measured as the price of the primary factors of production in one region relative to the world average price of the primary factors.

The CGE models are commonly categorized based on the so-called "closure rules" (Thissen, 1998). The discussion concerning macro-closures is initiated by Sen (1963). Taylor and Lysy (1979) contribute to this discussion by showing that the choice of macro-closures could affect the simulation results generated by a CGE model.[6] Because the employment effect is an important concern in the economic analysis at the national level, it should be appropriately evaluated. In this study, an "South Africa (SA) closure" is developed to reflect the real-world situation of the labor market in South Africa, in which skilled labor is fully employed and unskilled labor is underemployed. Moreover, the investment scenario is also simulated using two conventional closures widely adopted in the CGE modeling – the Keynesian closure and the neo-classical closure. A comparison of the quantitative results from the two closures contributes to the academic literature by showing how the specification of labor market closures can affect the simulation results and make recommendations for future studies on the South African economy with appropriate closure for the labor market.

**Design of simulation scenarios**

As mentioned before, the quantitative analysis of port development in South Africa is conducted from two perspectives. One is the once-off impact of port investment during the construction phase, and the other is the effect of a reduction in freight rates due to improved capacity. The associated simulation scenarios are introduced as follows.

*Scenario 1: Port investment*

This simulation scenario aims at exploring the economic impacts of port investment on the South African economy. The investment amount is presumed to be ZAR 4 billion.[7] The investment of ZAR 4 billion acts as an injection into the capital stock in the five port-related sectors, and the amount is allocated according to the following percentages: 15.61 percent to transport equipment, 9.37 percent to transport service,

1.98 percent to trade, 59.88 percent to construction, and 13.16 percent to water transport. The above percentages of port-related sectors are obtained from Lee et al. (2008), a project report concerning port development in South Africa prepared for the Transnet group, and they are determined based on the information about how the Standard Industrial Classification (SIC) codes are classified into smaller group products by Statistics South Africa (2003).[8]

*Scenario 2: Reduction in freight rates*

As indicated before, an increase in vessel waiting time means a potential shortage in port services and capacity. This scenario aims at estimating the benefits associated with a reduction in vessel waiting time as a result of improved port capacity. As shown in Table 7.2, this scenario is designed to estimate the economic gains of reducing the average vessel waiting time between the period of 2001 and 2007 (30 hours) to that in 2001 (20 hours), which is around 33 percent reduction in waiting time.

This scenario is simulated by shocking the associated decreases in sea freight costs. The values of shock are quantified based on the data for Durban and Cape Town in Table 7.2 and the following assumptions: (i) the average waiting time of vessels in the queue is 30 hours; (ii) the time per voyage for different trading routes, as shown in Table 7.5, is obtained from the website of Global Shipping Cost;[9] and (iii) the ship costs account for 39 percent of total voyage costs (Stopford, 2009, Table 13.9).

Using the above data and assumptions, we calculate the reduced freight costs (in terms of percentage) of the container carriers due to a reduction in waiting time of 10 hours (or 0.42 days). The calculated

*Table 7.5* Reduced total voyage time and costs for container carriers by routes

| **Decrease in waiting time** | **Reduced waiting time (days) (A)** | **Time per voyage (days) (B)** | | **Reduced costs (%) [= [(A)/(B)]*39%]** |
|---|---|---|---|---|
| 10 hours | 0.42 | SSA | 0.75 | 21.84 |
| | | Northern Europe | 15.64 | 1.05 |
| | | Asian countries | 19.18 | 0.85 |
| | | Middle East | 10.90 | 1.50 |
| | | North America | 21.80 | 0.75 |
| | | Mediterranean | 13.85 | 1.18 |
| | | Rest of the world | 13.69 | 1.20 |

*Source*: Lee et al. (2012).

results of percentages changes in reduced freight costs, as shown in Table 7.5, apply to all imports and exports of containerized commodities. The shocks are higher for the nearby countries but lower for the faraway countries. Accordingly, one can expect a significant (minor) impact on trade with a nearby (faraway) country.

The scenario of reducing freight rates captures the economic impacts of resolving congestion problem. The qualitative implications of this simulation scenario are similar to those in a trade liberalization scenario of import tariff reduction. However, a reduction in sea freight rates can influence exports and imports directly, while removal of import tariffs can affect exports indirectly (unless there is an export tax that can be reduced). The quantitative implications are quite different owing to the following three reasons. First, tariff variables are shocked in the simulation scenario of trade liberalization, while technical variables related to transport cost are shocked in our simulation scenario.[10] A major difference between the two is the ensuing implication on government fiscal revenue. In the simulation scenario of trade liberalization, there will be a reduction in the government's revenue as a result of removing tariffs. However, our simulation scenario does not have any implication on government fiscal revenue. Second, the magnitudes of shocks in the trade liberalization scenario depend on the existing tariff rates. Therefore, trade liberalization is expected to have a relatively significant impact on high tariff products. In contrast, in the scenario of port development, the impacts on trade with nearby countries would be more significant. Finally, a reduction in tariff directly affects the imports while a reduction in freight rates can affect both imports and exports.

**Simulation results and analysis**

The simulation results for the two scenarios of port development are analyzed as follows.

*Scenario 1: Port investment*

The quantitative impacts of port investment on the macro-economy are summarized in Table 7.6 (with 2002 as the base year). Under the Keynesian closure, an investment of ZAR 4 billion leads to an increase in GDP by 0.122 percent. Given that South African GDP was ZAR 1,168,699 million in 2002, the change in real GDP is ZAR 1,426 million. Under the neo-classical closure, GDP increases by 0.599 percent, or, in terms of monetary value, by ZAR 7,001 million. The results under the SA closure (0.235 percent and ZAR 2,746 million) lie in between the above two.

*Table 7.6* Simulation results for the scenarios of investment in the port-related sectors

| Variables | Base data[a] (2002) | Scenario 1(a) ZAR 4 billion investment Keynesian closure | Scenario 1(b) ZAR 4 billion investment Neo-classical closure | Scenario 1(c) ZAR 4 billion investment SA closure |
|---|---|---|---|---|
| Real GDP (ZAR millions) | 1,168,699 | 1,170,125 | 1,175,700 | 1,171,445 |
| Change in real GDP (ZAR millions) | | 1,426 | 7,001 | 2,746 |
| Change in real GDP (%) | | 0.122 | 0.599 | 0.235 |
| Employment[b] | | | | |
| Unskilled labor (persons) | 5,798,000 | 5,800,667 | 5,828,497 | 5,806,117 |
| Change (persons) | | 2,667 | 30,497 | 8,117 |
| Change (%) | | 0.046 | 0.526 | 0.140 |
| Skilled labor (persons) | 5,500,000 | 5,503,905 | 5,531,020 | 5,511,055 |
| Change (persons) | | 3,905 | 31,020 | 11,055 |
| Change (%) | | 0.071 | 0.564 | 0.201 |
| Consumer Price Index (CPI) | 100.000 | 99.985 | 99.939 | 99.972 |
| Trade (ZAR millions) | 599,821 | 600,558 | 602,554 | 601,067 |
| Change in trade (%) | | 0.123 | 0.456 | 0.208 |
| Export (ZAR millions) | 323,840 | 324,212 | 325,174 | 324,468 |
| Change in export (%) | | 0.115 | 0.412 | 0.194 |
| Import (ZAR millions) | 275,981 | 276,345 | 277,380 | 276,599 |
| Change in import (%) | | 0.132 | 0.507 | 0.224 |
| Value-added – sum (ZAR millions) | 1,064,676 | 1,064,921 | 1,070,085 | 1,065,986 |
| Change in value-added (ZAR millions) | | 245 | 5,409 | 1,310 |
| Change in value-added (%) | | 0.023 | 0.508 | 0.123 |

*Note*: [a] The base year is 2002, and the values are in terms of the 2002 South African Rand.
[b] The classifications of the skilled labor and unskilled labor are based on the occupations. Skilled labor consists of managers, professionals, technicians, clerks, sales and service personnel, and skilled agricultural workers. Unskilled labor consists of craftsmen, machine operators, elementary laborers, domestic workers, and unspecified occupations.
*Source*: Lee et al. (2012).

The increase in real GDP means a larger scale of domestic production which requires a higher level of labor input. The average employment induced by the investment is 1.64 persons per million ZAR under the Keynesian closure, 15.37 persons per million ZAR under the neo-classical closure, and 4.79 persons per million ZAR under the SA closure. In particular, the result under the neo-classical closure (15.37 persons per million ZAR) is close to the number in the associated analysis using I-O model (12.57 persons per million ZAR; quoted from Lee et al. (2008)). This finding is consistent with McGregor et al. (1996), which show that the results of the I-O analysis are similar to the long-run impacts in the CGE analysis under neo-classical assumptions.

The difference in the quantitative results under the three closures is attributed to the assumptions concerning the labor market situation. In the Keynesian closure, labor supply is fixed (inelastic), labor is under-employed and the nominal wage is rigid. If there is an increase in labor demand, the current unemployment would decline to keep the nominal wage unchanged. In contrast, the neo-classical closure assumes that labor supply is endogenous (varied), that labor is fully employed and that the real wage is unchanged. If there is an increase in labor demand, the labor supply will increase to meet the demand so as to fix the real wage. The SA closure is similar to a mixture of the above two, assuming that skilled labor is fully employed and unskilled labor is underemployed.

In sum, the employment effect in the Keynesian closure accounts for only the impact from the demand side, while that in the neo-classical closure takes account of the impact from both the demand and supply sides.[11] As a consequence, the employment effect obtained from the neo-classical closure is higher, as compared with that from the Keynesian closure. The results of the SA closure lie in between them because it reflects a market situation that mixes the two closures.

As for the change in international trade, an investment in the port-related sectors has a positive impact on imports and exports, as well as on the total trade value. Under the Keynesian closure, the percentage changes (change in monetary value) in exports, imports and total trade value are 0.115 percent (ZAR 372 million), 0.132 percent (ZAR 364 million), and 0.123 percent (ZAR 736 million), respectively. Under the neo-classical closure, the impacts on exports, imports and total trade value are 0.412 percent (ZAR 1,334 million), 0.507 percent (ZAR 1,399 million) and 0.456 percent (ZAR 2,733 million), respectively. Again, the impacts under the SA closure lie in between the above two, i.e., 0.194 percent (ZAR 628 million), 0.224 percent (ZAR 618 million), and 0.208 percent (ZAR 1,246 million). Based on the numerical results

in Table 7.6, we also see that there is a tiny decrease in Consumer Price Index (CPI). Finally, the value-added (or, equivalently, the payment to primary factors) increases if there is an investment in the port industry. At the industrial level, port investment brings significant benefits to the five port-related sectors, but tiny impacts to the other sectors. Under the SA closure, water transport sector has the highest percentage increase in output (0.91 percent), followed by transport equipment (0.65 percent), construction (0.58 percent), transport service (0.22 percent), and trade (0.22 percent). In sum, an investment in the port industry is beneficial to the South African economy.

*Scenario 2: Reduction in freight rates*

The quantitative impacts of Scenario 2 are summarized in Table 7.7 (with 2002 as the base year). The percentage change in real GDP as a

*Table 7.7* Simulation results for the scenarios of a decrease in freight rate

| **Variables** | **Base data[a] (2002)** | **Scenario 2 Decrease in freight rate** |
|---|---|---|
| Real GDP (ZAR millions) | 1,168,699 | 1,171,013 |
| Change in real GDP (ZAR millions) | | 2,314 |
| Change in real GDP (%) | | 0.198 |
| Employment[b] | | |
| Unskilled labor (persons) | 5,798,000 | 5,810,524 |
| Change (persons) | | 12,524 |
| Change (%) | | 0.216 |
| Skilled labor (persons) | 5,500,000 | 5,510,230 |
| Change (persons) | | 10,230 |
| Change (%) | | 0.186 |
| Consumer Price Index (CPI) | 100.000 | 99.994 |
| Trade (ZAR millions) | 599,821 | 601,708 |
| Change in trade (%) | | 0.315 |
| Export (ZAR millions) | 323,840 | 325,122 |
| Change in export (%) | | 0.396 |
| Import (ZAR millions) | 275,981 | 276,585 |
| Change in import (%) | | 0.219 |
| Value-added – sum (ZAR millions) | 1,064,676 | 1,065,741 |
| Change in value-added (ZAR millions) | | 1,065 |
| Change in value-added (%) | | 0.100 |

*Note*: [a] The base year is 2002, and the values are in terms of the 2002 South African (ZAR).
[b] The classifications of the skilled labor and unskilled labor are based on the occupations. Skilled labor consists of managers, professionals, technicians, clerks, sales and service personnel, and skilled agricultural workers. Unskilled labor consists of craftsmen, machine operators, elementary laborers, domestic workers, and unspecified occupations.
*Source*: Lee et al. (2012).

result of a decrease in freight rates is 0.198 percent, which is equivalent to a change in monetary value of ZAR 2,314 million. An increase in real GDP means a larger scale of domestic production. Hence there is a higher demand for labor input, and the employment of unskilled and skilled labor increases. Based on Table 7.7, there is a 0.216 percent increase in the employment of unskilled labor (approximately 12,524 persons) and a 0.186 percent increase in the employment of skilled labor (approximately 10,230 persons).

Regarding the price index in the South African economy, there is a decrease in CPI, but its impact is insignificant. The decrease in CPI can be explained by the fact that a decrease in freight rate will lead to lower prices of foreign commodities (through the supply effect), as well as lower prices of domestic commodities (through the substitution effect). As for the international trade value, there is an increase in both imports and exports, hence the total value of trade. Finally, the value-added (or, equivalently, the payment to primary factors) increases. In sum, a decrease in freight rate promotes international trade and is beneficial to the South African economy.

A reduction in freight rate will cause an asymmetric impact on export patterns and import patterns, as respectively shown in Table 7.8 and Table 7.9. Given the Armington assumption (Armington, 1969) in the GTAP model which allows for the substitution between different sources of exports or imports, the reduction in sea freight costs leads to a shift toward closer trading partners, while away from partners further away. According to Table 7.8, the exports of containerized general commodities to SSA increase most (3.657 percent), followed by the exports of containerized agricultural commodities to SSA (3.066 percent) and the exports of containerized agricultural commodities to Middle East (0.812 percent). Regarding the imports, Table 7.9 shows that the imports of containerized general commodities from SSA increase most (0.810 percent), followed by the imports of containerized agricultural commodities from SSA (0.565 percent).

## Conclusions

Ports have been regarded as an economic infrastructure and catalysts for the economies they serve, and it is evident that the associated development generates economic benefits. An important contribution of the case study of South Africa is that it provides the quantitative effects of port development on the South African economy which support the above viewpoint. Using a global CGE model, namely, the GTAP, the

*Table 7.8* Impacts (% change) on export patterns for the scenario of a decrease in freight rate

| Commodity | SSA | Northern Europe | Asian Countries | Middle East | North America | Mediterranean | Rest of the world |
|---|---|---|---|---|---|---|---|
| Containerized – G | 3.657 | 0.243 | 0.528 | 0.311 | 0.170 | 0.276 | 0.302 |
| Containerized – A | 3.066 | 0.402 | 0.329 | 0.812 | 0.330 | 0.346 | 0.378 |
| Major bulk | 0.020 | 0.024 | 0.027 | 0.026 | 0.029 | 0.025 | 0.027 |
| Break and minor bulk | 0.026 | 0.025 | 0.025 | 0.025 | 0.027 | 0.025 | 0.026 |
| Liquid | 0.016 | 0.018 | 0.018 | 0.019 | 0.019 | 0.018 | 0.018 |
| Automobile | 0.029 | 0.018 | 0.018 | 0.018 | 0.019 | 0.017 | 0.018 |

*Source*: Lee et al. (2012).

*Table 7.9* Impacts (% change) on import patterns for the scenario of a decrease in freight rate

| Commodity | SSA | Northern Europe | Asian Countries | Middle East | North America | Mediterranean | Rest of the world |
|---|---|---|---|---|---|---|---|
| Containerized – G | 0.810 | 0.236 | 0.256 | 0.243 | 0.178 | 0.293 | 0.317 |
| Containerized – A | 0.565 | 0.159 | 0.243 | 0.240 | 0.143 | 0.172 | 0.247 |
| Major bulk | 0.205 | 0.201 | 0.199 | 0.198 | 0.199 | 0.200 | 0.199 |
| Break and minor bulk | 0.213 | 0.207 | 0.207 | 0.206 | 0.205 | 0.207 | 0.206 |
| Liquid | 0.212 | 0.202 | 0.202 | 0.200 | 0.201 | 0.202 | 0.201 |
| Crude oil | 0.146 | 0.153 | 0.154 | 0.153 | 0.154 | 0.154 | 0.154 |
| Automobile | 0.159 | 0.141 | 0.140 | 0.140 | 0.139 | 0.141 | 0.140 |

*Source*: Lee et al. (2012).

ensuing economic impacts of port development are examined from an investment perspective and an operational (freight cost) perspective.

The key findings are that port development generates growth and employment and is beneficial to the South African economy as a whole, that port investment brings significant benefit to the port-related sectors (particularly to those activities related to water transport, transport equipment and construction), and that reduction in freight rates as a result of a saving in waiting time will cause asymmetric impact on the shipping costs across regions and consequently lead to a shift toward closer trading partners (in particular, SSA and Middle East).

The results of the case study of South Africa highlight the significance of port sector to the South African economy and show that port development, as a means of promoting trade and employment, is an important dimension for promoting economic growth in South Africa. Our quantitative results supplement to the assessment of the national economic benefits associated with port-related activities. They also provide policymakers with references to explore the macro-economic benefits of a complementary ports system and to assess the country's port development strategy.

In Lee et al. (2012), we note the significance of the global CGE model, the GTAP, in port-related analysis. In particular, the international dimension of the global CGE model enables us to explore the associated impact of port development, not only in terms of a total trade level, but also in terms of a disaggregated level by major export and import commodities and by major international trading routes. Combining the global model with an optimization model and origin–destination analysis will be a useful tool to identify the products/commodities and freight corridors that offer high-growth potentials for South Africa. The associated results would also suggest the cost-minimizing corridor route linking ports that will enhance South Africa's competitiveness. This issue will be a future research topic.

## Notes

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1. According to Bennathan and Walters (1979), there are two doctrines concerning the port development policy drivers: the Anglo-Saxon doctrine and the Continental (European) doctrine. The Anglo-Saxon Doctrine views ports

as commercial entities. Hence port should be self-sufficient and should make a profit (or at least should not make a loss).

2. For detailed introduction of various approaches in evaluating the economic impacts of port sector, please refer to Acciaro (2008) and Danielis and Gregori (2013).
3. https://www.gtap.agecon.purdue.edu/ (accessed April 27, 2015).
4. A closure is a classification of exogenous and endogenous variables.
5. The other way is to fix the trade balance (DTBAL is assumed to be exogenous) or national savings (saveslack is assumed to be exogenous).
6. See, for example, Decaluwe et al. (1988) and Ekinci (1993).
7. Our investment scenario is designed to evaluate the economic impacts of the whole port expenditure (equal to ZAR 4 billion) in the year of 2002.
8. Because of data limitation, the port-related activities could not be further separated from the five port-related sectors. The simulation results are the best approximations for the impacts of aggregate investment in these sectors.
9. http://www.globalshippingcosts.com/.
10. In the GTAP model, the relationship between c.i.f. prices and f.o.b. prices is characterized by the following equation:

    **pcif(i,r,s)= FOBSHR(i,r,s) * pfob(i,r,s) + TRNSHR(i,r,s) * ptrans(i,r,s),**

    where ptrans(i,r,s) is the cost of the international transportation of commodity i from region r to region s.

    Furthermore,

    **ptrans(i,r,s)= sum(m,MARG_COMM, VTFSD_MSH(m,i,r,s) * [pt(m) – atmfsd(m,i,r,s)]),**

    where MARG_COMM is composed of two different modes of transport ("water (sea) transport" and "others" (such as air transport)), and atmfsd(m,i,r,s) is an exogenous variable. The changes between the c.i.f. prices and f.o.b. prices (either due to a change in the sea freight rate or due to a change in port cost) can be simulated by shocking atmfsd(m,i,r,s). This variable is a four-dimensional variable, which can specifically capture the changes between c.i.f. prices and f.o.b. prices caused by the modes of transport (m), commodity types (i) and routes (from r to s).

11. In other words, the major difference between the two closures is the assumption of the supply of primary factors. The simulation using the Keynesian macroeconomic closure can be seen as a short-run situation because it captures the effect in a period of time in which the supply of the primary factors is fixed (inelastic). In contrast, the simulation based on the neo-classical macroeconomic closure captures the long-run effect given the assumption under which the supply of primary factors can be adjusted.

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# 8

# Developing the Fifth Generation Ports Model

*Paul Tae-Woo Lee and Jasmine Siu Lee Lam*

## Introduction

Port functions including container ports have been dramatically developing since the inception of container transportation. The United Nations Conference on Trade and Development (UNCTAD) (1994), Van den Berg and Van Klink (1995), and Van Klink (1995) documented the function and role in the development of ports from the first generation stage to the fourth generation stage under the category of external environment, functional organization, spatial organization and port organization and strategy (see Table 8A.1). UNCTAD (1999) in its newsletter proposed the concept of "fourth generation port" (4GP), referring to vertical and horizontal integration port strategies. Following the above literature contribution, several studies contributed to classifying ports' typologies and to elaborating their roles and functions in a comprehensive way (e.g., Beresford et al., 2004; Bichou and Gray, 2005; Flynn et al., 2011; Lee and Lam, 2014, 2015; Paixao and Marlow, 2003; Pettit and Beresford, 2009; Verhoeven, 2010). Flynn et al. (2011) proposed the "fifth generation port" (5GP) with the introduction of "port ladder" for customer centric community-focused port. Most existing literature has not focused on the types of container ports. Container ports are key facilitators of international trade development, being a critical node in the context of supply chain management. Therefore, we need to further develop the concept of 5GP from the viewpoint of container ports. Highlighting some glitches and missing points in the 5GP, Lee and Lam (2013, 2015) modified it and tested it empirically by descriptive and quantitative methods, taking cases of four major international ports, namely, Shanghai, Singapore, Hong Kong, and Busan ports. Their empirical test results and implications in tandem with the feedback from the field industry and the readers of Lee and Lam (2014, 2015)

have motivated the authors to revisit the 5GP. Therefore, this chapter attempts to purify and further elaborate 5GP, focusing on container ports and maritime logistics.

## Literature review

To elaborate the conceptualization of 5GP proposed in Lee and Lam (2015), we first start to revisit the literature review and add relevant references for each item and minimize any ambiguity in it (see Lee and Lam, 2015, Table 2). UNCTAD (1994) coined the "third generation port" (3GP), referring to ports that focus on cargo handling in association with value-added services such as warehousing, packaging, distribution and other types of activities generation additional job opportunities and regional economic development. Paxiao and Marlow (2003) argued that the idea of 3GP would be sufficient if the world economic growth pattern could be forecasted with any uncertainty, but unfortunately, this is not the case. The external environment in the globalized economy having characteristics, among others, mega carrier and mega container hub-port development, relocation of manufacturing production lines in tandem with free trade agreements and growing China's economic impact in Africa and South America, have been causing structural changes in maritime flow and supply chain management. Having said that, the authors maintained that port authorities and/or managers need to adopt a new logistics approach based on agility in order to cope with these developments and its pertaining uncertainties. Beresford et al. (2004) critically examined the 3GP model by UNCTAD and concluded that it was developed in discrete steps so that it had fundamentally glitches in it. A port is a kind of organic system in a national socio-economic-political system as well as the globalized economic system. Therefore, port devolution would be understood in the context of structural changes of the overall systems because a port is a dynamic and systematic organism. Developing countries have different economic, social, political systems from developed countries. As a social and economic organization, a port evolves continuously, adapting to changing economic and trading patterns, new technologies, legislation and port governance system. Even the critical comments made by Beresford et al. (2004) are sensible, in reality, it is not easy to develop continuous steps for port next generation models including the modified 5GP models to be proposed in this chapter.

Following 3GP in 1994, UNCTAD (1999) coined the concept of 4GP under the eight categories – that is, service quality, information

technology (IT), community environmental impact, port cluster, maritime cluster, logistics hub, inland, waterside, referring to vertical and horizontal integration port strategies (see the first and second column in Table 8.1). Flynn and Lee (2010) coined the fifth generation port (5GP) under the same categories. While 4GP is driven by the internal profit, 5GP is driven by customer centric community interests. Flynn and Lee (2010) proposed a new port classification into five levels as indicated in Figure 8.1:

- Level One – Cargo ports
- Level Two – Logistics Ports
- Level Three – Supply chain management (SCM) ports (bilateral e-ports)
- Level Four – Globalized E-ports
- Level Five – Customer-centric community ports

The figure shows a framework of port generations evolving along a "port ladder" to describe how leading ports are continuously improving and strengthening their operations. In other words, it depicts how some leading ports are adapting to new customers and customer requirements in tandem with their responses to changing shipping and port environments to level up the port ladder. As a port goes up "economic value creation" on *y*-axis and "complexity" on *x*-axis to the top right corner, we see the port that is providing port stakeholders with integrated service to meet their multifaceted business requirements. Flynn and Lee (2010) and Flynn et al. (2011) explained that port business activities consist of different level of complexity so that the port as a service provider should integrate the activities to meet needs of their clients or port stakeholders such as shipping companies, shippers and community. From the viewpoint of the port's marketing strategy, this is an issue of how the port develops and keeps a long-term core of client or what Charan (2007) described as "customer-centric strategy". Thanks to the concept, Flynn et al. (2011) define 5GP as "customer-centric and community focused ports, with service deliverables related to port user's multi-faceted business requirements, while also taking care of community stakeholder requirements" (Flynn et al., 2011: p. 502). Thus, the authors argued that 5GP needs to be keen on its customers' requirements and the local community's interests, paying attention to changing shipping and port environments and inter-port competition. The dynamics between the port and its client base become much more complex in association with security issue as well as national and international regulations.

*Table 8.1* Differentiation of the fifth generation ports

| Items | The 4GP by UNCTAD | The 5GP proposed by Flynn et al. (2011) |
|---|---|---|
| Service quality | Meeting regulations and general levels of standards | Finding dynamic incentives to perform beyond basic standards |
| IT | Cargo clearance and tracking | Measures focused on service, security and performance impact. IT is not only based on tracking and tracing but also on event management (anticipation) and performance measurement. |
| Community environmental impact | Regulatory compliance with environmental impact and planning statutes | Active outreach to community in planning and decision-making process |
| Port cluster | Handled through land-use planning | Port services provision integral to mission and vision. Port leaders have role as "port cluster managers" contributing to generating value-added. |
| Maritime cluster | Treated as separate from port function | Still functionally independent of the port cluster, but creative financial incentives to attract shipowner and cargo by creating jobs and value-added |
| Logistics hub | Logistics developed as a back of port function; and Physical Free Trade Zones and Logistics Parks | Logistics seen as part of a maritime logistics chain; Airport interface for high-value added flexibility; and Advanced Free Trade Zone and Logistics Park functions. |
| Inland | Inland connections develop through natural evolution | Ports develop hinterland strategies through pricing and incentive policies ensuring that evolution does not disadvantage interest of cargo owners. |
| Waterside | Port marketing as two dimensional price and quantity approach | Ports developing foreland strategies through pricing and other incentive policies |

*Source*: Flynn et al. (2011, p. 503).

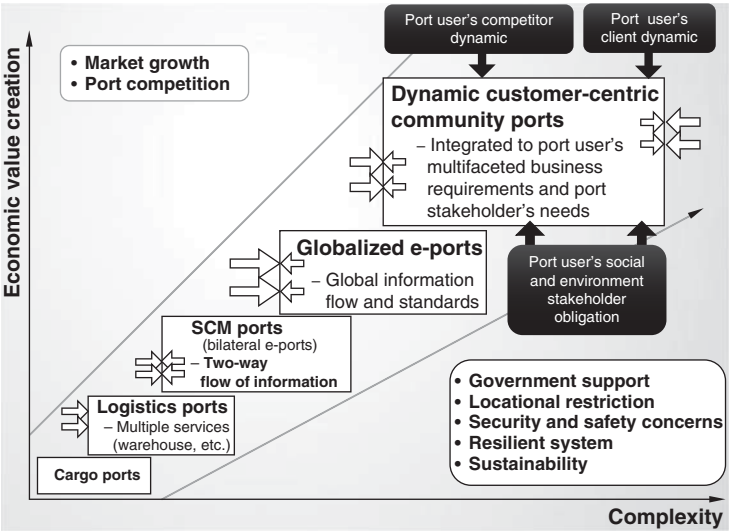


*Figure 8.1* Evolution path to the fifth generation as "Dynamic Customer-Centric Community Ports"
*Source*: Flynn and Lee (2010); modified by Lee (2014).

Flynn et al. (2011) articulated 5GP under the same eight categories, highlighting differentiation of the eight definitions between the UNCTAD 4GP and the 5GP (see Table 8.1), referring to their findings drawn by their survey among port experts, port service users and port system managers with the concept of customer-centric and community-focused ports. As Flynn et al. (2011) defined the 5GP as 'customer-centric and community-focused ports, the first version of 5GP is required to meet the port client's multifaceted requirements by utilizing market mechanism, incentives and government policy for port users and port operators. The updated 5GP is secondly grounded in the concept of community and, stakeholder relations (Dooms et al., 2013; Flynn et al., 2011; Hall, 2006) because the 5GP should be capable to deal with community issues in a sustainable and structured way.

As can be seen in the table, the authors contributed to further elaborating the definitions of the eight items compared to 4GP, reflecting current developments in container ports in terms of logistics hub, clustering and IT. Arguing that the description of the eight items in Flynn et al. (2011) is to some extent vague and does not have a sharp demarcation line among some items for the sake of comparison and

evaluation of port generation, Lee and Lam (2015) modified the 5GP on the basis of their critique on the third column in Table 8.2 as follows:

- In Flynn et al. (2011), the item of service quality is defined as finding dynamic incentives to perform beyond basic standards. While this is a higher requirement on service quality to make a port situated beyond the 4GP level, the description is rather broad. It does not explain where a 5GP should be directed to. In the aspect of service quality, the achievement of customers' satisfaction should be specified since a core concept of 5GP is being customer-centric (Ha, 2003).
- The feature of IT in the original concept of 5GP is also too general. On top of functions including track and trace, event management and performance measurement, we propose single window system (SWS) as a main framework behind these IT functions (Lee et al., 2000). The implementation of one-stop services will put a port in a more advantageous position in view of huge volume of cargo and information flows.
- Regarding the item of community environmental impact, we enrich the concept by adding "port-city interface", "waterfront development", and "active green port policy" (Acciaro et al., 2014). These additions help guiding ports on what they need to conform in terms of community environmental efforts. The emphasis on the interface with urban planning is highlighted which will lead to higher social values obtained by a 5GP.
- The two items "port cluster" and "maritime cluster" are functionally independent. However, in practice a port cluster is interconnected with a maritime cluster (Zhang and Lam, 2013). The two cannot be analyzed without understanding the interrelationships of their path of development. The synergy between a port cluster and a maritime cluster is particularly important for a port to advance to a 5GP status.
- As for the feature of logistics hub in Flynn et al. (2011), the positioning of the logistics function in a 5GP is not very clear. We added the logistics function's connection with hinterland strategies. It means that a 5GP should be well connected to the inland side in order to build synergy effects (Pettit and Beresford, 2009). In this case, a 5GP is able to move beyond a pure port to a logistics hub.
- Regarding the feature of inland connection, we mainly add more elaboration to specify the capability of a 5GP to generate efficiency of an intermodal system with possible reduction of total transportation costs. Thus a 5GP does not only have incentive pricing and policies,

it also creates the outcome of higher efficiency and cost effectiveness in inland connection. This is essential especially in view of the accelerated development in dry ports or inland ports (Monios and Wilmsmeier, 2012).

- Lastly, for the item of waterside, its description should be more explicit to differentiate a 5GP from a 4GP. Hence, the purpose of foreland strategies is added to this feature, specifying the direction moving toward SCM to improve inter-port competition by capturing transshipment cargoes (Lam, 2011). That is, a 5GP is not a pure gateway port but also a competitive transshipment center.

Referring to the above critiques on the 5GP proposed by Flynn et al. (2011), Lee and Lam (2015) proposed the first revision of 5GP (hereinafter, the first 5GP) under the same eight items in Table 8.2 with further relevant references and then tested it to evaluate container port generation status of the four major container ports in Asia, that is, Shanghai, Singapore, Busan and Hong Kong ports. The first 5GP modified by Lee and Lam (2015) is grounded firstly on the concept of customer-oriented service (Flynn et al., 2011; Martelo et al., 2013).

## Empirical test of the modified 5GP with multiple case studies

With reference to their revised 5GP, Lee and Lam (2015) examined the status of major Asian container ports which are a representative port from each economy having container ports listed as top 10 ports in the world – that is, Busan, Hong Kong, Shanghai and Singapore – referring to the characteristics on the eight items of the 5GP as shown in Table 8.2. The analysis of the port case studies was based on desk research and the authors' field trips to the ports and interviews. Multiple case studies are suitable for regional port research especially for comparative analysis (e.g., Debrie et al., 2013). This section summarizes the major findings of the evaluation and comparison of the status of the four ports, aiming at drawing any glitches in the 5GP model so that we can further modify it (Table 8.3).

Table 8.3 summarizes the evaluation results of port generation status of the four major container ports, referring to the modified 5GP, that is, the first 5GP, as shown in Table 8.2 (Lee and Lam, 2014, 2015). The table reveals that in general, the ports are no longer entirely belonging to the 4GP stage. In other words, among the eight items – that is, service quality, IT, community environmental impact, port cluster, maritime cluster, logistics hub, inland and waterside – IT has

*Table 8.2* Comparison of key features of the fourth and the fifth generation ports

| Items | The fourth generation ports by UNCTAD | The 5GP proposed by Flynn et al. (2011) | The 5GP modified by the authors | References |
|---|---|---|---|---|
| Service quality | Meeting regulations and general levels of standards | Finding dynamic incentives to perform beyond basic standards | Finding dynamic incentives to perform beyond basic standards and to meet customers' satisfaction | Ha (2003), Lee and Hu (2012) |
| IT | Cargo clearance and tracking | Measures focused on service, security and performance impact. IT is not only based on tracking and tracing but also on event management (anticipation) and performance measurement. | IT focuses on one stop service and security to improve port performance and users' satisfaction. IT is not only based on tracking and tracing of both cargoes and information via a "single window" system but also on performance measurement including gas emission information | Lee et al. (2000) |
| Community environmental impact | Regulatory compliance with environmental impact and planning statutes | Active outreach to community in planning and decision-making process | Active outreach to community stakeholders in port-city interface, planning and decision-making process, in particular waterfront development. Active green port policy with rewarding system is envisaged. | Acciaro et al. (2014), Lee et al. (2013, 2015) |
| Port cluster | Handled through land-use planning | Port services provision integral to mission and vision. Port leaders have role as "port cluster managers" contributing to generating value-added. | Port services provision integral to mission and vision. Port leaders have role as "port cluster managers" in tandem with maritime cluster contributing to generating value-added in in the context of logistics hub. | De Langen (2007), Zhang and Lam (2013) |

*Table 8.2* (Continued)

| Items | The fourth generation ports by UNCTAD | The 5GP proposed by Flynn et al. (2011) | The 5GP modified by the authors | References |
|---|---|---|---|---|
| Maritime cluster | Treated as separate from port function | Still functionally independent of the port cluster, but creative financial incentives to attract shipowner and cargo by creating jobs and value-added | Still functionally independent of the port cluster, but subject to clustering, functionally interrelated with creative financial incentives to attract shipowner and cargo by creating jobs and added value | Othman et al. (2011), Zhang and Lam (2013) |
| Logistics hub | Logistics developed as a back of port function; and Physical Free Trade Zones and Logistics Parks | Logistics seen as part of a maritime logistics chain; Airport interface for high-value added flexibility; and Advanced Free Trade Zone and Logistics Park functions. | Logistics seen as part of a maritime logistics chain; Airport interface for high-value added flexibility; and Advanced Free Trade Zone and Logistics Park functions. This logistics function is interrelated to the feature of "inland" to maximize its synergy effect. | Pettit and Beresford (2009), Wang and Cheng (2010) |
| Inland | Inland connections develop through natural evolution | Ports develop hinterland strategies through pricing and incentive policies ensuring that evolution does not disadvantage interest of cargo owners. | Ports develop hinterland strategies through pricing and incentive policies ensuring that evolution does advantage interest of cargo owners and generates efficiency of intermodal system with possible reduction of total transportation costs. | Monios and Wilmsmeier (2012), Pettit and Beresford (2009) |
| Waterside | Port marketing as two dimensional price and quantity approach | Ports developing foreland strategies through pricing and other incentive policies | Ports developing foreland strategies to capture transshipment cargoes in tandem with SCM through pricing and other incentive policies | Lam (2011), Lam and Yap (2011b) |

*Source*: Authors, with excerpts from table 2 in Flynn et al. (2011, p. 503) and table 4.2 in Lee and Lam (2015, pp. 101–2).

*Table 8.3* Evaluation status and comparison of the ports generation of the four ports with the modified 5GP model

| Items | Busan | Hong Kong | Shanghai | Singapore |
|---|---|---|---|---|
| Service quality | Forwarding to 5GP, most efficient container port, providing comprehensive services to ships but some service attributes requiring improvements | 5GP, one of the world's best ports satisfied by shipping liners, providing comprehensive services to ships | 4GP, gaining lowest service satisfaction from the port users | 5GP, one of the world's best ports satisfied by shipping liners, providing comprehensive services to ships |
| IT | 5GP, integrated IT solutions | 5GP, integrated IT solutions | 4GP, no single window system connected with Chinese container ports | 5GP, integrated IT solutions |
| Community environmental impact | 4GP, Busan Port Authority (BPA) having limited authority to implement decision making on the community impact | Toward 5GP, largely led by the maritime industry | 4GP, focusing on regulatory compliance | Toward 5GP, largely led by Maritime and Port Authority |
| Port cluster | 4GP, Busan Port Authority with limited autonomous to use land | 4GP, government as land use planner | 4GP, government as land use planner | 5GP, Maritime and Port Authority and PSA Corporation as port cluster developers |
| Maritime cluster | 4GP, offering neither FOC nor tax incentives for maritime business | 5GP, offering advanced maritime services and the fourth largest shipping register in the world | 4GP, developing maritime services expertise | 5GP, offering advanced maritime services and the fifth largest shipping register in the world |

*Table 8.3* (Continued)

| Items | Busan | Hong Kong | Shanghai | Singapore |
|---|---|---|---|---|
| Logistics hub | 4GP, Korea's Logistics Performance Index (LPI) is relatively low at 21st rank in the world but moving forward to 5GP under the Government's Master Plan | 5GP, the whole of Hong Kong is a free port, ranked second in World Bank's LPI | 4GP, China's LPI is relatively low at 26th, but highly ranked as a developing country | 5GP, ranked first in World Bank's LPI |
| Inland | 4GP hindered by North Korea | 4GP, hindered by congested and inefficient cross-border hinterland transport | Toward 5GP, extensive transport network penetrating the vast hinterland in the Yangtze River Delta and central China | 4GP, small island state without extensive freight corridors to neighbor countries |
| Waterside | Moving forward to 5GP, focusing on transshipment cargoes with proactive port pricing | 4GP, extensive connectivity to forelands with growing transshipment traffic | 4GP, developing a coastal feeder network in its Northeast Asia Strategy | Somewhere 4GP to 5GP, focusing on common user strategy as a major transshipment hub |

*Source*: Table 4.9 in Lee and Lam (2015, pp. 130–31).

reached the most advanced stage with three ports being classified as the 5GP, except for Shanghai. In the era of globalization and SCM, high-end IT solutions meeting customer and community's sophisticated and diversified demands are indispensable. IT including SWS and RFID are connecting stakeholders in public and private sectors to share information and, as a result, to save time and costs in documentation and manpower. In addition, it contributes to developing maritime logistics chain, saving time and costs, generating higher values and activating free trade zone adjacent to ports. The common feature among the first 5GP is the development of integrated IT solutions. Korea and Singapore are among the leaders in seaport electronic information system. Both systems of the two nations have well-developed SWS, port management information system (MIS) and cargo tracking system so that at anytime and anyplace, port users can obtain data such as vessel arrival/departure and overall information. But as far as IT service is concerned, Shanghai Port is behind the three ports.

In view of the multi-case analysis, Lee and Lam (2015) concluded that Singapore Port has transformed into a 5GP in seven items except the item of "Inland" and hence can be evaluated as a leading port among the four case study ports in the first 5GP model. The Singapore government has a lean and efficient organization which enables its role as a multi-dimensional port developer. Many government policies are favorable to Singapore's advancement as a 5GP. The Singapore government, represented by the Maritime and Port Authority (MPA), is particularly forward-looking in port cluster and maritime cluster development. The government's drive in this aspect is regarded as the most proactive among the four ports. For example, it encourages international ship owners and operators to establish their commercial shipping operations in Singapore through tax concession and exemption. Thanks to the strong development of the port and business incentive policies, Singapore is only port having a 5GP status for both items of port cluster and maritime cluster. The feature of inland connection remains at the 4GP stage. As compared with major gateway ports such as Shanghai, massive intermodal connection is not really applicable to Singapore due to the small size of the city state and the port's focus on transshipment traffic. Singapore's major constraint is the lack of space (Yap and Lam, 2013). Inland connections are developed mainly through natural evolution thus far. Without developing extensive freight corridors to neighbor countries, there is a capacity limitation for Singapore's growth in inland connectivity.

On the contrary, inland connectivity is a major strength of Shanghai Port. This is the only item that Shanghai is rated as toward a 5GP. In particular, the domestic road network makes transport flexible. Owing to the leading role of the central government, Shanghai Port has rapidly developed higher standards in the overall port efficiency and service quality in the past decade. The government has invested heavily in port infrastructure and facilities, to capture the benefit from the tremendous growth in China's economy (Lee and Flynn, 2011). However, according to the survey conducted by Lee and Hu (2012), Shanghai obtained the lowest service satisfaction from the port users among the four container ports. Also, Shanghai does not have an SWS to share cargo information among the Chinese ports. The port also has no collaboration interaction with service by using smart phone mobile integrated functions in the IT system. These would be the key points for Shanghai to improve on.

As for Busan, the port is more of a 4GP than a 5GP based on its current conditions. Busan Port is a case that the Korean government plays a proactive role in forwarding the port's status to 5GP, although some limitations due to the bureaucratic system and the geo-political situation exist. Having constructed the Busan new container terminal port, the Korean government has made strenuous effort to catch up rapid and significant changes in shipping and port environments (Lee and Flynn, 2011). IT in Busan Port is at the 5GP stage, while service quality is moving toward the first 5GP status. The port has five items – that is community environmental impact, port cluster, maritime cluster, logistics hub and inland – which are classified as 4GP, so that it needs relatively more essential policies for developing port and maritime clusters, as well as improving Busan's logistics performance. However, active port-city interface among port stakeholders is found in the course of waterfront development in Busan Port. In particular, Busan Port Authority (BPA, 2013) has played a central role in accommodating and reflecting views of Busan city government and residents. Hence, the port is considered proactive and has made efforts in improving its community relations. However, BPA has limited autonomous power in areas such as environmental policy and land use. It will be a good move to raise a bar to 5GP in the terms of "community environmental impact".

Table 8.3 shows that Hong Kong has achieved or is toward the 5GP status in five items – that is service quality, IT, community environmental impact, maritime cluster and logistics hub. Unlike the other ports, the Hong Kong Special Administrative Region (HKSAR) Government's role as a port developer is less significant as it adopts a free market macroeconomic policy. Nevertheless, Hong Kong is an interesting case that

in a liberal governance environment, the private sector prospers and contributes to the port's 5GP status. Capable of handling a huge cargo volume, the port of Hong Kong is highly satisfied by shipping lines in terms of service quality (Lee and Hu, 2012). Even Hong Kong Port has achieved a very good logistics performance, its inland connectivity is found to be a major weakness that undermines the port's competitiveness. Mainland China is the port's vast hinterland so the inland connection to the mainland is crucial (Lam and Yap, 2011a). However, this is hindered by congested and inefficient cross-border hinterland transport which has existed for long time. The Hong Kong SAR government realized the issue and the Hong Kong–Zhuhai–Macau Bridge is being constructed to improve the situation. Moving forward as a 5GP, it is also strategic for the port to capture more transshipment business.

The findings in Lee and Lam (2015) draw managerial insights that the ports have evolved at different paces for various items largely to achieve strategic fit of the port's major clientele. This is virtually a customer-centric approach in enhancing the port's competitive advantage.

The main policy implication drawn from the case studies is that the government indeed plays a key role in advancing the port to a higher port generation status. The concept of 5GP explicitly requires the inclusion of green port priorities to assist with gas emissions reductions and waterfront development to harmonize with urban planning. These two issues are critical for further developing port generations. This chapter has illustrated with examples on how government policies drive port development in these areas. This makes a practical contribution in terms of policymaking in the context of Asian container ports in Korea, Singapore and China (Lee and Flynn, 2011).

Conclusively, Lee and Lam (2015) made an original attempt to analyze port generation status by employing multiple case studies. Future research can evaluate generation status of container ports in a more quantifiable way taking more cases of container hub ports in Asia and Europe. Their research findings presented can be a good reference in testing 5GP in the container port sector as well as overall ports. In addition, port authorities can conduct benchmarking with reference to the eight items of the first 5GP and the second revision of 5GP, which is discussed in the next section.

## The second revision of the 5GP

Lee and Lam (2015) modified the 5GP proposed by Flynn et al. (2011), which was called the first revision of 5GP, and tested it empirically

by descriptive and quantitative methods, taking cases of Shanghai, Singapore, Hong Kong and Busan ports. The empirical test results and implications in tandem with the feedback from the field industry and the readers of the authors' work have motivated us to revisit the modified 5GP. Therefore, Lee et al. (2014) attempt to purify and further elaborate the modified 5GP (Lee and Lam 2015), focusing on container port and maritime logistics. The authors revised their criteria and added more detailed evaluation criteria for 5GP, which is called the second version of 5GP, consisting of 5 aspects, 8 features, and 12 criteria (see Table 8.4). With reference to the literature and the latest trend in the industry, the features and criteria are formulated for the sake of specific performance measurement in practice.

*Table 8.4* Key components of the second version of the 5GP

| Aspects | Features | Criteria | Definitions |
|---|---|---|---|
| Service | Service quality | (A1) Reliability | Productive, quality and reliable services provided for port users, minimizing their uncertainty |
| | | (A2) Resilient system | Resilient system with proactive actions responding to any risks and accidents (including natural disasters) at the port in terms of operator's responsiveness |
| Technology | Communication system | (B1) Single window system | Development of single window system integrating port MIS and logistics EDI network system using IT, and nanotechnology and biotechnology |
| | Information of technology (IT) | (B2) Radio-frequency of identification (RFID) or other IT applications | Applications of RFID or other IT to port operation and management |

| | | | |
|---|---|---|---|
| Sustainable development | Symbiosis of port and city | (C1) Coordination of port and city development | Port and public authorities coordinate port and city development for sustainability |
| | Green environment | (C2) Integrated development | Integrated development of technical system to reduce gas emission and pollution with incentive pricing system |
| | | (C3) Green port development | Friendly environment which means the sustainable measures will benefit the port city |
| Cluster | Clustering | (D1) Port cluster management | Port clustering management and policy supported by port authority and government |
| | | (D2) Maritime cluster management | Creative financial incentives and social infrastructure to attract ship owners and cargoes by creating jobs and value-added in the port city and adjacent cities |
| Hub port | Globalized hub link | (E1) Port infrastructure | Accommodating mega carriers without any technical limitation to improve port efficiency |
| | | (E2) Port connections | Connectivity to other ports including feeder service with major carriers' callings |
| | Logistics hub | (E3) Inland connections and value-added function | Logistics chain for high value-added in association with free trade zone or logistics complex |

*Source*: Lee et al. (2014).

The key differences between the first 5GP and its second version are as follows:

- The second revision of 5GP consists of aspects, features and criteria so that it has numerated elements in the 5GP, helping port managers evaluate port performance in quantitative way, for example, multi-criteria decision-making (MCDM) technique as proposed in Lee et al. (2014).
- The item of "Service quality" in the first 5GP model added customer's satisfaction to the regulation and general levels of standards about it. The second revision of 5GP has selected two criteria, that is, reliability and resilient system, under the features of "Service quality", referring to empirical test results that the Asian major five container ports and major worldwide shipping liners are most concerned with the two criteria out of 19 service attributes (Hu and Lee, 2011; Lee and Hu, 2012). Productive, quality and reliable services provided by ports are critical services for port users and help them minimizing their uncertainty. This is one of the core values of customer-centric services to satisfy port users' needs and, as a result, attract loyalties of port users. A resilient system with proactive actions responding to any risks and accidents, including natural disasters, at the port is required for ports in light of a similar rationale. Due to the overall customer demand, the feature of service quality is to be measured by the criteria of reliability and resilient system (Wu and Goh, 2010; Zhang and Lam, 2014).
- Recognizing the importance of container cargo information flows in maritime logistics, the second revision of 5GP takes into account high-end IT solutions such as SWS and radio-frequency of identification (RFID) meeting stakeholder's and diversified demands. The technology aspect is represented by the criteria of SWS and RFID or other IT applications (Perego et al., 2011). Both SWS and RFID contribute to sharing container cargo information among the stakeholders involving container transportation, private and public, generating multi-dimensional benefits. In this regard, the *economies of fusion technology* of nanotechnology, biotechnology and IT is considered in tandem with *economies of flow* and *economies of connection* in the process of container cargo flows. On the benefits of SWS and the three economies, see Chapter 9 in Volume 1 of this book.
- The aspect of "Sustainability" has been reinforced in the second revision owing to its growing importance in the shipping and port industry as well as city-port community. Chang et al. (2013) measured

greenhouse gas emissions (GGE) from port vessel operations by considering the case of Korea's Port of Incheon, providing estimates of GGE based on the type and the movement of a vessel from the moment of its arrival, to its docking, cargo handling and departure. On the other hand, the International Maritime Organization (IMO) designated the Baltic Sea as the world's first Emission Control Areas (ECA) in 2006 and similarly designated the North Sea in 2007 to control $SO_x$ and $NO_x$. Ships entering ports in ECA areas must burn fuels with much lower sulfur levels and run engines that are cleaner and more efficient than what is allowed in non-ECA areas to comply with the ECA regulations. This trend has become a critical issue for the port industry to consider health exposure issue caused by GGE generated in the port for the city-port community (on this issue, see Chapter 4 in Volume 1 of this book; Chang and Wang, 2012; Liao et al., 2010).

- Under the aspect of "Sustainability", the feature of "symbiosis of port and city" is added to the first revision of 5GP because the coordination of the port and the city development is essential for a sustainable community. Port cities serve as a link between local and global environments, acting as centers of exchange where different cultures and different environments meet, at the boundary between land and sea (Wang and Ducruet, 2012). As a port evolves from a 4GP to a 5GP, the city linked up to the port also evolves. While ecological concerns are important, policymakers must also consider the issue of social harmony between the port and the city for the long term development of both. Therefore, the aspect of sustainable development is measured by the criteria of coordination of port and city development, integrated development and green port development (Acciaro et al., 2014).
- Port cluster and maritime cluster are grouped under the same clustering subgroup because they are closely interrelated to meet port users' multifaceted requirements and needs (De Langen, 2007; Zhang and Lam, 2013). The feedback of Lee and Lam (2015) from its readers and the port field industry pointed out that both items are overlapping and functionally interdependent in scope of business and implementing polices for port stakeholders. Then under the feature of clustering, the two criteria are set as port cluster management and maritime cluster management, measuring a port's capability to initiate and implement policies in managing the two clusters. The items of logistics hub, Inland and Waterside in the first revision of 5GP have been replaced by three criteria, that is, port infrastructure, port

connections, inland connections and value-added function under the aspect of "Hub port". The features of the three are to be evaluated by the aspect of hubbing (Monios and Wilmsmeier, 2012; Pettit and Beresford, 2009). Those criteria are not only crucial factors in dynamic shipping and port environment but also much more quantifiable to evaluate container port status, compared to previous models including 4GP.

## Conclusion

Port development is an evolving concept especially in the modern era. Ports are confronted with complex issues stemming from the most recent developments of big data, clustering, social concern and environmental concern. It is a major challenge for such a capital-intensive industry to cope with conflicting interests and uncertainties in charting future operational and investment decisions. This chapter contributes to the understanding of the port industry from the perspective of port evolution.

Focusing on the development of ports' functionality and competitiveness, the chapter thoroughly reviewed the concepts of 3GP, 4GP, and 5GP in the literature. After UNCTAD proposed the concepts of 3GP and 4GP in 1994 and 1999, respectively, Flynn et al. (2011) put forth the concept of 5GP with world-class customer-centric and community ports representing the next evolutionary step in the port sector. Thereafter, Lee and Lam (2015) used the same eight features as in 4GP (UNCTAD, 1999) and 5GP (Flynn et al., 2011) to refine the concept of 5GP, thus leading to the first revision of 5GP, that is, the first 5GP. The modifications were meant for clearly distinguishing a 5GP from a 4GP by making the characteristics more specific. Lee and Lam (2015) also performed empirical case studies of four major container ports in Asia, using the 5GP concept. The comparative case analysis evaluated whether the four ports have advanced to the stage of a 5GP. The feasibility of the first 5GP features was also demonstrated.

Based on the literature survey and our critical analysis, some major container ports have indeed evolved to attain a more advanced generation status beyond a 4GP. The concept of 5GP is grounded on conceptual development and supported by empirical evidence. Nevertheless, in the present study the authors made a further step to develop a more updated and sophisticated 5GP model. Improvement on the first GP is required as the characteristic of sustainable development should be more concrete. The major progression of a 5GP is that it is a customer-centric

community port. As discussed in the chapter, the features of "symbiosis of port and city" and "green environment" should be added. Furthermore, the eight features of the first 5GP are not easily measurable. In order to facilitate more rigorous empirical investigations, this chapter has further developed the features of 5GP and conceptualize the key components of the second version of the modified 5GP model. The second version of 5GP consists of 5 aspects, 8 features and 12 criteria, thus enables the use of the MCDM technique. As we can see from the major differences between the first 5GP and the second version of 5GP, the modified version is more comprehensive and quantifiable. The modified 5GP model can be applied to many ports for quantitative empirical test.

Port research is an applied science domain and is a fast-growing research area. In the literature of port evolution, much effort was given to descriptive and qualitative studies. We found only very few quantitative and modeling studies in the research field so far. In order to further develop port research as a solid academic field, more conceptualization and modeling through scientific means are highly demanded. This chapter contributes to the literature by demonstrating a rigorous process of conceptual development and model building through multiple stages. The anticipated outcome is a scientifically sound 5GP model which will stimulate future research. As a suggestion for future studies, researchers can empirically investigate port evolution and its relationship with integrated urban planning for sustainable development.

## Appendix

*Table 8A.1* Functional and spatial development of a seaport

| | **First generation, stage I** | **Second generation, stage II** | **Third generation, stage III** | **Fourth generation, stage IV** |
|---|---|---|---|---|
| External environment | | | | |
| Period of developments (Western European ports) | Before 1960s | After 1960s | After 1980s | 2000s |
| Exogenous developments | Colonization steam ships<br>Rise of nations<br>Rise of trade | Petrochemistry<br>Lorry and pipeline<br>Structural prosperity<br>Industrialization | Multinationals container<br>Ecological protection<br>Internationalization | Global economy<br>Information systems<br>Environment<br>Informatization |
| Functional organization | | | | |
| Port functions | Transshipment (1)<br>Storage (2)<br>Trade (3) | (1) to (3) = Industry (4) | (1) to (4) + Distribution (5) | (1) to (5) + Logistic control |
| Production characteristic | Cargo flow<br>Simple service<br>Low value-added | Cargo flow<br>Cargo transformation<br>Combined services<br>Improved value-added | Cargo/information flow<br>Cargo distribution<br>Multiple service package<br>High value-added (port-oriented) | Cargo/information flow<br>Cargo/information distribution<br>Multiple service package<br>High value-added (network-oriented)<br>Chain management |
| Type of cargo | Break-bulk cargo | Break bulk and dry/liquid bulk | Bulk and unitized/containerized cargo | General cargo/containers information |

| | | | | |
|---|---|---|---|---|
| Spatial organization | | | | |
| Spatial scale of port | Port city | Port area | Port region | Port network |
| Spatial expansion of port | Quay and waterfront area | Enlarged port area | Terminals and distribelt toward landside | Network-related functional expansion |
| Principal locational factors | Presence of market<br>Availability of labor | Access to raw materials<br>Access to sales market<br>Availability of capital | Availability of transshipment facilities<br>Access to sales market<br>Space<br>Flexibility and costs of labor | Availability of transshipment facilities<br>Access to sales market<br>Space<br>Flexibility and costs of labor<br>Available know-how quality of life |
| Port organization and strategy | | | | |
| Organization characteristics | Independent activities within port<br>Informal relationship between port and port users | Closer relationship between port and port users loose relationship between activities in port<br>Causal relationship between port and municipality | United port community<br>Integration of port with trade and transport chain<br>Close relation between port and municipality<br>Enlarged port organization | Port network community<br>Close relation between port network and public authorities on different levels |
| Port authority's task | Nautical services (1) | (1) + development of grounds and infrastructure (2) | (1), (2) + Port marketing (3) | (1) to (3) + Network management |
| Attitude and strategy | Conservative<br>Port as changing point of transport | Expansionist<br>Transport, industrial and commercial center | Commercial-oriented integrated transport and logistics center | Commercial oriented<br>Integrated transport, logistic and information complex and network |

*Source*: Flynn et al. (2011, Table 1); compilation based on UNCTAD (1994), Van den Berg and Van Klink (1995), and Van Klink (1995).

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# Index