The Rise of Chinese Ports and Its Impact on the Port of Singapore

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Abstract

The economic rise of China and its implications for the rest of the world are well discussed in the literature. However, there is very limited discussion on the rise of Chinese ports and how it could impact the ports in East Asia. Moreover, although there have been few studies on the adverse effects of Chinese port growth on the ports of Hong Kong, Kaoshiung and Busan, there has so far no systematic study of its impact on the port of Singapore.

In this light, the objective of this paper is to assess how the expansion and growth of Chinese ports is likely to affect Singapore’s port. No doubt, the importance of the port to Singapore’s national and regional economy cannot be overemphasized. And the economic rise of China brings with it tremendous challenges as well as business opportunities. But, the debate on whether the rise of Chinese ports is more of an opportunity rather than a threat to the port of Singapore remains unresolved as the public opinion is still divided on this issue.

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The continued rise of Chinese ports has raised the question of whether their continued rise will have beneficial or detrimental effects on other Asian ports. Last year the port of Shanghai has surpassed the port of Singapore as the world’s top container port, while the list of top 10 container ports is dominated by Chinese ports. Although the throughputs of other non-Chinese ports have consistently grown, their market shares have subsequently declined.

Their rise reflects to a great extent the spectacular economic growth of China, which has been mainly driven by its export-oriented industrialization strategy. Its GDP increased at an average rate of 9.7 percent in the 1980s and 10.7 percent in the 1990s with an annual growth continuing at 7-9 percent to date and is projected to continue despite the efforts by the Chinese government to slow down the economy. Underlying its spectacular growth is its trade. In 2005, exports rose by 28 percent to $762 billion while imports grew by 17.6 percent to $600 billion producing a $102 billion trade surplus (Morrison, 2006).

It is generally agreed that China’s economic rise has caused significant repercussions for the global economy in terms of trade patterns and orientation. Much has been written on its trade implications (for example, see Tongzon, 2001), but very little in-depth study if any has been done to assess the implications for the port in Southeast Asia and in particular the port of Singapore. The port of Singapore is important not only to Singapore’s national economy but also to the ASEAN region as a transhipment port and gateway to the region. A great bulk of the cargoes handled at the port are transhipped, which implies a heavy dependence of the port of Singapore on the trade volumes coming from and/or destined for the other countries in the region. Economic developments in this region and their trade with the rest of the world will have significant implications for the Singapore port. Among the newly industrializing economies, the port of Singapore vis-à-vis Chinese ports has received the least attention in the current literature; existing literature have explored the adverse implications of China’s economic growth on the ports of Hong Kong, Kaohsiung and Busan (for example, see Cullinane et al. 2004; Tongzon and Chang, 2007 and Yap et al., 2006), but no systematic analysis has yet been undertaken on the implications for the port of Singapore.

In light of the continued rise of Chinese ports, it is therefore relevant to assess its implications for the port of Singapore. The rest of the paper consists of the following sections: section 1 briefly reviews the growth of China’s port industry and the various studies undertaken to assess the impact of the rise of China’s port industry on other East Asian ports; section 2 lays out a theoretical framework to explore the various possible scenarios and the likely impacts of the growth of the Chinese port industry on Singapore port from which an empirical model is derived, and section 3 presents the findings and policy implications followed by a conclusion and future areas for further research.

1. Review of the literature

Benefiting from the global economic recovery, the port industry of China witnessed robust growth in 2010 after experiencing the downturn in 2009. In 2010, cargo throughput of the ports
in China accomplished 8.93 billion tons, up 16.7 percent year on year and the container throughput reached 146 million TEUs, a 19.4 percent year on year rise (Research and Markets, 2011). The major ports of China are centred around Yangtze river delta (ports of Shanghai and Ningbo, Pearl river delta (ports of Shenzhen and Guangzhou) and Pan-Bohai Rim (ports of Dalian, Tianjin and Qingdao). In 2010, the port of Shanghai registered a record 29.07 million TEUs (ranked top 1 worldwide) and a cargo throughput of 563 million tons while the port of Shenzhen (mainly a container port) reached 22.51 million TEUs (ranked 4th worldwide).

The remarkable growth of China’s port industry can be further evidenced from the dominance of Chinese ports in the top 10 world’s container ports in 2010 where six of the 10 largest container ports are based in China. The port of Shanghai is now occupying the top spot after surpassing Singapore for the first time. The spectacular growth of the port of Shanghai in particular cannot be ignored.

<table>
<thead>
<tr>
<th>Ports</th>
<th>Container throughput (in million TEUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Port of Shanghai</td>
<td>29.069</td>
</tr>
<tr>
<td>2. Port of Singapore</td>
<td>28.400</td>
</tr>
<tr>
<td>3. Port of Hong Kong</td>
<td>23.530</td>
</tr>
<tr>
<td>4. Port of Shenzhen</td>
<td>22.510</td>
</tr>
<tr>
<td>5. Port of Busan</td>
<td>14.180</td>
</tr>
<tr>
<td>6. Port of Ningbo</td>
<td>13.144</td>
</tr>
<tr>
<td>7. Port of Guangzhou</td>
<td>12.550</td>
</tr>
<tr>
<td>8. Port of Qingdao</td>
<td>12.012</td>
</tr>
<tr>
<td>9. Port of Dubai</td>
<td>11.600</td>
</tr>
<tr>
<td>10. Port of Rotterdam</td>
<td>11.100</td>
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</tbody>
</table>

Sources: Websites ([http://www.supplychaindigital.com](http://www.supplychaindigital.com))

Growth in trade volume, especially its domestically-produced exports, has been the main driver behind this spectacular port growth, fuelled by China’s entry into the World Trade Organization and foreign investment-led economic growth. China’s strong economic growth is manifested in terms of spectacular aggregate, industrial output and investment growth, especially after China joined the WTO, is evident throughout the 1980s, 1990s and this current decade (Tongzon and Chang, 2007).

On the other hand, the port of Singapore’s market share in the container business started to decrease slightly from 2000 before recovering slightly in 2004 and 2005 and stabilized at around 6 percent for the period of 2007 to 2010, as Figure 1 shows.
Few studies have been undertaken to determine the presence and nature of container port competition in East Asia as well as the implications of Chinese ports’ rise. Yap and Lam (2006) and Yap et al. (2006) examined the nature and intensity of inter-port competition in East Asia and predicted that inter-port competition in the region would intensify in the future as the centre of gravity of cargo volume shifts to mainland China. However, the study failed to include mainland Chinese ports in the examination of the dynamics of competition in the region. Seabrooke et al. (2002) and Cullinane et al. (2004) attempted to assess the implications of the rise of mainland Chinese ports for the port of Hong Kong and concluded that their rise would result in a slower growth rate for the port of Hong Kong. Tongzon and Chang (2007) tried to assess the impact of the rise of China for the port of Busan and found that the rise of Chinese ports has so far been reducing the hub status of the port of Busan due to more direct ship calls by major shipping lines at the Chinese ports.

2. Theoretical Framework

The implications of the rise of Chinese ports for the port of Singapore could be adverse or beneficial depending on whether they are substitutes or complementary ports. Ports are substitutes if, as a result of certain changes in cost and non-cost factors, only one of these ports are directly serviced by the shipping lines. Under these circumstances, an increase in throughput handled by one port occurs at the expense of the other ports. On the other hand, ports are complementary if they are directly serviced by the shipping lines and thus, an increase in throughput handled by one port is accompanied by an increase in throughput handled in the other ports. There are therefore two possible scenarios depending on certain factors. These factors need to be identified and assessed in order to determine the likely impact of the continued rise of the Chinese ports on the port of Singapore.

2.1 Possible scenarios

Yap and Lam (2004) showed these two possible cases using the standard indifference curve analysis. This paper extends their theoretical framework by further identifying and assessing the key factors behind these two possible scenarios from the perspective of shipping lines.
Under a case of substitution, they demonstrated how a drop in generalized cost in a random Chinese port due to China’s maritime rise, denoted $C_x$, would affect a port user’s choice of both $TEU_x$ and $TEU_y$, which represent level of service consumption in the random Chinese port and the Singapore port, respectively. These scenarios are replicated in Figure 2.

The first scenario (Figure 2a) shows the least drastic scenario, where the reduction in cost in the Chinese port will result in an increase in quantity of $TEU_x$, and a small drop in $TEU_y$. A second scenario (Figure 2b) would see a port user, who, before the reduction in cost at the Chinese port, always based its shipping activity at the Singapore port. After the reduction in $C_x$, the port user now conduct its shipping activities in both ports. The third diagram (Figure 2c) depicts a worse scenario for the Singapore port, where the port user reduces significantly his consumption level in the Singapore port, and transfers most of his port activity into the Chinese port.

Having considered three possible competitive situations, we now look at the scenarios where the Chinese ports and the Singapore port are complements.

The first complementary scenario (Figure 2d) shows that with a decrease in $C_x$, the port user will utilize this cost savings in one port and spread it amongst both the Singapore and Chinese port, thus increasing both $TEU_x$ and $TEU_y$. The second complementary scenario (Figure 2e) illustrates a situation where a port user that initially does not carry out any shipping activity at the Singapore port. After the drop in $C_x$, the port user, while maintaining a high level of activity in the Chinese port, also starts to consume some shipping service in the Singapore port.

Figure 2a: Case of substitution: small drop  Figure 2b: Case of substitution – two ports used in Singapore port
2.2 Cost and non-cost factors

There are numerous factors to consider when shipping companies are making decisions on which port to call, which can be classified as cost and non-cost factors. Cost factors such as cargo size, vessel size, voyage costs, port infrastructure characteristics and availability of efficient and adequate feeder services. These factors are considered in the calculation of the likely costs and revenues generated in relation to the design of shipping service networks. Non-cost factors
include the scope of coverage, security and vulnerability, strategic alliances and industry consolidation as well as shippers’ preferences.

Freight rates are usually similar for shipping services with the same origin-destination port pairs in most trade routes. Hence, the cost structure is the main factor in the differentiation of the profits generated by different shipping companies (Imai et al., 2006). Furthermore, there is a ‘survival of the fittest’ phenomenon on container trades routes particularly on the world’s largest volume trade routes: East Asia-North America, East-Asia-Europe and North America-Europe (Lim, 1994). Price wars among the container lines meant that only firms with the lowest cost are able to survive, resulting in only a few big shipping lines in the industry currently. Given the competitiveness of the liner shipping industry, cost factors plays a particularly significant importance in deciding the choice of shipping networks as it directly affects the competitiveness of the shipping line.

The following cost factors are considered as key factors in determining the choice of which port to call from the perspective of shipping lines and have therefore implications on whether Chinese ports and Singapore port are substitutes or complementary:

**Cargo size**

Cargo size is important as it determines whether the shipping line is able to achieve the economies of scale. If the cargo size is sufficiently large to allow ships to be fully loaded and reap the economies of scale, it would be better to offer direct shipments so as to avoid unnecessary transshipment costs. If the cargo size is not sufficient to fill up the ship’s space or achieve the economies of scale, it is more likely that this port will be relegated to a feeder port to be better served by smaller feeder ships.

In this context of Singapore’s entrepot role in Southeast Asia, Singapore’s cargo size depends on its trade with China as well as on ASEAN-China trade. As ASEAN-China trade and investment flows grow, Singapore should continue to enjoy an increasing cargo size and thus remains a port of call for shipping lines.

**Vessel size**

Since hub and spokes have resulted from the increasing ship size, it is reasonable to postulate that the bigger the ship becomes, the more ports are likely to be left out of the direct calls list for the main liners to reduce the number of port calls and achieve the economies of scale advantage. The scale economies advantage offers shipping lines the benefits of low shipping costs and greater diversification of schedules. Given the high cost of investments in ships, savings from reduced port calls and economies of scale become very critical to make positive returns from large capital investments. Given the trend towards increasing ship size, inter-port competition located in the same range is likely to intensify with more negative implications for ports within the same range.
Voyage costs

These costs are a major cost item in running commercial ships. These include the cost of bunker fuel, port charges and canal dues, and cargo handling expenses. The port location therefore becomes an important issue since the farther the port is from the shipping lane, the longer the ship route has to be diverted and thus incurring more bunker fuel costs. Hence, location is of paramount importance. Ports located close to the main navigation course of main liners have a clear advantage of operating as ports of call. Furthermore, if the port has a hinterland with captive cargoes, it will add to the location advantage of the port. Examples of ports with strategic location advantage are Kingston and the Panama port in the Caribbean, Gioia Tauro in the Mediterranean, Salalah and Colombo in the Gulf area and Tanjung Pelepas in South East Asia (World Bank report, 2007).

Shippers’ preferences and the nature of shippers

Shippers and freight forwarders’ preferences acting on behalf of the shippers are the shipping lines’ customers and thus, their preferences have to be taken into account in the choice of direct shipments or hub and spokes. For example, if shippers prefer a less complicated shipping route and require the cargoes to be shipped in the quickest time possible, they will probably prefer direct services rather than hub-and-spoke services which may take a longer time to reach the port of destination. However, the smaller the shipper or the less their bargaining power, the more likely that their preferences will be ignored by the shipping lines.

Port infrastructure characteristics

These port characteristics include adequacy of port infrastructure, cost and quality of service (such as efficiency and reliability)

Clearly, port infrastructure characteristics such as its draught, quay cranes and berths can only accommodate certain ship sizes and types. But the most important characteristic which enters into a ship’s decision to make a call at a port or not is its depth. Most carriers believe a 15-meter draught is adequate to accept the majority of container ships currently in service. However, for post-Panamax container ships a depth of 16 meters is required. Thus, all potential hub ports will need a depth of 15 meters and above in order to be able to accommodate container vessels in excess of 10,000 TEUs.

A hub port of call should have terminal facilities that will enable a quick ship turnaround. These include adequate number of cranes, sufficient container handling and storage areas, and a first rate computer system to run the entire terminal. As a matter of fact, it is generally believed that container cranes capable of spanning at least 18 rows and 6 tiers of containers on dock will be required to handle 8000 TEU ships now in service. The berth should be capable of accommodating one mother ship and four feeder ships along the same quay. This requires that a port should have a quay length of 1000 meters for terminal designs in order to be able to receive two main line vessels and their feeder vessels. The container yard depth should not be less than 400-500 meters and preferably even deeper. These characteristics are a major factor in the choice of shipping service network.
Port charges and efficiency of port operation will also have an impact on the overall cost for ships when calling at ports. The port charges and other dues represent port direct charges and port efficiency or lack of it represents port indirect cost.

Port efficiency is a key determinant of port cost and depends mainly on container handling productivity. Most carriers measure port efficiency in terms of how long it takes to turnaround the ship that enters port, discharge containers and leave the port. The efficiency of a port also depends on the availability of adequate facilities, a suitable system, absence of administrative bottlenecks and terminal workers’ motivation and ability to operate cranes, position containers and handle documentations.

Developments in other competing ports in terms of infrastructure and efficiency will have implications on whether there would be any or more direct calls between these ports and Chinese ports.

**Availability of efficient and adequate feeder services**

A choice of shipping networks depends on the availability of adequate feeder services to and from the transhipment hub. There is also an option of operating an integrated network (i.e. the main shipping line also operated the feeders). Under this option the cost of providing feeder services will be weighed against the option of offering direct shipping services. Liners have to check the cost of feeder services from the hub ports. Since the savings that can be derived from hub and spoke can be offset by the cost of feeder service, but they have to figure out which one is more beneficial before adopting the hub and spoke network.

Further, this requires a constant flow of traffic, which will attract common carriers to serve the hub. For hub to be attractive enough to line big carriers, there must be an established network of common feeder services that can be used to pick-up and distribute containers. For feeder service companies to call regularly at a hub, there must be at least one and preferably several line haul carriers, whose containers need to be picked-up and distributed.

The hub port should offer scale economies of low cost handling charges. The cost of shipping to the hub port and the feeder cost should be lower than the total cost of direct shipments. Port and cargo handling charges should be low at transhipment ports. The benefit accruing from these determinants will offer a direct choice between the hub and spokes network and direct shipment. Furthermore, shipping lines also have to check their market conditions and the profit and loss from checking the cost of its operation and contract for the feeder service vendors when they are planning to use the H/S network.

Shipping lines regularly evaluate the economic environment in terms of these factors and based on their analysis decide on an appropriate shipping network. These factors are outside the control of the shipping lines except for the factors referring to the vessel size and availability of efficient and adequate feeder services.
3. Methodology

To empirically test whether the Chinese ports are complementary or rivals to Singapore port, container cargo movements through the port of Singapore are regressed against container cargo movements through the four selected Chinese ports, i.e. ports of Dalian, Shanghai, Yantian, and Tianjin. These four geographical areas are selected since they are often cited in existing literature as growth regions of the Chinese port industry and because consistent data on these regions are available. Other areas, like Ningbo and Guangzhou, are also mentioned in literature as key growth areas, but due to the paucity of data, they are left out from the analysis. The data used are panel data obtained from the various issues of Containerization International Yearbook for the period of 1994 to 2010. Data on their number of berths and terminal area also obtained to see if any changes in these indicators have any significant impact on the performance of the port of Singapore.

4. Main Findings

Since the study made use of panel data, an existence of country and temporal effects was initially tested before the data were pooled and a series of OLS regression analyses were conducted. These regression results are shown in Table 2.

| Table 2: Regression Results of Singapore container throughput against Major Chinese Ports |
|-----------------------------------------------|----------------|----------------|----------------|----------------|
|                                              | Coefficient   | Standard Error | T-ratio        | Adjusted R²    | D.W. | h |
| 1. Overall                                   | 8,130,427     | 2,019,887      | 4.02           | 0.97           | 1.72 | 0.76 |
| Constant                                     | 0.293         | 0.064          | 4.57           |                |      |    |
| AreaC                                        | -0.48         | 0.399          | -1.20          |                |      |    |
| BerthC                                       | 25,688        | 88,113         | 0.30           |                |      |    |
| TEUₗ (t-1)                                   | 0.35          | 0.17           | 2.02           |                |      |    |
| 2. By Port                                   | 1.067E7       | 587,630        | 18.15          | 0.98           | 2.07 |    |
| Constant                                     | 2.28          | 4.05           | 0.56           |                |      |    |
| TEUₗ                                         | 1.45          | 0.34           | 4.26           |                |      |    |
| TEUₗ                                         | -1.91         | 0.77           | -2.48          |                |      |    |
| TEUₗ                                         | -2.83         | 2.29           | 1.23           |                |      |    |
| Time                                         | 705,812       | 238,923        | 2.95           |                |      |    |
| 3. Share                                     | 8.39          | 0.30           | 27.73          | 0.71           | 1.33 |    |
| Constant                                     | 3.023E-7      | 0.0002         | 1.12           |                |      |    |
| TEUₗ                                         | -5.523E-7     | 0.00058        | -0.16          |                |      |    |
| TEUₗ                                         | -6.997E-7     | 0.00029        | -1.35          |                |      |    |
| TEUₗ                                         | -1.647E-7     | 0.00058        | -0.08          |                |      |    |

Notes: TEUₗ = total TEUs in four Chinese ports; TEUₗ = no. of TEUs at the port of Dalian; TEUₗ = no. of TEUs at the port of Shanghai; TEUₗ = no. of TEUs at the port of Yantian; TEUₗ = no. of TEUs at the port of Tianjin; TEUₗ = no. of TEUs at the port of Singapore.
### 4.1 Overall relationship between Singapore and Chinese ports

In the first regression (equation 1), both country and temporal effects were not statistically significant, but the lagged values of the dependent variable were found to be highly significant at 1 percent level, indicating an autoregressive nature of the aggregate relationship. The Durbin-Watson and H-statistics also indicated an absence of serial correlation, while the high value of adjusted $R^2$ suggests that the variables in the equation can sufficiently explain the TEU throughput of the Singapore port. But changes in the terminal area and number of container berths in the four Chinese ports did not have any significant impact on Singapore port throughput. These results empirically support the notion that Chinese ports overall and the port of Singapore are complementary. The lack of significance of the changes in terminal area and number of berths in Chinese ports is intuitively logical, given that port infrastructure by definition is fixed in the short run and thus any changes in the number of cargoes handled at a port do not have to be associated with changes in these port assets. The coefficient of 0.293 suggests that a 1,000 TEU increment in container throughput of the four Chinese ports will result in approximately 293 TEU increment in Singapore port’s throughput.

A key reason for complementarity between the port of Singapore and the four Chinese ports is the growing trade between China and ASEAN countries leading to increasing cargo size at their respective major ports. Increasing trade volumes would necessarily mean that more goods are travelling between these countries, therefore explaining the increased TEU throughput in both countries. Trade volume between Singapore and China has seen steady growth in the past decade. The following table indicates such a relationship:

<table>
<thead>
<tr>
<th>Year</th>
<th>Trade Amount (in US$ billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>20</td>
</tr>
<tr>
<td>2000</td>
<td>200</td>
</tr>
<tr>
<td>2008</td>
<td>223</td>
</tr>
</tbody>
</table>

The bilateral trade between China and ASEAN had increased more than 10 times between 1995 and 2008. The total trade amount increased from about US$20 billion in 1995 to US$223 billion in 2008. Since entering WTO in 2001, the two initiated talks to create ACFTA. Subsequently, the increase has been more rapid than before. Between 2001 and 2008, bilateral trade grew by around 30 percent a year on average, relative to 15 percent for the years between 1995 and 2001 (Tong and Chong, 2010). Consequently, China became ASEAN’s third largest trading partner and ASEAN became China’s fourth largest by 2008.

With China’s entrance to WTO and the ongoing process of FTA between China and ASEAN, there has been a decrease in tariffs for trade between China and ASEAN. Since the port of Singapore plays the role of a transhipment hub for ASEAN cargoes, the increase in trade between China and ASEAN has resulted in more cargoes passing through the port of Singapore. It has been estimated that Singapore is benefiting with a rate of US$153,080 to US$636,270 for every 1% reduction of tariff in China (Liu, 2007). As tariffs were fully removed in 2010, the total impact on Singapore’s export is expected to be large.

Such increasing trade between China and ASEAN can be partially attributed to China’s demand for electronic components manufactured in Singapore and other ASEAN countries (Loy, 2001). Singapore is able to capture the benefits of the growing Chinese economy by exporting high-tech products and investing more in China to maintain their market shares, despite its comparative advantage in labor-intensive manufactured exports. (Goh, 2004). The need for raw materials and agricultural products in the process of continued industrialization and growth has also led to
more exports from the ASEAN countries. On the other hand, increases in trade volume between these countries have led to more investments in China’s port infrastructure in terms of higher cargo handling capacity (i.e. in terms of number of berths and terminal area). The improved handling capacity of Chinese ports, which is seen as a major indicator of the growth in China’s port sector, complements China-ASEAN trade.

China’s complementarity with Singapore can be further explained by its dependence on seaborne resources that transit key choke points in Southeast Asian waters, due to its rapid economic growth. The Straits of Malacca is of particular importance as a strategic strait of Southeast Asia, in which some 50,000 ships carrying a quarter of the world’s seaborne trade, including half of the world’s seaborne oil, pass through it (The Economist, 2004). China is also likely to be increasingly dependent on energy passing through Southeast Asia, of which some is supplied by Singapore. Therefore, China’s growth is likely to benefit Singapore as the Straits of Malacca bustles with activity and provides Singapore’s maritime industry with more trade volumes as the number of ships and the need for efficient ports in the Strait increases. Since 1996, COSCO has used Singapore as its base for Sino-foreign shipping operations in Asia. In 1997, China’s COSCO and Singapore’s Port of Singapore Authority (PSA) signed a long-term bilateral shipping terminal services agreement to set shipping prices and regular shipping schedules (Fairplay, 1997). This further shows the complementarity between the ports of Singapore and China in terms of trade.

Looking at infrastructure, including port area and berth size, Singapore also contributes significantly in China’s maritime development, where PSA is upgrading maritime transportation infrastructure in the Chinese ports of Dalian, Changsu, Shanghai, Suzhou and Taicang (Hugar, 1998). PSA also cooperates with China’s MSI by providing it access to port terminals and warehouses in several international foreign ports (Chan, 1997). Singapore reportedly sees in its relationship with China the potential for mutual gain (Vaughn & Morrison, 2006), and shares a complementary relationship with China’s maritime industry.

4.2 Relationship with individual Chinese ports

To learn whether each of the four Chinese ports is a complement or a rival to the Singapore port, the following regression as seen in equation 2 was run: $TEU_{sg} = TEU_d + TEU_s + TEU_y + TEU_t + \mu$. The number of berths and terminal areas are now deleted from equation 2 since they were found to be statistically significant.

Unlike equation 1, time effects were found to be statistically significant and are now represented by variable “Time”. The statistical indicators point to relatively robust estimates as indicated by relatively high coefficient of determination and absence of serial correlation. Looking at the coefficients of the various ports, the port of Shanghai as a region is complementary to the port of Singapore and is the only significant variable at 1% level, while the port of Yantian appears to be a significant competitor to the port of Singapore. The other two ports – the ports of Dalian and Tianjin are both statistically insignificant.
In order to analyze further the relationship between the port of Singapore and the four Chinese ports, the number of routes from Asia to Europe that make stops at these ports were collected and collated. The data consists of 130 routes by the top 19 container shipping lines. Out of 130 routes, a total of 66% of the routes involves Singapore and either one of the 4 Chinese ports under consideration, but only 6% of the total routes involve Singapore to Dalian, Tianjin and/or Yantian. These findings reinforce the regression results pointing to the fact that Dalian, Tianjin and Yantian have only a minimal significance on the port of Singapore’s performance.

The insignificance of Dalian and Tianjin ports might be due to the location of these regions. Tianjin and Dalian are located further northeast of China at the Bohai Sea and ships may choose to only stop by the ports in the Shanghai region where main maritime activities take place. In contrast, the port of Yantian is located close to Hong Kong which is one of the major ports that Singapore competes with rather frequently, causing the ships to switch between ports of Singapore, Yantian and Hong Kong.

The strong complementarity between Shanghai and Singapore can be explained by a myriad of factors. Statistically, as discussed previously, 60 percent of the shipping routes in Asia-Europe route consists of interaction between Singapore and Shanghai that do not include other Chinese regions. This high percentage can be attributed to the fact that these two ports are hub ports of their respective regions; hence, high trade volume from China will result in an increase in trade volume for Singapore.

In late 1997, the China Ocean Shipping Company (COSCO) moved its headquarters from Beijing to Shanghai to be co-located with the newly established Shanghai Shipping Exchange (SSE). This is in line with China’s goal to expand Shanghai into an international maritime economic, financial, trading, and shipping centre for Asia (Hugar, 1998). As Shanghai becomes increasingly more prominent in its role in China’s maritime industry as the main region for maritime activity, its growth would be a good indicator of China’s growth. The positive correlation of the ports located within just Shanghai, with that of Singapore, is therefore a good indicator to investigate the complementary relationship between China and Singapore.

### 4.3 Market shares

Finally, regressing Singapore’s market shares with China’s four ports’ container throughput produced somewhat different results. All four Chinese ports’ port performances over the period under consideration do not have any significant impact on Singapore port’s market share. The positive sign of the coefficient for the port of Shanghai’s container throughput suggests a complementary relationship but is statistically insignificant.
Based on Figure 3, Singapore’s market share declined drastically during the period of 2000-2003 even when the share of the port of Shanghai continued to grow. Therefore, there are other factors that affect Singapore’s market share, and the complementarity between China and Singapore acts as a buffer to this decrease. This can be seen in the stabilizing of the market share from 2002 onwards, at about 6 percent, after China entered the WTO in 2001.

Other factors affecting Singapore’s market share could be the increasing incidence of direct calls at its neighbouring ports in Southeast Asia, particularly at Malaysia’s Tanjong Pelepas, Thailand’s Laem Chabang and Indonesia’s Tanjung Priok, as these ports are increasingly building up a sufficient cargo base and improving their operational efficiency. Singapore, being highly dependent on transhipment, is highly vulnerable to the changes and port developments in these countries. The port of Singapore needs to continually improve its efficiency and service quality ahead of its competitors to compensate for their relatively high operating costs. Singapore’s relationship with its neighbouring countries may play a more important role than its relationship with China, since they are direct players in the same Southeast Asian region. Even when there is a complementary relationship between Singapore and China, the many more competitive relationships that Singapore has with its neighbours may then explain the downward trend in its market share. The complementarity that China shares with Singapore thus deflates the effect of a decreasing trend.

5. Conclusion

The objective of this paper is to test empirically the impact of the rise of Chinese ports on the port of Singapore based on available data on container cargo movements and their relationship between four major Chinese ports and the port of Singapore for the period of 1995 to 2007. The findings point to a complementary relationship between Chinese ports and Singapore port.

This represents an interesting result because it is commonly thought that China’s growing market share will hurt the neighbouring ASEAN countries (Goh, 2004). Most importantly, this study has
established the key complementary relationship between Shanghai, as a growth region, and the Singapore port. Thus, although the port of Shanghai has overtaken the port of Singapore as the world’s busiest port (The Straits Times, Asia News Network, 2010), this has not adversely affected the performance of Singapore port.

However, although our study shows that the rise of the Chinese ports has benefited the Singapore port, this complementary relationship might become one that is competitive in the future depending on how the major underlying factors behind the choice of ports would develop in the future. These factors must therefore be constantly monitored and analyzed. China’s maritime industry is growing at a tremendous rate. China’s planners are consistently changing and adjusting their plans for the various ports, changing their focus to match the market’s demand. As such, the four major ports of China that are the current focus of evaluation in this paper may change in the near future. As the Chinese ports changes their focus on the type of imports they are processing, the ports relationship to Singapore ports will differ depending on the shift. Additionally, the currently deemed insignificant ports may change their focus and could instead rival or complement Singapore port. Thus, the data and interpretations in this paper could only be accurate as of now and a new analysis will need to be done as new information about China’s maritime industry is made available as it continues to grow.

The regression and data are not without its limitations. Because complete statistics from Containerisation International Yearbook can only be obtained for years 1994 to 2010, there are only 17 observations in our regression analysis, which may then pose plausible inaccuracies when estimating the model due to the small sample size.

The analysis was only limited to the ports of four fast-growing regions in China, but failed to account for two other similar regions, Ningbo and Guangzhou, due to the lack of complete data for the same period. This may cause a potential downward bias in the regression and understate the variables, where China’s total container throughput, port area and berth size is underrepresented by using only four regions. However, it can be assumed that using the four most prominent port regions of China is representative enough to provide an intuition of the relationship between the ports of China and Singapore.

The model might be oversimplified. While TEUs, number of berths and port area provide good measurement variables for the growth of the Chinese maritime industry, other variables that measure the maritime industry growth of China, such a fleet size, could not be included in our analysis due to the paucity of data.

The expansion of the Chinese maritime industry would have contributed to their port’s efficiency, supply chain orientation and reputation. The regression analyses how direct growth measures of the ports affect the Singapore port throughput, but fails to account for these ‘indirect’ measures of growth. For future studies, surveys can be done to provide adequate measures for such factors so that growth in such areas can be incorporated into the study.
References


