MARITIME SHIPPING

DISADVANTAGES OF SCALE

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AN ASYMMETRIC DRIVER

Maritime shipping, more than any other form of transportation, benefits from the application of economies of scale since they have a direct impact on operating costs. The larger the ship, the more cargo it can carry, and as such the lower the transport cost per unit of cargo. There has thus been a push to deploy larger ships, particularly in container shipping, which were put on high volume trade routes, such as between Asia and Europe and across the Pacific.

The port of Los Angeles (and North America) received its first 18,000 TEU ship in December, 2015. Many large infrastructure projects around the world such as the Panama Canal expansion, the recently completed Suez Canal expansion and numerous port infrastructure investments are in whole or in part justified through the rationale of accommodating larger ships.

Economies of scale appear however to be an asymmetric force in which maritime shipping companies are internalising benefits since they have a positive impact on operations, while externalising many of the costs to other actors along the transport chain. These actors, such as terminal operators, trucking companies, railways and distributors, are then facing the challenge of mitigating these externalities, often with capital investment projects. A perverse outcome is the provision of capital investment simply to maintain existing traffic levels. In this asymmetry, the shipping line benefits, at times marginally, while other actors are being penalised.

FROM ECONOMIES TO DISADVANTAGES OF SCALE

Diseconomies of scale are a common economic concept stating that after a specific level of output the input costs per unit of output are starting to rise. There are therefore no incentives to increase the output of the particular unit beyond a threshold. Optimally, a system tries to achieve equilibrium by minimising total costs. This assumes that there are tradeoffs between its elements. A fundamental issue is that although the concept of diseconomies of scale applies to maritime shipping, port operations and hinterland distribution, it does not involve the same threshold for each and more than often an actor is unwilling to assume a tradeoff.

In this hierarchy of scale economies, maritime shipping has the highest capability, followed by terminal operations and then hinterland distribution. Each transport segment cannot be massified to the same extent because of technical, regulatory or operational considerations. Disadvantages

of scale are used mainly because that although the benefits of economies of scale still apply in the maritime segment of the transport chain, these benefits are not well shared with other actors.

Unlike a standard logistics costs structure, where there can be a tradeoff between transport (distance) and warehousing (number of distribution centers) costs, a maritime transport chain is usually a pseudo tradeoff (See Figure 1). Shipping lines are unwilling to assume a trade-off where they would limit ship sizes so that port and hinterland operations could function more effectively. This means that a shipping line will push for the use of larger containerships even if this involves an increase in total costs, since it does not assume the externalities of increasing terminal costs but get the benefits of higher economies of scale.

While the optimal ship size is subject to contention since it would vary by trade route, cargo volume and port capacity, a range of 8,000 – 10,000 TEU is usually considered around the optimal. To accommodate this trend ports are therefore constrained to provide capital investment with risk of not seeing any significant increase in the cargo they handle. Some inland actors, like trucking companies, may also be negatively impacted with declining operational efficiency as they are forced to a similar level of traffic, but with a more significant time compression of this traffic (not shown on the figure).

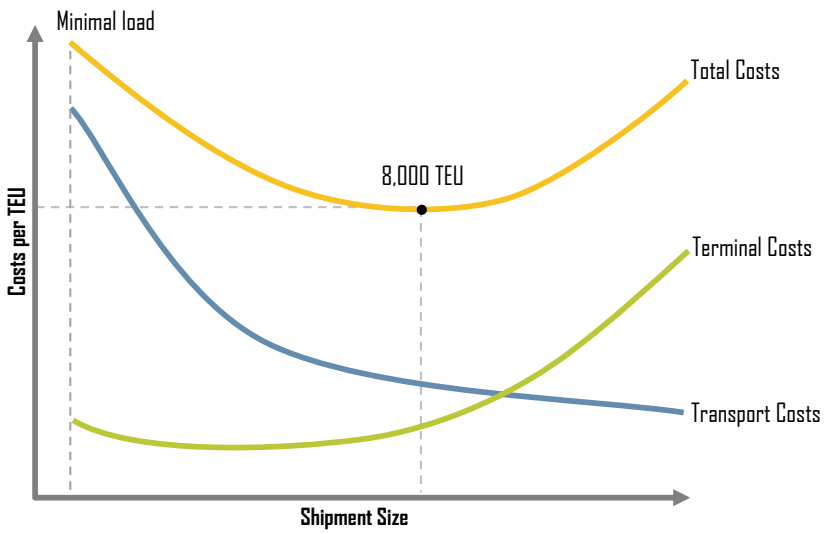

Figure 1

PORT OF CALL ISSUES

Larger ships require deeper drafts, which limit the number of ports able to accommodate them. Many port terminals around the world were built to handle Panamax ships, which has been a standard scale of port operations for a century. A sample of more than 500 container terminals revealed that only 38% of them have a draft of more than 14 metres, which would place them within the post-Panamax range. Less port of call options can limit the commercial appeal of larger ships since their market coverage is more limited, inciting a greater reliance on transshipment, which usually take place at ports that do not generally handle much cargo.

In light of this trend, several ports have faced the pressure to invest in infrastructure expansion projects, such as terminal automation, new cranes, yard expansion and dredging port access channels. 15 metres is a common draft goal that ports seek to meet to handle a wide range of post-Panamax ships and expand their commercial appeal. These infrastructure projects are highly capital intensive, often publically funded by port authorities. When such investments take place along a maritime range, many ports find themselves in the situation of simply competing for the same amount of traffic. Infrastructure investments can become a zero sum game increasing the options of shipping lines. Additionally, larger ships are calling the same ports less frequently and the need to improve their load factor can result in worsened schedule reliability.

TERMINAL OPERATIONS

A way to increase the capacity of a ship is to make it wider, which requires cranes with a deeper reach. A post-Panamax ship has between 15 and 23 containers in width as opposed to 13 for a Panamax ship. Furthermore, larger ships require a higher level of terminal throughput since a greater amount of cargo must be handled roughly within the same port call time. This places pressures on terminal operations due to a time compression in cargo handling, requiring more yard space and equipment.

A terminal surface of 40 hectares is required to handle a volume of 3 million TEU per year, particularly if the bulk of this volume is handled by post-Panamax ships. However, only 41% of a sample of more than 500 container terminals have a surface above 40 hectares. Terminal gate access is also facing constraints as more trucks are entering and exiting the terminal during the same timeframe. Port dues paid by shipping companies are essentially remaining the same on a per TEU basis, implying that the terminal operator does not necessarily see a growth in its revenue with larger containerships. Capital investment in infrastructure is therefore even more difficult to amortise. Larger ships could actually involve a decline in terminal capacity because of the time compression of cargo operations larger ships impose, tying more equipment, labour and yard space into the mix.

SUPPLY CHAIN CONSTRAINTS

External issues, such as supply chain management, are often neglected when considering the impacts of using larger containerships since they concern beneficial cargo owners not involved in transport operations. The coordination of supply chains can be impacted in a significant manner, since a lower frequency of port calls imply the necessity to hold higher inventory levels, both in warehouses and in transit. For instance, an importer facing decreasing port of call frequency would be forced to maintain a higher inventory level in its distribution centers to maintain a similar average lead time and meet the expectations of its customers. More cargo being carried on a single ship also represents a greater risk for partial loss or damage, particularly near ports (collision risks), involving higher insurance premiums. Still, the risk factors of mega containerships remain to be better assessed by the insurance industry.

LIVE BY ECONOMIES, PERISH BY DISADVANTAGES

Ongoing discrepancies between maritime operations, terminal operations, hinterland distribution and supply chain management are emerging in part to what is a growing scale mismatch.

Maritime shipping companies appear caught in a vicious cycle where low profit margins are inciting the introduction of larger ships to improve productivity, which in turn result in additional capacity that puts pressures on rates and profitability. If disadvantages of scale for other actors in the transport chain are taken into account, the economic benefits of larger containerships may actually be limited. Still, economies of scale are contingent upon trade routes, the port of call sequence and even the general nature of the cargo being carried. There is thus no standard optimal ship size; no 'one size fits all', but sizes that fit functions such as gateway, hub and feeder ports. The issue is that maritime shipping companies have been driving the scale factor, effectively internalising the benefits of economies of scale and externalising its costs. Therefore, for several ports, scale becomes a disadvantage.

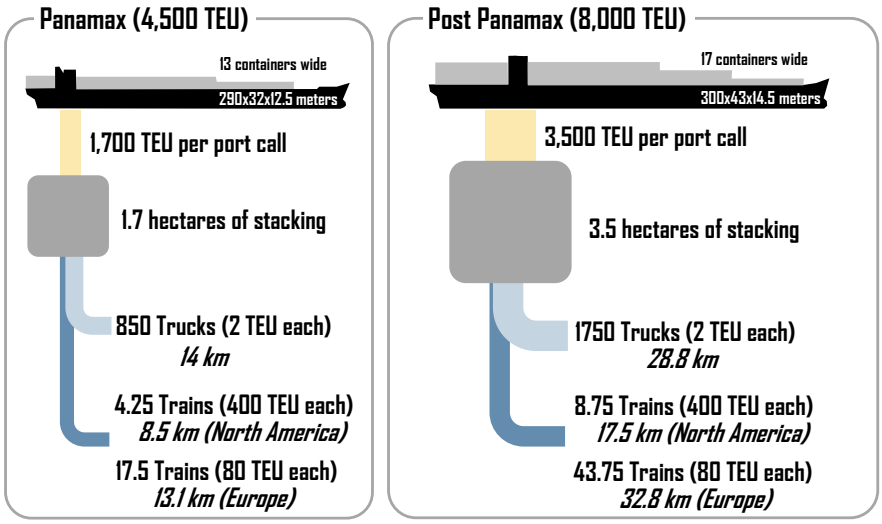

Figure 2

PORT CALLS AND HINTERLAND TRAFFIC

Larger containerships usually imply less frequent port calls, particularly if a similar amount of traffic is involved. For instance, a service involving two port calls per week using Panamax ships of 4,500 TEU could be replaced by Post-Panamax ships of 8,000- 9,000 TEU calling once a week. Although this new configuration would improve the productivity of maritime shipping, it also implies externalities for ports operations and hinterland transportation.

Figure 2 depicts a scenario where a port terminal using RTGs has an average stacking density of 1,000 TEU per hectare. A truck can carry an average of 2 TEU (one forty-foot container) with a length of 16.5 metres. The average intermodal train carries 400 TEU and has a length of 2,000 metres, which corresponds to North American conditions. For Europe, trains of 750 metres and 80 TEU are the average, which would involve significantly more train services for the same traffic.

A Panamax containership call generating about 1,700 TEUs of traffic, including import and export containers, which would require about 1.7 hectares of stacking area. If no transshipment activity is involved, this volume would require about 850 single truck trips (carrying 2 TEU each), which if those trucks were lined up would extend for 14 kilometres. Such a volume handled by intermodal rail would require the equivalent of 4.25 trains extending over 8.5 km (or 21.25 European intermodal trains totaling 15.9 kilometres). This is contingent upon the presence of on-dock rail facilities since containers would need to be trucked to near-dock rail terminals if this was not the case. In reality, ports handle their hinterland traffic in various combinations of road and rail options, so the more rail is prevalent, the less trucking assets are required (and vice-versa).

North American and European ports have significant modal differences, with rail usually more prevalent in North America and trucking more prevalent in Europe. Many European ports also have including the option of using barge services, with the average barge able to carry about 200 TEU.

A post-Panamax containership call can generate about 3,500 TEU, which would require about 3.5 hectares of stacking area. This volume would take about 1,750 truck trips (extending 28.8 kilometres if lined up) or 8.75 intermodal trains (extending 17.5 kilometres if lined up). As such, the same amount of traffic generates a larger and more compressed level of port activity, putting additional pressures on its port and hinterland servicing assets. A likely impact would be that some ports may be facing declining capacity issues as a consequence of larger containerships calls. This situation becomes more acute if even larger containerships are used (such as 10,000 to 12,000 TEU ships) since they may further compress the use of port and hinterland assets.

ABOUT THE AUTHOR

Dr Jean-Paul Rodrigue is a Professor at Hofstra University, New York. His research interests mainly cover the fields of economic and transport geography as they relate to global freight distribution. Areas of interest involve North America and East and Southeast Asia, particularly China.

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