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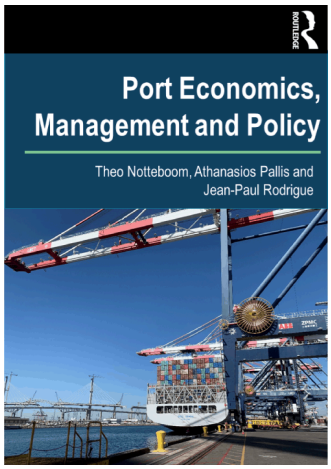

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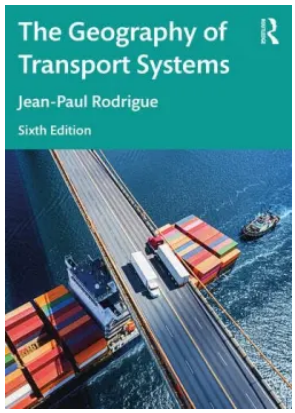

Chapter 1.1 – Maritime Shipping and International Trade

Authors: Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom

Seaports are affected by a wide range of economic, technological, and geopolitical developments. Shifts in global production and international trade are affecting port activity levels and operations. The demand for port traffic is derived from world trade.

1. Maritime Shipping as a Driver of Globalization

Global **economic integration** is a key factor behind the rising significance of international trade. Historically, trade was prevalent but set up under constraining conditions in terms of the technical means to support it. Trading over long distances remained slow and expensive, limiting its scale and scope. By the early 20th century, transport technologies such as the steamship became ubiquitous and efficient enough to support a complex international trade system. Particularly, the steamship enabled economies of scale that could not have been achieved beforehand. However, it was not until the mid-20th century that the global regulatory regime became open enough to allow an expanded form of globalization.

Global trade is impossible without transportation, making efficient transport a key trade facilitator. By definition, almost all the cargo carried by maritime shipping is considered to be international trade. Transport costs (both freight costs and time costs) constitute a key component of **total trade costs**. These trade costs also include other costs incurred in getting goods to final users other than the marginal cost of producing the good itself, such as policy barriers, information costs, legal and regulatory costs. Lower trade costs contribute to trade growth as it has been underlined that for developing economies, a 10% reduction in transportation costs was associated with a 20% growth in international trade. Distance has become a factor that plays a lesser role in the intensity of maritime trade relations, making the capacity and direct connectivity of maritime shipping networks an important factor.

Since the end of World War II, ongoing trade liberalism under the banner 'World Peace through World Trade', has led to the gradual removal of political, regulatory, and cultural obstacles to trade. Integration processes took place both at the regional level and at the global level. The collapse of the Soviet Union and the opening up of China in the 1990s represented landmark events that incited the entry of close to 2 billion consumers as well as the related resources into the global economy. Regional trading blocs have been formed with differing trade liberalization levels, such as NAFTA in North America, the EU Single Market in Europe, ASEAN in Southeast Asia, Mercosur in South America, and Ecowas in West Africa. An important share of international trade occurs **within economic blocs**, especially the European Union and NAFTA, which rely more on land transport modes such as road and rail. The European Union and NAFTA are considered the world's most integrated trade agreements, with 62.3% and 51.2% of their respective trade concerning member nations. For ASEAN, 75.5% of its trade concerns nations outside the agreement, implying a greater relative share of maritime shipping. International trade influences the structure of maritime shipping networks which is organized according to a hierarchy.

The **globalization of production** is a driver for the **globalization of trade** as they are interrelated. The **scale**, **volume,** and **efficiency** of international trade have continued to

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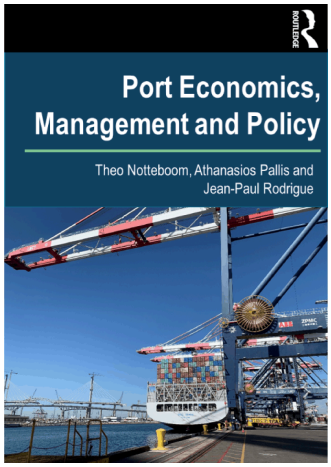

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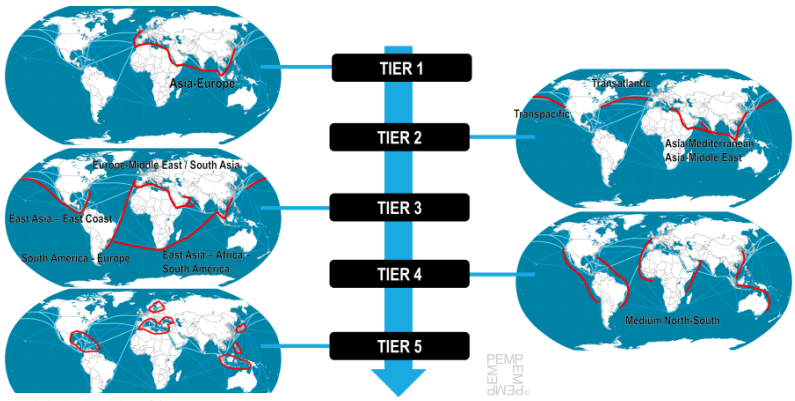
improve. The liberalization of global trade is supported by the continuing evolution of the World Trade Organisation (WTO) and initiatives by organizations such as UNCTAD or the World Bank. After World War II, a number of international corporations sought the support of intergovernmental organizations such as the United Nations for regulatory frameworks that enabled the pursuit of international operations. In such an environment, multinational corporations assumed growing importance as investors and traders. As a result, it might be argued that the slogan 'World Peace through World Trade' slowly shifted to 'World Peace for World Trade'. At present, inter-governmental organizations still play an essential role in shaping the rules of the game in international competition and global trade.



Global Hierarchy of Shipping Lanes

2. Ongoing Growth of International Trade

World trade has experienced a significant increase since the 1950s and represents a growing share of global economic output. In 2007, international trade surpassed 50% of the global GDP for the first time, a share that was conventionally in the 20% to 25% range in the first half of the 20th century. In the 19th century, this share was around 10%. Several factors explained this growth:

- **Income growth** linked with additional consumption of goods and services, some of which are traded.
- **Falling transport costs** allowing more options and opportunities to trade.
- **Trade liberalization** and the associated tariff rate reductions, easing trade transactions.
- **Economic convergence** of countries around trade agreements and common commercial policies.
- **Increase of intermediate goods trade** in the context of global production chains, outsourcing, and offshoring.

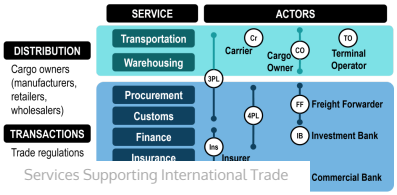
Between 1958 and 1988, income growth explained 67% of the real growth of world trade, while tariff reductions accounted for about 26% and transport-cost reductions roughly 8%. However, developed and developing economies might face different economic characteristics, and those play different roles in the growth of international trade. Low-income economies tend to have a high reliance on the trade of resources and low added value goods, intermediate income economies are oriented around manufacturing, and high-income economies tend to be net importers of products and services.

The ongoing growth of international trade also impacted firms, many of which expanded to become multinational corporations. The benefits that multinational corporations derive from trade are varied:

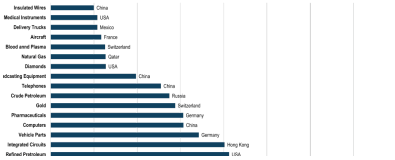
- **Competition**. Seeking new resources, markets, and processes in international markets increases the competitiveness of corporations.
- **Economies of scale**. International markets allow firms to produce larger quantities of goods, which enables lower unit costs.
- **Innovation**. International markets incite the development of new products or the adaptation of existing products to different market characteristics.

As international trade depends on the provision of distribution and transactional services, the demand for these services has increased substantially, leading to the growth of carriers, cargo owners, terminal operators, third-party logistics service providers (3PL), freight forwarders, and insurers. International transportation and transaction service providers represent a complex ecosystem aiming at supporting international trade and extracting added value. The providers of transportation services, like manufacturing firms, have become large multinational corporations due to the extensive markets they cover.

The nature of what is being traded and the main traders involved influence the transportation modes used for international transportation. Maritime transportation dominates, handling about 80% of the volume and 70% of the value of international trade.



Services Supporting International Trade



Worlds Most Traded Goods and Lead Exporter 2016

3. The Containerization of Trade

A. The emergence of the container

The container and the associated maritime and inland transport systems have proved to be instrumental to the consecutive waves of globalization and global trade growth since the 1970s. The launching of the first containership by Malcolm McLean in 1956, the Ideal X, marked the beginning of containerization. The first transatlantic container service between the US East Coast and Northern Europe in 1966 marked the start of long-distance containerized trade. The first specialized cellular containerships were delivered in 1968, and containerization expanded over maritime and inland freight transport systems. Container shipping developed rapidly due to the adoption of **standard container sizes** in the late 1960s. The cost savings resulting from faster vessel turnaround times in ports, the reduction in the level of damages and associated insurance fees, and the integration with inland transport modes such as trucks, barges, and trains became acknowledged as clear containerization advantages.

The container offered a standard around which physical distribution systems could operate. Hence, emerging container shipping networks allowed changes in the economic and transport geography as they significantly reduced maritime costs between production and consumption centers across the world. Container shipping also became an **essential driver in reshaping global supply chains** allowing sourcing strategies of multinational enterprises and developing global production networks. New supply chain practices increased the requirements on container shipping in terms of frequency, schedule reliability/integrity, global coverage of services, rate setting, and environmental performance. The outcome has been an ongoing growth of the global container throughput.

The container has evolved from a transport unit to a supply or commodity chain unit. Containerization is inherently linked to the **transport of load units** (containers) across several transportation modes. It is more than a box as it acts as a vector for production and distribution. Containerization has led to various changes in the geography of transport, trade, and distribution, particularly in how production and physical distribution interact. The container can be considered revolutionary, as new practices have taken place after its introduction. It has become a ubiquitous transport product servicing mobility requirements at almost all stages of supply and commodity chains and is able to be carried virtually everywhere there are transport infrastructures.

B. Containerized trade networks

Before containerization, many goods subject to trade had to be handled manually. Emerging worldwide container shipping networks allowed changes in the economic and

transport geography as they significantly shortened the maritime cost distances between production and consumption centers around the world. Container shipping also became an essential driver in reshaping global supply chain practices, allowing global sourcing strategies of multinational enterprises, pull logistics solutions, and developing global production networks.

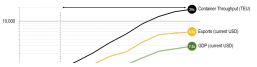
Containerization has been the most dynamic physical component of globalization, far exceeding the growth of the value of exports and the GDP. As globalization developed, each new individual, GDP, or export unit was associated with a higher level of container flows. This is often referred to as the TEU-to-GDP multiplier. While up to 1980, the growth of container port throughput went on par with the growth of the value of exports, a divergence is noted afterward, with container flows growing faster than trade flows. Containerization entered the acceleration phase of its diffusion cycle as the fundamental support of export-oriented strategies pursued by Asian economies.

The composition of international trade goods carried in containers is impressive in its diversity. The 20 most important SITC (Standard International Trade Classification) categories accounted for 65% of the global containerized trade, underlining that the container has been used to carry any possible good that could be fitted in. More than 75% of container freight flows are related to consumer spending on retail goods. However, many of the most significant categories of containerized trade are the outcome of comparative advantage factors, namely labor, that can be temporary and subject to change. If these advantages were to shift because of technological changes (e.g. automation), then a notable share of the containerized trade could be impacted.

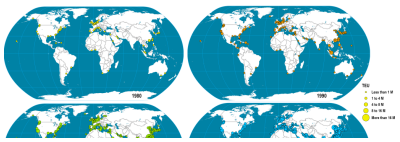
About one out of every ten containers handled worldwide is handled in ports of the **Yangtze River Delta**. In East Asia, export-oriented industrialization policies undertaken by Hong Kong, Taiwan, and South Korea sustained the strong growth in container throughput handled by these economies from the 1980s. China developed similar strategies in the late 1980s resulting in elevated growth first in the Pearl River Delta and then in the Yangtze Delta port system and the Bohai Bay region. In the past ten years, Shanghai, Guangzhou, Shenzhen, Qingdao, and Ningbo joined Hong Kong, Busan, and Singapore as the world's busiest container ports. The Rhine-Scheldt Delta (Belgium/the Netherlands) was the world's number one container handling region until the mid-1990s when South China took the lead. While the dynamics of containerization and container flows are well-known, much less is known about what is being carried by containers, particularly as it concerns commodities.

World Container Throughput 1980 2022

TEU to GDP Multiplier 1985 2022



Global Trade and Container Throughput 1970=100



Evolution of Traffic Handled by Container Ports 1980 2010

Global Merchandise Exports and Container Throughput 1980 2021

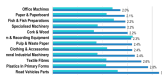
C. Containerized growth dynamics

The conventional growth dynamics of containerization have mainly relied on an array of drivers, which include:

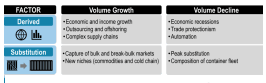
- **Derived Growth**. Often labeled as organic growth, derived growth is an economic development outcome with greater quantities of containerized cargoes being traded. Globalization also implies a growth in the average distance over which containerized freight is being carried. In both cases, greater containerized capacities are required, average voyage days per vessel increase, and the number of vessel roundtrips per year decreases. The dynamics based on derived demand may have reached maturity in containerization potential as many global supply chains are now fully containerized.

- **Substitution-based growth**. Initially, substitution was the main factor behind containerization with the gradual capture of the breakbulk cargo market. This process has been particularly visible in many ports, as illustrated by rising containerization degrees (the ratio between the containerized throughput of the port and the total general cargo volumes). Since almost all break-bulk cargo that could be containerized has been containerized, this substitution process is essentially near completion in developed economies. It is also rising rapidly in emerging economies and developing countries. This leaves the possible further containerization of niche markets, namely commodities and temperature-sensitive cargo.
- **Incidental growth**. Production and trade imbalances in the global economy are reflected in physical flows and transport rates and lead to specific container repositioning strategies. Containerized flows are rarely balanced, implying that empty containers must be repositioned to locations where export cargo is available.
- **Induced Growth**. The growth of deep-sea services and the use of larger containerships has led to the setting up of intermediary hubs connecting different systems of circulation via transshipment. Intermediary hubs emerge in locations offering clear advantages over direct port calls at mainland ports. The setting up of intermediate hubs occurs around specific regions ideally suited for maritime hub-and-spoke distribution patterns. Transshipment has proven to be a major driver for global container port throughput, with substantially higher growth rates than observed for gateway traffic. The worldwide transshipment incidence has steadily increased from around 18% in 1990 to around 35% in 2018.

In terms of the value of global trade carried in containers, if maritime shipping accounts for 70% of the total trade, and 66% of this value is carried in containers, which represented in 2020 about $54,000 per TEU.



Global Containerized Trade by Main Cargo Category in TEU



Containerization Growth Factors

Value of Containerized Trade 2020

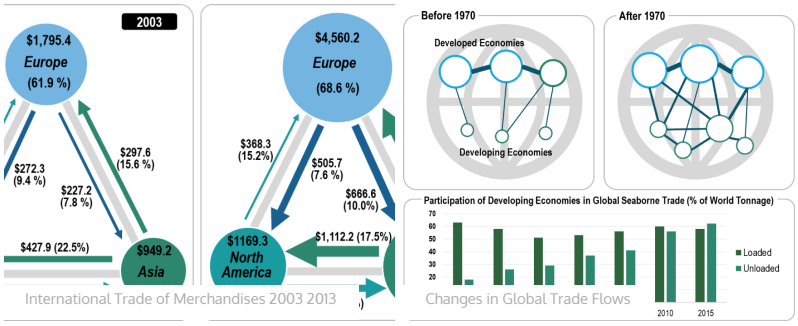
4. The Shift in Global Trade Patterns

The recent decades have seen important changes in international trade flows. A growing share of international trade occurs within regions (and particularly economic blocs) even if long-distance trade has increased in absolute numbers. Trade predominantly takes place within Europe, North America, and East Asia, commonly called the triad. Still, a shift in trade relations between the northern and southern hemispheres, particularly between developed and developing economies, has occurred. The structure of global trade has become much more complex in its relations and diversified in what is being traded. The pattern of trade relations is mainly explained by the following factors:

- **Geographical proximity**. The intensity of trade relations is commonly a function of proximity unless notable advantages can be found further away. The European Union has significant trading linkages with adjacent areas in Eastern Europe, North Africa, and the Middle East. North America also maintains important trade linkages with Latin America, notably Mexico, as part of the USMCA (United States-Mexico-Canada Agreement). Shorter distances have an important impact on the modes used for trade, with maritime shipping less suitable outside short sea shipping. Still, a key advantage of maritime shipping is that it substantially attenuates the negative effects of long distances on trade as the development of containerized shipping underlines.
- **Resources availability**. The scarcity and availability of resources have shaped maritime networks for close to two centuries and remain the main component, ton-wise, of maritime shipping. Energy, mineral, and agricultural trades have distinct shipping networks and specialized port facilities designed to handle bulk cargoes such as petroleum, natural gas, coal, grains, alumina, and iron ore.
- **History and culture**. The trade networks established during the colonial era have endured in relations such as those between Europe and Africa or between the United States and Latin America. China has commercial historical ties with Central Asia and Southeast Asia, which have been recreated and expanded in recent decades.

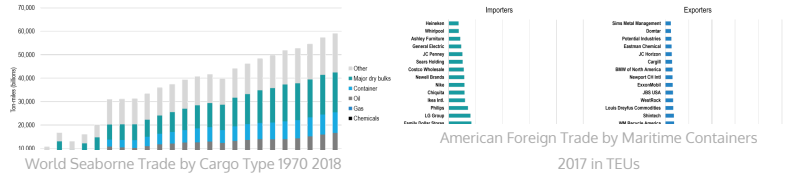
Irrespective of the political context, trade networks tend to endure because of the reciprocal systems of supply and demand on which they depend.

Another characteristic of the contemporary commercial setting concerns **imbalances in trade flows**. For instance, China exports more than it imports with partners such as the United States and the European Union. Trade imbalances directly reflect imbalances in shipping flows. For bulk trade, such as energy and minerals, it is common that a return trip will be empty. For containerized trade, the load factors of return trips are lower, and the share of empty containers is higher. The imbalanced trade structure is also reflected in the composition of container imports and exports that differs substantially. Further, trade imbalances imply the repositioning of empty containers which accounts for about 20% of global container moves.



International Trade of Merchandises 2003 2013

Changes in Global Trade Flows



World Seaborne Trade by Cargo Type 1970 2018

American Foreign Trade by Maritime Containers 2017 in TEUs

Geographical and economic shifts in international trade are directly observable in the evolution of the level of trade intensity by ocean, as the Trans-Pacific trade has grown faster than the Trans-Atlantic trade. The most significant trade flows are between Asia and North America (especially the United States), between Europe and North America, and between Europe and Asia. The associated maritime routes are the most commercially used, with sizeable trade going through chokepoints such as the Strait of Malacca (30% of global trade transiting), the Suez Canal (15%), the Strait of Gibraltar, and the Panama Canal (5%). These bottlenecks allow connection between major systems of maritime circulation where the transatlantic, the transpacific, and the Asia-Europe routes dominate. North-south flows are complementing these east-west routes, many of which interact at major transshipment hubs around Singapore, Dubai, and the Caribbean (Panama, Cartagena, Kingston). The evolution of international trade shapes the structure of maritime shipping networks and port development as shipping lines tend to organize their services to connect the dominant trade flows directly, and the less dominant trade flows indirectly through transhipments.

Worlds 20 Largest Exporters and Importers of Goods and Services 2018

Trade Intensity by Ocean 1980 2020

5. International Trade and Maritime Shipping Services

International trade relies volume-wise for about 80% on maritime transportation, which involves several markets such as dry bulk, roll-on/roll-off, general cargo, and containers.

A. Maritime services in dry bulk shipping

The maritime transport of **major bulks** such as iron ore and coal typically relies on end-to-end services between a port of loading (connected by rail to mines) and a port of discharge. Economies of scale in vessel size are significant in dry bulk shipping, so operators will try to maximize vessel size on the end-to-end tramp service. The nautical accessibility in the port of loading and port of discharge, the charter price level, and the availability of vessel types play a decisive role in vessel size choice. Inland transport costs per ton-kilometer are typically 20 to 30 percent higher than sea transport costs per ton-kilometer.

Consequently, market players make a trade-off between, on the one hand, the minimization of inland transport costs by routing the bulk flows via the ports that are closest to the final destination, and on the other hand, maximizing the scale economies in vessel size by calling at the ports that offer the best nautical accessibility. This exercise in some cases leads to multiple calls whereby a large Capesize vessel will first call at a deepwater port to discharge part of the cargo and then proceed to the second port of call with a less favorable nautical access to discharge the remainder (e.g. a call sequence starting in Dunkirk and ending in Antwerp). Another practice consists of lightening deepsea vessels on stream, whereby floating cranes discharge part of the load to barges given decreasing vessel draft (e.g. lightning operations on River Scheldt to access the Canal Ghent-Terneuzen).

The vessels deployed in the **minor bulk segments** (grain, fertilizers, minerals) are generally much smaller, so that vessel operators have a much wider range of potential ports of call at their disposal. The eventual call patterns will be determined by factors such as proximity to the market, the specificities of the distribution network (centralized or decentralized), the number of cargo batches on the vessel, and the need for dedicated terminal facilities (e.g. grain silos).

B. Maritime services in the roll-on/roll-off market

The operational characteristics of maritime services in the ***RORO*** segment depend on the submarkets considered:

- Intra-regional **RORO and ropax services** are typical of the end-to-end type with a port of call at either side of the route. The shipping services follow a fixed schedule with medium to high frequencies (sometimes several times a day). The ferry capacities tend to vary greatly with the cargo density on the route and the one-way distance. For example, in Europe, large units are deployed on the English Channel and parts of the Baltic (e.g. 120 trucks per voyage on the Dover-Calais link and several hundreds of passengers between Travemünde and Finland). In contrast, vessel capacities on services in smaller markets (e.g. the Irish isles) tend to be much smaller. Trucks using ferry services can have a long pre- and end haul by road (for instance, a truck driving from Dortmund to Zeebrugge to catch a ferry to Hull and onward by road to the final destination Manchester).
- The market for **unaccompanied RORO transport** is based on end-to-end services with dedicated RORO freight vessels, which often have reserve space for containers.
- The **deepsea and shortsea car carrying trade** is another submarket in the RORO market. On intercontinental routes, the operators deploy Pure Car and Truck Carriers (PCTC) with capacities of up to 8000 CEU, resulting in significant cost savings on the sea leg (economies of scale). The number of ports of calls is kept to a strict minimum as shipping lines aim for a short port time, and they face a shortfall in the number of ports that have the infrastructure to accommodate large quantities of new cars. As a result, a significant part of the market is concentrated in large car handling ports. The port of Zeebrugge in Belgium is a good example, with 2.96 million units handled in 2019. The position of the main ports is strongly entwined with their proximity to the main buyer markets and the spatial concentration of car assembly plants. A number of large car ports have successfully combined deepsea services with intra-regional shortsea services. The resulting hub-and-spoke network configuration is combined with growing local clusters of automotive logistics companies. While road haulage is by far the dominant mode of inland transport to/from car terminals, rail and barge play an ever more important role in securing inland access for the larger car ports, particularly in Belgium, the Netherlands, and the Rhine and Yangtze river basins.

C. Maritime services in the general cargo market

The diversity in maritime service configurations is probably the highest in the market of **conventional general cargo**. In contrast to the bulk cargo market, where parcel sizes are usually big enough to fill an entire ship, the general cargo market deals with the shipment of consignments smaller than a ship or hold size. Given the enormous variety of different cargoes involved, there are several ways in which breakbulk cargoes can be shipped. The most common is the conventional liner-type concept of "weekly fixed-day services", characterizing the liner shipping industry, which is something the deepsea trade of conventional cargo has never really been able to achieve. Instead, the following service/schedule options can be distinguished in the case of breakbulk shipping (the typology is based on Dynamar):

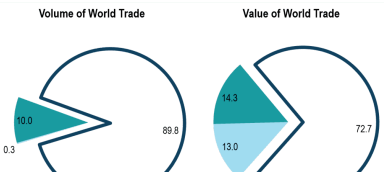
- Services of a specific frequency operated with dedicated ships.
- Services offering sailings within a certain period, deploying trip charters.
- Services operated on inducement but still within a more or less defined trade lane.
- A mixture of two or three of the above options.
- "Parcelling", such as tramping, whereby a vessel is chartered (usually on a trip-out basis) once a specific cargo volume is available.

The conventional general cargo market includes many specialized ships designed to carry specific cargo loads. For example, heavy-lift vessels do not operate on fixed routes, but they are attracted to those areas where large investments in the oil and gas industry are being made. Conventional reefer ships mainly carry high-value foodstuffs that require refrigeration and atmosphere control on an end-to-end service (e.g. bananas from a port of loading in Latin America to a specialized terminal in Europe). Examples of reefer cargoes include fresh and frozen fruit (e.g. bananas, deciduous, and other citrus fruits), vegetables, fish, meat, poultry, and dairy products. Reefer shipping is a prime example of a one-way (and for some products seasonal) business with cargoes mainly exported from the southern hemisphere to the rest of the world. The reefer shipping sector is increasingly being put under pressure from container shipping.

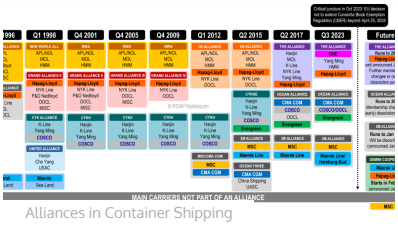
D. Maritime services in container shipping

The most advanced structures in maritime services are found in **container shipping**. Shipping lines design the networks they find it convenient to offer, but at the same time, they are bound to provide the services their customers want in terms of frequency, direct accessibility, and transit times. In the last two decades, increased cargo availability has made carriers and alliances reshape their liner shipping networks by introducing new types of liner services on the main east-west trade lanes.

Observing recent developments in liner shipping, productivity has been improved by using larger ships and devising **new operational patterns and co-operation between shipping lines**. Since the 1990s, a great deal of attention has been devoted to larger, more fuel-economical vessels, and this indeed has produced a substantial reduction in the cost per TEU of capacity provided. Adding post-Panamax capacity gave a short-term competitive edge to the early mover, putting pressure on the followers in the market to upgrade their container fleet and to avert a serious unit cost disadvantage. Alliance structures (The Alliance, Ocean Alliance, and 2M) provide their members easy access to more loops or services with relatively low-cost implications and allow them to share terminals, cooperate in many areas at sea and ashore, thereby achieving cost savings in the end. Alliances and consolidation have created multi-string networks on the major trade routes, and both shippers and liners have adapted. The largest ships operate on multi-port itineraries calling at a limited number of ports. The networks are based on traffic circulation through a network of specific hubs.



Modal Shares of World Trade by Volume and Value 2008



Alliances in Container Shipping

Related Topics

- Chapter 1.2 Ports and Maritime Supply Chains
- Chapter 1.3 Ports and Container Shipping
- Chapter 1.4 Ports and Distribution Networks
- Chapter 8.4 Containers

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