Containerised trade trends and implications for Australian ports

A report for Port of Newcastle

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Executive Summary

As a small trading nation, Australia has benefited significantly from growth in global trade over the last 60 years. The growth in trade has been facilitated principally by the reduction in trade barriers through a shift towards rules-based trade administered now by the World Trade Organization, and improvements in the efficiency of shipping. This has allowed countries to obtain economic benefits from specialisation, and transformed how goods are produced and consumed, creating global supply chains.

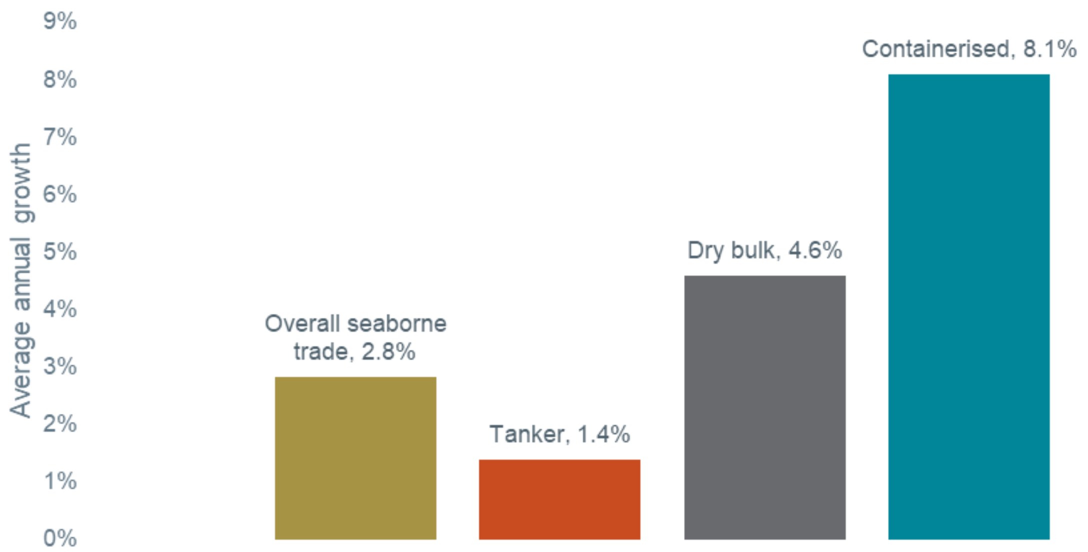
As global trade started to grow in the 1950s, there was an increased focus on improving the efficiency of seaborne shipping as the principal mode of transport to support global supply chains. This led to the creation of shipping containers, to replace more traditional break-bulk shipping. Containers dramatically lowered the cost of transporting goods internationally, by reducing time and labour costs for the loading and unloading of ships, with additional benefits from reduced theft, lower insurance costs, reduced warehousing costs and lower costs of interconnection with other modes of transport.

HoustonKemp Economists has been engaged by Port of Newcastle to set out global trends in containerised trade and explain the implications for Australian ports. This information provides the high-level context for port planning decisions into the future.

Containerised trade is the fastest growing component of seaborne trade

Containerised trade volumes have been growing at an annual rate of over 8.1 per cent since 1980, well over double the growth of overall seaborne trade, at 2.8 per cent – Figure E-1. While the growth rate in containerised trade is likely to lower over time, containerised trade is expected to continue to be a dominant form of international shipping well into the future – growing in line with increasing globalisation and population growth.

Figure E-1 Containerised trade volumes have been growing at a faster annual rate between 1980 and 2018 than overall seaborne trade

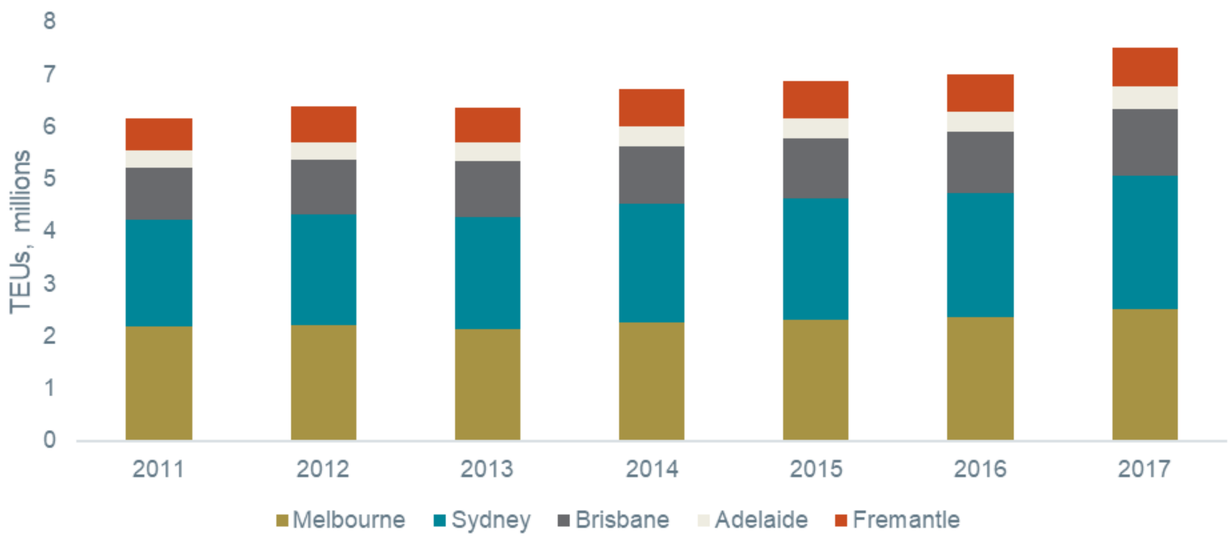


Source: UNCTAD, Review of Maritime Transport 2018*, October 2018, p 4.*

Containerised trade in Australia is also continuing to grow

Containerised trade of Australian imports and exports have experienced an average growth rate of 2.4 per cent annually over the last seven years across Australia's five largest container ports in Melbourne, Sydney, Brisbane, Fremantle and Adelaide. Overall, wharfside throughput at these five ports grew from handling 6.2 million TEUs (twenty-foot equivalent unit) in 2011 to 7.5 million TEUs in 2017 equating to an increase of 21.7 per cent during that period.

Figure E-2 Wharfside TEUs handled by Australian ports containerised trade in terms of TEUs



Source: BITRE, Maritime Waterline 62, October 2018, pp 12-15.

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) forecasts that container trade in Australia will increase by between 172 and 205 per cent across each of the five major Australian container ports to 2032-33. The highest growth across the east coast of Australia is expected to be in Brisbane, followed by Adelaide, then Melbourne and Sydney – Table E-1.

Table E-1 Implied BITRE growth rates for containerised trade

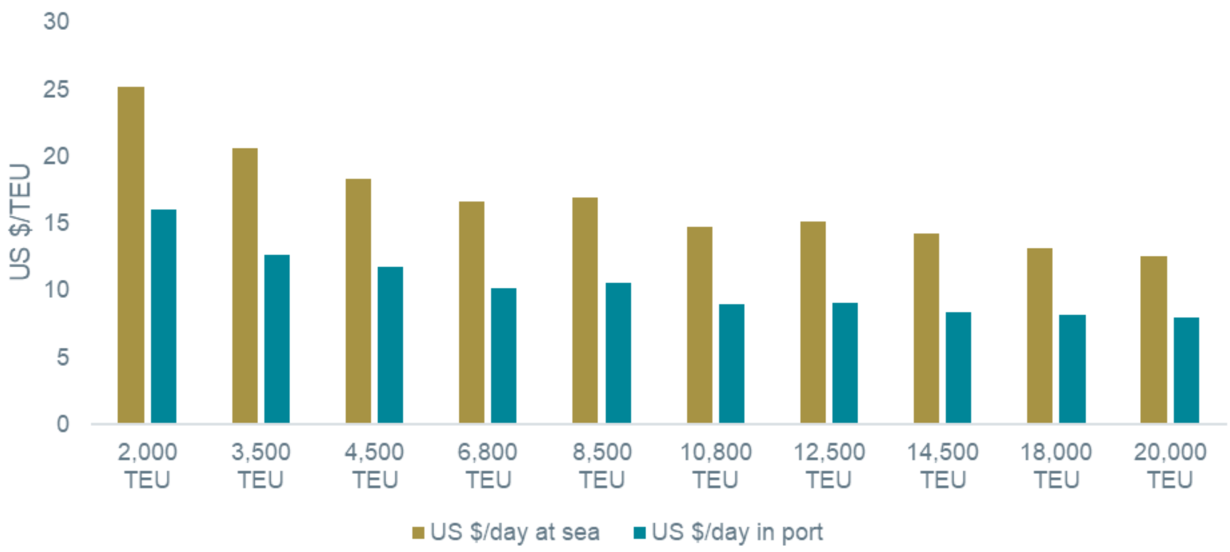
Port	Annual TEU growth rate	Percentage growth by 2032-33
Port of Melbourne	4.0	72.4
Port Botany	4.0	72.4
Port of Brisbane	5.1	100.6
Port Adelaide	4.6	86.6
Port of Fremantle	5.3	105.1
East coast average	4.2	78.8

Source: BITRE, Containerised and non-containerised trade through Australian Ports to 2032-33, December 2014, pp 34-63.

Global containerised shipping is shifting towards larger vessels to obtain cost efficiencies

A fundamental principle of global shipping is that the cost of transporting a container falls as vessel size increases – Figure E-3. This reflects the considerable economies of scale associated with shipping. The key impediment to obtaining these cost reductions are limitations at port facilities, and associated landside transport to accommodate the size of vessel and volumes of containers involved.

Figure E-3 Per day costs of container ships



Source: *https://www.wsp.com/en-AU/insights/the-ceiling-on-economies-of-scale-in-container-vessels*

Australia is currently capable of accommodating container ships size up to a maximum of approximately 8,000 TEU to 10,000 TEU at both the Port of Melbourne and Port Botany.[1]

Supply chain efficiency has a disproportionately large impact on competitiveness and welfare in Australia compared to other countries

Australia's distance from other markets means that small improvements in the efficiency of international supply chains lead to large improvements in our competitiveness in overseas markets, and lower costs for imported goods and secondary inputs for consumers and producers.

For example, shipping costs between Australia and Shanghai are over three times higher than between Japan and Shanghai (US $677/TEU from Australia compared to US $215/TEU from Japan). This means that when say Australian meat producers compete against Japanese meat producers into the Chinese market, Australia needs to overcome the shipping cost differential to be competitive. It follows that a similar percentage increase in supply chain efficiency will assist Australia's competitiveness more than a Japanese supplier, all other things equal.

Port expansions are needed to accommodate growth in container trade by 2032

The ongoing growth in containerised trade is placing pressures for expansion at Australia's major ports. Current total port throughput at Australia's east coast container ports equals 7 million TEU. Given current growth, this means that port capacity expansions are needed as soon as 2032.

[1] Approximate figures are presented here given that the maximum size of ships that a port can accommodate will depend on a number of factors, including the tides, the ship itself, and its displacement at the time the ship is calling on the port. Approximately figures have been sourced from Port of Melbourne, *2050 Port Development Strategy Discussion Paper*, p 16; Infrastructure Victoria, *Advice on securing Victoria's ports capacity,* May 2017, p 59.

Each of the major ports have container facility expansion plans – Table E-2.

Table E-2 Expansion plans at major east coast container ports

	Port of Melbourne	Port Botany	Port of Brisbane	Port Adelaide
Current port capacity	5 million TEU	7.2 million TEU	4.9 million TEU	900,000 TEU
Additional capacity from planned or proposed expansions	3 million TEU	-	-	300,000 TEU
Final port capacity after planned or proposed expansions	8 million TEU	7.2 million TEU	4.9 million TEU	1.2 million TEU
Description of expansion	Expansion of container operations on Webb dock	-	-	Use of automated crane systems

In principle, container port expansions should be preferred in locations where the upfront costs plus the costs along the entire supply chain over time are minimised. This requires consideration to be given to:

- any channel related costs to support containerised trade;
- upfront wharfside investments that may be needed;
- landside investments to support an increase in container movements; and
- the implications for adjacent road and rail networks, and particularly road congestion.

Similar to the role that the Port of Tauranga has in New Zealand, there may be scope to consider the development of a container port facility that can accommodate the largest ships as a transhipment port for other destinations within Australia and beyond.

1. Introduction

As countries become increasingly interdependent the size of global trade has continued to increase, bringing prosperity all over the globe. Global trade has been growing since the 1950s driven by reductions in trade barriers, the increasing prominence of the World Trade Organization, and bilateral country efforts to promote competition. Despite the recent imposition of trade barriers by the United States and in retaliation, China, generally global trade is expected to continue to grow well into the future.

The growth in global trade has led to changes to shipping practices – the dominant mode of global freight transport – to improve the efficiency of global supply chains. In practical terms this has led to the growth of containerised trade, which minimises freight handling costs compared to earlier forms of shipping. Over time the shipping industry has also seen increases in the size of container ships as volumes increase.

Against this backdrop, HoustonKemp Economists has been asked by Port of Newcastle to set out global trends in containerised trade and explain the implications for Australian ports. This provides the high-level context for port planning decisions into the future.

This report provides a high-level overview of containerised trade trends, and is structured as follows:

- section 2 sets out trends in global trade, and expectations about future volumes and major trade flows by commodity type;
- section 3 describes the nature of the global shipping industry, and how the shipping industry is changing in response to changes in global trade;
- section 4 outlines the ports industry in Australia, and highlights how ports will likely need to develop in response to the future challenges; and
- section 5 sets out the implications of the emerging trade and shipping trends for the ports industry in Australia, with a particular focus on the opportunities in New South Wales.

2. Global trade continues to grow as countries become more interdependent

Key points:

- The multilateral trade system developed after World War II underpins the trade environment that has allowed globalisation to occur.
- Global trade in merchandise exports has grown by nearly 135 times (13,500 per cent) between 1960 and 2017, or approximately 9 per cent annually.
- In terms of value, global merchandise trade predominantly consists of 70 per cent processed and manufactured goods, while a quarter is fuels and agricultural products.
- Australia's exports are transported largely by bulk carriers. However, imports of manufactured goods and some exports such as meat, rely on containerised shipping.
- Apart from fuel and petroleum products, imports are transported to Australia by containerised shipping and reflects demand for consumption goods and inputs to production.
- Containerised shipping to and from Australia is expected to grow in line with population growth and overall levels of consumption growth in Australia.

This section sets out the current trends in global trade, with a focus on containerised trade.

2.1 Global trade continues to grow

In 1960, 15 years after the end of World War II, global merchandise exports[2] were US $130.5 billion.[3] 57 years later in 2017 global merchandise exports were US 17.7 trillion, or 135 times the nominal value of global merchandise exports achieved in 1960. This equated to a growth rate of 9 per cent annually over nearly six decades. As a proportion of Gross World Product (GWP), 2017 global merchandise exports reached 21.9 per cent compared to only 9.6 per cent in 1960.

The dramatic increase in global merchandise exports in the post war period has had an equally dramatic effect on how countries undertake the production and consumption of goods. Instead of predominantly producing and consuming intermediate and final consumption goods in the same country, as occurred in the immediate post-war period, global trade has facilitated a trend that moved production away from where consumption takes place.

The trend towards internationalisation of production and globalised trade has its origin at the end of World War II where Allied powers, led by the US, sought to establish institutions and systems to prevent economic depressions that were considered by many to be a principal cause of the war.

The first of these systems was the Bretton Woods system that consisted of rules, institutions and procedures that regulated the international monetary system. This established the International Monetary Fund (IMF) (in

[2] Merchandise exports is used as an indicator of global export and import trade given that, by definition, the export of one country is the import of another country. Merchandise exports includes manufactured goods, fuels and mining products, agricultural products and other products. See WTO, *World Trade Statistical Review 2018*, 2018, p 11.

[3] WTO data.

1945), International Bank for Reconstruction and Development[4] (in 1944) and a system of exchange rates pegged to the value of gold.

Agreements and institutions that worked toward reduced trade barriers were also established from the 1940s onward, starting with the General Agreement on Tariffs and Trade (GATT), the forerunner to the World Trade Organization (WTO). Seven rounds of negotiations occurred under GATT, which focused on reducing tariffs, antidumping, non-tariff barriers, services, and intellectual property. These negotiations culminated in the establishment of the WTO in 1995. Significantly, 2001 saw the entry of China into the WTO, bringing a country of 1.4 billion people into the international trading system, further accelerating the shift toward a global supply chain.

In Europe, the European Coal and Steel Community (1951), European Economic Community (1957), and finally the European Economic Area (1994) under the European Union (1993) gradually created the world's largest free trade block.

In North America, the US and Canada entered into a free trade agreement in 1988, which was superseded by the North American Free Trade Agreement (NAFTA) between the US, Canada and Mexico in 1994. It is anticipated that NAFTA will be superseded by the United States Mexico Canada Agreement (UNMCA) that has been agreed upon and is currently in the process of ratification.

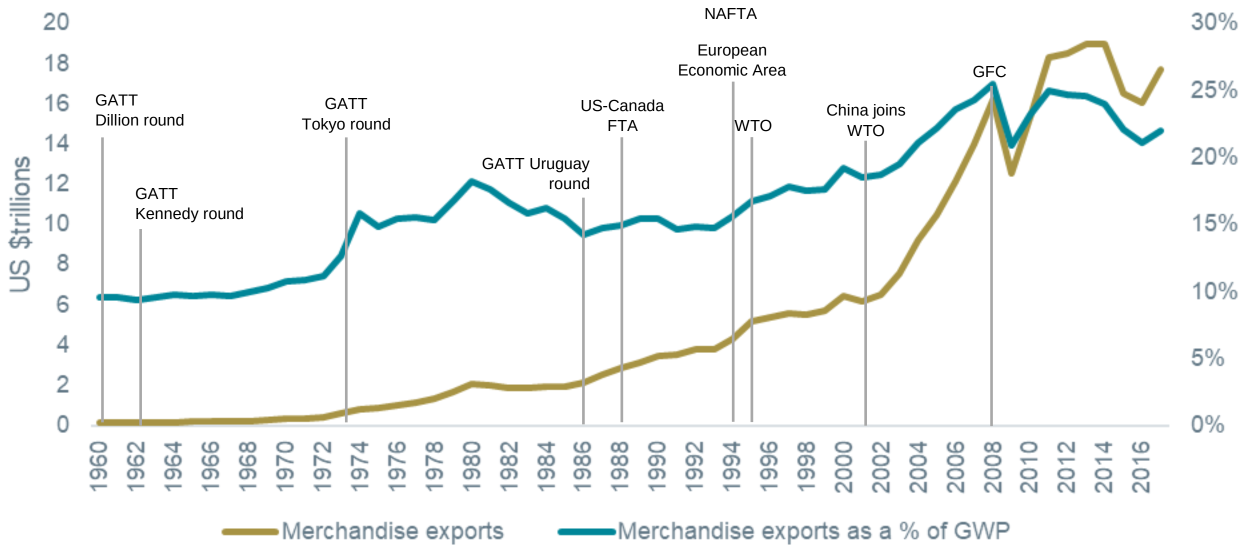
These institutions and agreements established over a period of nearly 80 years have gradually formed what we see today as the multilateral trade system based on reduced tariff and non-tariff barriers, common markets, open capital accounts and a rules-based trading system. The impact of the multilateral trade system has been felt across the world where manufacturing used to be co-located where consumption occurred but is now determined by comparative advantages of each country, giving rise to global supply chains that seek to exploit those advantages to drive cost efficiencies in production.

Arguably, the most visible example of the benefits from the development of a multilateral trade system is found in East Asia where post war agricultural or war-torn economies have evolved into developed economies, starting with Japan in 1960, then the 'Asian Tiger' economies of Hong Kong, Singapore, South Korea and Taiwan beginning in the 1970s, and China in the 1990s. The development of these East Asian economies has led to increasing standards of living and the rise of a large middle class that itself has become a driver of global consumption, along with North America and Europe.

The impact of the multilateral trade system can also be found in the rapid expansion of merchandise exports, where the system's institutions and agreements have contributed to an environment that enabled growth to expand significantly - Figure 2-1. The level of merchandise exports in 2017 is equivalent to 13 times the size of Australia's GDP or 91 per cent of US GDP.

[4] The International Bank for Reconstruction and Development became part of the World Bank.

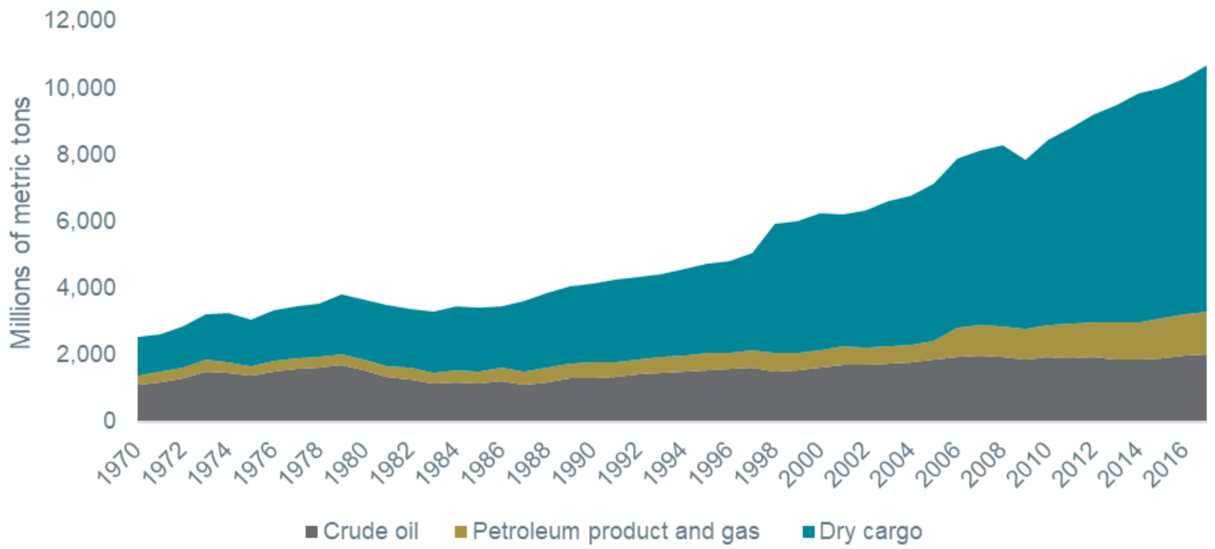
Figure 2-1: Global merchandise exports have increased from 10 per cent of GWP in 1960 to above 20 per cent in 2017



Source: WTO data.

In volume terms, dry cargo has experienced the greatest degree of growth, increasing from 1.1 billion metric tons to 7.4 billion metric tons in 2016 (an increase of 550 per cent) since 1970. This translates to an annual growth rate of 4.0 per cent over a period of nearly 50 years, compared to 3.0 per cent annual rate of growth for seaborne merchandise trade overall. Consequently, dry cargo represents the largest component of seaborne merchandise trade - Figure 2-2.[5]

Figure 2-2 Unloaded dry cargo has grown the most and at the greatest rate since the 1970s

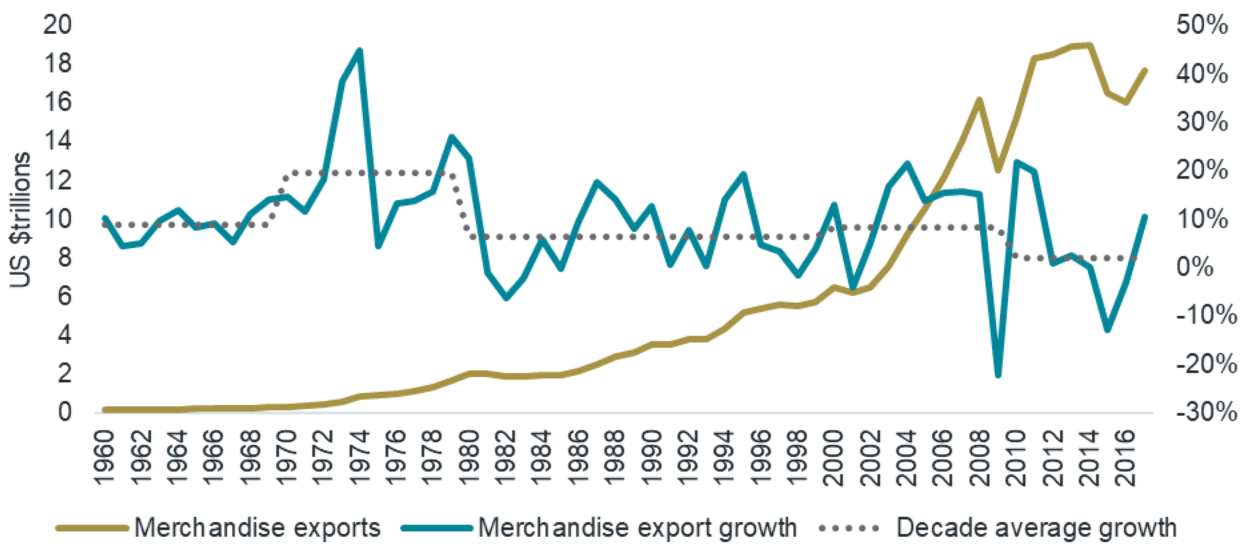


Source: WTO Data

[5] A significant portion of dry cargo volume growth (in metric tons) is related to dry bulk cargo.

The growth in merchandise exports occurred in fits and starts as individual countries were brought into the multilateral trade system. Global merchandise exports growth was highest in the 1970s with growth achieving 19.6 per cent per year on average, reflecting the relatively low base that global merchandise trade started from in the 1960s but also the rapid economic development of Hong Kong, Singapore, South Korea and Taiwan, continued development of the multilateral trade system and the adoption of containerisation. Growth in merchandise trade during the 1980s to the 2000s has been robust with decade growth rates averaging between 6.3 per cent and 8.2 per cent and the rapid expansion of global supply chains.

Figure 2-3 Merchandise export growth rate



Source: WTO Data

More recently global merchandise exports have been growing at a more modest rate of 1.8 per cent each year between 2010 and 2017 post the 2008 Global Financial Crisis (GFC). However, merchandise exports in 2017 still translated to 15.7 per cent more than in 2010.

The WTO is forecasting that merchandise trade in terms of volume is expected to be 3.7 per cent in 2018 and 3.1 per cent in 2019.[6] Over the long run, global trade is expected to grow in line with GWP, which could grow by more than 130 per cent by 2050.[7]

The ten largest exporting and importing countries in the world, set out in Table 2-1 account for over half of the world's merchandise trade. These countries are all located in only three regions of the world: Europe, East Asia and North America.

Table 2-1 The 10 largest merchandise exporting and importing countries are all located in only three regions of the world

Rank	Exporters	Region	Value in billions	Importers	Region	Value in billions
1	China	East Asia	2,263	US	North America	2,410
2	US	North America	1,547	China	East Asia	1,842
3	Germany	Europe	1,448	Germany	Europe	1,167
4	Japan	East Asia	698	Japan	East Asia	672
5	Netherlands	Europe	652	United Kingdom	Europe	644

6 https://www.wto.org/english/news_e/pres18_e/pr822_e.htm

7 https://www.pwc.com/gx/en/world-2050/assets/pwc-the-world-in-2050-full-report-feb-2017.pdf

Rank	Exporters	Region	Value in billions	Importers	Region	Value in billions
6	South Korea	East Asia	574	France	Europe	625
7	Hong Kong	East Asia	550	Hong Kong	East Asia	590
8	France	Europe	535	Netherlands	Europe	574
9	Italy	Europe	506	South Korea	East Asia	478
10	United Kingdom	Europe	445	Italy	Europe	453
Total for 10 largest exporters/importers			9,218			9,455
Percentage of world total			52.0			52.5

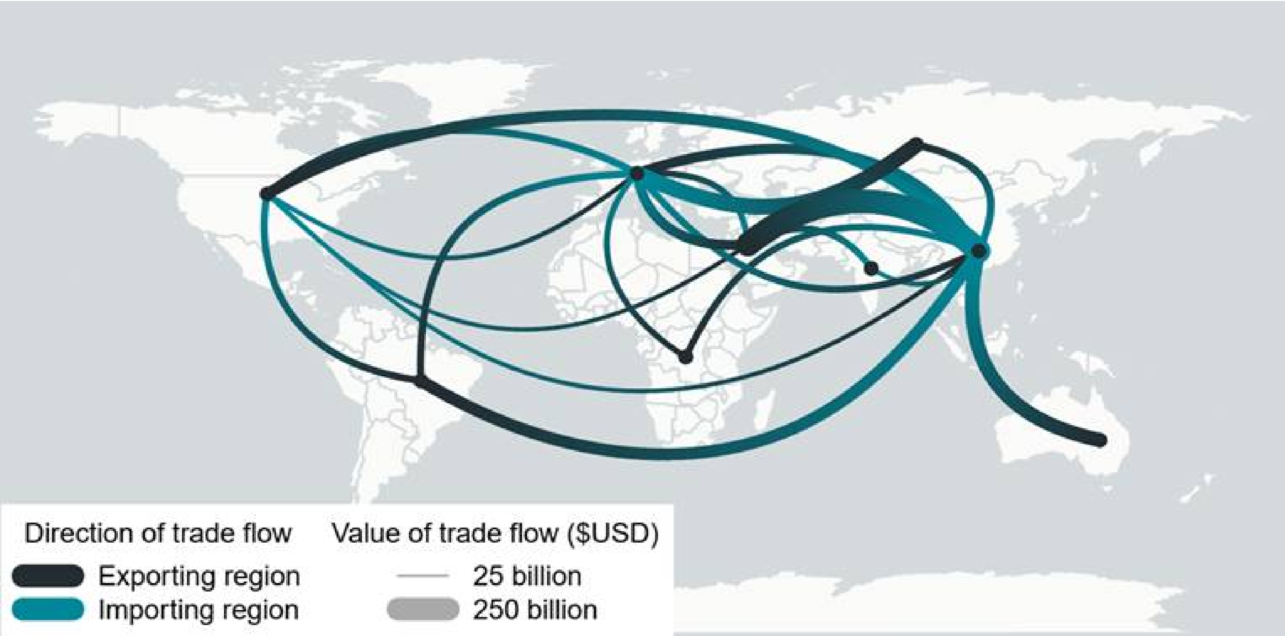
These three regions together are responsible for 79.3 per cent[8] of total merchandise exports and 79 per cent[9] of total merchandise imports in 2017 and consequently define how merchandise trade flows across the world's oceans. In broad terms, trade flows are driven by demand from Europe, East Asia and North America where large middle-class populations reside. These populations import consumer goods and intermediate goods that originate within the region and from East Asia where a significant share of the world's manufacturing occurs. To supply the resources needed to produce vast quantities of manufactured goods, East Asia draws upon energy from the Middle East, and raw materials and agricultural products from South America, Africa and the rest of the Asia Pacific, including Australia. Approximately 80 to 90 per cent of international trade flows (in terms of value) are carried by seaborne shipping.[10] The 25 largest export flows by value between different regions of the world are illustrated in Figure 2-4 below.

[8] WTO, *World Trade Statistical Review 2018*, May 2018, p 122.

[9] WTO, *World Trade Statistical Review 2018*, May 2018, p 123.

[10] UNCTAD, *50 Years of Review of Maritime Transport 1968-2018: Reflecting on the past, exploring the future*, 2018, p 4.

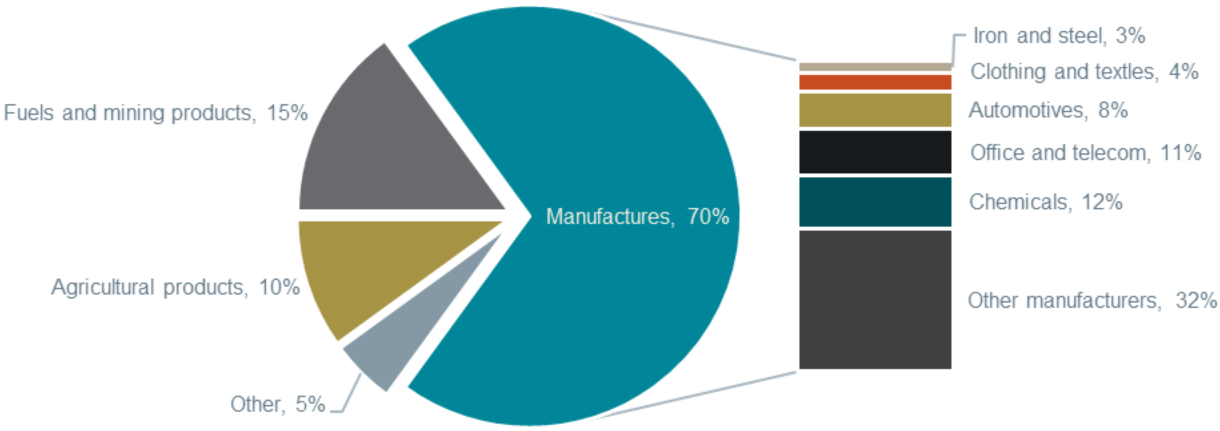
Figure 2-4 Top 25 merchandise export and import trade flows, by region and value[11]



Source: HoustonKemp, based on data from Chatham House, see https://resourcetrade.earth

The composition of merchandise exports, shown in Figure 2-5, predominantly consists of manufactured goods (ie 70 per cent), reflecting the trade flows between East Asian manufacturing centres and North American and European consumers and producers. Another 25 per cent of merchandise exports relate to agricultural products (ie food products) and input resources such as fuel and mining products that flow toward East Asia and Europe to feed and fuel their populations.

Figure 2-5 Breakdown of global merchandise exports by value



[11] Figure 2-4 shows the top 25 trade export relationships between different regions of the world. Direction of flows are indicated by colours where the origin of exports is depicted in black and the destination of exports are depicted in green.

Source: WTO, World Trade Statistical Review 2018, May 2018, p 11.

Comparative advantages of countries change over time as their economies industrialise. For many East Asian economies such as Japan and the East Asian Tigers, comparative advantages have shifted away from low cost labour as they reach the Lewis turning point,[12] and move up the value chain. Increasing labour costs suggests that China, the world's largest exporter, is also reaching the Lewis turning point and will consequently induce a shift of labour-intensive manufacturing away from China to other countries or regions where low-cost labour still exists, such as:

- **South East Asia and South Asia**, where the Philippines, Vietnam, Indonesia, Cambodia and Bangladesh have low cost labour, access to Pacific and Indian Ocean trade routes, and close proximity to large consumer markets; and
- **Central America**, where Mexico and other central American countries with lower labour costs, access to the Pacific and Atlantic Ocean trade routes, and proximity to the growing North American consumer market.

A shift of manufacturing to these regions would present a significant change in the role of China in the multilateral trade system by redirecting export manufacturing inputs away from China, and the evolution of consumer consumption toward patterns that resemble those in other developed East Asian economies. At the same time, South East Asia, South Asia, Central Europe and Central America will present new trade opportunities as countries in those regions industrialise and develop.

2.2 Containerised trade is the fastest growing component of seaborne trade

On 26 April 1956, a modified World War II oil tanker, the Ideal-X set out from the Port of Newark in New Jersey to Port Houston, Texas, carrying 58 of the first modern shipping containers. These containers were invented by Malcom McLean, who calculated that loading a medium-sized ship in 1956 the conventional way at the time (ie break bulk) was costing $5.83 a ton. In contrast, Malcom McLean estimated that loading the Ideal-X was costing less than $0.16 a ton.[13]

The compelling economics of containerisation arose from several improvements:

- **time and labour savings**: most of the improvement related to significant time and labour savings by avoiding the need to manually break bulk to load and offload general cargo ships that could take up to several days. This meant that general cargo ships would spend less time shipping cargo and more time incurring costs at port. In contrast, average days in port for today's significantly higher capacity container ships to load and unload cargo is less than one day;[14]
- **reduced theft and insurance costs**: containerisation prevented the theft of cargo that was rampant with break bulk and consequently drove down insurance costs;[15]
- **reduced warehousing costs**: cargo that had been warehoused before loading onto and off from general cargo ships could now be placed inside containers for storage, which avoided the need for dedicated warehousing; and
- **enabled intermodal transport**: standardised containers simplified the transfer to and from ships to other modes of transport such as road or rail.

[12] The Lewis turning point is where surplus rural labour is exhausted by manufacturing, causing labour shortages and rising real wages for agricultural and unskilled labour.

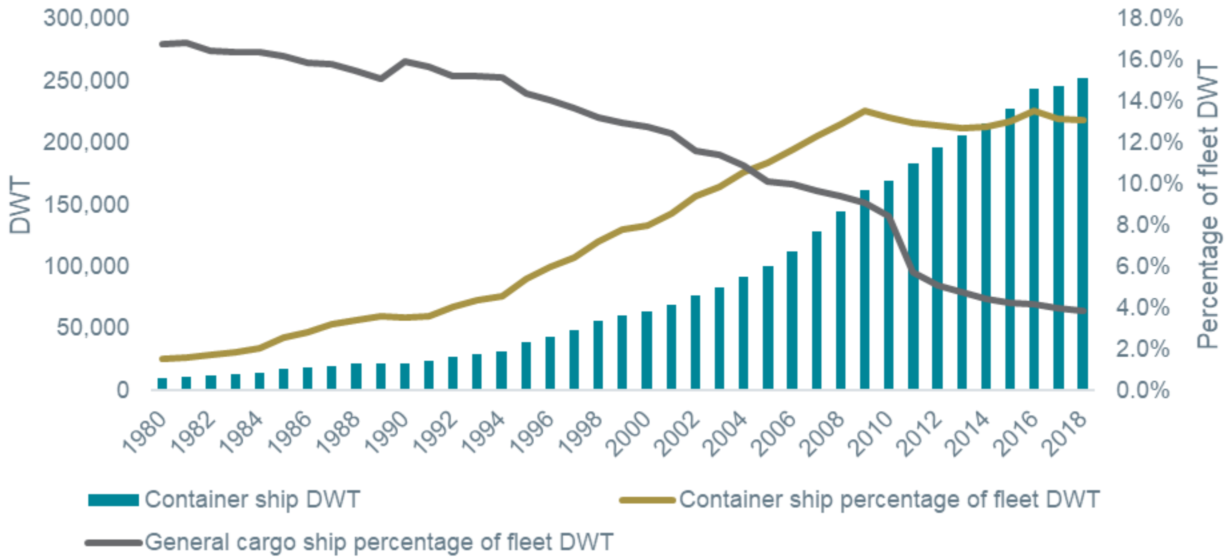
[13] Jean-Paul Rodrigue, The Geography of Transport Systems, 2017.

[14] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p 75.

[15] UNCTAD, *50 years of Review of Maritime Transport, 1968-2018*, November, p 55.

By the 1970s and 1980s, the compelling economics of containerisation lead to the standardisation of the container and the development of fully cellular container ships. Growth in container ships increased from 10.3 million deadweight tons[16] (DWT) in 1980 to 252.8 million DWT in 2018.

Figure 2-6 Container ship DWT have grown by 8.6 per cent annually and now is approximately 13 per cent of the world fleet



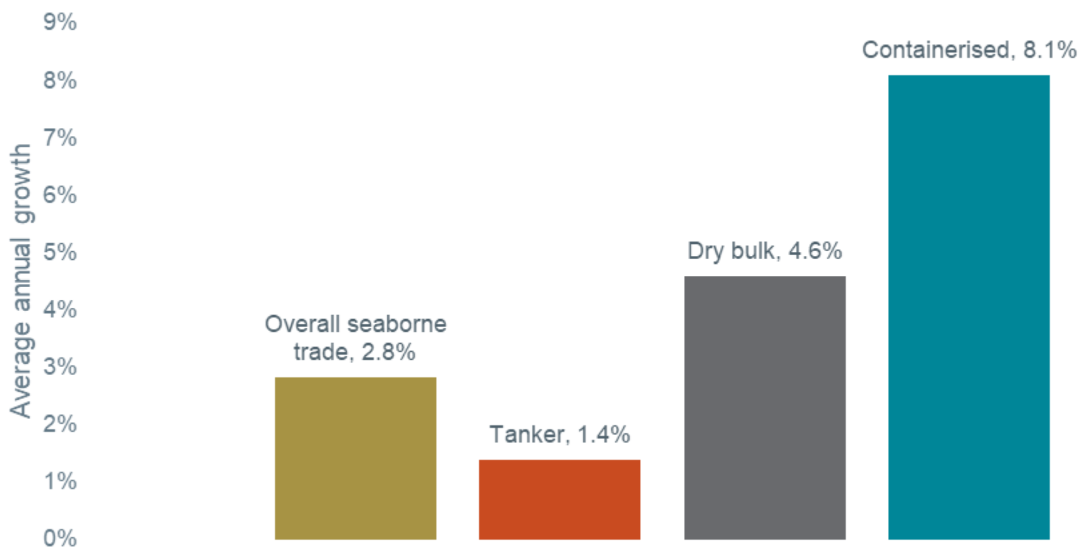
Source: UNCTAD data center.

This translates to an annual average growth rate of 8.6 per cent over the 38 years between 1980 and 2018, which is faster than the 2.7 per cent annual average growth rate for the global fleet over the same period. As a percentage share of the world's fleet in terms of DWT, container ships have grown as a share of fleet DWT from less than two per cent in 1980 to approximately 13 per cent at the expense of general cargo ships that decreased from 16.8 per cent of fleet DWT in 1980 to 4 per cent today.

In terms of trade volumes, containerised trade has grown significantly faster at an average growth rate of 8.1 per cent annually compared to other types of seaborne trade over the period between 1980 and 2018.

[16] Deadweight tons refers to how much weight a ship can carry, not the ships weight.

Figure 2-7 Containerised trade volumes have been growing at a faster annual rate between 1980 and 2018 than overall seaborne trade



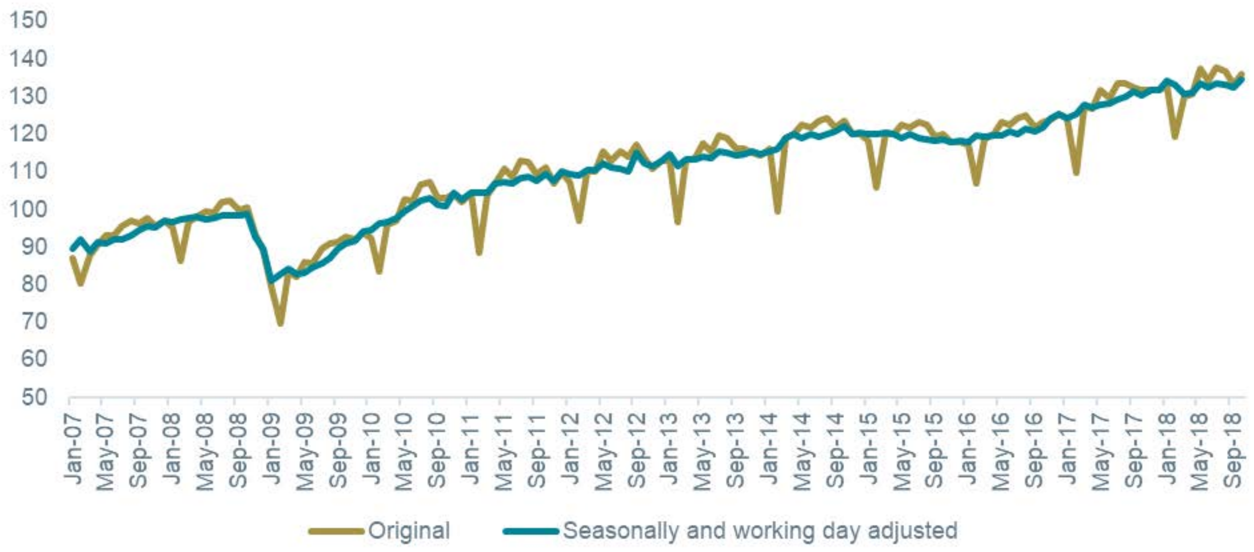
Source: UNCTAD, Review of Maritime Transport 2018*, October 2018, p 4.*

2.3 Future trends for global containerised trade

Historically, containerised trade has grown faster than other seaborne trade as general cargo shipping transitioned to containerised shipping, which is now largely complete. Consequently, global containerised trade is unlikely to continue growing at annual rates of 8.1 per cent as it did during the period between 1980 and 2018. Instead, global containerised trade has been growing at rates more closely aligned with overall seaborne trade.

Figure 2-8 sets out an index of container throughput at 88 ports around the world and shows annual growth rates averaging 4.1 per cent on a seasonally adjusted basis between 2010 (after the GFC) and 2018. It is more likely that future trends for global containerised trade will continue at this short-term trend absent material changes in technology or the trade environment that is underpinned by the multilateral trade system.

Figure 2-8 RWI/ISL container throughput index,[17] 2008 =100



Source: Institute of Shipping Economics and Logistics. See https://isl.org/en/containerindex/october-2018, accessed 18 December 2018.

There are several risks and uncertainties that might affect continued growth in global containerised trade, despite its historical growth since the 1950s. These risks and uncertainties can be grouped into short term risks that may temporarily depress containerised trade as the GFC had done in 2008 and 2009. These risks and uncertainties include:

- **US and China trade dispute**: a range of trade disputes including large and continuing US trade deficits with China, non-tariff trade barriers, intellectual property theft and China's industrial policy have given rise to tariffs and counter tariffs between the US and China, that will reduce trade volumes and values in the short term between the world's largest training countries;
- **European debt**: debt continues to be a concern for certain members of the European Union. Debt to GDP ratio for Greece, Italy, Portugal, and Belgium continues to be higher than 100 per cent, making them vulnerable to external macroeconomic shocks that could result in the need to tighten fiscal economic policy and induce recessionary economic conditions in Europe more broadly as has been the case with Greece. A European debt crisis would likely impede global trade flows within Europe and with its North American and Asian trading partners; and
- **China's debt financed growth**: China has relied on a program of stimulus largely financed by corporate debt since the GFC to maintain economic growth at acceptable levels. However, fiscal stimulus will be increasingly ineffective as economically beneficial projects and initiatives are exhausted. Over time, the increase in debt used to finance investment led GDP growth increases the risk of a debt crisis that could materially affect the ability of China to engage in global trade.

In the long term, risks and uncertainties exist that could lead to structural changes in the multilateral trade system or the economics of domestic production. These risks and uncertainties include:

- **retreat from the multilateral trade system**: developments such as the failure of the Trans Pacific Partnership, Brexit, the US-China trade dispute, and China's mercantilist trade and industrial policies (eg China 2025) to name a few may change the multilateral trade system that has evolved since the end of World War II and consequently increase trade barriers and limit the opportunities for international trade;
- **demographic changes:** much of the developed world is aging as the baby boomer generation transitions into retirement. This will have consequences on consumption and expenditure patterns as

[17] https://www.isl.org/en/containerindex/october-2018

subsequent generations are smaller than the baby boomer generation and may not be able to replace their consumption that has driven global economic growth in both developed and developing nations; and

- **new technologies in producing goods**: increasing levels of automation, the advent of artificial intelligence, and other technological changes may shift production back to locations where consumption occurs, which would affect the prospects for global trade. This may occur if new technologies reduce the cost of producing domestically to such an extent that it negates cost savings from low cost labour and economies of scale found in global supply chains.

While these risks and uncertainties may impact on global trade, overall increases in global population is expected to lead to ongoing increases in containerised trade well into the future.

2.4 Australia is the 23rd largest exporter and importer in the world

The development of the post war multilateral trading system and the growth of global supply chains has changed the structure of Australia's economy where manufacturing has been de-emphasised while services have expanded. In 1975, manufacturing constituted nearly 14 per cent of Australia's economy but is now only 5.8 per cent.[18] Practically, this has meant that Australia evolved from a country where many manufactured goods that were used or consumed domestically were produced domestically, to one where most manufactured goods are imported (outside of food products). This evolution is reflected in Australia's international trade.

Australia's international trade totaled US $460 billion in 2017, consisting of US $231 billion in exports and US $229 billion in imports. Australia's total level of international trade makes it the 23rd largest trading power in the world in both exports and imports,[19] despite only having the 56th largest population at 23.5 million.[20] Australia's position as one of the top 25 trading countries in the world reflects the fact that it is an island nation where international trade drives the ability to maintain and improve the Australian lifestyle.

Percentage wise, Australia only contributes to approximately 1.3 per cent[21] of global trade by value but it is a major exporter in two categories of merchandise exports:

- **agricultural products**: Australia exported US $40 billion of agricultural products in 2017, making it the eighth largest agricultural product exporter in the world.[22] Major categories of agricultural products exported include wheat and other grains (US $4.7 billion) and meat products (US $8.2 billion);[23]
- **fuels and mining products**: Australia exported 145 billion of fuels and mining products in 2017, making it the fifth largest exporter in this category.[24] Major categories of fuels and mining products exported include iron ore (US $48.5 billion), coal products (US $43.3 billion), petroleum gasses (US $20.2 billion), gold (US $13.1 billion) and corundum (US $5.8 billion).[25]

The composition of Australian merchandise exports reflects its comparative advantage in producing mineral and agricultural resources. Transporting much of these resources to export markets efficiently requires bulk carriers (eg coal and iron ore) or specialised tankers (ie natural gas). However, there is demand to containerise bulk goods for export for smaller shipments, as not all destination ports will have the infrastructure to receive bulk shipments. Container ships also offer more availability compared to bulk

[18] ABS, *5204.0 Australian System of National Accounts, Table 5 Gross Value Added (GVA) by Industry*, October 2018. Accessed 15 December 2018.

[19] WTO, *World Trade Statistical Review 2018*, May 2018, p 124.

[20] CIA, *The World Factbook: Australia*. See https://www.cia.gov/library/publications/the-world-factbook/geos/as.html. Accessed 14 December 2018.

[21] WTO, *Trade Profiles 2018*, 2018, p 22-23.

[22] WTO, *World Trade Statistical Review 2018*, May 2018, p 43.

[23] WTO, *Trade Profiles 2018*, 2018, p 22-23.

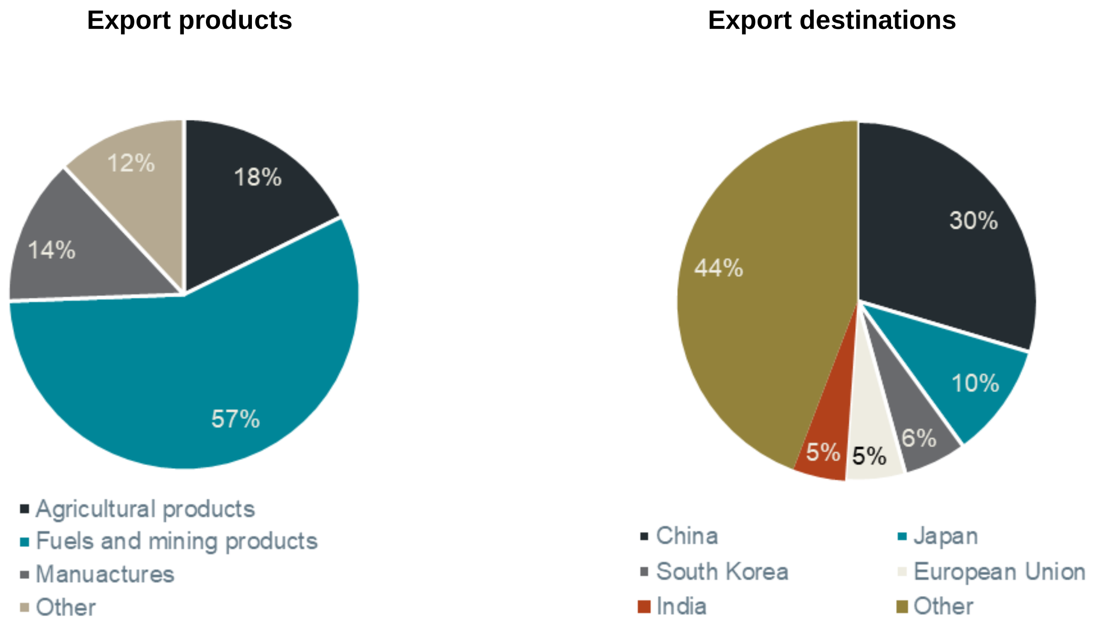
[24] WTO, *World Trade Statistical Review 2018*, May 2018, p 44.

[25] WTO, *Trade Profiles 2018*, 2018, p 22-23.

carriers, which provides exporters greater flexibility. Australian non-bulk exports will typically be shipped in containers, including manufactured goods and most meat products.

Just over 50 per cent of Australian exports are currently directed to support manufacturing or the development of Asian countries who lack sufficient mineral and agricultural resources themselves, such as China, Japan, South Korea, and India. Australia will likely continue to provide mineral and agricultural resources to developing and export focused countries in Asia into the future, given Australia's comparative advantages in producing these products.

Figure 2-9 Share of Australian exports and their destinations by value

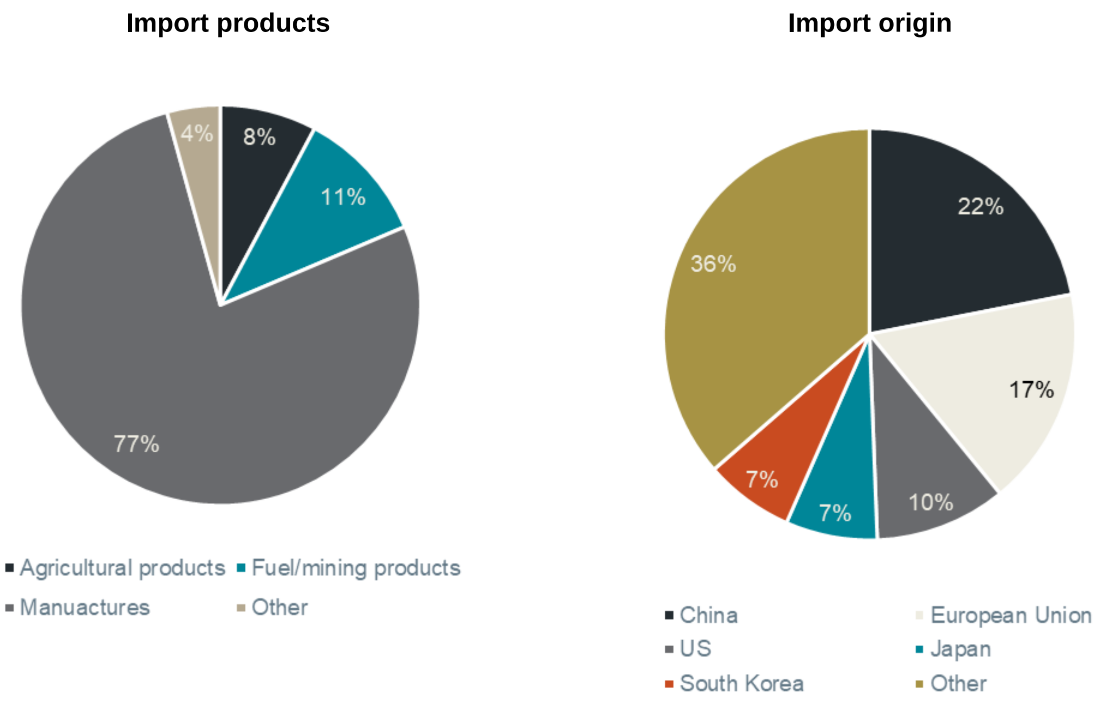


WTO, Trade Profiles 2018, 2018, p 22-23.

In contrast, Australia imports much of its manufactured goods, which are used by consumers or as intermediate inputs in Australian production processes. The largest two categories of manufactured goods imported into Australia by value are petroleum products (US $22.6 billion) and vehicles (US $18.0 billion), which are transported in bulk carriers and roll-on/roll-off ships respectively. Remaining imports (ie excluding petroleum products and vehicles) are typically shipped to Australia in containers.

Australia's largest import partner is China where more than one third of Australian imports originate. Another 14 per cent of imports originate from Japan and South Korea, making imports from East Asia total over 50 per cent of total Australia imports by value once other East Asian countries are included. The origin of the majority of Australian imports reflects the dominance of East Asia's role in global manufacturing. This can be compared to imports from the US and the European Union, where their combined share of Australian imports is just over one quarter.

Figure 2-10 Share of Australian import products and their origin by value



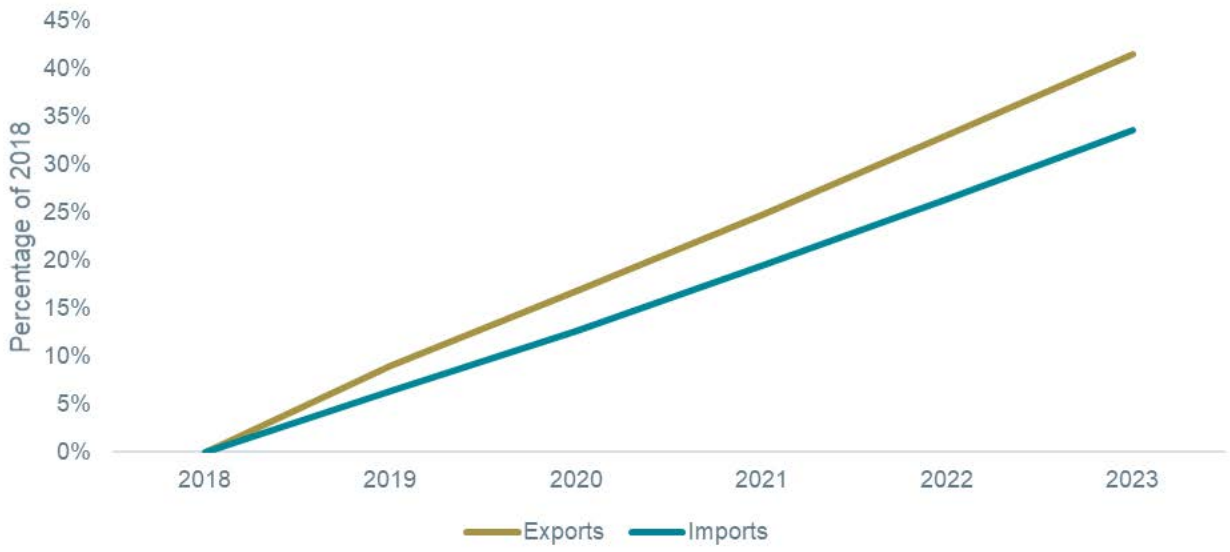
Source: WTO, Trade Profiles 2018, 2018, p 22-23.

Australia will likely continue to import most of its manufactured merchandise and petroleum products from other countries for the foreseeable future absent disruptive technological change or fundamental changes in the multilateral trade system. This is due to Australia's relatively small domestic market, the distance from large global markets and relatively high labour costs constraining the opportunities for viable Australian manufacturing to a limited set of products.

Over the next five years from 2019 to 2023 exports and imports are expected to grow faster than the 2.14 per cent annual GDP growth forecasted for the period.[26] The IMF is expecting Australian export volumes will grow by 41 per cent compared to 2018 levels, or 5.4 per cent annually. Import volumes are also expected to grow but at a slightly lower rate of 4.7 per cent annually, increasing 33.7 per cent on 2018 levels by 2023.

[26] IMF, *World Economic Outlook Database*, April 2018, Australia Gross domestic product, constant prices.

Figure 2-11 IMF forecasts increasing export and import volumes through to 2023



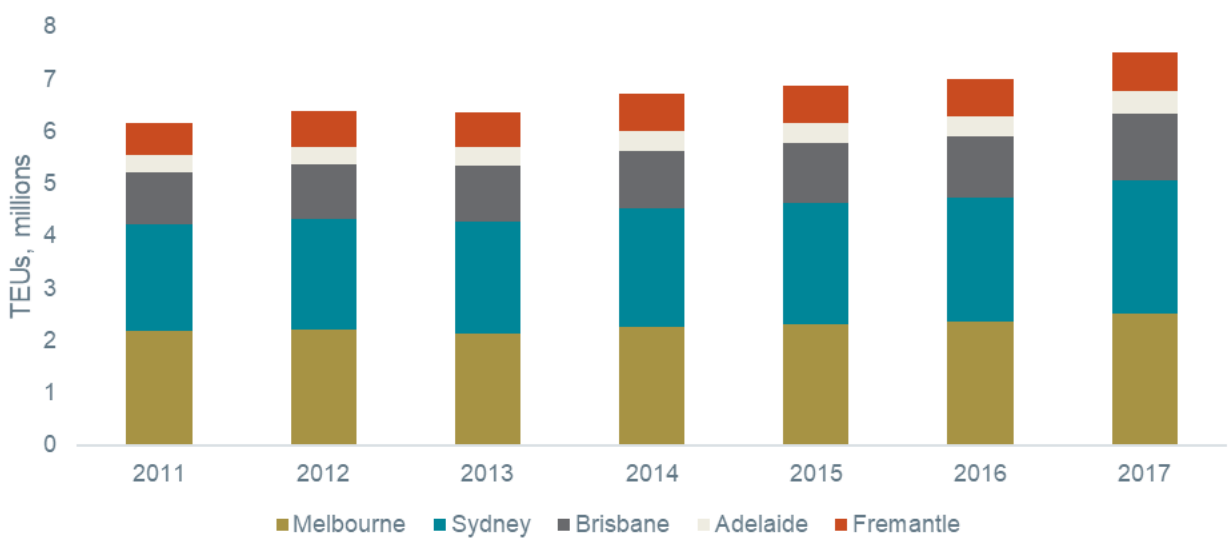
Source IMF, World Economic Outlook Database, April 2018

If realised, forecast growth in exports and imports will mean that both demand for bulk shipping from Australia and containerised shipping to Australia will likely continue to grow over the 2019-2023 period.

2.5 Containerised trade in Australia has been growing

Containerised trade of Australian imports and exports have experienced an average growth rate of 2.4 per cent annually over the last seven years across Australia's five largest container ports in Melbourne, Sydney, Brisbane, Fremantle and Adelaide. Overall, wharfside throughput at these five ports grew from handling 6.2 million TEUs in 2011 to 7.5 million TEUs in 2017 equating to an increase of 21.7 per cent during that period.

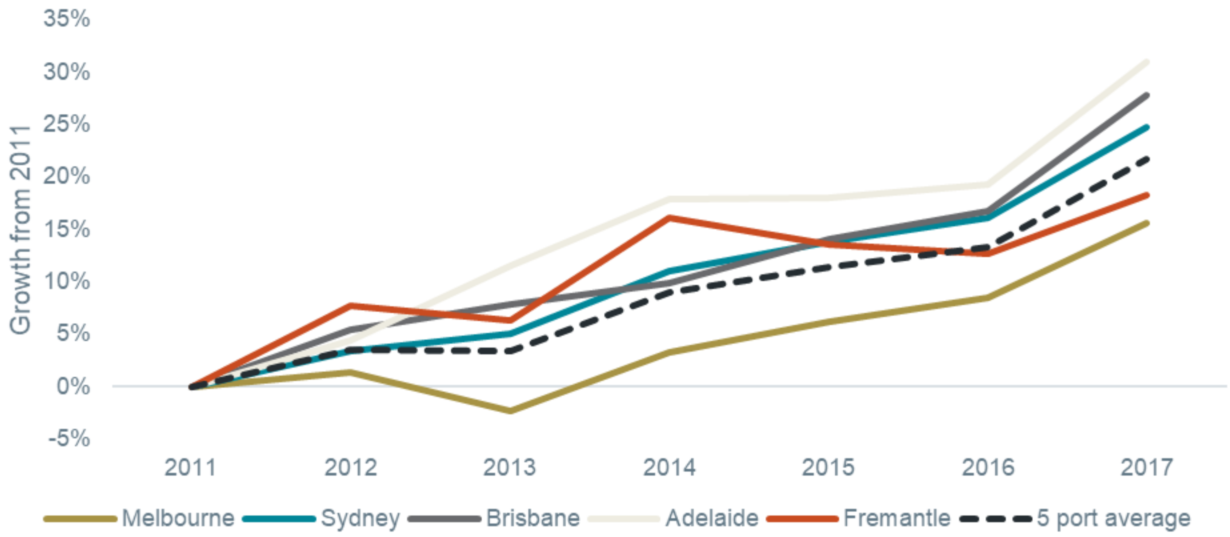
Figure 2-12 Wharfside TEUs handled by Australian ports containerised trade in terms of TEUs



Source: BITRE, Maritime Waterline 62, October 2018, pp 12-15.

Container throughput growth in Adelaide and Sydney has been above the average for the five ports, while growth in Melbourne has been the more modest, as shown in Figure 2-13.

Figure 2-13 Wharfside TEUs handled by Australia's five main ports has grown by between 12 and 29 per cent



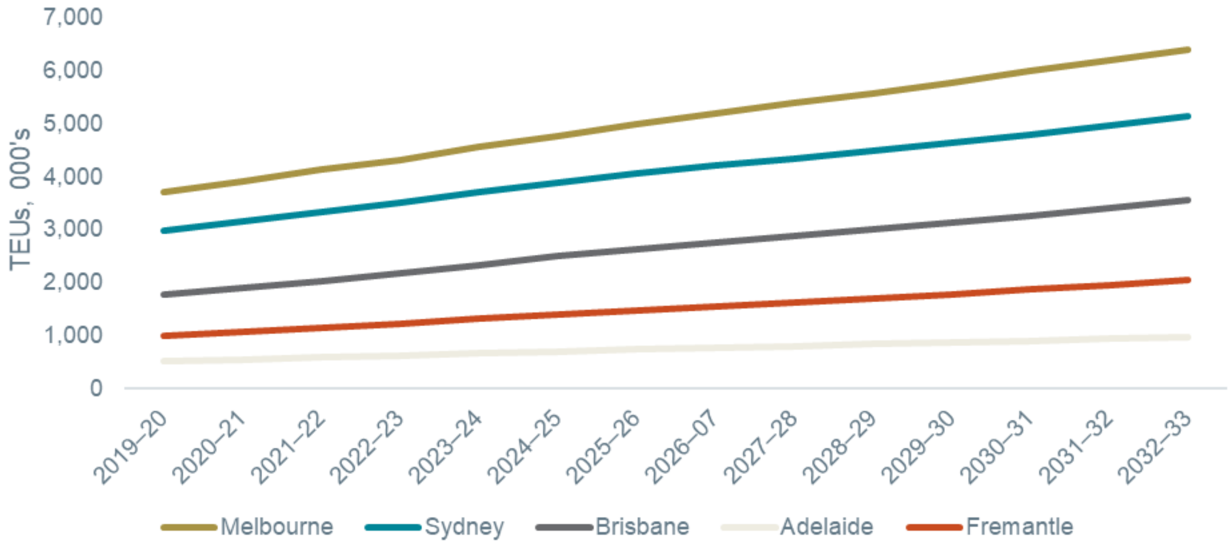
Source: BITRE, Maritime Waterline 62, October 2018, pp 12-15.

Growth in containerised trade is driven by several factors including:

- **population growth**: demand for manufactured merchandise will grow as Australia's population grows over time, inducing derived demand for containerised imports;
- **income growth**: income growth allows increased consumption on a per capita basis, which will in part result in increased demand for imported manufactured goods; and
- **exchange rates:** the relative cost of imports and exports are affected by the exchange rate, which in turn affects demand. For example, a strong Australian dollar reduces the cost of imports for domestic customers and stimulates inbound containerised trade but increases the cost of Australian exports for overseas customers that would reduce outbound containerised trade. On balance, a strong Australian dollar will likely drive more demand for containerised trade than it reduces as most imports are containerised while most exports are bulk.

Bureau of Infrastructure, Transport and Regional Economics (BITRE), developed an econometric model based on these factors to forecast containerised trade in terms of TEUs out to 2032-33, shown in Figure 2-14.

Figure 2-14 TEUs at Australia's five main ports is forecast to increase by between 72 and 105 per cent



Source: BITRE, Containerised and non-containerised trade through Australian Ports to 2032-33, December 2014, pp 34-63.

BITRE's forecast of containerised trade for each port indicate that the ports of Melbourne and Sydney (Port Botany) will grow by 72 per cent by 2032/33 from the number of TEU forecast for 2019/20, while the Port of Brisbane and Port Adelaide is forecast to grow faster at 101 per cent and 87 per cent respectively. Implied growth rates are presented in Table 2-2 below.

Table 2-2 Implied BITRE growth rates for containerised trade

Port	Annual TEU growth rate	Percentage growth by 2032-33
Port of Melbourne	4.0	72.4
Port Botany	4.0	72.4
Port of Brisbane	5.1	100.6
Port Adelaide	4.6	86.6
Port of Fremantle	5.3	105.1
East coast average	4.2	78.8

Source: BITRE, Containerised and non-containerised trade through Australian Ports to 2032-33, December 2014, pp 34-63.

If the forecast trend from BITRE holds into the future, it can be expected that container trade will reach 28.1 million TUEs by 2050 for both wharfside and landside. This is compared to 7.8 million TEU in 2017 across the five ports.

3. The shipping industry is focused on improving the efficiency of global supply chains

Key points:

- Globalisation and the multilateral trade system have allowed supply chains to develop across national borders and harness comparative advantages of each individual country.
- Containerised shipping has been a significant enabler of the global supply chain by reducing the cost of transport that links distant production processes together.
- The cost of containerised shipping has a proportionally larger effect on Australian exporters and their relative competitiveness and the costs of inputs used in production processes domestically.
- Global freight rates suffered from a glut of capacity, which pushed the industry toward consolidation and reduced shipping rates. The supply and demand balance for container shipping capacity has only improved recently where demand has grown faster than supply.
- Container ships are trending toward larger, more efficient ships and decommissioning of smaller ships.
- Port infrastructure is constraining possible destinations of very large container ships, which are used between long distance trans-shipment hubs.

In this section, we set out the changes occurring in the global shipping industry, in response to increasing global containerised trade.

3.1 Shipping is an important part of global supply chains

The development of containerisation has dramatically decreased the cost of shipping general cargo merchandise, which has made it economically viable to separate the production of a vast amount of manufactured goods from the location of their consumption. Concurrently, reduced trade barriers resulting from the development of a multilateral trade system enabled the establishment of global supply chains that span multiple countries. Such supply chains can take advantage of comparative advantages that each country offers and in doing so has increased the efficiency with which merchandise goods and services are produced. Box 3-1 provides an illustration of how a single product, the Apple iPhone, can involve a supply chain spanning the world.

Box 3-1: The Apple iPhone. Designed in California, made in the US, Japan, Germany, Italy, Taiwan, South Korea, and assembled in China

The ubiquitous Apple iPhone is famously ‘designed in California’ and ‘assembled in China’, and is ‘Made in China’ for its country of origin when imported into consumer markets around the world. However, these descriptions of the iPhone’s origin are at best incomplete.

While it is true that the iPhone is designed in California by Apple, a US company, and assembled in China, its assembly is done by two Taiwanese companies (Foxconn and Pegatron), and its components are sourced from all over the world. The table below sets out component suppliers and their country of origin and illustrates the expansiveness of the global supply chain that produces the Apple iPhone.

Table 3-1 Components used to make the Apple iPhone[27]

Component	Company	Country of origin
Accelerometre	Bosch	Germany
Audio chipsets and codec	Cirrus Logic	US
Baseband processor	Qualcomm	US
Batteries	Samsung	South Korea
	Huizhou Desay Battery	China
Cameras	Sony	Japan
Camera chips	OmniVison subcontracting to TMSC	US (OmniVison) and Taiwan (TMSC)
Chipsets and processors	Samsung	South Korea
	TSMC	Taiwan
Controller chips	PMC Sierra	US
	Broadcom Corp	US
Display	Japan Display	Japan
	Sharp	Japan
	LG Display	South Korea
DRAM	TSMC	Taiwan
	SK Hynix	South Korea
eCompass	Alps Electric	Japan
Fingerprint sensor authentication	Authentec	China
Flash memory	Toshiba	Japan
	Samsung	South Korea
Gyroscope	STMicroeletronics	France/Italy
Inductor coils	TDK	Japan
Mixed-single ships	NXP	Netherlands
Plastic construction	Hi-P	Singapore
	Green Point	Singapore
Radio frequency modules	Win Semiconductors	Taiwan
	Avago Technologies	US
	TriQunit Semiconductor	US
	Qualcomm	US

[27] Components for the iPhone described is for the iPhone 6. See https://www.macworld.co.uk/feature/apple/where-are-apple-products-made-3633832/, accessed 16 December 2018.

Screen and glass	Corning	US
	GT Advanced Technologies	US
Semiconductors	Texas Instruments	US
	Fairchild	US
	Maxim Integrated	US
Touch ID sensor	TSMC	Taiwan
	Xintec	Taiwan
Transmitter and amplification modules	Skyworks	US
	Qorvo	US

The country of origin for iPhone components listed above depicts a supply chain that takes advantage of comparative advantages in each country.

Shipping costs can have a significant impact on the relative competitiveness of exporters and input costs for domestic production, especially for a country like Australia where it is geographically distant from global manufacturing or consuming centres.

Australia has relatively high levels of shipping costs compared to other countries in the Asia Pacific. For example, Shanghai to Australia costs US $677/TEU, while Shanghai to Japan costs US $215/TEU and Shanghai to Singapore costs US $148/TEU. The higher cost reflects Australia's geographic isolation and the composition of vessels by size used to transport containers.

However, while Australia incurs higher shipping costs improvements to the efficiency of shipping and port services have a proportionally larger effect on Australian supply chains than those of other countries more closely located to global manufacturing or consuming centres. Box 3-2 provides a worked example of how shipping costs proportionally affect Australian supply chains more than other countries closer to major international markets.

Box 3-2: An illustrative example of Australian manufacturing and the global supply chain

Australia's geographically distant location to major international consumer and manufacturing centres increases the cost of shipping for Australian importers and exporters. However, improvements to the efficiency of shipping and port operations can have a proportionally bigger effect for Australia than other countries. For example, suppose a product that is one TEU in size and exported to China can be produced in Australia and Japan for US $1,000. Shipping costs are US $677 from Australia and US $215 from Japan, while port costs are US $100 in each country. This scenario is set out in the table below.

Table 3-2 Illustrative example of shipping costs from Australia and Japan to China

	Australia (US $/TEU)	Japan (US $/TEU)
Product cost	1,000	1,000
Shipping cost	677	215
Port costs	100	100
Total cost	**1,777**	**1,315**

Suppose shipping lines and port operators can reduce costs by 20 per cent in both Australia and Japan, perhaps by the use of larger container ships and port automation. This generates a cost reduction of US $155 or 8.7 per cent for Australian exporters compared to US $63 or 4.8 per cent for Japanese exporters.

Table 3-3 Illustrative example of 20 per cent shipping and port cost reductions from Australia and Japan to China

	Australia (US $/TEU)	Japan (US $/TEU)
Product cost	1,000	1,000
Shipping cost	542	172
Port costs	80	80
Total cost	**1,622**	**1,252**
Total cost reduction	155	63
Total cost reduction percentage	8.7%	4.8%

In simplistic terms, the example demonstrates that efficiencies in shipping will improve the competitiveness of Australian supply chains relative to other countries closer to international markets.

Taking the example further, suppose if Australian product costs were US $600 because of comparative advantages, then the total cost would be US $1,222 after the 20 per cent reduction in shipping and port costs in which case the Australian product would have a cost advantage over the Japanese product.

The example in Box 3-2 illustrates the importance of shipping and port costs in determining Australia's comparative advantage, where minimising those costs would enable exporters to be more competitive in global markets, and importers to reduce supply chain costs borne by Australian consumers and producers.

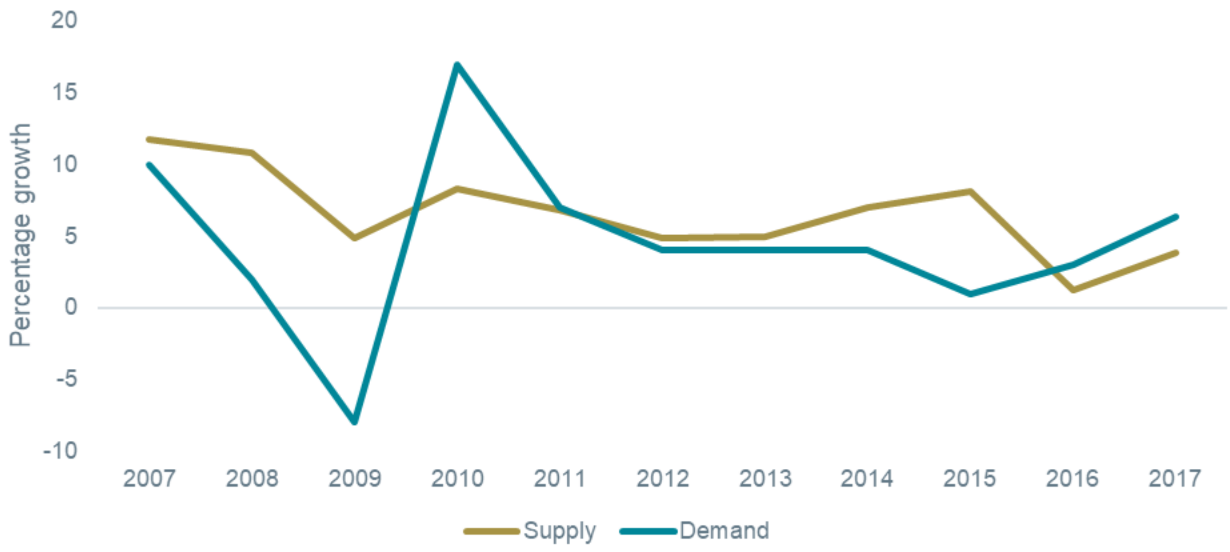
Shipping costs for Australian supply chains can be minimised by ensuring Australian ports can accommodate the most efficient container ships that can reasonably be expected to serve an economy the size of Australia, and that port operations are as efficient as possible given technologies and systems available today.

3.2 Global container shipping costs have been falling since 2010 and has only recently been recovering

Container shipping costs depend on the supply of container ship capacity and the demand for containerised shipping, which change over time. In recent years, containerised shipping has experienced overcapacity beginning in 2006 with Maersk commissioning 14,770 TEU E-Class container ships that are called Ultra Large Container Ships (ULCS). These container ships provided economies of scale for Europe to East Asia routes. Not to be outdone, other shipping lines commissioned their own fleets of ULCS that contributed to overcapacity and falling shipping rates, contributing to financial losses for shipping lines.

Only in 2016 and 2017 has the growth in demand been higher than the growth in supply, as shown in Figure 3-1.

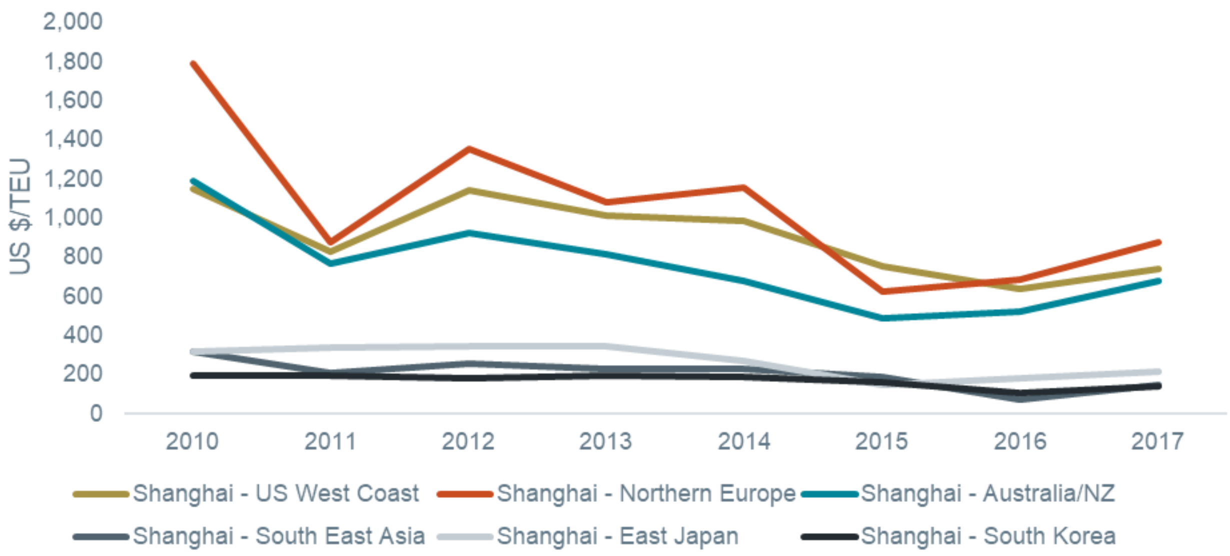
Figure 3-1 Growth of demand and supply in container shipping between 2007 and 2017



Source: UNCTAD, Review of Maritime Transport 2018, October 2018, p 45.

Despite over investment in container ship capacity, shipping costs are likely to decrease over the long term, as the shipping industry rationalises, and smaller ships are retired in favour of larger, more efficient ships. Figure 3-2 shows the downward trend for container ship freight rates in selected markets from Shanghai (being the busiest container port in the world). For Australia and New Zealand, container freight rates have decreased from US $1,189/TEU in 2010 to US $677/TEU in 2017, which represents a 43 per cent change. While rationalisation of the industry will likely increase prices over time, those increases will be moderated by a higher proportion of larger more efficient ships and competitive pressures between container shipping lines.

Figure 3-2 Container freight rates for selected markets 2010 to 2017



Source: UNCTAD, Review of Maritime Transport 2018, October 2018, p 46.

3.3 Trend towards larger container ships

The drag of a ship increases by its length to the power of two, while the cargo carrying capacity increases by its length to the power of three, assuming other dimensions of the ship remain the same. This means that while ships are costlier and use more fuel as they get bigger, the increase is less than the increase in its cargo carrying capacity. It follows that the cost per DWT or TEU and the fuel consumption per DWT or TEU is lower than a smaller ship. Consequently, shipping lines operating container ships have increasingly adopted larger ships to drive efficiency and reduce costs.

Figure 3-3 illustrates the growth in container ships beginning in the 1970s when the first cellular ships specifically designed to carry standardised containers were commissioned. These ships could carry approximately 2,500 TEUs. In the 1980s Panamax ships increased the carrying capacity to approximately 4,500 TEUs, which was defined by their ability to fit through the Panama Canal's original locks.

As global trade expanded to East Asia then to China, large container ships were developed that didn't need to transit the Panama Canal, like the Post Panamax, which were deployed on the growing East Asia-Europe and East Asia-US West Coast trade. In 2006, Maersk introduced the Emma Maersk, an E class container ship that could carry 14,770 TEUs that introduced the world to its own size category: the Ultra Large Container Ship (ULCS). Today's largest container ship, OOCL's G Class, can carry 21,413 TEU, which represents an increase in size of approximately 860 per cent on the first specialised container ships from the 1970s.

Figure 3-3 illustrates the growth of container ships since the mid 1950s. Ship dimensions presented in Figure 3-3 are only approximate and do not provide a definitive view on container ship size categories and dimensions, which will vary depending on the information source.

Figure 3-3 Container ships have progressively increased in size

Early container ships (1956)

Beam: 17 metres
Length: 137 metres
Draft: 8 metres
TEU: 500 to 800

Fully cellular (1970)

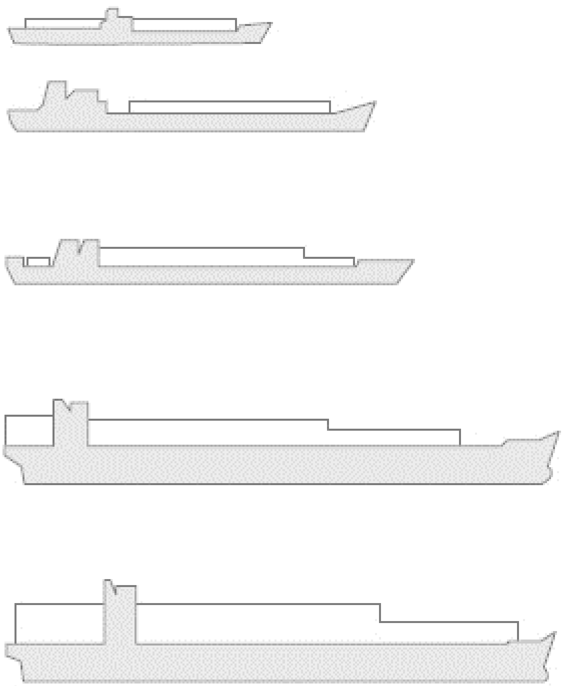
Beam: 20 metres
Length: 215 metres
Draft: 10 metres
TEU: 1,000 to 2,999

Old Panamax (1985)

Beam: 32 metres
Length: 290 metres
Draft: 12 metres
TEU: 3,000 to 4,999

Old post Panamax (1988)

Beam: 40 metres
Length: 300 metres
Draft: 13 metres
TEU: 5,000 to 7,499



Old post Panamax plus (2000)

Beam: 43 metres
Length: 335 metres
Draft: 13 metres
TEU: 7,500 to 9,999

New Panamax (2014)

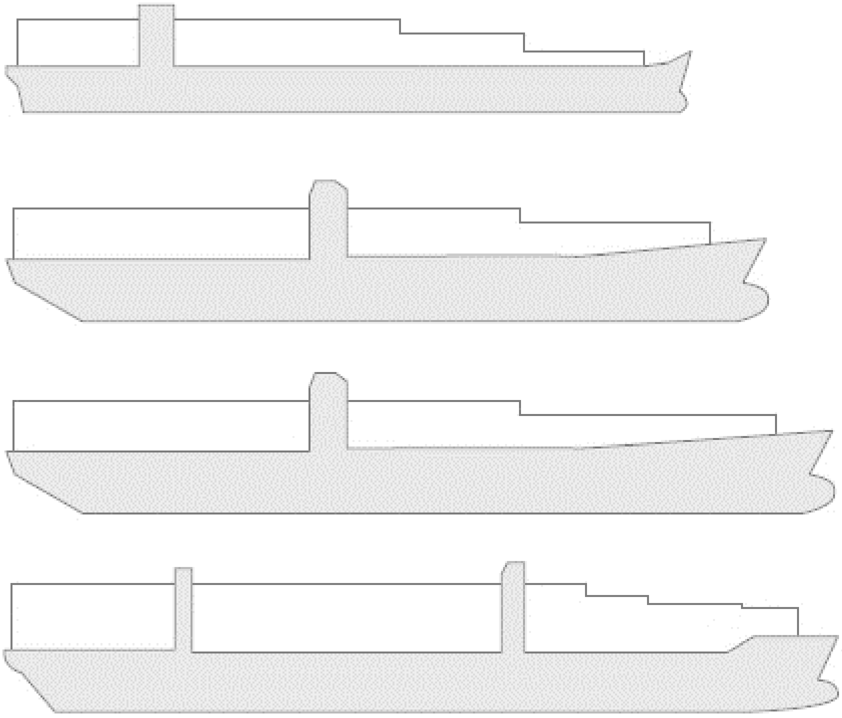
Beam: 49 metres
Length: 366 metres
Draft: 15.2 metres
TEU: 10,000 to 12,999

Very large container ship (2006)

Beam: 56 metres
Length: 397 metres
Draft: 15.5 metres
TEU: 11,000 to 15,000

Ultra large container ship (2013)

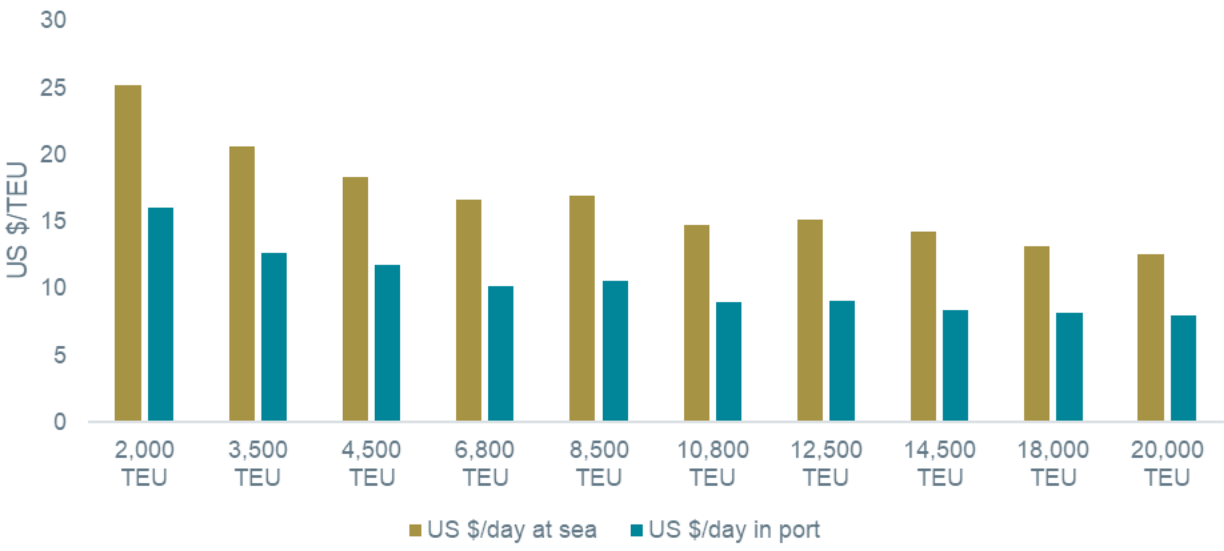
Beam: 59 metres
Length: 400 metres
Draft: 16 metres
TEU: 18,000+



Source: Adapted from Infrastructure Victoria, See Infrastructure Victoria, Advice on securing Victoria's ports capacity, May 2017, p 55, with amendments from J Rodrigue, The Geography of Transport Systems, 2017. See https://transportgeography.org/?page_id=2232, accessed 10 January 2018.

The increase in container ship size over time reflects the pressure for container ship liners to introduce ever more efficient ships to reduce costs. Per TEU the largest container ships at approximately 20,000 TEU fully loaded are able to achieve costs that are less than half of that incurred by a 2,000 TEU container ship, as shown in Figure 3-4.

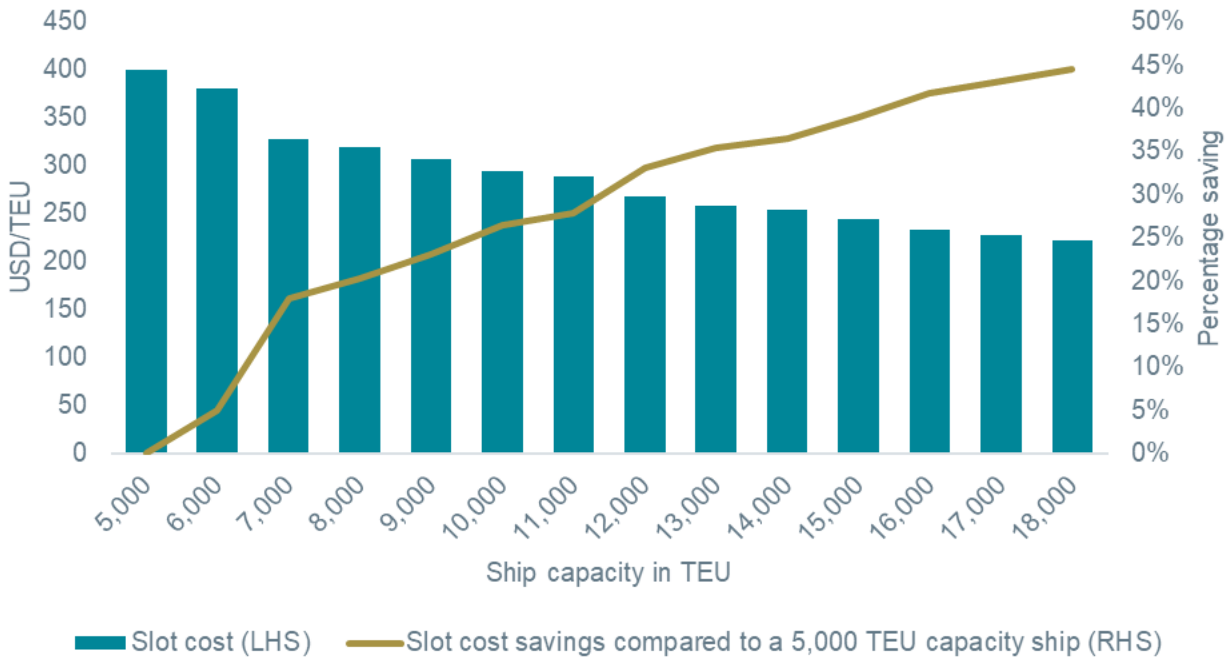
Figure 3-4 Per day costs of container ships



Source: https://www.wsp.com/en-AU/insights/the-ceiling-on-economies-of-scale-in-container-vessels

Reflecting economies of scale of larger container ships, Figure 3-5 further illustrates slot cost savings from adopting larger container ships, assuming a 28 day round voyage[28] at an average speed of 17 knots and an 85 per cent capacity utilisation rate. It shows that going from an 8,000 TEU container ship with slot costs of US $319/TEU to a 13,000 TEU container ship with slot costs of US $258/TEU would result in savings of 19 per cent or US $61/TEU.

Figure 3-5 Round voyage slot cost at 85 per cent utilisation

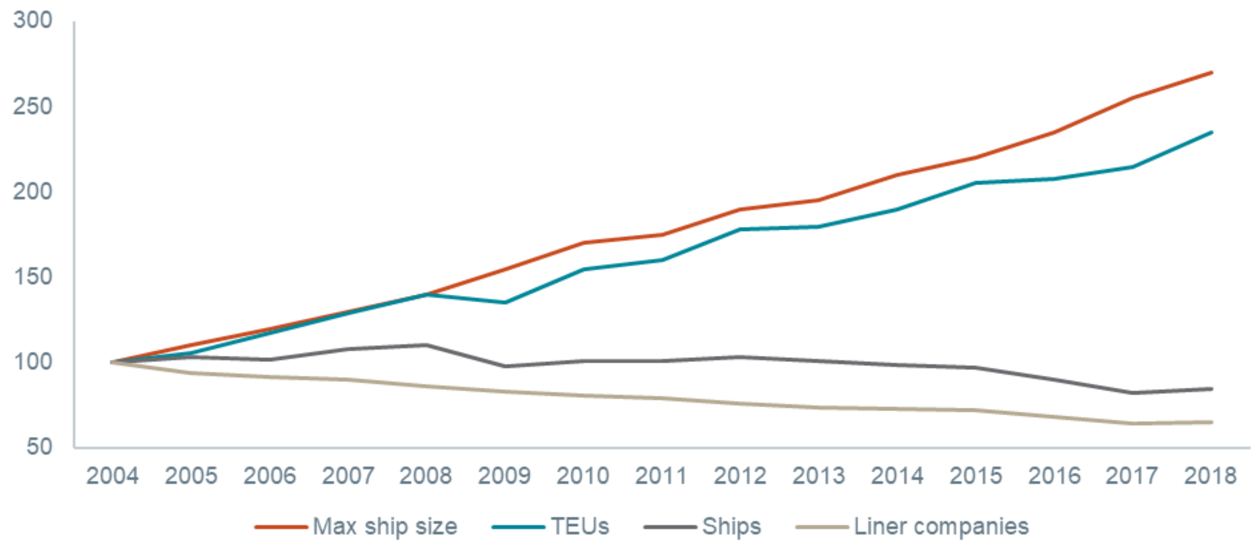


Source: Drewry, Container ship fleet forecast and maritime economic assessment, March 2017, p 29.

Unsurprisingly, competitive pressures to lower costs among container shipping lines have resulted in container ship capacities growing over time. Figure 3-5 shows the decreasing number of container ships operating, despite an increasing number of total TEUs being transported.

[28] 28 days is approximately the length of time required for a round trip from Australian east coast ports to transhipment ports in Asia.

Figure 3-6 Ships have been increasing in size and the industry has been consolidating



Source: UNCTAD, Review of Maritime Transport 2018, October 2018, p 28.

3.4 The ability of ports to handle increasingly larger ships

Container ships still have room to grow. The largest container ships today by length and tonnage are approximately 400 metres in length, weighing in at 218,000 gross tons, with nearly 200,000 DWT of carrying capacity. This compares to the largest ship ever built, the Mont,[29] coming in at 458 metres, nearly 261,000 gross tons and capable of carrying nearly 565,000 DWT. Theoretically, ships can be built even larger than the Mont.[30]

However, there are practical and economic limits to how large container ships will be able to grow, reflecting physical constraints of port facilities, and the economic merits of using large container ships outside the largest ports.

Large container ship sizes place significant pressure on ports and terminals to process a large number of containers in a short amount of time, which requires efficient and sufficiently scaled landside operations to avoid unacceptable levels of congestion both at port and landside transport networks. On the wharfside, ports need to have sufficiently sized infrastructure (eg cranes, berths, quays, channel), labour and technology to service physically larger ships efficiently. It is important to recognise that ports may have some but not all the characteristics necessary to accommodate larger container ships.

Even when ports can accommodate the largest ships, some observers contend that port logistics perform best when ships are between 4,000 and 14,000 TEUs. Ships with over 14,000 TEUs in contrast places pressure on equipment and space where this has not been directly planned for, which can negatively affect performance.[31]

Economic limitations may also affect the growth in container ships outside the largest ports like Shanghai, Singapore or Rotterdam. For example, ULCS can only be efficient when its capacity is sufficiently utilised when transporting cargo between ports that have invested in infrastructure that can accommodate the largest of container ships. If the carrying capacity of ULCS is not utilised, then cost per TEU will be higher

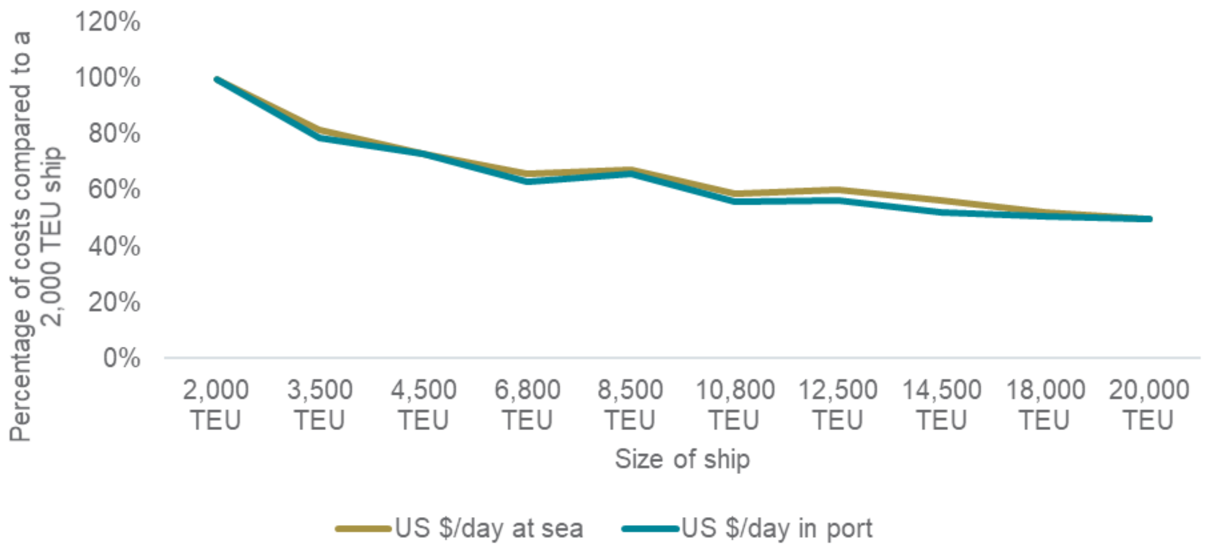
[29] The Mont had previously been named as Knock Nevis, Jahre Viking, Happy Giant and Seawise Giant.

[30] See https://www.maritime-executive.com/editorials/50000-teu-the-future-or-not, accessed 10 January 2019.

[31] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p 74.

than smaller container ships. Furthermore, returns to scale for increasingly larger container ships is not constant and in fact reduces as ship size increases.

Figure 3-7 Incremental savings decrease from increasingly large container ships



Source: https://www.wsp.com/en-AU/insights/the-ceiling-on-economies-of-scale-in-container-vessels

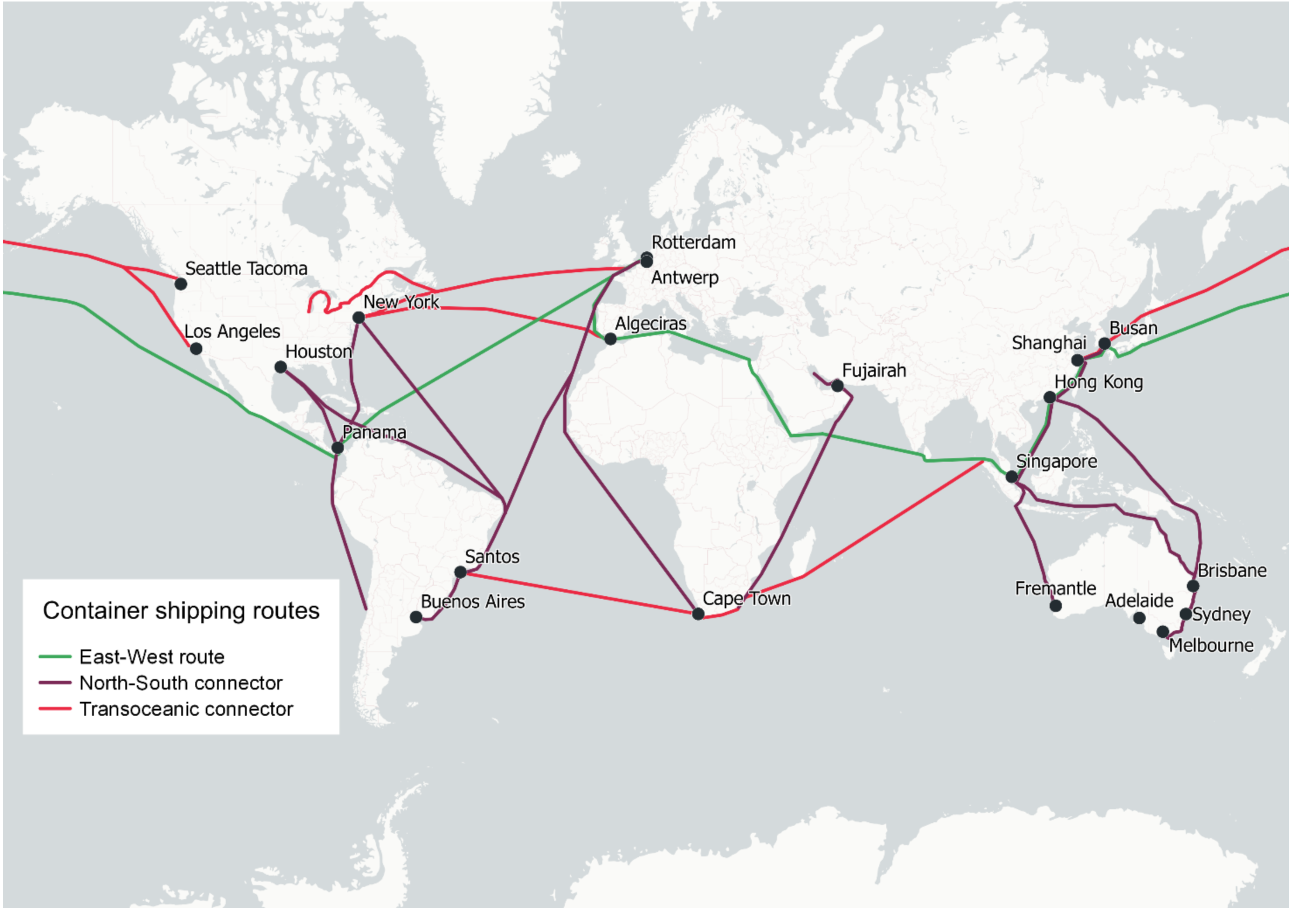
The decreasing return to scale means that there will be limits to what is economic, which raises the prospect that large container ships are too large to operate economically, despite their economies of scale.

Consequently, the largest container ships (eg container ships with 14,000+ TEU) are used on long distance east-west routes between large transhipment ports that serves as the hub in a global hub and spoke network,[32] such as the high-density Shanghai-Rotterdam route. Complementing the east-west route are north-south routes that connect regions including Australia, Africa, South America, and North America to global transhipment ports in a relay pattern. Somewhat separate from the east-west and north-south routes are transoceanic routes that spans the Atlantic, Indian and Pacific oceans in a point to point pattern.

Figure 3-7 sets out significant transshipment ports and routes where larger container ships are used, as well as other types of container shipping routes.

[32] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p 29.

Figure 3-8 Existing ULCS routes connects the world's largest transhipment ports



Source: Adapted from https://www.cruisemapper.com/wiki/2259-largest-container-ships and https://transportgeography.org/?page_id=4750

Australia is served by a north-south route that connects Australian ports to global transhipment hubs in Singapore, Shanghai, Hong Kong, and with East Asian countries on a relay pattern.[33]

A mix of container ship sizes are currently used to facilitate container trade between Australia and international markets. More recently Australia has experienced increased visitation from larger ships reflecting the global trend toward larger container ships. In 2017, approximately half of the container ship visits were over 50,000 gross tons (shown in Figure 3-8), which roughly equates to a Post Panamax sized ship with a capacity of around 5,000 to 8,000 TEU or larger. Currently, the largest container ships that the Port of Melbourne, Port Botany and the Port of Brisbane can accommodate is in the range of 8,000 TEU to 10,000 TEU, fully loaded.[34]

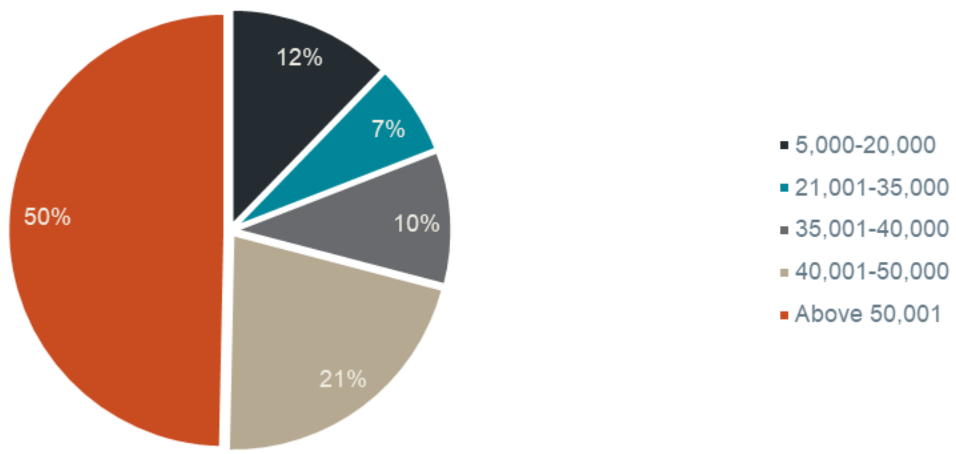
It follows that current containerised port facilities in Australia have natural limitations for visiting ship sizes, which constrains the scope to obtain lower shipping cost benefits from larger ship sizes as containerised trade continues to grow into the future.

[33] The exact routes will differ between container shipping lines where they have may have preferences to use different hubs and destination ports.

[34] Port of Melbourne, *2050 Port Development Strategy Discussion Paper*, p 16; Infrastructure Victoria, *Advice on securing Victoria's ports capacity,* May 2017, p 59. It might be possible for larger ships to dock in Australia, if they are not fully loaded and so are capable of traversing current depth restrictions.

The composition of the container fleet suggests that large ships above 55,000 gross tons provide the majority of shipping capacity and serves the minimum or base level of container shipping demand to and from Australia's main ports at the lowest practical cost. Smaller ships on the other hand would service demand that exceeds the base line of container shipping demand (ie peak) during busy periods as well as smaller markets such as the Pacific Islands where a direct service by large container ships would not be economical. These smaller ships cost more to operate due to their smaller scale.

Figure 3-9: Container ship visits to Australian ports by gross ton in 2017



Source: BITRE, Maritime Waterline 62, October 2018, p 18.

3.5 Future trends for the shipping industry

There are currently approximately 8,200 container ships providing 25.3 million TEUs in capacity. The 10 largest container shipping lines make up 68.8 per cent of total TEU.

Table 3-4: 10 largest container shipping fleets as at 1 June 2018

Rank	Company	Country	Number of ships	Capacity TEU	Market share TEU	Average vessel size TEU
1	Maersk	Denmark	700	3,879,439	15.3	5,542
2	Mediterranean Shipping Company (MSC)	Switzerland	473	3,118,108	12.3	6,592
3	CMA-CGM	France	476	2,54,264	10.1	5,366
4	China Ocean Shipping Company (COSCO)	China	330	1,972,491	7.8	5,977
5	Hapag-Lloyd	Germany	217	1,550,874	6.1	7,147
6	Ocean Network Express	Japan	228	1,536,312	6.1	6,738
7	Evergreen	Taiwan	200	1,110,708	4.4	5,554

8	Orient Overseas Container Line (OOCL)	Hong Kong	99	689,986	2.7	6,970
9	Yang Ming	Taiwan	100	609,749	2.4	6,097
10	Pacific International Lines	Singapore	132	413,334	1.6	3,131
	Global total		8,163	25,290,013	100	3,098

The recent overcapacity in container shipping capacity (see section 3.2) has led to a period of consolidation where the largest container shipping lines have been increasing their share of the market and the building of new container ships have been subdued. In 2017, 11.8 million gross tons of new container ships were delivered, compared to 4.5 million gross tons of container ships that were sold for demolition, while orders are at a 10 year low.[35]

This is expected to continue as the industry further rationalises through mergers and acquisitions.[36] In terms of the container shipping fleet, it is likely to mean increasing average size of the fleet, and reduction in the number of ships, with a few large container shipping lines further dominating global containerised shipping.

Global alliances among container shipping lines have also been another way the industry has consolidated its activities in the face of overcapacity. Three global shipping liner alliances now account for 93 per cent of deployed capacity along three major East-West routes (Asia-Europe, Europe-US East Coast, US West Coast to Asia).[37]

However, uncertainties around global trade (see section 2.3) may materially change the calculus involved in container ship investments by container shipping lines. Despite downside uncertainties, existing efforts to automate ports and new technologies such as autonomous ships, and information management with blockchain platforms, could have the potential to further increase container shipping efficiency, productivity and safety into the future.

[35] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p 37.

[36] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p xi.

[37] UNCTAD, *Review of Maritime Transport 2018*, October 2018, p xi.

4. East coast of Australia will need extra containerised port capacity to accommodate expected growth in containerised trade

Key points:

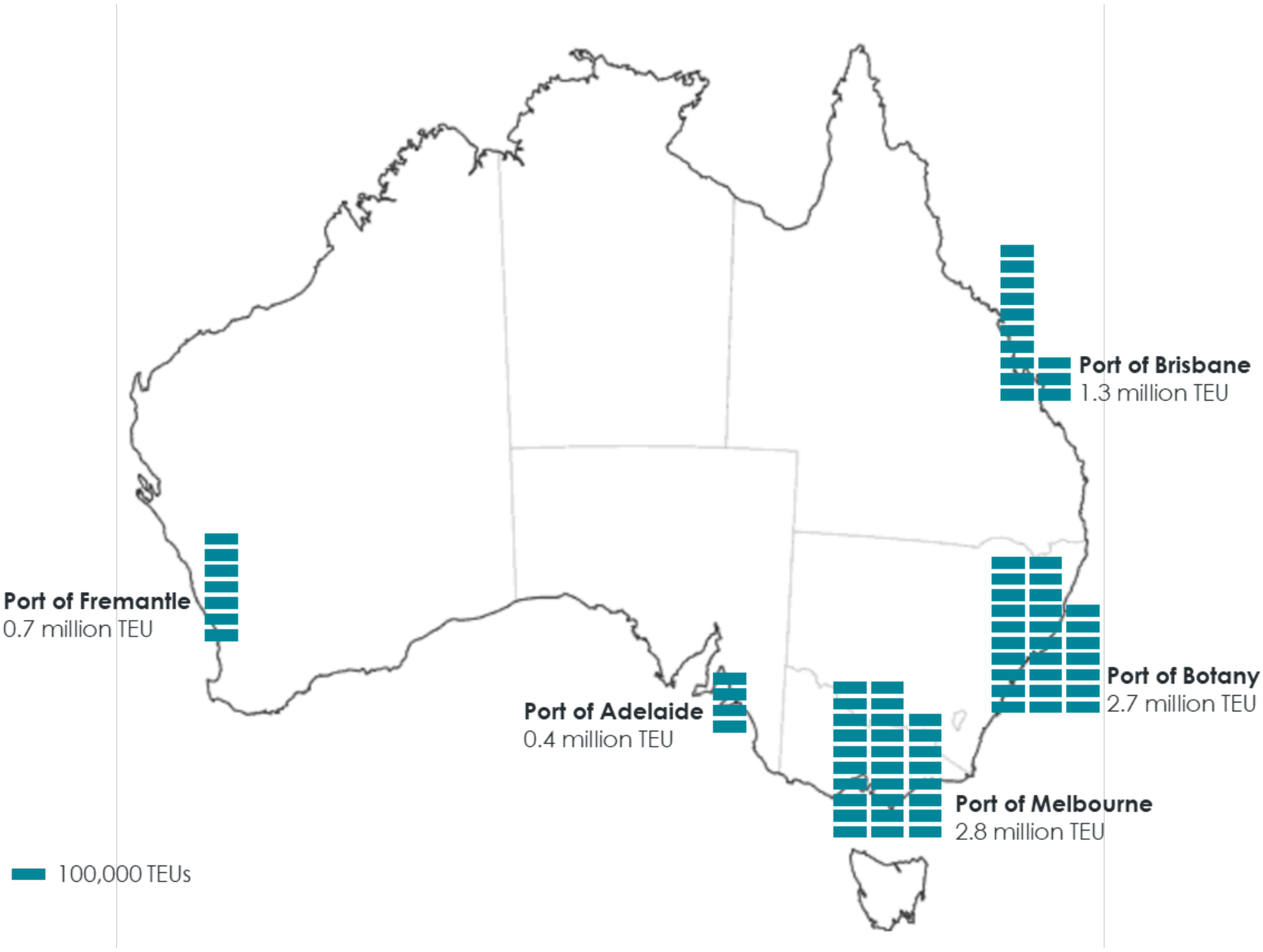
- Australia has five main container ports, of which the Port of Melbourne is currently the largest.
- Australian ports are currently able to handle container ships up to around 8,000 TEU to 10,000 TEU, fully loaded.
- Existing container ports on the east coast are forecast to reach capacity between 2032 and 2052, without expansion.
- Existing container ports have plans in place for expansion to meet expected growth in containerised trade.
- It is not certain that existing expansion plans are desirable as increased throughput at existing ports would add to congestion in highly urbanised areas.

This section describes the port industry in Australia. It is intended to highlight the timeframe within which capacity expansions might be needed in Australia, given global trends.

4.1 Major container ports on the east coast of Australia will start reaching their capacities between 2032 and 2052 without expansion

Australia currently has five main container ports that provide the gateway for imports of manufactured merchandise into Australia and the export of several types of agricultural and manufactured merchandise. The two busiest container ports are in Melbourne and Sydney and are comparable in TEU throughput. The third busiest port is in Brisbane while the smallest of the five main Australian ports is Port Adelaide.

Figure 4-1 Main Australian ports and their TEU throughput in 2017



Source: BITRE, Maritime Waterline 62, October 2018, p 12-16.

The four existing east coast container ports are capable of accommodating container ships that have maximum drafts of up to 14 metres and lengths of around 300 metres, depending on the tides and the ship characteristics. This roughly equates to old post Panamax class vessels that can carry between 7,500 and 10,000 TEUs, fully loaded. However, the depth of existing channels and berths at Australia's east coast ports prevents them accommodating larger more efficient ships like new post Panamax container ships that can carry over 12,000 TEUs, which have drafts of over 15 metres fully loaded, and lengths of over 350 metres. To accommodate these ships, Australian container ports would need to resolve physical constraints by investing in deeper shipping channels and berths, lengthening berths, and acquire new cranes that can span beams (ie width) of between 50 to 60 metres.

The capacity of each of the four main container ports on the east coast is examined in more detail in the remainder of this section.

4.1.1 Port of Melbourne

The Port of Melbourne is Australia's largest port, handling over 2.8 million TEUs in 2017. It has exhibited an average TEU growth rate of 2.1 per cent over the period between 2011 and 2017. The Port of Melbourne consists of three separate docks with a total of 11 berths for container ships. In addition to container shipping, the Port of Melbourne provides facilities for bulk goods and break-bulk cargo.

The port has deepened its channel to allow ships with drafts of 14 metres to pass through. However, a bridge across the Yarra River (the West Gate Bridge) limits the height of ships to between 50 and 60 metres, which limits the size of ships that can reach the Swanson docks located close to the opening of the Yarra River. These restrictions are being partially alleviated through the Webb dock port capacity project, which does not have height restrictions.

The Port of Melbourne anticipates that current infrastructure at Swanson docks has the capacity of between 3.4 million to 4 million TEUs,[38] while the Webb docks have capacity of approximately 1 million TEUs. Based on BITRE forecast growth rates and TEU throughput in 2017, the Port of Melbourne will reach its current capacity constraint in 2032 in the absence of expansion projects.

With expansion, the Port of Melbourne anticipates capacity is estimated to be approximately four million TEUs at both Swanson docks and Webb dock providing a total of eight million TEU.[39] Based on BITRE forecast growth rates and TEU throughput in 2017, the Port of Melbourne will reach eight million TEU in 2044.

Table 4-1 Current infrastructure at the Port of Melbourne

Port infrastructure and ship capacities	Details
Maximum ship dimensions[40]	
Maximum depth (draft)	14 metres[41]
Maximum length (LOA)	320 metres[42]
Maximum width (beam)	42.9 metres[43]
Wharfside infrastructure	
Berths	10 x container berths 1 x general cargo berth that handle containers
Cranes	Patrick: 3 x post Panamax, 5 non Panamax DP World: 3 x post Panamax, 5 non Panamax VICT: 5 x Neo-Panamax
Other	Patrick: 42 straddle carriers DP World: 48 straddle carriers VICT: 11 automated container carriers, 20 automated stacking cranes
Landside infrastructure	
Rail sidings	Patrick: 1 x 510 metre dual gauge siding DP World: 3 x 640 metre dual gauge sidings VICT: 2 x 630 metre dual gauge sidings
Road	Three roads provide access to the three container ship terminals

4.1.2 Sydney - Port Botany

Port Botany in Sydney is the second largest container port in Australia by TEU handled. In 2017, Port Botany processed 2.5 million TEUs and has exhibited a TEU growth rate of 3.2 per cent during the period from 2011

[38] Port of Melbourne, *Port Development Strategy 2035*, August 2009, p 22.

[39] Port of Melbourne, *Port Development Strategy 2035*, August 2009, pp 21-22.

[40] Maximum ship dimensions presented in Table 4-1, Table 4-2, Table 4-3 and Table 4-4 are based on Harbor Master Directions where available, and berth dimensions published by the port were Harbor Master Directions are not available. Actual maximum ship dimensions that a port can accommodate can be larger at the discretion of the Harbor Master.

[41] Port of Melbourne, *Harbour Master's Directions*, August 2017, pp 37-39.

[42] Port of Melbourne, *Harbour Master's Directions*, August 2017, pp 37-39.

[43] Port of Melbourne, *Harbour Master's Directions*, August 2017, pp 37-39.

to 2017. Port Botany currently has two docks: Brotherson Dock and Hayes Dock. Brotherson Dock has two sides that hosts eight container ship berths, and has the capacity to accommodate ships with drafts up to 14 metres and looks to develop the capability to accommodate ships with drafts of 15 metres without restrictions in the future. Hayes Dock has deeper berths but is constrained by the channel leading into Port Botany.

Port Botany has assessed its capacity at 7.2 million TEU per year.[44] Based on BITRE forecast growth rates and TEU throughput in 2017, Port Botany would reach 7.2 million TEUs in 2044.[45]

Table 4-2 Infrastructure at Port Botany

Port infrastructure and ship capacities	Details
Maximum ship dimensions[40]	
Maximum depth (draft)	14.0 metres[46]
Maximum length (LOA)	380 metres[47]
Maximum width (beam)	50 metres[48]
Wharfside infrastructure	
Berths	11 x container berths
Cranes	Patrick: 7 x twin lift quay cranes, 1 x single lift quay cranes DP World: 4 x twin lift quay cranes, 4 x single lift quay cranes Hutchison: 4 post-Panamax quay cranes
Other	Patrick: 45 x automated straddle carriers Hutchison: 12 x automated stacking cranes
Landside infrastructure	
Rail sidings	Patrick: 2 x sidings 650 metres DP World: 3 x sidings 340 metres Hutchison: 2 x sidings 680 metres
Road	Three roads provide road access to the three container terminals

4.1.3 Port of Brisbane

The Port of Brisbane is the third largest container port in Australia but has throughput of approximately half that of Sydney. In 2017, the Port of Brisbane processed 1.3 million TEUs and exhibited average growth in TEUs handled of 3.6 per cent between 2011 and 2017.

Despite having relatively modest throughput, the capacity for potential growth is significant with scope for land reclamation of Fisherman Island where the Port is located. The Port of Brisbane assessed the capacity of existing container facilities to be able to handle 2,000 TEUs per quay line metre, which translates to 4.9 million TEUs given approximately 2,460 metres of quay line now in service.[49]

[44] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015, p 44.

[45] NSW Ports has estimated that TEUs would reach between 7.5 million and 8.4 million by 2045.

[46] Vessels are required to maintain an under keel clearance of 1 metre at both Brotherson Dock and Hayes Dock and 10 per cent of a vessel's deepest draft for harbour transit. Translates to a maximum draft of approximately 14 metres to allow sufficient under keel clearance for transit through the entrance and main channel at Port Botany. See NSW Ports, *Harbour Master's Directions: Sydney Harbour & Botany Bay*, July 2016, p 13 and NSW Ports, *Berths and Channels*, December 2018, pp 12-16.

[47] The longest berths at Brotherson Docks are 400 metres (see NSW Ports, *Berths and Channels*, December 2018, pp 12-16.) However, ships are required to maintain clearances of 20 metres at each end of an arriving vessel (see NSW Ports, *Harbour Master's Directions: Sydney Harbour & Botany Bay*, July 2016, p 28), which reduces LOA to 380 metres assuming 10 metre clearances are maintained at the bow and stern of adjacent ships in berth.

[48] NSW Ports, *Berths and Channels*, December 2018, pp 12-16.

[49] Port of Brisbane, Response to the Inquiry into National Freight Supply Chain Priorities, p 5.

The Port of Brisbane does not expect to reach capacity until beyond 2040, at which point further berths could be built.[50] Based on BITRE forecast growth rates and TEU throughput in 2017, the Port of Brisbane would reach its current 4.9 million TEU capacity in 2052 without capacity expansion.

Table 4-3 Infrastructure at the Port of Brisbane

Port infrastructure and ship capacities	Details
Maximum ship dimensions[40]	
Maximum depth (draft)	13.7 metres[51]
Maximum length (LOA)	308 metres[52]
Maximum width (beam)	45 metres[53]
Wharfside infrastructure	
Berths	9 x container berths
Cranes	Patrick: 4 x post-Panamax, 1 x Panamax cranes DP World: 3 x post-Panamax, 1 x Panamax cranes Hutchison: 4 x post-Panamax
Other	Patrick: 31 x automated straddle carriers DP World: 16 x automated stacking cranes Hutchison: 6 x automated stacking cranes
Landside infrastructure	
Rail sidings	Intermodal facilities are provided on Fisherman Island and is able to accommodate train lengths of up to 850 metres
Road	Road access is via the Captain Bishop Bridge to Fisherman Island

4.1.4 Port Adelaide

Port Adelaide is the smallest of Australia's main container ports and only has two berths located in the outer harbour of Port Adelaide. In 2017, Port Adelaide handled over 400,000 TEUs and has exhibited an annual growth rate of 3.9 per cent over the period 2011 and 2017.

Maximum capacity of the container terminal at Port Adelaide is approximately 1.2 million TEU with changes to the straddle operation and the adoption of auto stacking cranes.[54] Based on current infrastructure at the container terminal and BITRE forecast growth rates and TEU throughput in 2017, Port Adelaide is not expected to reach capacity until 2045.[55]

[50] Port of Brisbane, Response to the Inquiry into National Freight Supply Chain Priorities, p 5.

[51] Berths have a nominal depth of 14 metres, with a requirement to have a under keel clearance of 0.3 metres giving maximum draft of 13.7 metres. See Port of Brisbane, *Shipping Handbook 2015/16*, 2016, p 14 and p 23.

[52] Port of Brisbane, *Port Procedures and Information for Shipping*, September 2017, p 45.

[53] Beam refers to the width of the berth. See Port of Brisbane, *Shipping Handbook 2015/16*, 2016, p 14.

[54] Capacity of 1.2 million TEU is based on a speech given by Steward Lammin, General Manager of Finders Ports (who owns the Port of Adelaide) in September 2013. See https://www.informa.com.au/insight/adelaide-box-terminal-weighs-options-to-lift-its-future-game/, accessed 17 December 2018.

[55] In his speech Steward Lammin, General Manager of Finders Ports noted that capacity would need to be around 2.5 million in 2050, which could be meet by the adoption of auto stacking cranes.

Table 4-4 Infrastructure at Port Adelaide

Port infrastructure and ship capacities	Details
Maximum ship dimensions[40]	
Maximum depth (draft)	13.9 metres[56]
Maximum length (LOA)	300 metres[57]
Maximum width (beam)	36 metres[58]
Wharfside infrastructure	
Berths	2 x container berths
Cranes	3 x post Panamax
Landside infrastructure	
Rail sidings	2 x 640 metre standard gauge rail sidings
Road	Single access road via Coghlan Road

4.2 Opportunities for capacity expansions at existing container ports

Each of the East Coast ports has options to expand their current capacity. Some ports will have more opportunities to expand than others:

- Port of Brisbane has the most potential to expand by extending Fisherman Island and building more berths;
- Port of Melbourne also has significant room for expansion by developing Webb docks where ship heights are not constrained by the West Gate Bridge spanning the Yarra River. The Port is currently undergoing stage 2 of building out Webb docks for container operations;[59]
- Port Botany could further expand container operations at Hayes dock to the west of Brotherson dock. Hayes dock currently hosts Hutchison Ports container terminal, which shares the area with small ships and tugs. Should container demand increase beyond the capacity of Brotherson dock, Hayes dock could be further repurposed for container ship sizes of approximately 10,000 TEU; and
- Port Adelaide is able to increase capacity within its current footprint by adopting more automated systems such as auto staking cranes. Expansion beyond this is likely to be more limited.

While each of the main ports of the east coast could expand capacities to serve expected demand through to around 2044/45, it is not clear that such expansion would be desirable. Increasing wharfside capacity would require a proportionate increase in landside logistics capacity that currently look to rely predominantly on road transport. This would generate additional freight traffic and road congestion through densely urban areas. A way to mitigate road congestion could be to rely more on rail but the current length of rail sidings at the Port of Melbourne and Port Botany limits rail throughput at these two ports.

[56] See https://www.flindersports.com.au/ports-facilities/port-adelaide/, accessed 10 January 2019.

[57] See https://www.flindersports.com.au/ports-facilities/port-adelaide/, accessed 10 January 2019.

[58] See https://www.flindersports.com.au/ports-facilities/port-adelaide/, accessed 10 January 2019.

[59] See https://www.portstrategy.com/news101/insight-and-opinion/post-script/melbourne-big-box-ship-ready, accessed 18 December 2018.

5. Opportunities for Australia's ports industry

Key points:

- There are currently no ports in Australia that can handle container ships with capacities over 10,000 TEUs.
- The Port of Tauranga in New Zealand has the capacity to host large container ships over 10,000 TEUs and has become a transhipment hub for New Zealand, and potentially also for the east coast of Australia.
- Opportunities exist for new container ports to come online in the 2040s as existing ports reach capacity.
- New container ports have been proposed at Port Kembla and the Port of Newcastle in NSW, and Bay West in Victoria.
- An efficient port that can serve larger container ships would incur less costs relating to dredging channels, provide efficient on-dock rail access that accommodates longer trains and provide uncongested access to rail and road networks.
- Creating a large ship container port facility provides scope to act as a trans-shipment hub delivering benefits

This section outlines the key opportunities for Australia's ports industry, given the global and Australian trends.

5.1 Opportunities to construct new container ports

Over the next 15 to 35 years, Australia's container ports are forecast to be able to meet demand without expansion. This extends further to 27 to 35 years if options for expansion are realised.

The Port of Melbourne and Port Botany has assessed that they are able to meet demand of 5 million and 7.2 million TEU respectively, which provides room to grow until 2032 for the Port of Melbourne and 2044 for Port Botany. Exercising an expansion option at the Port of Melbourne would add another 3 million TEU of capacity and extend its capacity to meet demand out to 2044. At the Port of Brisbane, capacity is currently underutilised and location on Fisherman Island provides it with options to grow capacity unconstrained by space limitations faced by the Port of Melbourne and Port Botany. Without expansion, the Port of Brisbane is not forecast to reach capacity until 2052. Port Adelaide is not expected to meet demand until 2045 without material expansion of port facilities and use of automated crane systems.

Despite options to increase port throughput at each of the four major east coast ports, it is not clear these options should be pursued as increasing capacity will contribute to congestion in urbanised areas.

Regardless of whether expansion options are exercised at existing container ports, New South Wales and Victoria will eventually need additional container port capacity as the population and per capita incomes continues to grow. As container shipping demand grows, the capacity to handle large container ships will become more pressing. The largest capacity container ships that are currently able to visit Australia is around 8,000 to 10,000 TEU. These ships roughly are equivalent to post Panamax ships that were built in the late 1990s and early 2000s. More cost effective New Panamax container ships with drafts of over 15 metres and capacities up to 13,000 TEU are unable to call into Australian ports, which have maximum drafts of around 14 metres. Consequently, the limited size and capacities of container ships servicing Australian means that Australian supply chains are foregoing advantages that would improve competitiveness.

The largest capacity port in Australasia, in terms of the size of container ship that can be handled, is the Port of Tauranga. Its ability to handle container ships with capacities over 10,000 TEU has led to high TEU growth rates and as a trans-shipment hub for New Zealand. Box 5-1 provides an overview of the port of Tauranga and its growth as a container port.

Box 5-1 Port of Tauranga welcoming the largest capacity container ships in Australasia

The Port of Tauranga is New Zealand's largest port located 200 kilometres south east of Auckland. The Port handles approximately 40 per cent of New Zealand's container traffic and in 2018 it processed nearly 1.2 million TEU, up 8.9 per cent from 1.1 million TEU in 2017. This compares to Port Adelaide's 414,000 TEU in 2017 noting that Auckland has a population of approximately 1.6 million while Adelaide has a population of 1.3 million.

Over the period between 2011 and 2018, the Port of Tauranga has grown the number of TEU handled at an annual average rate of 9.0 per cent, effectively doubling over that period. A large part of its growth is driven by constraints at the Port of Auckland located next to Auckland's central business district, but also its deep channel and investment in port infrastructure.[60]

The depth of its channel and berths, together with automated wharfside infrastructure, means that container ships that have drafts of up to 14.5 metres and capacities over 10,000 TEU can call at the Port of Tauranga.[61] The ability to accommodate large container ships complements the Port's logistics network that includes:[62]

- **Metroport Auckland**: an inland intermodal freight hub or 'port' located in Auckland that is connected to Hamilton and Tauranga;
- **Metroport Christchurch**: an inland intermodal freight hub or 'port' located in Christchurch connected to the Timaru container terminal and the rest of the South Island;
- **Northport**: which is a deep water commercial port near Whangarei in the North Island: and
- **Timaru Container Port**: a container port in the South Island.

These logistic nodes, along with New Zealand's network of state highways and rail lines function as a spoke in a hub and spoke network centred on the Port of Tauranga as a transhipment hub for New Zealand to East Asian, North American, South American and Australian destinations.

In 2018, 25.7 per cent (or approximately 310,000 TEU handled by the Port of Tauranga were related to transhipments after a 23.3 per cent growth in transhipment on 2017.[63]

Apart from the four east coast ports examined above, other major ports could develop container handling capabilities to meet container shipping demands over the long term. Potentially new container shipping ports at major non-container ports include be established at:

[60] Port of Tauranga, *Annual Report 2018*, August 2018, p 9

[61] The largest ever container ship to visit New Zealand, the Maersk Antares with capacity of 11,294 TEU called into the Port of Tauranga in 2016.

[62] Port of Tauranga, *Annual Report 2018*, August 2018, p 3.

[63] Port of Tauranga, *Annual Report 2018*, August 2018, p 9.

- **Port Kembla**: NSW Ports have included plans for a container port at Port Kembla in its 30-year master plan. The Outer Harbour Development calls for container facilities that can handle at least three million TEU with both rail and road access;[64]
- **Port of Newcastle**: More recently, the Port of Newcastle has proposed a container port with capacity in excess of two million TEU that can handle ships up to 18,000 TEU;[65] and
- **Hastings or Bay West**: expected capacity constraints at Port of Melbourne, which some estimated to occur in the mid to late 2030s would require a second container port to be built. Options discussed include Hastings south of Melbourne and Bay West near Werribee.[66] Bay West is currently preferred[67] and is to have an ultimate capacity of nine million TEU.[68]

5.2 What is needed for an efficient containerised port?

In general, containerised port capacity expansion should be preferred in locations where the upfront costs, plus the costs along the entire supply chain over time are minimised. This means there is a need to consider:

- **any channel related costs**: the need to dredge channels to increase its depth or to remove silt build up in maintaining a channel can be an expensive process, where the costs incurred would ultimately be borne by container shipping lines and their customers. A port that can accommodate larger container ships without incurring significant channel related costs would reduce capital and/or operating costs compared to a port that requires significant or regular dredging to accommodate the same sized container ships;
- **upfront wharf side investment costs needed to support container movements**: wharfs, docks, and berths need to be built to withstand the stresses that handling millions of tons of containerised cargo brings. Some existing ports would need to strengthen berths to accommodate larger container ships, which would add additional costs to the supply chain. Investments in container cranes, stacking cranes; and straddle carriers would also need to be made to support container movements from larger container ships that have larger beams. Limitations on crane dimensions, for example at Port Botany due to its proximity to the airport, could increase cost or reduce lift capacity. Systems that automate container handling would also be needed to achieve throughput efficiency necessary to minimise downtime for large container ships at port; and
- **landside investments:** integrated and uncongested access to the national rail and heavy vehicle road networks**,** length of possible rail sidings, and intermodal facilities is critical in ensuring that logistics to and from the port are as efficient as possible. Rail transport at ports are more efficient when rail sidings are over 1.2 kilometres long, allowing for scale in rail loading and unloading operations. Relying more heavily on rail transport is beneficial from the standpoint of mitigating road congestion. For road transport, trucking through major urban areas is less efficient due to the higher concentration of intersections and congestion, especially in the area around the port. Avoiding urban areas and direct access to the heavy vehicle road network would minimise logistics costs and the environmental impact in densely populated areas. Apart from access to efficient and integrated freight transport, sufficient capacity for container storage, handling, packing and distribution would also be needed to ensure efficient landside operations.

A port will be more competitive and deliver the greatest economic benefits when the sum of these costs is lowest compared to an alternative capacity expansion.

Finally, developing container port facilities to accommodating the increasing size of ships will allow Australia to capture the benefits from lower seaborne freight costs. It could also potentially create a substantive

[64] NSW Ports, Navigating the Future NSW Ports' 30 Year Master Plan, October 2015, p 70.

[65] See https://www.portofnewcastle.com.au/Projects-and-Development/Newcastle-Container-Terminal.aspx

[66] Infrastructure Victoria, *Second Container Port Advice – Evidence Based Discussion Paper*, May 2017, p 3.

[67] See http://www.infrastructurevictoria.com.au/node/94, accessed 18 December 2018.

[68] Infrastructure Victoria, *Second Container Port Advice – Evidence Based Discussion Paper*, May 2017, p 73.

transhipment hub, in the same way Port of Tauranga has done for New Zealand and facilitate greater use of coastal shipping within Australia.

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