Australian Government

Department of Infrastructure, Transport, Regional Development and Local Government

Bureau of Infrastructure, Transport and Regional Economics

STATISTICAL REPORT

Maritime

Australian maritime activity to 2029–30

Bureau of Infrastructure, Transport and Regional Economics

Australian maritime activity to 2029–30

Statistical report

Department of Infrastructure, Transport,
Regional Development and Local Government
Canberra, Australia

ISBN 978-1-921769-00-9

April 2010 / INFRASTRUCTURE09186

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An appropriate citation for this report is:

Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2010, Australian Maritime Activity to 2029–30, Canberra ACT.

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Published by

Bureau of Infrastructure, Transport and Regional Economics

GPO Box 501, Canberra ACT 2601, Australia
Telephone (international) +61 2 6274 7210
Fax +61 2 6274 6816
Email: bitre@infrastructure.gov.au
internet: http://www.bitre.gov.au

Desktop publishing by [INSERT NAME].

Printed by [INSERT PRINTING FIRM].

Typeset in Optima LT Std and Gill Sans MT [Mac].

Paper [INSERT PAPER TYPE].

Foreword

This report presents forecasts of maritime activity in Australian ports to 2029–30. This includes imports and exports of containerised and non-containerised freight, coastal freight movements, temporary arrivals and departures of passengers by sea, and vessel activity. These update results previously published by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) in Container and ship movements through Australian ports 2004–05 to 2024–25 (Working Paper 65).

The approach adopted for these forecasts is demand-based. Measures of income per capita for each of 12 trading regions are used in demand equations for Australian exports to those regions and for inbound seaborne passengers originating in those regions. Likewise, measures of income per capita for each Australian mainland state are used in demand equations for imports and coastal freight unloaded in each state's capital city port (Adelaide, Brisbane, Fremantle, Melbourne, and Sydney). Imports to other Australian ports and outbound coastal freight and seaborne passengers are assumed to be driven by income per capita for the whole of Australia.

Statistical models are used to estimate elasticities associated with these demand equations, and to forecast freight and passenger movements based on the expected growth in income for each region or state. This is done for each of the five major Australian container ports and for other Australian ports in aggregate. Based on forecasts of freight volumes and passenger numbers, estimates of future vessel activity are calculated.

This publication was prepared by Anatoli Lightfoot in the Infrastructure, Surface Transport and Road Safety Statistics section. Some of this work was originally published in a conference paper presented at the 32nd Australasian Transport Research Forum held in Auckland, New Zealand in September 2009. The author would like to acknowledge the contributions of BITRE colleagues Godfrey Lubulwa, Rob Bolin, Peter Kain, David Gargett, and Krishna Hamal, and comments provided by Port of Melbourne and Sydney Ports. Further acknowledgements go to Port of Brisbane, Flinders Ports, Fremantle Ports, Port of Melbourne, Sydney Ports, and Tasports for providing vital additional data on container movements at short notice.

For more information about this report or related BITRE publications please phone (02) 6274 7312 or email data.team@infrastructure.gov.au.

Gary Dolman
Head of Bureau
Bureau of Infrastructure, Transport and Regional Economics
Canberra
April 2010

At a glance

Containerised freight

- Australian containerised exports in 2007–08 totaled 1.50 million TEU.[1] This is forecast to increase to 1.74 million TEU in 2012–13, and to 6.32 million TEU by 2029–30.
- Australian containerised imports in 2007–08 totaled 2.46 million TEU. This is forecast to increase to 2.67 million TEU in 2012–13, and to 5.17 million TEU by 2029–30.
- In 2007–08, there were 362 000 TEU transported between Australian ports. This is forecast to increase to 415 000 TEU in 2012–13, and to 824 000 TEU by 2029–30.
- The estimated income elasticities for total outbound freight varied by port from 1.01 to 1.32.
- The estimated income elasticity for total inbound freight was 2.45.

Non-containerised freight

- Australian non-containerised exports in 2007–08 totaled 685 million tonnes. This is forecast to increase to 754 million tonnes in 2012–13, and to 1.35 billion tonnes by 2029–30.
- Australian non-containerised imports in 2007–08 totaled 61.5 million tonnes. This is forecast to increase to 63.1 million tonnes in 2012–13, and to 89.7 million tonnes by 2029–30.
- In 2007–08 there were 54.6 million tonnes of non-containerised freight transported between Australian ports. This is forecast to increase to 65.1 million tonnes in 2012–13 and to 92.7 million tonnes by 2029–30.
- The estimated income elasticities for total outbound freight from capital city ports were not statistically significant.
- The estimated income elasticity for total outbound freight from regional ports was 0.66.
- The estimated income elasticity for total inbound freight was 0.69.

1 Twenty-foot equivalent units, a measure which weights the number of containers by their physical size.

Seaborne passengers

- Historically, the annual numbers of temporary arrivals and departures by sea have been highly variable.
- The number of temporary arrivals and departures by sea are forecast to increase from around 40 000 per annum to around 50 000 per annum in the period 2007–08 to 2029–30.
- The estimated income elasticities for inbound and outbound passengers were not statistically significant.

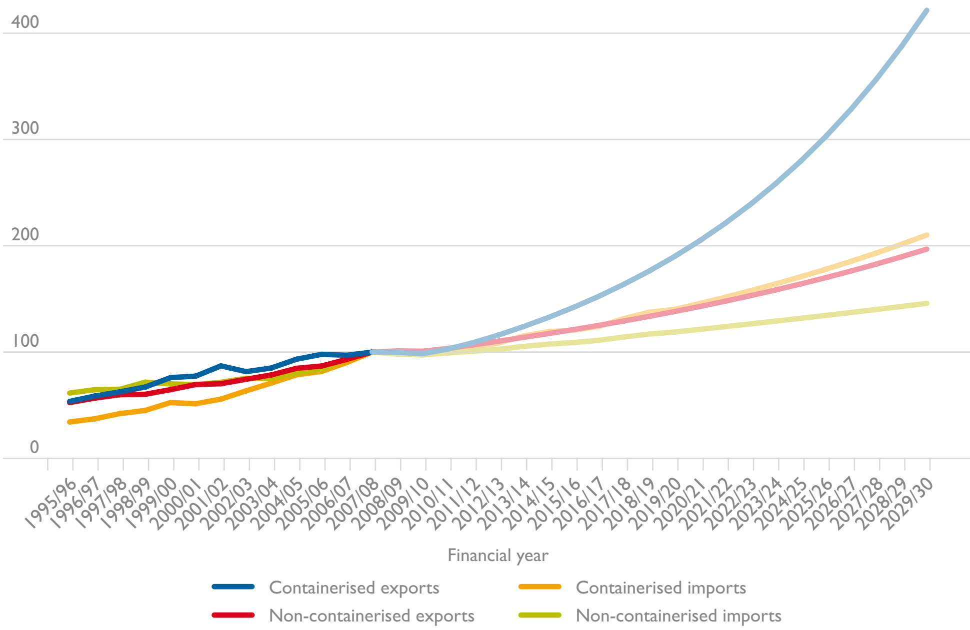
Vessel activity

- In 2007–08, there were 27 434 calls to Australian ports of which 7161 were by containerships, 14 439 were by bulk carriers, 3633 were by general cargo vessels, and 2201 were by other vessels.
- Based on forecasts of containerised imports and exports, calls by containerships are expected to increase to 6910 in 2012–13, and to 11 200 by 2029–30.
- Based on forecasts of non-containerised imports and exports, calls by bulk carriers are expected to increase to 15 500 in 2012–13, and to 23 100 by 2029–30.
- Based on forecasts of non-containerised imports and exports, calls by general cargo vessels are expected to increase to 3710 in 2012–13, and to 4080 by 2029–30.

Executive summary

The growth of Australia's imports and exports is forecast to slow in the period to 2010–11 due to the prevailing global economic conditions before returning to growth for the remainder of the forecast period to 2029–30. Containerised imports and exports and non-containerised imports are all predicted to decline by between 1.5 to 2.5 per cent during the first two years of forecasts, while non-containerised exports are expected to remain relatively flat for this period. A return to historical growth trends is expected to occur around 2011–12.

FES.1 Indices of international trade



Source: ABS (2009a), BITRE (2009), BITRE modelling.

As shown in Figure ES.1, total containerised exports are predicted to fall slightly before returning to strong growth experienced historically. This is driven primarily by the expected recovery in South East Asian economies from 2011, and by the rapid expansion of the Chinese economy to 2014[2] and assumed continuing growth beyond that. China and South East Asian countries were between them the destination for 47.1 per cent of Australia's containerised exports by weight in 2007–08. This share is forecast to increase to 59.6 per cent in the ten years to 2017–18, during the same period in which total containerised exports are forecast to increase by 64.0 per cent. These forecasts rely heavily on assumptions regarding the future

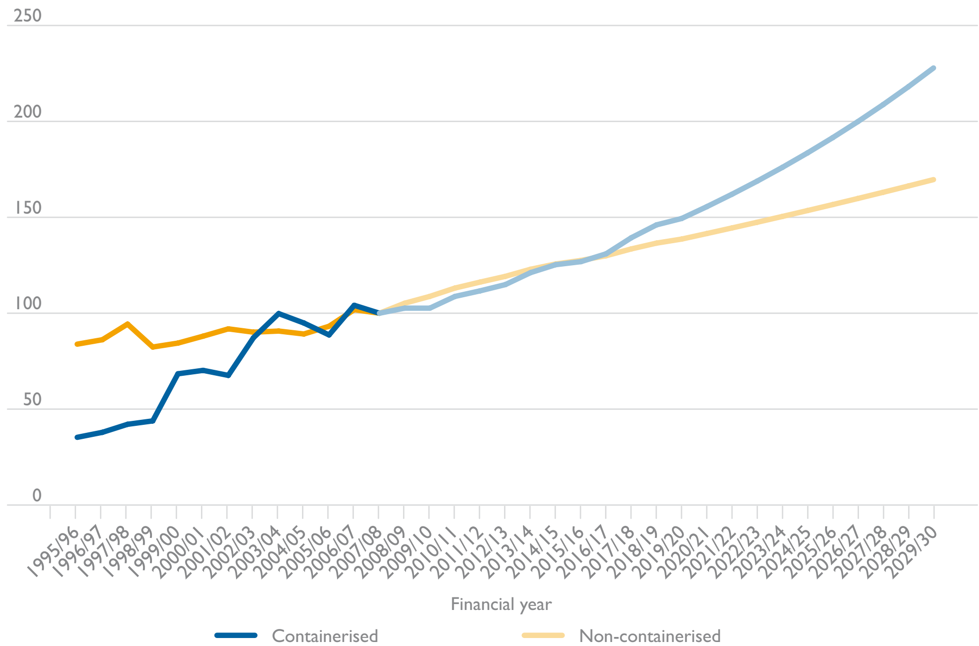
2 IMF (2009).

economic growth of Australia's trading partners, particularly China, and whether this will have the same effect on demand for Australian exports as the historical data suggests.

Non-containerised exports show a slightly different pattern, remaining steady until 2010–11 when forecasts indicate a return to trend growth. China features prominently here, too, with forecasts showing average annual growth in non-containerised exports of 4.6 per cent per annum for the ten years to 2017–18, increasing China's share from 35.8 per cent to 43.6 per cent of Australian non-containerised exports. Japan and Korea are the other major importers of Australian non-containerised freight. Korea is forecast to maintain a share of approximately 11 per cent of non-containerised exports into the future, while exports to Japan remain relatively flat over this period in absolute terms resulting in Japan's share dropping from 34.7 per cent in 2007–08 to 28.3 per cent in 2017–18.

Model-based forecasts suggest that growth in the coastal container trade will return to historical growth patterns around 2011–12 after a period of near-zero growth (Figure ES.2). However, domestic container volumes have historically been relatively volatile, leading to substantial uncertainty in these forecasts. In contrast, coastal movement of non-containerised freight is expected to continue to grow steadily throughout the forecast period.

FES.2 Indices of coastal trade

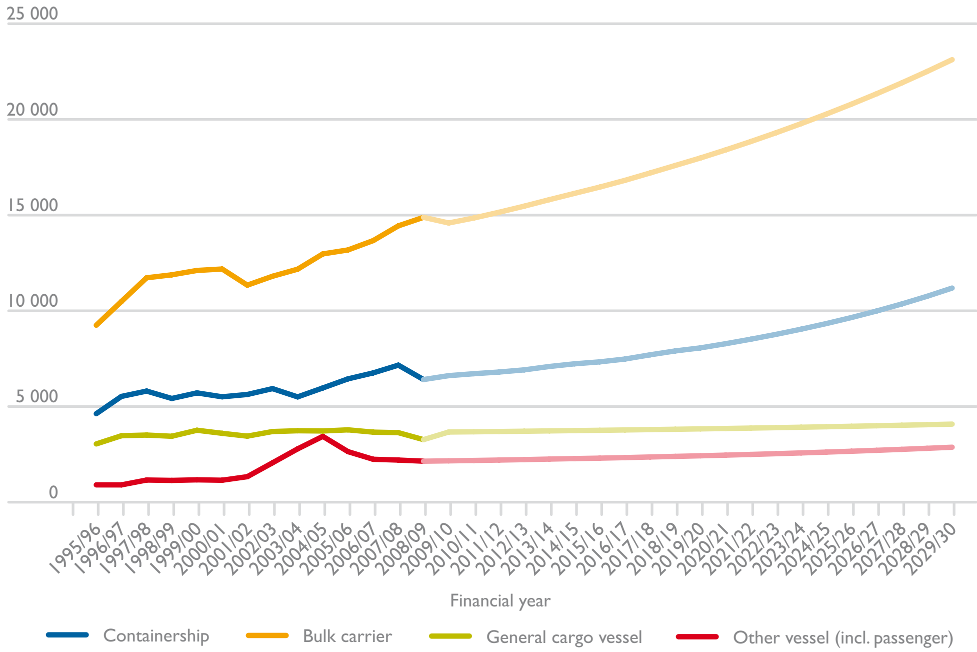


Source: BITRE (2008), BITRE (2009), BITRE modelling.

The volatility of historical temporary passenger arrivals and departures make it difficult to forecast them with much precision. Additionally, non-economic factors strongly influence demand for international travel. These include major sporting events like the Olympic Games, international terrorist events, and global outbreaks of disease such as SARS or H1N1. As such, the forecasts of steady long-term growth driven by increases in per capita income shown in Chapter 4 should be regarded as a baseline from which actual passenger movements will vary in response to changes in factors such as these.

Vessel activity is measured by the number of container, bulk, general cargo, passenger, and other vessels arriving at Australian ports (port calls). This is forecast to increase in line with Australian maritime activity, as shown in Figure ES.3.

FES.3 Calls to Australian ports by vessel type



Source: LMIU (2009), BITRE modelling.

Contents

Tables

Figures

CHAPTER 1
Introduction

The maritime industry is of vital importance to the Australian economy. As an island nation Australia depends on maritime freight to bring in imported goods and to export Australian goods to foreign markets. In the 2007–08 financial year, over 70 per cent of imports and 80 per cent of exports by value were transported by sea, representing a combined value of over $311 billion.[3] In that year there were over 27 000 visits by ships to Australian ports.

This report presents forecasts of Australian exports and imports of containerised and non-containerised freight, coastal freight movements, temporary arrivals and departures of passengers by sea, and vessel movements. The general approach uses per capita real GDP or real final demand as predictors in demand equations for per capita import and export volumes, coastal freight volumes, and inbound and outbound seaborne passengers.

T1.1 Overview of statistical models

Model	Dependant variable	Independent variable	Number of observations used	Data grouped and analysed by
Outbound containerised	Log of exports (TEU) per capita of destination region	Log of real gross product per capita of destination region	1013	Financial year, Australian port, trading region
Inbound containerised	Log of imports (TEU) per capita of destination state	Log of real final demand per capita of destination state	156	Financial year, Australian port, coastal/international
Outbound non-containerised	Log of exports (tonnes) per capita of destination region	Log of real gross product per capita of destination region	1012	Financial year, Australian port, trading region
Inbound non-containerised	Log of imports (tonnes) per capita of destination state	Log of real final demand per capita of destination state	156	Financial year, Australian port, coastal/international
Outbound seaborne passengers	Log of outbound passengers per capita of origin state	Log of real final demand per capita of origin state	18	Financial year
Inbound seaborne passengers	Log of inbound passengers per capita of origin region	Log of real gross product per capita of origin region	211	Financial year, trading region

3 ABS (2009a)

Four statistical models were used to estimate elasticities and produce forecasts of maritime freight, one for each of outbound containerised, inbound containerised, outbound non-containerised and inbound non-containerised freight. Two models were used for seaborne passengers; one for inbound passengers and one for outbound passengers. Empty container movements and vessel activity were estimated using other methods based on the output of the statistical models.

Table 1.1 summarises the key features of each of the statistical models. All of the models use real gross domestic product (GDP) per capita or real final demand per capita as the primary predictor for freight volumes and passenger numbers. Further details on the models can be found in the relevant chapters and in Appendix A.

This work is intended to provide an indication of possible future maritime industry activity in Australia, assuming unconstrained supply and given certain assumptions about future demand. Tables of detailed forecasts are provided in Appendix C. Electronic copies of these tables are available on the BITRE website at www.bitre.gov.au. More detailed information on any aspect of this paper can be obtained by contacting BITRE.

CHAPTER 2
Containerised freight

The container trade in Australia is concentrated around the five mainland capital city ports: Adelaide, Brisbane, Fremantle, Melbourne, and Sydney. Around 90 per cent of total container imports and exports were handled at one of these ports in 2007–08, and between them they were the origin of over 70 per cent of the containers shipped domestically in that year.[4]

Inbound and outbound full containers are modelled separately. Demand for inbound containers to each mainland capital city port is assumed to be driven by real final demand per capita for the state in which the port is located (e.g. NSW real final demand drives growth in Sydney's inbound container numbers), while Australian real final demand per capita drives inbound freight to other Australian ports. Demand for outbound containerised freight is assumed to be driven by real Gross Regional Product (GRP) per capita[5] in each of thirteen destination regions. Australia is included as one of the destination regions in order to model outbound coastal freight. Further information on the data and models is provided in Appendix A.

Model output

The outbound model estimates separate elasticities with respect to per capita GRP of the destination region for each of the five mainland capital city ports and another for the aggregation of all other Australian ports. In contrast, the inbound model estimates a single elasticity with respect to state or Australian final demand per capita. Estimated movements of empty containers are calculated from the model-based forecasts for full containers, using a methodology based on assumptions about the relationship between full and empty container movements.[6]

Table 2.1 summarises elasticity estimates obtained from both containerised freight models. As shown, the elasticities for each port in the exports model vary from 1.02 for Adelaide to 1.33 for Melbourne. The estimates are all significantly different from zero, clearly demonstrating the relationship between GRP and exported containers. When tested as a group (using an F-test to compare nested models with and without the port terms) it was found that estimating different elasticities by port explained a significant amount of additional variation in export volumes compared to estimating a single export elasticity. This suggests that the additional terms should be included in the model. However, there is insufficient evidence to conclude that containerised exports from any of the ports are not unit elastic with respect to GRP.[7]

4 ABS (2009a), BITRE (2009).

5 GRP per capita is calculated for a region by dividing the sum of the GDP of all countries in that region by the sum of the populations of those countries. See Appendix B for the composition of the trading regions.

6 UNESCAP (2001).

7 Based on t-tests with H_0: elasticity = 1.

For the imports model, the additional terms required to estimate elasticities by port were included in preliminary models, producing elasticity estimates by port ranging from 2.14 for other ports to 2.57 for Melbourne. However, these terms were dropped from the final model. This was due to the similarity of the estimates for the five mainland capital ports (which ranged from 2.43 to 2.57), and also because including the terms caused convergence problems for the model-fitting algorithm. A t-test of the single import elasticity rejects the hypothesis that the elasticity equals one (t = 6.19), so it can be concluded that Australian imports are relatively elastic with respect to Australian state final demand per capita.

T2.1 Containerised model output, summary

Model/port	Elasticity with respect to	Estimate	Standard error	DF[a]	P-value[b]
Outbound Adelaide	Gross Regional Product	1.0153	0.2307	994	< 0.0001
Outbound Brisbane	Gross Regional Product	1.1697	0.2350	994	< 0.0001
Outbound Fremantle	Gross Regional Product	1.1245	0.2303	994	< 0.0001
Outbound Melbourne	Gross Regional Product	1.3286	0.2324	994	< 0.0001
Outbound Sydney	Gross Regional Product	1.2521	0.2326	994	< 0.0001
Outbound other ports	Gross Regional Product	1.0917	0.2349	994	< 0.0001
Inbound all ports	Domestic final demand	2.4463	0.2337	143	< 0.0001

Source: BITRE modelling.
Note: Selected model output shown. See Appendix A for details.
a Degrees of freedom, a function of the number of observations used to estimate the parameter
b For a t-test with H_0: elasticity = 0

The slight differences in elasticity estimates between the ports in the outbound model may be due to differences in the mix of commodities shipped from each. Demand for different types of goods can be expected to respond differently to changes in average income. For instance, demand for consumer items tends to be income elastic while demand for necessities such as food or fuel is relatively inelastic. This is also likely to be the reason for the much higher estimated elasticity for inbound containers than outbound: Consumer items represent a much larger proportion of Australian containerised imports than containerised exports. It follows that the elasticities will not necessarily remain constant if there are changes to the relative proportions of the various commodities shipped.

Forecast overview

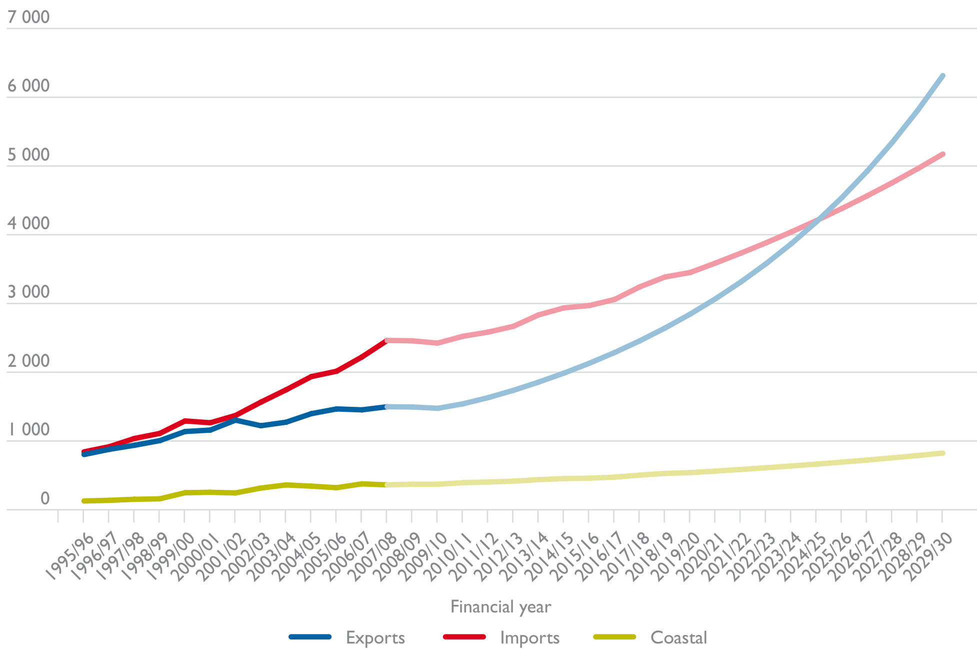
Figures 2.1 and 2.2 show model-based forecasts of total containerised trade. Coastal freight figures are based on forecasts of inbound freight by port of destination, as inbound models use the more detailed Access Economics Australian final demand figures rather than IMF's Australian GDP figures as the predictor. Total inbound and outbound freight are both forecast to flatten during 2008–09 and 2009–10 before returning to growth in the following years. From 2010–11 to 2019–20 growth in imports and coastal freight are expected to closely follow the strong growth forecast in Australian final demand for this period.[8] Longer-term forecasts show growth rates for both imports and coastal freight stabilising at around 4 per cent per annum.

8 Access Economics (2009).

Containerised exports are expected to flatten out in a similar pattern to containerised imports. The forecasts show a return to growth rates of 7 per cent per annum around 2014–15. This rate of growth is predicted to gradually increase at approximately 0.1 per cent per annum, finishing the forecast period at 8.8 per cent per annum. This is consistent with the increasing GDP growth rates predicted for Australia's trading partners: growth in global gross product per capita is expected to accelerate from 2.3 per cent per annum to 3.2 per cent per annum between 2014 and 2030.[9] Whether or not the levels of economic growth predicted will eventuate and whether they are sustainable over such a long period are matters for debate, but these forecasts are produced under the assumption that they will eventuate and that they are sustainable.

Historical coastal container movements appear relatively volatile when compared with imports and exports, as shown in Figure 2.2. Figure 2.2 also shows that although historical imports are much more stable than coastal freight, the pattern of maxima and minima are similar for these two series. This suggests that similar processes may be driving growth (or decline) in imports and coastal freight.

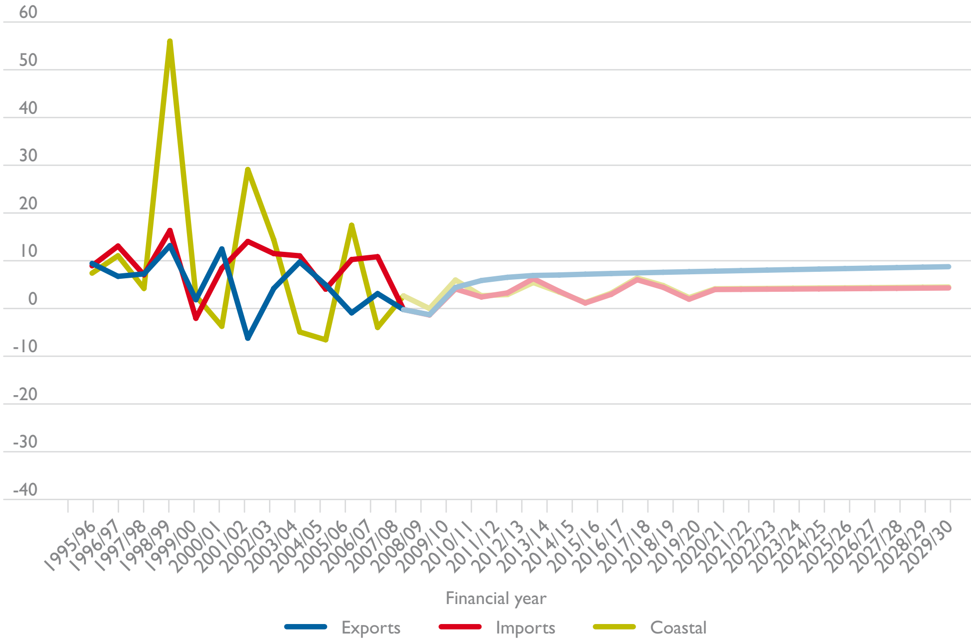
F2.1 Australia's containerised trade, summary



Source: BITRE (2008), BITRE (2009), BITRE modelling.

9 IMF (2009), BITRE estimates.

F2.2 Australia's containerised trade, growth rates



Source: BITRE (2008), BITRE (2009), BITRE modelling.

Containerised exports

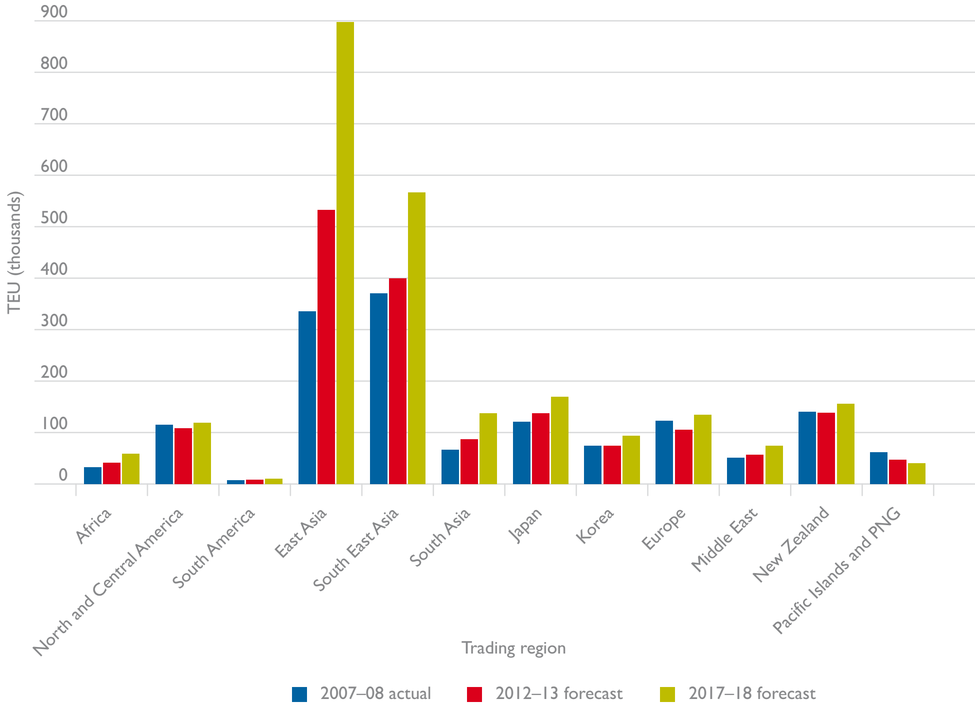
Figure 2.3 shows the regional breakdown of Australian containerised exports. East Asia and South East Asia represent the destination for the majority of Australia's containerised exports, although substantial volumes are exported to all regions except South America. The majority of the growth forecast in the ten years to 2017–18 is in the East Asian market, corresponding to the expected rapid economic growth in China during this period.

Containerised exports to East Asia from the five mainland capital city ports and from other ports are all forecast to increase rapidly between 2007–08 and 2017–18. In contrast, containerised exports to South East Asia are predicted to remain relatively steady for the first two to three years of the forecasts for Brisbane, Melbourne, and Sydney, while exports to South East Asia from Adelaide and Fremantle are forecast to decline in the short term. The long-term predicted rate of export growth from 2010–11 onwards is also lower for South East Asia compared to East Asia.

The substantial growth in exports to East Asia is driven primarily by the high rate of GDP growth (approximately 10 per cent per annum) assumed for China during this period.[10] However, these results should be interpreted with caution as they are based on the assumption that China's future GDP growth will drive increases in containerised exports to China according to the same relationships observed in the historical data. The nature of these relationships is assumed to remain constant. As such, actual exports may differ from forecasts if the relationship between GDP and demand for imports changes in the future. It is also possible that the actual rate of growth of China's economy will differ from the assumed GDP growth that underpins the forecasts.

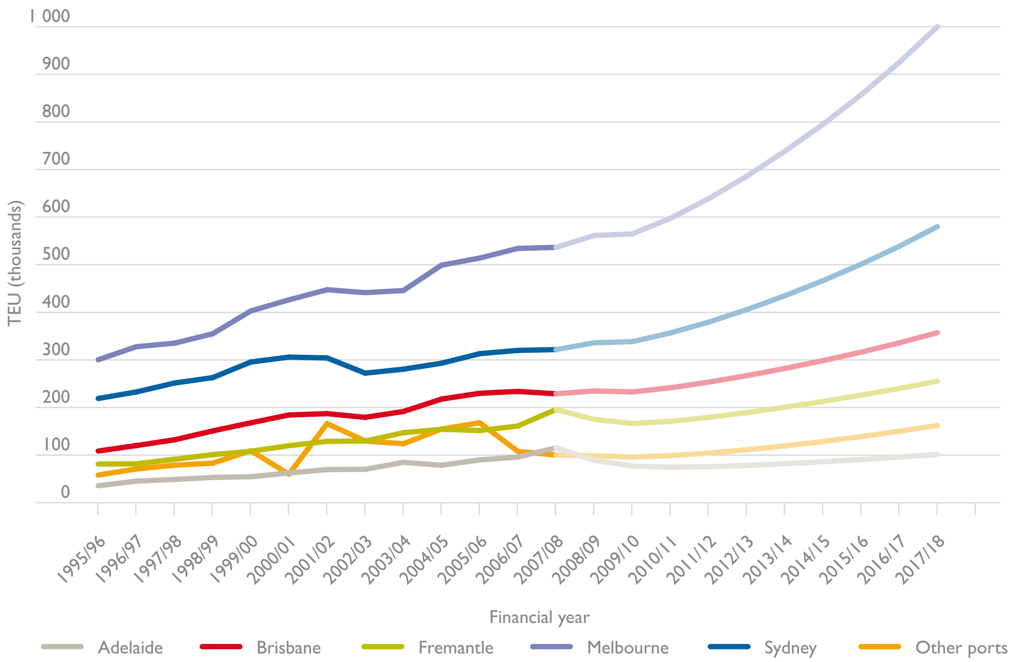
10 IMF (2009), BITRE estimates.

F2.3 Australia's containerised exports by destination region, selected years



Source: ABS (2009a), BITRE (2009), BITRE modelling.

F2.4 Australia's containerised exports by port of origin



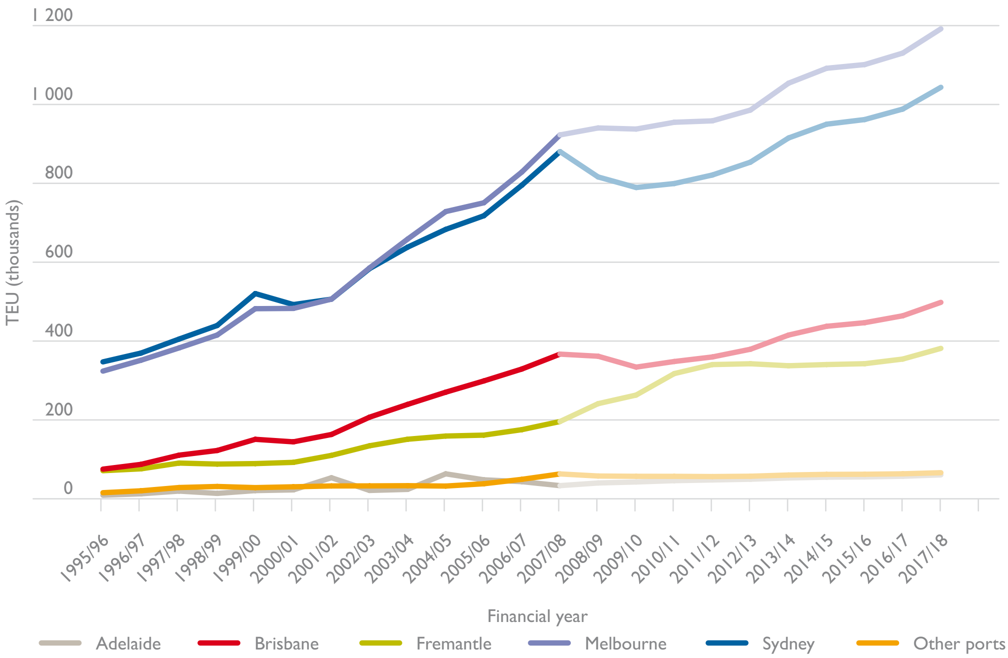
Source: ABS (2009a), BITRE (2009), BITRE modelling.

Containerised imports

Sydney and Melbourne, Australia's two largest container ports, handled more than two-thirds of total containerised imports in 2007–08. They are expected to remain Australia's busiest ports into the future, despite the forecast flattening of Melbourne's imports and the short-term decline in imports to Sydney.

The breakdown of the forecasts of containerised imports by port is shown in Figure 2.5. As the inbound model estimates a single elasticity for all ports, the forecasts reflect predicted differences in future real final demand between the states.[11] However, the decline forecast for Sydney is exaggerated by above-trend imports recorded in 2006–07 and 2007–08. If these recent results represent a permanent departure from the historical trend rather than statistical noise then it is likely that the forecasts systematically underestimate future containerised imports to Sydney.

F2.5 Australia's containerised imports by port of destination



Source: BITRE (2009), BITRE modelling.

Coastal freight

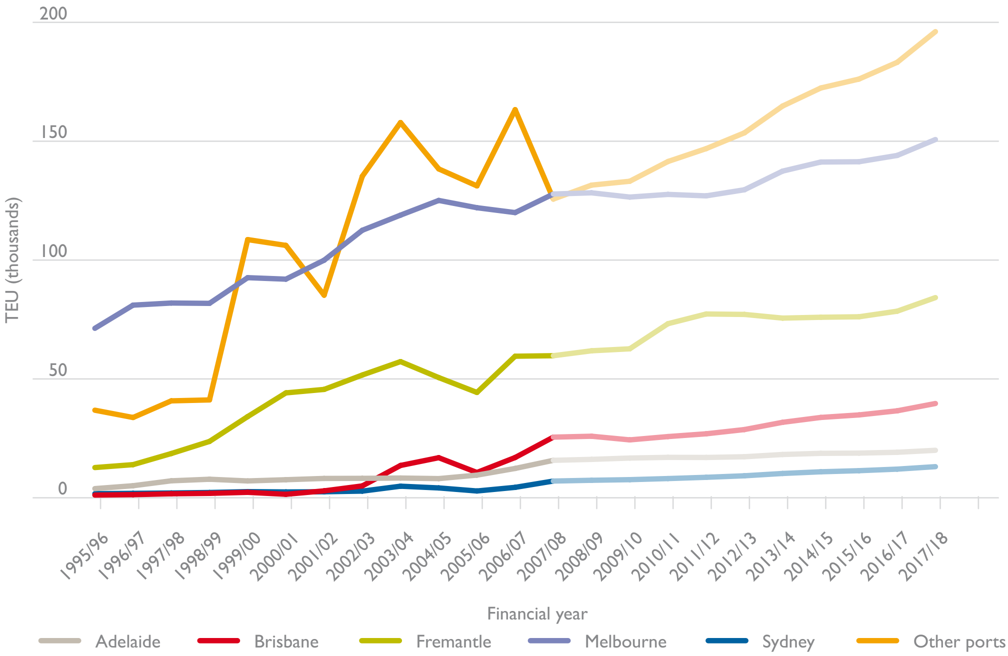
Both inbound and outbound container models incorporate coastal freight. This is done in the outbound model by including Australia as a destination region and treating coastal freight as 'exports' to Australia. In the inbound model, coastal inbound freight is modelled separately but identically to international imports. Figure 2.6 presents a ten-year forecast of coastal container movements by port of destination.

11 Access Economics (2009).

Some ports, most notably Sydney, handle far more outbound coastal containers than inbound. However, due to a lack of consistent data on coastal container movements, and the fact that the movement of freight in general is driven by demand at destination rather than origin, it was not possible to produce reliable forecasts of coastal freight by port of origin.

As shown in Figure 2.6, regional ports are a substantial player in terms of containerised coastal freight. However, the vast majority of the other ports figures are attributable to ports in Northern Tasmania (Burnie, Bell Bay, and Devonport) and the Bass Strait trade with Melbourne. There is also a significant flow of coastal containers to Fremantle originating from the other mainland capitals evident in the historical data which explains the substantial numbers of containers destined for Fremantle in the forecasts.

F2.6 Australia's coastal container movements by port of destination



Source: BITRE (2009), BITRE modelling.

Empty containers

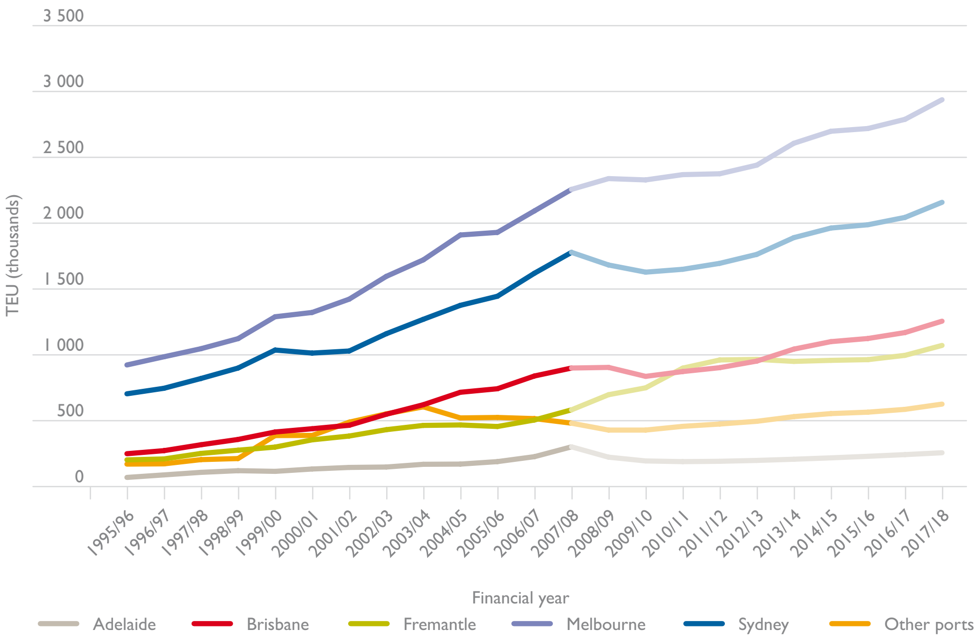
The inclusion of empty container movements provides a measure of port activity which is useful for assessing capacity, particularly in terms of container terminal operations. Empty containers take time to load and unload, and require space for storage and transport. Of the 5.8 million TEU moved through the five mainland capital city ports in 2007–08, approximately one-quarter were empty containers.[12] Figure 2.7 shows total container movements for each port, including imports, exports, coastal movements of both full and empty containers.

12 BITRE (2009).

As the numbers of empty containers imported and exported are not directly related to demand for goods, these estimates are not based directly on the statistical models. Rather, assumptions are made regarding the relationship between full and empty imports and exports, and the empty container movements are then estimated based on the full container forecasts.[13] The method used requires assuming that the net flow of containers into or out of a port by other modes (road and rail) is zero.

All of the mainland capital city ports except Adelaide currently handle more full containers in the inbound direction than outbound. This creates a need to re-position empty containers which are not required for outbound goods. As a result, total container movements at these ports are sensitive to changes in the number of full containers in the inbound direction only, while changes to full outbound container numbers tend to be absorbed by corresponding changes to empty outbound containers. The reverse is true for Adelaide, where in recent years outbound containers have exceeded inbound.

F2.7 Total container throughput by Australian port



Source: BITRE (2009), BITRE modelling.
Note: Includes empty containers.

13 UNESCAP (2001).

CHAPTER 3
Non-containerised freight

Much of Australia's non-containerised trade is handled through regional ports. This is especially true of bulk exports. Approximately 247 million tonnes of coal and 314 million tonnes of iron ore were exported from regional ports in 2007–08, representing over 80 per cent by mass of all non-containerised exports in that year. At these ports, some of which are purpose-built, high volumes of specific bulk commodities are loaded or unloaded using specialised port infrastructure unsuitable for other types of cargo. In contrast, the mainland capital ports handle smaller quantities of a more diverse range of goods, and as a result are relatively small players in this market.

To illustrate this, consider the Australian ports with the highest total throughput in 2007–08 as measured in tonnes. These are: Dampier (125.7 million tonnes, of which 82.3 per cent was iron ore); Port Hedland (106.8 million tonnes, of which 95.9 per cent was iron ore); Hay Point/Dalrymple Bay (86.4 million tonnes, of which 84.2 per cent was coal); and Newcastle (82.5 million tonnes, of which 77.0 per cent was coal). In comparison, the capital city ports handle much lower volumes of non-containerised freight, and are much less specialised: Fremantle handled 10.1 million tonnes in 2007–08 of which 37.7 per cent was grain, Brisbane handled 9.3 million tonnes of which 44.9 per cent was coal, and the other mainland capital city ports had even lower total throughput.[14]

Inbound and outbound non-containerised freight are modelled separately, as for the container trade. Demand for non-containerised inbound freight to mainland capital city ports is assumed to be driven by real final demand per capita for the state in which the port is located, while Australian real final demand per capita drives inbound freight (imports and coastal) to other Australian ports. Demand for non-containerised outbound freight is assumed to be driven by real Gross Regional Product (GRP) per capita[15] in each of thirteen destination regions, of which Australia is one. Further information on the data and models is provided in Appendix A.

Model output

As with the containerised models, the outbound non-containerised model estimates separate elasticities with respect to GRP for each of the five mainland capital city ports and another for the aggregation of all other Australian ports, and the inbound model estimates a single elasticity with respect to Australian real final demand by state for all Australian imports. Table 3.1 summarises elasticity estimates produced by the non-containerised models.

14 BITRE (2009).
15 GRP per capita is calculated for a region by dividing the sum of the GDP of all countries in that region by the sum of the populations of those countries. See Appendix B for the composition of the trading regions.

Elasticity estimates for non-containerised exports for the mainland capital city ports are all near zero (and not statistically significant), while the estimate for other ports of 0.66 is significant. This illustrates the differences between the five capital city ports and other ports. The relatively thin volumes of outbound non-containerised freight handled by capital city ports together with the volatility of historical data hides any relationship between outbound freight volumes and destination GRP for these ports. Consequently, forecasts of outbound freight for the five mainland capitals should be interpreted with caution. For this reason, and to maintain consistency with containerised freight forecasts shown in Chapter 2, future growth rates for total coastal non-containerised freight shown in Figure 3.1 are based on forecasts of coastal freight by destination from the inbound freight model.

T3.1 Non-containerised model output, summary

Model/port	Elasticity with respect to	Estimate	Standard error	DF3	P-value
Outbound Adelaide	Gross Regional Product	0.0608	0.2339	993	0.7949
Outbound Brisbane	Gross Regional Product	0.1972	0.2317	993	0.3950
Outbound Fremantle	Gross Regional Product	0.2455	0.2329	993	0.2922
Outbound Melbourne	Gross Regional Product	0.1022	0.2320	993	0.6596
Outbound Sydney	Gross Regional Product	-0.0365	0.2327	993	0.8756
Outbound other ports	Gross Regional Product	0.6628	0.2292	993	0.0039
Inbound all ports	Domestic final demand	0.6907	0.2266	143	0.0027

Source: BITRE modelling.
a Degrees of freedom, a function of the number of observations used to estimate the parameter
b For a t-test with H_0: elasticity = 0
Note: Selected model output shown. See Appendix A for details.

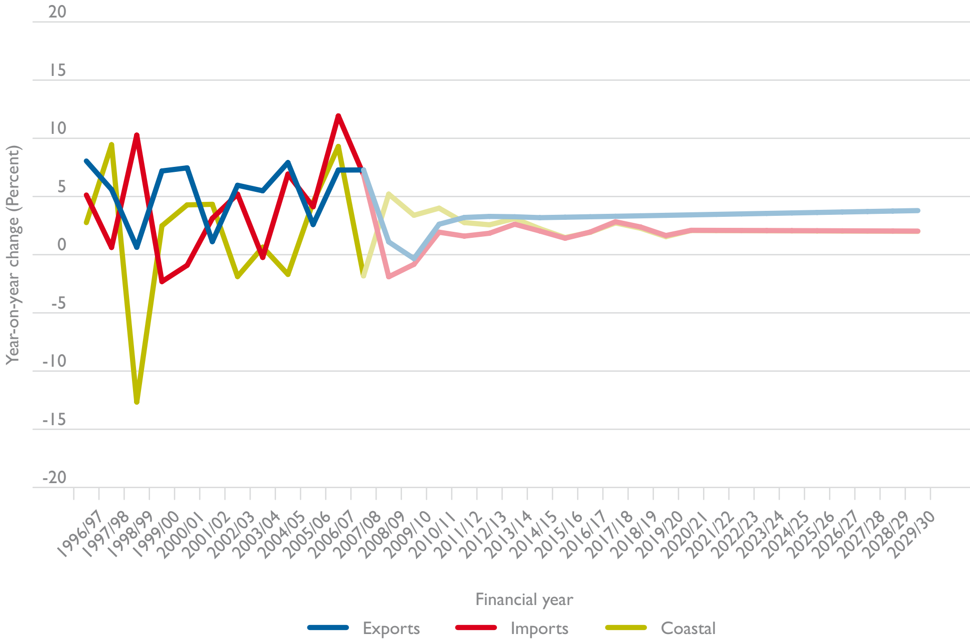
The terms required to estimate elasticities by port were initially included in the non-containerised imports model, producing estimates ranging from 0.64 to 0.74. As in the containerised case, these terms were dropped from the final model. In this case, the addition of the port-level elasticity estimates significantly reduced the overall fit of the model, despite the additional terms appearing significant in an F-test. The elasticity estimate for all ports is 0.69. Based on this estimate there is insufficient evidence to conclude that non-containerised exports are not unit elastic.

Forecast overview

Figure 3.1 shows forecast growth rates for non-containerised trade. Imports of non-containerised goods are expected to decline in 2008–09 and 2009–10 before returning to growth in the following years, while exports are expected to remain flat but not decline. The long-term growth rates forecast for non-containerised freight appear similar to the containerised freight forecasts, which is to be expected due to the use of the same GDP and final demand data for both sets of models. However, the annual growth rates at which the forecasts stabilise are different due to lower estimated elasticities for non-containerised freight. For both imports and coastal freight, long-term growth is predicted to stabilise at around 2 per cent per annum from 2020–21 to 2029–30. For exports the model predicts year-on-year growth of 3.2 per cent for 2012–13, gradually increasing to 3.8 per cent per annum by 2029–30, again reflecting the accelerating rate of global GDP growth assumed between 2014 and 2030.[16]

16 IMF (2009), BITRE estimates.

F3.1 Australia's non-containerised trade, growth rates

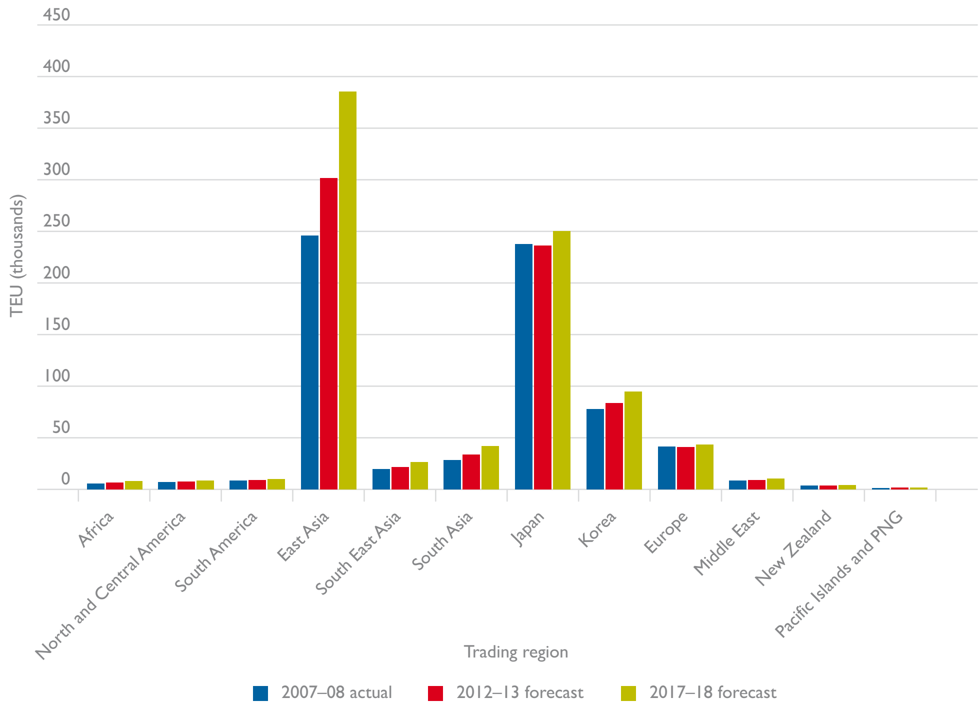


Source: ABS (2009a), BITRE (2008), BITRE modelling.

Non-containerised exports

Figure 3.2 shows the regional breakdown of Australian non-containerised exports. They are dominated by exports to East Asia and Japan, which together accounted for 70.6 per cent of total non-containerised exports in 2007–08. Korea and Europe are the next biggest markets, representing 11.4 per cent and 6.1 per cent respectively in 2007–08, with most of the remaining 11.9 per cent accounted for by South and South East Asia. Like the container trade, the majority of the growth forecast over the initial ten-year period is in the East Asian market, corresponding to the expected rapid economic growth in China during this period. In contrast, growth in non-containerised exports to Japan is expected to remain largely flat between 2007–08 and 2017–18.

F3.2 Australia's non-containerised exports by destination region, selected years



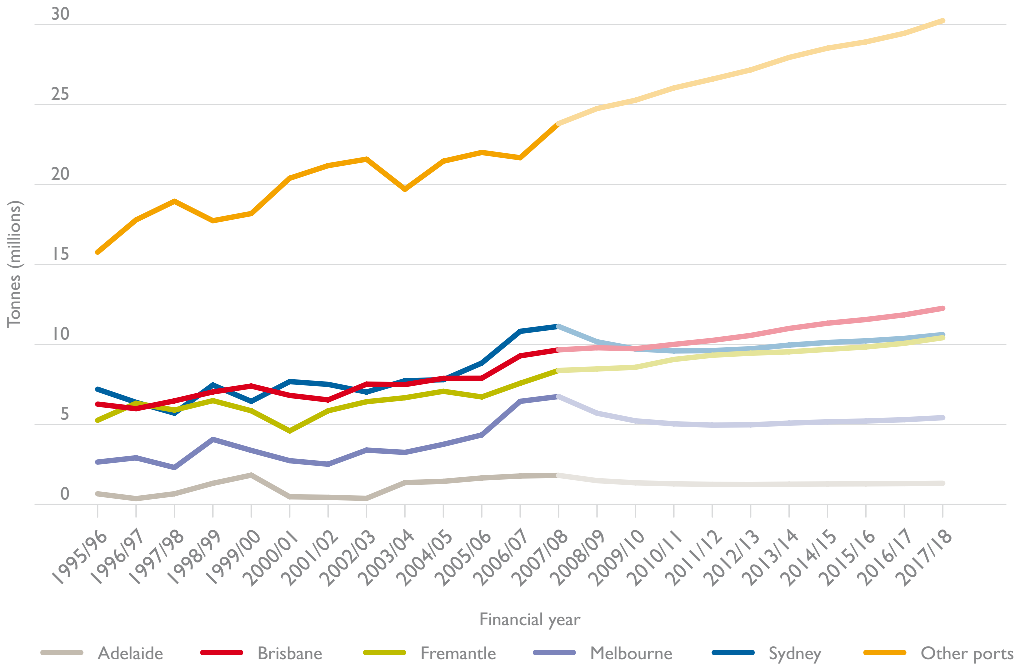
Source: ABS (2009a), BITRE modelling.

Non-containerised imports

Fuels represent the majority of Australia's non-containerised imports. Of 65.8 million tonnes of non-containerised imports in 2007–08, 53.7 per cent were petroleum products. Other commodities with a substantial of total imports by weight in that year were inorganic chemicals (7.2 per cent); metal ores and metal scrap (7.0 per cent); natural and manufactured gases (6.9 per cent); manufactured fertilisers (4.1 per cent); crude minerals, including crude fertilizers (3.9 per cent); other non-metallic manufactured minerals (3.9 per cent); iron and steel (3.0 per cent); and road vehicles (2.5 per cent). As all five of the mainland capital city ports except Adelaide have bulk liquids facilities for nearby oil refineries, a substantial proportion of non-containerised imports are handled through these ports as illustrated in Figure 3.3. This is in contrast to non-containerised exports where the capital city ports are minor players.

Brisbane, Fremantle, and other ports are all expected to continue to grow their non-containerised imports at a relatively steady rate into the future. The forecasts show imports declining for the first two to three years of the forecast period for Sydney and Melbourne before returning to the levels of growth seen in historical data by 2010–11. This decline appears to be due primarily to above trend imports in 2006–07 and 2007–08 for both of these ports. However, if these two years of higher than expected imports are due to a systemic change to Australian non-containerised imports that persists into the future then the predicted falls are unlikely to eventuate. A similar pattern is also visible in forecasts for Adelaide, although this does not appear to be due to recent above-trend imports but rather the relative volatility of historical data. This is exacerbated by low volumes and possible issues with data quality due to the closure of the Port Stanvac refinery during the period, so these forecasts should be interpreted with some caution. Historical data for Melbourne and Sydney are also relatively volatile compared to Brisbane, Fremantle, and other ports.

F3.3 Australia's non-containerised imports by port of destination



Source: BITRE modelling.

CHAPTER 4

Seaborne passengers

Seaborne passengers do not constitute a substantial proportion of total passenger movements to and from Australia. Nevertheless, there are a substantial numbers of passengers arriving and departing by sea each year. In 2008–09, over 28 000 temporary visitors to Australia arrived and more than 18 000 Australian residents departed by sea. This has impacts on the Australian maritime industry both in terms of port utilisation and maritime safety and security.

This chapter examines only short-term arrivals and departures of passengers requiring customs clearance. Permanent movements (migration) and long-term arrivals or departures, which are not driven by income in the same way as temporary movements, are excluded. Also excluded are movements of passengers between Australian ports, due to a lack of suitable data.

Inbound and outbound passenger movements are modelled separately in a similar fashion to imported and exported freight. Demand for inbound passenger movements is assumed to be driven by real Gross Regional Product per capita[17] in each of twelve freight destination regions (Australian domestic movements are not included). Demand for outbound passenger movements is assumed to be driven by Australian real final demand.

Model output

As the source data used contains no information on which Australian port the passengers arrived at or departed from, port-level elasticity estimates are not possible. As such, a single elasticity is estimated for each of inbound and outbound passengers. These are presented in Table 4.1.

T4.1 Passenger model output, summary

Model/port	Elasticity with respect to	Estimate	Standard error	DF	P-value[a]
Inbound passengers	Gross Regional Product	0.4843	0.3446	198	0.1615
Outbound passengers	Domestic final demand	1.5800	1.0152	16	0.1392

Source: BITRE modelling.
Note: Selected model output shown. See Appendix A for details.
a For a t-test with H_0: elasticity = 0

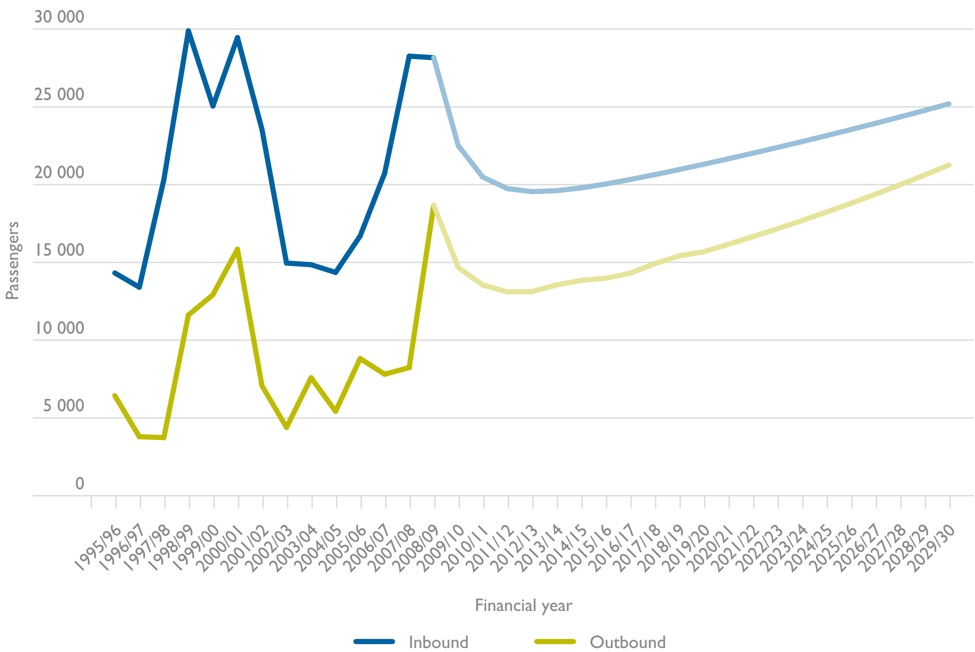
17 GRP per capita is calculated for a region by dividing the sum of the GDP of all countries in that region by the sum of the populations of those countries. See Appendix B for the composition of the trading regions.

There is insufficient evidence to conclude that either elasticity is different from zero. The high standard error for the outbound passengers estimate is due to the small number of observations used. Due to the relative magnitude of the standard errors for both estimates, caution should be exercised when interpreting the results of these models.

Forecasts

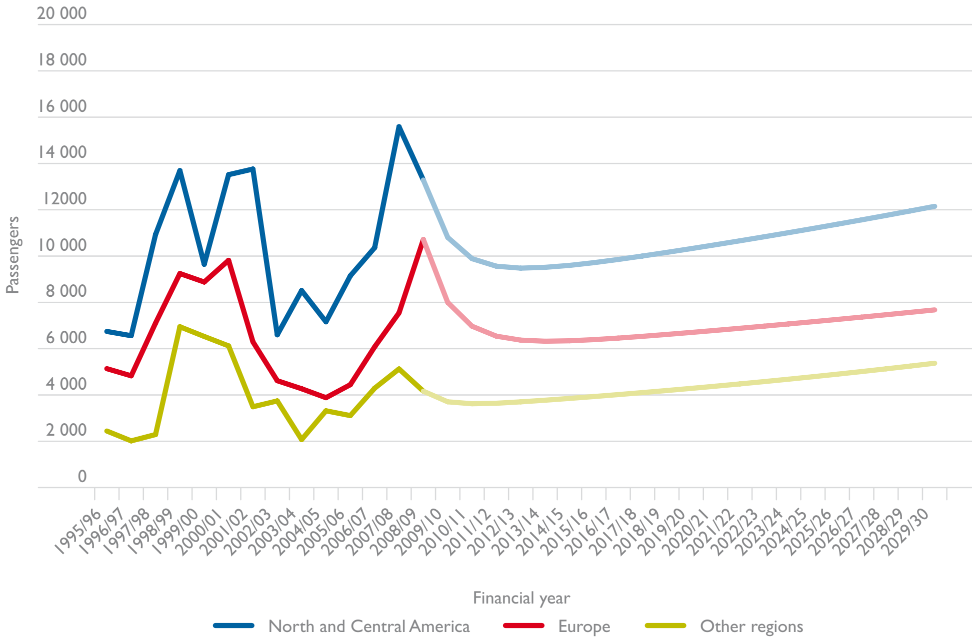
As shown in Figures 4.1 and 4.2, temporary arrivals and departures by sea have exhibited significant volatility historically. This is due primarily to the fact that, in addition to economic factors, the international movement of passengers is sensitive to a large number of other factors such as intensity of tourism advertising campaigns, the global political climate, major sporting events such as the Olympic Games, terrorism, and many others. As these factors are extremely difficult to measure quantitatively they have not been used in the models. As such, the forecast steady long-term growth driven by increases in per capita income should be regarded as a baseline prediction from which actual passenger movements will vary in response to changes in these other variables.

F4.1 Australia's temporary arrivals and departures by sea, summary



Source: BITRE modelling.

F4.2 Australia's temporary arrivals by sea from selected regions



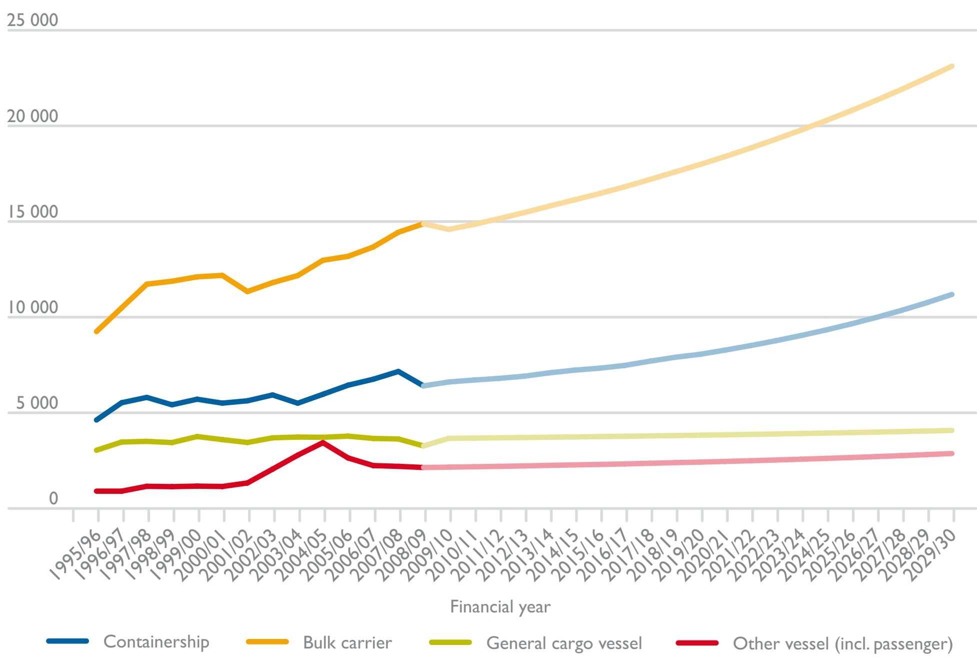
Source: BITRE modelling.

CHAPTER 5
Vessel activity

The movement of freight and passengers by sea examined in the previous chapters is facilitated by the activity of vessels at ports. A simple but useful measure of vessel activity is the number of arrivals at port (port calls) during a period of time. The annual number of calls to Australian ports has grown steadily from just over 20 000 in 1996–97 to more than 27 000 in 2007–08. More than half of this increase is due to an increase in the number of calls by bulk vessels from 10 500 to nearly 15 000 over the same period.

Vessel activity is modelled differently to freight and passenger movements. It is not directly driven by economic factors but rather by the need to move freight and passengers. As such, simple models relating historical freight volumes and passenger numbers linearly to the number of port calls by different types of vessel were used to predict future vessel movements. Figure 5.1 shows historical and forecast numbers of Australian port calls for four broad vessel categories.

F5.1 Calls to Australian ports by vessel type



Source: LMIU (2009), BITRE modelling.

The number of calls by passenger vessels was not significantly correlated with either the number of passenger movements or time. This may be partly due to the lack of availability of consistent data on passenger vessel movements. As such, the number of port calls by passenger vessels was assumed to remain constant throughout the forecast period.

Other vessels include tugs and supply ships, research vessels, and other types of vessel not involved in the transport of freight or passengers. Rather than being related to the movement of passengers or freight, activity by these vessels was assumed to continue to represent approximately 5 per cent of total port calls into the future. This assumption allows an estimate of total port calls for all vessel types to be calculated, but caution should be exercised in interpreting the other vessels prediction on its own. Another assumption is made about the future relative proportions of bulk and general cargo that makes up non-containerised cargo, in order to provide separate estimates for the activity of bulk carriers and general cargo vessels.

Average vessel size for freight vessels has changed noticeably during the period covered by the historical data, and this might be expected to invalidate a linear relationship between freight volume and vessel activity. However, attempting to account for the change in average size did not significantly improve the fit of the models. Furthermore, predictions of future changes in vessel size would be required to produce forecasts using a model that included it as an explanatory variable. As such, the simpler models were used. If vessel sizes continue to increase substantially in the future this may cause the forecasts, particularly those towards the end of the forecast period, to overestimate future vessel activity.

The R^2 statistic for the regression of container movement on containership activity is 0.72, and that for the regression of non-container freight movement on bulk and general cargo vessel activity is 0.84.

APPENDIX A
Methodology

The general approach to modelling is based on the assumption that economic activity occurring in a geographic area can be used to explain demand for imported goods in that area, and demand for seaborne travel by passengers residing in that area. Thus, per capita GDP, aggregated by destination region, is used as the primary predictor for Australian freight bound for each region (including outbound coastal freight), and temporary arrivals of foreign passengers from corresponding origin regions. Similarly, per capita real final demand for each mainland state is used as the primary predictor for freight bound for the capital city port in that state, and for coastal cargo discharged at that port. Outbound passenger data was available only at the national level. As such, per capita real final demand for Australia as a whole was used as the primary predictor for temporary departures of Australian passengers. Australian final demand was also used as the predictor for inbound freight for ports other than the five mainland capital city ports (referred to collectively as 'other ports').

It is clear that in reality a vast multitude of factors influence maritime industry activity. However, explicitly including all of these factors in a statistical model is impractical. Instead, it is assumed that many of the underlying factors that drive maritime industry activity are the same as those that drive changes in GDP or final demand, and that there is sufficient similarity between these two sets of relationships that one can be used to predict the other. The extent to which this assumption holds true can be informally tested by examining various model diagnostics obtained from statistical software used to fit the models. The most straightforward of these is a simple numerical measure of model fit. For the models used this is the 'residual log-likelihood', which is a measure of the amount of variation in the response variable remaining after that which is explained by the model is removed.

The models used to forecast freight and passenger movements are linear mixed models[18], an extension of standard linear regression models. These models estimate a number of parameters in addition to those reported in the previous chapters. These are of two general forms. The first is additional intercept terms for subsets of the data which define the bases which the models use when forecasting increases or decreases in the response variable using the estimated elasticities. The second is autoregressive covariance parameters designed to capture some of the effect of unmodelled time-dependent covariates. These are not reported because their interpretation is of little practical use. While the presence of these additional parameters affects the forecasts, it does not substantially change the interpretation of the reported elasticity estimates.

18 See Littell et al (1996)

As shown in Table A.1, for all models except the outbound passengers model the inclusion of the additional autoregressive covariance parameters substantially improves the residual log-likelihood (a measure of model fit shown here in lower-is-better form). A likelihood ratio chi-square test on the outbound passenger model shows that the improvement from the addition of these parameters is marginal (P = 0.0881). It was decided to retain them despite this, but there are valid arguments for their removal. However, as there are no random effects in the outbound passenger model, doing this would reduce the outbound passenger model to a standard linear regression (see model methodology below).

The residual likelihood is a relative rather than an absolute measure because it is a function of both the data and the effects included in the model. As such, the statistics in Table A.1 should only be used to compare different parameterisations of the same model (e.g. outbound container). It would not generally be useful to compare goodness-of-fit statistics between the outbound container and inbound container models, for instance. In this way it is somewhat different to the analogous measure for standard linear regression, R^2.

TA.1 Goodness-of-fit statistics

Model	Model including fixed effects only	Model including fixed and random effects	Full model including all covariance parameters
	(–2 times residual log-likelihood)		
Outbound container	5511.9	3152.4	1522.9
Outbound non-container	5379.0	3702.5	2600.9
Inbound container	619.6	146.5	33.1
Inbound non-container	245.6	44.7	0.5
Outbound passenger	20.4	20.4	17.5
Inbound passenger	945.9	524.6	479.5

Source: BITRE modelling.

Input data

All models use the same basic set of variables: An independent variable (GRP or final demand), a dependant variable (freight or passenger numbers), and financial year. All freight data are disaggregated by Australian port (grouping non-mainland capital ports into 'other ports'), and exports are further disaggregated by destination region. Inbound passenger data are disaggregated only by origin region, and outbound passengers are not disaggregated at all. Nominal (unordered) categorical variables are used to represent Australian port and origin/destination region, from which the model-fitting algorithm creates a number of indicator (zero/one) variables. Financial year is also a categorical variable, but the models take advantage of the ordering of years to estimate time dependent parameters.

Freight, passenger, GRP, and final demand variables used are all per capita. This is intended to remove any time dependence related to changes in population. These variables are then log-transformed, as this produces much better fitting models and also allows coefficients to be interpreted as elasticities.

The datasets used to fit outbound freight models contain 78 observations per financial year: One observation per Australian port per destination region. Each of these observations contains GRP for that destination region for a particular financial year, and the freight movement figure for a particular Australian port to that destination region for that financial year.

The datasets used to fit inbound freight models contain one observation per financial year per Australian port, or six observations per financial year. Each observation contains the freight movement figure for a particular Australian port for that financial year, and a demand measure for the Australian state in which that port resides (or Australia as a whole for 'other ports'). This differs from the models used in Lubulwa et al (2009) in that no price measure is included.

The dataset used to fit the inbound passenger model contains one observation per financial year per origin region, or 12 observations per financial year. Each observation contains total inbound passengers from a particular origin region, and GRP for the corresponding destination region for that financial year. The outbound passenger model was fit using a dataset with a single observation per financial year, containing the total outbound passengers and Australian real final demand for that year. It is worth noting that the origin regions used for inbound passengers and the destination regions used for outbound freight and GRP differ slightly due to limitations of the passenger data.

Dependent variables

The natural logarithm of annual freight movement measured in twenty-foot equivalent units (TEU) or tonnes per capita of destination is the dependent (response) variable in each of the freight models presented in this paper. Passenger models use the natural logarithm of the number of passengers per capita of origin as the dependent variable.

Non-containerised international imports and exports are obtained from ABS (2009a). This is data originally collected by the Australian Customs Service. Quarterly historical imports and exports data from 1994 quarter 3 to 2008 quarter 2 are used, comprising approximately 15.8 million unit records. These are aggregated by financial year and by Australian port, and for exports also by destination region. Non-liner cargo is used as a proxy for non-containerised cargo, as there is no element in the source data that can be used to distinguish non-containerised from containerised cargo. This is an approximation. However, while there are measurable quantities of containerised cargo moved on non-liner vessels, these constitute a negligible proportion of total non-liner cargo by weight.

Australian coastal freight data used is as published in BITRE (2009b), and previous editions. This data is collected by BITRE directly from various port authorities. In tonnage terms, containerised and non-containerised cargo can be distinguished in this data.

Data used for total inbound and outbound TEU by port is obtained from Ports Australia (2009). From this total, outbound (loaded) coastal container figures provided by port authorities[19] are subtracted to obtain total international exported containers for each mainland capital city port. These total exports are then apportioned amongst the 12 trading regions for each year according to the proportion of the total combined weight of liner cargo shipped to each destination in that year, according to ABS (2009a). As sufficiently long time series of coastal TEU figures were not available for all five ports some older data were imputed. The coastal/ international split for other ports was calculated based on the ratio of the tonnage of coastal and international containerised freight.

Data used for inbound and outbound seaborne passenger numbers is from ABS (2009b). This is based on overseas arrivals and departures data published by ABS under catalogue number 3401.0. This data is not available by Australian port, so the passenger models are unable to forecast passenger movements by port. Additionally, there are some differences in the grouping of countries between sources which may cause passengers from some countries counted as Africa for GRP purposes to be included in Middle East passenger numbers instead. Likewise, some passengers from countries counted as North and Central American for GRP purposes may have been included in South America. As the countries for which this may have occurred contribute only small numbers to overall passenger movements for these regions this is not expected to have a major impact.

Independent variables

The independent (explanatory) variable used for the inbound freight and outbound passenger models is the natural logarithm of state real final demand per capita for Australia, from Access Economics (2009).

In the two outbound freight models and the inbound passenger model, countries are grouped into 12 destination regions.[20] For each of these, the population and real GDP of each of the countries in the region are used to calculate per capita Gross Regional Product (GRP). Historical and forecast foreign GDP and population are obtained from IMF (2009).

The sources used include forecasts of varying lengths; in order to be able to produce forecasts of the dependent variables to 2029–30 the existing forecasts of independent variables were projected beyond the end of their forecast periods based on an assumption of constant growth rates in subsequent years.

19 Flinders Ports (2010), Fremantle Ports (2010), Port of Brisbane (2010), Port of Melboune (2010), Sydney Ports (2010), Tasports (2010).

20 See Appendix B for details.

Model methodology

The models use the linear mixed model methodology.[21] This generalisation of standard linear regression relaxes some of the assumptions and introduces additional parameters which allow the observed covariance between observations to be modelled explicitly. For example, total annual exports from Brisbane to South East Asia in a particular year are related to exports from Brisbane to South East Asia in other years in ways which are not accounted for by changes in South East Asia's GRP alone. The mixed model framework allows the covariance between all Brisbane–South East Asia observations to be explicitly estimated and incorporated into the forecasts, giving more robust results.

The general form of model equations for all the models, expressed using matrix notation, is:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}\boldsymbol{\Upsilon} + \boldsymbol{\varepsilon}$$

where:

$\mathbf{y}$ is a vector containing the response variable;

$\mathbf{X}$ is a matrix whose columns contain the variables associated with the fixed-effects part of the model—an intercept term and the explanatory variables in the demand equation;

$\boldsymbol{\beta}$ is a vector of fixed-effect parameters to be estimated—the intercept and explanatory variable coefficients (elasticities);

$\mathbf{Z}$ is a matrix whose columns contain the variables associated with the random-effects part of the model;

$\boldsymbol{\Upsilon}$ is a vector of random-effect parameters to be estimated—coefficients of the random-effects variables in the $\mathbf{Z}$ matrix; and

$\boldsymbol{\varepsilon}$ is a vector of random errors (residuals).

The $\boldsymbol{\varepsilon}$ are assumed to be normally distributed with zero mean. However, the standard linear model constraints of constant variance and zero covariance are relaxed. Instead, the variance-covariance matrix of $\boldsymbol{\varepsilon}$, denoted by $\mathbf{R}$, is assumed to have a particular structure. The parameters associated with that structure are then estimated.

The structure chosen for $\mathbf{R}$ in the freight models was a homogeneous 1st order autoregressive structure with blocks by destination. In this structure pairs of residuals associated with observations in adjacent time periods have covariance ρ, and those for observations in non-adjacent time periods have covariance ρ^{1+n} where n is the number of intervening observations. Residuals for observations for different destinations have zero covariance. $\mathbf{R}$ therefore has two parameters to be estimated: The covariance parameter ρ and a variance parameter σ_R^2. In the exports models, a separate pair of parameters was estimated for each origin (the five mainland capital city ports and 'other ports'). In the imports models, a separate pair of parameters was estimated for international imports and for inbound coastal freight.

The structure chosen for $\mathbf{R}$ in the seaborne passenger models was also a homogeneous 1st order autoregressive structure with blocks by passenger origin. For the outbound passenger model, this results in the residuals for all observations in the dataset being correlated, as all observations are treated as having the same origin.

21 See Littell et al. (1996).

The random effects parameters $\boldsymbol{\Upsilon}$ are also assumed to be normally distributed with mean zero. The values of $\boldsymbol{\Upsilon}$ are estimated during model fitting along with the parameters associated with $\mathbf{G}$, the variance-covariance matrix of $\boldsymbol{\Upsilon}$. Like $\mathbf{R}$, $\mathbf{G}$ is assumed to have a particular structure.

For all models except the outbound passenger model $\mathbf{G} = \sigma_G^2 \mathbf{1}$ where $\mathbf{1}$ is the identity matrix, and the single variance parameter σ_G^2 is estimated. This structure does not allow for any covariance in $\boldsymbol{\Upsilon}$. The imports models estimate a separate set random effects parameters $\boldsymbol{\Upsilon}$ for international imports and inbound coastal freight. This results in a separate variance parameter for each group, as with the $\mathbf{R}$ matrix. In contrast, the exports models use a homogeneous structure for $\mathbf{G}$ and estimates just one random-effects parameter per origin. As the outbound passenger model does not have a random effects component, there are no $\boldsymbol{\Upsilon}$ or $\mathbf{Z}$ in the model equation and hence no $\mathbf{G}$ matrix.

The matrix equation above does not have a general analytical solution so parameters are estimated using an approximate iterative process. The technique used was REML (restricted maximum likelihood), as implemented by the MIXED procedure in SAS. This algorithm attempts to choose the set of parameters ($\boldsymbol{\beta}, \boldsymbol{\Upsilon}, \sigma_R^2, \sigma_G^2$, and ρ) which are most likely given the observed data ($\boldsymbol{\Upsilon}$, $\mathbf{X}$, and $\mathbf{Z}$) and the constraints on $\boldsymbol{\varepsilon}$, $\boldsymbol{\Upsilon}$, $\mathbf{Z}$ and $\mathbf{G}$.

The general approach of UNESCAP (2001) was used to produce estimates of empty container movements, making use of the major directional movement for containers for each port. A consequence of this methodology is that growth in total container movements is closely tied to growth in full container movements in the major direction for each port, while changes in volumes moved in the minor direction have little effect on the total. In contrast to UNESCAP (2001), the proportion of major direction empty containers is set based on historical data and differs between ports, rather than assumed to be constant globally.

Estimates of future vessel activity are based on simple linear regression of historical freight vessel movements on historical and forecast freight movements, along with a number of assumptions regarding future non-freight vessel activity (including passenger vessels). No comprehensive analysis of historical vessel movements was undertaken. As such, the results should be treated as indicative only.

Model selection

The choice of models, including the preparation of the input data, the variables to include in the fixed- and random-effects parts of the models, and the covariance matrices was determined through examination of a number of alternative models. Candidate models were compared using the residual log-likelihood from the model fit, as well as more qualitative examinations of parameter estimates, standard errors, various model diagnostics, and forecasts produced by each model.

All models except outbound passengers group the data by the Australian port through which the freight or passengers pass. Data associated with the five mainland capital city ports (Adelaide, Brisbane, Fremantle, Melbourne, and Sydney) are identified separately, while data for all other Australian ports is aggregated and modeled together as 'other ports'.

There are a number of reasons for examining the capital city ports separately. Capacity is a much bigger issue for these ports than many others around Australia. Located as they are in urban areas, there is limited scope to expand their operations. This creates a specific need for detailed forecasts for these ports. Furthermore, with the exception of non-containerised exports, all five handle relatively large amounts of a broad range of commodities which provides sufficient data to attempt analysis by port. This also affects the volatility seen in historical data for these five ports, which is lower than for most other Australian ports, many of which specialise in particular commodities and are therefore affected by fluctuations in demand for those commodities which are not reflected in GRP or final demand figures.

Technical details

The SAS language was used to prepare and analyse the data for the freight and passenger models. The statements used to fit the models are shown in Box 1. Comments begin with an asterisk and are terminated with a semicolon, and keywords are shown in capitals. The statements used for the two exports models are identical, as are those for the two imports models. See Littell et al (1996) for more information on the MIXED procedure in SAS.

The variables, appearing in Box 1 in lower case, are defined as follows:

Variable	Description
`region`	Categorical variable representing destination region or origin region.
`port`	Categorical variable representing Australian port.
`coastal`	Categorical variable distinguishing imports from inbound coastal freight.
`freight`	Natural logarithm of freight volume (in TEU for containerised models and tonnes for non-containerised) per capita of destination state or region.
`passengers`	Natural logarithm of passengers per capita of origin state or region.
`grp`	Natural logarithm of per capita gross regional product of destination region.
`rfd`	Natural logarithm of per capita real final demand of destination state, or for the whole of Australia for imports to "other ports".

Box 1

```
* Statements to fit exports models;
PROC MIXED COVTEST;

    * Define classification variables (factors);
    CLASS region port;

    * Define fixed effects (y-vector and X-matrix);
    MODEL freight = port * grp / S;

    * Define random effects (Z- and G-matrices);
    RANDOM INTERCEPT / S TYPE=VC SUBJECT=region;

    * Define covariance structure (R-matrix);
    REPEATED / TYPE=AR(1) SUBJECT=region GROUP=port;

RUN;

* Statements to fit imports models;
PROC MIXED COVTEST;

    * Define classification variables (factors);
    CLASS coastal port;

    * Define fixed effects (y-vector and X-matrix);
    MODEL freight = rfd / S;

    * Define random effects (Z- and G-matrices);
    RANDOM INTERCEPT / S TYPE=VC SUBJECT=port;

    * Define covariance structure (R-matrix);
    REPEATED / TYPE=AR(1) SUBJECT=port GROUP=coastal;

RUN;

* Statements to fit inbound passenger model;
PROC MIXED COVTEST;

    * Define classification variables (factors);
    CLASS region;

    * Define fixed effects (y-vector and X-matrix);
    MODEL passengers = grp / S;

    * Define random effects (Z- and G-matrices);
    RANDOM INTERCEPT / S TYPE=VC SUBJECT=region;

    * Define covariance structure (R-matrix);
    REPEATED / TYPE=AR(1) SUBJECT=region;

RUN;

* Statements to fit outbound passenger model;
PROC MIXED COVTEST;

    * Define classification variables (factors);
    CLASS port; * Note: all observations have same value of
"port";

    * Define fixed effects (y-vector and X-matrix);
    MODEL passengers = rfd / S;

    * Define covariance structure (R-matrix);
    REPEATED / TYPE=AR(1) SUBJECT=port;

RUN;
```

APPENDIX B

Destination regions as at November 2009

Africa[22]

Algeria	Angola	Benin
Botswana	British Indian Ocean Territory	Burkina Faso
Burundi	Cameroon	Cape Verde
Central African Republic	Chad	Comoros
Congo, Democratic Republic of the	Congo, Republic of the	Côte d'Ivoire
Djibouti	Egypt	Equatorial Guinea
Eritrea	Ethiopia	Gabon
Gambia	Ghana	Guinea
Guinea-Bissau	Kenya	Lesotho
Liberia	Libya	Madagascar
Malawi	Mali	Mauritania
Mauritius	Morocco	Mozambique
Namibia	Niger	Nigeria
Réunion	Rwanda	Sao Tomé and Principe
Senegal	Seychelles	Sierra Leone
Somalia	South Africa	St. Helena
Sudan	Swaziland	Tanzania
Togo	Tunisia	Uganda
Western Sahara	Zimbabwe	

North and Central America[23]

Anguilla	Antigua and Barbuda	Bahamas
Barbados	Belize	Bermuda
Canada	Cayman Islands	Costa Rica
Cuba	Dominica	Dominican Republic
El Salvador	French Antilles	Grenada
Guatemala	Haiti	Honduras
Jamaica	Johnston and Sand Island	Mexico
Midway Islands	Montserrat	Netherlands Antilles
Nicaragua	Panama	Panama Canal Zone

22 Due to limitations of the data used, some passenger arrivals from North African countries may be counted as being from Middle Eastern countries instead.

23 Due to limitations of the data used, some passenger arrivals from Central American countries may be counted as being from South American countries instead.

Puerto Rico
St. Kitts and Nevis
St. Lucia
St. Pierre and Miquelon
St. Vincent and Grenadines
Trinidad and Tobago
Turks and Caicos Islands
United States of America
Virgin Islands (British)
Virgin Islands (U.S.)

South America

Argentina
Bolivia
Brazil
Chile
Columbia
Ecuador
Falkland Islands
French Guiana
Guyana
Paraguay
Peru
Suriname
Uruguay
Venezuela

East Asia

China
Hong Kong (SAR of China)
Macau (SAR of China)
Mongolia
Taiwan

South East Asia

Brunei
Burma (Myanmar)
Cambodia
Indonesia
Laos
Malaysia
Philippines
Singapore
Thailand
Vietnam
Timor-Leste

South Asia

Afghanistan
Armenia
Azerbaijan
Bangladesh
Bhutan
Georgia
India
Kazakhstan
Kyrgystan
Maldives
Nepal
Pakistan
Sri Lanka
Tajikistan
Turkmenistan
Uzbekistan

Japan

Japan

Korea

Korea, Democratic People's Republic of
Korea, Republic of

Europe

Albania
Austria
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Gibraltar
Greece
Hungary
Iceland
Ireland
Italy
Kosovo
Latvia
Lithuania
Macedonia
Malta
Moldova
Montenegro
Netherlands
Norway
Poland
Portugal
Romania
Russian Federation
Serbia
Slovak Republic
Slovenia
Spain
Sweden
Switzerland
Ukraine
United Kingdom

Middle East

Bahrain
Iran
Iraq
Israel
Jordan
Kuwait
Lebanon
Oman
Palestine
Qatar
Saudi Arabia
Syria
Turkey
United Arab Emirates
Yemen

New Zealand

New Zealand

Pacific Islands and PNG

American Samoa
Australian Antarctic Territory
Cook Islands
Fiji
French Polynesia
French South Antarctic Territory
Guam
Kiribati
Marshall Islands
Micronesia
Nauru
New Caledonia
Niue
Norfolk Island
Northern Mariana Islands
Palau
Papua New Guinea
Pitcairn Island
Ross Dependency
Samoa
Solomon Islands
Tokelau
Tonga
Tuvalu
Vanuatu
Wake Island
Wallis and Futuna Islands

Australia

Australia

APPENDIX C
Tabulated forecasts

TC.1 Containerised exports by port of origin

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	35 631	108 520	81 110	300 371	218 976	58 135	802 743
1996–97	45 395	120 093	81 738	327 714	232 689	70 884	878 514
1997–98	48 866	132 181	91 254	335 151	251 393	78 812	937 657
1998–99	53 100	150 778	100 949	354 869	262 784	83 088	1 005 568
1999–00	54 535	167 795	107 981	402 877	295 559	109 167	1 137 914
2000–01	62 661	184 339	119 745	426 168	305 880	59 943	1 158 736
2001–02	69 572	187 084	128 880	447 464	304 173	166 081	1 303 254
2002–03	70 118	179 359	129 560	441 268	272 173	129 646	1 222 124
2003–04	84 752	191 631	146 934	445 754	280 478	123 922	1 273 471
2004–05	78 741	217 704	154 305	499 018	293 033	154 655	1 397 455
2005–06	89 978	229 842	151 569	513 948	313 081	167 984	1 466 402
2006–07	95 871	233 842	161 177	534 168	320 015	107 900	1 452 973
2007–08	115 495	228 873	195 752	536 389	321 649	100 097	1 498 255
2008–09	88 914	234 795	175 081	561 387	335 962	98 565	1 494 705
2009–10	77 114	232 783	166 382	564 794	338 403	95 819	1 475 293
2010–11	74 811	241 543	170 977	597 423	356 596	98 900	1 540 249
2011–12	75 721	253 247	179 241	638 639	379 344	104 260	1 630 453
2012–13	78 254	266 879	189 295	685 801	405 552	111 134	1 736 914
2013–14	81 813	282 068	200 644	738 286	434 862	119 349	1 857 021
2014–15	85 989	298 430	212 823	794 933	466 513	128 588	1 987 276
2015–16	90 693	316 331	225 960	857 031	501 055	138 872	2 129 942
2016–17	95 870	335 886	240 112	925 157	538 771	150 173	2 285 969
2017–18	101 500	357 230	255 358	999 953	579 968	162 482	2 456 492
2018–19	107 587	380 509	271 788	1 082 135	624 991	175 808	2 642 817
2019–20	114 144	405 886	289 505	1 172 501	674 217	190 176	2 846 428
2020–21	121 197	433 542	308 621	1 271 939	728 066	205 627	3 068 992
2021–22	128 777	463 679	329 258	1 381 442	787 001	222 215	3 312 372
2022–23	136 924	496 517	351 552	1 502 114	851 538	240 009	3 578 653
2023–24	145 678	532 300	375 650	1 635 189	922 244	259 094	3 870 155
2024–25	155 087	571 299	401 714	1 782 044	999 751	279 566	4 189 461
2025–26	165 205	613 811	429 920	1 944 216	1 084 755	301 537	4 539 445
2026–27	176 088	660 164	460 462	2 123 423	1 178 032	325 135	4 923 303
2027–28	187 797	710 718	493 553	2 321 581	1 280 440	350 501	5 344 590
2028–29	200 403	765 871	529 425	2 540 834	1 392 929	377 793	5 807 255
2029–30	213 977	826 063	568 334	2 783 576	1 516 556	407 186	6 315 692
Average growth rate (per cent per annum)							
Actual historical	10.30	6.42	7.62	4.95	3.26	4.63	5.34
2007–08 to 2029–30	2.84	6.01	4.96	7.77	7.30	6.59	6.76
2007–08 to 2012–13	–7.49	3.12	–0.67	5.04	4.74	2.11	3.00
2012–13 to 2029–30	6.10	6.87	6.68	8.59	8.07	7.94	7.89

Source: ABS (2009a), BITRE (2008), BITRE modelling.

TC.2 Containerised imports by port of destination

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	15 436	75 216	71 228	323 808	347 237	9 139	842 064
1996–97	20 296	87 318	75 991	351 401	369 601	12 672	917 279
1997–98	28 572	110 680	90 597	382 657	405 096	19 581	1 037 183
1998–99	31 219	122 484	88 027	415 293	439 507	13 687	1 110 217
1999–00	28 342	150 828	89 235	482 061	520 424	20 815	1 291 705
2000–01	30 406	144 439	92 401	482 769	492 554	22 588	1 265 157
2001–02	32 550	163 106	110 078	506 368	506 271	53 369	1 371 743
2002–03	32 703	206 988	134 437	585 441	583 686	21 165	1 564 420
2003–04	33 225	239 408	151 051	658 632	638 142	23 847	1 744 304
2004–05	32 279	270 368	159 139	728 385	683 199	63 285	1 936 655
2005–06	38 147	298 865	161 454	750 643	717 733	48 149	2 014 991
2006–07	49 374	329 146	175 338	828 807	795 443	43 420	2 221 528
2007–08	63 040	366 826	195 948	922 781	880 458	33 349	2 462 402
2008–09	57 743	361 560	241 216	940 435	816 190	40 088	2 457 232
2009–10	57 046	333 957	263 097	937 660	789 361	42 693	2 423 814
2010–11	56 957	348 184	317 522	954 852	799 470	46 029	2 523 014
2011–12	56 391	359 679	340 376	958 450	821 100	47 795	2 583 791
2012–13	57 232	379 267	342 446	985 813	853 728	49 660	2 668 146
2013–14	60 299	415 204	337 383	1 053 934	915 015	52 868	2 834 703
2014–15	61 906	437 460	340 427	1 091 781	950 005	54 801	2 936 380
2015–16	62 238	446 610	342 590	1 101 175	961 749	55 469	2 969 830
2016–17	63 382	464 133	354 396	1 130 367	988 370	57 140	3 057 789
2017–18	66 178	498 175	381 461	1 191 815	1 043 548	60 596	3 241 771
2018–19	68 305	525 396	404 050	1 238 236	1 086 280	63 310	3 385 578
2019–20	69 038	539 582	415 717	1 257 199	1 104 837	64 587	3 450 960
2020–21	72 235	556 871	429 446	1 308 527	1 153 776	67 160	3 588 014
2021–22	75 596	575 003	443 833	1 362 342	1 205 132	69 855	3 731 761
2022–23	79 132	594 018	458 918	1 418 784	1 259 062	72 682	3 882 595
2023–24	82 852	613 941	474 729	1 477 972	1 315 690	75 645	4 040 830
2024–25	86 768	634 826	491 308	1 540 075	1 375 186	78 753	4 206 917
2025–26	90 892	656 728	508 698	1 605 278	1 437 733	82 015	4 381 344
2026–27	95 239	679 703	526 943	1 673 774	1 503 523	85 441	4 564 622
2027–28	99 823	703 823	546 100	1 745 801	1 572 795	89 041	4 757 382
2028–29	104 660	729 155	566 218	1 821 576	1 645 768	92 826	4 960 204
2029–30	109 768	755 765	587 351	1 901 333	1 722 683	96 809	5 173 708
Average growth rate (per cent per annum)							
Actual historical	12.44	14.12	8.80	9.12	8.06	11.39	9.35
2007–08 to 2029–30	2.55	3.34	5.12	3.34	3.10	4.96	3.43
2007–08 to 2012–13	–1.91	0.67	11.81	1.33	–0.61	8.29	1.62
2012–13 to 2029–30	3.91	4.14	3.22	3.94	4.22	4.00	3.97

Source: ABS (2009a), BITRE modelling.

TC.3 Coastal container movements by port of destination

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	3 859	1 145	12 721	71 287	1 733	36 846	127 591
1996–97	5 074	1 330	13 945	81 044	1 864	33 774	137 031
1997–98	7 143	1 685	18 617	81 928	2 019	40 778	152 171
1998–99	7 805	1 865	23 705	81 792	2 225	41 168	158 560
1999–00	7 085	2 297	34 156	92 596	2 590	108 618	247 342
2000–01	7 602	1 479	44 130	91 975	2 458	106 168	253 812
2001–02	8 138	2 913	45 586	99 941	2 536	85 229	244 343
2002–03	8 176	4 994	51 649	112 538	2 810	135 263	315 430
2003–04	8 306	13 599	57 292	118 907	4 876	157 847	360 828
2004–05	8 070	16 864	50 572	125 088	4 147	138 345	343 086
2005–06	9 537	10 640	44 313	122 023	2 861	131 207	320 581
2006–07	12 344	16 941	59 556	119 975	4 392	163 269	376 477
2007–08	15 760	25 517	59 765	127 791	7 041	125 668	361 542
2008–09	16 160	25 895	61 837	128 287	7 368	131 528	371 075
2009–10	16 718	24 361	62 670	126 503	7 627	133 156	371 035
2010–11	17 007	25 752	73 235	127 624	8 087	141 463	393 169
2011–12	16 965	26 920	77 314	127 011	8 616	146 884	403 710
2012–13	17 267	28 701	77 139	129 570	9 255	153 519	415 452
2013–14	18 211	31 754	75 587	137 422	10 229	164 795	437 997
2014–15	18 700	33 802	75 947	141 246	10 940	172 390	453 025
2015–16	18 798	34 860	76 148	141 366	11 402	176 148	458 722
2016–17	19 139	36 591	78 500	144 014	12 057	183 188	473 489
2017–18	19 978	39 663	84 213	150 707	13 094	196 108	503 763
2018–19	20 614	42 237	88 910	155 422	14 014	206 819	528 016
2019–20	20 829	43 795	91 185	156 653	14 650	212 947	540 058
2020–21	21 786	45 627	93 899	161 877	15 718	223 457	562 365
2021–22	22 793	47 554	96 744	167 339	16 862	234 528	585 820
2022–23	23 852	49 580	99 725	173 051	18 087	246 196	610 492
2023–24	24 966	51 711	102 849	179 025	19 399	258 491	636 440
2024–25	26 138	53 951	106 123	185 275	20 803	271 451	663 742
2025–26	27 373	56 308	109 555	191 819	22 308	285 120	692 483
2026–27	28 674	58 788	113 154	198 675	23 919	299 543	722 754
2027–28	30 046	61 401	116 931	205 866	25 646	314 773	754 663
2028–29	31 493	64 154	120 896	213 411	27 498	330 863	788 314
2029–30	33 021	67 056	125 057	221 332	29 483	347 866	823 814
Average growth rate (per cent per annum)							
Actual historical	12.44	29.52	13.76	4.98	12.39	10.77	9.07
2007–08 to 2029–30	3.42	4.49	3.41	2.53	6.73	4.74	3.81
2007–08 to 2012–13	1.84	2.38	5.24	0.28	5.62	4.08	2.82
2012–13 to 2029–30	3.89	5.12	2.88	3.20	7.05	4.93	4.11

Source: ABS (2009a), BITRE modelling.

TC.4 Total container throughput by port

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	69 355	249 439	202 680	923 303	704 276	170 470	2 319 523
1996–97	88 497	272 632	209 775	985 584	746 297	172 527	2 475 312
1997–98	107 912	317 568	251 594	1 046 863	820 765	204 615	2 749 317
1998–99	120 586	357 703	276 156	1 123 095	899 919	212 667	2 990 126
1999–00	115 506	414 449	299 756	1 289 459	1 036 622	387 270	3 543 062
2000–01	133 236	439 194	354 855	1 322 083	1 013 498	388 247	3 651 113
2001–02	145 226	465 359	383 676	1 423 078	1 029 255	488 947	3 935 541
2002–03	148 333	548 945	431 861	1 595 909	1 160 452	552 145	4 437 645
2003–04	169 108	621 380	464 274	1 721 395	1 270 143	605 459	4 851 759
2004–05	170 585	715 995	467 778	1 910 362	1 376 194	521 271	5 162 185
2005–06	189 391	742 756	456 032	1 929 988	1 445 064	524 607	5 287 838
2006–07	219 117	839 716	505 507	2 093 423	1 620 112	515 971	5 793 846
2007–08	280 121	899 984	582 674	2 256 640	1 778 366	481 170	6 278 955
2008–09	223 119	904 764	697 451	2 338 500	1 682 415	428 843	6 275 092
2009–10	194 549	836 724	749 726	2 328 522	1 628 136	428 884	6 166 541
2010–11	189 340	873 197	899 296	2 368 593	1 649 728	457 279	6 437 433
2011–12	191 905	902 766	961 280	2 375 125	1 694 995	474 807	6 600 878
2012–13	198 411	952 664	965 641	2 440 598	1 762 955	495 539	6 815 809
2013–14	207 463	1 043 712	950 415	2 606 836	1 890 145	530 866	7 229 437
2014–15	217 951	1 100 465	958 250	2 698 018	1 963 078	554 103	7 491 864
2015–16	229 668	1 124 302	963 690	2 718 835	1 988 014	564 897	7 589 406
2016–17	242 584	1 169 262	996 273	2 788 506	2 043 735	586 145	7 826 505
2017–18	256 689	1 255 928	1 071 709	2 937 607	2 158 573	626 083	8 306 590
2018–19	271 881	1 325 506	1 134 507	3 049 500	2 247 750	658 826	8 687 969
2019–20	288 171	1 362 270	1 166 592	3 093 685	2 286 957	676 888	8 874 564
2020–21	305 737	1 406 920	1 204 435	3 270 680	2 389 115	708 794	9 285 681
2021–22	324 608	1 453 761	1 244 091	3 517 757	2 496 367	742 371	9 778 955
2022–23	344 878	1 502 895	1 285 669	3 789 502	2 609 041	777 721	10 309 706
2023–24	366 652	1 554 394	1 329 248	4 088 617	2 727 403	814 933	10 881 247
2024–25	390 048	1 608 395	1 374 938	4 418 123	2 851 814	854 124	11 497 441
2025–26	415 195	1 665 042	1 422 858	4 781 391	2 982 661	895 418	12 162 565
2026–27	442 234	1 724 484	1 473 130	5 182 186	3 120 354	938 948	12 881 335
2027–28	471 319	1 786 911	1 525 911	5 624 714	3 265 394	984 874	13 659 123
2028–29	502 619	1 852 492	1 581 334	6 113 673	3 418 252	1 033 348	14 501 717
2029–30	536 315	1 958 283	1 639 546	6 654 312	3 579 432	1 084 531	15 452 419
Average growth rate (per cent per annum)							
Actual historical	12.34	11.29	9.20	7.73	8.02	9.03	8.65
2007–08 to 2029–30	3.00	3.60	4.81	5.04	3.23	3.76	4.18
2007–08 to 2012–13	–6.67	1.14	10.63	1.58	–0.17	0.59	1.65
2012–13 to 2029–30	6.02	4.33	3.16	6.08	4.25	4.72	4.93

Source: ABS (2009a), BITRE modelling.
Note: Includes empty containers.

TC.5 Non-containerised exports by port of origin

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	1 420 647	5 719 632	8 056 807	1 822 833	922 911	341485108	359427938
1996–97	1 855 199	6 480 068	8 005 878	2 376 918	999 592	368636904	388354559
1997–98	1 290 067	5 613 058	9 461 514	2 326 961	826 637	390565953	410084190
1998–99	1 776 130	5 322 337	8 960 521	2 065 840	449 687	394105473	412679987
1999–00	1 932 500	6 017 329	9 269 146	2 232 327	738 137	422174757	442364196
2000–01	2 422 978	6 293 967	8 576 395	3 046 012	1 027 699	453994345	475361396
2001–02	2 810 287	7 479 442	7 349 875	3 332 473	576 975	459145708	480694760
2002–03	2 310 161	6 343 126	7 311 907	1 861 610	572 172	490962299	509361276
2003–04	2 041 559	5 589 575	8 687 181	2 317 505	631 803	518065550	537333171
2004–05	2 178 468	5 996 356	9 321 525	2 219 435	796 056	559338074	579849913
2005–06	2 323 581	6 578 799	9 707 432	1 419 406	877 321	573974431	594880970
2006–07	1 815 569	6 740 237	8 089 650	2 837 135	1 631 119	617022913	638136622
2007–08	1 285 745	8 292 043	7 121 875	2 251 066	1 608 982	664037453	684597164
2008–09	1 216 222	4 993 293	6 736 948	2 011 412	1 094 533	676062814	692115222
2009–10	1 206 335	4 694 137	6 712 945	1 983 975	877 378	674317859	689792628
2010–11	1 228 812	4 702 188	6 885 838	2 005 619	770 028	692247115	707839599
2011–12	1 264 122	4 756 857	7 092 018	2 033 111	712 572	714619539	730478219
2012–13	1 303 321	4 821 172	7 287 924	2 059 695	680 592	738340569	754493274
2013–14	1 340 820	4 885 384	7 461 137	2 083 704	662 156	762639505	779072706
2014–15	1 375 747	4 949 667	7 613 826	2 106 783	652 061	787164983	803863068
2015–16	1 407 653	5 015 417	7 753 978	2 129 831	647 113	812799753	829753747
2016–17	1 436 560	5 082 620	7 886 340	2 153 096	645 413	839601210	856805239
2017–18	1 462 800	5 151 302	8 014 516	2 176 703	645 809	867629872	885081001
2018–19	1 486 814	5 221 499	8 141 030	2 200 716	647 582	896949561	914647201
2019–20	1 509 051	5 293 250	8 267 577	2 225 172	650 275	927627585	945572910
2020–21	1 529 921	5 366 594	8 395 277	2 250 092	653 597	959734937	977930418
2021–22	1 549 774	5 441 576	8 524 871	2 275 493	657 359	993346496	1011795569
2022–23	1 568 902	5 518 238	8 656 858	2 301 390	661 437	1028541252	1047248076
2023–24	1 587 540	5 596 625	8 791 581	2 327 796	665 752	1065402534	1084371828
2024–25	1 605 876	5 676 784	8 929 292	2 354 724	670 254	1104018255	1123255186
2025–26	1 624 060	5 758 766	9 070 183	2 382 188	674 910	1144481172	1163991279
2026–27	1 642 209	5 842 619	9 214 414	2 410 203	679 699	1186889156	1206678301
2027–28	1 660 417	5 928 399	9 362 124	2 438 784	684 609	1231345485	1251419819
2028–29	1 678 758	6 016 160	9 513 443	2 467 946	689 633	1277959151	1298325091
2029–30	1 697 290	6 105 960	9 668 496	2 497 706	694 768	1326845179	1347509400
Average growth rate (per cent per annum)							
Actual historical	–0.83	3.14	–1.02	1.77	4.74	5.70	5.52
2007–08 to 2029–30	1.27	–1.38	1.40	0.47	–3.75	3.20	3.13
2007–08 to 2012–13	0.27	–10.28	0.46	–1.76	–15.81	2.14	1.96
2012–13 to 2029–30	1.57	1.40	1.68	1.14	0.12	3.51	3.47

Source: ABS (2009a), BITRE (2008), BITRE modelling.
Note: Due to the volatility and relative thinness of historical export volumes for the five capital city ports, forecasts for these ports are subject to substantial uncertainty.

TC.6 Non-containerised imports by port of destination

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	661 887	6 269 527	5 259 901	2 647 620	7 201 151	15769455	37809541
1996–97	360 168	5 983 367	6 323 672	2 913 790	6 380 633	17786224	39747853
1997–98	664 193	6 473 365	5 898 204	2 305 603	5 704 115	18949626	39995106
1998–99	1 319 974	7 031 658	6 487 164	4 065 129	7 463 297	17735525	44102747
1999–00	1 829 929	7 397 995	5 852 718	3 377 385	6 443 559	18182321	43083909
2000–01	477 691	6 814 219	4 595 234	2 733 334	7 678 596	20392383	42691456
2001–02	443 000	6 533 159	5 852 384	2 513 900	7 503 920	21178570	44024933
2002–03	376 815	7 516 424	6 420 800	3 396 446	7 025 055	21580828	46316368
2003–04	1 361 079	7 491 535	6 668 691	3 251 311	7 730 241	19704118	46206975
2004–05	1 442 602	7 881 489	7 071 768	3 757 336	7 795 910	21457314	49406418
2005–06	1 652 043	7 886 641	6 718 909	4 342 712	8 836 980	22002831	51440115
2006–07	1 777 049	9 287 124	7 574 117	6 443 908	10 820 337	21672359	57574894
2007–08	1 815 777	9 661 466	8 373 966	6 745 770	11 130 229	23805827	61533035
2008–09	1 486 724	9 793 653	8 468 665	5 702 046	10 167 093	24746368	60364548
2009–10	1 350 053	9 732 761	8 572 072	5 223 501	9 717 539	25266872	59862799
2010–11	1 287 020	10 003 682	9 062 476	5 038 535	9 594 852	26033507	61020072
2011–12	1 254 874	10 251 971	9 326 733	4 958 519	9 615 952	26585844	61993894
2012–13	1 248 947	10 564 672	9 454 560	4 976 073	9 728 814	27163560	63136626
2013–14	1 265 447	11 000 143	9 538 408	5 082 100	9 960 209	27942601	64788908
2014–15	1 277 793	11 327 669	9 692 022	5 162 162	10 123 613	28522660	66105918
2015–16	1 285 286	11 558 943	9 841 521	5 213 321	10 225 946	28914430	67039448
2016–17	1 298 930	11 851 566	10 070 621	5 295 924	10 377 941	29452445	68347427
2017–18	1 322 677	12 259 843	10 419 605	5 422 827	10 614 919	30242150	70282023
2018–19	1 342 788	12 616 241	10 729 805	5 530 574	10 814 557	30917910	71951874
2019–20	1 355 268	12 882 817	10 956 607	5 604 034	10 945 875	31391739	73136339
2020–21	1 381 272	13 169 935	11 198 459	5 718 062	11 161 079	32040175	74668983
2021–22	1 407 779	13 462 013	11 444 555	5 834 292	11 380 275	32699758	76228672
2022–23	1 434 759	13 759 126	11 694 901	5 952 644	11 603 352	33370619	77815401
2023–24	1 462 205	14 061 426	11 949 581	6 073 108	11 830 332	34053061	79429713
2024–25	1 490 109	14 368 951	12 208 629	6 195 664	12 061 191	34747159	81071703
2025–26	1 518 468	14 681 738	12 472 082	6 320 301	12 295 919	35452971	82741479
2026–27	1 547 281	14 999 837	12 739 982	6 447 017	12 534 515	36170564	84439195
2027–28	1 576 540	15 323 232	13 012 324	6 575 790	12 776 930	36899857	86164672
2028–29	1 606 246	15 651 971	13 289 158	6 706 627	13 023 172	37640921	87918096
2029–30	1 636 399	15 986 104	13 570 532	6 839 535	13 273 248	38393823	89699641
Average growth rate (per cent per annum)							
Actual historical	8.77	3.67	3.95	8.11	3.70	3.49	4.14
2007–08 to 2029–30	–0.47	2.32	2.22	0.06	0.80	2.20	1.73
2007–08 to 2012–13	–7.21	1.80	2.46	–5.90	–2.66	2.67	0.52
2012–13 to 2029–30	1.60	2.47	2.15	1.89	1.84	2.06	2.09

Source: ABS (2009a), BITRE modelling.
Note: Due to the volatility of historical import volumes for Adelaide, Melbourne and Sydney, forecasts for these ports are subject to substantial uncertainty.

TC.7 Coastal non-containerised freight by port of destination

Financial year	Adelaide	Brisbane	Fremantle	Melbourne	Sydney	Other ports	Total
				(TEU)			
1995–96	1 596 677	2 159 112	2 145 912	3 628 504	5 068 190	31 210 432	45 808 827
1996–97	1 923 008	2 555 730	2 476 988	2 638 820	5 679 757	31 797 814	47 072 117
1997–98	2 843 016	3 531 072	2 079 929	3 386 078	6 081 813	33 598 336	51 520 244
1998–99	1 569 529	2 619 035	1 347 107	2 694 773	3 675 948	33 090 628	44 997 020
1999–00	2 036 003	3 116 632	1 746 036	2 774 706	5 648 328	30 790 380	46 112 085
2000–01	2 205 359	2 897 522	2 966 555	3 255 454	5 677 526	31 082 698	48 085 114
2001–02	2 245 762	3 264 350	2 498 576	3 668 933	5 370 785	33 117 881	50 166 287
2002–03	2 514 199	3 622 459	2 666 120	3 618 262	5 852 934	30 949 521	49 223 496
2003–04	2 847 917	2 844 543	2 645 216	4 050 907	5 893 627	31 259 767	49 541 977
2004–05	3 094 087	2 794 259	2 032 106	3 540 594	5 378 767	31 863 200	48 703 013
2005–06	4 073 562	3 530 974	2 079 471	3 498 560	5 054 584	32 664 492	50 901 643
2006–07	5 156 375	3 993 968	2 591 725	3 984 002	6 064 631	33 843 256	55 633 956
2007–08	5 739 241	3 575 185	2 820 677	3 489 308	4 134 381	34 864 451	54 623 243
2008–09	4 546 777	3 860 790	3 011 505	3 874 828	4 890 561	37 281 001	57 465 462
2009–10	3 993 949	3 982 595	3 144 777	4 124 527	5 412 777	38 752 454	59 411 078
2010–11	3 706 379	4 184 515	3 384 938	4 321 979	5 809 787	40 378 356	61 785 954
2011–12	3 543 049	4 344 420	3 519 968	4 452 806	6 106 775	41 523 159	63 490 176
2012–13	3 478 186	4 511 386	3 589 702	4 583 713	6 349 330	42 608 107	65 120 423
2013–14	3 491 810	4 718 662	3 634 175	4 748 178	6 602 940	43 945 751	67 141 515
2014–15	3 504 690	4 872 178	3 700 185	4 861 309	6 772 016	44 930 259	68 640 636
2015–16	3 511 619	4 979 521	3 761 692	4 931 317	6 876 119	45 591 995	69 652 263
2016–17	3 540 203	5 110 357	3 851 907	5 021 965	6 999 327	46 467 892	70 991 651
2017–18	3 599 385	5 289 329	3 986 990	5 149 546	7 171 633	47 730 946	72 927 829
2018–19	3 650 622	5 444 872	4 106 649	5 256 048	7 313 901	48 808 047	74 580 139
2019–20	3 682 380	5 560 996	4 194 031	5 328 269	7 407 066	49 562 497	75 735 240
2020–21	3 751 677	5 685 585	4 286 954	5 438 086	7 555 282	50 590 228	77 307 811
2021–22	3 822 826	5 812 071	4 381 371	5 549 441	7 705 203	51 634 104	78 905 016
2022–23	3 895 566	5 940 585	4 477 336	5 662 490	7 857 159	52 694 897	80 528 033
2023–24	3 969 762	6 071 249	4 574 914	5 777 361	8 011 405	53 773 431	82 178 123
2024–25	4 045 320	6 204 115	4 674 136	5 894 113	8 168 068	54 870 036	83 855 789
2025–26	4 122 186	6 339 221	4 775 027	6 012 780	8 327 226	55 984 936	85 561 377
2026–27	4 200 328	6 476 600	4 877 611	6 133 388	8 488 929	57 118 314	87 295 170
2027–28	4 279 711	6 616 254	4 981 889	6 255 930	8 653 173	58 270 093	89 057 051
2028–29	4 360 325	6 758 209	5 087 884	6 380 423	8 819 983	59 440 413	90 847 237
2029–30	4 442 161	6 902 488	5 195 614	6 506 879	8 989 372	60 629 399	92 665 913
Average growth rate (per cent per annum)							
Actual historical	11.25	4.29	2.30	–0.33	–1.68	0.93	1.48
2007–08 to 2029–30	–1.16	3.04	2.82	2.87	3.59	2.55	2.43
2007–08 to 2012–13	–9.53	4.76	4.94	5.61	8.96	4.09	3.58
2012–13 to 2029–30	1.45	2.53	2.20	2.08	2.07	2.10	2.10

Source: ABS (2009a), BITRE modelling.

TC.8 Temporary arrivals and departures by sea

Financial year	Arrivals	Departures	Total
		(persons)	
1995–96	14 322	6 434	20 756
1996–97	13 404	3 794	17 198
1997–98	20 324	3 739	24 063
1998–99	29 885	11 614	41 499
1999–00	25 051	12 924	37 975
2000–01	29 453	15 848	45 301
2001–02	23 544	7 065	30 609
2002–03	14 957	4 393	19 350
2003–04	14 852	7 586	22 438
2004–05	14 356	5 424	19 780
2005–06	16 700	8 820	25 520
2006–07	20 735	7 811	28 546
2007–08	28 256	8 238	36 494
2008–09	28 161	18 680	46 841
2009–10	22 507	14 672	37 179
2010–11	20 478	13 546	34 024
2011–12	19 743	13 109	32 852
2012–13	19 550	13 119	32 669
2013–14	19 610	13 544	33 154
2014–15	19 787	13 843	33 631
2015–16	20 036	13 980	34 016
2016–17	20 325	14 300	34 625
2017–18	20 638	14 915	35 553
2018–19	20 967	15 412	36 379
2019–20	21 307	15 684	36 991
2020–21	21 658	16 158	37 816
2021–22	22 017	16 650	38 667
2022–23	22 384	17 159	39 543
2023–24	22 760	17 685	40 445
2024–25	23 144	18 230	41 374
2025–26	23 536	18 794	42 331
2026–27	23 937	19 378	43 316
2027–28	24 347	19 984	44 331
2028–29	24 765	20 611	45 376
2029–30	25 193	21 261	46 454
Average growth rate (per cent per annum)			
Actual historical	5.83	2.08	4.81
2007–08 to 2029–30	–0.52	4.40	1.10
2008–09 to 2013–14	–7.10	9.75	–2.19
2013–14 to 2029–30	1.50	2.88	2.09

Source: ABS (2009b), LMIU (2009), BITRE modelling.
Note: Historical growth rates for temporary arrivals and departures includes figures from 1992–93 to 1994–95 not shown in table.

TC.9 Vessel activity at Australian ports

Financial year	Containership	Bulk carrier	General cargo	Non-freight	Total
			(port calls)		
1995–96	4 624	9 247	3 044	905	17 820
1996–97	5 527	10 488	3 472	904	20 391
1997–98	5 806	11 725	3 508	1 158	22 197
1998–99	5 419	11 880	3 445	1 139	21 883
1999–00	5 711	12 108	3 759	1 168	22 746
2000–01	5 507	12 184	3 599	1 148	22 438
2001–02	5 628	11 340	3 450	1 333	21 751
2002–03	5 934	11 805	3 692	2 056	23 487
2003–04	5 502	12 175	3 733	2 786	24 196
2004–05	5 969	12 973	3 721	3 439	26 102
2005–06	6 444	13 180	3 780	2 641	26 045
2006–07	6 755	13 668	3 660	2 242	26 325
2007–08	7 161	14 439	3 633	2 201	27 434
2008–09	6 408	14 884	3 269	2 143	26 704
2009–10	6 612	14 589	3 666	2 160	27 027
2010–11	6 713	14 850	3 679	2 180	27 421
2011–12	6 801	15 150	3 693	2 201	27 845
2012–13	6 914	15 468	3 708	2 225	28 315
2013–14	7 091	15 807	3 725	2 253	28 876
2014–15	7 231	16 136	3 741	2 278	29 386
2015–16	7 332	16 464	3 757	2 302	29 854
2016–17	7 479	16 816	3 774	2 329	30 398
2017–18	7 700	17 201	3 792	2 362	31 056
2018–19	7 903	17 593	3 811	2 394	31 702
2019–20	8 062	17 985	3 830	2 424	32 302
2020–21	8 281	18 405	3 851	2 459	32 996
2021–22	8 515	18 844	3 872	2 495	33 727
2022–23	8 768	19 301	3 894	2 534	34 497
2023–24	9 040	19 779	3 917	2 575	35 310
2024–25	9 332	20 277	3 941	2 617	36 168
2025–26	9 648	20 797	3 967	2 663	37 075
2026–27	9 989	21 341	3 993	2 711	38 034
2027–28	10 358	21 909	4 021	2 761	39 048
2028–29	10 756	22 502	4 049	2 815	40 123
2029–30	11 188	23 122	4 079	2 872	41 262
Average growth rate (per cent per annum)					
Actual historical	1.46	2.16	1.38	8.23	2.19
2007–08 to 2029–30	2.05	2.16	0.53	1.22	1.87
2008–09 to 2013–14	–0.70	1.39	0.41	0.21	0.63
2013–14 to 2029–30	2.87	2.39	0.56	1.51	2.24

Source: ABS (2009b), LMIU (2009), BITRE modelling.
Note: Historical growth rates for temporary arrivals and departures includes figures

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