

Interstate Freight in Australia, 1972–2005

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1 Introduction

There have been previous BTRE aggregate estimates and forecasts of interstate freight. Perry and Gargett (1998) made the first estimates. Later and updated estimates have recently been published by the Bureau (BTRE 2006, Chapter 5).

A start was made last year on disaggregate road interstate freight estimates – 56 State-to-State origin-destination (OD) time series (Gargett *et. al.* 2006).

This paper adds new disaggregate rail and coastal shipping State-to-State OD pair freight series and derives new OD pair interstate freight forecasts to 2030–31.

These estimates are important because capital city to capital city data has dried up, whereas annual interstate freight estimates can be derived from the Survey of Motor Vehicle Use (SMVU) (ABS 2007) for road, from rail companies for rail (BTRE 2007a), and from the BTRE for coastal shipping (BTRE 2007b).

2 Interstate road freight estimates

As detailed in an Australian Transport Research Forum (ATRF) paper last year (see Gargett *et. al.* 2006), a methodology has been developed to estimate new road freight origin destination (OD) matrices. Table 18 in the SMVU data cube gives what is termed a ‘State of registration to State of destination’ table. This is multiplied by a correction matrix (see Table 1), derived from a comparison of the SMVU Table 18 for 2001 with the ABS 2001 Freight Movement Survey (FMS) OD table. The result of the multiplication is an estimated interstate road freight OD matrix for the latest year of SMVU data.

For each of the 56 OD pairs, a regression is then re-run to interpolate between what are scattered interstate road freight estimates. The regressors used are truck tonnage series for the Hume and Eyre highways. The result is a series of 56 OD pair estimates of road freight flows (see Table 2 at the end of the paper).

Table 1 Correction table for SMVU data cube Table 18.

Origin	Destination							
	NSW	VIC	Qld	SA	WA	TAS	NT	ACT
NSW		3.56	3.78	4.01	6.79	0.00	6.79	4.53
VIC	0.70		1.51	1.08	0.97	0.00	1.00	1.48
QLD	0.93	2.89		1.78	2.00	0.00	1.27	1.00
SA	0.83	1.14	1.65		2.07	0.00	2.43	2.50
WA	2.00	4.49	2.87	2.40		0.00	4.25	1.00
TAS	0.00	0.00	0.00	0.00	0.00		0.00	0.00
NT	1.67	1.00	2.19	0.85	1.96	0.00		1.00
ACT	0.32	0.44	0.72	1.61	1.00	0.00	1.00	

Figure 1 shows an example from Victoria to New South Wales.

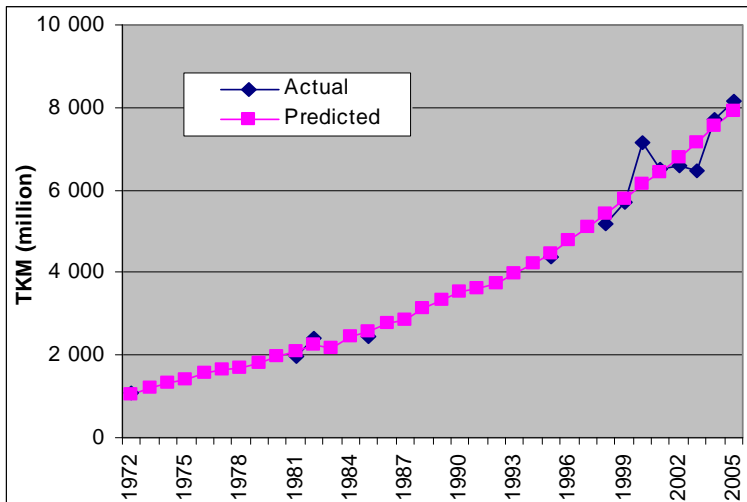


Figure 1 Interstate road freight data points and interpolation, Victoria to New South Wales.

3 Interstate rail forecasts

Many data sources were used to provide the base matrices of interstate rail freight for interpolation. The rail freight figures are for total interstate rail freight (inter-modal plus bulk).

These data sources included BTE (1976, 1979, 1983, 1985), FreightInfo™04 (and earlier), ABS (1982), ABS (1993 and earlier), ABS (1999 and earlier), ABS (2001) and BTRE (2007a). This latter publication has included interstate rail freight data for 2006 from the various rail systems, thus partially ending a rail data drought that has lasted since 2001.

The methodology for interpolation between data points was by straight lines. Judgement was often needed, as there were often multiple and sometimes conflicting data points. However, rail has a fair number of measured data points, which limits the interpolation task.

Figure 2 shows an example of the rail data points for the Victoria to Queensland route and the final series estimated (dotted line).

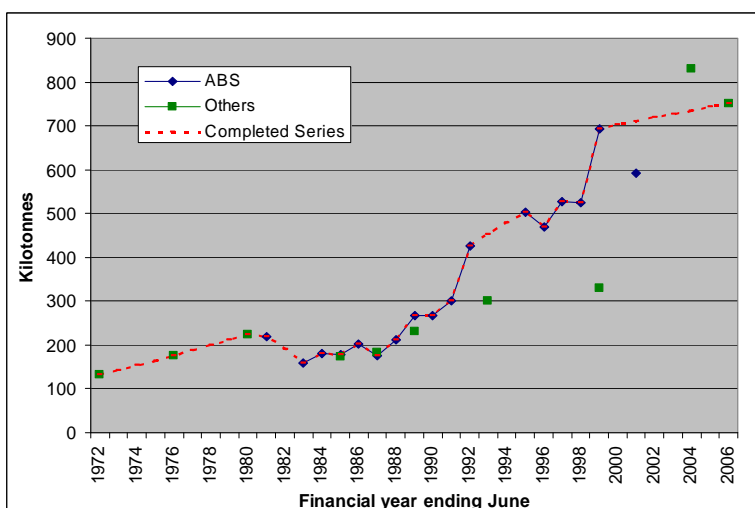


Figure 2 Interstate rail freight data points and interpolation, Victoria to Queensland. The result was a series of 56 OD pair estimates of State-to-State rail freight flows (see Table 2 at the end of the paper).

As can be seen from Figures 3 and 4, the assignment of our State-to-State estimates of interstate freight to the East-West and North-South Australian Rail Track Corporation (ARTC) routes, results in gross tonne-kilometre series that are similar to the ARTC series, which is available from 1999 onwards on the East-West corridor, and for 2005 and 2006 on the North-South corridor (ARTC 2007). Net tonne-kilometres in our estimates have been doubled to approximate gross tonne-kilometres. ARTC tonne-kilometre figures include some intrastate traffic, and so our estimates should be lower, but with the same trend — as they are.

4 Interstate shipping

Shipping data for most years is available from the BTRE’s Coastal Shipping databases (BTRE 2007 and earlier). Unlike road and rail, coastal shipping was defined to include only non-bulk freight, as shipping bulk freight is a very different animal from road and rail cargoes. Interpolation was only necessary in the early 1970s.

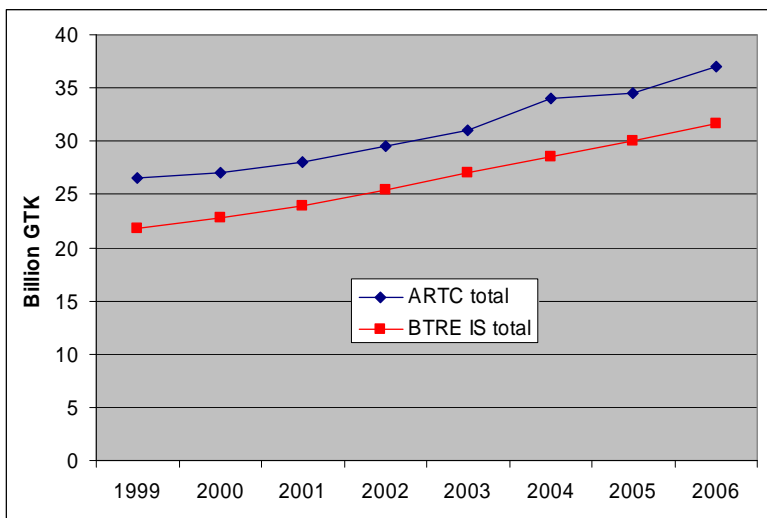


Figure 3 East-West rail gross tonne-kilometres, ARTC and current interstate rail freight estimates assigned.

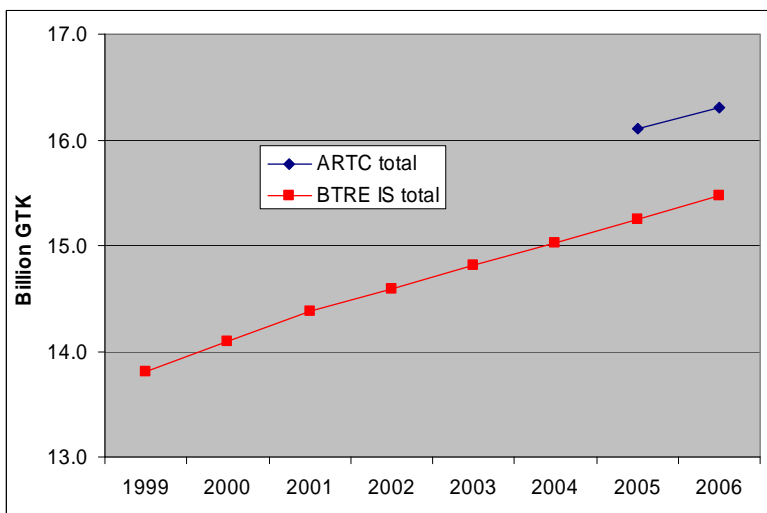


Figure 4 North-South rail gross tonne-kilometres, ARTC and current interstate rail freight estimates assigned.

5 Final interstate freight database

Table 2 sets out the tonnage estimates by mode for the 56 OD pairs.

Forecasts are also included in Table 2. There are two components of the forecasts – total freight on each of the 56 OD pairs, and the mode shares.

Table 3 gives the forecasting equations derived for total (all modes) freight on each route. Non-farm Gross Domestic Product (GDP) and change in GDP are the major explanators. Minor variables are a dummy for 1979 to 1988 (for delayed fuel price effects) and some route-specific dummies. The tonnage forecasts were made using Treasury's Intergenerational GDP forecasts (Treasury 2007). The average assumed GDP growth rate between 2005 and 2031 was 2.7 per cent per year. The assumed rates taper off over the years. One change has been made to the OD pair forecasts – that is, after 2010, the maximum income elasticity has been set to 1.9. Some of the ODs have huge elasticities and unless these are constrained they blow up the forecasts. Thus, to err on the side of the conservatism, we have constrained the huge elasticities. For example, Western Australia to South Australia has an income elasticity of 2.7442 (see Table 3). After 2010, this has been set to 1.90 in deriving the OD forecasts. If the OD elasticities are not constrained, the resulting aggregate interstate freight forecast would be 10 per cent higher.

Mode share forecasts were made using a logistic substitution methodology (BTRE 2006, p 66). Basically, the mode shares are projected forward using competitiveness indices based on past experience. These are business-as-usual forecasts, based as they are on historical trends alone.

Also shown in Table 2 are the route distances by mode. These have been derived from the 2001 Freight Movement Survey of the Australian Bureau of Statistics (ABS 2001, Cat. No. 9220.0, Table 4 divided by Table 3). When these are multiplied by the route kilotonnes, and the resulting tonne-kilometres summed over the routes, aggregate interstate tonne-kilometres by mode and total are derived. These are shown in Table 4.

Also shown in Table 4 are previous BTRE estimates of interstate freight derived from aggregate data on interstate freight (BTRE 2006, p 53). For example, the road figures were from SMVU estimates of total interstate road freight multiplied by 1.4 to allow for the interstate task done within the State of origin – something the SMVU does not define as interstate. For example, for road, freight tonne-kilometres of a shipment from Melbourne to Sydney, the SMVU would only record as interstate that portion of the task done on the Albury-Sydney leg. The 1.4 is a national-level adjustment of SMVU data to account for this fact. The two estimated series agree tolerably well given the differences in their methods of derivation and source datasets.

Table 4 also presents the forecast to 2031 derived from aggregating OD pair tonne-kilometre forecasts, and a forecast series for total interstate freight resulting from an aggregate regression. Table 5 gives the details of that equation. The income elasticity is 1.54, compared to an earlier BTRE income elasticity estimate for interstate freight of 1.4 (BTRE 2006, p 250).

Both the 'sum of routes' and 'aggregate' forecasts come to about the same result, with one reaching the level of the other only one year earlier by the end of the forecasts period (see Figure 5). Interstate freight is forecast to almost triple in 25 years. If one restricts the growth period to 20 years, then interstate freight is 2.5 times as great at the end of the period. This compares to the non-bulk freight category, which doubles over 20 years. But interstate has always been the fastest growing major freight category.

Table 3 Equations for individual routes.

Route	Years	Constant	GDP	Change GDP	dummy 1979-88	dummy 2	dummy 2 defined as:
NSW-VIC	72-05	-11.7957	1.5652	0.0070	-0.0477		
VIC-NSW	72-05	-12.5081	1.6169	-0.0048	0.0133	-0.0512	99-02=1.0; 03-05=1.5
NSW-QLD	72-05	-15.1392	1.7855	-0.0040	0.0315	-0.0619	00-01=1.0; 02-05=1.5
QLD-NSW	72-05	-19.0992	2.0691	-0.0088	0.0606	-0.0710	99-02=1.0; 03-04=1.5; 05=2.0
NSW-SA	72-96	-17.8669	1.8965	0.0053	-0.0199		
	97-05	-4.9436	0.9439	-0.0074			
SA-NSW	72-97	-16.3447	1.7775	-0.0006	0.0655		
	98-05	-9.4713	1.2554	-0.0038			
NSW-WA	72-94	-13.3063	1.4906	0.0222	-0.0842		
	95-05	-0.9469	0.5732	-0.0033		-0.1004	99=1.0
WA-NSW	72-05	-12.9706	1.4027	0.0205	-0.2184	0.1550	03-05=2.0
NSW-ACT	72-05	-7.2720	1.0813	0.0216	-0.1099	0.0972	01-05=1.0
ACT-NSW	72-00	-23.5102	2.2115	-0.0087	0.0757		
	01-05	-16.6531	1.7033	-0.0091			
NSW-NT	72-88	7.5113	-0.3115	0.0190	-0.1320		
	89-05	-15.7753	1.4696	0.0066			
NT-NSW	72-05	-14.5027	1.2847	0.0161	-0.1239		
NSW-TAS	72-05	set to 40					
TAS-NSW	72-05	set to 100					
VIC-QLD	72-05	-11.5187	1.4183	0.0152	-0.0533		
QLD-VIC	72-05	-28.4933	2.6591	0.0049	-0.0617	-0.0562	03-05=1.0
VIC-SA	72-05	-19.7142	2.0966	-0.0062	-0.0067	-0.0283	03-05=1.0
SA-VIC	72-05	-19.1015	2.0577	0.0052	0.0013		
VIC-WA	72-91	-8.0223	1.1020	0.0197	-0.1248		
	92-05	-14.0371	1.5534	-0.0009			
WA-VIC	72-05	-10.0855	1.1852	0.0161	-0.1957	0.3282	03-05=1.0
VIC-ACT	72-05	13.6371	-0.6891	-0.0030	0.0888		
ACT-VIC	72-05	-14.7782	1.3878	-0.0065	0.1849		
VIC-NT	72-05	set to 14					
NT-VIC	72-05	-11.3342	1.1046	0.0107	-0.1611	0.0942	01-05=1.0
VIC-TAS	72-05	4.4527	0.1678	0.0470	-0.4716	0.7929	00-02=0.3; 03=0.4; 04=0.65; 05=0.8
TAS-VIC	72-05	-13.5144	1.5405	0.0334	-0.1224	0.2278	04-05=1.0
QLD-SA	72-89	-21.9700	2.0705	-0.0038	-0.0757		
	90-05	-13.9367	1.4750	-0.0122			
SA-QLD	72-00	-12.9231	1.4244	0.0030	0.0327		
	01-05	2.5581	0.2801	0.0009			
QLD-WA	72-05	-13.4624	1.3239	0.0602	-0.6138	0.6780	93=0.25; 94=0.5; 95=0.75; 96-05=1.0
WA-QLD	72-05	-29.9427	2.6121	0.0093	-0.6545	-0.3376	00-05=1.0
QLD-ACT	72-05	set to 0					
ACT-QLD	72-05	set to 0					
QLD-NT	72-05	-13.7616	1.3933	-0.0016	0.0396	-0.2122	85-95=1.0
NT-QLD	72-05	-19.7275	1.8624	-0.0160	0.1078	-0.0815	00-04=1.0; 05=2.0
QLD-TAS	72-05	set to 6					
TAS-QLD	72-05	set to 10					
SA-WA	72-05	-23.8435	2.3258	0.0001	-0.2299	-0.5808	99=0.3; 00-01=0.6; 02=0.9; 03-05=1.0
WA-SA	72-05	-30.1980	2.7442	0.0280	-0.1947	-0.3946	97=0.25; 98=0.5; 99=0.75; 00-05=1.0
SA-ACT	72-05	set to 0					
ACT-SA	72-05	set to 0					
SA-NT	72-05	-13.3813	1.4467	0.0158	-0.0874		
NT-SA	72-05	-14.9499	1.5621	0.0063	-0.0327		
SA-TAS	72-05	set to 0					
TAS-SA	72-05	set to 10					
WA-ACT	72-05	set to 0					
ACT-WA	72-05	set to 0					
WA-NT	72-05	-21.2917	1.9594	0.0102	-0.0168		
NT-WA	72-05	-20.7870	1.9037	0.0085	-0.5597	0.6738	98=0.5; 04=1.0
WA-TAS	72-05	set to 8					
TAS-WA	72-05	set to 50					
ACT-NT	72-05	set to 0					
NT-ACT	72-05	set to 0					
ACT-TAS	72-05	set to 0					
TAS-ACT	72-05	set to 0					
NT-TAS	72-05	set to 0					
TAS-NT	72-05	set to 0					

Table 4 Aggregate estimates/forecasts.

Year	Current disaggregate methodology				Previous aggregate methodology				Current aggregate equation
	Total Road	Total Rail	Total Sea	Total Interstate	Total Road	Total Rail	Total Sea	Total Interstate	Total Interstate
1972	5.3	6.1	6.4	17.7	5.9	8.4	6.6	20.9	17.2
1973	6.6	6.6	5.6	18.8	6.8	8.6	6.1	21.4	18.5
1974	7.9	7.2	4.7	19.8	7.6	9.1	6.3	23.1	19.7
1975	8.4	7.7	4.0	20.1	7.9	8.7	5.8	22.3	19.8
1976	9.3	8.3	3.2	20.8	8.5	8.9	5.4	22.8	20.8
1977	9.8	8.5	2.5	20.8	9.2	9.2	4.8	23.3	21.9
1978	9.9	8.7	2.4	21.1	9.5	8.9	4.6	23.0	21.8
1979	11.0	8.9	2.4	22.3	10.7	9.7	4.0	24.4	22.7
1980	12.5	9.2	2.3	24.0	11.9	10.5	3.8	26.1	23.5
1981	13.5	9.4	2.3	25.2	13.0	10.9	3.5	27.5	25.1
1982	14.5	9.0	2.2	25.7	14.0	11.3	3.5	28.8	25.8
1983	12.9	8.6	2.4	23.9	13.9	10.0	2.4	26.2	24.2
1984	16.2	9.4	2.9	28.5	15.4	11.4	2.8	29.6	27.2
1985	16.7	9.4	2.9	29.0	16.9	11.3	2.9	31.1	29.8
1986	18.9	9.7	2.6	31.2	18.6	11.4	2.6	32.6	31.7
1987	19.1	10.8	2.5	32.5	19.3	11.8	2.6	33.6	32.3
1988	21.8	12.4	2.0	36.1	21.1	12.9	2.5	36.6	36.2
1989	24.2	14.0	2.2	40.4	22.9	14.5	2.8	40.2	40.3
1990	25.5	13.8	1.9	41.2	24.6	14.7	2.7	42.0	42.6
1991	25.5	13.1	1.7	40.3	24.2	13.6	2.8	40.6	40.2
1992	25.9	13.5	2.0	41.5	23.9	13.6	2.9	40.4	40.9
1993	28.8	14.5	2.0	45.3	25.5	14.2	3.1	42.8	44.5
1994	30.6	15.5	2.1	48.2	27.0	14.5	3.3	44.7	47.6
1995	32.9	16.4	2.5	51.8	29.7	13.9	3.4	47.0	52.1
1996	36.0	16.3	2.5	54.9	32.3	14.4	3.6	50.2	53.9
1997	38.5	16.9	2.6	57.9	34.1	15.3	3.6	53.0	57.4
1998	41.0	17.8	3.5	62.3	37.1	15.9	4.3	57.3	62.0
1999	43.6	18.4	3.0	65.1	40.0	16.5	4.4	60.9	67.1
2000	46.2	19.2	4.4	69.8	43.4	17.5	5.7	66.5	70.5
2001	47.2	20.0	4.6	71.7	45.2	17.6	6.9	69.8	71.2
2002	49.6	21.0	6.5	77.1	49.1	18.6	6.2	73.9	76.7
2003	52.1	22.0	7.3	81.4	51.9	19.5	7.3	78.7	82.2
2004	55.7	23.0	7.9	86.6					85.5
2005	58.5	24.0	6.4	88.9					88.8
2006	61.2	25.0	6.1	92.4					92.5
2007	64.2	26.1	6.3	96.6					96.3
2008	68.5	27.8	6.7	103.1					102.7
2009	71.0	28.6	6.8	106.4					105.4
2010	74.2	29.7	7.0	110.9					109.8
2011	77.4	30.8	7.1	115.3					113.9
2012	80.8	31.9	7.4	120.1					118.4
2013	84.4	33.1	7.6	125.2					123.3
2014	88.2	34.4	7.8	130.5					128.3
2015	92.3	35.8	8.0	136.1					133.8
2016	96.3	37.1	8.3	141.7					138.9
2017	100.6	38.5	8.5	147.7					144.5
2018	105.2	40.0	8.8	154.0					150.3
2019	109.9	41.5	9.0	160.6					156.5
2020	115.0	43.2	9.3	167.5					163.0
2021	120.2	44.9	9.6	174.7					169.7
2022	125.7	46.6	10.0	182.3					176.7
2023	131.4	48.5	10.3	190.2					184.0
2024	137.4	50.4	10.6	198.5					191.6
2025	143.7	52.4	11.0	207.2					199.7
2026	150.3	54.5	11.4	216.2					208.0
2027	157.2	56.7	11.7	225.7					216.7
2028	164.5	59.0	12.1	235.7					225.7
2029	172.1	61.4	12.6	246.0					235.1
2030	180.0	63.9	13.0	256.9					245.0
2031	188.3	66.5	13.5	268.3					255.1

Table 5 Aggregate interstate freight equation.

SUMMARY OUTPUT						
<i>Regression Statistics</i>						
Multiple R		0.99923				
R Square		0.99846				
Adjusted R Square		0.99831				
Standard Error		0.02092				
Observations		34				
<i>ANOVA</i>						
		<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression		3	8.514744	2.838248	6483.201	2.91022E-42
Residual		30	0.013134	0.000438		
Total		33	8.527877			
		<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	
Intercept		-16.6372	0.159456	104.3377	5.57E-40	
log non-farm GDP		1.542471	0.012108	127.3924	1.41E-42	
Change non-farm GDP		0.00933	0.002148	4.3415	0.000148	
dummy 1979-88		-0.06881	0.008405	-8.1874	3.87E-09	

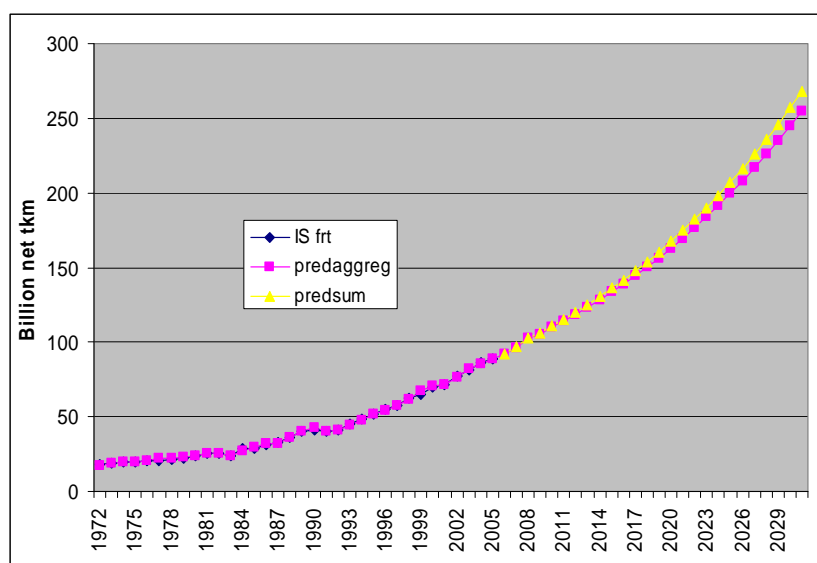


Figure 5 Interstate freight estimates and ‘sum of routes’ and ‘aggregate’ forecasts.

Of course, this forecast growth is predicated on there being no decoupling of freight growth from economic growth over the forecast period. It may well be that after a quarter of a century such decoupling, although not apparent as of 2007, will have become a reality, resulting in a tapering off of the exponential growth trend apparent in Figure 5.

Figures 6 and 7 show the mode splits derived from the ‘sum of routes’ forecasts — total and mode split. As has been commented on in conjunction with previous forecasts, there is nothing pre-ordained about the mode split forecasts. They are business-as-usual projections, and as such may not come to pass if, for example, rail became much more competitive on routes shorter than 1 500 kilometres as a result of investment, technological change and reorganisation, or if much higher oil prices changed the competitiveness of rail versus road.

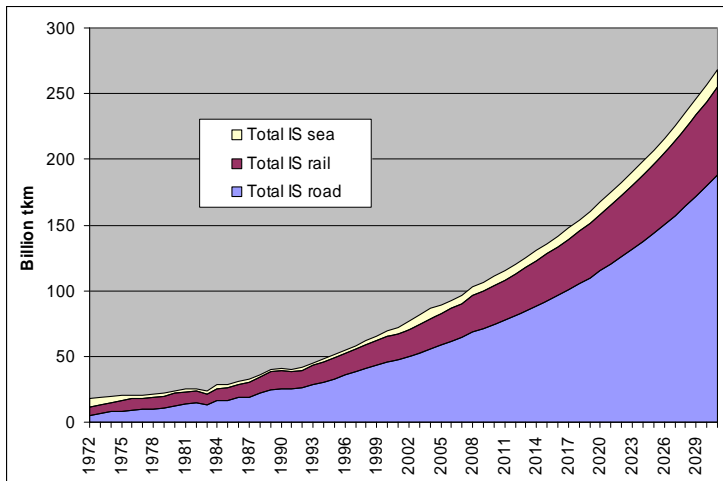


Figure 6 Total interstate freight by mode.

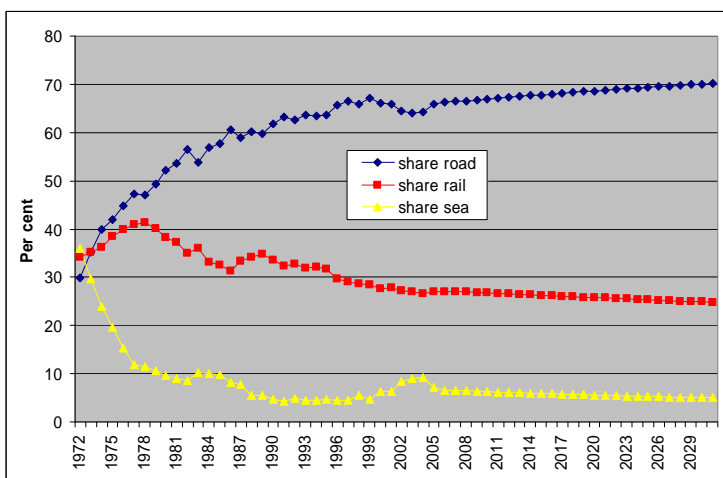


Figure 7 Interstate freight mode share.

6 Conclusions

It has been possible to derive detailed OD pair data on modal freight flows between States over almost 35 years.

The road estimates, when aggregated to tonne-kilometres, agree quite well with previous aggregate estimates by the BTRE. The rail estimates, when aggregated to tonne-kilometres and assigned to the rail network, agree quite closely with available ARTC data on corridor rail tasks. Coastal shipping has been quite completely measured by the BTRE in the past.

Thus it is now possible to use the estimation methodologies presented in this and a previous ATRF paper to update annually a comprehensive dataset on 56 OD pairs and to provide basecase forecasts for each OD pair and for the aggregate interstate freight task.

The paper also presents forecasts from 2006 to 2031 of freight tonnages, by corridor, by mode. When these forecasts are aggregated, the resulting total interstate freight task is forecast to almost triple over the next 25 years.

In conclusion, the State-to-State business-as-usual forecasts will be useful in assessing the likely future freight flows between States on the interstate road, rail and port networks, in assessing the success of efforts to improve these networks, and in assessing changes over time in the base State-to-State freight flow patterns.

References

- ABS (1982) Interstate Freight Movement, Australia: 1980–81, ABS Cat. No. 9212.0, ABS, Canberra
- ABS (1993) Interstate Freight Movement, Australia: 1991–92 and earlier, ABS Cat. No. 9212.0, ABS, Canberra
- ABS (1999) Experimental Estimates of Freight Movements, Australia, ABS Cat. No. 9217.0, ABS, Canberra
- ABS (2001) Freight Movements, ABS Cat. No. 9220.0, ABS, Canberra
- ABS (2007) Survey of Motor Vehicle Use Australia, 12 months ended 31 October 2005, ABS Cat. No. 9208.0, ABS, Canberra
- ARTC (2007) Powerpoint presentation by David Marchant, Rail 2007 Conference, April 2007, Sydney
- BTE (1976) Estimates of Australian Interregional Freight Movements, 1971-72, BTE Information Bulletin, AGPS, Canberra
- BTE (1979) Australian Rail Freight Movements, 1975-76, BTE Information Bulletin, AGPS, Canberra
- BTE (1983) Australian Rail Freight Movements, 1979-80, BTE Information Paper 8, AGPS, Canberra
- BTE (1985) Intersystem Rail Freight Movements, 1984-85, unpublished BTE manuscript, BTE, Canberra
- BTRE (2006) Freight Measurement and Modelling, Report 112, BTRE, Canberra
- BTRE (2007a) Australian Rail Freight Performance Indicators, 2005–06, Information Paper 59, BTRE, Canberra
- BTRE (2007b) Australian Sea Freight 2004–2005 and earlier, BTRE, Canberra
- FreightInfoTM04, Database of National Freight Flows 2003-04, FDF Management Pty Ltd, Melbourne
- Gargett, D, Hossain, A and Cosgrove, D (2006) Interstate Freight on States' Roads. Paper presented at the 29th Australasian Transport Research Forum, Gold Coast: ATRF
- Perry, R and Gargett, D (1998) Interstate Non-bulk Freight. Paper presented at the 22nd Australasian Transport Research Forum, 1998, Sydney: ATRF
- Treasury (2007) Personal communication