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Interstate non-bulk freight

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Abstract:

Interstate non-bulk freight is a substantial and fast-growing part of the Australian transport task. This paper presents estimates of the task by mode, and forecasts by mode to 2020.

The main competition between modes on interstate routes is now between road and rail. Coastal shipping has been reduced to those trades that cannot or cannot easily be performed by another mode.

On current trends, road looks to be the long-term winner of that contest, repeating patterns seen in most industrial countries. By 2020, road can be expected to have lifted its share of the interstate non-bulk freight task to over 70 per cent, from 57 per cent currently. However, much depends on the results of the rail reforms under way in most Australian States.

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Introduction

The main arena of competition between rail and road is in interstate non-bulk freight. Interstate non-bulk freight is a small part of the total freight task, comprising only 14 per cent of the 300 billion tonne-kilometres performed domestically (excluding pipelines). A tonne-kilometre (tkm) is a measure of the freight task. It is equal to one tonne moved one kilometre. At the national level most measures of task are in billions of tonne-kilometres (btkm)

However, the interstate non-bulk freight task is growing rapidly, at about 4 per cent per year. At this rate, interstate non-bulk freight doubles in about 18 years. Moreover, interstate non-bulk *road* freight is growing even more rapidly. Its 5 per cent per year growth rate will result in a doubling in under 15 years.

Given the importance of interstate highway and rail infrastructure for Federal Government transport funding, the basic statistics and dynamics of interstate freight need to be understood. The present paper attempts to lay the basis for such an understanding.

A Model of Total Non-Bulk Interstate Freight

Using a variety of data sources and estimation procedures, the BTCE has derived a set of 25-year time series for interstate non-bulk freight by mode (Table 1).

The data sources are diverse and scattered, and the operations needed to derive standardised series are complex. This explains why the data in Table 1 have not previously been available. Appendix I describes in detail the derivation of the data.

The classic way to analyse a freight market is to determine what causes growth in the total traffic (by all modes), and then to study the trends in mode share.

Looking at the data in Table 1, it can be seen that total interstate non-bulk freight (by all modes) grew at a little under 4 per cent per year in both the earlier and later halves of the 25 year period to 1995. (1984 was chosen as the break because it was not a recession year).

A regression of total freight on real GDP gives an income elasticity of 1.28. Appendix Table II.1 shows the details of the estimated equation. The fit to the data is quite good (Figure 1).

This equation for total interstate non-bulk freight implies a forecast growth rate of 4 per cent per year, if real income is assumed to grow smoothly at 3.25 per cent (BTCE 1996 - this ignores the business cycle, as is usual in long-term forecasting). Using this assumption, total interstate non-bulk freight rises from about 47 btkm in 1995 to about 126 btkm in 2020 (Figure 1). Thus the total task is assumed to rise to more than 2½ times the 1995 level by 2020.

Table 1 **The Interstate Non-Bulk Freight Task**
(billion tkm)

Year Ending June	Total	Road	Rail	Coastal shipping
1971	19.8	4.3	9.0	6.6
1972	20.2	4.5	9.1	6.6
1973	20.8	5.4	9.1	6.3
1974	22.1	6.0	9.6	6.6
1975	21.5	6.2	9.0	6.2
1976	22.6	7.4	9.4	5.8
1977	23.4	8.1	9.7	5.6
1978	23.7	8.5	9.4	5.8
1979	25.3	9.5	10.2	5.6
1980	27.7	10.8	11.0	5.8
1981	29.0	11.7	11.5	5.8
1982	30.2	12.6	11.9	5.7
1983	27.2	11.9	11.3	4.0
1984	30.5	14.1	12.0	4.4
1985	30.8	14.6	11.9	4.2
1986	32.2	16.2	12.0	4.1
1987	33.1	16.7	12.4	4.0
1988	35.9	18.4	13.6	3.9
1989	39.6	19.8	15.3	4.6
1990	41.0	21.1	15.4	4.5
1991	40.5	21.8	14.3	4.4
1992	41.1	22.1	14.4	4.6
1993	43.6	23.6	15.2	4.8
1994	45.4	24.8	15.6	5.1
1995	46.0	26.0	14.6	5.4

Source: Appendix I

A Model of Mode Share Trends

Figure 2 shows the trends over the past 25 years in each mode's share of interstate non-bulk freight, as well as forecasts derived using logistic substitution models of mode share (Marchetti and Nakicenovic 1979, Kwasnicki and Kwasnicka 1996).

Coastal shipping was shrinking rapidly in the years 1971 to 1984. By the late 1980s, non-bulk coastal shipping had basically fallen back to the more or less irreducible coastal trades – ie to and from Tasmania, Western Australia and the Northern Territory. Coastal shipping is also more prone than other modes to discontinuities. The sharp drop in 1982-83 coastal shipping seems to have been the discontinuation of services that were not resumed after the recession of that year ended.

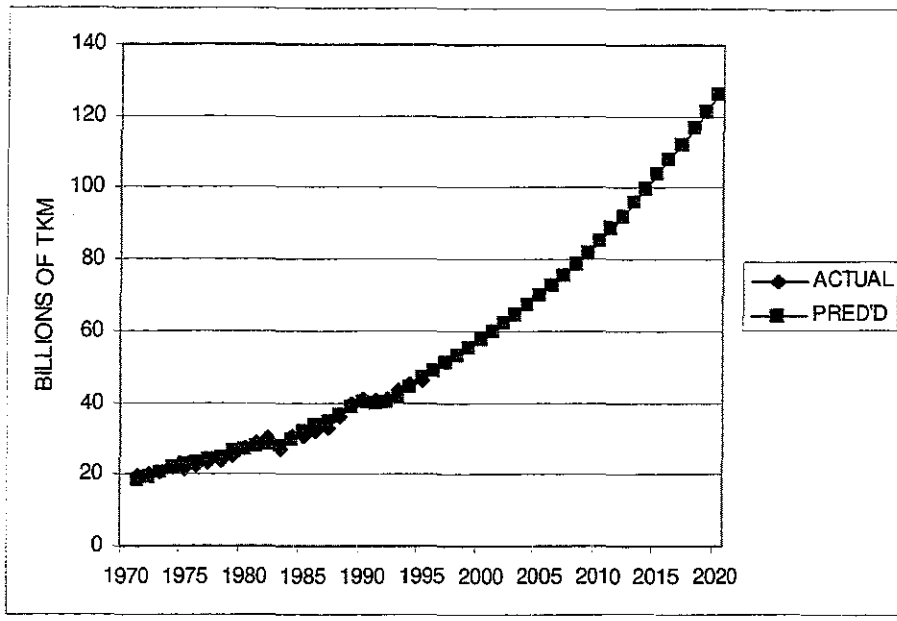

Figure 1 Trends in Total Interstate Non-bulk Freight
Source: BTCE estimates

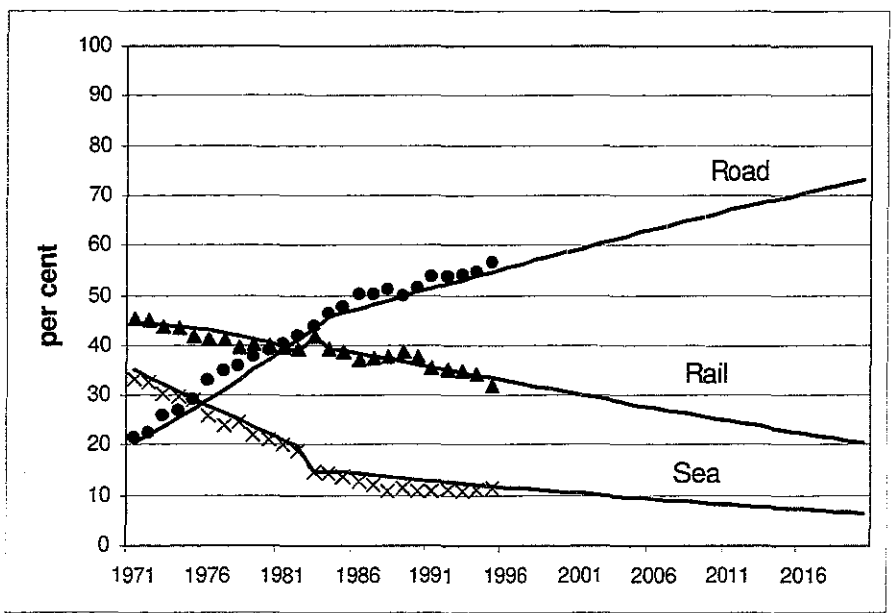

Figure 2 Trends in Interstate Non-bulk Freight Mode Share
Source: BTCE estimates

Rail share has been declining slowly but surely (aside from the discontinuity introduced by the 1983 coastal shipping drop) If the trend continues, rail's share of the interstate non-bulk freight market should drop to just over 20 per cent by 2020. This implies a rail task in 2020 of about 26 btkm, up by around 73 per cent from 15 btkm in 1995 (Table 2).

Table 2 Interstate Non-Bulk Freight: Growth Comparisons

	Non-bulk freight				Growth		
	Actual			Forecast	Actual		Forecast
	1970-71	1983-84	1994-95	2019-20	71-84	84-95	95-2020
	(billion tkm)				*(per cent/year)*		
Road	4.3	14.1	26.0	90	9.6	5.7	5.1
Rail	9.0	12.0	14.6	26	2.2	1.8	2.3
Coastal	6.6	4.4	5.4	10	-3.1	1.9	2.5
Total	**19.8**	**30.5**	**46.0**	**126**	**3.4**	**3.8**	**4.1**
Real GDP					3.2	3.4	3.25

Source: BTCE estimates

The years 1971 to 1984 were years when the share of road in interstate non-bulk freight was growing especially rapidly. Two factors contributed to this. First, road was gaining almost all the traffic that coastal shipping was losing. A second factor was the halving of real road freight rates from 1975 to 1985, as large articulated trucks took over the linehaul between centres. In contrast to the falls in rail and coastal shipping shares, road's share in 2020 is likely to be over 70 per cent. This would imply interstate road freight of about 90 btkm in 2020, versus 26 btkm in 1995.

There are several possible shocks that might upset these forecasts. The actual growth rate in GDP might be higher or lower than 3.25 per cent per year. Freight transport might start decoupling from economic growth and start to saturate (as car ownership has in Australia). There might be large increases or decreases in relative freight rates. There might be a new mode introduced, such as a 'new rail' mode, which would have radically improved service characteristics, and which would start to win share from both 'old rail' and from road.

Finally, there is the possible effect of radical upgrades of one modes' infrastructure. For example, because 'old rail' growth is forecast to continue at a rate half that of road, it is expected to continue to lose mode share (although growing in absolute terms). What would be the effect if a major rail investment program sought to alter these patterns and shift road freight to rail?

The Possible Effects of Rail Upgrading

BTCE 1996 (p. 465) analysed the likely freight shift benefits that might arise from a rail investment program. Based on an original estimate by the National Transport Planning Taskforce, the program could increase the interstate rail freight task in 2020 from 26 btkm to 32.5 btkm (out of a total by all modes of 126 btkm). In other words, rail's share would rise from 20 per cent to 26 per cent of the interstate non-bulk freight task.

The capital cost of the program was estimated at $3.4 billion in 1995-96 dollars (BTCE 1996, p. 210). However, taking account of network and environmental externalities, reductions in maintenance, and all other costs and benefits, the net social cost of the investment program was estimated to be negative. In other words, the shift from road to rail produced a social benefit. It was noted in the report, however, that this conclusion depended on both a costing assumption and also on an assumption about the capture of road freight, neither of which might be valid.

Conclusion

Interstate non-bulk freight is substantial and growing rapidly.

Coastal shipping has been reduced to those trades that cannot or cannot easily be performed by another mode.

The main competition between modes is now between road and rail.

On current trends, road looks to be the long-term winner of that contest, repeating patterns seen in most industrial countries. By 2020, road can be expected to have lifted its share of the interstate non-bulk freight task to over 70 per cent, from 57 per cent currently. However, much depends on the results of the rail reforms under way in most Australian States.

Appendix I: Data Sources and Construction of Estimates

The data on interstate road freight came from the Survey of Motor Vehicle Use (SMVU – ABS 1996, 1992 and earlier), interpolated using estimates of road freight derived from truck counts at Marulan on the Hume Highway (BTCE 1990, p. 75). A regression of SMVU tkm on Melbourne-Sydney tonnes, plus a time trend from 1975-76 to 1994-95, gave the fit shown in Figure I.1. Only the Melbourne-Sydney data in SMVU years was used in the regression, but once calculated, the equation allowed interstate road freight for intervening years to be estimated. These are the estimates presented in table 1 of the paper.

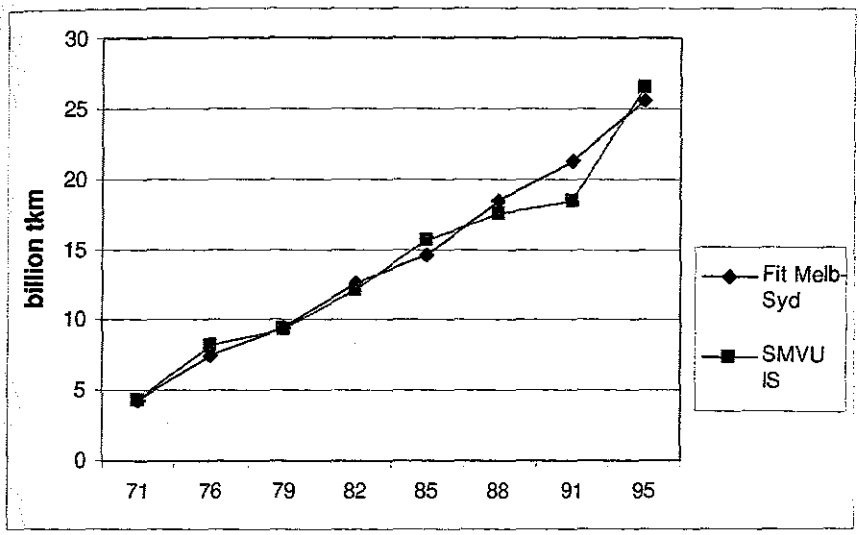

Figure I.1 SMVU Non-bulk Interstate Freight and Fit
Source: BTCE estimates

Data on total interstate rail freight tonnes was sourced from the National Rail Corporation and individual systems. A break in series in 1993-94 was allowed for by adjusting upwards by 12.5 per cent all data before this year. The resulting series of total interstate rail freight contained also some bulk freight. A series of interstate *non-bulk* rail freight tonnes was derived by multiplying by a 'non-bulk fraction'. Information on the size of this fraction over time came from numerous sources, and resulted in an assumed upwards trend from 75 per cent in 1970-71 to almost 90 per cent in 1994-95. Multiplying the 'total interstate rail freight' series, by the 'non-bulk fraction' series, by an assumed average haul of 1650 kilometres (BTCE 1996), gave the estimate of interstate non-bulk rail tkm shown in table 1 of the paper.

Data on coastal shipping came from the Commonwealth Department of Transport and Regional Development. 'Cargo tonnes' as used prior to 1980-81 were translated into tonnes by multiplying by 0.66. Multiplying by an assumed average haul of 1400 kilometres (BTCE 1996) gave the estimate of interstate non-bulk shipping tkm given in table 1 of the paper.

Appendix II: Estimated Equations

Total interstate freight was estimated with a single equation in the levels. Freight is Co-integrated with economic activity, its ultimate generator, and so a simple OLS regression results in a super-consistent estimator of the coefficient on GDP. The simple OLS coefficient was 1.23. Given autocorrelation, the equation was re-estimated using the Cochrane-Orcutt technique, resulting in a 1.28 elasticity for real GDP.

Table 1: Estimated Equation for Total Interstate Freight

Variable	Estimated Coefficient	t-statistic
Constant	-12.668	-17.22
ln real GDP	1.2768	21.91

Dependent variable - ln total interstate freight (billion tkm)
Estimation method – Cochrane-Orcutt, Rho = 0.48
Adjusted R^2 – 0.99
Estimation period – 1970/71 – 1994/95

Mode share equations were estimated using logistic substitution models. The logistic substitution model is an evolutionary model of technology use. In this case technology refers to the freight transport mode. The model is based on the following simple assumptions:

(i) each technology at time *t* can be characterised by a single index describing its performance; its index of competitiveness; and

(ii) the amount of technology *i* in use at time *t+1* is proportional to the amount of technology in use in the previous period and its competitiveness.

These assumptions give the 'evolution' equation:

$$f_i(t+1) = \frac{c_i}{c_{av}} f_i(t) \quad \text{, for each i} \qquad \text{(II.1)}$$

where

$f_i(t)$ is the share total freight transport of mode *i* at time *t*;

c_i is the competitiveness of technology *i*; and

$c_{av}(t)$ is the average competitiveness of all modes at time *t*.

Rearranging (II.1) and back substituting gives (II.2):

$$\ln \frac{f_i(t)}{f_k(t)} = \ln \frac{f_i(t_0)}{f_k(t_0)} + \ln \frac{c_i}{c_k}(t - t_0) \qquad \text{(II.2)}$$

where subscript *k* denotes the base, or reference, mode (in this case taken as road).

Equation (II.2) is then estimated using the estimating equation (II.3):

$$y_i(t) = a_i + b_i(t - t_0) \qquad \text{(II.3)}$$

where $y_i(t) = \ln \frac{f_i(t)}{f_k(t)}$, $a_i = \ln \frac{f_i(t_0)}{f_k(t_0)}$ and $b_i = \ln \frac{c_i}{c_k}$

Once b_2 for rail has been estimated, the competitiveness index of rail can be calculated as $c_2 = \exp(b_2)$.

In 1982-83, there was a large decline in the share of interstate freight transport carried by coastal shipping. To account for the shift in competitiveness before and after this event, separate competitiveness indexes were calculated for the pre– and post–1983 periods. The estimates are given in tables II.2 and II.3.

TABLE II.2 PARAMETER ESTIMATES: PERIOD 1971 TO 1982

Mode	*i*	*a*	*b*	*c*
Road	1	–	–	1.00
Rail	2	0.7709	-0.0759	0.927
Sea	3	0.5318	-0.1148	0.892

Note Road was used as the base mode.

Source BTE estimates

TABLE II.2 PARAMETER ESTIMATES: PERIOD 1983 TO 1995

Mode	*i*	*a*	*b*	*c*
Road	1	–	–	1.00
Rail	2	0.3311	-0.0344	0.966
Sea	3	-0.6722	-0.0407	0.960

Note Road was used as the base mode.

Source BTE estimates

REFERENCES

Abbreviations

ABS	Australian Bureau of Statistics
AGPS	Australian Government Publishing Service
BTCE	Bureau of Transport and Communications Economics

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