Road Freight Growth in Australian States and Cities

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1 Introduction

Road freight growth is obviously important for planning road systems. This is true with regard to the design pavement strengths for new roads (and thus their cost) and with regard to the expected growth in maintenance expenditures due to pavement damage. And this is in addition to the obvious importance of road freight for the smooth interchange of goods in our market economy.

The Australian Bureau of Statistics (ABS) has produced the Survey of Motor Vehicle Use (SMVU) since the early 1970s. It has been the principal source of our understanding of the growth in the road freight task over the years (where road freight includes tonnages carried by light commercial vehicles, rigid trucks, and articulated trucks).

The Bureau of Transport and Regional Economics (BTRE) has recently completed an exercise in adjusting past SMVU freight data to make it consistent with the current survey methodology. From a consistency point of view, there are three major problem areas that need to be adjusted within what is called a “disaggregation correction” framework. These problem areas are: (1) adjusting vehicle stock numbers, (2) adjusting for overstating of vehicle kilometres travelled in the recall surveys before 1998, and (3) correcting the proportion of laden vehicles (especially in 1998 and 1999). For a detailed description please refer to Chapter 2 of BTRE (2005) *Freight Measurement and Modelling in Australia,* Report 112. Other BTRE work on freight estimates is found in BTRE (2002) and BTRE (2003).

This paper builds on the adjusted SMVU data at a national level by reviewing measurement methods for deriving time-series estimates of road freight over the period 1971 to 2003 for each State and Territory in Australia.

Series are developed for freight tonne-kms for:

- State of Operation total
- Interstate by State of Operation
- Capital City
- Rest of State

Finally, as an example of what can be done with the data, the paper presents two simple models for forecasting freight growth in each of the Capital Cities.

2 Deriving road freight time series estimates

To derive the road freight time series estimates we need to start at the second item above (Interstate by State of Operation). This is because, prior to 1985, the SMVU only provides estimates of freight ‘by State of Registration’. We need to calculate the Interstate task ‘by State of Operation’ and net it out of the ‘by State of Registration’ figures to derive ‘by State of Operation’ task figures for the early years.

Once this is done, the basic method for getting the final adjusted estimates for each level of measurement consists of six basic steps

(1) Adjust the Australia-level aggregate for SMVU years using the methods detailed in Chapter 2 of BTRE (2005).
(2) Run a regression of the adjusted national SMVU data (with straight line interpolation) against income (and freight rates where applicable) to generate a final adjusted national estimate that varies over the economic cycle.
(3) Calculate ‘raw’ State or City shares from the unadjusted freight data for SMVU years.

(4) Smooth these shares to a believable trend, not worrying if the total goes above or below 100%.
(5) Interpolate these shares between SMVU years and normalise to add to 100%, giving the final share estimates.
(6) Multiply the final share estimate by the final adjusted national series from (2) to give a 33-year time series for each State, Interstate, Capital City or Rest of State.

But, as has been said, before we can start this process for each measurement level, we need to extend the Interstate 'by State of Operation' series from 1985 back to 1971 for the eight states and territories.

This is because, prior to 1985, only data on the freight task 'by State of Registration' is available. In contrast to the estimates of road freight 'by State of Operation', the estimate of the road freight task by State of Vehicle Registration show a much higher proportion of the freight task undertaken by Victorian, SA and WA registered freight vehicles. That data reflects the fact that a significant proportion of the interstate freight task carried by Victorian, SA and WA registered trucks takes place on NSW roads.

Estimation for the early SMVU survey years of annual road freight movements by State of Operation was thus a two-stage process. Step one involved estimating Interstate road freight movements 'by State of Operation' for each year of the SMVU. Step two involved netting this out of the 'by State of Vehicle Registration' figures to obtain 'by State of Operation' estimates.

2.1 Estimation of the interstate road freight task by state of operation

Estimates of raw interstate road freight movement by state of operation for 1971 to 1985 were derived using a simple gravity model and rules of thumb about the proportion of travel undertaken within each state, The 'gravity model' assignment method apportions total interstate road freight using the product of scaled populations and the inverse of distance as the measure of relative attraction. It was assumed that all interstate freight movements originated from the State of Vehicle Registration. Though this assumption may not be realistic, the BTRE had no information on the origin of interstate freight carried by road freight vehicles.

The share of freight destined for each state was estimated from the weighting function, equation 1.1.

$$w_{ij} = \frac{\left(P_i \cdot P_j\right)^{\beta}}{d_{ij}^{\ \gamma}} \qquad (1.1)$$

where

w_{ij} = weighting factors for the proportion of freight carried by vehicles from state i to state j;

P_i = total population of state i;

d_{ij} = road distance between capital cities in each state i and j; and

β, γ = parameters.

The weighting factors, w_{ij}, were weighted by the proportion of interstate vehicle travel undertaken within each state, producing a multi-dimensional array of factors. The multi-dimensional array was subsequently applied to estimates of total interstate freight by state of vehicle registration to derive estimates of freight carried within each state, $F_{\bullet\bullet k}$.

$$F_{\bullet\bullet k} = \sum_i \left\{ \sum_j F_i \frac{w_{ij}}{\sum_j w_{ij}} \frac{T_{ijk}}{\sum_k T_{ijk}} \right\} \qquad (1.2)$$

where

$F_{\bullet\bullet k}$ = total interstate freight carried within state k.

F_i = total interstate freight carried by vehicles registered within state i.

T_{ijk} = proportion of travel of freight vehicle movements from state i to state j undertaken within state k.

Estimation of the $F_{\bullet\bullet k}$ was an iterative procedure, undertaken through adjustment to the parameters β and γ until the difference between the estimates for 1988 and 1995 estimates of total road freight within each state of operation was sufficiently small. In the event, total freight movements to and from the ACT were found to be too large and the ACT population was scaled down by a factor of 10. The final values of β and γ used in the modelling were: β = 0.75 and γ = 1.0.

Having derived a full set of 1970-71 to 2002-03 raw estimates of Interstate Road Freight by State of Operation, we return to our six step method for turning this into a final adjusted set of estimates by State.

(1) The first step is to adjust the Australia level aggregate for Interstate Road Freight in the following manner. It is done by vehicle type, multiplying by the ratio of adjusted to raw tkm by vehicle type of the Australia-level adjustment. Then a final adjustment is made, for each vehicle type, that seeks to smooth the series. The articulated truck series pre-2001 is adjusted by a further factor of 0.9387. This is based on regressions to 2000 of the articulated interstate series on GDP and rates, and the predicted change to 2001. Finally, the aggregate is increased by 40 per cent, to account for the portion of interstate trips done within the state of origin (which the ABS does not count as interstate).

(2) The second step in deriving estimates of Interstate Freight 'by State of Operation', is to use the regression equation of total interstate against GDP and real road freight rates on the adjusted interstate series interpolated between SMVU years, to generate a final adjusted Australia level estimate of interstate freight tkm that varies over the economic cycle. (the details of the regression are given in Chapter 2, BTRE Report 112, 2005).

(3) Next we calculate the raw SMVU state shares of interstate freight from the raw interstate freight estimates.

(4) Then we smooth these shares to a believable trend, not worrying if the total share goes above or below 1.0.

(5) Then these shares are interpolated between SMVU years, and normalised to add to 1.0.

(6) Finally, these shares are multiplied by the adjusted Australia-level interstate tonne-kms from step 2 above, to get the final Interstate Freight 'by State of Operation' series.

Note that Western Australia's interstate road freight task is small compared with its size and population mainly because much of its trade with the other states is carried on rail and coastal shipping. Indeed, a much more general point is that any studies of Interstate freight should concentrate on specific routes in a multi-modal framework. BTRE (2005) does this with data to 2001 for the intercapital corridors (the road component of which comprises about 43 per cent of Interstate road freight as estimated here). The problem is that after 2001 the data to do this, both road and rail but not sea, has disappeared. Efforts to re-establish collections are being made, but so far have not succeeded.

2.2 Estimation of the road freight task by state of operation

As with the Interstate task, the estimation of the State task has to start with the 1970-71 to 1984-85 SMVU years, where estimates of the task 'by State of Operation' are missing. We subtract the SMVU estimates of interstate freight by state of registration and then add back in the final estimates of interstate freight by state of operation. This gives the raw estimate of

Freight by State of Operation. For example, for NSW in 1970-71, we take freight by State of Registration of 9481, subtract interstate freight by state of registration of 1466, add back in the interstate freight by state of operation of 1809, to get the raw estimate of freight task by State of Operation for NSW in 1970-71 of 9824 million tonne-kms.
Once we have the raw estimates, the six-step procedure can again be followed. The same steps are taken as for interstate freight replacing interstate totals with state of operation totals. For full details please refer to BTRE (2005).

2.3 Estimation of the capital cities road freight task

The estimation of the capital city tasks (defined as Statistical Divisions) again follow a 6-step procedure.

(1) The first step is to adjust the Australian-level aggregate for the eight capital cities' freight task in a manner similar to that used for total Australian freight. The mechanism for adjusting aggregate interstate tonne-kilometres, is done by vehicle type, multiplying by the ratio of adjusted to raw tkm by vehicle type of the Australia-level adjustment. Then a final adjustment is made, for each vehicle type, that seeks to smooth the series.

(2) The second step in deriving estimate of Capital City freight is to use the regression equation of total Capital City freight against GDP and real road freight rates and the adjusted Capital City series interpolated between SMVU years, to generate a final adjusted Australia-level estimate of Capital City freight tkm that varies over the economic cycle.

(3) Next we calculate the raw SMVU state shares of Capital City freight from raw capital city road freight task, which gives the raw ABS SMVU estimates of tkm by city.

(4) Then we smooth these shares to a believable trend, not worrying if the total share goes above or below 1.0.

(5) Then these shares are interpolated between SMVU years and normalised to add to 1.0.

(6) Finally, these shares are multiplied by the adjusted Australia-level 8 Capital City tonne-kms from Step 2 above, to get the final adjusted freight task by Capital City series.

The differences between cities in the estimates of freight per capita that result are probably explained by differences in the degree of specialization in freight-intensive industries.

2.4 Estimation of the 'rest of state' road freight task

This one is easy. It is simply the total freight task by State of Operation, minus the interstate freight task by State of Operation, minus the capital city freight task.

2.5 Final state–based road freight estimates

Tables 1 to 4 present the final state–based road freight estimates for 1970–71 to 2002–03.

For quick comparison, the Australia road freight totals (in billion tonne-kilometres) for 2002–03 are: total tonne-kilometres 153.62, interstate 55.76, capital cities 33.27 and rest of state 64.59. BTRE estimates the inter-capital road freight task at 23.9 billion tonne-kilometres in 2002–03 — see BTRE (2005). The ABS Freight Movements Survey in 2000–01 (multiplied by 1.15 for under-counting of artic trips and by 1.05 to account for rigids) gives 51.6 billion tonne–kilometres for interstate road, versus our estimate of 49.6.

Table 1: Freight disaggregation by state of operation NSW and VIC (billion tonne-kilometres)

Year end June	*NSW State of Oper.*	*NSW InterState*	*NSW Sydney*	*NSW RestState*	*VIC State of Oper.*	*VIC InterState*	*VIC Melbourn e*	*VIC RestState*
1971	9.27	2.25	2.82	4.20	6.20	1.69	1.96	2.56
1972	9.85	2.59	2.98	4.28	6.62	1.92	2.09	2.61
1973	10.34	3.01	3.16	4.17	6.98	2.21	2.23	2.54
1974	11.47	3.40	3.41	4.67	7.78	2.46	2.42	2.89
1975	11.97	3.54	3.49	4.94	8.14	2.53	2.51	3.11
1976	12.66	3.80	3.62	5.24	8.65	2.69	2.62	3.35
1977	13.81	4.19	3.82	5.80	9.16	2.90	2.81	3.46
1978	14.37	4.37	3.87	6.14	9.25	2.96	2.89	3.41
1979	15.89	4.98	4.09	6.82	9.92	3.31	3.10	3.51
1980	17.62	5.55	4.45	7.62	10.96	3.58	3.41	3.97
1981	19.08	6.07	4.69	8.32	11.83	3.81	3.63	4.39
1982	20.49	6.55	4.93	9.01	12.66	3.99	3.86	4.81
1983	20.42	6.62	4.90	8.90	12.56	3.81	3.88	4.88
1984	22.01	7.51	5.22	9.28	13.48	4.08	4.17	5.23
1985	23.78	8.48	5.56	9.74	14.51	4.34	4.50	5.66
1986	25.40	9.52	5.87	10.01	15.66	4.60	4.83	6.23
1987	25.58	10.07	5.90	9.61	15.94	4.59	4.94	6.41
1988	27.20	11.28	6.23	9.68	17.13	4.83	5.31	6.99
1989	28.52	12.32	6.49	9.71	18.27	5.04	5.61	7.62
1990	29.65	13.31	7.08	9.26	19.34	5.20	6.21	7.92
1991	28.72	13.21	6.93	8.58	19.07	4.91	6.18	7.98
1992	28.27	12.97	6.81	8.49	18.76	4.79	6.14	7.83
1993	29.63	13.75	7.05	8.84	19.65	5.04	6.43	8.19
1994	30.86	14.46	7.29	9.12	20.46	5.26	6.72	8.48
1995	33.51	15.80	7.75	9.96	22.20	5.70	7.23	9.28
1996	35.99	17.33	8.21	10.46	23.83	6.14	7.69	9.99
1997	37.41	18.48	8.40	10.53	24.74	6.43	7.92	10.39
1998	40.13	20.23	8.80	11.10	26.51	6.92	8.33	11.26
1999	43.01	22.44	8.95	11.62	27.93	7.29	8.61	12.03
2000	44.91	24.50	9.36	11.05	29.37	7.96	9.20	12.21
2001	46.38	25.89	9.62	10.86	30.21	8.29	9.45	12.46
2002	49.08	28.49	10.02	10.57	31.83	8.98	10.06	12.80
2003	51.51	31.15	10.39	9.98	33.29	9.67	10.28	13.35

Table 2: Freight disaggregation by state of operation QLD and SA (billion tonne-kilometres)

Yr end June	*QLD State of Oper.*	*QLD InterState*	*QLD Brisbane*	*QLD RestState*	*SA State of Oper.*	*SA InterState*	*SA Adelaide*	*SA RestState*
1971	2.76	0.61	0.62	1.53	2.66	0.67	0.67	1.32
1972	2.94	0.69	0.68	1.56	2.84	0.77	0.71	1.37
1973	3.09	0.80	0.75	1.54	3.01	0.89	0.75	1.36
1974	3.43	0.88	0.84	1.70	3.36	1.00	0.82	1.54
1975	3.58	0.90	0.90	1.78	3.52	1.04	0.84	1.64
1976	3.79	0.96	0.96	1.87	3.75	1.11	0.87	1.76
1977	4.42	1.03	1.11	2.28	4.00	1.22	0.93	1.86
1978	4.90	1.04	1.23	2.63	4.07	1.26	0.95	1.87
1979	5.75	1.16	1.41	3.18	4.41	1.43	1.01	1.97
1980	6.55	1.31	1.63	3.61	4.93	1.67	1.03	2.23
1981	7.30	1.45	1.83	4.01	5.39	1.92	1.01	2.45
1982	8.05	1.59	2.04	4.42	5.83	2.16	0.99	2.68
1983	8.24	1.54	2.05	4.66	5.87	2.13	0.99	2.74
1984	9.12	1.66	2.21	5.25	6.38	2.36	1.06	2.96
1985	10.12	1.79	2.38	5.94	6.95	2.60	1.14	3.21
1986	11.27	1.92	2.53	6.82	7.30	2.85	1.22	3.23
1987	11.82	1.94	2.56	7.32	7.22	2.95	1.23	3.04
1988	13.09	2.08	2.73	8.28	7.53	3.20	1.31	2.99
1989	14.37	2.37	2.85	9.15	7.79	3.46	1.37	2.96
1990	15.64	2.66	3.13	9.85	7.99	3.68	1.50	3.81
1991	15.84	2.74	3.08	10.02	7.62	3.58	1.47	2.57
1992	15.82	2.82	3.05	9.95	7.50	3.54	1.45	2.52
1993	16.82	3.12	3.19	10.51	7.87	3.77	1.50	2.60
1994	17.77	3.42	3.33	11.01	8.19	3.98	1.55	2.66
1995	19.56	3.90	3.58	12.08	8.90	4.38	1.66	2.86
1996	21.07	4.23	3.87	12.97	9.51	4.66	1.76	3.09
1997	21.95	4.46	4.04	13.46	9.83	4.81	1.82	3.20
1998	23.61	4.82	4.31	14.48	10.49	5.10	1.91	3.47
1999	25.14	5.13	4.64	15.37	11.12	5.18	1.93	4.00
2000	26.34	5.60	4.99	15.76	11.59	5.41	2.01	4.17
2001	27.31	5.83	5.18	16.30	11.97	5.39	2.04	4.54
2002	28.90	6.33	5.50	17.08	12.66	5.56	2.15	4.95
2003	30.35	6.40	5.71	18.23	13.48	5.89	2.25	5.33

Table 3: Freight disaggregation by state of operation WA and TAS (billion tonne-kilometres)

Yr end June	*WA State of Oper.*	*WA InterState*	*WA Perth*	*WA RestState*	*TAS State of Oper.*	*TAS InterState*	*TAS Hobart*	*TAS RestState*
1971	3.04	0.16	0.78	2.10	0.67	0.06	0.11	0.50
1972	3.16	0.19	0.84	2.13	0.71	0.06	0.13	0.52
1973	3.24	0.24	0.90	2.11	0.75	0.07	0.14	0.54
1974	3.51	0.29	0.98	2.25	0.83	0.08	0.15	0.60
1975	3.58	0.31	1.01	2.25	0.86	0.08	0.16	0.62
1976	3.69	0.35	1.06	2.28	0.91	0.08	0.18	0.65
1977	3.99	0.36	1.14	2.49	0.99	0.09	0.19	0.71
1978	4.12	0.35	1.17	2.59	1.02	0.09	0.20	0.73
1979	4.52	0.38	1.26	2.88	1.13	0.11	0.22	0.80
1980	5.04	0.41	1.39	3.24	1.26	0.12	0.23	0.91
1981	5.48	0.44	1.48	3.57	1.38	0.14	0.24	1.00
1982	5.92	0.47	1.57	3.89	1.49	0.15	0.25	1.09
1983	5.98	0.47	1.55	3.96	1.50	0.15	0.26	1.09
1984	6.53	0.52	1.65	4.36	1.63	0.16	0.29	1.18
1985	7.15	0.58	1.75	4.81	1.78	0.18	0.33	1.28
1986	8.10	0.64	1.86	5.60	1.86	0.19	0.34	1.33
1987	8.64	0.66	1.89	6.09	1.82	0.19	0.33	1.30
1988	9.72	0.72	2.02	6.98	1.89	0.21	0.34	1.34
1989	10.34	0.78	2.13	7.43	1.96	0.23	0.35	1.38
1990	10.92	0.84	2.36	7.72	2.01	0.25	0.38	1.39
1991	10.75	0.83	2.35	7.57	1.92	0.24	0.36	1.32
1992	10.56	0.88	2.32	7.36	1.86	0.19	0.34	1.33
1993	11.05	1.00	2.42	7.63	1.91	0.14	0.33	1.44
1994	11.49	1.13	2.52	7.84	1.95	0.09	0.32	1.54
1995	12.45	1.31	2.69	8.44	2.07	0.03	0.32	1.72
1996	13.38	1.43	2.87	9.09	2.19	0.03	0.31	1.85
1997	13.92	1.50	2.95	9.47	2.24	0.04	0.29	1.92
1998	14.94	1.63	3.10	10.21	2.37	0.04	0.27	2.06
1999	15.82	1.73	3.17	10.92	2.48	0.04	0.27	2.16
2000	16.52	1.79	3.40	11.32	2.56	0.05	0.28	2.23
2001	17.06	1.77	3.52	11.78	2.62	0.05	0.29	2.27
2002	18.05	1.81	3.75	12.50	2.74	0.09	0.31	2.34
2003	18.88	1.66	3.87	13.34	2.83	0.09	0.32	2.43

Table 4: Freight disaggregation by state of operation NT and ACT (billion tonne-kilometres)

Yr end June	*NT State of Oper*	*NT InterState*	*NT Darwin*	*NT RestState*	*ACT State of Oper*	*ACT InterState*	*ACT Canberr a*	*ACT RestState*
1971	0.52	0.03	0.04	0.44	0.14	0.03	0.10	0.01
1972	0.57	0.03	0.05	0.49	0.15	0.04	0.11	0.00
1973	0.61	0.04	0.05	0.52	0.16	0.04	0.11	0.00
1974	0.70	0.05	0.06	0.60	0.17	0.05	0.12	0.00
1975	0.75	0.05	0.06	0.64	0.18	0.05	0.13	0.00
1976	0.82	0.06	0.06	0.70	0.19	0.05	0.13	0.00
1977	0.89	0.06	0.06	0.77	0.20	0.06	0.14	0.00
1978	0.92	0.06	0.06	0.80	0.20	0.06	0.15	-0.01
1979	1.02	0.07	0.06	0.89	0.21	0.07	0.16	-0.01
1980	1.14	0.08	0.09	0.97	0.24	0.08	0.17	-0.01
1981	1.24	0.09	0.13	1.03	0.26	0.08	0.18	-0.01
1982	1.35	0.10	0.17	1.08	0.28	0.09	0.19	0.00
1983	1.35	0.10	0.18	1.08	0.28	0.09	0.19	0.00
1984	1.47	0.11	0.19	1.17	0.31	0.10	0.21	0.00
1985	1.61	0.13	0.21	1.27	0.33	0.10	0.22	0.01
1986	1.73	0.16	0.21	1.36	0.35	0.11	0.24	0.01
1987	1.76	0.19	0.21	1.36	0.35	0.10	0.24	0.00
1988	1.89	0.24	0.21	1.44	0.36	0.11	0.25	0.00
1989	2.01	0.29	0.22	1.50	0.39	0.11	0.27	0.01
1990	2.13	0.34	0.25	1.54	0.40	0.12	0.29	0.00
1991	2.10	0.37	0.25	1.48	0.39	0.11	0.29	0.00
1992	2.07	0.40	0.23	1.43	0.38	0.11	0.26	0.00
1993	2.17	0.47	0.23	1.48	0.38	0.12	0.26	0.01
1994	2.27	0.54	0.22	1.51	0.38	0.13	0.25	0.01
1995	2.47	0.63	0.22	1.61	0.40	0.14	0.24	0.02
1996	2.61	0.73	0.24	1.64	0.42	0.15	0.25	0.02
1997	2.67	0.82	0.25	1.60	0.41	0.16	0.24	0.01
1998	2.82	0.94	0.26	1.62	0.42	0.17	0.24	0.01
1999	2.99	1.02	0.29	1.69	0.44	0.19	0.24	0.01
2000	3.13	1.13	0.26	1.73	0.45	0.20	0.24	0.01
2001	3.23	1.21	0.22	1.81	0.46	0.21	0.24	0.01
2002	3.42	1.33	0.19	1.89	0.48	0.22	0.25	0.02
2003	2.79	0.67	0.19	1.93	0.49	0.22	0.26	0.01

3 Forecasting the capital city road freight task

Using the data derived for capital city tonne-kilometres, the BTRE has estimated two simple models of urban road freight demand.
The BTRE models relate urban freight transport to measures of city incomes and real urban freight rates. The models can be used to forecast the future capital city road freight transport tasks. The freight transport task projections may then be converted into vehicle movement estimates by dividing by projected average vehicle loads.

3.1 Cross section time series data

The first simple model was a 'cross-section, time series' model which relates total freight tonne-kilometres in each capital city to city incomes/production and real freight rates:

$$\ln(\text{Urban Freight}_i) = \beta_{0,i} D_i + \beta_1 \ln(\text{Population}_i \times \text{Real national - level per capita GDP}) + \beta_2 \ln(\text{Real freight rate}) \quad (1)$$

where
D_i = city-specific dummy variables and city specific time dummy variables, city *i*.
β_1 and β_2 = elasticity of demand with respect to city economic activity and real freight rate, respectively.
Urban freight$_i$ = total tonne-kilometres in urban area *I* (Statistical Division).
Population$_i$ = total population within urban area *i*.
Real per capita GDP = national-level per capita real gross domestic product.
Freight rate = real road freight rate for short-haul road freight.

Estimated resident population data for each capital city was obtained from a combination of various ABS data products. Population estimates for the period 1971 to 1996 are from the *Integrated Regional Data Base (IRDB)* (ABS 1996b), and subsequent years from ABS (2004) which provides population estimates to 2003 and projections to 2020.
The measure of output within a city was assumed equal to the product of national-level real gross domestic product per capita (ABS 2003c) times the estimated resident population within each city (Statistical Division).
TransEco (2003) publishes a series of short haul road freight rates. But that series is only available from fourth quarter 1984 to the present. However, short haul freight rates appear to move roughly in parallel to movements in long haul road freight rates. Therefore, where there are not measures of short haul freight rates, we have used movements in long haul freight rates as a proxy.
Estimation was undertaken for the capital cities, using pooled cross-section, timeseries regression techniques. The Ordinary Least Squares model results gave the real income elasticity as 0.96 and the real freight rate elasticity as –0.78. The resulting fit to the data is shown in Figure 1.

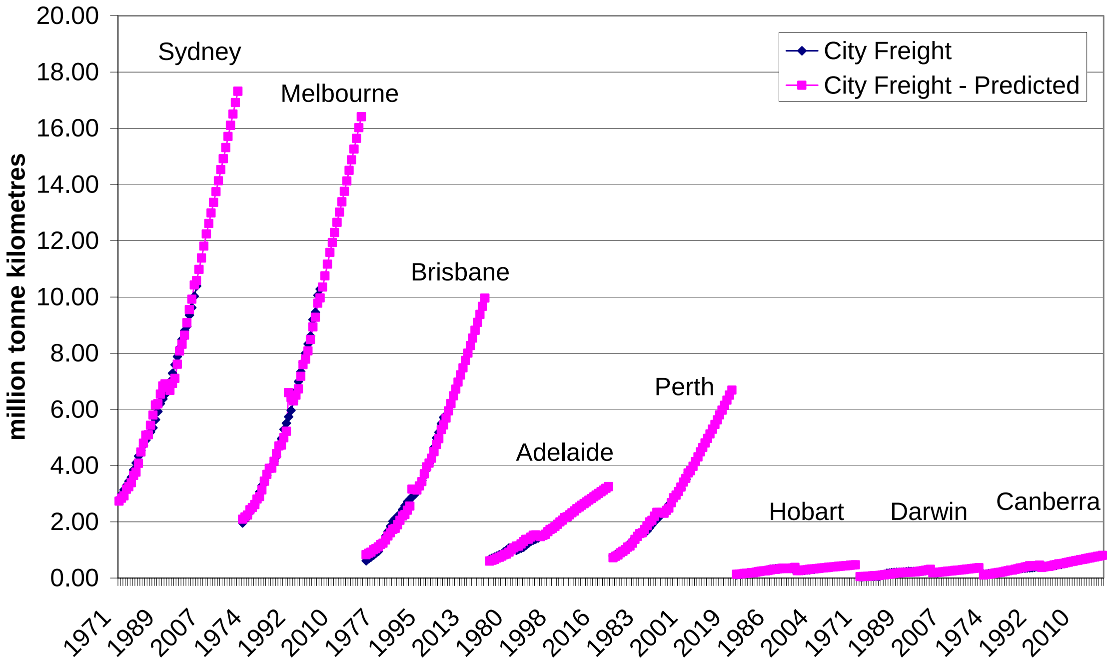

Figure 1: Cross section time series data and fit

3.2 An ‘aggregate’ model of the Australian ‘metro’ freight task

The second simple model was estimated by aggregating the tonne-km tasks for the eight capital cities – producing what is referred to as the Australian ‘metro’ freight task.

This was then regressed against metro GDP (national-level GDP per person times metro population), real road freight rates as before, and a dummy variable for 1990 onwards.
The 'aggregate' model results gave a real income elasticity of 1.014 and a real freight rate elasticity of -0.685. These values are similar to those derived for the 'cross-section, time series' model. The fit to the data is shown in figure 2.

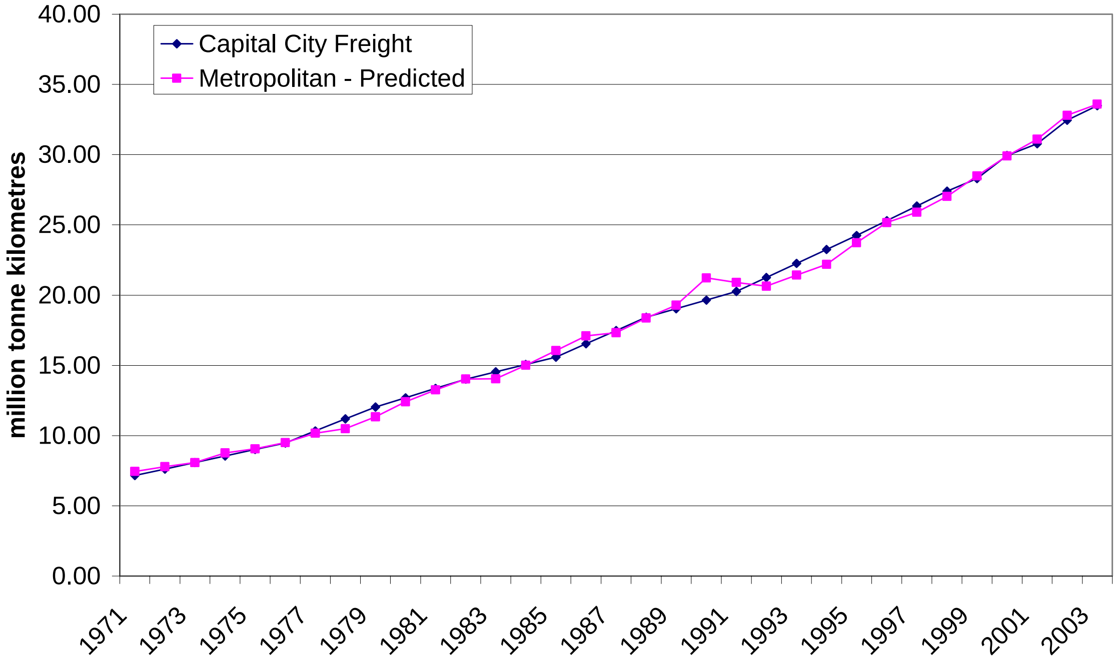

Figure 2: Aggregate model data and fit.

3.3 Forecasting urban freight movements

The results from the simple models may be combined with assumptions about future average income, population growth and trends in average freight rates, to produce forecasts of future urban freight transport.
The BTRE has produced forecasts of urban freight tonne-kilometres based on ABS median projections of population growth, together with growth of 2.7 per cent per annum in real non-farm domestic product (Treasury 2002), and -0.5 per cent per annum in real urban freight rates, reflecting assumed benefits from continuing technological change. Note, however, that these are business-as-usual assumptions. It may be that radical changes will invalidate them — for example, continually rising oil prices.
The forecast growth in capital city freight tonne-kilometres from both models is about 3.0 per cent per annum over the period 2003 to 2020. This compares with growth of 5.0 per cent per annum for the capital cities between 1971 and 2003.
These forecasts are derived in three steps. First, the aggregate 'metro' model is used to forecast the total metro freight task. Then the cross-section, time series model is used to derive each city's 'provisional' freight task. Finally each city's share of the cross-section, time series total for the eight capitals is multiplied by the aggregate 'metro' forecast to get the city's final forecast freight task.
Figure 3 and Table 5 show the projections of the freight task of the eight capital cities combined, using both the aggregate model and the cross-section, time series total before adjustment.

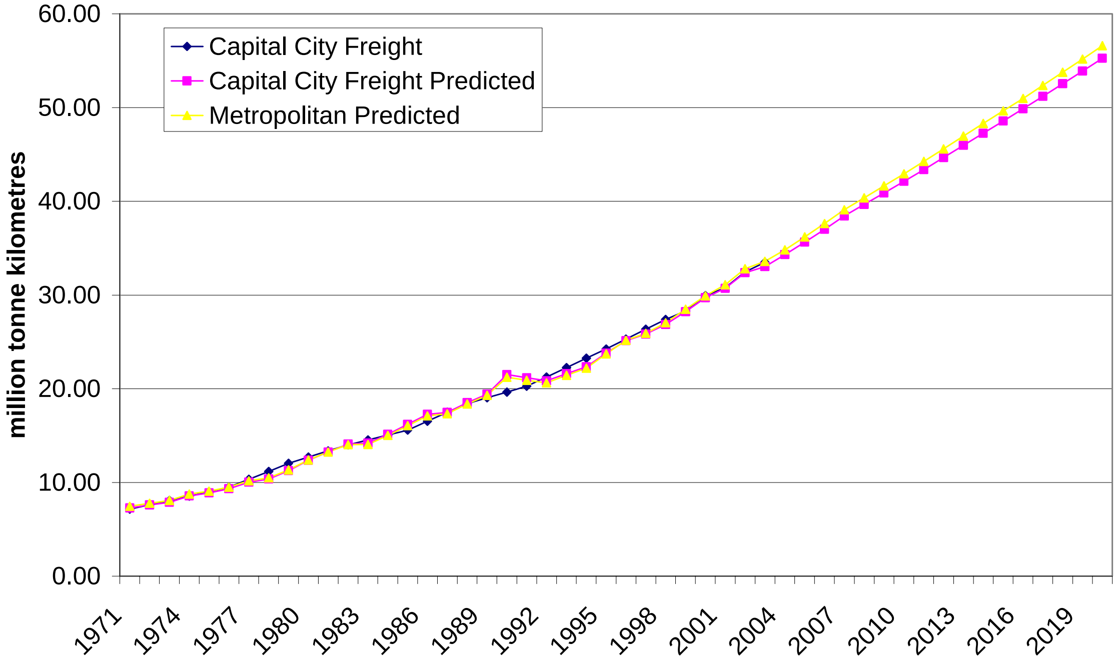

Figure 3: Actual and projected total urban freight, capital cities, 1971-2020

Table 5: Capital city road freight projections (million tonne-kilometres)

	SYD	MEL	BNE	ADL	PER	HOB	DRW	CBR	METRO (AGGR)
2003act	10.39	10.28	5.71	2.25	3.87	0.32	0.19	0.26	33.27
2003pred	10.84	10.21	5.58	2.23	3.91	0.33	0.20	0.28	33.59
2004	11.22	10.58	5.81	2.30	4.07	0.34	0.21	0.29	34.82
2005	11.64	11.00	6.08	2.37	4.24	0.35	0.23	0.30	36.20
2006	12.08	11.43	6.35	2.45	4.41	0.36	0.24	0.31	37.62
2007	12.54	11.86	6.64	2.52	4.60	0.37	0.25	0.32	39.09
2008	12.93	12.23	6.89	2.58	4.77	0.38	0.26	0.33	40.37
2009	13.32	12.61	7.15	2.65	4.92	0.39	0.27	0.34	41.65
2010	13.71	12.99	7.41	2.71	5.09	0.40	0.28	0.35	42.94
2011	14.11	13.36	7.68	2.77	5.27	0.41	0.29	0.36	44.26
2012	14.52	13.75	7.96	2.85	5.44	0.41	0.29	0.37	45.59
2013	14.94	14.15	8.23	2.91	5.62	0.42	0.30	0.38	46.95
2014	15.34	14.54	8.51	2.97	5.79	0.43	0.31	0.39	48.29
2015	15.76	14.93	8.79	3.04	5.97	0.44	0.32	0.40	49.65
2016	16.16	15.31	9.07	3.10	6.14	0.45	0.33	0.41	50.97
2017	16.58	15.71	9.36	3.16	6.33	0.45	0.34	0.42	52.36
2018	17.04	16.14	9.68	3.23	6.52	0.46	0.35	0.43	53.86
2019	17.43	16.51	9.96	3.29	6.70	0.47	0.37	0.44	55.17
2020	17.85	16.92	10.27	3.35	6.89	0.48	0.38	0.45	56.60

4 Summary

The BTRE has taken adjusted SMVU data and derived time-series estimates of road freight over the period 1971 to 2003 for each State and Territory in Australia.
Series were developed by a simple six-step procedure for freight tonne-kilometres for:

- State of Operation total
- Interstate by State of Operation
- Capital City
- Rest of State

Finally, as an example of what can be done with the data, the paper has presented a simple model for forecasting freight growth in each of the Capital Cities.

5 References

ABS (1973) *Survey of motor vehicle use Australia, 12 months ended 30 September 1971* Catalogue No. 9208.0 Canberra.

ABS (1978) *Survey of motor vehicle use Australia, 12 months ended 30 September 1976* Catalogue No. 9208.0 Canberra.

ABS (1981) *Survey of motor vehicle use Australia, 12 months ended 30 September 1979* Catalogue No. 9208.0 Canberra.

ABS (1983) *Survey of motor vehicle use Australia, 12 months ended 30 September 1981* Catalogue No. 9208.0 Canberra.

ABS (1987) *Survey of motor vehicle use Australia, 12 months ended 30 September 1985* Catalogue No. 9208.0 Canberra.

ABS (1990) *Survey of motor vehicle use Australia, 12 months ended 30 September 1988* Catalogue No. 9208.0 Canberra.

ABS (1996a) *Survey of motor vehicle use Australia, Preliminary, 12 months ended 30 September 1995* Catalogue No. 9202.0 Canberra.

ABS (1996b) *Integrated Regional Data Base (IRDB),* Catalogue No. 1353.0 Canberra

ABS (2002) *Motor vehicle census, 31 March 2002* Catalogue No. 9309.0 Canberra.

ABS (2003a) *Survey of motor vehicle use Australia, 12 months ended 31 October 2001* Catalogue No. 9208.0 Canberra.

ABS (2003b) *Survey of motor vehicle use Australia, 12 months ended 31 October 2002* Catalogue No. 9208.0 Canberra.

ABS (2003c) *Australian National Accounts: National Income, Expenditure and Product* Catalogue No. 5206.0 Canberra

ABS (2004) *Survey of motor vehicle use Australia, 12 months ended 31 October 2003* Catalogue No. 9208.0 Canberra.

BTRE (2002) *Freight between Australian Cities* Information Sheet 22 Canberra.

BTRE (2003) *Greenhouse Gas Emissions from Transport: Australian Trends to 2020* Report 107 Canberra.

BTRE (2005) *Freight Measurement and Modelling in Australia* Report 112 Canberra

Cosgrove, D & Mitchell, D (2001) Standardised time-series for the Australian road transport task, CD-ROM session 4b of *Papers of the 24th Australasian Transport Research Forum* Hobart: ATRF

TransEco (2003) *TransEco road freight cost indices, September quarter 2003* Melbourne.

Treasury (2002) *Australia's long-term demographic and economic prospects* Part II of the Budget Paper No. 5 Canberra.