Contents

1 FreightSim

The Study Team has chosen to use the *FreightSim* model developed by BTRE/FDF Management to forecast the future freight market because it is the best tool of its type currently available for conducting such an exercise. The *FreightSim* model uses the *FreightInfo* database developed by FDF Management for base year data. The Study Team considers the framework of *FreightSim* and the *FreightInfo* database to be robust, and a reasonable approach to forecasting future freight movements.

Analysis using *FreightSim* has been used by BTRE in a number of recent reports and publications (for example, BTRE; 2002, 2003, 2005) and is acknowledged internationally as an industry leading model (UK DTF, 2002). The model is used to forecast the total freight market and allocate freight tasks to modes of transport, and for this study it is proposed to use *FreightSim* for modelling the total freight market.

FreightSim models growth in freight flows through time as mainly a function of growth in production, imports and consumption of commodities. The latter is driven mainly by economic and population growth and can be specified as exogenous or endogenous to the model. With the exception of production of bulk commodities, growth in production of these commodities is always specified as exogenous. Production of non-bulk commodities can be endogenously or exogenously determined, as can imports and consumption of all commodities.

Where the growth in these variables is specified as exogenous, an externally-derived set of projections is fed into the model. Sources of these projections would include CSIRO, BRS and ABARE. Where the variables are described as endogenous, the model applies growth rates to the initial starting data. These growth rates are derived by regionally-weighted GDP growth adjusted by an elasticity of response of the variable to GDP growth.

FreightSim undertakes a mass balance process to reconcile the new commodity production, consumption and imports numbers (based on the projection of growth rates for these variables) with the O-D data in the *FreightInfo* database. The balance of consumption and imports from production is assigned to exports – an endogenous variable – that are available for freight transport.

Table 1 shows the commodity and mode of transport listings currently specified in *FreightSim*.

Table 1 - Commodities and modes of transport specified in *FreightSim*

Commodities covered in the model		
1. Non-bulk commodities	7. Coal and coke	12. Steel and minerals
2. Grains and oilseeds	8. Metallic minerals	13. Fertilisers
3. Sheep (live)	9. Non-metallic minerals	14. Cement
4. Cattle (live)	10. Oil and petroleum products	15. Timber
5. Meat	11. Gas	16. Other bulk
6. Other agriculture		

Modes of transport currently specified

Modes of transport currently specified	
0. No mode	3c. Sea coastal
1.Road	4. Conveyor
2i. Rail	6i. Air international
2c. Rail sugar cane	6d. Air domestic
3i. Sea international	

Source: BTRE, FDF

This breakdown reflects the nationwide scope of *FreightInfo*. Some of the categories have little importance for the Study, (for example, live sheep and cattle) whereas the single category of 'non-bulk commodities' covers a wide range (for example, manufactured goods, some refrigerated products) which account for most rail freight on the Corridor. The Study Team has been able to expand on some of this data with more finely broken down data from rail and track operators, freight forwarders and end users.

2 Freight transport models

2.1 Aggregate models

The objective of the modelling exercise is to forecast and measure the sensitivity of transportation demand to service quality at a given price.

Aggregate data consists of sums or volumes which are characterised by certain variables or service attributes. In transport economics, aggregate data consists of goods flows at the regional or national level. Rather than using absolute values, which is the case for disaggregate data, aggregate data is more likely to be made up of average values. As a result, company-specific elements remain hidden and the results may not represent particular companies' positions (Maeyer and Pauwels, 2003).

The use of aggregate data is more appropriate if the object of the study focuses on higher level decision-making and policy supporting predictions. The goal of this Study is not to measure the reaction of one specific shipper to particular changes in service attributes, but to analyse how complete flows will react to these alterations. For freight studies at the aggregate level, the aim is to allocate the total amount of goods to be transported over the different modes, that is, the aggregate modal split (Maeyer and Pauwels, 2003).

2.2 Aggregate volume demand models

These models attempt to explain the aggregate volume demand for freight transport by calculating the number or proportion of tonnes, or tonne kilometres (volumes) that will be transported by the different modes, given some set of explanatory variables, that is, freight transport service characteristics.

Price and service characteristics of different freight transport modes, such as reliability, frequency and transit time, influence the way demand is assigned to the modes. At the aggregate level this behaviour results in the observed modal split (Maeyer and Pauwels, 2003).

2.3 The linear aggregate demand volume model

The linear model for aggregate freight volume demand is specified such that:

$$Y_1 = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

where Y_1 is the proportion or total volume of freight carried by a particular transport mode, a is the intercept, X_1 through X_4 are the economic drivers of modal share, β_1 through β_4 are the regression parameters, and ε is the error term (Maeyer and Pauwels, 2003).

Here the elasticity of demand depends on the value of the independent variables, that is, the elasticities are not constant, but for each independent variable are equal to:

$$\frac{\partial Y_n}{\partial X_n} \cdot \frac{X_n}{Y_n}$$

2.4 The log-linear aggregate demand volume model

The log-linear model for aggregate freight volume demand estimates the logarithms of transport volumes as linear specifications of the logarithms of the independent variables, and can be estimated with a range of regression methodologies including ordinary least squares, generalised least squares, seemingly unrelated regression equations and maximum likelihood estimations (Maeyer and Pauwels, 2003).

For the log-linear model, the estimated parameters β_1 through β_4 are the demand elasticities for each variable, which are constant over time. The log-linear model is specified such that:

$$\ln Y_1 = a + \beta_1 \ln X_1 + \beta \ln X_2 + \beta \ln X_3 + \beta \ln X_4 + \varepsilon$$

where the elasticity is equal to:

$$\frac{\partial Y_n}{\partial X_n} \cdot \frac{X_n}{Y_n} = \beta_n = \text{a constant}$$

Ultimately, these models present methods for deriving elasticity measures (by commodity) of the economic drivers of aggregate modal split, given aggregate freight transport volume data by mode, across given origin destination routes.

2.5 Discrete Choice models

Discrete Choice models such as the logit and probit models are widely used in the mapping of the mode choice process. These approaches model the choice or market share for the available transport modes. The functional form is based on the assumption that the freight transport decision is made by utility maximising agents. Market share is based on the service characteristics of the transport model (Maeyer and Pauwels, 2003).

Booz Allen Hamilton (2001) use a logit model to estimate diversion from road to rail. Increases in market share and subsequent diversion to rail are derived from improvement in rail's competitive position in each corridor market; that is, increases in the utility derived from freight transport mode due to changes in service characteristics.

Rail market share can be derived using the logit model:

$$P_R = \frac{e^{U_R}}{e^{U_R} + e^{U_T}}$$

where P_R is the market share for rail, U_R is the consumer utility derived from use of rail and U_T is the consumer utility derived from use of road. The utility functions shown in equation (1) are transformed into probability functions in order to predict the behaviour of an individual shipper.

The potential improvement in modal share under each investment option varies according to the improvement in service characteristics and rail's initial competitive position in each market corridor. Where rail already holds a high market share, the relative increase in rail's market share from the same improvement in service characteristics will be lower than corridors where rail has a greater market growth potential.

The functional form is based on the assumption that the mode choice for freight transport services is made by utility maximising freight customers. Utility is defined as the total satisfaction a consumer receives from consuming a good or service.

The utility function for rail was formulated in the following way: $U_R = c + \beta_P.P_R + \beta_R.R_R + \beta_A.A_R$ where P_R equals current or future rail price, R_R equals current or future rail reliability, A_R equals current or future rail availability, β_P is the coefficient for price, β_R is the coefficient for reliability, β_A is the coefficient for availability and *c* is constant or balancing term to match actual mode shares with the logit model's forecast outcomes in year 1. The coefficients or beta values (β) determine the importance or weighting of each parameter (price, reliability and availability) in the utility function.

Rail's mode share, P_R, can be derived using the logit model:

$$P_R = \frac{e^{U_R}}{e^{U_R} + e^{U_T}}$$

where U_R is the consumer's utility derived from use of rail and U_T is the consumer's utility derived from use of road. The utility functions shown in equation (1) are transformed into probability functions in order to predict the behaviour of an individual shipper.

3 Regression analysis and results

The data from surveys which formed the basis of the simulation (logit) modelling was of a stated preference type, that is, firms said what they would do in defined circumstances. This section reports on separate regression analysis exercises, using revealed preference data to examine the relationship between the known drivers of rail freight modal share and actual historical firm response.

3.1 Rail freight mode share regression analysis

The following rail freight mode share regression analysis utilises previously identified economic drivers of mode share, including price and the various service characteristics of rail, with a view to establishing a quantitative measure of their relationship with commodity and route specific rail freight tonnage.

3.1.1 Data

Yearly and monthly data was obtained for 2000-2005 from several industry sources. The data obtained was available at a disaggregated level, that is, by route and commodity. Data for lower-volume sectors was excluded on confidentiality grounds. Data regarding the following routes was included:

- Melbourne-Brisbane;
- Brisbane-Melbourne;
- Sydney-Brisbane;
- Brisbane-Sydney;
- Sydney-Melbourne; and
- Melbourne-Sydney.

Commodity-specific data was available for:

- freight forwarders’ containers;
- shipping containers;
- automotive containers; and
- steel.

The dependent and independent (descriptive) variables concerning this data consisted of:

- freight tonnage (net tonnes) by commodity and route;
- price by route as published by operators;
- transit time by route;
- reliability by route;
- service availability (monthly capacity) by route;
- a calculated measure of availability by route; and

- total final consumption expenditure (TFC).

Price was initially obtained as a dollar per tonne measure by size of container. The final price measure used in the regression analysis is a weighted average of each price, given total tonnages by container size. This price data was deflated using ABS (2006) seasonally adjusted implicit price deflators. This allowed for examination of real price change effects.

Reliability refers to the proportion of all rail services that reached their destination within plus or minus 15 minutes of the scheduled arrival time. Service availability refers to the number of rail services per month, hereafter referred to as monthly capacity.

The calculated measure of availability was constructed as a measure of the proportion of the market that could be serviced within a particular timeframe. This timeframe takes into account transit time for rail and the average pickup and delivery time for road freight between the customer and rail freight terminal.

The calculation involves working backwards from:

- The time trains need to arrive (8 am) to meet customers' overnight delivery requirements between Melbourne and Sydney; and Sydney and Brisbane; and
- The time trains need to arrive (8 am) to meet customers' over two-night delivery requirement between Melbourne and Brisbane.

Assuming that freight needs to arrive at the customer's door by 8am and that trains therefore need to arrive in cities by 5 am (allowing for a three-hour pickup and delivery by truck), by subtracting the rail transit time and the three-hour pickup and delivery time from the:

- maximum elapsed transit time for the Melbourne-Sydney and Sydney-Brisbane routes; and
- maximum elapsed transit time for the Melbourne-Brisbane route.

we can estimate the time on the previous day (or day before for Melbourne to Brisbane) that the freight would need to leave the customer's door. The calculations for the Melbourne-Sydney and Sydney-Brisbane, and Melbourne-Brisbane routes, respectively, are:

$$METT - RTT + PUD = PDDT$$

$$METT - RTT + PUD = DBPDDT$$

where $METT$ is the maximum elapsed transit time

RTT is rail transit time

PUD is pickup and delivery time (3 hours)

$PDDT$ is previous day delivery time

$DBPDDT$ is day before previous day delivery time.

A histogram of truck departures was used as an indicator of customers' preferred departure times to determine the proportion of customers' freight that could be picked up and delivered to a rail terminal via road freight, by the above departure time. This proportion is the calculated measure of availability used in the analysis, hereafter referred to as availability.

Finally, total final consumption (TFC) expenditure figures are taken from ABS (2006) seasonally adjusted chain volume measures of GDP. For yearly data sets, the ABS TCF numbers were applied directly. For monthly data sets, the ABS quarterly TCF figures were divided by three to determine the monthly TCF figure.

3.1.2 Panel data estimation

The econometric analysis was conducted via pooled cross-section time-series panel data estimation. The data was organised within the panel so that commodity and route were combined to form a specific or individual 'commodity-route', for example, Melbourne-Brisbane steel or Sydney-Melbourne shipping containers. The panel data set is therefore organised so that pooled time-series cross-section analysis could be performed across commodity routes for 2000-2005.

Panel data estimation is advantageous in that it allows for the estimation of dynamic time-series with few time periods, while controlling for cross commodity route heterogeneity, where heterogeneity is defined as the inherent difference between commodity routes.

A further benefit of panel data estimation is the ability to identify and measure effects that are not detectable via standalone cross-section or time-series analysis. Bias resulting from aggregation over observations is eliminated via panel data estimation, which also provides less co-linearity among variables, more degrees of freedom and greater efficiency (Baltagi, 1995).

The simplest model for the analysis of panel data is the linear (pooled) model in which explanatory variables are taken as exogenous, that is, independent of the disturbances contained in the estimating equations, where the estimating equation has the general functional form:

$$T_{it} = \alpha_0 + \beta_1 P_{it} + \beta_2 TT_{it} + \beta_3 \mathrm{Re}\,l_{it} + MC_{it} + A_{it} + e_{it}$$

Where

i denotes a specific commodity route

t denotes a specific time period

T_{it} is the tonnage for commodity route i at time t

β_i is the coefficient of the it^{th} variable

α_0 is a scalar intercept (constant)

P_{it} is the price of commodity route i at time t

TT_{it} is the transit time for commodity route i at time t

$\mathrm{Re}\,l_{it}$ is the reliability of commodity route i at time t

MC_{it} is the monthly capacity of commodity route i at time t

A_{it} is the availability of commodity route i at time t

e_{it} is the error term.

Depending on the results for a given model, variables were excluded or included in order to obtain a feasible model with the best fit.

3.1.3 Fixed-effects model

The commodity route panel data set outlined above is utilised for the ordinary least squares (OLS) estimation of various fixed-effects models (FEM). In the FEM, intercepts are assumed to be commodity route specific. The FEM contains separate constant/intercept terms, or commodity route specific effects (c_i), and is depicted by:

$$T_{it} = \sum_{j=i}^{108} c_i d_{jit} + \beta_1 P_{it} + \beta_2 TT_{it} + \beta_3 \mathrm{Re}\, l_{it} + \beta_4 MC_{it} + \beta_5 A_{it} + e_{it}$$

where $i, j = 1,2,...108$ and $t = 1,2,3,4,5,6$ for yearly data. For the monthly data $i, j = 1,2,...1080$ and $t = 1,2,...,72$.

The d_j terms in the FEM are commodity route specific dummy variables equal to one when $i = j$ and zero otherwise. A commodity route specific effect is interpreted as the inherent difference in the service characteristics for that route not captured by the explanatory variables.

3.1.4 Econometric models and results

Econometric analysis of the panel data set comprising economic drivers of rail freight tonnage by commodity route was conducted using alternative aggregate demand models via fixed-effects OLS estimation. The alternative aggregate demand models are the:

- linear aggregate demand fixed-effect model
- log-log aggregate demand fixed-effect model.

Log-linear models were trialled as part of this analysis. However, this variation did not produce sensible results. In general, there does not appear to be a logarithmic relationship between rail freight tonnage and the applied economic drivers used here.

The models presented below are those that yielded the most feasible results, particularly with regard to the signs and significance level of the estimated coefficients, and the overall fit (R-squared) of the model.

3.1.5 Linear aggregate demand fixed-effects models

The linear aggregate demand FEMs are shown in Model 1 and Model 2. The first FEM model includes monthly capacity which (along with price) is shown to be highly significant. The signs of the coefficients are sensible despite transit time and reliability not being significant (see Model 1).

The results from this model indicate that price and monthly capacity are important factors in the decision to send freight by rail. This indicates that where transit time and reliability are important or applicable factors in the decision to transport freight, freight is sent by road.

Model 1: price, transit time, reliability and monthly capacity

$$T_{it} = \sum_{j=i}^{108} c_i d_{jit} - 3140.4 P_{it} - 4701.1 TT_{it} + 8726.8 \mathrm{Re}\, l_{it} + 2462\, MC_{it}$$

T-Ratio -2.182 -1.002 0.4109 3.317

R-squared = 0.9638

Source: The Study Team.

The second FEM includes the calculated availability measure. This was included (despite being shown to be insignificant) due to concerns regarding the direction of causality between monthly capacity and tonnage. Namely, that increased tonnages may be driving increases in monthly capacity, as opposed to increased monthly capacity making rail freight transport more attractive, in the way that a decrease in price would.

The results for model two indicate that only price was significant; however, the signs for all of the coefficients are sensible. The inclusion of the calculated measure of availability (without the inclusion of monthly capacity) reinforces the significance of price as a determining factor in the use of rail for freight transport (see **Error! Reference source not found.**).

Model 2: price, transit time, reliability and availability

$$T_{it} = \sum_{j=i}^{108} c_i d_{jit} - 4804.8 P_{it} - 2087.8 TT_{it} + 2081.6 \mathrm{Re}\, l_{it} + 45952\, A_{it}$$

T-Ratio -4.263 -0.1612 0.07226 0.2335

R-squared = 0.9604

Source: The Study Team.

3.1.6 Application of monthly data to the aggregate demand FEM

Monthly data was obtained from three sources in the course of this Study for the purpose of performing the above estimations with a larger time-series, that is, 72 months (as opposed to six years) for each commodity route in the panel. It was intended that the larger time-series would allow for the examination of short-term effects and produce more reliable results.

Transit time was not included in these estimations as data could not be obtained by month. However, transit time is implicit in the calculated availability measure which is highly significant in this model. Price was also highly significant.

Model 3: price, lagged reliability and availability

$$T_{it} = \sum_{j=i}^{1080} c_i d_{jit} - 275.96 P_{it} + 774.8 \operatorname{Re} l_{it-1} + 9010.0 A_{it}$$

T-Ratio -4.931 1.109 2.053

R-squared = 0.9294

Source: The Study Team.

The overall fit of the model is indicated by its R-squared value of 0.9294. The negative sign of the price coefficient indicates an inverse relationship with tonnage as expected. Lagged reliability ($\operatorname{Re} l_{it-1}$) produced better results than the current period value of reliability ($\operatorname{Re} l_{it}$) and was therefore included.

This is also expected since previous month (historical) rail reliability is potentially more likely to influence the decision to send freight by rail than current period reliability. The extent of current period reliability may not be known at time t.

3.1.7 Log-log aggregate demand FEM incorporating relative road price

In its application to the yearly panel data set, in most cases it did not appear that a logarithmic relationship existed between rail freight tonnage and the explanatory variables. Despite this, the log-log aggregate demand FEM was used to successfully include relative road price in the model with a positive coefficient[1].

The t-ratio for the model coefficients LNP_{it} (-1.957), $LNRRP_{it}$ (0.1944), $LNTT_{it}$ (-2.384) and $LNMC_{it}$ (3.389) indicate that the natural log (LN) of price, transit time and monthly capacity are significant while LN relative road price (RRP) is not. The signs for all of the coefficients in this model are sensible, in particular the natural log of price and transit time are negative, indicating an inverse relationship with rail freight tonnage as expected, and the natural log of relative road price and monthly capacity are positive.

Positive coefficients for relative road price and monthly capacity are indicative of a positive relationship with rail freight tonnage. As relative road price and the monthly capacity of rail freight transport increase, the demand for rail freight transport increases.

[1] Relative road price was obtained using the ABS (2006) *Producer Price Indexes* which comprise relative price indexes for Australian Transport (Freight) and Storage Industries (see Table 4).

Model 4: LN price, LN relative road price, LN transit time and LN monthly capacity

$$LNT_{it} = \sum_{j=i}^{108} c_i d_{jit} - 6.8964\ LNP_{it} + 0.3374\ LNRRP_{it} - 7.7769\ LNTT_{it} + 2.2018\ LNMC_{it}$$

T-Ratio -1.957 0.1944 -2.384 3.389

R-squared = 0.8494

Source: *ACIL Tasman*

3.1.8 Examining the effect of total final consumption expenditure

The inclusion of total final consumption (TFC) expenditure moves from existing modal share modelling methodology designed to quantify the relationship between each mode's service characteristics and price, and that mode's respective share of aggregate freight flow. Under this scenario, the aggregate freight flows are exogenous. The inclusion of economic activity variables such as TFC makes aggregate freight flow an endogenous input to the model.

Despite this, TFC was included as an explanatory variable in the aggregate demand FEM in order to examine the relationship between economic activity and rail freight tonnage. TFC was included instead of GDP, as the direction of causality between rail freight tonnage and GDP is ambiguous, that is, rail freight transport is used to facilitate components of aggregate demand such as consumption and net exports and is therefore an explanator, or driver of GDP.

By contrast, TFC affects inventory levels which, when depleted, would have a positive effect on rail freight transport demand, especially in the transport of manufactured goods for domestic consumption via freight forwarders' containers. Therefore, lagged TFC (previous quarter TFC) was included as a measure of economic activity and a possible explanatory (causal) factor of rail freight tonnage (specifically freight forwarders' containers).

A linear aggregate demand FEM was estimated using monthly freight forwarders' container tonnage data by route as the dependent variable. The results for the most feasible model are presented in **Error! Reference source not found.** below. Price (-7.884) and availability (2.123) were significant. Reliability (0.9217) and lagged TFC (0.2976) were not.

Model 5: price, reliability, availability and total final consumption expenditure (TFC)

$$LNT_{it} = \sum_{j=i}^{108} c_i d_{jit} - 1004.7 P_{it} + 1529.6 \mathrm{Re} l_{it} + 20060\ A_{it} + 0.91848 \times 10^{-8} TFC_{t-3}$$

T-Ratio -7.884 0.9217 2.123 0.2967

R-squared = 0.9303

Source: The Study Team.

3.1.9 Rail freight price and service characteristic elasticities

Rail freight price and service characteristic elasticities were derived for all econometric models presented (see Table 2). Using the price elasticity of rail freight tonnage as an example, the elasticities were derived as:

(5)
$$E_P = \frac{\partial T}{\partial P} \cdot \frac{P}{T}$$

which equates to:

(6)
$$E_P = \beta_1 \cdot \frac{P_{mean}}{T_{mean}}$$

where β_1 is the price coefficient. The elasticity estimates are short-run, elasticity at mean value measures.

In summary the elasticity ranges for each rail service characteristic and price were:

- Price: -2.4653 to -1.155.
- Transit time: -2.3421 to -0.3872.
- Reliability: 0.0081 to 0.1247.
- Monthly capacity: 0.7354 to 0.7671.
- Availability: 0.1587 to 0.243.

Table 2 - Elasticity at means estimates for rail freight price and service characteristics

Model Number	Explanatory variable elasticity					
Model 1	Price	Transit time	Reliability	Monthly capacity		
Elasticity at mean values	-1.155	-0.8719	0.034	0.7354		
Model 2	Price	Transit time	Reliability		Availability	
Elasticity at mean values	-1.7672	-0.3872	0.0081		0.1587	
Model 3	Price		Lagged reliability		Availability	
Elasticity at mean values	-1.2033		0.0309		0.2114	
Model 4	LN Price	LN Transit time	LN Relative road price	Monthly capacity		
Elasticity at mean values	-2.4653	-2.3421	0.1247	0.7671		
Model 5	Price		Reliability	Monthly capacity	Availability	Lagged total final consumption
Elasticity at mean values	-2.2585		0.0284		0.243	0.0158

Source: The Study Team.

The elasticity results from this study can be cross-checked with previous results from Australian and international studies. Table 2 uses data sourced from an extensive literature review to determine known elasticity ranges for rail freight transport price and service characteristics.

Table 3 presents a summary of the available international literature regarding rail elasticity estimates. The most likely international rail price elasticity ranges from -1.52 to -0.09 with a most likely range of -1.20 to -0.4.

Table 3 - International and Australian freight elasticity ranges by attribute

Region	Corridor / Descriptor	Elasticity measure
	Rail	Price
International	Entire range	-1.52 to -0.09
	Most likely range	-1.20 to -0.4
		Transit time
International	Rail	-0.15 to 0.17
	Road	-1.00 to -0.13
		Quality / reliability
International	Rail	2.00
	Road	0.6 to 1.47
		Flexibility / service availability
International	Rail	0.4 to 1.79
	Road	1.27

Note: International includes Australian results.

Source: MM Starrs (2005), Effect of Truck Charges on Rail Information Paper.

From this table we can conclude that model 1 and model 3 produce price elasticities which fall into the existing international rail price elasticity range. Furthermore, model 1, model 3 and model 4 are the models in which price *and* availability (or monthly capacity) was found to be significant. Given the issues regarding monthly capacity, model 3 which included availability as an explanatory variable, would seem to be the most feasible of the models presented. The price elasticity measure is within the known and acceptable range and the availability measure is outside, but close to the known and acceptable range (0.2114 compared to 0.4 to 1.79).

3.1.10 Summary

A range of models have been presented in this section, each of which examines the relationship of price and alternative service characteristics to rail freight tonnage. The results for model 3 indicate that the explanatory variables have sensible coefficients, and price and availability are significant and have elasticity at means values which are within or close to known (previously determined) ranges. Finally, the model has an R-squared of 0.9294.

In relation to the use of this model for forecasting, it should be remembered that monthly data was used to conduct the estimation and it is therefore likely that this model captures short-term effects.

4 Price index

Table 4 - Relative price indexes for Australian road and rail freight transport

Period	Road	Rail
Jun 2001	101.8	93.9
Sep 2000	101.6	93.7
Dec 2000	102.7	95.7
Mar 2001	103.8	95.7
Jun 2001	104.2	96.2
Sep 2001	104.5	95.2
Dec 2001	104.8	96.1
Mar 2002	105.2	94.1
Jun 2002	105.3	94.0
Sep 2002	105.4	94.7
Dec 2002	106.6	93.6
Mar 2003	108.1	95.6
Jun 2003	109.2	95.4
Sep 2003	109.2	94.8
Dec 2003	109.8	95.0
Mar 2004	110.7	97.3
Jun 2004	111.0	95.7
Sep 2004	112.7	97.3
Dec 2004	115.6	98.0
Mar 2005	116.4	95.9
Jun 2005	118.5	95.7
Sep 2005	120.1	97.4
Dec 2005	121.8	98.1

Source: ABS (2006b) Producer Price Indexes, Catalogue Number 6247.0: Table 23 'Output of the transport (freight) and storage industries (A)'.

5 Forecast passenger numbers

Table 5 - Sydney-Wollongong projected passenger travel ('000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	1.009	1.007	1.027	1.03	1.007	1.025
1999	2.900	407.400	10717.800	15.600	1434.700	12578.400
2000	2.926	410.252	11007.181	16.068	1444.743	12892.860
2001	2.952	413.124	11304.374	16.550	1454.856	13215.182
2002	2.979	416.015	11609.593	17.047	1465.040	13545.561
2003	3.006	418.928	11923.052	17.558	1475.295	13884.200
2004	3.033	421.860	12244.974	18.085	1485.622	14231.305
2005	3.060	424.813	12575.588	18.627	1496.022	14587.088
2006	3.088	427.787	12915.129	19.186	1506.494	14951.765
2007	3.115	430.781	13263.838	19.762	1517.039	15325.559
2008	3.144	433.797	13621.961	20.354	1527.659	15708.698
2009	3.172	436.833	13989.754	20.965	1538.352	16101.415
2010	3.200	439.891	14367.478	21.594	1549.121	16503.951
2011	3.229	442.970	14755.399	22.242	1559.965	16916.550
2012	3.258	446.071	15153.795	22.909	1570.884	17339.463
2013	3.288	449.194	15562.948	23.596	1581.881	17772.950
2014	3.317	452.338	15983.147	24.304	1592.954	18217.274
2015	3.347	455.504	16414.692	25.033	1604.104	18672.705
2016	3.377	458.693	16857.889	25.784	1615.333	19139.523
2017	3.408	461.904	17313.052	26.558	1626.640	19618.011
2018	3.438	465.137	17780.504	27.355	1638.027	20108.461
2019	3.469	468.393	18260.578	28.175	1649.493	20611.173
2020	3.500	471.672	18753.614	29.021	1661.040	21126.452
2021	3.532	474.973	19259.961	29.891	1672.667	21654.614
2022	3.564	478.298	19779.980	30.788	1684.376	22195.979

Year	Air	Bus	Car	Other	Rail	All modes
2023	3.596	481.646	20314.040	31.712	1696.166	22750.878
2024	3.628	485.018	20862.519	32.663	1708.039	23319.650
2025	3.661	488.413	21425.807	33.643	1719.996	23902.642
2026	3.694	491.832	22004.303	34.652	1732.036	24500.208
2027	3.727	495.275	22598.420	35.692	1744.160	25112.713
2028	3.760	498.742	23208.577	36.762	1756.369	25740.531
2029	3.794	502.233	23835.209	37.865	1768.664	26384.044

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

Table 6 - Sydney-Canberra projected passenger travel ('000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	1.004	1.025	1.032	1.031	1.005	1.028
1999	538.000	409.400	3370.900	3.500	158.500	4480.300
2000	540.152	419.635	3478.769	3.609	159.293	4605.748
2001	542.313	430.126	3590.089	3.720	160.089	4734.709
2002	544.482	440.879	3704.972	3.836	160.889	4867.281
2003	546.660	451.901	3823.531	3.955	161.694	5003.565
2004	548.846	463.199	3945.884	4.077	162.502	5143.665
2005	551.042	474.778	4072.153	4.204	163.315	5287.688
2006	553.246	486.648	4202.462	4.334	164.131	5435.743
2007	555.459	498.814	4336.940	4.468	164.952	5587.944
2008	557.681	511.284	4475.722	4.607	165.777	5744.406
2009	559.912	524.067	4618.946	4.750	166.606	5905.249
2010	562.151	537.168	4766.752	4.897	167.439	6070.596
2011	564.400	550.597	4919.288	5.049	168.276	6240.573
2012	566.657	564.362	5076.705	5.205	169.117	6415.309
2013	568.924	578.471	5239.160	5.366	169.963	6594.938
2014	571.200	592.933	5406.813	5.533	170.813	6779.596
2015	573.484	607.757	5579.831	5.704	171.667	6969.425
2016	575.778	622.951	5758.385	5.881	172.525	7164.569
2017	578.082	638.524	5942.654	6.064	173.388	7365.177
2018	580.394	654.487	6132.819	6.251	174.255	7571.401
2019	582.715	670.850	6329.069	6.445	175.126	7783.401
2020	585.046	687.621	6531.599	6.645	176.002	8001.336
2021	587.386	704.811	6740.610	6.851	176.882	8225.373
2022	589.736	722.432	6956.310	7.063	177.766	8455.684
2023	592.095	740.492	7178.912	7.282	178.655	8692.443
2024	594.463	759.005	7408.637	7.508	179.548	8935.831

Year	Air	Bus	Car	Other	Rail	All modes
2025	596.841	777.980	7645.713	7.741	180.446	9186.035
2026	599.229	797.429	7890.376	7.981	181.348	9443.244
2027	601.625	817.365	8142.868	8.228	182.255	9707.654
2028	604.032	837.799	8403.440	8.483	183.166	9979.469
2029	606.448	858.744	8672.350	8.746	184.082	10258.894

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

Table 7 - Sydney-Melbourne projected passenger travel (‘000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	1.039	1.003	0.99	1.002	0.982	1.031
1999	4284.100	201.300	1024.900	22.900	129.800	5663.100
2000	4451.180	201.904	1014.651	22.946	127.464	5838.656
2001	4624.776	202.510	1004.504	22.992	125.169	6019.654
2002	4805.142	203.117	994.459	23.038	122.916	6206.264
2003	4992.543	203.726	984.515	23.084	120.704	6398.658
2004	5187.252	204.338	974.670	23.130	118.531	6597.016
2005	5389.555	204.951	964.923	23.176	116.397	6801.524
2006	5599.747	205.566	955.274	23.223	114.302	7012.371
2007	5818.137	206.182	945.721	23.269	112.245	7229.755
2008	6045.045	206.801	936.264	23.316	110.224	7453.877
2009	6280.802	207.421	926.901	23.362	108.240	7684.947
2010	6525.753	208.043	917.632	23.409	106.292	7923.180
2011	6780.257	208.668	908.456	23.456	104.379	8168.799
2012	7044.687	209.294	899.371	23.503	102.500	8422.032
2013	7319.430	209.921	890.378	23.550	100.655	8683.115
2014	7604.888	210.551	881.474	23.597	98.843	8952.291
2015	7901.478	211.183	872.659	23.644	97.064	9229.812
2016	8209.636	211.816	863.932	23.691	95.317	9515.937
2017	8529.812	212.452	855.293	23.739	93.601	9810.931
2018	8862.475	213.089	846.740	23.786	91.916	10115.069
2019	9208.111	213.728	838.273	23.834	90.262	10428.637
2020	9567.227	214.370	829.890	23.881	88.637	10751.924
2021	9940.349	215.013	821.591	23.929	87.042	11085.234
2022	10328.023	215.658	813.375	23.977	85.475	11428.876
2023	10730.816	216.305	805.242	24.025	83.936	11783.171
2024	11149.318	216.954	797.189	24.073	82.426	12148.450

Year	Air	Bus	Car	Other	Rail	All modes
2025	11584.141	217.605	789.217	24.121	80.942	12525.052
2026	12035.923	218.257	781.325	24.169	79.485	12913.328
2027	12505.324	218.912	773.512	24.218	78.054	13313.642
2028	12993.031	219.569	765.777	24.266	76.649	13726.364
2029	13499.759	220.228	758.119	24.315	75.270	14151.882

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

Table 8 - Sydney-Dubbo projected passenger travel ('000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	0.994	1.007	1.025	1.004	0.995	1.022
1999	161.900	120.100	2849.500	26.400	114.900	3272.700
2000	160.929	120.941	2920.738	26.506	114.326	3344.699
2001	159.963	121.787	2993.756	26.612	113.754	3418.283
2002	159.003	122.640	3068.600	26.718	113.185	3493.485
2003	158.049	123.498	3145.315	26.825	112.619	3570.342
2004	157.101	124.363	3223.948	26.932	112.056	3648.889
2005	156.158	125.233	3304.546	27.040	111.496	3729.165
2006	155.221	126.110	3387.160	27.148	110.938	3811.206
2007	154.290	126.993	3471.839	27.257	110.384	3895.053
2008	153.364	127.882	3558.635	27.366	109.832	3980.744
2009	152.444	128.777	3647.601	27.475	109.283	4068.320
2010	151.529	129.678	3738.791	27.585	108.736	4157.824
2011	150.620	130.586	3832.261	27.695	108.192	4249.296
2012	149.717	131.500	3928.067	27.806	107.651	4342.780
2013	148.818	132.421	4026.269	27.917	107.113	4438.321
2014	147.925	133.348	4126.926	28.029	106.578	4535.964
2015	147.038	134.281	4230.099	28.141	106.045	4635.756
2016	146.156	135.221	4335.851	28.254	105.515	4737.742
2017	145.279	136.168	4444.248	28.367	104.987	4841.973
2018	144.407	137.121	4555.354	28.480	104.462	4948.496
2019	143.541	138.081	4669.238	28.594	103.940	5057.363
2020	142.679	139.047	4785.968	28.709	103.420	5168.625
2021	141.823	140.020	4905.618	28.823	102.903	5282.335
2022	140.972	141.001	5028.258	28.939	102.388	5398.546
2023	140.126	141.988	5153.965	29.054	101.876	5517.314
2024	139.286	142.981	5282.814	29.171	101.367	5638.695

Year	Air	Bus	Car	Other	Rail	All modes
2025	138.450	143.982	5414.884	29.287	100.860	5762.746
2026	137.619	144.990	5550.256	29.405	100.356	5889.527
2027	136.794	146.005	5689.013	29.522	99.854	6019.096
2028	135.973	147.027	5831.238	29.640	99.355	6151.516
2029	135.157	148.056	5977.019	29.759	98.858	6286.850

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

Table 9 - Sydney-Brisbane projected passenger travel ('000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	1.042	0.997	0.992	0.992	0.986	1.033
1999	1717.800	87.400	507.800	37.600	49.500	2400.000
2000	1789.948	87.138	503.738	37.299	48.807	2479.200
2001	1865.125	86.876	499.708	37.001	48.124	2561.014
2002	1943.461	86.616	495.710	36.705	47.450	2645.527
2003	2025.086	86.356	491.744	36.411	46.786	2732.829
2004	2110.140	86.097	487.810	36.120	46.131	2823.013
2005	2198.765	85.839	483.908	35.831	45.485	2916.172
2006	2291.114	85.581	480.037	35.544	44.848	3012.406
2007	2387.340	85.324	476.196	35.260	44.220	3111.815
2008	2487.609	85.068	472.387	34.978	43.601	3214.505
2009	2592.088	84.813	468.608	34.698	42.991	3320.584
2010	2700.956	84.559	464.859	34.420	42.389	3430.163
2011	2814.396	84.305	461.140	34.145	41.795	3543.359
2012	2932.601	84.052	457.451	33.872	41.210	3660.289
2013	3055.770	83.800	453.791	33.601	40.633	3781.079
2014	3184.112	83.549	450.161	33.332	40.064	3905.855
2015	3317.845	83.298	446.560	33.065	39.504	4034.748
2016	3457.195	83.048	442.987	32.801	38.950	4167.894
2017	3602.397	82.799	439.443	32.539	38.405	4305.435
2018	3753.697	82.550	435.928	32.278	37.867	4447.514
2019	3911.353	82.303	432.440	32.020	37.337	4594.282
2020	4075.629	82.056	428.981	31.764	36.815	4745.894
2021	4246.806	81.810	425.549	31.510	36.299	4902.508
2022	4425.172	81.564	422.145	31.258	35.791	5064.291
2023	4611.029	81.320	418.767	31.008	35.290	5231.412
2024	4804.692	81.076	415.417	30.760	34.796	5404.049

Year	Air	Bus	Car	Other	Rail	All modes
2025	5006.489	80.832	412.094	30.513	34.309	5582.383
2026	5216.762	80.590	408.797	30.269	33.828	5766.601
2027	5435.866	80.348	405.527	30.027	33.355	5956.899
2028	5664.172	80.107	402.283	29.787	32.888	6153.477
2029	5902.067	79.867	399.064	29.549	32.427	6356.542

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

Table 10 - Melbourne-Brisbane projected passenger travel ('000s) by mode: 1999 to 2029

Year	Air	Bus	Car	Other	Rail	All modes
Average annual growth rate	1.036	0.984	0.986	0.992	0.991	1.031
1999	838.200	15.600	132.600	3.500	3.100	992.900
2000	868.375	15.350	130.744	3.472	3.072	1023.680
2001	899.637	15.105	128.913	3.444	3.044	1055.414
2002	932.024	14.863	127.108	3.417	3.017	1088.132
2003	965.576	14.625	125.329	3.389	2.990	1121.864
2004	1000.337	14.391	123.574	3.362	2.963	1156.642
2005	1036.349	14.161	121.844	3.335	2.936	1192.498
2006	1073.658	13.934	120.138	3.309	2.910	1229.465
2007	1112.310	13.712	118.456	3.282	2.884	1267.578
2008	1152.353	13.492	116.798	3.256	2.858	1306.873
2009	1193.837	13.276	115.163	3.230	2.832	1347.386
2010	1236.816	13.064	113.551	3.204	2.807	1389.155
2011	1281.341	12.855	111.961	3.178	2.781	1432.219
2012	1327.469	12.649	110.393	3.153	2.756	1476.618
2013	1375.258	12.447	108.848	3.128	2.731	1522.393
2014	1424.767	12.248	107.324	3.103	2.707	1569.587
2015	1476.059	12.052	105.822	3.078	2.683	1618.245
2016	1529.197	11.859	104.340	3.053	2.658	1668.410
2017	1584.248	11.669	102.879	3.029	2.634	1720.131
2018	1641.281	11.482	101.439	3.005	2.611	1773.455
2019	1700.367	11.299	100.019	2.981	2.587	1828.432
2020	1761.581	11.118	98.619	2.957	2.564	1885.113
2021	1824.998	10.940	97.238	2.933	2.541	1943.552
2022	1890.697	10.765	95.877	2.910	2.518	2003.802
2023	1958.763	10.593	94.534	2.886	2.495	2065.920
2024	2029.278	10.423	93.211	2.863	2.473	2129.963

Year	Air	Bus	Car	Other	Rail	All modes
2025	2102.332	10.256	91.906	2.840	2.451	2195.992
2026	2178.016	10.092	90.619	2.818	2.429	2264.068
2027	2256.425	9.931	89.351	2.795	2.407	2334.254
2028	2337.656	9.772	88.100	2.773	2.385	2406.616
2029	2421.811	9.616	86.866	2.751	2.364	2481.221

Note: Projections are made using BTRE (2006) average annual growth rates which are applied to the 1999 base year data. Differences between the BTRE (2006) publication and the above values are due to rounding.

Source: BTRE (2006).

6 Forecast population and route passenger growth

Table 11 - Population and route-specific passenger rail growth rates: 2006 to 2029

Year	ABS (2005) Sydney area population growth rates	BTRE (2006) Sydney-Canberra passenger rail growth rates	BTRE (2006) Sydney-Wollongong passenger rail growth rates	TPDC (2004) Sydney-Newcastle area population growth rates
2006	1.00978745	1.005	1.007	1.005
2007	1.00940922	1.005	1.007	1.005
2008	1.00940922	1.005	1.007	1.005
2009	1.00940922	1.005	1.007	1.005
2010	1.00940922	1.005	1.007	1.005
2011	1.00940922	1.005	1.007	1.005
2012	1.00859696	1.005	1.007	1.008
2013	1.00859696	1.005	1.007	1.008
2014	1.00859696	1.005	1.007	1.008
2015	1.00859696	1.005	1.007	1.008
2016	1.00859696	1.005	1.007	1.008
2017	1.00791769	1.005	1.007	1.008
2018	1.00791769	1.005	1.007	1.008
2019	1.00791769	1.005	1.007	1.008
2020	1.00791769	1.005	1.007	1.008
2021	1.00791769	1.005	1.007	1.008
2022	1.00732965	1.005	1.007	1.008
2023	1.00732965	1.005	1.007	1.008
2024	1.00732965	1.005	1.007	1.008
2025	1.00732965	1.005	1.007	1.008
2026	1.00732965	1.005	1.007	1.008

Year	ABS (2005) Sydney area population growth rates	BTRE (2006) Sydney-Canberra passenger rail growth rates	BTRE (2006) Sydney-Wollongong passenger rail growth rates	TPDC (2004) Sydney-Newcastle area population growth rates
2027	1.00657636	1.005	1.007	1.008
2028	1.00657636	1.005	1.007	1.008
2029	1.00657636	1.005	1.007	1.008

Note: The ABS (2005) population growth rates used here are an average of the Series A, B and C projections for NSW (catalogue number 3222.0).

Source: ABS (2005). TPDC (2004). BTRE (2006).

Table 12 - Newcastle-Sydney route passenger and capacity utilisation projections: 2005 to 2029

Morning peak time rail services departing Woy Woy south: average seating capacity (2001-2005) = 12,874 seats				
Year	TPDC Newcastle area population growth rates		ABS (2005) Sydney area population growth rates	
	Passengers	Utilisation %	Passengers	Utilisation %
2005	8949	0.70	8949	0.70
2006	8994	0.70	9036	0.70
2007	9039	0.70	9122	0.71
2008	9084	0.71	9207	0.72
2009	9129	0.71	9294	0.72
2010	9175	0.71	9381	0.73
2011	9221	0.72	9470	0.74
2012	9294	0.72	9551	0.74
2013	9369	0.73	9633	0.75
2014	9444	0.73	9716	0.75
2015	9519	0.74	9800	0.76
2016	9596	0.75	9884	0.77
2017	9672	0.75	9962	0.77
2018	9750	0.76	10041	0.78
2019	9828	0.76	10120	0.79
2020	9906	0.77	10201	0.79
2021	9986	0.78	10281	0.80
2022	10065	0.78	10357	0.80
2023	10146	0.79	10433	0.81
2024	10227	0.79	10509	0.82
2025	10309	0.80	10586	0.82
2026	10391	0.81	10664	0.83
2027	10475	0.81	10734	0.83
2028	10558	0.82	10804	0.84

Morning peak time rail services departing Woy Woy south: average seating capacity (2001-2005) = 12,874 seats				
2029	10643	0.83	10875	0.84

Note: Average seating capacity is the average seating capacity after the year 2000. The initial passenger (utilisation) value is the greater of the average passengers after the year 2000 or the most recent passenger value. This methodology results in the most conservative measure, that is, the earliest year in which capacity could be exceeded.

Source: The Study Team.

Table 13 - Sydney-Newcastle route passenger and capacity utilisation projections: 2005 to 2029

Evening peak time rail services departing Hornsby north: average seating capacity (2001-2005) = 12,728 seats				
Year	TPDC (2004) Newcastle area population growth rates		ABS (2005) Sydney area population growth rates	
	Passengers	Utilisation %	Passengers	Utilisation %
2005	9191	0.72	9191	0.72
2006	9237	0.73	9281	0.73
2007	9284	0.73	9369	0.74
2008	9330	0.73	9457	0.74
2009	9377	0.74	9546	0.75
2010	9424	0.74	9636	0.76
2011	9471	0.74	9726	0.76
2012	9546	0.75	9810	0.77
2013	9623	0.76	9894	0.78
2014	9700	0.76	9979	0.78
2015	9777	0.77	10065	0.79
2016	9856	0.77	10152	0.80
2017	9934	0.78	10232	0.80
2018	10014	0.79	10313	0.81
2019	10094	0.79	10395	0.82
2020	10175	0.80	10477	0.82
2021	10256	0.81	10560	0.83
2022	10338	0.81	10637	0.84
2023	10421	0.82	10715	0.84
2024	10504	0.83	10794	0.85
2025	10588	0.83	10873	0.85
2026	10673	0.84	10953	0.86
2027	10758	0.85	11025	0.87
2028	10844	0.85	11097	0.87

Evening peak time rail services departing Hornsby north: average seating capacity (2001-2005) = 12,728 seats				
2029	10931	0.86	11170	0.88

Note: Average seating capacity is the average seating capacity after the year 2000. The initial passenger (utilisation) value is the greater of the average passengers after the year 2000 or the most recent passenger value. This methodology results in the most conservative measure, that is, the earliest year in which capacity could be exceeded.

Source: The Study Team.

Table 14 - Sydney-Wollongong route passenger and capacity utilisation projections: 2005 to 2029

Evening peak time rail services departing Sutherland south: average seating capacity (2001-2005) = 6,122 seats				
Year	BTRE (2006) Sydney-Wollongong passenger rail growth rates		ABS (2005) Sydney area population growth rates	
	Passengers	Utilisation %	Passengers	Utilisation %
2005	3422	0.56	3422	0.56
2006	3445	0.56	3455	0.56
2007	3469	0.57	3488	0.57
2008	3494	0.57	3520	0.57
2009	3518	0.57	3554	0.58
2010	3543	0.58	3587	0.59
2011	3567	0.58	3621	0.59
2012	3592	0.59	3652	0.60
2013	3618	0.59	3683	0.60
2014	3643	0.60	3715	0.61
2015	3668	0.60	3747	0.61
2016	3694	0.60	3779	0.62
2017	3720	0.61	3809	0.62
2018	3746	0.61	3839	0.63
2019	3772	0.62	3870	0.63
2020	3799	0.62	3900	0.64
2021	3825	0.62	3931	0.64
2022	3852	0.63	3960	0.65
2023	3879	0.63	3989	0.65
2024	3906	0.64	4018	0.66
2025	3933	0.64	4048	0.66
2026	3961	0.65	4077	0.67
2027	3989	0.65	4104	0.67
2028	4017	0.66	4131	0.67

Evening peak time rail services departing Sutherland south: average seating capacity (2001-2005) = 6,122 seats				
2029	4045	0.66	4158	0.68

Note: Average seating capacity is the average seating capacity after the year 2000. The initial passenger (utilisation) value is the greater of the average passengers after the year 2000 or the most recent passenger value. This methodology results in the most conservative measure, that is, the earliest year in which capacity could be exceeded.

Source: The Study Team.

Table 15 - Wollongong-Sydney route passenger and capacity utilisation projections: 2005 to 2029

Morning peak time rail services departing Helensburgh north: average seating capacity (2001-2005) = 6,222 seats				
Year	BTRE (2006) Sydney-Wollongong passenger rail growth rates		ABS (2005) Sydney area population growth rates	
	Passengers	Utilisation %	Passengers	Utilisation %
2005	3885	0.62	3885	0.62
2006	3912	0.63	3923	0.63
2007	3940	0.63	3960	0.64
2008	3967	0.64	3997	0.64
2009	3995	0.64	4035	0.65
2010	4023	0.65	4073	0.65
2011	4051	0.65	4111	0.66
2012	4079	0.66	4146	0.67
2013	4108	0.66	4182	0.67
2014	4137	0.66	4218	0.68
2015	4166	0.67	4254	0.68
2016	4195	0.67	4291	0.69
2017	4224	0.68	4325	0.70
2018	4254	0.68	4359	0.70
2019	4284	0.69	4394	0.71
2020	4314	0.69	4428	0.71
2021	4344	0.70	4463	0.72
2022	4374	0.70	4496	0.72
2023	4405	0.71	4529	0.73
2024	4436	0.71	4562	0.73
2025	4467	0.72	4596	0.74
2026	4498	0.72	4629	0.74
2027	4529	0.73	4660	0.75
2028	4561	0.73	4691	0.75

Morning peak time rail services departing Helensburgh north: average seating capacity (2001-2005) = 6,222 seats				
2029	4593	0.74	4721	0.76

Note: Average seating capacity is the average seating capacity after the year 2000. The initial passenger (utilisation) value is the greater of the average passengers after the year 2000 or the most recent passenger value. This methodology results in the most conservative measure, that is, the earliest year in which capacity could be exceeded.

Source: The Study Team.

7 OZPASS Model

The BTRE (2006) domestic passenger travel projections are derived from the OZPASS model which uses a constrained gravity-model relationship to project growth in total domestic resident inter-regional passenger travel. In this gravity model formulation, growth in passenger travel between each origin-destination pair is modelled as a function of relative population and income growth, which are inversely related to the distance between the two regions.

In the OZPASS model, growth in passenger travel out of any region is a function of the growth in the population of that region and growth in national incomes and travel costs. This growth is constrained, however, in that total passenger trips out of any region are not allowed to exceed the trip generating capacity of that region, where that trip generating capacity is equal to:

$$T_{ij} = 0.5(\hat{P}_i + \hat{P}_j) - 1.25(\hat{C} - \hat{Y}) \qquad (1)$$

where T_{ij} is growth in total trips from region i to region j;

$\hat{P}_i$ and $\hat{P}_j$ are growth in total population in region i and region j ;

$\hat{C}$ is the growth in the real generalised cost of travel; and

$\hat{Y}$ is the growth in real average weekly earnings.

The constrained gravity model provides projections of total passenger trips between each origin-destination pair, but does not determine modal share.

8 Expected truck driver shortages

Further to the discussion in the main report, the impending shortage of linehaul truck drivers is expected to be the biggest challenge facing the trucking industry.

The transport firms interviewed by ACIL Tasman identified truck driver recruitment problems as a growing challenge for the industry (and an opportunity for the rail industry).

The possibility of a serious shortage of truck drivers was first identified in 2000 when an APS (2000) *Freight Business Australia Quarterly Industry Survey* revealed that 62% of the freight company heads surveyed saw a shortage of skilled truck drivers as one of the biggest issues facing the industry (BTRE 2003).

Shortage of particular types of labour will normally result in an increase in wages, relative to wages in general. In economic terms as the quantity of drivers decline, the price rises and the industry adapts by more efficient use of drivers (e.g. larger trucks) and/or a switch to other modes.

8.1 Factors affecting the supply of truck drivers

Industry representatives have expressed concern about the steep decline in the uptake of the truck driving profession by young people. The decline is believed to be associated with the falling margins of the freight industry, changing lifestyle preferences of younger generations, high insurance cost for drivers under the age of 25 and lack of formal training programs. Overall, regulation, lifestyle, age and age restriction effects are decreasing the supply of drivers in the transport industry.

Ageing population

The rate of retirement of truck drivers is likely to increase in the near future, in line with Australia's ageing population. An ageing workforce is believed to be one of the important contributing factors to the decreased supply of truck drivers. Census data indicates that the age profile of workers who classify themselves as truck drivers is rapidly increasing. Between 1996 and 2001, both the number and proportion of truck drivers aged between 15 and 35 years of age fell significantly. This trend is apparent at both national and state levels. Continuation of this trend would mean that by 2011 nearly 70% of truck drivers will be aged over 45, and only about 10% will be under 35 years of age (BTRE, 2003).

Recruitment

ACIL Tasman's industry interviews confirmed that truck driving does not appeal to young people in the way it has to previous generations, that is, the labour preferences of younger generations have changed.

In response, changes have been made to the trucking industry which potentially makes the work more acceptable. These include better training, improved professional standards, and rostering arrangements which have decreased the likelihood of having to spend nights away from home.

8.1.1 The potential to counter a driver shortage

To date, the effects of the looming shortage have been delayed by improvements in vehicle productivity, requiring fewer numbers of vehicles to undertake a given freight movement task - a trend that is expected to continue.

In the United States, companies in an attempt to lure drivers into the industry have begun outfitting more of their cabs with satellite radio and television and introducing policies to allow drivers to bring partners and pets on the road. Large truck stops are being encouraged to install internet portals in an attempt to increase the accessibility of the Internet and its associated benefits. (Urbina, 2006).

In Australia, reform of regulatory regimes such as Performance Based Standards (PBS) and improved driver conditions may also assist the situation to some extent. But in view of the magnitude of shifts in the age profile of truck drivers and the growth in freight volumes, the road freight transport industry will face a challenge in the task of having its demand for qualified truck drivers met at the current wage rates (BTRE, 2003).

8.2 Effects of higher truck driver wage rates

The increased wage rates are likely to be passed on, at least in part, to consumers of road freight transport, that is, the decreased supply of truck drivers is likely to place upward pressure on future road prices. A consequence of decreased driver supply is an increase in road transport prices as production costs increase, with increasing truck driver labour costs (drivers' wages).

Some States/Territories are likely to be affected more than others. Data shows that Queensland and Western Australia have experienced decreases in the numbers of drivers relative to the number of trucks for 1996–2001. It appears that an increasing driver shortage is more acute in the long-distance section of the industry and in rural Australia (Lawson 2002).

8.2.1 Increased driver labour costs across modes

Increasing labour costs are likely to impact on total road freight costs more than on rail or sea freight because driver wages form a larger part of total costs. The difference is not as great as it first may appear, as labour costs are spread across terminal facilities for rail and sea freight transport. Labour is estimated to be above 20% of total road operating costs (on short and medium haul routes typically found within the North-South corridor) and only 15-17% of rail operating costs.

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