DEMAND FOR AIR PASSENGER TRAVEL IN AUSTRALIA

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ABSTRACT: *Apart from the impact of significant fluctuations in general economic conditions over the last decade, the air passenger travel market has witnessed many important policy changes and industry initiatives during that period. This paper reports the results of empirical investigations dealing with the demand for air travel.*

The air passenger travel industry is segmented into international, trunk, secondary trunk, reigonal and commuter markets. For each of the identified travel markets, the analysis starts by reviewing recent trends in patronage. Aggregate demand models are developed for each market using pooled cross-sectional and time series data. Where applicable, these models are supplemented by route-specific sub-models to allow for differences in purposes of travel and in route characteristics.

The views expressed in this paper do not necessarily reflect the opinions of the Bureau of Transport Economics.

INTRODUCTION

The air travel industry is dynamic in nature. The industry has witnessed many important changes over the last decade. Apart from the impact of significant fluctuations in general economic conditions, there have been major policy and industry initiatives. These included:

- introduction of excursion fares to London (1972);
- establishment of a national air fare formula in Australia (1974);
- introduction of advance purchase excursion (APEX) fares to London (1977);
- Domestic Air Transport Policy Review (1978) leading to some liberalisation in the domestic scene (for example, limited ability to compete in price on trunk routes);
- Australia's International Civil Aviation Policy was reviewed in 1978 resulting in the introduction of 'point-to-point' fares to Europe, the United States and New Zealand in 1979 and to Asian destinations in 1980;
- introduction of off-peak/APEX fares and the promotion of group/holiday fares by the trunk airlines;
- use of wide-bodied aircraft and vertical integration by the two main domestic airlines (TAA and AAA) into tourist development;
- establishment of the Independent Air Fares Committee (1981); and
- significant increases in air navigation charges for general aviation for cost recovery purposes (1982).

The impact of these changes on the demand for air travel (in terms of passenger movements) is examined in this paper. Demand for air passenger travel has been disaggregated according to types of services (or markets) in this study. These markets are international, trunk, secondary trunk, regional and commuter(1). In each of these markets, the analysis starts by briefly reviewing recent trends in patronage (between 1971 and 1981). This is followed by estimating aggregate market demand models for each market using pooled cross-sectional and time series data (during the period from March quarter 1976 to September quarter 1981). Where necessary, the market demand aggregate model is supplemented by route-specific sub-models to allow for differences in the purposes of air travel (such as business or non-business) and differences in route characteristics(2).

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(1) Data limitations precluded the inclusion of the rest of general aviation in this study.

(2) For a detailed discussion of the models reported in this paper, see BTE (1982) and BTE (1983). For earlier work by the BTE on demand for air travel, see BTE (1978a) and BTE (1978b).

DEMAND-AND-SUPPLY MODEL

Market statistics (equilibrium price and quantity for a given commodity/service) are the outcome of the interaction between the market forces of demand and supply. The 'demand-and-supply' model representing the interplay between these forces consists of the two structural relationships of demand and supply plus the market clearance identity (Say's condition). Unless an explicit assumption can be made regarding the elasticity of supply in the short run (that is, supply is either completely elastic or inelastic to changes in price), the 'demand-and-supply' model must be solved simultaneously for the two endogenous variables of price and quantity.

However, when supply is either completely elastic or inelastic in the short run, the 'demand-and-supply' model can be reduced to a single market transformation (reduced form) function(1). If supply is assumed to be perfectly elastic, the market transformation function would approximate the Cournot-Marshall demand curve subject to the *ceteris paribus* clause (that is, describing how consumers/users would react to changes in price - Wold and Jureen, 1953). In view of the nature of supply response of air services in the short run (for example, the ability of airlines to increase the level of aircraft utilisation, diversion of aircraft between routes, and so on), the assumption that supply is completely elastic in the short run was adopted.

MODEL SPECIFICATION

Subject to the above assumption relating to the elasticity of supply of air services in the short run, an extended version of the market transformation function was used in the empirical analyses reported below. Such an extension was undertaken to gauge the effect of the explanatory variables, other than price, on demand for air passenger travel. These variables comprised income, cost of alternative modes of transport, population and market-specific factors for route-specific sub-models.

In general, the different air passenger market demand models can be expressed in functional form as follows:

$$\text{demand} = f(\text{air fare, income, cost of alternative modes, population(2), seasonal dummies}) \qquad (i)$$

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(1) Butler and Saad (1974) have shown how the 'demand-and-supply' model can be reduced to a single equation under these two assumptions relating to the elasticity of supply in the short run.

(2) In some cases, the empirical analysis was couched in terms of demand per capita. This involves the implicit assumption that the demand elasticity with respect to population is equal to unity. Such specification was made necessary when variations in population during the estimation period were relatively small and/or it was desired to reduce the number of coefficients to be estimated.

where air fare, income and cost of alternative modes of transport are in real terms. For route-specific sub-models, the specific and local factors are included as appropriate in model (i). The ordinary least-squares method was used to estimate the coefficients of the market demand models which were in 'double-log' specification. Hence, the estimated coefficients represent average 'constant' elasticities.

INTERNATIONAL AIR PASSENGER TRAVEL MARKET

The pattern of international travel by Australian residents and that of overseas visitors to Australia is viewed in this paper from a number of perspectives. These perspectives include duration of the trip (short- or long-term movements), purpose of travel (business or non-business travel), or country of origin and destination of the traveller. Table 1 shows total passenger movements (both long- and short-term) to and from Australia over the 11 years between 1971 and 1981. Some significant features that can be observed in Table 1 are as follows:

- total international passenger movements increased from 1.84 million movements in 1971 to over 4.53 million movements in 1981 (an average annual growth rate of nearly 10 per cent);
- the relative significance of long-term movements (of 12 months or more duration) continually declined throughout this period, as a result of the cutback in migration contracts and the assisted passage scheme;
- short-term movements (of less than 12 months duration) by Australian residents more than tripled during this period;
- short-term movements by overseas visitors experienced an increase from 0.84 million movements in 1971 to nearly 1.84 million movements in 1981; and
- since 1977 the annual growth rates for overseas visitors were higher than the corresponding rates for Australian residents.

The break-down of short-term movements by air to and from Australia by purpose of travel for the two calendar years of 1976 and 1981 is given in Table 2. Between these years, short-term movements of Australian residents to visit friends and relatives and to holiday overseas (that is, non-business travel) remained relatively constant at about 78 per cent of total movements, while business travel increased from 13 per cent in 1976 to 16 per cent in 1981. For overseas visitors, non-business travel to Australia increased in relative terms from just over 57 per cent in 1976 to 70 per cent in 1981. Business travel to Australia by overseas residents declined in relative terms from just over 20 per cent in 1976 to under 17 per cent in 1981.

The geographical destinations of the trips made by Australian residents have undergone marked changes, between 1976 and 1981. Such destination switching is due partly to the relatively lower ground cost component in Asia-Pacific countries compared with Europe, and partly to the changes in tastes and

TABLE 1 - OVERSEAS ARRIVALS AND DEPARTURES - TOTAL MOVEMENTS[a], YEARS ENDING 31 DECEMBER 1971 TO 31 DECEMBER 1981

('000)

Year ending 31 December	Permanent/Long-term			Short-term						Total		
				Australian residents			Overseas visitors					
	Movements ('000)	Proportion of total (per cent)	Annual change (per cent)	Movements ('000)	Proportion of total (per cent)	Annual change (per cent)	Movements ('000)	Proportion of total (per cent)	Annual change (per cent)	Movements ('000)	Proportion of total (per cent)	Annual change (per cent)
1971	254	13.9		736	40.1		844	46.0		1835	100.0	
1972	245	12.3	-3.7	922	46.2	25.3	830	41.6	-1.7	1997	100.0	8.9
1973	259	10.9	5.9	1195	50.2	29.6	924	38.9	11.3	2378	100.0	19.1
1974	282	10.2	8.7	1455	52.7	21.8	1023	37.1	10.7	2759	100.0	16.0
1975	251	8.2	-10.8	1792	58.5	23.2	1022	33.4	-	3066	100.0	11.1
1976	257	7.9	2.5	1942	59.9	8.4	1044	32.2	2.1	3244	100.0	5.8
1977	267	8.1	3.7	1945	58.7	0.2	1104	33.3	5.7	3316	100.0	2.2
1978	258	7.2	-3.4	2092	58.5	7.6	1228	34.3	11.2	3577	100.0	7.9
1979	265	6.4	2.9	2320	56.2	10.9	1546	37.4	25.9	4131	100.0	15.5
1980	275	6.2	3.7	2398	53.9	3.4	1779	40.0	15.1	4452	100.0	7.8
1981	298	6.6	8.4	2399	52.9	-	1837	40.6	3.3	4534	100.0	1.8
Average annual growth rate (per cent)	1.6			12.5			8.1			9.5		

(a) This table includes movements by both sea and air. However, sea represents a relatively small proportion of the total (varies between one and two per cent of total overseas arrivals and departures since 1976). See Trace (1982) p3.

Source: ABS (1982)

TABLE 2 - SHORT-TERM MOVEMENTS BY AIR BY PURPOSE OF TRAVEL, YEARS ENDING 31 DECEMBER 1976 AND 31 DECEMBER 1981

Purpose	Visitors arriving				Residents departing			
	1976		1981		1976		1981	
	Number ('000)	Proportion (per cent)	Number ('000)	Proportion (per cent)	Number ('000)	Proportion (per cent)	Number ('000)	Proportion (per cent)
Visiting friends and relatives	102	22.8	271	29.0	178	18.7	226	18.7
Holiday	153	34.3	387	41.5	570	60.0	709	58.6
Business, convention and employment	91	20.4	154	16.5	124	13.1	189	15.6
Other[a]	100	22.4	121	13.0	78	8.2	87	7.1
Total	446	100.0	932	100.0	950	100.0	1210	100.0
Average annual growth rate (per cent)			15.9				5.0	

(a) Includes 'in transit', education, other and not stated.

Source: ABS (1982)

preference of the Australian traveller(1). Figure 1 illustrates the changes in travel patterns to some major international destinations. Continuation of such trends could have some significant impact on the future patterns of international air travel. As a destination, the United States shows a small decline to near zero growth in 1981, and the United Kingdom route has experienced a drop in demand of nearly 40 per cent between 1979 and 1981. By contrast, in 1981 travel to Malaysia/Singapore and to Indonesia increased by 100 per cent and 200 per cent respectively, compared to their average levels during 1976 and 1978.

The responsiveness of international air travel to changes in the explanatory variables is expected to vary with purpose of travel and intended length of stay. Data on purpose of travel are only available for short-term movements. Further, the relative significance of long-term/permanent movements has been continually declining over the study period as indicated above (see Table 1). Consequently, the empirical investigation of this market has been confined to short-term movements (representing over 90 per cent of total air passenger movements). This market was segmented by purpose of travel (business and non-business) for both Australian residents and overseas visitors.

Four behavioural sub-models were developed to examine the factors which influence short-term air travel between Australia and 14 destinations(2) (representing over 77 per cent and 86 per cent of short-term passenger movements by Australian residents and overseas visitors respectively, in 1980).

The results of the statistical analyses for the four sub-models are reported in Table 3. For all sub-models, the relationships derived represented close approximations to the actual variations in the quarterly demand for international air travel. Further, all the estimated coefficients were of the expected sign and most of them were highly significant statistically. The demand elasticities appeared to be consistent and the broad conclusions to be drawn from the analyses are:

- as might be expected, business travel (both for Australian and overseas visitors) is less responsive to changes in fares in comparison to non-business travel;

- business travel to Australia by overseas visitors is more sensitive to fare changes than is business travel by Australians;

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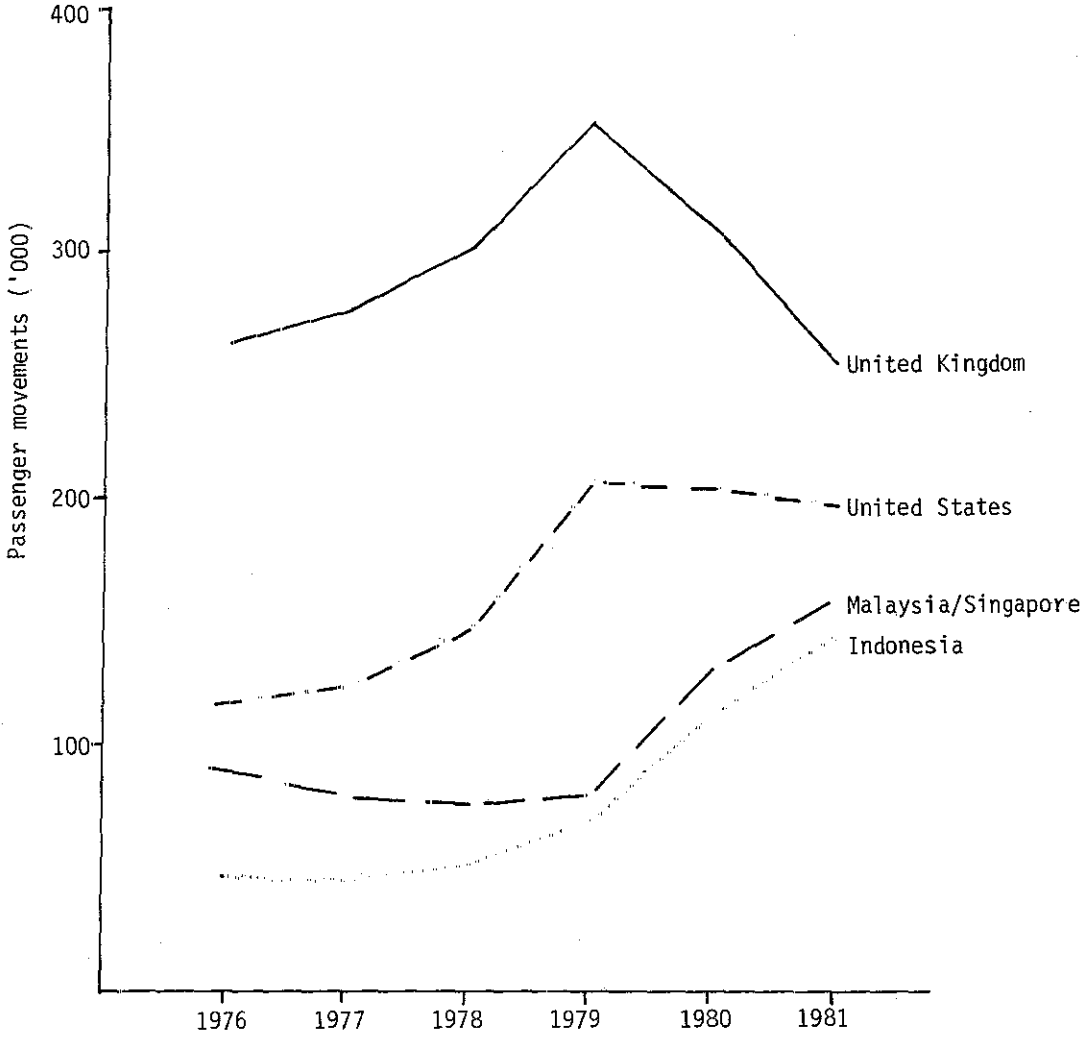
(1) The Asian and Pacific carriers more than doubled their shares of the international air travel market during the 1970s. It must be noted, however, that this does not only reflect destination switching but also the possibility of increased penetration of the passenger market to points beyond Asia by Asian carriers. See BTE (1983).

(2) The countries involved and regarded as origins and destinations in the analyses were: Canada, France, the Federal Republic of Germany, Fiji, Greece, Indonesia, Italy, Japan, Malaysia and Singapore (combined), New Zealand, Papua New Guinea, South Africa, the United Kingdom and the United States.



Source: ABS (1982)

FIGURE 1 - NON-BUSINESS AIR TRAVEL BY AUSTRALIANS TO UNITED KINGDOM, UNITED STATES, MALAYSIA/SINGAPORE AND INDONESIA (1976-1981)

TABLE 3 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR SHORT-TERM INTERNATIONAL AIR TRAVEL

Dependent variable	Constant	Explanatory variable						$\bar{R}^2$	D.W.
		Fare[b]	Imports	Exports	GDP	Proportion of migrants[c]	Exchange rate		
Business travel by Australians									
Total demand	1.804 (3.25)	-0.543 (-4.95)	0.336 (5.13)	0.235 (5.36)	..	..	..	0.86	2.21
Business travel by overseas visitors									
Total demand	0.592 (ns)	-0.616 (-7.58)	0.272 (5.79)	0.380 (12.12)	..	..	..	0.95	2.44
Non-business travel by Australians									
Demand per capita	1.964 (ns)	-0.687 (-4.94)	..	..	0.827 (2.29)	0.403 (7.17)	..	0.83	1.97
Non-business travel by overseas visitors									
Demand per capita	7.550 (29.43)	-1.857 (-13.12)	..	..	..	..	-0.494 (-9.46)	0.91	2.23

ns - not significant at the 5 per cent level.

(a) t-values are given in brackets below the corresponding coefficient. The greater the absolute value of the t-value, the more likely that the value of the coefficient is statistically significant and different from zero.
(b) For business travel by both Australian residents and overseas visitors, the air fare used was a weighted average of first class and business class fares, in real terms. For non-business travel the air fare used was a weighted average of economy class and all discounted fares, in real terms.
(c) Represents the proportion of Australia's resident population born overseas (expressed as a per cent in the models).

TABLE 4 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR SHORT-TERM INTERNATIONAL NON-BUSINESS TRAVEL BY AUSTRALIANS TO EUROPE AND ASIAN-PACIFIC REGIONS

Dependent variable	Constant	Explanatory variable				$\bar{R}^2$	D.W.
		Fare[b]	GDP	Proportion of migrants[c]	Exchange rate		
Europe[d]							
Demand per capita	-2.211 (ns)	-0.769 (-2.36)	0.251 (ns)	0.750 (16.02)	..	0.96	2.20
Asian-Pacific[e]							
Demand per capita	4.668 (3.60)	-1.496 (-5.70)	1.379 (4.87)	0.667 (5.55)	-0.028 (ns)	0.75	1.80

ns - not significant at the 5 per cent level.

(a) t-values aregiven in brackets.
(b) The air fare used was a weighted average of economy class and all discounted fares, in real terms.
(c) Refers to the Australian resident population born overseas (expressed as a per cent in the models).
(d) Europe includes the United Kingdom, France, the Federal Republic of Germany, Italy and Greece.
(e) Asian-Pacific region refers to Malaysia/Singapore, Fiji and Indonesia.

- non-business travel by Australians is less responsive to fare changes than is non-business travel to Australia by overseas residents; and

- changes in the exchange rate have an effect on non-business travel by overseas residents; that is, appreciation of the Australian dollar in terms of the overseas currencies reduces non-business travel to Australia and vice versa(1).

In view of the destination switching between 1976 and 1981, in non-business travel by Australians, two separate sub-models representing demand per capita for Europe and the Asian-Pacific region were estimated. The results are shown in Table 4. For Europe, the results indicate the significance of the proportion of Australians born overseas (which might be a reflection of the expected high proportion of the 'visiting friends and relatives' category of non-business travel to this region). By contrast, the results relating to the Asian-Pacific region suggest that non-business travel to this region is elastic with respect to fares and income (GDP per capita). This is in line with our *a priori* expectations of the characteristics of non-business travel.

These results, coupled with the non-business travel's relative significance in short-term air passenger movements, indicate the need for further separate studies of travel to and from Australia on individual routes. This forms the basis of a study to be undertaken in the future where careful consideration is to be given (among other factors) to the ground cost component of the non-business trip total cost. However, preliminary estimates of the elasticities obtained using simple individual route sub-models relating to most of the 14 overseas countries are reported in Table 5. These results should, however, be regarded as indicative only of the order of magnitude of the elasticities and the importance of exchange rates on certain routes.

TRUNK AND SECONDARY TRUNK AIR TRAVEL MARKETS

The trunk market encompasses the jet network operated by the two major domestic airlines in Australia: Trans-Australia Airlines (TAA) and Ansett Airlines of Australia (AAA). To identify non-jet aviation services operated by TAA and AAA from similar services operated by regional airlines, a secondary trunk market is defined.

Annual passenger movements in these two markets are shown in Table 6 for the period 1969-70 to 1980-81. Patronage almost doubled during this period from just over 5 million passenger movements to almost 10 million movements. Patronage on AAA increased at a slightly faster rate (6.5 per cent per annum) than TAA (6.2 per cent per annum) resulting in a marginal increase in AAA's market share. The passenger movements profiles of AAA and TAA are very similar and in line with the growth pattern of the market as a whole. Hence, TAA's data was considered as a reliable indicator of total travel.

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(1) This variable can be regarded, in part, as a proxy for the ground cost component of the non-business traveller's trip total cost.

TABLE 5 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR SHORT-TERM INTERNATIONAL NON-BUSINESS TRAVEL TO AND FROM AUSTRALIA

Country	Australian residents					Overseas visitors				
	Explanatory variable					Explanatory variable				
	Fare[b]	Exchange rate	Income	$\bar{R}^2$	D.W.	Fare[b]	Exchange rate	Income	$\bar{R}^2$	D.W.
United Kingdom	-1.343 (-4.42)	-0.032 (ns)	..	0.87	2.31	-0.259 (ns)	-1.116 (-3.33)	..	0.78	1.52
West Germany	-1.038 (-2.58)	0.102 (ns)	1.645 (ns)	0.79	2.50	-1.762 (-2.20)	-2.047 (-3.88)	..	0.64	0.99
Greece	-1.817 (-4.04)	..	2.032 (ns)	0.94	2.50					
Italy	-0.423 (ns)	..	2.555 (ns)	0.93	2.16	-0.566 (ns)	..	..	0.59	1.86
Canada	-2.642 (-3.63)	1.217 (ns)	..	0.90	2.25	-1.032 (-2.75)	..	..	0.87	1.94
United States	-1.996 (-6.01)	..	..	0.89	1.93	-0.473 (-2.02)	..	..	0.72	2.55
New Zealand	-1.475 (-6.26)	0.854 (4.22)	0.627 (ns)	0.98	1.62	-1.574 (-3.36)	..	-1.519 (ns)	0.53	2.14
South Africa	-1.221 (ns)	..	6.666 (2.14)	0.64	1.39	-2.336 (-5.84)	..	0.132 (ns)	0.72	2.03
Japan	-0.973 (ns)	..	..	0.82	2.20	-0.937 (-2.12)	..	7.774 (8.20)	0.90	2.11
Malaysia/Singapore	-2.193 (-6.67)	0.858 (ns)	..	0.81	1.80	-1.336 (ns)	..	1.943 (4.88)	0.71	2.17
Fiji	-2.437 (-3.68)	1.022 (ns)	..	0.87	1.18					
Indonesia	-1.178 (-2.27)	1.342 (2.10)	2.147 (ns)	0.74	0.53	-0.474 (-3.99)	..	..	0.68	1.03
Papua New Guinea	..	..	..	..	..					

ns - not significant at the 5 per cent level.

(a) t-values are given in brackets below the corresponding coefficient.
(b) The air fare used was a weighted average of economy class and all discounted fares, in real terms.

TABLE 6 - TOTAL REVENUE PASSENGERS [(a)] - TRUNK AND SECONDARY TRUNK MARKETS, YEARS ENDING 30 JUNE 1970 TO 30 JUNE 1981

Year ending 30 June	AAA Number ('000)	AAA Annual change (per cent)	TAA Number ('000)	TAA Annual change (per cent)	Total Number ('000)	Total Annual change (per cent)	Market Shares AAA (per cent)	Market Shares TAA (per cent)
1970	2 421		2 590		5 011		48.3	51.7
1971	2 635	8.8	2 744	5.9	5 379	7.3	49.0	51.0
1972	2 767	5.0	2 910	6.0	5 677	5.5	48.7	51.3
1973	3 135	13.3	3 296	13.3	6 431	13.3	48.7	51.3
1974	3 801	21.3	3 857	17.0	7 658	19.1	49.6	50.4
1975	3 920	3.1	4 132	7.1	8 052	5.1	48.7	51.3
1976	3 949	0.7	4 056	-1.8	8 005	-0.6	49.3	50.7
1977	3 890	-1.5	4 227	4.2	8 117	1.4	47.9	52.1
1978	4 330	11.3	4 456	5.4	8 786	8.2	49.3	50.7
1979	4 468	3.2	4 680	5.0	9 148	4.1	48.8	51.2
1980	4 885	9.3	5 057	8.1	9 942	8.7	49.1	50.9
1981	4 856	-0.6	5 013	-0.9	9 869	-0.7	49.2	50.8
Average annual growth rate (per cent)		6.5		6.2		6.4		

(a)A domestic passenger is one making any contribution to airline revenue. Uplift-discharge patronage figures.

Source: DoTA (1982b)

TABLE 7 - TAA ORIGIN/DESTINATION PATRONAGE INDICES FOR TRUNK AND SECONDARY TRUNK MARKETS, YEARS ENDING 31 DECEMBER 1973 TO 31 DECEMBER 1981.

Year ending 31 December	Trunk market Group 1 Index	Group 1 Annual change (per cent)	Group 2 Index	Group 2 Annual change (per cent)	Group 3 Index	Group 3 Annual change (per cent)	Group 4 Index	Group 4 Annual change (per cent)	Secondary trunk market F27 Gladstone Index	F27 Gladstone Annual change (per cent)	F27 Tasmania Index	F27 Tasmania Annual change (per cent)	Total Index	Total Annual change (per cent)
1973	100.0		100.0		100.0		100.0		100.0		100.0		100.0	
1974	113.0	13.0	114.8	14.8	113.7	13.7	114.8	14.8	121.1	21.1	119.2	19.2	113.6	13.6
1975	113.6	0.5	110.4	-3.8	123.2	8.4	128.9	12.3	110.5	-8.7	113.7	-4.6	115.1	1.3
1976	112.0	-1.4	114.0	3.3	116.5	-5.4	114.8	-10.9	100.0	-9.5	108.2	-4.8	112.6	-2.2
1977	117.1	4.6	123.6	8.4	125.0	7.3	119.3	3.9	110.5	10.5	94.5	-12.7	118.0	4.8
1978	122.1	4.3	132.4	7.1	134.2	7.3	125.9	5.6	110.5	-	93.2	-1.4	123.8	4.9
1979	125.4	2.7	138.0	4.2	153.5	14.4	146.7	16.5	115.8	4.8	95.9	2.9	130.0	5.0
1980	130.9	4.4	134.0	-2.9	175.0	14.0	150.4	2.5	152.6	31.8	102.7	7.1	136.5	5.0
1981	126.8	-3.2	129.2	-3.6	190.1	8.7	153.3	2.0	178.9	17.2	87.7	-14.7	134.7	-1.3
Average annual growth rate (per cent)		3.0		3.3		8.4		5.5		7.5		-1.6		3.8

Source: TAA unpublished data.

Available TAA origin/destination(1) data for 28 jet routes (covering more than 85 per cent of TAA's total passenger travel) was used as a sample to represent the trunk air travel market, while 7 non-jet routes represented the secondary trunk market in the reported demand analyses. The trunk routes were grouped into four sub-markets and the secondary trunk routes into two sub-markets depending on demand characteristics and patterns. The sub-markets identified for the trunk market were:

- A Group 1 sub-market, consisting of 12 jet routes on which the percentage of business travel was relatively higher than on other routes;
- A Group 2 'summer holiday' sub-market, consisting on the 4 jet routes between Tasmania and the Australian mainland which are predominantly leisure routes;
- A Group 3 'winter sunspots' sub-market, consisting of 8 jet routes to the Queensland coast and which are, once again, predominantly leisure routes providing access to the winter sunspots on and off the Queensland coast; and
- A Group 4 sub-market, comprising the remaining 4 jet routes which did not belong to any of the above sub-markets but are characterised as being long distance routes.

The sub-markets identified for the secondary trunk market were:

- An F27 Gladstone sub-market, consisting of 3 non-jet routes operated by TAA using Fokker F27 aircraft to Gladstone in Queensland; and
- An F27 Tasmanian sub-market, comprising 4 F27 routes, operated by TAA to the Tasmanian centres of Devonport and Burnie (Wynyard).

Patronage indices for the period 1973 to 1981 are given in Table 7. The growth rate indices varied between sub-markets with the Queensland trunk and secondary trunk sub-markets exhibiting the strongest growth, even in 1981.

The results of the statistical analyses for the four trunk and two secondary trunk sub-markets are reported in Table 8. The equations provided a close fit to the quarterly demand for air travel and most of the estimated

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(1) Origin refers to an aerodrome at which an airline journey commences. Destination is the aerodrome at which the airline journey concludes. Origin/destination data are usually only available for the individual airline systems. All Department of Aviation (formerly, the Department of Transport Australia) statistics represent uplift/discharge data by airline. Uplift refers to a passenger embarkation on aircraft with a given flight number and discharge refers to a passenger disembarkation from an aircraft with a given flight number. This can result in 'double-counting' of passenger movements on routes where flight numbers do change.

coefficients are statistically significant and of the expected sign. Some observations can be made:

- A particular feature of demand for air services is the strong seasonal pattern exhibited in most sub-markets. For instance, there is a marked increase in patronage during the September quarters on routes in the Queensland sub-markets and during the March quarters for the 'summer holiday' sub-market.

- The fare elasticity of about -0.85 on the Group 1 routes probably reflects the greater importance of business travel on these routes. This compares with the more leisure-dominated Queensland 'winter sunspots' and Tasmanian 'summer holiday' sub-markets, which have fare elasticities of approximately -1.1.

- For the Group 4 sub-market, demand was generally highly responsive to fare levels (with a fare elasticity of about -1.8). This is probably due to the fact that on such routes the cost of travel is sufficiently high that fare changes affect traveller's total budgetting and lead to significant changes in the decision of whether or not to travel.

- The highly elastic demand on the F27 Gladstone routes (fare elasticity of -3.9) reflects the fact that Gladstone aerodrome is only a Fokker F27-grade aerodrome with low frequency of service, and that it faces strong competition from Rockhampton aerodrome which is serviced by jet aircraft with much greater frequency of services to main centres.

- The less responsive demand in relation to fare level on the F27 Tasmanian routes (fare elasticity of about -0.6) is revealing when compared with the 'summer holiday' group of trunk routes (fare elasticity of nearly -1.1), indicating that F27 routes provide (among other possibilities) substitutes for the jet services but not vice versa.

Individual route analyses were undertaken for the 28 jet routes. Table 9 reports the fare elasticities for these routes within the four trunk sub-markets. Within each sub-market, the fare elasticities for individual routes show marked variation. Nevertheless, for Groups 1 and 3 the aggregate estimate of fare elasticity approximates the weighted average of individual route elasticities. In the Group 2 sub-market, two of the individual route elasticities denote elasticity with respect to the ratio of air fare to sea fare (and one of the two coefficients is not statistically significant). Also, two of the elasticities in the Group 4 sub-market are not statistically significant.

TABLE 9 - AIR FARE ELASTICITIES FOR INDIVIDUAL TRUNK ROUTES

Route	Air fare elasticity
Group 1	
Canberra-Sydney	-1.072
Canberra-Melbourne	-0.531
Brisbane-Canberra	-1.089
Adelaide-Brisbane	-1.246
Brisbane-Melbourne	-0.807
Adelaide-Melbourne	-0.448
Melbourne-Sydney	-0.314
Brisbane-Sydney	-0.388
Adelaide-Canberra	-0.883
Adelaide-Sydney	-0.502
Perth-Sydney	-1.483
Brisbane-Perth	-1.602
Group 2 - 'summer holiday'	
Launceston-Melbourne	-0.794
Hobart-Melbourne	-0.602
Launceston-Sydney	-0.131(a) (b)
Hobart-Sydney	-0.284 (b)
Group 3 - 'winter sunspots'	
Cairns-Townsville	-0.514
Coolangatta-Sydney	-0.898
Melbourne-Coolangatta	-1.744
Sydney-Townsville	-1.581
Brisbane-Rockhampton	-0.590
Brisbane-Townsville	-0.500
Brisbane-Cairns	0.099 (a)
Cairns-Sydney	-0.008 (a)
Group 4	
Adelaide-Perth	-0.224 (a)
Adelaide-Darwin	-0.403 (a)
Melbourne-Perth	-0.865
Darwin-Sydney	-1.359

(a) Not significant at the 5 per cent level.
(b) Denotes elasticity with respect to the ratio of air fare to sea fare.

REGIONAL AIR TRAVEL MARKET

The regional air market is defined as that segment of the domestic air transport industry served by the six airlines listed below:

- East-West Airlines (EWA);
- Air New South Wales (ANSW);
- Airlines of South Australia (ASA);
- Airlines of Western Australia (AWA);
- Airlines of Northern Australia (ANA); and
- Air Queensland (AQ), non-commuter operations.

ANSW, ASA, AWA and ANA are subsidiaries of Ansett Transport Industries (ATI).

For total regional passenger services in Australia (Table 10), the average annual growth rate in revenue passengers uplifted was 4.1 per cent over the period 1969-70 to 1980-81. Total patronage fluctuated around an upwards trend peaking in 1978-79 at nearly 1.8 million revenue passengers uplifted. Since then, absolute declines were recorded in 1979-80 and 1980-81.

Trends in the patronage of regional airlines (reflecting growth rates in the sub-markets they serve) varied considerably over the period examined. For example, revenue passengers uplifted by EWA increased from 284 000 in 1969-70 to 457 000 in 1980-81 although traffic in 1980-81 was lower than that uplifted in 1974-75 (479 000 passengers). Some growth in the number of passengers uplifted by EWA can be attributed to the introduction of new services by the airline. There has however, been a marked decline in traffic uplifted on the shorter routes such as Sydney to Bathurst and Orange and Sydney to Cowra and Parkes. Much of this traffic appears to have been attracted to the commuter operators such as Hazelton Airlines' service from Cudal and Orange to Sydney(1).

EWA have recently withdrawn from the routes mentioned above. However, they have expressed an intention to reintroduce services with smaller more appropriate aircraft (Cromie, 1982).

A sample of 15 regional routes operated by EWA, AWA and ASA during the study period (March quarter 1976 to September quarter 1981) formed the basis of the statistical analyses reported below (see Table 11). New South Wales regional

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(1) This diversion of traffic may be due to a number of factors. Firstly, the greater frequency of service provided by the commuter operators. Secondly, by its more convenient arrival and departure times. Together these factors enable some passengers to make a one-day return journey to Sydney and hence avoid accommodation costs. Increasing competition from road travel may also have been important for the less time sensitive traveller.

TABLE 10 - TOTAL REVENUE PASSENGERS[a] - REGIONAL MARKET, YEARS ENDING 30 JUNE 1970 TO 30 JUNE 1981

Year ending 30 June	ANSW		ASA		EWA		AWA[b]		ANA[c]		Qantas (Norfolk Island)[d]		Ansett Flying Boat [e]		Total	
	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)	Number ('000)	Annual change (per cent)
1970	283		167		284		191		22		15		8		970	
1971	276	-2.5	164	-1.8	302	6.3	265	38.7	20	-9.1	16	3.0	8	2.6	1 050	8.2
1972	272	-1.4	159	-3.0	327	8.3	288	8.7	23	15.0	16	-	10	18.4	1 095	4.3
1973	307	12.9	165	3.8	385	17.7	261	-9.4	27	17.4	18	12.5	10	8.2	1 173	7.1
1974	336	9.4	193	17.0	435	13.0	313	19.9	40	48.1	20	9.4	-	-	1 336	13.9
1975	382	13.7	203	5.2	479	10.1	323	3.2	47	17.5	22	11.2	-	-	1 456	9.0
1976	371	-2.9	215	5.9	445	-7.1	304	-5.9	54	14.9	22	0.6	-	-	1 411	-3.1
1977	376	1.3	214	-0.5	436	2.0	293	-3.6	53	-1.9	13	-40.9	-	-	1 386	-1.8
1978	395	5.0	227	6.1	493	13.1	327	11.6	62	17.0	-	-	-	-	1 503	8.4
1979	426	7.8	228	0.4	505	2.4	346	5.8	68	9.7	-	-	-	-	1 572	4.6
1980	444	4.2	217	-4.8	476	-5.7	363	4.9	63	-7.4	-	-	-	-	1 563	-0.6
1981	420	-5.4	202	-6.9	457	-4.0	366	0.8	55	-12.7	-	-	-	-	1 522(f)	-3.3
Average annual growth rate (per cent)		3.7		1.7		4.4		6.1		8.7		6.6		7.7		4.1

(a) Uplift/discharge patronage figures.
(b) Formerly Macrobertson Miller Airlines (MMA).
(c) Connair ceased operations in May 1980, Northern Airlines commenced June 1980 and ceased February 1981, Airlines of Northern Australia commenced operations April 1981.
(d) Route taken over by East-West Airlines.
(e) Sydney-Lord Howe Island operated by Avdev Airlines of Australia.
(f) Includes 10410 revenue passengers for Air Queensland which was formerly Bush Pilots Airlines.

Source: DoTA (1982b)

TABLE 11 - REGIONAL ROUTE SAMPLE

Regional airlines	Route
East-West Airlines	Sydney-Coolangatta
	Sydney-Albury
	Sydney-Parkes
	Sydney-Cowra
	Sydney-Orange
	Sydney-Bathurst
Airlines of Western Australia	Perth-Kalgoorlie
	Perth-Geraldton
	Perth-Derby
	Perth-Learmonth
	Perth-Port Hedland
	Perth-Darwin
	Perth-Karratha
Airlines of South Australia	Adelaide-Mt Gambier
	Adelaide-Broken Hill

TABLE 8 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR TRUNK AND SECONDARY TRUNK AIR TRAVEL

Dependent variable	Constant	Explanatory variable						$\bar{R}^2$	D.W.
		Fare[b]	Population	Income	Car cost[c]	Air travel time	Local		
Trunk Market									
Group 1 Total demand[d]	-11.610 (-18.82)	-0.854 (-11.94)	1.789 (35.73)	1.895 (6.60)	..	..	..	0.99	2.26
Group 2 - 'summer holiday' Demand per capita[d]	27.180 (3.40)	-1.087 (-2.35)	..	3.846 (3.28)	0.030 (ns)	..	..	0.93	1.92
Group 3 - 'winter sunspots' Demand per capita	-5.049 (-6.10)	-1.120 (-6.10)	..	2.565 (3.11)	..	..	..	0.83	2.26
Group 4 Total demand[d]	-6.465 (ns)	-1.816 (-5.30)	1.386 (7.88)	..	0.693 (2.01)	..	..	0.92	2.32
Secondary Trunk Market									
F27 Gladstone Demand per capita[d]	-30.360 (-6.22)	-3.923 (-23.77)	..	..	0.700 (2.23)	..	1.612 (2.54)	0.99	2.27
F27 Tasmania Demand per capita[d]	-4.295 (-5.72)	-0.646 (-2.29)	..	..	..	-4.066 (-9.66)	..	0.99	2.60

ns - not significant at the 5 per cent level.

(a) t-values are given in brackets below the corresponding coefficient.
(b) The air fare used was the economy air fare in real terms.
(c) Cost of sea travel in the case of the Tasmanian routes.
(d) Seasonal dummy variables are significant.

routes were further divided into two groups (a group consisting of routes linking Sydney to Coolangatta and Albury, and the remainder)(1). The patronage of these three regional airlines on the routes included in the analyses represented some 25 per cent of total revenue passenger movements in 1980. Further, this sample was selected to represent a varied range of route features (particularly availablility and quality of road networks), to reflect differences in demand characteristics and to minimise possible bias due to using uplift/discharge data(2).

The results of the statistical analyses are reported in Table 12. In all cases, the regressions provided satisfactory explanations of variations in the quarterly demand for air travel. Most of the estimated coefficients were statistically significant and of the expected sign. Two broad observations that can be drawn are as follows:

- demand responsiveness to fare changes seems to depend on distance, availability and quality of road networks (demonstrated, for example, by inelastic demand on routes operated by AWA (fare elasticity of about -0.1) as opposed to fare elasticities of -1.2 and -1.3 for routes operated by ASA and EWA respectively); and

- the higher level of responsiveness to changes in fares on EWA special routes (fare elasticity of -2.3) reflects the higher proportion of leisure travel on these routes.

COMMUTER AIR TRAVEL MARKET

Commuter services (which were formalised in July 1967 with three operators(3) operate regular public transport (RPT) services under Air Navigation Regulation (ANR) 203. Since 1967, the number of commuter operators has continually increased, recording 62 operators in 1980-81 (see Table 13).

Commuter services have become a significant part of aviation in Australia. In September 1979, commuter operators served 251 aerodromes in comparison with the 59 aerodromes served by the two major domestic carriers (BTE 1980, p4). As at 31 December 1981, the number of aerodromes served by TAA and AAA had decreased

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(1) During the period under consideration, EWA faced competition from TAA and AAA on the routes linking Sydney to Coolangatta and Albury.

(2) Data relating only to passenger uplift/discharge levels were available for these analyses. To the extent that the routes concerned generally operate under a single flight number, the data can be considered to represent the desired origin/destination information.

(3) Prior to that date only airlines holding airline licences (issued under ANR 198 to enable the holder to engage in RPT operations specified in ANR 191) were permitted to operate scheduled air services at published fares and freight rates.

TABLE 12 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR REGIONAL AIR TRAVEL

Dependent variable	Constant	Explanatory variable			$\bar{R}^2$	D.W.
		Fare[b]	Population	Income		
Airlines of Western Australia Total demand	0.872 (ns)	-0.139 (ns)	0.337 (4.13)	0.938 (4.42)	0.86	2.04
Airlines of South Australia Demand per capita	-4.253 (ns)	-1.191 (-2.18)	..	0.510 (ns)	0.72	2.49
East-West Airlines - NSW routes Total demand	-0.645 (ns)	-1.321 (-7.01)	0.661 (6.20)	0.091 (ns)	0.84	2.40
East-West Airlines - special routes (Sydney-Coolangatta and Albury) Total demand	-7.213 (-3.35)	-2.333 (-5.07)	1.204 (4.45)	0.630 (ns)	0.91	2.02

ns - not significant at the 5 per cent level.

(a) t-values are given in brackets.

(b) The air fare used was the normal applicable fare, in real terms.

TABLE 13 - TOTAL REVENUE PASSENGERS[a] AND NUMBER OF OPERATIONS - COMMUTER MARKET, YEARS ENDING 30 JUNE 1968 TO 30 JUNE 1981

Year ending 30 June	Revenue passengers	Annual change (per cent)	Operators[b] (number)	Annual change (per cent)
1968	28 760		16	
1969	74 415	158.7	22	37.5
1970	107 657	44.7	20	-9.1
1971	104 292	-3.1	22	10.0
1972	110 664	6.1	25	13.6
1973	131 755	19.1	28	12.0
1974	205 424	55.9	26	-7.1
1975	277 565	35.1	29	11.5
1976	332 788	8.6	36	24.1
1977	418 088	25.6	43	19.4
1978	502 695	20.2	50	16.3
1979	602 702	19.9	54	8.0
1980	700 503	16.2	57	5.6
1981	827 115	18.1	62	8.8
Average annual growth rate (per cent)		29.5		

(a) Passengers paying 25 per cent or more of the normal applicable fare.

(b) Those reporting revenue passenger carriage during the year.

Source. DoTA (1982a)

to 52, while those served by commuter services had increased to 294 aerodromes(1). Commuter operators provide feeder services to trunk route operations as well as providing RPT (that is, 'airline type') services to rural areas and to smaller communities near major metropolitan centres. Originally, commuter operators were restricted to aircraft with capacity limited to 18 seats. Since September 1980, this restriction has been relaxed to 30 seats or 3 500 kg freight capacity. However, commuter operators need to assess the impact that larger aircraft would have on frequency of service and subsequently on demand. This is especially important for short-haul routes and on 'thin' routes.

The annual average growth rate of revenue passenger uplifted over the period 1967-68 to 1980-81 was some 29.5 per cent (see Table 13). This relatively high growth rate is attributed to traffic growth on some existing routes (although traffic declined on certain long-established routes such as Sydney-Temora and Sydney-Cootamundra), and to the establishment of new routes by existing operators and by new operators. Some of the new services provided by commuter operators are replacing those formerly operated by regional airlines, including (for example) those between Sydney and Parkes, Cowra, Bathurst and Orange.

A sample of seven commuter routes, consisting of three routes in New South Wales (Sydney to Young/Cootamundra, Temora and Newcastle) and four routes in Western Australia (Perth to Albany, Meekatharra, Wiluna and Esperance), was selected to represent commuter services. The patronage on these seven routes represented some 20 per cent of commuter total revenue passenger movements in 1980-81. The sample selection criteria were identical to those used in selecting regional routes. Again, uplift/discharge quarterly data over the period of study were used.

The results are reported in Table 14. Despite the fairly high explanatory power of the regressions in explaining quarterly demand levels for air travel, the income coefficients were not statistically significant for commuter services in New South Wales and Western Australia. The fare elasticity coefficients (nearly -3.2 and -2.4 for New South Wales and Western Australia respectively) indicate that demand for commuter services is highly responsive to fare changes (particularly over shorter routes), and to the existence of good quality road networks(2).

SUMMARY AND CONCLUSIONS

This paper reports some of the earlier results of an ongoing detailed empirical investigation undertaken by the Bureau of Transport Economics in regard to the demand for air services (both passenger and freight). The theoretical 'demand-and-supply' model responsible for generating the market statistics used in the reported analysis was reviewed under the assumption of supply being completely elastic in the short run. The derived market transformation (reduced form) function formed the basis of the aggregate models specified for the different air passenger markets identified in this paper.

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(1) Department of Aviation (DofA) unpublished data.

(2) Earlier work (BTE 1980) by the BTE estimated these elasticities to be between -2 and -4. These estimates are consistent with the current estimates.

TABLE 14 - COEFFICIENTS[a] OF THE DEMAND RELATIONSHIPS DERIVED FOR COMMUTER AIR TRAVEL

Dependent variable	Constant	Explanatory variable			$\bar{R}^2$	D.W.
		Fare[b]	Income	Car cost		
New South Wales Total demand	-3.711 (ns)	-3.155 (-12.91)	1.040 (ns)	..	0.91	2.06
Western Australia Total demand	-0.995 (ns)	-2.367 (-4.75)	0.228 (ns)	1.373 (4.78)	0.92	2.77

ns - not significant at the 5 per cent level.

(a) t-values are given in brackets.
(b) The air fare used was the normal applicable fare, in real terms.

These air passenger travel markets are: international, trunk, secondary trunk, regional and commuter. For each of these markets, trends in patronage over the last decade or so were reviewed. Two broad trends were evident. Firstly, the switch in overseas destination to the Asian-Pacific region for Australian non-business travel since the latter part of the 1970s. Secondly, the marked increase in commuter air travel which has been partly at the expense of regional air travel.

In addition, aggregate models were developed to identify socio-economic factors (other than air fares) affecting the air passenger demand. Where required, these models were supplemented by route-specific sub-models to allow for differences in purposes of travel and in route characteristics.

The ordinary least-squares regression method was employed to estimate these models using pooled cross-sectional and time series data (from the March quarter 1976 to the September quarter 1981). In general, the estimated regression equations gave close approximations to the quarterly demand for air passenger travel and the coefficients were of the expected sign on *a priori* grounds. The broad conclusions that can be drawn from the regression analyses are:

- For international air travel, demand response to fare changes was found to be more elastic for leisure travel than for business travel;
- The results suggest (among other possibilities) that in some instances (exemplified by air routes to Tasmania) secondary trunk services can represent a competitive service to trunk (jet) services but not vice versa;
- Demand for commuter services was found to be highly responsive to fare changes and the existence of good quality road networks (particularly over shorter routes); and
- There is a need for route-specific empirical studies, particularly in view of the recent destination switching in the case of overseas non-business travel by Australians.

The specified aggregate models can be viewed as constituting the basis of a consistent 'industry-wide' framework for air passenger travel demand. The results indicate possible interaction between the various segments of the industry (inter-service competition). In addition to the substitution possibility between secondary trunk and trunk services on the Tasmanian routes noted above, available evidence suggests the existence of competition between commuter operators and regional airlines (on the Sydney to Bathurst and Orange, and Sydney to Parkes and Cowra routes).

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ABBREVIATIONS

AAA	Ansett Airlines of Australia
ABS	Australian Bureau of Statistics
AGPS	Australian Government Publishing Service
ANA	Airlines of Northern Australia
ANR	Air Navigation Regulation
ANSW	Air New South Wales
APEX	Advance Purchase Excursion Fare
AQ	Air Queensland
ASA	Airlines of South Australia
ATI	Ansett Transport Industries
AWA	Airlines of Western Australia
BAE	Bureau of Agricultural Economics
BTE	Bureau of Transport Economics
DofA	Department of Aviation
DoTA	Department of Transport Australia
D.W.	Durbin-Watson statistic
EWA	East-West Airlines
GDP	Gross Domestic Product
MMA	Macrobertson Miller Airlines
NSW	New South Wales
$\bar{R}^2$	Coefficient of Determination (adjusted for degrees of freedom)
RPT	Regular Public Transport
TAA	Trans-Australia Airlines