Modelling interstate tourism demand in Australia: A cointegration approach

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Abstract

Interstate tourism is an important component of the domestic tourism business in Australia. However, empirical analyses of interstate tourism demand have not been previously undertaken. The motivation for this paper is to investigate the short- and long-run causal relationships between economic factors and interstate tourism demand in Australia. Using a cointegration approach, this study discovers two distinct results. First, Australian household income, accommodation prices, prices of recreation and restaurants, and domestic airfares have significant impacts on the demand in the short-run. Second, some of the long-run economic coefficients show incorrect sign, which contradicts the theory of consumer demand.

Keywords: Interstate tourism demand; Australia; Cointegration; Economic determinants

1. Introduction

In Australia, domestic tourism has a greater impact on a state's economy than international tourism. Dwyer et al. [6] measured the economic impacts of an AUD[2]1 million increase in tourist expenditure by domestic and international tourists on the economy of New South Wales. The study revealed that domestic tourists' spending would generate an additional AUD0.71 million in gross state product (GSP) and create 11 jobs for the state, whereas international tourists would cause an increase of AUD0.393 million in GSP and create additional 6 jobs. There are also more domestic

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[2] AUD stands for the Australian Dollar.

tourists as 203 million domestic tourists in Australia consumed 75.8% of Australian tourism goods and services while five million international tourists consumed 24.2% [2].

Interstate travellers in Australia are relatively higher spenders than intrastate visitors. On average, the duration of travel and expenditure per interstate visitor was 5.4 nights and AUD710, respectively, which is approximately twice the amount of travel duration and expenditure per intrastate visitor. Moreover, most of the interstate visitors were holiday-makers and visitors of friends and relatives, which both accounted for 19 million people or 76% of the overall number of interstate visitors for the year ended 31 March 2007.

According to recent statistics, the total expenditure by interstate visitors for the year ended 31 March 2007 was AUD17.5 billion, compared to AUD16.7 billion for the expenditure by intrastate visitors [27]. Furthermore, Figure 1 demonstrates that expenditure by interstate visitors was the main source of revenue for tourism industries in Queensland, South Australia, Tasmania, Northern Territory and Australian Capital Territory. For Victoria, the expenditure by interstate visitors was slightly higher than the expenditure by intrastate and international visitors. However, West and Gamage [29] employed a non-linear input-output model to study the economic impacts of tourism on the Victorian economy and they discovered that interstate tourism contributes the greatest amount to gross state product and employment in the Victorian economy in Australia, followed by international visitors. In conclusion, interstate tourism is important in terms of generating tourism revenue for six Australia States. Therefore, it is imperative to sustain a growth in interstate tourism demand in Australia.

[Insert Figure 1]

In the tourism literature, the demand analysis of interstate tourism has not been assessed thoroughly. The intention of this paper is to investigate the effects of economic factors on interstate tourism demand. The objectives of the paper are two-fold. First, this paper will construct a demand model for interstate tourism. Second, the model will be employed to examine the causal relationships between the economic factors and interstate tourism demand in Australia in the short- and long-run. The contribution of the paper is to generate an interstate tourism demand model for the purpose of forecasting and planning marketing strategies for interstate tourism.

2. A model for interstate tourism demand

The study of economic determinants of tourism demand has been well-documented in the literature on modelling tourism demand. Lim [14] concluded that tourists' income, prices of tourism goods and services and transportation costs are the most important determinants that influence international tourism demand. Furthermore, a recent study conducted by Vogt [28] found that changes in income and relative prices can significantly affect the demand for US tourism exports in the long-run.

In the context of Australian domestic tourism demand, the literature reveals that domestic tourists' income and the prices of tourism goods and services are the main economic determinants that influence Australians to travel domestically [1,5,9]. Furthermore, domestic tourists make choices between domestic destinations, by comparing the costs between travelling to intrastate and interstate destinations [10].

Seddighi and Shearing [22] argued that the elements of tourism prices are the costs of travel to destinations and the cost of living at the destination. Hence, this study proposes domestic airfares as the cost of travel, as well as the prices of tourist accommodation, recreation and restaurants as the costs of living.

Despite domestic airfares, transportation costs also strongly relate to the costs of fuel. Australia's Tourism Forecasting Committee incorporated the price of fuel in modelling Australian domestic tourism demand and assumed that rising costs of fuel will reduce the number of domestic night stays [25]. Hultkrantz [9] found that petrol taxes in Sweden had increased since 1990, thereby increasing transportation costs in Sweden and reducing the number of domestic trips by Swedish households. Given this fact, price of fuel should be included in a domestic tourism demand model as a proxy for transportation costs.

The prices of substitute products are important economic determinants in tourism demand analysis. In the tourism literature, it is well-acknowledged that domestic tourism is a substitute product for international tourism demand [13,20]. Conversely, the prices of overseas holidays can affect domestic tourism demand. Hamal [8] discovered that the correlation between domestic holiday nights in Australia and prices of overseas holidays is positive, implying that increases in the costs of overseas travel will lead to a growth in the demand for domestic holidays.

Based on the literature of tourism demand above, an interstate tourism demand model can be written as follows:

$$DIT = f(Y, ACC, RR, F, DA, OC) \qquad (1)$$

where DIT = interstate tourism demand, Y = income, ACC = price of tourist accommodation, RR = prices of recreation and restaurants, F = price of fuel, DA = domestic airfares and OC = prices of overseas holidays. Also note that equation (1) is a deterministic model which assumes that interstate tourism demand is influenced by household income and tourism prices.

3. Data

Data on interstate tourism demand can be obtained from *Travel by Australians*, which is produced quarterly by Tourism Research Australia. In this paper, data on interstate visitor nights will be employed. As highlighted by Faulkner [7], statistics based on visitor nights are significant from an economic viewpoint because they reflect the utilisation of tourism facilities and related tourism expenditure.

For economic variables, gross domestic product (GDP) per capita is employed as a proxy for income variable. For prices of tourism goods and services in Australia, data on average price of accommodation per night and household expenditure on recreation, restaurant and cafes are used. In addition, the consumer price index (CPI) of automotive fuel and domestic economy airfares are used as a proxy variable for domestic transportation costs. The domestic economic airfares data is based on the weighted average of one-way fully refunded economy airfares of the top 70 routes in the Australian domestic flight network [3]. This paper also employs data on the CPI of overseas holidays, travel and accommodation to represent the price of substituting interstate travel.

All the abovementioned economic data are available on a quarterly basis from quarter 3 of 1998 to quarter 4 of 2006 and can be obtained from the websites of the Australian Bureau of Statistics (ABS) and Bureau of Infrastructure, Transport and Regional Economics (BITRE).

4. Cointegration analysis and error-correction model

To investigate the long-term relationship between economic variables and domestic interstate tourism demand, cointegration and error-correction models will be employed. These models are useful because they provide long-run and short-run estimations for the purpose of long-term tourism planning and short-term business forecasting [24].

The interstate tourism demand model, Equation (1), is specified as a log-linear model because it is easy to interpret the estimated coefficients in terms of elasticities [13]. In fact, log-linear models have been widely used in the literature on tourism demand [16,22]. According to Morley [19], such model is required to avoid the problem of tourism demand data being integrated to order two, I(2), when the standard cointegration techniques use the data which are integrated at order one, I(1). However, he further argued that the model may not be correct in modelling tourism demand because it implies constant elasticities. This can yield incorrect functional form as the demand elasticities can vary over time. Hence, to take account of Morley's comments, we conduct regression specification error test (RESET), which has been suggested by McAleer [17], to examine whether the functional form used in this paper is correctly specified or not.

The first step in testing cointegration is to ensure that all economic variables have the same order of integration. The order of integration can be tested using an augmented Dickey-Fuller (ADF) test, which is written as follows:

$$\Delta z_t = \alpha + \beta z_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta z_{t-i} + \lambda T + e_t$$

where z = time series of a variable, T = time trend, p = number of lag value and e = error term. The hypotheses of the ADF test are specified as follows:

Ho: $\beta = 0$ H_1: $\beta < 0$

If the null hypothesis is not rejected, this implies that the data is non-stationary.

Conversely, the rejection of the null hypothesis indicates that the data is stationary or I(0). Song and Witt [24] highlighted that it is important to select the appropriate lag length for all time series data because the ADF test tends to over-reject the null hypothesis when using too few lags or to reduce degrees of freedom when there are too many lags. This paper employs the Akaike information criterion (AIC) and Schwarz Bayesian criterion (SBC) as the criteria for selecting the lag length of the ADF test.

Nevertheless, Phillips and Perron [21] argued that ADF test is rather restrictive because the test assumes no autocorrelation and heteroscedesticity in the estimated residuals. Hence, the Phillips-Perron (PP) test will be employed because the test relaxes the abovementioned assumptions.

Johansen's [10] cointegration procedure will be employed in this study. To illustrate the procedure, let $Z_t = \begin{pmatrix} DIT_t \\ Y_t \\ ACC_t \\ RR_t \\ F_t \\ DA_t \\ OC_t \end{pmatrix}$, then, the vector autoregressive (VAR) can be written as:

$$Z_t = B_1 Z_{t-1} + B_2 Z_{t-2} + ... + B_P Z_{t-P} + U_t \qquad (2)$$

where p = number of lags, B_i = an (m x m) matrix of parameters, and U_t = error term. AIC and SBC are used to determine the length of lags for VAR model. In fact, the selected length of lags is based on the highest AIC and SBC [24].

To obtain the error-correction mechanism, equation (2) is transformed as follows:

$$\Delta Z_t = \sum_{i=1}^{P-1} \Phi_i \Delta Z_{t-i} + \Phi Z_{t-P} + U_t \qquad (3)$$

where $\Phi_i = -(I - B_1 - B_2 - ... - B_i)$, and $\Phi = -(I - B_1 - B_2 - ... - B_p)$. Φ_i and Φ are short-run and long-run adjustments to the changes in Z_t, respectively. Equation 3 is named as vector error-correction model (VECM). The equilibrium relationship can be expressed as:

$$\Phi = \alpha\beta',$$

where α is the speed of adjustment to disequilibrium, and β' is a set of cointegrating vectors. The existence of cointegration relationships can be determined by the rank of Φ, $r \leq (m-1)$. To choose *r*, maximal eigenvalue and trace tests will be employed. All the estimations are carried out using Microfit 4.0 [18].

In the long-run, the cointegrated parameters are expressed as follows:

$$DIT = \lambda_1 + \lambda_2 Y + \lambda_3 ACC + \lambda_4 RR + \lambda_5 F + \lambda_6 DA + \lambda_7 OC$$

The signs of the long-run cointegration parameters are expected as follows: $\lambda_2 > 0$, $\lambda_3 < 0$, $\lambda_4 < 0$, $\lambda_5 < 0$, $\lambda_6 < 0$ and $\lambda_7 > 0$.

5. Empirical results

Prior to conducting the cointegration analysis, it is important to determine the order of integration of all economic variables. ADF test statistics in Table 1 and 2 show that the logarithms and log-difference of DIT, Y and RR are I(0), but I (1) for ACC, F, DA and OC. Based on the ADF test results, it concludes that the first difference of all variables do not have the same order of integration. However, the PP test statistics in Table 1 and 2 reveal a different perspective. The logarithms of ACC, F, DA and OC are I(1) and the rest of the variables are I(0). Eventually, all variables become I(0) after taking the first difference. In other words, the results of PP test imply that the first difference of all variables have the same order of integration.

[Insert Table 1]

[Insert Table 2]

In the literature of international tourism demand, Chan et al. [4] and Shareef and McAleer [23] preferred the PP test over the ADF test. They asserted that PP test has higher power in finite samples than ADF test. Hence, this study prefers the results of PP test which concludes that the same order of integration exists in all economic variables. Given the above results, Johansen's cointegration analysis can be carried out.

The first stage of cointegration analysis is to specify a lag length (*p*) for the VAR model. Given large number of explanatory variables (n=6) for a given time-series data (*T*=34), Microfit 4.0 can generate a maximum of three lags in order to allow sufficient degrees of freedom. Table 3 reveals that the AIC and SBC for $p = 2$ are higher than that for $p = 1$ and the chi-squared test does not reject $p = 2$ at 1% significance level. Therefore, the study chooses the lag length $p = 2$.

[Insert Table 3]

To determine *r* or the number of cointegrating vectors, maximal eigenvalue and trace tests are carried out (Tables 4). Based on the likehood ratio statistics of both tests, there is no single conclusion found from the tests. The maximal eigenvalue test suggests that the number of cointegrating vectors is three while the trace test recommends five. This paper chooses $r = 3$ because, according to Seddighi and Shearing [22], the maximal eigenvalue test has greater power than the trace test.

[Insert Table 4]

For the error-correction terms, the first and third cointegrating vectors are statistically significant (Table 5). This indicates that there are two sets of long-run coefficients for interstate tourism demand.

[Insert Table 5]

The diagnostic tests reveal that the error-correction model is correctly specified. Based on the test results in Table 5, the residuals of the model do not have problems of misspecification, serial correlation and heteroscedasticity. The model also does not reject the null hypothesis of normality.

The signs of long-run coefficients for variables F, DA and OC in Table 6 are consistent with the economic theory. In the long-run, a 1% increases in fuel price and domestic airfares will lead to a decline in interstate tourism demand up to 3.65% and 22%, respectively. On the other hand, given a 1% rise in the price of overseas holidays, the number of interstate night stays will increase up to 7.17%.

[Insert Table 6]

However, the relationship between interstate tourism demand and accommodation price (ACC) does not support economic theory. The figures in Table 6 show that the coefficients of ACC range between +0.93 and +21.08, indicating that a rise in accommodation price increases the number of interstate visitor nights.

Table 6 also reveals that the long-run coefficients for income and prices of recreation and restaurants are +47.31 and -34.67, respectively. This indicates that income and prices of tourism goods and services have significant impacts on the interstate tourism demand in the long-run. However, this study also finds that the long-run income elasticities can be -0.77. One of the possible explanations is that, even if household income increases in the long-run, Australian residents will likely choose not to travel domestically because it is preferential to use their income for overseas holidays [1]. In addition, the long-run elasticities of the prices of recreation and restaurants can be +0.84, implying that, to a certain extent, an increase in the prices of recreation and restaurants will not reduce the number of night stays by interstate visitors.

6. Concluding remarks

This paper has carried out an error-correction model and Johansen's cointegration analysis to examine the short- and long-run relationships between interstate tourism demand in Australia and its economic determinants.

The study discovered several distinctive results. First, changes in income, the price of accommodation, domestic airfares, and the prices of recreation and restaurants can influence interstate tourism demand in the short-run.

Second, the signs of the long-run coefficients for fuel prices, domestic airfares and price of overseas holidays are consistent with economic theory. For transportation costs, the results demonstrated that interstate visitors are relatively more sensitive to the changes in domestic airfares than fuel prices.

Third, changes in income and prices of recreation and restaurants can significantly affect the demand for interstate tourism in the long-run. This study also found that an increase in income can lead to a decrease in the demand because Australian residents perhaps may prefer to use their additional income for overseas holidays. Furthermore, to a certain extent, an increase in the price of recreation and restaurants will not lead to a decline in interstate tourism demand.

Fourth, the long-run elasticities of accommodation costs are positive, which signify that a rise in accommodation price will increase the number of night stays by interstate visitors. Further investigation of the positive relationship between interstate tourism demand and accommodation prices is required because the relationship is not consistent with prior expectations based on economic theory.

The diagnostic tests certified that there are no serial correlation, misspecification, non-normality and heteroscedesticity issues in the residuals of the error-correction model. In other words, the interstate tourism demand model, which is proposed in this paper, is correctly specified. Given this fact, the model can be employed by tourism stakeholders to plan pricing policies and marketing strategies for promoting interstate tourism.

A significant limitation of this study is that some of the estimated coefficients are not consistent with consumer demand theory. A possible reason is that the number of observations used in this research is small, given that only about 34 observations were employed, and regressions using small sample size data can yield incorrect inferences [15].

Therefore, using panel data analysis is suggested as this analysis technique provides larger degree of freedom. Furthermore, Kim and Moosa [12] suggested using disaggregate data in tourism demand analysis because the data can generate better estimations and forecasts. Hence, in the future, this current research can be replicated using disaggregate data, namely number of interstate visitors and visitor nights by state and by purpose of visits.

Using quarterly data in this research is another limitation because such data smooth out random variations which could lead to information loss. In addition, the estimation using quarterly data are unable to generate high-frequency tourism demand forecasts (i.e. monthly interstate tourist arrivals). Hence, since daily and monthly data have been used in tourism demand literature, it would be worthwhile to employ high frequency data in the study of domestic interstate tourism demand in the future.

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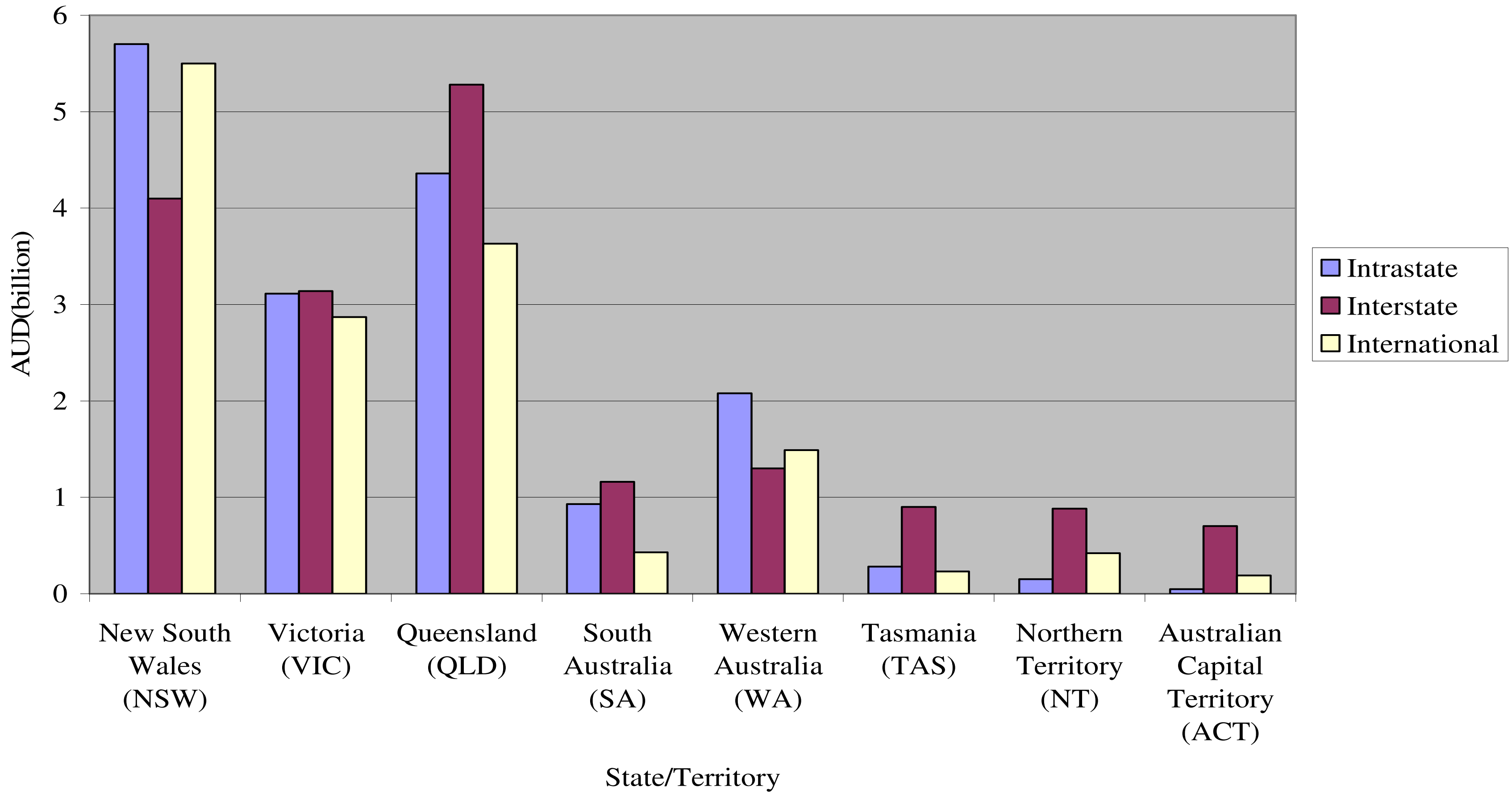

Fig. 1. Visitor expenditure in each States/Territory for the year ended 31 March 2007.
(Source: Based on [22,23]).

Table 1. Unit root test statistics for economic variables in logarithms

Variable	ADF test	Lag length of ADF	PP test
DIT	-3.5176	1	-10.4084
Y	-3.6361	0	-3.7227
ACC	-2.1791*	4	-2.8031*
RR	-5.8312	0	-9.1065
F	-2.8248*	4	-2.3213*
DA	-2.4115*	4	-2.2360*
OC	-1.3813*	3	-1.7291*

Note: Critical values at 5% for ADF and PP tests are -3.5731 and -3.5514, respectively. * denotes null hypothesis is not rejected at 5% significant level.

Table 2. Unit root test statistics for economic variables in log-difference

Variable	ADF test	Lag length of ADF	PP test
DIT	-5.1900	1	-33.2893
Y	-5.4870	0	-6.0926
ACC	-2.7954*	4	-7.3072
RR	-6.9141	0	-14.6024
F	-2.4475*	4	-4.8503
DA	-2.5635*	4	-4.8403
OC	-1.8004*	4	-5.4413

Notes: Critical values at 5% for ADF and PP tests are -3.5796 and -3.5562, respectively. * denotes null hypothesis is not rejected at 5% significant level.

Table 3. Test statistics for the length of lags of VAR model

Length of lags (*p*)	Log likelihood ratio	Akaike Information Criterion (AIC)	Schwarz Bayesian Criterion (SBC)	Chi-squared statistics
3	712.1110	565.1110	459.7129	NA
2	600.6259	502.6259	432.3605	71.9259[0.018]*
1	508.5403	459.5403	424.4076	131.3359[0.014]*
0	166.9208	166.9208	166.9208	351.7356[0.000]

Notes: The chi-squared statistics for $p = 3$ is not available.
* indicates that the chi-squared statistics are not rejected at 1% significance level.

Table 4. Cointegration test

Rank	Maximal eigenvalue test statistics	5% critical value	Trace test statistics	5% critical value
$r = 0$	86.5371*	46.47	244.2486*	132.45
$r = 1$	59.6172*	40.53	157.7115*	102.56
$r = 2$	38.9532*	34.40	98.0943*	75.98
$r = 3$	23.3572	28.27	59.1412*	53.48
$r = 4$	15.7629	22.04	35.7839*	34.87
$r = 5$	11.5702	15.87	20.0211	20.18
$r = 6$	8.4509	9.16	8.4509	9.16

Note: * indicates the rejection of rank (or the number of cointegrating vectors) at 5% significant level.

Table 5. Error-correction model

Variable	Coefficient	t-ratio	p-value
Δ DIT(-1)	-0.1458	-1.0871	0.289
Δ Y(-1)	-3.2161*	-3.1894	0.004
Δ ACC(-1)	-1.6222*	-3.6694	0.001
Δ RR(-1)	1.0309*	3.2663	0.004
Δ F(-1)	0.0632	0.2753	0.786
Δ DA(-1)	3.1397*	3.7814	0.001
Δ OC(-1)	-0.0767	-0.2051	0.839
$Z_{1,t-1}$	0.2104*	3.9976	0.001
$Z_{2,t-1}$	0.0772	1.4671	0.157
$Z_{3,t-1}$	0.2299*	4.3684	0.000
Adjusted R^2		0.9329	
Diagnostic tests:		Chi-squared	p-value
Serial correlation		7.0205	0.135
RESET		0.0049	0.944
Normality		0.1822	0.913
Heteroscedesticity		0.8392	0.360

Notes: Δ DIT(-1) = DIT_t-DIT_{t-1}; Δ Y(-1) = Y_t-Y_{t-1}; Δ ACC(-1) = ACC_t-ACC_{t-1}; Δ RR(-1) = RR_t-RR_{t-1}; Δ F(-1) = F_t-F_{t-1}; Δ DA(-1) = DA_t-DA_{t-1}; Δ OC(-1) = OC_t-OC_{t-1}; $Z_{j,t-1}$ = error correction term (*j = 1, 2 or 3*). * indicates statistical significance at the 1% level of significance for a one-tail test.

Table 6. Long-run coefficients for interstate tourism demand

Variable	Cointegrating vector 1	Cointegrating vector 2
DIT	-0.1910	-4.9590
	[-1.000]	[-1.000]
Y	9.0357	-3.8091
	[47.3128]	[-0.7681]
ACC	4.0252	4.6257
	[21.0765]	[0.9328]
RR	-6.6220	4.1764
	[-34.6742]	[0.8422]
F	-0.6980	-2.3688
	[-3.6548]	[-0.4777]
DA	-4.1979	-1.4977
	[-21.9812]	[-0.3020]
OC	1.3696	2.3998
	[7.1713]	[0.4839]
Intercept	-15.4984	32.7175
	[-81.1525]	[6.5976]

Notes: DIT = Interstate visitor nights; Y = Gross domestic product (GDP) per capita; ACC = Average price of accommodation per night; RR = Household expenditure on recreation, restaurant and cafes; F = Consumer price index (CPI) for automotive fuel; DA = CPI for domestic airfare; and OC = CPI of overseas holidays, travel and accommodation.
Figures in brackets are normalized value.