AUSTRALIAN DOMESTIC TOURISM DEMAND ANALYSIS USING PANEL DATA STATIC REGRESSION

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Abstract

The main aim of this research is to achieve sustainability of domestic tourism businesses in Australia. This study reveals several distinct findings. First, the income elasticity for domestic visitors of friends and relatives and interstate trips is negative, implying that Australian households will not choose to travel domestically when there is an increase in household income. Second, an increase in the current prices of domestic travel can cause the demand for domestic trips to fall in the next one or two quarters ahead. Third, the coefficients for lagged dependent variables are negative, indicating perhaps, that trips are made on a periodic basis.

Keywords: Domestic visitors, domestic tourism, income elasticity, domestic travel
JEL classification numbers: L83

Abstrak

Tujuan utama dari penelitian ini adalah untuk mengupayakan keberlanjutan usaha pariwisata domestik di Australia. Studi ini mengungkapkan beberapa temuan yang berbeda. Pertama, elastisitas pendapatan bagi pengunjung domestik yang terdiri dari teman dan kerabat, dan perjalanan antar negara bagian adalah negatif, menyiratkan bahwa para penduduk Australia tidak akan memilih untuk melakukan perjalanan wisata dalam negeri ketika ada peningkatan pendapatan rumah tangga. Kedua, kenaikan biaya perjalanan domestik dapat menyebabkan permintaan untuk perjalanan dalam negeri turun dalam satu atau dua kuartal ke depan. Ketiga, koefisien untuk variabel dependen tunda adalah negatif, menunjukkan bahwa perjalanan tersebut bisa jadi merupakan perjalanan yang bersifat periodik.

Keywords: Pengunjung domestik, wisatawan domestik, elastisitas pendapatan, perjalanan domestik
JEL classification numbers: L83

INTRODUCTION

Domestic tourism dominates most of the tourism businesses in Australia. For the year ended 30th June 2007, there were 74 million domestic visitors in Australia, whereas the number of international tourist arrivals was only five million (Travel by Australians, 2007). Furthermore, domestic visitors spent 288 million nights in Australia, while international visitors only spent 160 million nights. In terms of generating tourism revenue, the total spending by domestic visitors in 2007 was AUD 43 billion, which is 1.5 times higher than the aggregate expenditure by international tourist arrivals. Hence, this suggests that domestic tourism is an important market segment in the industry.

In general, domestic tourism is an important business for tourism in Australia because it has the largest shares of total tourist numbers and expenditure. Because of this, it is imperative to sustain this business and avoid losing its competitiveness.

This study examine Australian domestic tourism demand by investigating whether changes in economic conditions in Australia will affect the demand.

There is a growing concern about the stagnant growth of domestic tourism. Mazimhaka (2007) argued that, in Rwanda, a lack of variety of tourism products offered to the local travellers has caused a significant barrier to the development of Rwandan domestic tourism. Furthermore, the costs of domestic travel could be the cause of this concern. For instance, Sindiga (1996) asserted that Kenyans could not afford to pay for domestic tourism facilities due to the high costs of travel in Kenya. Similarly, Wen (1997) has noticed that Chinese domestic travellers tend to be frugal in spending because of relatively high travel costs in China. To overcome the problem, these authors suggested that the government should develop tourism facilities which can cater for the needs and affordability of domestic travellers. The following question is related to how much domestic travellers are willing to pay for accessing such tourism facilities.

In addition, domestic tourism competes with other household products for a share of disposable income. Dolnicar et al. (2008) conducted a survey of 1,053 respondents to investigate how Australian households spend their discretionary income. Based on their findings, 53% of the survey respondents in Australia would think of allocating their disposable income to paying off debt whereas only 16% of the respondents would spend on overseas and domestic holidays. If the cost of other household products (i.e. debt) has increased, Australian households would increase their use of disposable income on these products while postponing their decisions to travel. If this holds true, domestic tourism may encounter stiff competition from other household products. Furthermore, a rising cost of living could cause negative impacts on the demand for domestic tourism.

The growth of income per capita in a country can encourage more local residents to travel overseas, causing domestic tourism to compete with foreign tourism. For instance, in China, since the Chinese government introduced a new policy that promotes outbound tourism and with the continuous growth of the residents' income, more wealthy Chinese residents substitute from domestic holidays to overseas travel (Huimin and Dake, 2004). Moreover, during the period of increasing economic activity in Australia, Athanasopoulos and Hyndman (2008) found that the number of visitor nights by domestic holiday-makers declined significantly, which could relate to Australians choosing overseas travel rather than domestic holidays.

In addition, several empirical papers reported inconsistent findings, particularly, about the effects of negative events on domestic tourism demand. On one hand, a study conducted by Blunk et al. (2006) discovered that the 9/11 terrorist attacks have had permanent adverse effects on US domestic air travel. On the other hand, there are empirical papers which argued that domestic tourism demand is not sensitive to negative events. For instance, Bonham et al. (2006) noticed that the number of US domestic visitors to Hawaii increased after the US terrorist attacks. Moreover, Salman et al. (2007) found that the Chernobyl nuclear disaster in 1986 did not have a significant influence on domestic tourism demand in Sweden. Similarly, Hamilton and Tol (2007) argued that climate change would not have negative impacts on the demand for domestic tourism in Germany, UK and Ireland. In summary, we are unable to make a conclusion based on the discussion above for two reasons. First, the empirical findings contradict each other and second, the number of papers in this research area appears to be too few.

Overall, the domestic tourism industry encounters several issues, such as the stagnant growth of demand and strong competition with other household products. Therefore, an in-depth understanding of domestic tourism demand is required because we can identify the travel characteristics of each domestic market segment and also examine the factors that affect the decisions about domestic travel. By doing so, it should assist tourism stakeholders to realise their potential markets and provide affordable and good quality of tourism products for the targeted domestic markets.

In the tourism literature, the analysis of domestic tourism demand in Australia is lacking in the literature. Divisekera (2007) argued that economic analyses of international tourism demand inbound to Australia have been well-documented, but virtually no study examines the economic determinants of Australian domestic tourism demand. Currently, several empirical papers such as Athanasopoulos and Hyndman, 2008; Crouch et al., 2007; Divisekera, 2007; Hamal, 1996; and Huybers, 2003 have examined the economic factors that determine the demand for domestic tourism in Australia.

Hamal (1996) argued that domestic holiday nights are strongly affected by tourists' income, prices of domestic goods and services, and prices of overseas holidays. To conduct the demand analysis, the author employed cointegration and an error-correction model to estimate the economic determinants, based on annual data from 1978-79 to 1994-95. All of the above variables had statistically significant impacts on the demand. Furthermore, the variables of income and prices of overseas holidays were positive, implying that an increase in these variables will result in an increase in the demand for domestic holidays; whilst the variable for prices of domestic goods and services was negative.

Divisekera (2007) employed a different approach to estimate the economic determinants of Australian domestic tourism demand. In the study, an Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer, 1980) was used. The model was able to explain how domestic tourists allocate their travel budgets for various tourism goods and services. The study used annual data on tourism expenditure by states of origin from 1998 to 2004. The empirical results showed that demand for tourism goods and services was elastic in terms of income but varied across different states of origin. However, the demands for tourism goods and services appeared to be price inelastic for tourists from all states of origin. This shows that expenditure on tourism goods and services by domestic tourists is not affected by the changes in tourism prices but is strongly influenced by tourists' income.

However, the most recent study (Athanasopoulos and Hyndman, 2008) revealed different findings. The authors proposed that the number of domestic holiday nights is a function of a time trend, personal debts, GDP per capita, the prices of domestic holidays, dummy variables for the Bali bombings and the Sydney Olympics, and seasonal dummies. The price of overseas holidays was omitted from the study because the effects of this variable were statistically insignificant. In terms of models and data used, the authors combined an innovation state space model with exogenous variables and employed quarterly data from 1998 to 2005. According to the empirical findings, the signs of the coefficients of debt and GDP were positive and negative, respectively. This implies that an increase in the growth rate of borrowing can increase consumers' confidence to spend in domestic holidays. In contrast, the negative coefficient of GDP indicates that, an increase in domestic tourists' income can lead to a decrease in the demand for domestic holiday travel. This may be due to Australians preferring overseas holidays as income increases.

In a further study, Huybers (2003) found that travel decisions by domestic tourists were influenced by whether the destinations were intrastate or interstate. The research was carried out to understand the factors that influence choices of domestic tourism destination by potential tourists from Melbourne. The study employed discrete choice modelling analysis. According to the empirical results, a 1% increase in the expenditure for trips to Sydney and the Goldfields of Victoria in Victoria reduced the number of Melbourne overnight tourists by around 1% and 0.5%, respectively. One of the possible reasons for such results is that the cost of travelling to Sydney (interstate) is relatively more expensive, being about twice of the cost of visiting the Goldfields of Victoria (intrastate). Hence, this indicates that the costs of intrastate and interstate tourism can determine domestic tourists' decisions to travel within Australia.

Lastly, Crouch et al. (1997) found that rising expenditure on other household products, particularly household debt, may have effects on the demand for domestic tourism in Australia. The underlying rationale is that Australian consumers have a strong tendency to trade off their discretionary income for repaying debt, rather than for travel. Crouch et al. (2007) discovered that most Australian households used 45% of their discretionary income for household debt repayments. Hence, if Australian households have an increasing accumulation of debt, this could lead to a reduction of disposable income available to spend on leisure.

Nevertheless, Athanasopoulos and Hyndman (2008) reported that an increase in household debt would not lead to a decline in domestic holiday and business travel in Australia. In fact, the elasticities of one-quarter-lagged debt variables for domestic holiday and business tourism demand were 4.41 and 5.91, respectively. The author suggested that the variable is considered as a proxy for consumer confidence and hence, an increase in borrowing rate in previous quarter will result in a rise in domestic travel demand.

Overall, the empirical papers above reveal several arguments. First, domestic tourists' income and the prices of tourism goods and services are the important economic determinants that influence Australians to travel domestically. Furthermore, another characteristic of domestic tourists is that they make choices between domestic destinations, by comparing the costs between travelling to intrastate and interstate destinations. Third, the literature above has inconsistent findings about the effects of income, tourism prices and household debt growth on domestic tourism demand. Lastly, there is little empirical analysis of using panel data analysis in domestic tourism demand analysis.

METHODS

According to consumer demand theory, domestic tourism demand can be written (in panel data format) as:

$$TD_{jt} = f(Y_{jt}, TP_{jt}, TC_{jt}, OC_{jt}, DUM_{jt})$$

where *TD* = Demand for domestic tourism at time *t* in State *j*, *Y* = domestic household income, *TP* = tourism prices, *TC* = transportation costs ,*OC*= the price of overseas holidays and *DUM* = dummy variable for one-off events (such as the Bali bombings in 2005 and the Sydney Olympic Games in 2000) and seasonality.

This paper employs pooled data which are based on seven Australia States from 1999 quarter 1 to 2007 quarter 4. This provides a total of 252 pooled observations. It uses numbers of domestic overnight visitors and visitor nights in Australia as the dependent variables for Australian domestic tourism demand.

This study uses six types of domestic tourism demand data, namely the numbers of visitor nights by holiday-makers (*HOL*), business visitor nights (*BUS*), visitors of friends and relatives (*VFR*), other purpose of visits (*OTH*), interstate and intrastate visitors. In addition, another two types of data are employed, namely the number of interstate and intrastate overnight visitors.

For the independent variables, several variables are used as a proxy for household income. They are disposable income, gross domestic product (*GDP*) and *GDP* per capita. On the other hand, the *CPI* for domestic holidays and accommodation is used as a proxy for tourism prices. It represents the aggregate prices of domestic travel in Australia. As for transportation costs, the proxy variables are the *CPI* for automotive fuel. All variables are expressed in logarithms.

Panel Unit Root and Static Regression Analyses

In a panel data analysis, it is crucial to investigate whether the pooled data is stationary or not. For this research, an IPS unit root test is employed. The test is developed by Im, Pesaran and Shin (2003) which allows for individual unit root process to vary across all cross-sections (Eviews, 2007). In the tourism literature, Narayan (2006) used this test to examine international tourist arrival to Australia.

To illustrate that, a panel Augmented Dickey-Fuller (ADF) regression is written as follows:

$$\Delta Y_{jt} = y_{jt-1} + \sum_{l=1}^{p_i} \varphi_{jl} \Delta Y_{jt-l} + \alpha_j + \theta_j t + u_{jt} \qquad (1)$$

where Y_{jt} = a panel data with individuals j = 1,2,...,N and time-series observations t = 1,2,...,T , α_j = unit-specific fixed effects, t = time trend, θ_j = coefficients of time-trend and u_{jt} = error term. Unlike the pure time-series ADF test, the auxiliary equation (1) contains unit-specific fixed effects which allow for heterogeneity across cross-section data (Asteriou and Hall, 2007).

For the IPS test, it allows heterogeneity on φ and runs the auxiliary regression (1) based on the average of the individual unit root test statistics (Im et al., 2003) and Asteriou and Hall, 2007). To illustrate that, the hypotheses of IPS test are written as follows:

H_0: j = 0 for all j
$H_1 : \varphi_j < 0$, j = 1, 2, ..., N_1, $\varphi_i = 0$, $j = N_1+1$, $N_1+2,...,N$.

The null hypothesis states that all cross-section series are non-stationary whereas under the alternative hypothesis, a part of the total series in the panel is stationary. For the IPS test, Im et al. (2003) constructed a t-statistic which the null hypothesis follows the standard normal distribution as T (and subsequently N) approaches to infinity.

Panel data analysis is the combination of time-series and cross-section techniques. There are two types of models, namely fixed effects and random effects models. To illustrate that, a simple domestic tourism demand can be written as a pooled OLS model, as follows:

$$y_{jt} = c + \delta v_{jt} + \alpha_j + \eta_{jt} \qquad (2)$$

where:

y_{jt} is demand for domestic tourism in State j
c is a common constant term
v is a vector of explanatory variables.
t is time subscript.
α_j is individual-specific effect of each State j
δ is a coefficient matrix
η is error term.

Estimating equation (2) could be problematic because including many α_j can cause dummy variable trap or perfect multicollinearity. Hence, to avoid such issue, Baltagi (2008) developed a regression that averages the regression (2) over time. The regression is expressed as follows:

$$\overline{y}_j = c + \delta\overline{v}_j + \alpha_j + \overline{\eta}_j \quad (3)$$

where $\bar{y}$ is mean value of domestic tourism demand data, $\bar{v}$ is mean value of the explanatory variables, and $\overline{\eta}$ is mean of error terms. Thereafter, by subtracting (3) from (2), it is written as:

$$y_{jt} - \overline{y}_j = \delta(v_{jt} - \overline{v}_j) + (\eta_{jt} - \overline{\eta}_j) \quad (4)$$

or $y^*_{jt} = v'^*_{jt}\delta + \eta^*_{jt}$,

where y^*_{jt} is $y_{jt} - \bar{y}_j$, v'^*_{jt} is $(v_j - \bar{v}_j)$, η^*_{jt} is $(\eta_{jt} - \bar{\eta}_j)$ and $\sum_{i=1}^{j} \alpha_i = 0$

Equation 3 is called a fixed effects model. Nevertheless, the model suffers from losing a number of degrees of freedom. According to Gujarati (2003), if equation (2) includes too many α_j, then the degrees of freedom will decline.

Hence, to tackle this issue, a random effects model is introduced. Unlike the fixed effects model which incorporates the individual-specific effects as dummy variables, the random effect model treats the effects as error components. It is written as follows:

$$y_{jt} = v'_{jt}\delta + \varepsilon_{jt} \quad (5)$$

where v_{jt} is a matrix of explanatory variables, δ is coefficient matrix. The error term of equation (5) is $\varepsilon_{jt} = u_j + \eta_{jt}$, where u_j is individual-specific error component and η_{jt} is errors from different cross-section units. Equation (5) assumes that v_{jt} are uncorrelated with ε_{jt}. OLS estimation of this model is asymptotically unbiased, but it can generate inefficient standard errors.

To determine the appropriate models for modelling domestic tourism demand, the Hausman Specification (HS) tests will be carried out. The test examines whether α_j are correlated with v_{jt}. If the null hypothesis (H_0: α_j are not correlated with v_{jt}) is not rejected, it indicates that both estimates of fixed and random effects models are consistent. In other words, there is no difference between the estimations of both models. Conversely, if the HS test rejects the null hypothesis, this implies that the fixed effects estimator is consistent but not the random effects model (Romilly et al., 1998; Johnston and DiNardo, 1997).

The fixed-effects model shown in regression (4) assumes homoskedasticity in the residuals. According to Baltagi (2001), this is a restrictive assumption for panel data models. Cross-section heteroskedasticity may exist because cross-sectional units may be of varying size and exhibit different variation. To take accounts of heteroscedasticity effects in panel data regressions, generalised least square (GLS) models are introduced.

To tackle cross-section heteroscedasticity, the OLS estimations in the panel data models have to be transformed into GLS estimations in order to obtain unbiased and efficient estimates. For example, the OLS estimates of δ in equations (5) are given as follows:

$$\hat{\delta}_{OLS} = \left(\sum_{j=1}^{N} V'_j V_j\right)^{-1} \sum_{j=1}^{N} V'_j y_j$$

where $V_j = (v_{j1}, v_{j2}, \ldots, v_{jT})'$ and N is the number of cross-section units. According to

Arellano (2003), the above OLS estimate is unbiased and consistent but inefficient. Hence, the optimal estimation can be achieved through the GLS transformation, which is expressed as follows:

$$\hat{\delta}_{GLS} = \left(\sum_{j=1}^{N} V_j' \Omega^{-1} V_j \right)^{-1} \sum_{j=1}^{N} V_j' \Omega^{-1} y_j \qquad (6)$$

where $\Omega = E(\varepsilon_j \varepsilon_j')$. This GLS estimator is not feasible as Ω is unknown. However, in Eviews 6.0, we can estimate fixed effects model using feasible GLS coefficients by generating a series of estimated residuals and then use these residuals for estimating weighted least squares. Further mathematical derivations of feasible GLS can be found in Arellano (2003) and Baltagi (2001). For convenience, we name the fixed-effects model which is cross-sectional heteroscedascity adjusted, as FE-CSH.

Another method of analysing panel data is to use seemingly unrelated regression estimation. It assumes that the errors are correlated across cross-section units but independent over time [Eviews (2007)]. According to Maddala (2001), this type of correlation would arise if there are omitted variables which are common to all equations. To conduct SUR estimation in a GLS method (hereafter named as FE-SUR), the GLS coefficient is similar to (6) but the difference is that $\Omega = E(\varepsilon_j \varepsilon_l')$ where $j \neq l$.

RESULTS DISCUSSION

The results of the panel unit root tests in Table 3 consist of two auxiliary regressions, in which one with intercept and without trend, and another with an intercept and a trend. Based on the table, it is found that there are no unit root problems in the logarithm and first differenced panel data for all types of dependent variables.

On the other hand, for independent variables, Table 4 shows that the IPS test rejects the null hypothesis for the *DI* and *DT* level data, indicating that these variables are stationary in panels. In contrast, the test does not reject the null hypothesis for the F, *GDP*, *GDPP* and *OC* level data. After taking first-differencing on all variables, all independent variables become stationary, except for *GDP*. Nevertheless, the *GDP* variable becomes stationary when the auxiliary regression included a trend. Overall, this concludes that the panel data for F, *GDP*, *GDPP* and *OC* variables are *I*(1), whereas the panel data for *DI* and *DT* are I(0).

In conclusion, the IPS test found that four out of six variables are *I*(1) when logarithm data are tested and *I*(0) after first-differenced the data. Hence, to ensure data stationary for all variables, this thesis uses first-difference data. Furthermore, by differencing the data and removing the problem of potentially non-stationary observations, panel data analysis will give us confidence in the reported coefficients and standard errors (Garin-Munoz, 2007). Given this, the following panel data estimations are based on first differenced pooled data (or percentage growth panel data).

All estimations using the panel data static models are summarised in Tables 5 to 12. Note that, According to Allen, Yap and Shareef (2009), the *ACC* and *RR* appear in time-series cointegration analysis are found to be statistically significant. However, when the panel data for *ACC* and *RR* variables are used, the *ACC* and *RR* are statistically insignificant. Therefore, these variables are excluded from panel data analysis. Instead, *CPI* for domestic holidays and accommodation (*DT*) is used to replace *ACC* and *RR* as a proxy variable for tourism prices. Similarly, as the *CPI* for overseas holidays and accommodation is found to be statistically insignificant in all cases, I decided to omit this variable from this study.

Table 3: IPS Panel Unit Root Test for the DependentV ariables

Panel data	Auxiliary regression specification	Level	First-differenced
BUS	No trend	-5.036	-18.998
	Trend	-10.106	-18.109
HOL	No trend	-10.178	-34.304
	Trend	-9.368	27.761
VFR	No trend	-6.185	24.156
	Trend	-5.176	23.792
OTH	No trend	-14.982	-17.293
	Trend	-13.923	-17.199
NV	No trend	-7.490	-21.642
	Trend	-12.651	-21.136
NVI	No trend	-4.569	-13.800
	Trend	-11.565	-12.941
OV	No trend	-4.120	-18.397
	Trend	-10.904	-17.384
OVI	No trend	-3.491	-25.163
	Trend	-4.588	-24.701

Notes: The critical values for the regression without a trend at the 1%, 5% and 10% significance levels are -2.29, -2.07 and -1.95, respectively. The critical values for the regression with a trend at the 1%, 5% and 10% significance levels are -2.90, -2.68 and -2.57, respectively.
Source: Data estimation

Table 4: IPS Panel Unit Root Test for the Independent Variables

Panel data	Auxiliary regression specification	Level	First-differenced
DI	No trend	-3.20	-7.576
	Trend	-3.051	-4.384
DT	No trend	-4.308	-14.803
	Trend	-2.957	-11.681
F	No trend	-0.458	-13.808
	Trend	-1.634	-9.818
GDP	No trend	-0.748	-2.103
	Trend	-2.723	-7.277
GDPP	No trend	-3.352	-9.660
	Trend	-1.131	-8.061
OC	No trend	-1.442	13.513
	Trend	-0.589	12.250

Notes: The critical values for the regression without a trend at the 1%, 5% and 10% significance levels are -2.29, -2.07 and -1.95, respectively. The critical values for the regression with a trend at the 1%, 5% and 10% significance levels are -2.90, -2.68 and -2.57, respectively.
Source: Data estimation

The effects of income changes on domestic travel are distinct from one type of visitors to another. On one hand, the income variables for holiday and business visitor nights are highly elastic and positive. On the other hand, the income variables are shown as negative for *VFR*, *OTH* and interstate tourism data. For instance, in Table 5, the *GDPP*(-1) estimate for holiday visitor night data is 8.56, suggesting that Australians tend to travel more domestically for holiday purposes when their household income increases. As the estimated elasticity is high and exceeded one, domestic holiday trips can be regarded as a luxury trip. Similarly, the *GDP* and

GDPP(-1) coefficients for business visitor night data are 1.12 and 11.1, respectively, showing that the demand for domestic business tourism is strongly responsive to the conditions of Australian economy (See Table 6). Conversely, the disposable income coefficients for domestic *VFR* visitor night data range between -0.70 and -1.18 (See Table 7), whilst the GDPP coefficient for interstate visitor data range between -3.42 and -6.97 (See Tables 9 and 11). This means that a growth in disposable income will cause Australian households to forego domestic *VFR* and interstate trips, and alternatively, may choose overseas travel or purchase other luxury household products.

Table 5: Estimate of the Double-log Static Panel Model [Dependent Variable: Holiday Visitor Nights (HOL)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.149*** (0.043)
GDPP(-1)			8.564** (3.516)	
DT(-1)	-3.057*** (1.033)	-0.965** (0.458)	-1.833*** (0.485)	-3.040*** (1.040)
DT(-2)	-7.010*** (1.036)	2.092*** (0.391)	3.40*** (0.544)	6.972*** (1.035)
Bali	0.212* (0.092)	0.10*** (0.026)	0.078* (0.043)	0.211** (0.091)
*S*1	0.749*** (0.118)	0.532*** (0.048)	0.539*** (0.052)	0.747*** (0.118)
*S*2	0.223** (0.105)	-0.199*** (0.036)	-0.062 (0.058)	0.221** (0.102)
W($\delta_1$is$\delta_2$is...is$\delta_n$is 0)	9.128***	21.563***	9.666***	20.551***
$\left\|\sum \eta\right\|$	4.663E-15	1.776E-14	0	1.532E-14
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 6: Estimate of the Double-log Static Panel Model [Dependent Variable: Business Visitor Nights (BUS)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.062* (0.032)
GDP	1.122** (0.514)		1.010** (0.480)	1.122** (0.508)
GDPP(-1)	11.096** (4.894)	9.276* (4.934)	8.905** (4.503)	11.096** (4.829)
DT(-1)	-1.414* (0.728)	- 1.304** (0.618)	- 1.398** (0.627)	- 1.413* (0.718)
W($\delta_1$is$\delta_2$is...is$\delta_n$is 0)	3.257***	2.857***	2.731***	9.947***
$\left\|\sum \eta\right\|$	2.165E-15	1.887E-15	3.331E-15	4.496E-15
Hausman test (Prob)				0.000 (1.000)

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 7: Estimate of the Double-log Static Panel Model [Dependent Variable: VFR Visitor Nights]

Coeff cients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.020
				(0.031)
DI	-1.184*	-0.779	-0.698	-1.177*
	(0.667)	(0.520)	(0.479)	(0.648)
DT(-2)	-3.959***	-2.836***	-2.957***	-3.922***
	(0.699)	(0.366)	(0.369)	(0.683)
Bali	0.261***	0.158***	0.231***	0.261***
	(0.053)	(0.039)	(0.085)	(0.053)
*S*1	0.251**	0.190**	0.239***	0.251**
	(0.109)	(0.082)	(0.070)	(0.106)
$W(\delta_1 \text{is} \delta_2 \text{is} ... \text{is} \delta_n \text{is } 0)$	7.879***	12.345***	11.567***	20.017***
$\lvert\sum \eta\rvert$	5.718E-15	1.066E-14	1.388E-14	3.331E-16
Hausman test (Prob)				0.000 (1.000)

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 8: Estimate of the double-log static panel model [Dependent variable: OTH visitor nights]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.062
				(0.042)
DI(-1)	-4.460***	-2.525***	-3.035***	-4.418***
	(0.883)	(0.689)	(0.608)	(0.847)
DT(-2)	-5.811***	-3.512***	-3.787***	-5.719***
	(1.271)	(0.825)	(0.796)	(1.218)
F	-1.318**	-0.663	- 1.098**	- 1.318**
	(0.661)	(0.580)	(0.508)	(0.643)
*S*1	0.459***	0.167*	0.194**	0.454***
	(0.113)	(0.088)	(0.085)	(0.110)
*S*3	0.374***	0.174	0.284***	0.372***
	(0.106)	0.110	(0.088)	(0.104)
$W(\delta_1 \text{is} \delta_2 \text{is} ... \text{is} \delta_n \text{is } 0)$	3.321***	1.620***	2.604***	7.290***
$\lvert\sum \eta\rvert$	2.154E-14	1.998E-14	1.044E-14	1.521E-14
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 9: Estimate of the Double-log Static Panel Model [Dependent Variable: Interstate Visitor Nights (NV)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.013
				(0.033)
GDPP	-6.971*	-5.369*	-6.704**	-6.917*
	(3.889)	(2.527)	(3.002)	(3.856)
DT(-1)	-2.128**	-0.917	-1.403**	-2.076**
	(1.020)	(0.644)	(0.630)	(1.036)
DT(-2)	-4.131***	-2.767***	-2.620***	-4.090***
	(0.472)	(0.334)	(0.300)	(0.488)
Bali	0.249***	0.222***	0.220***	0.248***
	(0.054)	(0.041)	(0.064)	(0.053)
*S*1	0.283***	0.359***	0.328***	0.281***
	(0.080)	(0.049)	(0.054)	(0.080)
*S*3	0.073	0.111**	0.113***	0.076
	(0.058)	(0.044)	(0.041)	(0.058)
$W(\delta_1$is$\delta_2$is...is$\delta_n$is 0)	5.256***	10.221***	6.362***	10.522***
$\left\lvert\sum \eta\right\rvert$	1.604E-14	8.826E-15	3.442E-15	2.942E-15
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

With regard to the tourism prices, only the *CPI* of domestic travel (*DT*) and automotive fuel (*F*) variables are found to be statistically significant in this current research. Accordingly, the estimates for one-period-lagged domestic tourism prices [*DT*(-1)] and two-period-lagged domestic tourism prices [*DT*(-2)] are negative and statistically significant for most types of domestic tourism data. This implies that an increase in current tourism prices will lead to a fall in domestic tourism demand in the next one and two quarters (See Tables 5 – 12). Moreover, this study also discovers that the *DT*(-1) coefficients are considerably high (ranging from -0.49 to -3.06), but this is somewhat lower that the *DT*(-2) estimates (ranging from -0.59 to -7.10). To put it differently, those Australian households who plan their domestic trips two-quarters ahead are more responsive to price changes than those who plan a quarter ahead. In addition, for *OTH* visitor night data in Table 8, the coefficient for F is -1.3, indicating that an increase in current fuel prices will have an inverse effect on 'other' visitor travel.

The incidents of the Bali bombings have influences on the demand for holiday, *VFR*, interstate and intrastate trips. Furthermore, the coefficients for Bali have a positive sign for all cases, suggesting that Australians would substitute from overseas travel (Bali) to domestic trips when Bali bombings incidences occurred. Nevertheless, as most of the coefficients are below one, this means that the influences of Bali bombing incidences on Australian domestic tourism demand are not strong.

This study also reports that seasonality exists in Australian domestic tourism demand. Seasonal dummy variables are shown as significant for all types of domestic visitors, except for the business visitor night data. This implies that domestic tourists travel mostly during summer school holidays in January and mid-term school holidays in July.

Apart from that, the *F*-statistics reject the null hypothesis of $\delta_1$is $\delta_2$is...is $\delta_n$is0 at the 1% significance level for most cases, indicating that all independent variables are important in explaining all types of domestic tourism demand data. However, the only exception is when using FE-SUR in modelling interstate tourism demand (See Table 11). Accordingly, the F-test cannot reject the null hypothesis at the 10% significance level, indicating that the independent variables are not jointly significant using the FE-SUR model.

The random effects estimations show relatively similar results to the fixed effects regression results. Based on the Hausman test, they do not reject the null hypothesis that α_j are not correlated with v_{jt}. In other words, the choice between the fixed and random effects models is indifferent because the estimates from both models are consistent. Nevertheless, note that the chi-squares statistics for the Hausman test are zero and this is not unusual because the estimations for the fixed and random effects models are not significantly different from each other (Johnston and DiNardo, 1997).

The residuals determinants are reported in the tables in order to determine the best statistical representation of each category of domestic tourists. Accordingly, the best model is justified by the criterion of the minimum value of the determinants. Based on the results, the best static panel data models for holiday and OTH tourism demand are FE-SUR, whilst FE-CSH is the best model for business, VFR and intrastate overnight tourism demand. As for interstate overnight tourism demand, the fixed effects model has the lowest value of residuals determinants.

Table 10: Estimate of the double-log static panel model [Dependent variable: Intrastate visitor nights (NVI)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				0.046
				(0.032)
DT(-1)	-1.262*	-0.620 *	-0.671**	-1.260*
	(0.708)	(0.361)	(0.310)	(0.726)
DT(-2)	-2.328***	-0.772 ***	-0.676 **	-2.324***
	(0.618)	(0.243)	(0.306)	(0.622)
Bali	0.124***	0.106***	0.083**	0.124***
	(0.033)	(0.034)	(0.033)	(0.033)
*S*1	0.276***	0.177***	0.191***	0.276***
	(0.056)	(0.028)	(0.024)	(0.056)
*S*2	-0.131*	-0.290***	-0.254***	-0.132*
	(0.069)	(0.036)	(0.038)	(0.068)
*S*3	-0.224***	-0.228***	-0.210***	-0.224***
	(0.049)	(0.026)	(0.026)	(0.049)
$W(\delta_1$is$\delta_2$is...is$\delta_n$is 0)	9.844***	29.063***	21.418***	20.168***
$\left\|\sum \eta\right\|$	4.566E-15	1.546E-14	1.818E-15	4.330E-15
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 11: Estimate of the Double-log Static Panel Model [Dependent Variable: Number of Interstate visitors (OV)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				-0.124***
				(0.041)
GDPP	-5.764**	-4.100***	-3.417**	-5.771**
	(2.509)	(1.414)	(1.466)	(2.470)
DT(-2)	-3.914***	-1.114***	-1.373***	-3.881***
	(0.651)	(0.381)	(0.343)	(0.644)
Bali	0.160***	0.105***	0.066**	0.159***
	(0.041)	(0.028)	(0.029)	(0.041)
*S*1	0.237***	0.098***	0.111***	0.235***
	(0.068)	(0.033)	(0.029)	(0.068)
*S*2	0.349***	0.078*	0.102**	0.347***
	(0.083)	(0.046)	(0.044)	(0.081)
*S*3	0.152***	0.060**	0.101***	0.152***
	(0.049)	(0.029)	(0.028)	(0.048)
$W(\delta_1 \text{is} \delta_2 \text{is} ... \text{is} \delta_n \text{is } 0)$	4.738***	1.741*	1.175	9.512***
$\left\|\sum \eta\right\|$	1.787E-14	2.220E-15	3.775E-15	2.076E-14
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

Table 12: Estimate of the Double-log Static Panel Model [Dependent Variable: Number of Intrastate Visitors (OVI)]

Coefficients	Panel models			
	Fixed effects	FE-CSH	FE-SUR	Random effects
Constant				0.034
				(0.025)
DT(-1)	-0.720*	-0.490	-0.734**	0.716
	(0.424)	(0.315)	(0.303)	(0.436)
DT(-2)	-1.748***	-0.587***	-0.605**	-1.739***
	(0.374)	(0.217)	(0.246)	(0.369)
Bali	0.087***	0.068***	0.068***	0.087***
	(0.025)	(0.023)	(0.023)	(0.025)
*S*1	0.110**	0.044*	0.062**	0.110**
	(0.045)	(0.026)	(0.026)	(0.044)
*S*2	-0.012	-0.103***	-0.110***	-0.013
	(0.047)	(0.031)	(0.031)	(0.046)
*S*3	-0.169***	-0.169***	-0.180***	-0.169***
	(0.034)	(0.028)	(0.028)	(0.034)
$W(\delta_1 \text{is} \delta_2 \text{is} ... \text{is} \delta_n \text{is } 0)$	5.846***	10.133***	6.386***	11.932***
$\left\|\sum \eta\right\|$	1.998E-15	5.163E-15	2.776E-15	6.41E-15
Hausman test				0.000
Prob(Hausman test)				1.000

Notes: ***, **, and * denote significant at 1%, 5% and 10% levels, respectively.
Source: Data estimation

CONCLUSION

Even though the static panel data models have generated convincing estimates, we cannot be sure that the models are completely free of specification errors. As it is widely known in tourism literature that tourists tend to have habit persistency, omitting such information could lead to serious misspecification. Hence, in the following section, dynamic panel data models are employed by adding lagged dependent variables to take account of tourists' habit persistency. Perhaps, replicating this study using dynamic panel data models would be ideal.

The current econometric analysis has significant implications for practitioners. A better understanding of income and travel cost impacts on Australian households' demand allows tourism companies to develop price strategies more effectively. Moreover, tourism researchers can use economic variables to investigate how changes in these indicators may have an impact on individual decisions to travel.

REFERENCES

Allen, D., G. Yap, and R. Shareef (2009), "Modelling Interstate Tourism Demand in Australia: A Cointegration Approach," *Mathematics and Computers in Simulation*, 79, 2733-2740.

Arellano, M. (2003), *Panel Data Econometrics*, Oxford University Press, New York.

Asteriou, D. and S.G. Hall (2007), *Applied Econometrics: A Modern Approach Using Eviews and Microfit*, Palgrave Macmillan, New York.

Athanasopoulos, G., and R.J. Hyndman (2008), "Modelling and Forecasting Australian Domestic Tourism," *Tourism Management*, 29, 19-31.

Baltagi, B.H. (2001), *Econometric Analysis of Panel Data*, 2nd Edition, West Sussex: John Wiley & Sons Ltd.

Blunk, S.S., D.E. Clark, and J.M. McGibany (2006), "Evaluating the Long-Run Impacts of the 9/11 Terrorist Attacks on Us Domestic Airline Travel," *Applied Economics*, 38, 363-370.

Bonham, C., C. Edmonds, and J. Mak (2006), "The Impact of 9/11 and Other Terrible Global Events on Tourism in the United States and Hawaii," *Journal of Travel Research*, 45, 99-110.

Crouch, G.I., H. Oppewal, T. Huybers, S. Dolnicar, J J. Louviere, and T. Devinney (2007), "Discretionary Expenditure and Tourism Consumption: Insights from a Choice Experiment," *Journal of Travel Research*, 45, 247-258.

Deaton, A., and J. Muelbauer (1980), "An Almost Ideal Demand System," *American Economic Review*, 70, 312-326.

Divisekera, S. (2007), "Domestic Demand for Australian Tourism: Elasticity Estimates," in *Modelling and Estimation of Tourism Demand Elasticities: A Study of Tourist Expenditure Allocation in Australia*, Queensland, CRC for Sustainable Tourism, 6-14.

Dolnicar, S., G.I. Crouch, T. Devinney, T. Huybers, J.J. Louviere, and H. Oppewal (2008), "Tourism and Discretionary Income Allocation: Heterogeneity among Households," *Tourism Management*, 29, 44-52.

Dwyer, L., P. Forsyth,R. S purr, and T. Vanho (2003), "Tourism's Contribution to a State Economy: A Multi-Regional General Equilibrium Analysis," *Tourism Economics*, 9, 431-448.

Garin-Munoz, T. (2007), "German Demand for Tourism in Spain," *Tourism Management*, 28, 12-22.

Hamal, K. (1996), "Modelling Domestic Holiday Tourism Demand in Australia: Problems and Solutions," *Asia Pacific Journal of Tourism Research*, 1, 35-46.

Hamilton, J.M., and R.S.J. Tol (2007), "The Impact of Climate Change on Tourism in Germany, the UK and Ireland: A Simulation Study," *Regional Environmental Change*, 7, 161-172.

Huimin, G., and L. Dake (2004), "The Relationship between Resident Income and Domestic Tourism in China," *Tourism Recreation Research*, 29, 25-33.

Huybers, T. (2003), "Domestic Tourism Destination Choices: A Choice Modelling Analysis," *International Journal of Tourism Research*, 5, 445-459.

Johnston, J. and J. Dinardo (1997), *Econometric Methods*, 4th Edition, McGraw-Hill Companies Inc., New York.

Mazimhaka, J. (2007), "Diversifying Rwanda's Tourism Industry: A Role for Domestic Tourism," *Development Southern Africa*, 24, 491-504.

Narayan, P.K. (2006), "Are Australia's Tourism Markets Converging?" *Applied Economics*, 38, 1153-1162.

Romilly, P., X. Liu, and H. Song (1998), "Economic and Social Determinants of International Tourism Spending: A Panel Data Analysis," *Tourism Analysis*, 3, 3-16.

Salman, A.K., G. Shukur, and M.L.V. Bergmann-Winberg (2007), "Comparison of Econometric Modelling of Demand for Domestic and International Tourism: Swedish Data," *Current Issues in Tourism*, 10, 323-342.

Schyvens, R. (2007), "Poor Cousins No More: Valuing the Development Potential of Domestic and Diaspora Tourism," *Progress in Development Studies*, 7, 307-325.

Sindiga, I. (1996), "Domestic Tourism in Kenya," *Annals of Tourism Research*, 23, 19-31.

Wen, Z. (1997), "China's Domestic Tourism: Impetus, Development and Trends," *Tourism Management*, 18, 565-571.