Modelling International Travel Demand from Singapore to Australia

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Revised: January 2003

Abstract

Prior to the recent Asian currency and economic crises, tourism from Asia had rapidly become Australia's major tourism export industry. Tourists from Singapore, which is Australia's fifth major market, represented 6% of international tourist arrivals to Australia in 1996. The average annual growth rate of tourist arrivals from Singapore of around 20% over 1990-96 far exceeded the 10.5% average annual percentage growth rate of all tourist arrivals to Australia over the same period (Australian Bureau of Statistics, 1997). Despite the Asian currency and economic crises in 1997-98, tourist arrivals to Australia from Singapore has continued to grow slowly. It is imperative to consider the economic factors influencing international tourism demand for Australia by Singapore, and to undertake a sensitivity analysis of tourist arrivals to changes in the factors. The purpose of the paper is to estimate the income, price and transportation cost elasticities of inbound tourism from Singapore to Australia using seasonally unadjusted quarterly data. Initially, estimation is undertaken using ordinary least squares. Given New Zealand's proximity to Australia, it is also useful to determine using a single-equation model if Australia and New Zealand are substitute or complementary destinations for Singaporean tourists by examining the effects of the relative price changes in New Zealand and Australia on international travel demand for Australia. In addition, seasonal influences are examined using the single-equation model. The OLS estimates of the appropriate single-equation model are also compared with the estimates obtained using the cointegration method in Lim and McAleer (2001).

Keywords: International tourism, elasticities, income, tourism prices, transportation costs, cointegration.

1. Introduction

Australia was ranked tenth in 1996 in world travel service exports, measured in terms of travel credits, and ranked ninth in travel surplus, in millions of U.S. dollars (International Monetary Fund, Balance of Payments Statistics Yearbook, 1997). In terms of world market share, Australia attracted 0.7% of international tourist arrivals and was ranked at number 30 in the world's top tourism destinations in 1996. Between 1990 and 1996, Australia experienced an average annual growth rate of 23% in tourist arrivals from Asia (Australian Bureau of Statistics, 1997).

Tourists from Singapore, which is Australia's fifth major market and most important non-Japanese Asian tourist source country, represented 6% of international tourist arrivals to Australia in 1996. The average annual growth rate of tourist arrivals from Singapore in 1990-96 was around 20%, which had increased from an average growth rate of 12.6% in 1985-89. Singapore has the highest Gross Domestic Product per capita in South-East Asia. Like Hong Kong, South Korea and Taiwan, it has emerged as one of the four Newly Industrialised Economies (NIEs) of East Asia. Its impressive economic growth has been sustained mainly through its outward-oriented export-led and import-substitution industrialization policies. Singapore has one of the highest saving rates in the world, which was equivalent to 46% of GDP in 1997. By comparison, Australia's saving rate in the same period was about 17% of GDP. Forced saving through the compulsory employer-funded Superannuation Guarantee Charge, which is known as the Central Provident Fund, has operated in Singapore for more than three decades.

Singapore is a small densely populated city state, which was ranked at number 6 as a tourism spender in East Asia and the Pacific in 1997 (World Tourism Organization, 1999). In terms of the share of Asia-Pacific destinations, departures by Singaporean residents to Australia exceeded 11% in 1996 (Pacific Asia Travel Association, 1996). Although tourist arrivals from the rest of Asia fell by about 30% due to the currency and economic crises, Singapore has remained the largest non-Japanese Asian tourist market for Australia (Stretton and Thomas, 1998). Despite the Asian economic and financial crises in 1997-98, tourist arrivals from Singapore continued to rise during this period, but the growth rate fell substantially from 7.4% in 1996/97 to 3.3% in 1997/98.

Holiday and recreation is the main reason stated on their disembarkation cards by inbound tourists for visiting Australia. The majority of visitors are independent tourists who are not travelling with any tour groups. In 1998, 46% of Singaporean visitors were between the ages of 20 and 39, and the gender balance was almost equal for this age group. Many Singaporean tourists to Australia are repeat tourists, which is supported by surveys undertaken by the Bureau of Tourism Research (BTR): 74% of about 1,300 interviewed Singaporean tourists (aged 15 years and above) responded that they had previously been to Australia (Bureau of Tourism Research, 1999). Invariably, Perth, the capital city of Western Australia, attracts most, or roughly one-third, of tourists from Singapore, followed closely by Sydney. A large proportion of Singaporean tourists are visiting their friends or relatives who have migrated to Western Australia, and a considerable number of Singaporean students attend school or university in Perth. This attraction to Perth can also be attributed to geographical proximity, the same time zone, and frequent daily flights. Until 1999, there were as many as 2 flights per day between Singapore and Perth, with 3 flights on Sundays. The number of flights between Perth and Singapore has now increased to 3 flights per day throughout the week. Not surprisingly, the BTR survey showed that the dominant activities undertaken in Australia by tourists are shopping, and visiting friends and relatives.

The primary purpose of the paper is to use ordinary least squares to estimate the important influences of several economic factors on tourism demand by Singapore for Australia based on alternative non-nested models. As observations on most economic variables are available on a quarterly basis, econometric modelling of inbound tourism will be undertaken using seasonally unadjusted quarterly data to obtain estimates of income, price and transportation cost elasticities of travel to Australia by Singaporean residents. These empirical results will then be compared with the estimated coefficients obtained from the cointegration method, which accommodates the presence of unit roots (that is, nonstationarity) in the variables. Previous econometric studies of overseas tourism demand using single-equation models do not seem to have tested the validity of the assumptions based on the elasticity estimates obtained by undertaking a sensitivity analysis. In section 5, the elasticity of tourist arrivals from Singapore to changes in the economic variables will be analysed.

2. Data and Methodology

Most econometric analyses of tourism demand have used the single-equation approach. A review of 100 empirical tourism studies by Lim (1997b) indicated that 81% of these studies used single-equation models in linear and/or log-linear (logarithmic) specifications. The latter yields estimated elasticities, which measure the percentage change in tourism demand as a result of a percentage change in an independent variable. Lim (1997a) considered four variations of linear and log-linear regression models, and observed that linear and log-linear (or logarithmic) models are typically used in tourism studies rather than alternative specifications. There is generally no theoretical basis for choosing between linear and log-linear, or other, regression models. Nevertheless, there has been a strong preference in the tourism demand literature for the log-linear model because of the ease of interpretation of the coefficients as estimated elasticities, as well as other convenient statistical attributes of the model.

Growth in international tourism is closely aligned to economic variables which, at a microeconomic level, influence the consumer's decision to undertake overseas travel. The three most frequently used explanatory variables are income, tourism prices and transportation costs (Lim, 1999). In the underlying economic framework, the demand for international travel is positively related to income in the origin country, and negatively related to relative prices and transportation costs. Empirical research on international tourism demand has been based overwhelmingly on aggregate time series data, which permit estimation of income and price elasticities on inbound tourism (see Lim, 1997b). Few published empirical tourism studies have used quarterly data. The number of observations used in recent studies (see, for example, Bakalis et al. (1994), Di Matteo and Di Matteo (1993), Kulendran (1996), Lim and McAleer (2000, 2001), Morris et al. (1995), and Seddighi and Shearing (1997)) ranges from 44 to 90. Lim (1997b) highlighted the fact that many previous tourism studies based on annual data have typically had small sample sizes, thereby making it difficult to obtain meaningful and precise parameter estimates. The use of quarterly data has helped to alleviate the problem related to the unavailability of extended annual time series data. Moreover, with seasonality (or intra-year fluctuations) being such a prominent feature of tourism data, it is sensible to use quarterly data in international tourism demand analysis in order to examine seasonal influences on tourist arrivals.

A simple origin-destination demand model for international tourism can be written as:

$$D_t = f(Y_t, TC_t, P_t) \qquad (1)$$

where

D_t is a measure of travel demand at time t (t = 1, … , T);

Y_t is a measure of income of the tourist-generating or origin country at time t;

TC_t is a measure of transportation costs from the origin to destination country at time t;

P_t is a measure of the tourism price of goods and services, or the relative price of a competing tourist destination, at time t.

Equation (1) is often expressed in log-linear (or logarithmic) form to capture the multiplicative effects in the levels of the variables. Furthermore, the estimated elasticities are obtained as the coefficients of the following equation:

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln TC_t + \delta \ln P_t + u_t \qquad (2)$$

where β, γ and δ are elasticities, and u_t is a zero mean, independently and identically distributed error term. Estimation of equation (2) requires data on tourist arrivals, income, transportation costs and prices. Alternatively, equation (2) can be rewritten as:

$$\begin{aligned}\ln D_t = {} & \alpha + \beta \ln Y_t + \gamma \{\ln F1_t \text{ or } F2_t\} + \delta \ln\{RP_t, ER_t \text{ or } RER_t\} + \phi \ln D_{t-1} \\ & + \theta \ln\{CP1_t \text{ or } CP2_t\} + u_t\end{aligned} \qquad (3)$$

Aggregate tourist arrivals from Singapore to Australia represent international tourism demand by Singaporean residents (denoted by D_t). Numerous variables have been used in previous tourism studies to represent income (see Lim, 1997b). In this paper, real Gross Domestic

Product (GDP) per capita of Singapore at 1990 prices (S$ millions) is used as a proxy for tourist income (Y_t).

The amount of international travel demanded is also likely to depend to a significant extent on prices. Tourism expenditures compete with other goods and services for the consumer's budget. Thus, any divergence between the price of goods and services in the destination country (Australia) and the domestic price of goods and services in the origin country (Singapore) is likely to have implications for the tourist industry in Australia. Transportation cost is typically the single most important item in the overall travel costs for a tourist.

Some methodological issues and data problems arise concerning the measurement of the tourism price and transportation cost variables. Many past tourism studies have used the ratio of the consumer price indices (CPI) of the destination country and the CPI of the origin country as a proxy for the tourism or relative price variable (denoted by RP_t). The choice of such a measure is debatable. It is argued in Lim (1997b, p. 842) that: "In measuring relative price movements in the origin and destination, it is desirable to have indices constructed using a basket of goods purchased by tourists." However, the use of the CPI ratio as a proxy for the tourism price variable is appropriate when data on the tourist price indices are not available.

The exchange rate (ER_t) has also been used to represent tourism prices in the empirical literature, since such information is readily available to tourists and is generally known in advance. Alternatively, the CPI ratio could be adjusted for differences in exchange rates between the origin and destination currencies. The exchange rate-adjusted CPI ratio, also known as the real exchange rate (RER_t), is also included in the model as a proxy for tourism prices. Transportation costs are represented by two variables. Real round-trip normal coach economy class airfares from Singapore to Sydney, published in Neutral Units of Construction (formerly known as Fare Construction Units) (denoted by $F1_t$) and in Singaporean currency ($F2_t$), are used as a proxy for transportation costs. Real return-trip coach economy low apex fares, excursion fares, or discount fares are preferable as proxies for transportation costs, but they are published only occasionally. A lagged dependent variable (D_{t-1}), namely previous values of tourist arrivals, is also included to capture the simple dynamics of tourism. The presence of a significant lagged dependent variable implies the existence of lagged values of all the explanatory variables in the model.

Australia and New Zealand have always enjoyed close economic, political and social relations. Even more so than Australia, tourism exports are a very important foreign exchange earner for New Zealand, with tourism receipts representing a sizable 50% of its service exports. Since the early 1990s, the New Zealand Tourism Board has embarked on sophisticated marketing campaigns in countries such as the UK, USA, Japan and Korea, which are also important tourist markets for Australia. Filming associated with "The Lord of the Rings" trilogy has given New Zealand global exposure, in addition to its established image as a safe destination. Given its proximity to Australia, it is important to examine whether rebounding travel demand by the major tourist markets for New Zealand is at the expense of (namely a substitute), or is complementary to, Australia. In particular, it would be useful to examine the effects of the relative price changes in New Zealand and Australia on international travel demand for Australia. If a fall in the relative tourism prices in New Zealand reduces the demand for international tourism demand for Australia, New Zealand could be considered as Australia's competing (or substitute) destination for the Singaporean tourist market. Specifically, Singapore may consider New Zealand as a substitute overseas destination for Australia. When a fall in New Zealand relative tourism prices increases international tourism demand for Australia, the two countries are complementary destinations for Singaporean tourists. It is imperative from the tourism marketing SWOT (strengths, weaknesses, opportunities and threats) analysis to examine whether New Zealand is Australia's substitute or complementary destination. The inclusion of the CPI ratio and the real exchange rate of Australia and New Zealand as proxy variables (denoted by $CP1_t$ and $CP2_t$, respectively) for competitive prices is to accommodate such a possibility.

Regression analysis in this paper is based on seasonally unadjusted quarterly data. Since the exchange rate data are available only from 1980, inbound tourism from Singapore to Australia is examined for the period 1980(4) to 1996(4). Data for all the variables are obtained from various statistical publications by the Australian Bureau of Statistics, Singapore Department of Statistics, Statistics New Zealand Infos database, IMF Balance of Payments Statistics Yearbook, ABC World Airways Guide and OAG World Airways Guide.

3. Empirical Results and Analysis

The graphs of the logarithms of the variables for the period 1980(4) to 1996(4) are given in Figures 1 and 2. Several of the series display upward trends. If income, tourism prices and transportation costs are important factors that affect international tourism demand, economic theory postulates that the coefficient of the income variable will be positive, and the coefficients of tourism (or relative) prices, exchange rate, real exchange rate and transportation costs will be negative. Moreover, if New Zealand is a substitute foreign destination for Australia, the coefficient of the relative price variable will be positive. The opposite is true for the coefficient of the relative price variable if New Zealand and Australia are complementary destinations for tourists from Singapore**.** As a model is a set of assumptions, and the variables included in the model are well known and firmly grounded in demand theory, no further discussion of these variables or the assumptions underlying the model would seem to be warranted (see Lim, 1997b).

Using the EViews 3 (1997) software package to estimate a single-equation model by ordinary least squares, the results shown in Tables 1 to 4 are obtained for twelve dynamic alternative non-nested variations of equation (3) (for a detailed discussion of non-nested models, see McAleer (1995)), as follows:

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln RP_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3a)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln ER_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3b)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln RER_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3c)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln RP_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3d)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln ER_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3e)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln RER_t + \phi \ln D_{t-1} + \theta \ln CP1_t + u_t \quad (3f)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln RP_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3g)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln ER_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3h)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F1_t + \delta \ln RER_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3i)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln RP_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3j)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln ER_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3k)$$

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln F2_t + \delta \ln RER_t + \phi \ln D_{t-1} + \theta \ln CP2_t + u_t \quad (3\ell)$$

where

$\ln D_t$ = logarithm of short-term quarterly tourist arrivals (or demand) from Singapore to Australia at time t;

$\ln Y_t$ = logarithm of Singaporean real GDP per capita at time t;

$\ln F1_t$ = logarithm of real round-trip coach economy airfares in Neutral Units of Construction (NUC) between Singapore and Sydney at time t;

$\ln F2_t$ = logarithm of real round-trip coach economy airfares in Singapore currency between Singapore and Sydney at time t;

$\ln RP_t$ = logarithm of relative prices [or CPI (Australia)/CPI (Singapore)] at time t;

$\ln ER_t$ = logarithm of exchange rate (Singaporean dollar per Australian dollar) at time t;

$\ln RER_t$ = logarithm of real exchange rate [or CPI (Australia)/CPI (Singapore) * 1/ER] at time t;

$\ln CP1_t$ = logarithm of competitive prices using CPI (Australia)/CPI (New Zealand) at time t;

$\ln CP2_t$ = logarithm of competitive prices using CPI (Australia)/CPI (New Zealand) * 1/ER at time t;

u_t = independently distributed random error term, with zero mean and constant variance σ_u^2 at time t;

$\alpha, \beta, \gamma, \delta, \phi, \theta$ = parameters to be estimated;

$\beta > 0, \gamma < 0$, $\delta < 0$, $0 < \phi < 1, \theta > 0$ (substitutes) and $\theta < 0$ (complements) are the prior restrictions on the parameters.

In Tables 1 and 2, the CPI ratio of Australia and New Zealand is used as a proxy for competitive prices $(CP1_t)$, whereas the real exchange rate of Australia and New Zealand is included as a proxy for competitive prices in Tables 3 and 4 $(CP2_t)$. Real GDP per capita (measure of income) has a positive and highly significant effect in all the models. The results in Tables 1 and 2 show that all the estimated coefficients are significant at the 5% level for model (3a). Between one and as many as four insignificant coefficients are obtained for the other models at the 5% level. The results of models (3a) and (3d) in Table 1 and 2, respectively, support the view that inbound tourism is positively related to the income of the origin country and negatively related to tourism prices. Furthermore, the significant negative estimate of the competitive price variable suggests that New Zealand is a complementary destination for Australia. However, the estimated coefficients of transportation costs and the lagged dependent variable in model 3(a) do not have the correct signs, even though they are significant. In fact, none of the estimated coefficients of the lagged dependent variable has the correct sign in any of the models.

The adjusted R-squared ($\overline{R}^2$) values, as measures of goodness of fit, are quite high and all exceed 0.89. Since none of the six models in Tables 1 and 2 has serial correlation in the residuals, as indicated by the Lagrange multiplier test for serial correlation (LM(SC)), the OLS estimates are consistent. Serial correlation is present (marginally) in models (3h) and (3k) of Tables 3 and 4. Thus, models (3a) and (3d) have the largest number of significant estimated coefficients (with the correct sign) and no serial correlation.

As a guide to model selection, the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) are often used, in which case the model with the smallest AIC and SBC values is preferred. Since model (3a) has the smaller information criterion, it is considered to be the 'best' estimated regression model to represent international tourism demand by Singapore for Australia. If the model is re-specified by deleting the transportation cost and the lagged dependent variables, there is a problem with serial correlation in the residuals. The serial correlation problem is also encountered when only the lagged dependent variable is deleted from model (3a). However, by omitting the transportation cost variable only, the estimated model has no serial correlation and the estimates are quite similar to the initial results obtained for model (3a), namely (with absolute t-statistics in parentheses):

$$\ln D_t = -24.6 + 4.76 \ln Y_t - 2.12 \ln RP_t - 0.30 \ln D_{t-1} - 4.11 \ln CP_t \qquad (4)$$
$$\qquad (7.17) \quad (9.69) \qquad (2.44) \qquad (3.16) \qquad (3.01)$$

$\overline{R}^2 = 0.905$, AIC = 0.233, SBC = 0.400.

It is generally recognised that seasonality in tourist arrivals gives rise to distinct patterns in the series. For instance, using seasonal dummy variables (see Lim and McAleer, 2000), the fourth quarter tourist arrivals from Singapore tend to be high, whereas the growth rates of arrivals decline to the lowest level in the first quarter. In this case, the seasonal pattern is assumed to be constant, that is, seasonality is deterministic. However, a test for the presence of seasonal unit roots was also examined in Lim and McAleer (2000), using the Hylleberg, Engle, Granger and Yoo (1990) (HEGY) test. The HEGY test indicated a varying seasonal pattern for tourist arrivals from Singapore to Australia. More specifically, the results suggested that quarterly tourist arrivals from Singapore have unit roots at the zero and semi-annual frequencies, but not at the annual frequency.

Short-term tourist arrivals from Singapore may have a positive or negative shift in certain quarters. Quarterly dummy variables are included in model 1 to allow for seasonal shifts in tourist arrivals. By fitting equation (3a) with three quarterly dummy variables, the following results are obtained (with absolute t-ratios in parentheses):

$$\ln D_t = -8.71 + 1.31 \ln Y_t + 0.27 \ln F1 - 0.74 \ln RP_t + 0.60 \ln D_{t-1} - 1.60 \ln CP_t$$
$$(2.95) \quad (2.94) \quad (1.70) \quad (1.71) \quad (4.88) \quad (2.21)$$
$$+ 0.44 D_{2t} + 0.05 D_{3t} + 0.96 D_{4t} \qquad (5)$$
$$(5.41) \quad (0.66) \quad (8.37)$$

$\bar{R}^2 = 0.985$, AIC = -1.48, SBC = -1.18.

However, omitting one seasonal dummy variable, namely D_{3t} in the above model yields the following results (with absolute t-ratios in parentheses):

$$\ln D_t = -10.1 + 1.54 \ln Y_t + 0.31 \ln F1 - 0.87 \ln RP_t + 0.53 \ln D_{t-1}$$
$$(5.08) \quad (5.56) \quad (2.16) \quad (2.28) \quad (7.92)$$
$$- 1.85 \ln CP_t + 0.39 D_{2t} + 0.90 D_{4t} \qquad (6)$$
$$(3.04) \quad (9.75) \quad (16.5)$$

$\bar{R}^2 = 0.985$, AIC = -1.503, SBC = -1.236.

A respecification of model (3a) by accommodating seasonal factors has led to a better empirical model than equation (4). As shown in equation (6), the lagged dependent variable is significant with the correct sign, and the model has no evident serial correlation.

4.0 Comparison of OLS & Cointegration results

The determining variables of international tourism demand are likely to be non-stationary, that is, the mean and variance of the variables do not remain constant over time (in which case the variables have unit roots). However, stationarity is rarely tested in empirical tourism research with time series data, where a time series refers to a sequence of observations for one or more random variables. A time series is stationary if its mean, variance and covariance are constant over time. If the series is nonstationary, it is difficult to estimate the mean with any degree of precision because the variance of the process increases without limit as the number of observations increases. Hence, the estimated mean will be unreliable and will tend to provide forecasts with extremely large forecast errors.

Tests of nonstationarity using the Augmented Dickey-Fuller (ADF) test provide useful information to explain the long-run relationships of the variables in equation (3). Tests of unit roots and cointegration for tourist arrivals from Singapore to Australia are reported in Lim and McAleer (2001). In particular, ADF tests for a unit root based on the auxiliary regression:

$$\Delta y_t = \alpha + \delta t + \beta y_{t-1} + \sum_{i=1}^{k} \psi \Delta y_{t-i} + u_t .$$

have been applied to each of the quarterly series, namely the logarithms of tourist arrivals from Singapore to Australia (denoted by a), real GDP per capita (y1), real round-trip coach economy airfares in Fare Construction Units (rf1) and in Singapore $ (rf2), exchange rate (er), relative prices (rp) and real exchange rate (rer). [It should be noted that the competitive price variables were not used by Lim and McAleer (2001).] The null and alternative hypotheses for a unit root in y_t are:

$$H_0 : \beta = 0, \quad H_1 : \beta < 0.$$

A deterministic time trend is included in the auxiliary regression equation when the reported ADF t-statistics, with and without a deterministic trend (t), are substantially different from each other. The purpose of including sufficient lagged first differences (Δy_{t-i}) is to remove any serial correlation in the residuals. In order to determine k, an initial lag length of 4 is used, and is tested for significance using the standard asymptotic t-ratio. If the fourth lag is insignificant, the lag length is reduced successively until a significant lag length is obtained. In addition, u_t is the error term and α, δ, β and ψ are the parameters to be estimated.

Table 5 shows that unit roots are present in all variables and they are integrated of order one, I(1). Johansen's maximum likelihood procedure is used to estimate and test the cointegrating relations, and ten vector autoregressive (VAR) models have been identified (see Table 6). However, only one cointegrating equation has all the significant estimated coefficients with correct signs, which shows that a long-run relationship exists among international tourism demand, real income, real airfares (in Singapore currency) and the exchange rate for tourist arrivals from Singapore to Australia. [In the other 9 cointegrating models, the variables either do not have significant estimated coefficients or the significant estimated coefficients do not have the correct signs (these additional results are available on request)]. The cointegrating regression of the long-run demand for international travel to Australia by tourists from Singapore is given as follows (with absolute t-ratios in parentheses):

$$\begin{aligned} a = 16.5 + &1.59y1 - 2.29rf2 - 1.27er \\ &(6.44) \quad (3.60) \quad (5.99) \end{aligned} \tag{7}$$

where

a = logarithm of tourist arrivals from Singapore to Australia;

y1 = logarithm of real GDP per capita in Singaporean dollar;

rf2 = logarithm of real round trip coach economy airfares in Singaporean dollar;

er = logarithm of exchange rate.

According to the error-correction model (ECM), changes in tourist arrivals from Singapore react in the short-run to the seasonal dummy variables and the one-period lagged change in tourist arrivals, with all variables significant at the 5% level.

In order to make a direct comparison with the estimates from the cointegrating model in Lim and McAleer (2001) and the single-equation OLS estimates of this paper, equation (3) is re-estimated without the competitive price variables:

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma\{\ln F1_t \text{ or } F2_t\} + \delta \ln\{RP_t, ER_t \text{ or } RER_t\} + \phi \ln D_{t-1} + u_t \quad (8)$$

The results in Table 7 show that model (8b), which has no serial correlation, is the best empirical model. Respecification of this model by omitting the insignificant transportation variable yields a superior empirical model, as follows (with absolute t-ratios in parentheses):

$$\ln D_t = \underset{(4.72)}{-11.9} + \underset{(9.30)}{3.28} \ln Y_t \; \underset{(3.62)}{-1.14} \ln ER_t \; \underset{(4.05)}{-0.39} \ln D_{t-1} \quad (9)$$

$\bar{R}^2 = 0.910$, AIC = 0.154, SBC = 0.287.

In contrast to the single-equation model, the transportation cost variable is significant in the cointegrating model, as shown in equation (7). The use of the exchange rate as the proxy variable renders the tourism price variable significant in both models (see equations (7) and (9)).

Table 8 shows that all of the diagnostic tests for the single-equation model in equation (9) and the cointegration model in equation (7) are insignificant, except for Chow 1 (for breakpoint) in the single-equation model. Thus, Chow's first test rejects the null hypothesis of parameter constancy for the tourism demand single equation model before and after the first quarter of 1990.

5.0 Sensitivity Analysis

It is evident from model (3a) that real GDP per capita of Singapore and tourism prices have significant positive and negative effects, respectively, on inbound tourism to Australia from Singapore (see equation (6)). In order to test whether tourist arrivals from Singapore are sensitive to changes in the origin's income and tourism prices (namely, the income elasticity exceeds 1.0 and the tourism price elasticity is less than –1.0), respectively, the null and alternative hypotheses to be tested are specified as follows:

$$H_0 : \beta = 1, \qquad H_1 : \beta > 1;$$

$$H_0 : \delta = -1, \qquad H_1 : \delta < -1.$$

Using the estimates provided in equation (6), the t-ratio for the null hypothesis for the income variable in model 1 is 1.95 (given by $t_\beta = \frac{\hat{\beta} - 1}{\hat{se}} = \frac{1.54 - 1}{1.54/5.56} = 1.95$). As the null hypothesis of a unitary income elasticity is (marginally) not rejected at the 5% significance level, inbound tourism from Singapore is income inelastic. In addition, the t-ratio of 0.34 for the tourism price variable in model 1 does not reject the null hypothesis at the 5% significance level (namely, $t_\delta = \frac{\hat{\delta} - (-1)}{\hat{se}} = \frac{-0.87 + 1}{-0.87/-2.28} = 0.34$), implying that international tourism demand is price inelastic.

6.0 Conclusion

Singapore has the second highest per capita GDP in Asia of US$29,610 in 1999, after Japan, which ranked sixth in the world (World Bank, 2000). The affluence of Singaporean residents, the country's proximity to Australia, and Australia's reputation as a safe and clean country, have led to Australia being one of the top overseas holiday destinations for Singaporeans. Using a dynamic log-linear single equation model, the empirical results show that real income per capita of Singapore and the relative (or tourism) prices of the two countries have significant influences on inbound tourism from Singapore to Australia.

If international travel demand for Australia by different tourist source markets enters the cycle of introduction, growth, maturity and decline (also known as the product life cycle), the Singapore market is at the growth stage of the life cycle. The empirical results suggest that Australia and New Zealand are complementary destinations for Singaporean tourists. An important marketing implication is the possible extension of the growth stage through joint marketing efforts by the Tourist Commissions of both Australia and New Zealand. The two Tourist Commissions could promote more frequent repeat tourists to Australia and New Zealand, and expand the current market by encouraging new tourists to participate in the tourism product, service and experience they can offer jointly.

The empirical findings also show that international tourism demand by Singapore for Australia is income and price inelastic. According to the cointegration model, the long-run real income, real airfare and exchange rate (proxy for price) effects are elastic. This paper highlighted an empirical issue involving the estimation of demand models using non-stationary data. A clear message is a need to distinguish between spurious and cointegrating regressions. The single-equation regression model presented in this paper may be deceptive in suggesting that such a relationship exists between tourist arrivals, real income and tourism prices. Cointegration provides a method of avoiding deceptive inferences associated with a spurious regression (see, for example, the discussion in Kulendran, 1996 and Morley, 2000). However, it is also worthwhile bearing in mind that the number of observations available for empirical tourism modelling is generally limited, and is reduced even further in a differenced series, whereas a large sample size is required for meaningful cointegration analysis.

Acknowledgements

The authors wish to thank two referees for helpful comments and suggestions. The first author wishes to acknowledge the financial support of the Australian Research Council and the Department of Economics at the University of Western Australia. The second author is most grateful for the financial support of the Australian Research Council and the Center for International Research on the Japanese Economy, Faculty of Economics, University of Tokyo.

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Table 1

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (3a)	Model (3b)	Model (3c)
Constant	-28.68 (7.38)	-9.00 (2.11)	-13.40 (2.20)
Y	4.66 (9.71)	3.30 (9.19)	3.31 (6.80)
F1	0.70 (2.07)	-0.38 (0.85)	0.10 (0.19)
RP	-2.53 (2.92)	–	–
ER	–	-1.39 (2.82)	–
RER	–	–	0.53 (1.05)
D_{t-1}	-0.34 (3.62)	-0.40 (4.02)	-0.35 (3.40)
CP1*	-4.84 (3.52)	0.21 (0.27)	0.09 (0.07)
$\overline{R}^2$	0.912	0.911	0.901
F	121.76	120.62	107.06
LM(SC)	1.407	1.504	0.670
AIC	0.194	0.202	0.310
SBC	0.394	0.403	0.511

[a] All variables are in logarithms, with absolute t-statistics in parentheses.

* Using the CPI ratio of Australia and New Zealand as a proxy variable.

Table 2

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (3d)	Model (3e)	Model (3f)
Constant	-31.27 (4.99)	-5.80 (0.95)	-7.96 (1.00)
Y	4.96 (9.66)	3.14 (8.23)	3.11 (5.82)
F2	0.63 (1.28)	-0.58 (1.10)	-0.37 (0.63)
RP	-2.47 (2.73)	_	_
ER	_	-1.32 (3.21)	_
RER	_	_	0.75 (1.76)
D_{t-1}	-0.30 (3.20)	-0.41 (4.15)	-0.36 (3.47)
CP1*	-4.73 (3.28)	0.18 (0.25)	0.69 (0.56)
$\overline{R}^2$	0.908	0.912	0.901
F	116.16	121.70	107.77
LM(SC)	0.161	1.964	0.475
AIC	0.237	0.194	0.304
SBC	0.437	0.395	0.505

[a] All variables are in logarithms, with absolute t-statistics in parentheses.
* Using the CPI ratio of Australia and New Zealand as a proxy variable.

Table 3

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (3g)	Model (3h)	Model (3i)
Constant	-18.11 (5.62)	-9.19 (2.45)	-11.84 (3.10)
Y	3.46 (7.68)	3.25 (9.21)	3.12 (7.63)
F1	0.49 (1.37)	-0.28 (0.74)	0.14 (0.39)
RP	-0.55 (1.16)	–	–
ER	–	-1.39 (3.71)	–
RER	–	–	0.68 (2.83)
D_{t-1}	-0.31 (3.05)	-0.41 (4.21)	-0.38 (3.77)
CP2*	0.61 (1.30)	0.54 (1.46)	0.78 (1.90)
$\bar{R}^2$	0.896	0.914	0.906
F	101.79	125.21	114.34
LM(SC)	0.594	3.782	1.403
AIC	0.356	0.168	0.251
SBC	0.556	0.369	0.452

[a] All variables are in logarithms, with absolute t-statistics in parentheses.
* Using the real exchange rate of Australia and New Zealand as a proxy variable.

Table 4

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (3j)	Model (3k)	Model (3l)
Constant	-17.95 (3.38)	-6.34 (1.14)	-9.61 (1.69)
Y	3.69 (8.61)	3.13 (8.53)	3.12 (7.47)
F2	0.18 (0.36)	-0.47 (0.99)	-0.13 (0.28)
RP	0.50 (1.04)	–	–
ER	–	-1.35 (4.02)	–
RER	–	–	0.72 (3.09)
D_{t-1}	-0.28 (2.78)	-0.42 (4.31)	-0.38 (3.76)
CP2*	0.51 (1.08)	0.53 (1.43)	0.77 (1.87)
$\bar{R}^2$	0.893	0.914	0.906
F	98.551	126.20	114.17
LM(SC)	1.124	4.449	1.071
AIC	0.385	0.161	0.252
SBC	0.585	0.362	0.453

[a] All variables are in logarithms, with absolute t-statistics in parentheses.

* Using the real exchange rate of Australia and New Zealand as a proxy variable.

Table 5

Unit Root Tests for Singapore, 1980(4)-1996(4)

Variable*	ADF lag length	ADF statistic	Critical value**
a	4	-2.225	-3.479
y1	4	-2.441	-3.479
rf1	0	-3.052	-3.479
rf2	3	-2.658	-3.479
er	0	-2.244	-3.480
rp	2	-0.915	-3.479
rer	4	-1.386	-3.485

Notes:
a: log of tourist arrivals from Singapore to Australia;

y1: log of real GDP per capita (SP$ millions);

rf1: log of real round trip (return) coach economy airfares in Fare Construction Unit using CPI (Singapore);

rf2: log of real round trip (return) coach economy airfares in Singapore (SP) dollar, using CPI (Singapore);

er: log of exchange rate (SP$ per AU$);

rp: log of relative prices = log [CPI (Australia)/CPI (Singapore)];

rer: log of real exchange rate = log [CPI (Australia)/Singapore CPI * 1/ER];

* A deterministic trend is included in all ADF auxiliary regressions.

** The critical values are given for the 5% level of significance.

Table 6

Johansen's Trace Test for One Cointegrating Equation for Singapore, 1980(4)-1996(4)

Variables	H_0	H_A	Trace	VAR	AIC, SBC
a, y1, rf1, er	$r = 0$	$r = 1$	52.73	2	-12.34, -10.84
	$r \leq 1$	$r \geq 2$	29.16		
a, y1, rf1, er	$r = 0$	$r = 1$	47.69	3	-12.02, -9.96
	$r \leq 1$	$r \geq 2$	17.82		
a, y1, rf1, er	$r = 0$	$r = 1$	50.00	4	-12.69, -10.06
	$r \leq 1$	$r \geq 2$	20.37		
a, y1, rf2, er	$r = 0$	$r = 1$	56.01	2	-12.07, -10.01
	$r \leq 1$	$r \geq 2$	26.46		
a, y1, rf2, er	$r = 0$	$r = 1$	52.12	3	-12.37, -10.87
	$r \leq 1$	$r \geq 2$	15.42		
a, y1, rf2, er	$r = 0$	$r = 1$	50.64	4	-12.83, -10.20
	$r \leq 1$	$r \geq 2$	20.75		
a, y1, rf1, rer	$r = 0$	$r = 1$	49.11	3	-11.62, -9.56
	$r \leq 1$	$r \geq 2$	19.15		
a, y1, rf1, rer	$r = 0$	$r = 1$	51.45	4	-12.44, -9.81
	$r \leq 1$	$r \geq 2$	23.36		
a, y1, rf2, rer	$r = 0$	$r = 1$	52.77	3	-11.71, -9.65
	$r \leq 1$	$r \geq 2$	13.64		
a, y1, rf2, rer	$r = 0$	$r = 1$	52.97	4	-12.58, -9.95
	$r \leq 1$	$r \geq 2$	22.49		

Notes:
All estimated coefficients are significant at the 5% level and have the correct signs.

Critical value for $H_0: r = 0$ at the 5% significance level is 47.21.

Critical value for $H_0: r \leq 1$ at the 5% significance level is 29.68.

Table 7a

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (8a)	Model (8b)	Model (8c)
Constant	-19.34 (6.25)	-9.52 (2.52)	-13.72 (3.63)
Y	3.67 (8.66)	3.30 (9.31)	3.32 (8.22)
F1	0.40 (1.12)	-0.32 (0.84)	0.18 (0.32)
RP	0.22 (0.54)	–	–
ER	–	-1.31 (3.50)	–
RER	–	–	0.50 (2.21)
D_{t-1}	-0.29 (2.87)	-0.40 (4.06)	-0.35 (3.43)
$\overline{R}^2$	0.893	0.911	0.901
F	125.35	153.12	136.08
LM(SC)	1.101	1.511	0.690
AIC	0.353	0.173	0.280
SBC	0.520	0.340	0.447

[a] All variables are in logarithms, with absolute t-statistics in parentheses.

Table 7b

Demand Elasticities for Inbound Tourism from Singapore to Australia

Explanatory Variables[a]	Model (8d)	Model (8e)	Model (8f)
Constant	-18.46 (3.49)	-6.37 (1.14)	-11.05 (1.92)
Y	3.83 (9.34)	3.16 (8.57)	3.30 (7.97)
F2	0.09 (0.17)	-0.53 (1.10)	-0.19 (0.38)
RP	0.22 (0.55)	–	–
ER	–	-1.26 (3.78)	–
RER	–	–	0.54 (2.50)
D_{t-1}	-0.27 (2.67)	-0.41 (4.18)	-0.35 (3.44)
$\bar{R}^2$	0.891	0.912	0.901
F	122.56	154.52	136.18
LM(SC)	0.612	1.937	0.586
AIC	0.373	0.164	0.279
SBC	0.541	0.332	0.446

[a] All variables are in logarithms, with absolute t-statistics in parentheses.

Table 8

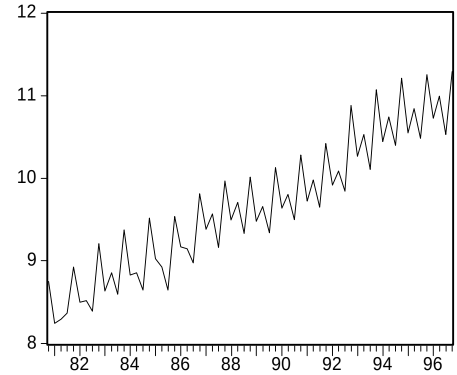
Diagnostic Tests for Inbound Tourism from Singapore
using Single-equation and Cointegration Models

Diagnostics	Single-equation	Cointegration
LM(SC)	1.531 (0.22)	2.02 (0.14)
LM(H)	1.458 (0.21)	0.79 (0.72)
LM(N)	2.232 (0.33)	0.78 (0.68)
CHOW 1	3.348 (0.02)	0.71 (0.74)
CHOW 2	0.938 (0.57)	0.52 (0.95)

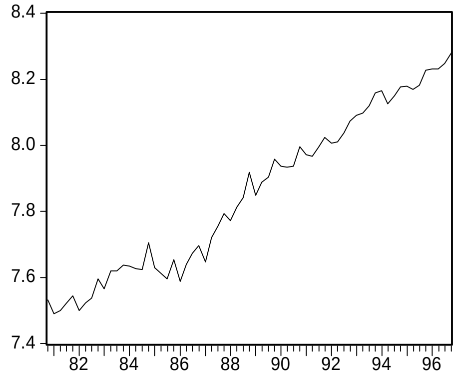
Notes:
LM(SC), LM(H) and LM(N) are the Lagrange multiplier test statistics for serial correlation, heteroskedasticity and normality, respectively, whereas CHOW 1 and CHOW 2 are Chow's (first) test for structural change and (second) test for predictive failure, respectively; figures in parentheses denote probability values.

Figure 1

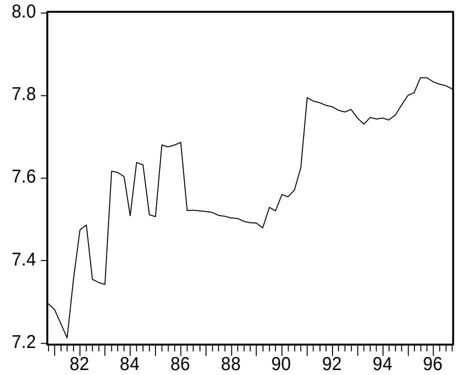
Logarithms of Tourist Arrivals, Real GDP Per Capita, Transportations Costs and Competitive Prices, Singapore 1980-1996



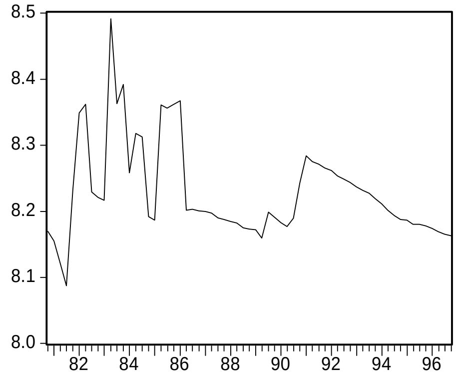
Tourist Arrivals from Singapore



Real GDP per capita



Real Round-Trip Airfare in NUC



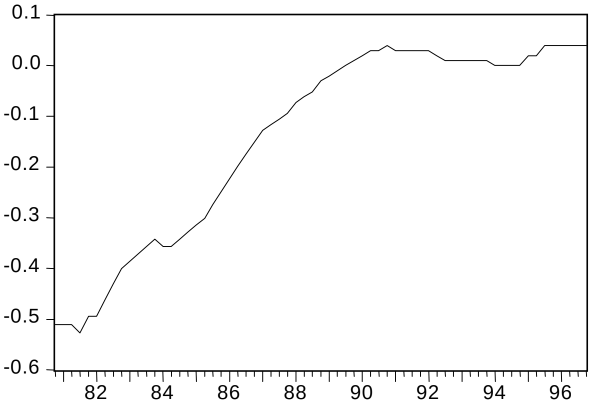
Real Round-Trip Airfares in Singapore Currency

CPI ratio of Australia & New Zealand

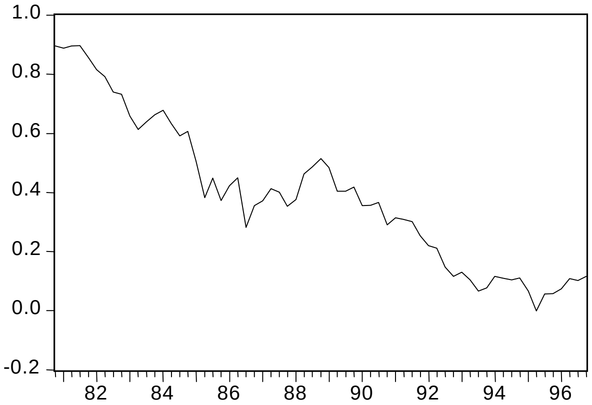
Real Exchange Rate of Australia & New Zealand

Figure 2

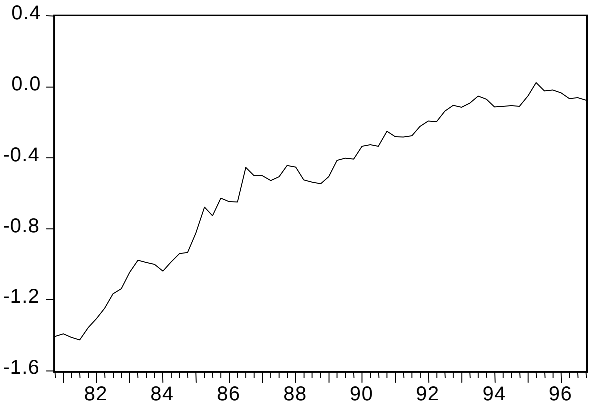
Logarithms of Tourism Prices, Singapore, 1980-1996



Relative Prices



Exchange Rate



Real Exchange Rate