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# 学术讲座汇编

主编 钱伟长

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王宽诚教育基金会

# 学术讲座汇编

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主编：钱伟长

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钱伟长 主编

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# 王宽诚教育基金会简介

王宽诚先生(1907—1986)为香港著名爱国人士，热心祖国教育事业，生前为故乡宁波的教育事业做出积极贡献。1985 年独立捐巨资创建王宽诚教育基金会，其宗旨在于为国家培养高级技术人才，为祖国四个现代化效力。

王宽诚先生在世时聘请海内外著名学者担任基金会考选委员会和学务委员会委员，共商大计，确定采用“送出去”和“请进来”的方针，为国家培养各科专门人才，提高内地和港澳高等院校的教学水平，资助学术界人士互访以促进中外文化交流。在此方针指导下，1985、1986 两年，基金会在国家教委支持下，选派学生 85 名前往英、美、加拿大、德国、瑞士和澳大利亚各国攻读博士学位，并计划资助内地学者赴港澳讲学，资助港澳学者到内地讲学，资助美国学者来国内讲学。正当基金会事业初具规模、蓬勃发展之时，王宽诚先生一病不起，于 1986 年年底逝世。这是基金会的重大损失，共事同仁，无不深切怀念，不胜惋惜。

1987 年起，王宽诚教育基金会继承王宽诚先生为国家培养高级技术人才的遗愿，继续对中国内地、台湾及港澳学者出国攻读博士学位、博士后研究及学术交流提供资助。委请国家教育部、中国科学院和上海大学校长钱伟长教授等逐年安排资助学术交流的项目。相继与（英国）皇家学会、法国科研中心、德国学术交流中心、法国高等科学研究院等著名欧洲学术机构合作，设立“王宽诚（英国）皇家学会奖学金”、“王宽诚法国科研中心奖学金”、“王宽诚德国学术交流中心奖学金”、“王宽诚法国高等科学研究院奖学金”，资助具有副教授或同等职称以上的中国内地学者前往英国、法国、德国等地的高等学府及科研机构进行为期 2 至 12 个月之博士后研究。

王宽诚教育基金会过去和现在的工作态度一贯以王宽诚先生倡导的“公正”二字为守则，谅今后基金会亦将秉此行事，奉行不辍，借此王宽诚教育基金会《学术讲座汇编》出版之际，特简明介绍如上。王宽诚教育基金会日常工作繁忙，基金会各位董事均不辞劳累，做出积极贡献。

钱伟长

二〇〇六年六月

# 前　言

王宽诚教育基金会是由已故全国政协常委、香港著名工商企业家王宽诚先生(1907—1986)出于爱国热忱，出资一亿美元于1985年在香港注册登记创立的。

1987年，基金会开设“学术讲座”项目，此项目由当时的全国政协委员、历任第六、七、八、九届全国政协副主席、著名科学家、中国科学院院士、上海大学校长、王宽诚教育基金会贷款留学生考选委员会主任委员兼学务委员会主任委员钱伟长教授主持。由钱伟长教授亲自起草设立“学术讲座”的规定，资助内地学者前往香港、澳门讲学，资助美国学者来中国讲学，资助港澳学者前来内地讲学，用以促进中外学术交流，提高内地及港澳高等院校的教学质量。

本汇编收集的文章，均系各地学者在“学术讲座”活动中的讲稿，文章内容有科学技术，有历史文化，有经济专论，有文学，有宗教和中国古籍研究等。本汇编涉及的学术领域颇为广泛，而每篇文章都有一定的深度和广度，分期分册以《王宽诚教育基金会学术讲座汇编》的名义出版，并无偿分送国内外部分高等院校、科研机构和图书馆，以广流传。

王宽诚教育基金会除资助“学术讲座”学者进行学术交流之外，在钱伟长教授主持的项目下，还资助由国内有关高等院校推荐的学者前往欧、美、亚、澳等参加国际学术会议，出访的学者均向所出席的会议提交论文，这些论文亦颇有水平，本汇编亦将其收入，以供参考。

王宽诚教育基金会学务委员会

# 凡　例

(一) 编排次序

本书所收集的王宽诚教育基金会学术讲座的讲稿及由王宽诚教育基金会资助学者赴欧、美、亚、澳等参加国际学术会议的论文均按照文稿日期先后或文稿内容编排刊列，不分类别。

(二) 分期分册出版并作简明介绍

因文稿较多，为求便于携带，有利阅读与检索，故分期分册出版，每册约 150 页至 200 页不等。为便于读者查考，每篇学术讲座的讲稿均注明作者姓名、学位、职务、讲学日期、地点、访问院校名称。内地及港、澳学者到欧、美、澳及亚洲的国家和地区参加国际学术会议的论文均注明学者姓名、参加会议的名称、时间、地点和推荐的单位。上述两类文章均注明由王宽诚教育基金会资助字样。

(三) 文字种类

本书为学术性文章汇编，均以学术讲座学者之讲稿原稿或参加国际学术会议者向会议提交的论文原稿文字为准，原讲稿或论文是中文的，即以中文刊出，原讲稿或论文是外文的，仍以外文刊出。

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王宽诚教育基金会
《学术讲座汇编》第 26 集，1～24（2006）

# Tourism Demand Forecasting

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**Abstract:** The forecasting of tourism demand has taken numerous turns in regard to methodology over the past twenty years. In the history of this development the methods have been variously assessed, compared and used in different contexts. Consequently, it is increasingly difficult to follow the methodological history and to understand the current front line, and where the next steps are likely to take research. This paper attempts to clarify both the historical development since 1990 of tourism demand forecasting, assess the various new developments and provide a view of current research directions.

## 1 Introduction

Tourism researchers and practitioners are interested in tourism demand forecasting for the following reasons. Firstly, tourism demand is the foundation on which all tourism-related business decisions ultimately rest. Companies such as airlines, tour operators, hotels, cruise ship lines, and recreation facility providers are interested in the demand for their products by tourists. The success of many businesses depends largely or totally on the state of tourism demand, and ultimate management failure is quite often due to the failure to meet market demand. Because of the key role of demand as a determinant of business profitability, estimates of expected future demand constitute a very important element in all planning activities. It is clear that *accurate* forecasts of tourism demand are essential for *efficient* planning by tourism-related businesses, particularly given the perishable nature of the tourism product. Secondly, tourism investment, especially investment in destination infrastructures, such as airports, highways and rail-links, requires long-term financial commitments and the sunk costs can be very high if the investment projects fail to fulfill their design capacities. Therefore, the prediction of long-term demand for tourism related infrastructure often forms an important part of project appraisal. Thirdly,

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* 宋海岩，教授，香港理工大学酒店及旅游业管理学院副院长。由王宽诚教育基金会资助，于 2005 年 8 月赴西安交通大学、陕西师范大学讲学，此为其讲学内容。

government macroeconomic policies largely depend on the relative importance of individual sectors within a destination. Hence, accurate forecasts of demand in the tourism sector of the economy will help destination governments in formulating and implementing appropriate medium-long term tourism strategies.

Tourism forecasts may be generated by either quantitative approaches or qualitative approaches. However, this chapter focuses on quantitative forecasting methods, especially econometric approaches. By econometric forecasting, we mean that the forecast variable is specifically related to a set of determining forces; future values of the forecast variable are obtained by using forecasts of the determining variables, in conjunction with the estimated quantitative relationship between the forecast variable and its determinants.

International tourism demand is generally measured in terms of the number of tourist visits from an origin country to a destination country, or in terms of tourist expenditure by visitors from the origin country in the destination country. The number of tourist nights spent by residents of the origin in the destination is an alternative tourism demand measure. International tourism demand data are collected in various ways. Tourist visits are usually recorded by frontier counts (inbound), registration at accommodation establishments (inbound) or sample surveys (inbound and outbound). A problem with frontier counts is that in certain cases a substantial transit traffic element may be present. Accommodation establishment records exclude day-trippers and tourists staying with friends or relatives or in other forms of unregistered accommodation. Sample surveys may be applied at points of entry/exit to returning residents or departing non-residents, or household surveys may be carried out (outbound), but in both cases often the sample size is relatively small. International tourist expenditure data are usually collected by the bank reporting method or sample surveys. The former method is based on the registration by banks and agencies of the buying and selling of foreign currencies by travellers. There are many problems associated with this method of data collection such as identifying a transaction as a tourism transaction, the non-reporting of relevant transactions and the unreliability of its use for measuring receipts from specific origin countries (the geographic breakdown relates to the denomination of the currency and not the generating country). Sample surveys provide more reliable data on tourist expenditures, but as with visit data the sample size is often relatively small.

The determinants of tourism demand depend on the purpose of visit. Approximately 70% of international tourist trips take place for holiday purposes, 15% for business purposes, 10% in order to visit friends and relatives and 5% for other purposes (where 'other' includes pilgrimages, and sports and health reasons). Therefore, the emphasis in empirical research on tourism demand modelling has been on holiday tourism, with only a few studies being concerned with business tourism. Consequently, we shall also concentrate on the demand for foreign holidays. Substantial agreement exists about the explanatory variables that are important in the case of international holiday tourism and they are discussed below.

***Population***: The level of foreign tourism from a given origin is expected to depend upon the origin population, an increase in population resulting in an increase in demand. Sometimes

population features as a separate explanatory variable, but generally the effect of population is accommodated by modifying the dependent variable to become international tourism demand per capita.

***Income***: The appropriate income variable is personal disposable income or private consumption expenditure in the origin country (in constant price terms), and is expected to have a positive influence on tourism demand. Income commonly enters the demand function in per capita form, corresponding to the specification of demand in per capita terms.

***Own price***: There are two price components – the cost of travel to the destination, and the cost of living for tourists in the destination (both in constant price terms) – and these are expected to have negative influences on demand. The cost of travel is often measured by the economy airfare. Usually the consumer price index in a destination country is taken to be a proxy for the cost of tourism in that country on account of lack of more suitable data, and Martin and Witt (1987) have shown this to be a reasonable approximation. The consumer price index is then adjusted by the exchange rate between the origin and destination currencies. If data relating to the price of the tourist's basket of goods/services are available these would be more appropriate, but usually such data do not exist.

Exchange rates are also sometimes used separately to represent tourist living costs, possibly in addition to the exchange-rate-adjusted consumer price index. The justification is that consumers are more aware of exchange rates than destination costs of living for tourists, and hence are driven to use the exchange rate as a proxy variable. However, the use of exchange rates alone can be misleading because even though the exchange rate in a destination may become more favourable, this could be counterbalanced by a relatively high inflation rate.

***Substitute prices***: The prices of substitutes may be important determinants of tourism demand, and are expected to have a positive influence. For example, an increase in holiday prices to Spain is likely to increase the demand for holidays to Portugal. The impact of competing destinations may be allowed for by specifying the tourist cost of living variable as destination cost relative to a weighted average value calculated for a set of alternative destinations; and by specifying the travel cost variable as travel cost from origin to destination relative to a weighted average value calculated for travel from the origin to competing destinations. The weights are generally based on previous market shares and are often allowed to vary over time.

***Marketing***: National tourist organisations engage in sales-promotion activities specifically to attempt to persuade potential tourists to visit the country, and these activities may take various forms including media advertising and public relations. Hence, promotional expenditure (in constant price terms) is expected to play a positive role in determining the level of international tourism demand. However, much tourism-related marketing activity is not specific to a particular destination (for example, general travel agent and tour operator advertising) and is likely to have little impact on the demand for tourism to that destination. The promotional activities of national tourist organisations are destination specific, and are more likely to influence tourist flows to the destination concerned.

***Lagged dependent variable***: A lagged dependent variable, that is an autoregressive term, can be justified on the grounds of habit persistence. Once people have been on holiday to a particular country and liked it, they tend to return to that destination. There is much less uncertainty associated with holidaying again in that country compared with travelling to a previously unvisited foreign country. Furthermore, knowledge about the destination spreads as people talk about their holidays and show photographs, thereby reducing uncertainty for potential visitors to that country. In fact, this 'word of mouth' recommendation may well play a more important role in destination selection than commercial advertising. A type of learning process is in operation and as people are in general risk averse, the number of people choosing a given alternative in any year depends (positively) on the numbers who chose it in previous years.

A second justification for the inclusion of a lagged dependent variable in tourism demand functions comes from the supply side. Supply constraints may take the form of shortages of hotel accommodation, passenger transportation capacity and trained staff, and these often cannot be increased rapidly. Time is also required to build up contacts among tour operators, hotels, airlines and travel agencies. Similarly, once the tourist industry in a country has become highly developed it is unlikely to dwindle rapidly. If a partial adjustment mechanism is postulated to allow for rigidities in supply, this results in the presence of a lagged dependent variable in the tourism demand function, with the parameter lying between zero and unity (Song and Witt, 2000, pp.7-8).

***Qualitative effects***: Dummy variables are often included in international tourism demand functions to allow for the impact of 'one-off' events. For example, the imposition by governments of foreign currency restrictions on their residents is likely to reduce the level of international tourism, as are threats of terrorism (for example, after September 11, 2001 in New York and October 12, 2002 in Bali), and threats of war (for example, the threat after the Iraqi invasion of Kuwait in 1990, followed by the Gulf Wars of 1991 and 2003). Similarly, various events are likely to stimulate international tourism, such as hosting the Olympic Games and other major attractions.

## 2 Overview of Main Contributions in Tourism Forecasting

Studies on tourism forecasting published before the 1990s are reviewed in Crouch (1994a, b), Frechtling (2001), Johnson and Ashworth (1990), Lim (1997), Witt and Witt (1995) and Uysal and Crompton (1985). Therefore, the main focus of this review is on studies published after 1990.

### 2.1 Single Equation Econometric Models with Fixed Parameters

It should be noted that the division of single-equation and system-of-equations models is based on the number of *measurement* equation(s) of tourism demand, rather than simply the number of equations in the model. Although the TVP (time varying parameter) model is a multiple-equation model, it is still regarded as a single equation approach, as only one equation in the TVP model is used to measure the demand for a destination's tourism.

***Model Specification***: Tourism, especially long-haul tourism, is normally regarded as a

luxury product, which often exhibits a non-linear relationship between the demand for tourism and its determinants. Therefore, many published studies of tourism forecasting use the double log linear (LL) functional form to linearise the relationship for ease of estimation, although a few studies use simple linear and semi log linear forms. Witt and Witt (1995) reviewed 40 studies published between 1966 and 1992 and found 31 of these 40 (78%) articles used the LL functional form in their empirical analysis. Lim (1997) examined 100 articles published during the period 1961~1994 and 73 (73%) of these 100 publications employed the LL model. In a recent survey, Li (2004) found 39 out of 45 (87%) published studies during the period 1990~2003 used the LL model in forecasting tourism demand. One of the advantages of using an LL functional form is that the estimated coefficients of the explanatory variables can be interpreted directly as the demand elasticities, which provide useful information for policy-makers in tourism destinations.

Studies published between the 1960s and early 1990s mainly follow the traditional regression approach in that the models are specified in static form with very limited diagnostic statistics being reported. Static regression models suffer from a number of problems including structural instability, forecasting failure and spurious regression relationships (see further discussion on this in Section 3). In the mid 1990s dynamic specifications such as the autoregressive distributed lag model (ADLM), and error correction model (ECM), began to appear in the tourism literature. Kim and Song (1998), Kulendran (1996), Kulendran and King (1997), Seddighi and Shearing (1997), Syriopoulos (1995) and Vogt and Wittayakorn (1998) were the first authors to apply recent advances in econometrics, such as cointegration and error correction techniques, to tourism forecasting. The monograph by Song and Witt (2000) was the first book that systematically introduced a number of modern econometric methods to tourism demand analysis. Over the last few years there has been a surge in the application of modern econometric techniques to tourism demand modeling and forecasting, including Dritsakis (2003), Kulendran and Witt (2001, 2003a,b), Lim and McAleer (2001, 2002), Morley (2000), Song, *et al.* (2000, 2003a,b,c) and Webber (2001).

***Diagnostic Checking of the Forecasting Models***: Witt and Witt (1995) point out the problems in tourism forecasting prior to the 1990s, one of which refers to the ignorance of diagnostic checking. However, this has changed since the mid 1990s. In addition to conventional statistics such as the goodness of fit, and the DW statistic for autocorrelation, reported in earlier studies; many recent publications have paid attention to the diagnostic statistics of the demand models. These tests include the tests for integration orders (unit roots) of the data used in the demand models, heteroscedasticity, non-normality, inappropriate functional form, and structural instability. In particular, Dristakis (2003), Kim and Song (1998), Kulendran and Witt (2001), Lim and McAleer (2001, 2002), Payne and Mervar (2002), Song, *et al.* (2000), Song, *et al.* (2003a,b,c) and Song and Witt (2003) all reported a full battery of available diagnostic statistics. The evidence has shown that a model is likely to generate more accurate forecasts if it passes all the available diagnostic statistics.

***Selection of Variables in the Demand Analysis***: In the first section we discussed the

potential variables for tourism demand analysis. In this section, we examine the utilization of these variables in empirical studies. The demand variable measured by total tourist arrivals is still the most frequently used measure of tourism demand, followed by tourist expenditure. Li (2004) pointed out in his literature survey that amongst the 45 selected studies published after 1990, 37 of them used tourist arrivals as the dependent variable while only 6 employed tourist expenditure as the dependent variable. Recent studies have also paid more attention to disaggregated tourism markets according to travel purpose (Morley (1998), Turner and Witt (2001a), Turner, *et al.* (1995)) or modes of transportation (Witt and Witt (1992)). In terms of market segmentation, holiday and leisure travel has attracted the most research attention (Johnson and Ashworth (1990), Kulendran and Witt (2003b) and Song, *et al.* (2000, 2003b)), followed by business travel (for example, Kulendran and Witt (2003a)). Some interest is also placed on the demand for international conferences (for example, Witt, *et al.* (1992, 1995)) and the demand for ski tourism (Riddington (1999, 2002)).

Lim (1997) argued that discretionary income, defined as the remaining income after spending on necessities in the country of origin, should be used as the appropriate measure of tourist income in the demand model. However, this is a subjective variable and the data cannot be easily obtained in practice. Therefore, alternative measures of income have to be used as a proxy for tourist discretionary income. Among these alternatives, real personal disposal income (PDI) is the best proxy to be included in a demand model related to holiday or VFR travel (Kulendran and Witt (2001), Song, *et al.*, 2000 and Syriopoulos (1995)). National disposal income (NDI), gross domestic product (GDP), gross national product (GNP), and gross national income (GNI), all in constant prices, have also been used in many empirical studies. These variables are more suitable for the study of business travel or the combination of business and leisure travel when these two types of data are inseparable (Song and Witt (2000)). Other possible proxies include real private consumption expenditure (Song, *et al.* (2003b)) and the industry production index (González and Moral (1995)). Although most studies have found that income is the most important factor influencing the demand for international tourism, this finding has not always been conclusive. For example, the income variable was found to be insignificant in some of the error correction models in Kulendran and King (1997), Kim and Song (1998), and Song, *et. al.*, (2003b), and specifically, an insignificant income variable tends to be associated with models that relate to demand for international tourism by residents from Japan and Germany. One possible reason is that there are measurement errors in the data, and this is particularly true for the German income data as a result of unification.

In terms of income elasticity, Li (2004) looked at published studies on the demand for international tourism by UK residents between 1990 and 2003. Li found that 54 of the 80 estimated income elasticities are greater than 1, 24 are between 0 and 1 and only in 2 cases was the income elasticity less than 0, and these two cases were related to European destinations. These findings suggest that international tourism is generally regarded as a luxury product, while long-haul travel is more income-elastic than short-haul travel. In terms of the magnitudes of long-run

and short-run income elasticities, Kim and Song (1998), Song, *et al.* (2003b, c), Song and Witt (2000) and Syriopoulos (1995) show that the values of the long-run income elasticities tend to be higher than short-run counterparts, suggesting that it takes time for income changes to take effect on the demand for tourism due to information asymmetry and relatively inflexible budget allocations (Syriopoulos 1995)).

Own price of tourism is another variable that has been found to have an important role to play in determining the demand for international tourism. In theory this variable should contain two components: costs of living in the destination and travel costs to the destination. However due to data unavailability, travel costs have been omitted in most studies with Witt and Witt (1991,1992), Lim and McAleer (2001, 2002), Dritsakis (2003) and Turner and Witt (2003) being some of the exceptions. The cost of living in the destination is normally measured by the destination consumer price index (CPI). Another factor that may also contribute to the cost of living in the destination is the exchange rate between the origin country and destination country, as a higher exchange rate in favor of the origin country's currency could result in more tourists visiting the destination from the origin country. Qiu and Zhang (1995) and Witt and Witt (1992) used CPI in the destination and the exchange rates between the destination and origin separately to account for the costs of tourism, while the majority of published studies (especially the most recent ones) have commonly employed an exchange rate adjusted relative price index between the destination and origin as the own price variable (Turner and Witt (2003)).

With respect to the own-price elasticity, Li (2004) found that 68 out of 78 estimates show negative values ranging from 0 to −1, in line with the theoretical assumption. Smaller values of own price elasticity compared with income elasticity suggest that sensitivity of tourist responses to tourism price changes, is much lower than to income changes; indicating that international tourism tends to be price inelastic.

In addition to the relative prices between the destination and origin, substitute prices in alternative destinations have also been shown to be important determinants. There are two forms of substitute prices: one allows for the substitution between the destination and separately, a number of competing destinations (Kim and Song (1998); Song, *et al.* (2000)) and the other calculates the cost of tourism in the relevant destination relative to a weighted average cost of living in various competing destinations; and this index is also adjusted by relevant exchange rates. The weight is the relative market share (arrivals or expenditures) in each competing destination (Song and Witt (2003)). The second form is used more often in empirical studies, as fewer variables are incorporated into the model; hence more degrees of freedom are available for the model estimation.

Marketing is also an important factor that influences tourism demand. The inclusion of this variable in the demand model with disaggregated data is expected to generate significant results. However, in aggregated studies the unavailability of marketing expenditure data across different origin countries has constrained its inclusion in the demand models. Only three studies incorporate this variable in their demand analyses (Crouch, *et al.*(1992), Ledesma-Rodriguez, *et*

*al.* (2001), Witt and Martin (1987b)).

In the studies by Lim and McAleer (2001, 2002), Kulendran and King (1997), and Song *et al.* (2000, 2003a,b,c) the lagged dependent variables have been found to be important factors that influence the demand for tourism, and their significance suggests that consumer persistency and 'word-of-mouth effects' should be properly considered in demand forecasting models. The exclusion of this variable in the modelling process can result in biased forecasts.

In order to account for the impacts of one-off events and tourist taste changes on the demand for tourism, dummy and time trend variables have been used in some studies. As far as one-off events are concerned, the impacts of the two oil crises in the 1970s are examined in some empirical studies, followed by the Gulf War in the early 1990s and the global economic recession in the mid 1980s. Other regional events and origin/destination-specific affects have also been included in some studies. As for the trend variable, the deterministic linear trend has been used, especially in studies prior to the 1990s. Of the 100 papers reviewed in Lim (1997) 25 incorporated a trend variable in the model specification. However, a time trend tends to be highly correlated with the income variable and can cause a serious multicollinearity problem in the model estimation. This is why most recent studies have avoided including a deterministic trend in the model specification. Li (2004) discovered that of the 45 selected papers published after 1990, only 6 considered time trend in the model specification.

***Forecasting Evaluation***: The forecasting performance assessment of single-equation econometric models is normally based on *ex post* forecasts. Different measures of forecasting performance are available. The predominant measure is the mean absolute percentage error (MAPE), which is used 127 times in 155 individual comparisons according to Li (2004). The next most popular measures are the root mean squared error (RMSE) and root mean squared percentage error (RMSPE), used 91 and 83 times respectively in the 155 comparisons. Other evaluation measures, such as mean absolute error (MAE) and Theil's U statistic (Turner, *et al.* (1997a), Kim and Song (1998), Song, *et al.* (2000)), the acceptable output percentage ($Z$) and normalised correlation coefficient ($r$) (Law and Au, 1999) have also been used. The tendency for the MAPE and RMSE (or RMSPE) to give the same rankings is small, as Li (2004) found in only 26 of 108 cases were MAPE and RMSE (or RMSPE) models in the same order. This discrepancy is due to the different assumptions imposed on the forms of the loss function.

Time series models including the naive no-change model and a variation of the Box-Jenkins ARIMA models have been used as benchmarks to assess the forecasting performance of econometric models in many of the published empirical studies. However, it has not been found that econometric models are superior to time series models in terms of forecasting accuracy, and the conclusion normally depends on the type of econometric and time series models included in the comparison. For example, when the static regression model is compared with time series models, such as those in Law (2000), Law and Au (1999), Witt and Witt (1991, 1992); the econometric models have always been outperformed by time series models. In particular, Witt and Witt (1991) show that the naive model is superior to the causal econometric models where the

econometric models are traditional static regressions. However, Li (2004) found that the particular time series models used only outperformed the econometric models in 52 out of 133 cases. In particular, the naive model generates the most accurate forecasts in only 34 of 131 studies (typically in Kulendran and Witt (2001)). These results suggest that the use of advanced econometric techniques can improve the forecasting performance of econometric models, and also raises the question of the capacity of more modern time series methods such as structural modeling (Turner and Witt (2001b)) and neural networks (Kon and Turner (2004)).

### 2.2 Single Equation Econometric Models with Time Varying Components

The structural time series model (STSM) and the time varying parameter (TVP) model belongs to this category of single equation models. The STSM incorporates stochastic and seasonal components into the classical econometric model. The stochastic and seasonal components in the STSM are specified in the state space form (SSF) and estimated by the Kalman filter algorithms (Kalman (1960)). However, the coefficients of the explanatory variables are still treated as fixed-parameters in the STSM. Applications of STSM in tourism demand studies include González and Moral (1995), Greenidge (2001), Kulendran and Witt (2001, 2003a) and Turner and Witt (2001b). These studies have shown that the STSM can successfully capture the time varying properties of the time series and reflect the seasonal characteristics of tourism demand. Although the trend, seasonal and cyclical components in the STSM are allowed to vary over time, the parameters of the explanatory variables are still fixed overtime and this can be a drawback, as these parameters may also change over time due to changing tourist preferences. As an alternative to the STSM, the TVP model may be more appropriate if the coefficients of the explanatory variables in the econometric models change over time. Song and Witt (2000) and Song and Wong (2003) demonstrate that the demand elasticities related to long-haul travel tend to vary over the sample period as a result of tourist expectations and preferences changing. It has been shown that changes in demand elasticities can be best simulated by TVP models (Song and Witt (2000), and Song and Wong (2003)). Song and Witt (2000) and Song, *et al.* (2003b) also suggest that the TVP model can improve short-term (one to two period ahead) forecasting performance.

### 2.3 Neural Network Models

As Law (2000) described, a neural network contains many simple processing units known as 'nodes' operating in parallel with no central control and the connections between these nodes have numeric weights that can be adjusted in the learning process. This learning process can be seen as a computational tool that mimics a human brain. Law and Au (1999) applied a feed-forward neural network to model the demand for Hong Kong tourism by Japan. In addition, Law (2000) extended the study by incorporating the back-propagation learning process to a non-linear tourism demand relationship. Pattie and Snyder (1996) employed the same method to forecast over-night backcountry stays in US national parks. All three studies have shown a superior performance of neural network models in terms of forecasting accuracy. Burger, *et al.* (2001) and

Uysal and Roubi (1999) also used neural networks to forecast tourism demand with some success. In depth discussion and application of different neural models and their relative forecasting accuracy compared with the basic structural model (BSM), naive and Holt Winters methods is given in Kon and Turner (2004), where the BSM and neural models are found to be the most accurate. However, the application of neural network models and other univariate time series methods including Box Jenkins ARIMA (Turner, *et al.* (1995)), BSM (Turner and Witt (2001b)) and simpler methods such as Holt Winters (Grubb and Mason (2001)) to tourism forecasting has been limited by their inability to provide policy implications, as the construction and estimation of the models are not based on solid economic theories. Although, it is often an overlooked limitation of econometric models that they also assume the determinant variables can be forecast ahead (most often using univariate time-series methods) before the econometric models can generate out of sample forecasts.

### 2.4 System Demand Models

***Vector Autoregressive Models*:** The main focus so far has been on single equation tourism demand models in which an endogenous tourism demand variable is related to a number of exogenous variables. The single equation approach depends heavily on the assumption that the explanatory variables are exogenous. If this assumption is violated, a researcher would have to model the economic relationships using a system (or simultaneous) equations method. The popularity of the simultaneous equation approach dates back to the 1950s and 1960s within the context of structural macroeconomic models that were used for policy simulation and forecasting. In estimating these structural models, restrictions were often imposed in order to obtain identified equations. Sims (1980) argued that many of the restrictions imposed on the parameters in the structural equations were 'incredible' relative to the data generating process, and hence he suggested that it would be better to use models that do not depend on the imposition of incorrect prior information. Following this argument, Sims developed a vector autoregressive (VAR) model in which all the variables apart from the deterministic variables such as trend, intercept and dummy variables, are modelled purely as dynamic processes, that is, the VAR model treats all variables as endogenous.

More importantly, the VAR technique has been closely associated with some of the recent developments in multivariate cointegration analysis, such as the Johansen (1988) cointegration method. Although there has been increasing interest in using the VAR technique in macroeconomic modelling and forecasting, relatively little effort has been made in using this method to forecast tourism demand. Exceptions are Song, *et al.* (2003b), Witt, *et al.* (2003, 2004), and Wong, *et al.* (2006) who used VAR models to forecast demand for tourism and tourism generated employment.

***Almost Ideal Demand System (AIDS) Model*:** Eadington and Redman (1991) noted another deficiency of the single equation approach, that is, single equation approaches are incapable of analysing the interdependence of budget allocations to different consumer goods/services. For