Volatility in International Tourism Demand for Small Island Tourism Economies

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Abstract: Volatility in monthly international tourist arrivals is defined as the squared deviation from mean monthly international tourist arrivals. Consequently, volatility is directly related to the standard deviation, which is a common measure of financial risk. Fluctuating variations, or conditional volatility, in international monthly tourist arrivals are typically associated with unanticipated events. There are time-varying effects related to SITEs, such as natural disasters, ethnic conflicts, crime, the threat of terrorism, and business cycles in tourist source countries, among others, which cause variations in monthly international tourist arrivals. In this paper, we show how the generalised autoregressive conditional heteroscedasticity (GARCH) model can be used to measure the conditional volatility in monthly international tourist arrivals to six SITEs, namely Barbados, Cyprus, Dominica, Fiji, Maldives and Seychelles, and to appraise the implications of conditional volatility of SITEs for modelling tourist arrivals.

Keywords: *Island economies, tourist arrivals, conditional volatility, GARCH, GJR, regularity conditions.*

1. INTRODUCTION

Volatility in monthly international tourist arrivals is defined as the squared deviation from mean monthly international tourist arrivals. Consequently, volatility is directly related to the standard deviation, which is a common measure of financial risk. Monthly international tourist arrivals to each of the six Small Island Tourism Economies (SITEs) analysed in this paper, namely Barbados, Cyprus, Dominica, Fiji, Maldives and Seychelles, exhibit distinct patterns and positive trends. However, monthly international tourist arrivals for some SITEs have increased rapidly for extended periods, and stabilised thereafter. Most importantly, there have been increasing variations in monthly international tourist arrivals in SITEs for extended periods, with subsequently dampened variations. Such fluctuating variations in monthly international tourist arrivals, which vary over time, are regarded as the conditional volatility in tourist arrivals, and can be modelled using econometric time series techniques.

Fluctuating variations, or conditional volatility, in international monthly tourist arrivals are typically associated with unanticipated events. There are time-varying effects related to SITEs, such as natural disasters, ethnic conflicts, crime, the threat of terrorism, and business cycles in tourist source countries, among many others, which cause variations in monthly international tourist arrivals. Owing to the nature of these events, recovery from variations in tourist arrivals from unanticipated events may take longer for some countries than for others.

In this paper, we show how the generalised autoregressive conditional heteroscedasticity (GARCH) model of Engle (1982) can be used to measure the conditional volatility in monthly international tourist arrivals to six SITEs. An awareness of the conditional volatility inherent in monthly international tourist arrivals and techniques for modelling such volatility are vital for a critical analysis of SITEs, which depend heavily on tourism for their macroeconomic stability. The information that can be ascertained from these models about the volatility in monthly international tourist arrivals is crucial for policy-makers, as such information would enable them to instigate policies regarding income, bilateral exchange rates, employment, government revenue, and so forth. Such information is also crucial for decision makers in the private sector, as it would enable them to alter their operations according to fluctuations in volatility.

The GARCH model is well established in the financial economics and econometrics literature. Extensive theoretical developments regarding the structural and statistical properties of the model have evolved (for derivations of the regularity conditions and asymptotic properties of a wide variety of GARCH models, see Ling and McAleer (2002a, 2002b, 2003)).

In this paper we model monthly international tourist arrivals data. GARCH is applied to model monthly international tourist arrivals in SITEs, which rely overwhelmingly on tourism as a primary source of export revenue. Such research would be expected to make a significant contribution to the existing tourism research literature. The GARCH model is appealing because both the conditional mean, which is used to capture the trends and growth rates in international tourism arrivals, and the conditional variance, which is used to capture deviations from the mean monthly international tourist arrivals, are estimated simultaneously. Consequently, the parameter estimates of both the conditional mean and the conditional variance can be obtained jointly for purposes of statistical inference.This paper models the conditional volatility of the logarithm of international tourist arrivals and the growth rate of monthly international tourist arrivals for six SITEs.

As the effects of positive and negative shocks in international tourism arrivals may have different effects on tourism volatility, it is useful to examine an asymmetric model of conditional volatility. For this reason, two popular univariate models of conditional volatility, namely GARCH and the asymmetric GJR model of Glosten, Jagannathan and Runkle (1992), are estimated and discussed.

2. SMALL ISLAND TOURISM ECONOMIES

In the literature on small economies, several attempts have been made to conceptualise the size of an economy, yet there has been little agreement to date. The issue of size first emerged in economics of international trade, where the small country is the price taker; the large country is the price maker with respect to imports, and export prices in world markets.

SITE	**Mean (1980-2000)** Pop. (mills)	GDP per capita ('000 US$)	**Mean 2000** Pop. (mills)	GDP per capita ('000 US$)	Surface Area (km^2)
Barbados	0.26	7.1	0.27	8.3	430
Cyprus	0.69	10.0	0.76	14.1	9,240
Dominica	0.07	3.4	0.07	3.4	750
Fiji	0.73	2.3	0.81	2.4	18,270
Maldives	0.21	1.3	0.28	1.9	300
Seychelles	0.07	5.9	0.08	7.0	450
Mean	**0.34**	**5.0**	**0.38**	**6.2**	**4,907**

Source: WDIs 2002, The World Bank

Table 1. Common Size Measures of SITEs

Size is a relative rather than absolute concept. In the literature, size deals with quantifiable variables, where population, GDP and land area are most widely used. Some notable examples in emphasising size are Kuznets (1960), where a country with a population of 10 million or less is regarded as small. By this measure, the World Bank's (2002) World Development Indicators (WDI) data show there are 130 small economies. In Robinson (1960), a population threshold of 10 to 15 million is used. Armstrong and Read (2002) argue that population is often used because it is convenient and provides information about the size of the domestic market and labour force.

Clearly, there is debate as to the definition of what constitutes a 'small' country.

There are six SITEs examined in this paper, these being the only SITEs for which monthly international tourist arrivals data are available. Viewing the populations of these 6 SITEs in Table 1, they are home to over two million people. Their populations range in size from micro-economies like Dominica and Seychelles, with populations between 50,000 and 100,000, to mini-economies like Barbados and Maldives, which have populations between 100,000 and 500,000, and Cyprus and Fiji, which have populations between 500,000 and 1 million. All of the economies reported in this paper are former British colonies, which gained independence during the latter half of the last century. All of these SITEs have relatively large per capita GDP figures. SITEs in this paper are in four geographic regions of the world, with 2 of them in the Caribbean, 1 in the Pacific Ocean, 2 in the Indian Ocean, and 1 in the Mediterranean.

Tourism plays a dominant role in the economic well being of SITEs, and tourism earnings account for a significant proportion of the value added in their national product. The fundamental aim of tourism development in SITEs is to increase foreign exchange earnings to finance imports. These SITEs have an overwhelming reliance on service industries, of which tourism accounts for the highest proportion in export earnings. In economic planning, tourism has a predominant emphasis in SITEs where the climate is well suited for tourism development and the islands are strategically located.

The square of the deviation from the mean of a GDP growth rate is known as the volatility of GDP growth. In SITEs, the volatility of GDP growth rate tends to be very high. Shareef (2003) calculated the real GDP growth rate and its volatility for 20 SITEs. Malta in the Mediterranean recorded the lowest mean volatility for the period 1980-2002, while St. Lucia in the Caribbean Sea recorded the highest mean volatility of 56.9 for the same period.

SITEs need a consistent inflow of foreign capital to smooth out consumption over the long run, while compensating for any adverse shocks to domestic production. A common feature of SITEs is that they depend heavily on foreign aid to finance development (see Commonwealth Secretariat/World Bank Joint Task Force on Small States (2000). Aid flows have dropped sharply during the last decade of the 20th Century, due to the collapse of communism in Europe. Aid from donor countries has been diverted towards former Soviet allies. SITEs have experienced a dramatic decline in per capita aid of around US$145 in 1990 to less than US$ 100 per capita in 2000. They have very limited access to commercial borrowings because these are perceived to suffer from frequent natural disasters or for other reasons considered to be high risk.

Although SITEs have achieved high average per capita GDP relative to the larger developing countries, poverty continues to be an unabated challenge. Generally, with the increase in per capita GDP, there has been a decline in poverty (Commonwealth Secretariat/World Bank Joint Task Force on Small States (2000)). However, there are a number of small economies that have higher poverty rates than reflected in their per capita incomes, primarily because SITEs are island archipelagos. In such archipelagos, a large proportion of economic activity is confined to the capital, while the dispersed communities remain poor. Poverty prevalence becomes high with the uneven distribution of income. The high volatility of GDP, together with the population's inability to absorb negative shocks to their incomes, means that inequality is further aggravated and hardship is intensified.

3. COMPOSTION OF TOURIST ARRIVALS IN SITES

Tourism arrivals from eleven major markets represent a significant proportion of the total international tourist arrivals to SITEs. Among these eleven markets are the world's richest seven countries, the Group of 7. The other 4 countries, namely Switzerland, Sweden, Australia and New Zealand, are among the highest per capita income countries of the world.

The eleven countries are geographically located with varying measures of distance relative to the six SITEs. These countries are diverse in their social and economic cultures, but explain more than two-thirds of the composition of international tourist arrivals in all the SITEs, except for Dominica. The capacity of the Dominican tourism industry is relatively small compared with the rest of the six SITEs. Moreover, the relatively small magnitudes of mean percentages of tourists from a wide variety of nationalities to Dominica is the dominant feature, besides US tourists dominating the visitor profile, accounting for just below one-fifth. During the same period, in Barbados, Cyprus and Dominica, international tourist arrivals account for six of the eleven source markets. While Fiji welcomed tourists from seven of these eleven sources, Maldives and Seychelles received tourists from the most number of source markets.

The USA, UK and Germany are the dominant markets for tourists to these SITEs. Moreover, these three markets also correspond to quite substantial mean percentages across most of the SITEs. Although the USA is the world's largest and richest economy, their prominence in international tourist arrivals is notable only in the two Caribbean SITEs, namely Barbados and Dominica, followed by Fiji. In the Indian Ocean SITEs, US tourists feature with very low mean percentages. However, UK tourists are spread more evenly among the six economies compared with US tourists. UK tourists are the most widely travelled among the eleven tourism markets, arguably because of the British colonial heritage attached to these SITEs. Generally, European tourists seem to travel to island destinations compared with US and Canadian tourists. German tourists have smaller magnitudes than their UK counterparts. The Germans are followed by French and Italian tourists who travel more to the Indian Ocean SITEs as compared with their Mediterranean and Caribbean counterparts. Canadian, Swiss, Swedish and Japanese tourist arrivals appear among three SITEs, with varying visitor profiles. Canadians tend to travel to the Caribbean and the Pacific, Swiss and Swedish tourists are present among all the regions except the Pacific, while Japanese tourists appear in the Indian Ocean and Pacific Ocean SITEs. Australian and New Zealand tourists travel substantially to SITEs in the Pacific region, but their arrivals are relatively small among the other SITEs.

4. DATA

This paper models the conditional volatility of the logarithm and the growth rate of international tourist arrivals in six SITEs. For these SITEs, the frequency of the data is monthly, and the samples are as follows: The sample periods for these six SITEs are as follows: Barbados, January 1973 to December 2002 (Barbados Tourism Authority); Cyprus, January 1976 to December 2002 (Cyprus Tourism Organization and Statistics Service of Cyprus); Dominica, January 1990 to December 2001 (Central Statistical Office); Fiji, January 1968 to December 2002 (Fiji Islands Bureau of Statistics); Maldives, January 1986 to June 2003 (Ministry of Tourism); and Seychelles, January 1971 to May 2003 (Ministry of Information Technology and Communication). In the case of Cyprus, monthly tourist arrivals data were not available for 1995, so the mean monthly tourist arrivals for 1993, 1994, 1996 and 1997 were used to construct the data for 1995 in estimating the trends and volatilities in international tourist arrivals.

The logarithm of international tourist arrivals to each of these SITEs exhibits distinct seasonal patterns and positive trends. For Barbados, there are some cyclical effects, which coincide with the business cycles in the US economy. These business cycles are the boom period in the latter half of the 1970s, the slump due to the second oil price shock of 1979, and the recession in the early 1990s. In Cyprus, the only visible change in monthly international tourist arrivals is the outlier of the 1991 Gulf War. In Dominica and the Maldives, there are no apparent changes during the respective sample periods. However, in Fiji, the coups of 1987 and 2000 are quite noticeable. Until the second oil shock of 1979, tourism was rapidly increasing in Seychelles, after which the growth rate of international tourist arrivals has stabilised.

The volatility of the logarithm of the deseasonalised and detrended monthly tourist arrivals were calculated from the square of the estimated residuals using non-linear least squares. The most visible cases of volatility clusterings of monthly international tourism demand are Barbados, Cyprus and Seychelles. In Barbados, in the first third of the sample, monthly international tourism arrivals have been highly volatile owing to the economic cycles in the US economy. For Cyprus and Seychelles, there is volatility clustering in the late-1970s to mid-1980s due to the second oil price shock. For Fiji, volatility clusterings are virtually non-existent, whereas for Dominica and Maldives, volatility seems to be accompanied by seasonality in tourist arrivals.

The growth rate of monthly international tourist arrivals is defined as the log-difference of monthly international tourist arrivals. Viewing the growth rates for the six SITEs, except for Fiji, there are dramatic changes in the magnitudes of the growth rates of monthly international tourist arrivals. Cyprus, Maldives and Dominica show a very high degree of variation in the growth rates, in their respective samples. Barbados and Seychelles share similar growth rates, while Fiji shows the lowest variations.

The volatility of the growth rate of deseasonalised monthly international tourist arrivals is calculated from the square of the estimated residuals using non-linear least squares. In this case, the dependent variable is the log-difference of TA_t. The volatility among the six SITEs show slightly different patterns over the respective sample periods, with the simple correlation coefficients for the volatilities being 0.86, 0.93, 0.91, 0.98, 0.92 and 0.60 for Barbados, Cyprus, Dominica, Fiji, Maldives and Seychelles, respectively. For Barbados, there is clear evidence of volatility clustering during the early 1970s and in the mid-1980s, after which there is little evidence of volatility clustering. Volatility clustering is visible for Cyprus in the mid-1970s. In Dominica, in late 1999 and early 2000, there is volatility clustering. The volatility structure of Fiji resembles that of a financial time series, with volatility clustering not so profound, except for outliers, which signify the coups d'état of 1987 and 2000. In Seychelles, volatility clustering is noticeable in the early 1970s, whereas in the Maldives, there are few extreme observations and little volatility clustering.

5. UNIVARIATE MODELS OF TOURISM DEMAND

This section discusses alternative models of the volatility of the logarithm of international tourist arrivals using the Autoregressive Conditional Heteroscedasticity (ARCH) model proposed by Engle (1982), as well as subsequent developments in Bollersllev (1986). The most widely used variation for symmetric shocks is the GARCH model. In the presence of asymmetric behaviour between positive and negative shocks, the GJR model of Glosten et al. (1992) is also widely used. Ling and McAleer (2002a, 2002b, 2003) have made further theoretical advances in both the univariate and multivariate frameworks.

5.1. Symmetric GARCH(1,1)

The uncertainty (h_t) in the ARMA(1,1)-GARCH(1,1) model for the logarithm of monthly international tourist arrivals, $\log TA_t$ is given in Table 2, and the unconditional shocks for monthly international tourist arrivals are given by ε_t^2, where $\omega > 0$, $\alpha \geq 0$ and $\beta \geq 0$ are sufficient conditions to ensure that the conditional variance $h_t > 0$. The ARCH (or α) effect captures the short-run persistence of shocks, while the GARCH (or β) effect measures the contribution of shocks to long-run persistence, $\alpha + \beta$. The parameters are typically estimated by maximum likelihood to obtain Quasi-Maximum Likelihood Estimators (QMLE) in the absence of normality of η_t.

It has been shown by Ling and McAleer (2003) that QMLE of GARCH (*p*,*q*) is consistent if the second moment is finite. The well known necessary and sufficient condition for the existence of the second moment of ε_t for GARCH(1,1) is $\alpha + \beta$ <1, which is also sufficient for consistency of the QMLE. Jeantheau (1998) showed that the weaker log-moment condition is sufficient for consistency of the QMLE for the univariate GARCH (p,q) model. Hence, a sufficient condition for the QMLE of GARCH(1,1) to be consistent and asymptotically normal is given by the log-moment condition (see Table 2).

5.2. Asymmetric GJR(1,1)

The effects of positive shocks on the conditional variance h_t are assumed to be the same as negative shocks in the symmetric GARCH model. Asymmetric behaviour is captured in the GJR model, as defined in Table 2, where $\omega > 0$, $\alpha + \gamma \geq 0$ and $\beta \geq 0$ are sufficient conditions for $h_t > 0$, and $I(\eta_t)$ is an indicator variable (see Table 2). The indicator variable distinguishes between positive and negative shocks such that asymmetric effects are captured by γ, with $\gamma > 0$. In the GJR model, the asymmetric effect, γ, measures the contribution of shocks to both short run persistence, $\alpha + \gamma/2$, and long run persistence, $\alpha + \beta + \gamma/2$. The necessary and sufficient condition for the existence of the second moment of GJR(1,1) under symmetry of η_t is given in Table 2 (see Ling and McAleer (2002b)). The weaker sufficient log-moment condition for GJR(1,1) is also given in Table 2. McAleer et al. (2002) demonstrated that the QMLE of the parameters are consistent and asymptotically normal if the log-normal condition is satisfied.

Model Specification	**Sufficient Conditions for $h_t > 0$**	**Regularity Conditions**
ARMA-GARCH (1,1): $\varepsilon_t = \eta_t \sqrt{h_t}$, $\eta_t \sim iid\,(0,1)$ $h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$	$\omega > 0$ $\alpha \geq 0$ $\beta \geq 0$	**Log-moment:** $E[\log(\alpha\eta_t^2 + \beta)] < 0$ **Second Moment:** $\alpha + \beta < 1$
ARMA-GJR(1,1): $\varepsilon_t = \eta_t \sqrt{h_t}$, $\eta_t \sim iid\,(0,1)$ $h_t = \omega + (\alpha + \gamma I(\eta_{t-1}))\varepsilon_{t-1}^2 + \beta h_{t-1}$ $I(\eta_t) = \begin{cases} 1, & \eta_t < 0 \\ 0, & \eta_t \geq 0 \end{cases}$	$\omega > 0$ $\alpha + \gamma/2 \geq 0$ $\beta \geq 0$	**Log-moment:** $E[(\log((\alpha + \gamma I(\eta_t))\eta_t^2 + \beta)] < 0$ **Second Moment:** $\alpha + \beta + \gamma/2 < 1$

Table 2. Symmetric GARCH (1,1) and Asymmetric GJR(1,1) Models of Conditional Volatilities

6. EMPIRICAL RESULTS

The GARCH(1,1) and GJR(1,1) models are used for six SITEs to estimate the volatility of the logarithm and the growth rate of monthly international tourist arrivals. The empirical models used take account of seasonal effects and deterministic time trends. Uncertainty in tourist arrivals is estimated from the unconditional shocks in the conditional mean. In this paper, an ARMA(1,1) specification is estimated with monthly seasonal dummies and deterministic time trends. Estimates of the parameters of the conditional mean and conditional variance for the GARCH(1,1) and GJR(1,1) models for 6 SITEs are available on request. The Brendt-Hall-Hall-Hausman (Berndt et al. (1974)) algorithm in EViews 4.1 is used to obtain the estimates of the parameters, with both asymptotic t-ratios and the Bollerslev-Wooldridge (1992) robust t-ratios.

The estimates for the logarithm of tourist arrivals are somewhat different in the 6 SITEs. The AR(1) estimates are highly significant for all SITEs, showing a high degree of persistence of tourist arrivals to these destinations.

A large majority of the 12 seasonal dummies for the logarithm of tourist arrivals are significant, indicating strong monthly seasonality (the results are available on request). As these SITEs are in tropical and subtropical regions, while the tourist source markets are in the temperate zones, seasonality is generally observed during November and December. This feature of seasonality can be generalised across all SITEs.

For Fiji, the same principle applies, but since their main tourist sources are in the southern hemisphere, the months change to July and August. Cyprus has the longest tourist season, which is from February to August.

For the logarithm of monthly international tourist arrivals, the estimates of the conditional volatility using GARCH(1,1) and GJR(1,1) are highly satisfactory. The sufficient conditions to ensure positivity of the conditional variance are met for all six SITEs, except for Maldives. It is worth noting that the empirical log-moment and second moment conditions are satisfied for both models and all six SITEs, which indicates model adequacy for policy analysis and formulation. The asymmetric effects are generally satisfactory, with the exception of Dominica. This implies that the effect of positive shocks on conditional volatility is greater than negative shocks in the short and long run. Thus, the results for Dominica suggest that an unexpected fall in monthly international tourist arrivals decreases the uncertainty about future monthly international tourist arrivals, which is contrary to the results for the other five SITEs.

The estimates for the growth rate of monthly international tourist arrivals vary among the six destination countries, but not substantially. Virtually all of the estimated seasonal effects in both models are statistically significant.

The estimates of conditional volatility for both models using the growth in monthly international tourist arrivals are reasonable, except for the Maldives, so that inferences regarding the estimates are valid for 5 of the 6 SITEs. An interesting feature of the estimates is that the asymmetric effect is negative for Dominica, Maldives and Seychelles. This outcome implies that the short and long run effects of a negative shock in the growth rate of monthly international tourist arrivals will result in less uncertainty in subsequent periods. However, for Barbados, Cyprus, and Fiji, if there is a negative shock to the expected growth rate of monthly international tourist arrivals, there will subsequently be greater uncertainty. This is perfectly plausible, as Fiji experienced military coups in 1987 and 2000, which undermined the perceptions of international travellers, and as Cyprus has had a volatile political climate for an extended period, which created uncertainty in tourist arrivals.

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