Managing Value-at-Risk in Daily Tourist Tax Revenues for the Maldives*

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Abstract: International tourism is the principal economic activity for Small Island Tourism Economies (SITEs). There is a strongly predictable component of international tourism, specifically the government revenue received from taxes on international tourists, but it is difficult to predict the number of international tourist arrivals, which determines the magnitude of tax revenue receipts. A framework is presented for risk management of daily tourist tax revenues for the Maldives, which is a unique SITE because it relies almost entirely on tourism for its economic and social development. As international tourism receipts are significant financial assets to the economies of SITEs, the time-varying volatility of international tourist arrivals and their growth rate is analogous to the volatility (or dynamic risk) in financial returns. The volatility in the levels and growth rates of daily international tourist arrivals are investigated in the paper. This paper provides a template for the future analysis of earnings from international tourism, particularly tourism taxes for SITEs, discusses the direct and indirect monetary benefits from international tourism, highlights tourism taxes in the Maldives as a development financing phenomenon, and provides a framework for discussing the design and implementation of tourism taxes. Furthermore, it is demonstrated that the analysis developed in this paper can be used by the Maldivian Government in determining monetary and fiscal policy, by creditors to evaluate the risks associated with providing financial support to the Maldives, and by resort operators to decide whether to expand or contract their operations.

Keywords: Small Island Tourism Economies (SITEs), International tourist arrivals, Tourism tax, Volatility, Risk, Value-at-Risk (VaR), Sustainable Tourism@Risk (ST@R).

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Introduction

International tourism is widely regarded as the principal economic activity in Small Island Tourism Economies (SITEs) (see Shareef (2004) for a comprehensive discussion). Historically, SITEs have been dependent on international tourism for economic development, employment, and foreign exchange, among other economic indicators. A unique SITE is the Maldives, an archipelago of 1190 islands in the Indian Ocean, of which 200 are inhabited by the indigenous population of 271,101, and 89 islands are designated for self-contained tourist resorts. The Maldivian economy depends substantially on tourism, and accounts directly for nearly 33% of real GDP. According to the Ministry of Planning and National Development (2005) of the Government of Maldives, transport and communications are the second largest economic sector, contributing 14%, while government administration accounts for 12% of the economy. Fisheries are still the largest primary industry, but its contribution to the economy has gradually declined to 6% in 2003. Employment in tourism accounts for 17% of the working population, while tourism accounts for 65% of gross foreign exchange earnings.

Any shock that would adversely affect international tourist arrivals to the Maldives would also affect earnings from tourism dramatically, and have disastrous ramifications for the entire economy. An excellent example is the impact of the 2004 Boxing Day Tsunami, which sustained extensive damage to the tourism-based economy of the Maldives and dramatically reduced the number of tourist arrivals in the post-tsunami period. Therefore, it is vital for the Government of the Maldives, multilateral development agencies such as the World Bank and the Asian Development Bank who are assisting Maldives in the Tsunami recovery effort, and the industry stakeholders, namely the resort owners and tour operators, to obtain accurate estimates of international tourist arrivals and their variability. Such accurate estimates would provide vital information for government policy formulation, international development aid, profitability and marketing.

A significant proportion of research in the literature on empirical tourism demand has been based on annual data (see Shareef (2004)), but such analyses are useful only for long-term development planning. An early attempt to improve the short-term analysis of tourism was undertaken by Shareef and McAleer (2005), who modelled the volatility (or predictable uncertainty) in monthly international tourist arrivals to the Maldives. Univariate and multivariate time series models of conditional volatility were estimated and tested. The conditional correlations were estimated and examined to determine whether there was specialisation, diversification or segmentation in the international tourism demand shocks from the major tourism source countries to the Maldives. In a similar vein, Chan, Lim and McAleer (2005) modelled the time-varying means, dynamic conditional variances and constant conditional correlations of the logarithms of the monthly arrival rate for the four leading tourism source countries to Australia.

This paper provides a template for the future analysis of earnings from international tourism, particularly tourism taxes for SITEs, discusses the direct and indirect monetary benefits from international tourism, highlights tourism taxes in the Maldives as a development financing phenomenon, and provides a framework for discussing the design and implementation of tourism taxes.

Daily international arrivals to Maldives and the number of tourists in residence are analysed for the period 1994-2003. The data are obtained from the Ministry of Tourism of Maldives. In the international tourism demand literature to date, there does not seem to have been any empirical research using daily tourism arrivals data. One advantage of using daily data, as distinct from monthly and quarterly data, is that volatility clustering in the number of international tourist arrivals and their associated growth rates can be observed and analysed more clearly using standard financial econometric techniques. Therefore, it is useful to analyse daily tourism arrivals data, much like financial data, in terms of the time series patterns, as such an analysis would provide policy makers and industry stakeholders with accurate indicators associated with their short-term objectives.

In virtually all SITEs, and particularly the Maldives, tourist arrivals or growth in tourist arrivals translates directly into a financial asset. Each international tourist is required to pay USD 10 for every tourist bed-night spent in the Maldives. This levy is called a ‘tourism tax’ and comprises over 30% of the current revenue of the government budget (Ministry of Planning and National Development, 2005). Hence, tourism tax revenue is a principal determinant of development expenditure. As a significant financial asset to the economy of SITEs, and particularly for Maldives, the volatility in tourist arrivals and their growth rate is conceptually identical to the volatility in financial returns, which is interpreted as financial risk.

This paper models the volatility in the number of tourist arrivals, tourists in residence and their growth rates. The purpose of this analysis of volatility is to present a framework for managing the risks inherent in the variability of total tourist arrivals, tourists in residence, and hence government revenue, through the modelling and forecasting of Value-at-Risk (VaR) thresholds for the number of tourist arrivals, tourists in residence and their growth rates. Thus, the paper provides the first application of the VaR portfolio approach to manage the risks associated with tourism revenues.

The structure of the paper is as follows. The economy of Maldives is described, followed by an assessment of the impact of the 2004 Boxing Day Tsunami on tourism in Maldives. The concept of Value-at-Risk (VaR) is analysed, the data are discussed, the models of volatility are presented, the empirical results are examined, forecasting is undertaken, and finally some concluding remarks are given.

The Tourism Economy of the Maldives

Maldives is an archipelago in the Indian Ocean, was formerly a British protectorate, and became independent in 1965. It stretches approximately 700 kilometres north to south, about 65 kilometres east to west, and is situated south-west of the Indian sub-continent. The Exclusive Economic Zone of Maldives is 859,000 square kilometres, and the aggregated land area is roughly 290 square kilometres.

With an average growth rate of 7% per annum over the last two decades, Maldives has shown an impressive economic growth record. This economic performance has been achieved through growth in international tourism demand. Furthermore, economic growth has enabled Maldivians to enjoy an estimated real per capita GDP of USD 2,261 in 2003, which is considerably above average for small island developing countries, with an average per capita GDP of USD 1,500. The engine of growth in the Maldives has been the tourism industry, accounting for 33% of real GDP, more than one-third of fiscal revenue, and two-thirds of gross foreign exchange earnings in recent years. The fisheries sector remains the largest sector in terms of employment, accounting for about one-quarter of the labour force, and is an important but declining source of foreign exchange earnings. Due to the high salinity content in the soil, agriculture continues to play a minor role. The government, which employs about

20% of the labour force, plays a dominant role in the economy, both in the production process and through its regulation of the economy.

Tourism in the Maldives has a direct impact on fiscal policy, which determines development expenditure. More than one-fifth of government revenue arises from tourism-related levies. The most important tourism-related revenues are the tourism tax, the resort lease rents, resort land rents, and royalties. Except for the tourism tax, the other sources of tourism-related revenues are based on contractual agreements with the Government of the Maldives. Tourism tax is levied on every occupied bed night from all tourist establishments, such as hotels, tourist resorts, guest houses and safari yachts. Initially, this tax was levied at USD 3 in 1981, and was then doubled to USD 6 in 1988. After 16 years with no change in the tax rate, the tax rate was increased to USD 10 on 1 November 2004. This tax is regressive as it does not take into account the profitability of the tourist establishments. Furthermore, it fails to take account of inflation, such that the tax yield has eroded over time.

Tourism tax is collected by tourist establishments and is deposited at the Inland Revenue Department at the end of every month. This tax revenue is used directly to finance the government budget on a monthly basis. As the tax is levied directly on the tourist, any uncertainty that surrounds international tourist arrivals will affect tourism tax receipts, and hence fiscal policy. Any adverse affect on international tourist arrivals may also result in the suspension of planned development expenditures.

The nature of tourist resorts in the Maldives is distinctive as they are built on islands that have been set aside for tourism development. Tourism development is the greatest challenge in the history of Maldives, and has led to the creation of distinctive resort islands. Domroes (1985, 1989, 1993, 1999) asserts that these islands are deserted and uninhabited, but have been converted into ‘one-island-one-hotel’ schemes. The building of physical and social infrastructure of the resort islands has had to abide by strict standards to protect the flora, fauna and the marine environment of the islands, while basic facilities for sustainability of the resort have to be maintained. The architectural design of the resort islands in Maldives varies profoundly in their character and individuality. Only 20% of the land area of any given island is allowed to be developed, which is imposed to restrict the capacity of tourists. All tourist accommodation must face a beachfront area of five metres. In most island resorts, bungalows are built as single or double units. Recently, there has been extensive development of water bungalows on stilts along the reefs adjacent to the beaches. All tourist amenities are available on each island, and are provided by the onshore staff.

Impact of the 2004 Boxing Day Tsunami on Tourism in the Maldives

As the biggest ever national disaster in the history of Maldives, the 2004 Boxing Day Tsunami caused widespread damage to the infrastructure on almost all the islands. The World Bank, jointly with the Asian Development Bank [World Bank (2005a)], declared that the total damage of the Tsunami disaster was USD 420 million, which is 62% of the annual GDP. In the short run, the Maldives will need approximately USD 304 million to recover fully from the disaster to the pre-tsunami state.

A major part of the damage was to housing and tourism infrastructure, with the education and fisheries sectors also severely affected. Moreover, the World Bank damage assessment highlighted that significant losses were sustained in water supply and sanitation, power, transportation and communications. Apart from tourism, the largest damage was sustained by the housing sector, with losses close to USD 65 million. Approximately, 1,700 houses were destroyed, another 3,000 were partially damaged, 15,000 inhabitants were fully displaced, and 19 of the 200 inhabited islands were declared uninhabitable.

The World Bank also stated that the tourism industry would remain a major engine of the economy, and that the recovery of this sector would be vital for Maldives to return to higher rates of economic growth, full employment and stable government revenue. In the Asian Development Bank report, similar reactions were highlighted by stating that it would be vitally important to bring tourists back in full force, as tourism is the most significant contributor to GDP. In fact, tourism is of vital importance to the Maldivian economy.

In the initial macroeconomic impact assessment undertaken by the World Bank, the focus was only on 2005. The real GDP growth rate was revised downward from 7% to 1%, consumer prices were expected to rise by 7%, the current account balance was to double to 25% of GDP, and the fiscal deficit was to increase to 11% of GDP, which is unsustainable, unless the government were to implement prudent fiscal measures.

The 2004 Boxing Day Tsunami also caused widespread destruction and damage to countries such as Indonesia, India and Sri Lanka. Compared with the damage caused to the Maldives, the destruction which occurred in these other countries is substantially different in terms of its scale and nature. In India, widespread socioeconomic and environmental destruction was caused in the eastern coast, affecting the states of Andhra Pradesh, Kerala and Tamil Nadu, and the Union Territory (UT) of Pondicherry. The Tsunami struck with 3- to 10-metre waves and penetrated as far as 3 kilometres inland, affecting 2,260 kilometres of coastline (World Bank (2005b)). Nearly 11,000 people died in India. The tsunami also adversely affected the earning capacity of some 645,000 people, whose principal economic activity is fisheries.

According to the damage assessment report published in World Bank (2005c), nearly 110,000 lives were lost in Indonesia, 700,000 people were displaced, and many children were orphaned. The total estimate of damages and losses from the catastrophe amounted to USD 4.45 billion, of which 66% constituted damages, while 34% constituted losses in terms of income flows to the economy. Furthermore, total damages and losses amounted to 97% of Aceh’s GDP. Although Aceh’s GDP derives primarily from oil and gas, which were not affected, and the livelihoods of most residents rely primarily on fisheries and agriculture, this was undeniably a catastrophe of unimaginable proportions.

In Sri Lanka, the human costs of the disaster were also phenomenal, with more than 31,000 people killed, nearly100,000 homes destroyed, and 443,000 people remaining displaced. The economic cost amounted to USD 1.5 billion dollars, which is approximately 7% of annual GDP (World Bank (2005d)). As in India, Indonesia and Maldives, the Tsunami affected the poorest Sri Lankans, who work in the fisheries industry, and some 200,000 people lost their employment in the tourism industry.

Compared with all the tsunami-stricken countries, Maldives was affected entirely as a result of its geophysical nature. When the tsunami struck, the Maldives was momentarily wiped off the face of the earth.

Tourism and Value-at-Risk

Value-at-Risk (VaR) is a procedure designed to forecast the maximum expected negative return over a target horizon, given a (statistical) confidence limit, (see Jorion (2000) for a discussion). Thus, VaR measures an extraordinary loss on an ordinary or typical day. VaR is used widely to manage the risk exposure of financial institutions and is a requirement of the Basel Capital Accord (see Basel Committee (1988, 1995, 1996)). The central idea underlying VaR is that, by forecasting the worst possible return for each day, institutions can be prepared for a worst case scenario. In the case of the banking industry, or authorized deposit-taking institutions, more generally, such an insurance policy can help avoid bank runs, which can be devastating to the economy if they result in widespread bank failures.

In the case of SITEs such as Maldives, where tourism revenue is a major source of income and foreign exchange reserves, it is important to understand the risks associated with this particular source of income, and to implement adequate risk management policies to ensure economic stability and sustained growth. Forecasted VaR thresholds can be used to estimate the level of reserves required to sustain desired long term government projects and foreign exchange reserves. Furthermore, an understanding of the variability of tourist arrivals, and hence tourism-related revenue, is critical for any investor planning to invest in or lend funds to SITEs.

Formally, a VaR threshold is the lower bound of a confidence interval in terms of the mean. For example, suppose interest lies in modelling international tourist arrivals as the random variable, Y_t, which can be decomposed as:

$$Y_t = E(Y_t \mid F_{t-1}) + \varepsilon_t .$$

This decomposition suggests that Y_t comprises a predictable component of tourist arrivals, $E(Y_t \mid F_{t-1})$, which is the conditional mean, and a random component of tourist arrivals, ε_t, that is unpredictable. F_t is the historical information set, or time series data, that is available to tourists, tourism industry stakeholders, and the Government of Maldives at time *t*. The variability of Y_t, and hence the distribution of tourist arrivals, is determined by the variability of ε_t. If ε_t follows an (as yet) unstated distribution (*D*), such that:

$$\varepsilon_t \sim D(\mu_t, \sigma_t),$$

where μ_t and σ_t are the unconditional mean and standard deviation of ε_t, respectively, these can be estimated using numerous parametric and non-parametric procedures. The parametric procedure that is used in this paper is discussed below. Therefore, the VaR threshold for Y_t can be calculated as:

$$VaR_t = E(Y_t \mid F_{t-1}) + z\sigma_t$$

where z is the negative critical value associated with the distribution of ε_t for a given level of significance, which is usually set at the 1% level. In practice, σ_t is replaced by one of several alternative estimates of the standard deviation, which will be discussed below. McAleer et al. (2005) develop a Sustainable Tourism@Risk (or ST@R) model, which examines the impact of alternative estimates of volatility on the VaR of international tourist arrivals.

Data Issues

The data used in this paper are total daily international tourist arrivals from 1 January 1994 to 31 December 2003, and were obtained from the Ministry of Tourism of Maldives. There were over four million tourists during this ten-year period, with Italy being the largest tourist source country, followed by Germany, United Kingdom and Japan. The top four countries accounted for over 60% of tourist arrivals to Maldives. Furthermore, tourists from Western Europe accounted for more than 80% of tourists to Maldives, with Russia seen as the biggest emerging market.

A significant advantage of using daily data, as distinct from monthly and quarterly data, is that volatility clustering in the number of international tourist arrivals and their associated growth rates can be observed and analysed more clearly using standard financial econometric techniques.

There exists a direct relationship between the daily total number of tourists in residence and the daily tourism tax revenue. Modelling the variability of daily tourist arrivals (namely, the number of international tourists who arrive in the Maldives, predominantly by air) can be problematic as institutional factors, such as predetermined weekly flight schedules, lead to excessive variability and significant day-of-the-week effects. This problem can be resolved in one of two ways. Weekly tourist arrivals could be examined, as this approach removes both the excess variability inherent in daily total arrivals and day-of-the-week effects. However, this approach is problematic as it leads to substantially fewer observations being available for estimation and forecasting.

An alternative solution, and one that is adopted in this paper, is to calculate the daily tourists in residence, which is the total number of international tourists residing in Maldives on any given day. This daily total tourists in residence is of paramount importance to the Government of Maldives as it has a direct effect on the tourism tax revenues. The tourists in residence series are calculated as the seven-day rolling sum of the daily tourist arrivals series, which assumes that tourists stay in the Maldives for seven days, on average. This is a reasonable assumption as the typical tourist stays in the Maldives for approximately 7 days (Ministry of Planning and National Development (2005)).

The graphs for daily tourist arrivals, weekly tourist arrivals and tourists in residence are given in Figures 1-3, respectively. All three series display high degrees of variability and seasonality, which is typical of tourist arrivals data. As would be expected, the highest levels of tourism arrivals in the Maldives occur during the European winter, while the lowest levels occur during the European summer. The daily tourist arrivals series display the greatest variability, with a mean of 1,122 arrivals per day, a maximum of 4,118 arrivals per day, and a rather low minimum of 23 arrivals per day. Furthermore, the daily arrivals series have a coefficient of variation (CoV) of 0.559, which is nearly twice the CoV of the other two series. The weekly arrivals and tourists in residence series are remarkably similar, with virtually identical CoV values of 0.3 and 0.298, respectively, and the normality assumption of both being strongly rejected.

[Insert Figures 1-3 here]

As the focus of this paper is on managing the risks associated with the variability in tourist arrivals and tourist tax revenues, the paper focuses on modelling the growth rates, namely the returns in both total tourist arrivals and total tourists in residence. The graphs for the returns in total daily tourist arrivals, total weekly tourist arrivals and total daily tourists in residence are given in Figures 4-6, respectively. Daily tourist arrivals display the greatest variability, with a standard deviation of 81.19%, a maximum of 368.23%, and a minimum of -412.57%. Based on the Jarque-Bera Lagrange Multiplier test statistic for normality, each of the series is found to be non-normal. Such non-normality can, in practice, change the critical values to obtain more precise VaR threshold forecasts (for further details, including a technical discussion of issues such as bootstrapping the distribution to obtain the dynamic critical values, see McAleer et al. (2005)).

[Insert Figures 4-6 here]

Volatility Models

Risk evaluations are at the heart of research in financial markets, so much so that any assessment of the volatility of financial asset returns without such evaluations cannot be taken seriously. Engle (1982) developed the Autoregressive Conditional Heteroskedasticity (ARCH) model for undertaking risk evaluations by assuming that the conditional variance of the random error depends systematically on its past history. In this context, volatility clustering is taken to mean that large (small) shocks in the current period are followed by large (small) fluctuations in subsequent periods. There are two components of the ARCH specification, namely a model of asset returns and a model to explain how risk changes over time.

Subsequent developments led to the extension of ARCH by Bollerslev (1986) to the Generalised ARCH (GARCH) model. The main feature of GARCH is that there is a distinction made between the short and long run persistence of shocks to financial returns. A serious limitation of GARCH is the assumption that a positive shock (or "good news") to daily tourist arrivals, tourists in residence, or their respective growth rates, has the same impact on their associated volatilities as does a negative shock (or "bad news") of equal magnitude. It is well known that a negative shock to financial returns tends to have a greater impact on volatility than does a positive shock. This phenomenon was first explained by Black (1976), who argued that a negative shock increases financial leverage through the debt-equity ratio, by decreasing equity which, in turn, increases risk. Although there is not necessarily a comparable interpretation of leverage that applies to international tourist arrivals, there is nevertheless a significant difference in terms of positive and negative shocks, which make a tourist destination more and less appealing, respectively. Therefore, positive and negative shocks would be expected to have differential impacts on volatility in daily tourist arrivals, tourists in residence, and in their respective growth rates.

In order to incorporate asymmetric behaviour, Glosten, Jagannathan and Runkle (1992) (GJR) extended the GARCH model by incorporating an indicator variable to capture the differential impacts of positive and negative shocks. Several alternative models of asymmetric conditional volatility are available in the literature (see McAleer (2005) for a comprehensive and critical review).

There have been only a few applications of GARCH models in the tourism research literature to date. Through estimation of ARCH and GARCH models, Raab and Schwer (2003) examine the short and long run impacts of the Asian financial crisis on Las Vegas gaming revenues. Shareef and McAleer (2005) model univariate and multivariate conditional volatility in monthly international tourist arrivals to the Maldives. Chan, Lim and McAleer (2005) investigate the conditional mean and variance in the GARCH framework for international tourist arrivals to Australia from the four main tourist source countries, namely Japan, New Zealand, UK and USA. Chan et al. (2005) show how the GARCH model can be used to measure the conditional volatility in monthly international tourist arrivals to three SITEs. Hoti et al. (2005) provide a comparison of country risk ratings, risk returns and their associated volatilities (or uncertainty) for six SITEs where monthly data compiled by the International Country Risk Guide are available (see Hoti and McAleer (2004, 2005) for further details). Their results also show that the GARCH(1,1) and asymmetric GJR(1,1) models provide an accurate measure of the uncertainty associated with country risk returns for the six SITEs. Nicolau (2005) investigates the variations in the risk of a hotel chain’s performance derived from opening a new lodging establishment.

The primary inputs required for calculating a VaR threshold are the forecasted variance, which is typically obtained as a conditional volatility, and the critical value from an appropriate distribution for a given level of significance. Several models are available for measuring and forecasting the conditional volatility. In this paper, two popular univariate models of conditional volatility will be used for estimating the volatilities and forecasting the corresponding VaR thresholds. These specifications are the symmetric GARCH model of Bollerslev (1986), which does not distinguish between the impact of positive and negative shocks to tourist arrivals (that is, increases and decreases in tourist arrivals), and the asymmetric GJR model of Glosten, Jagannathan and Runkle (1992), which does discriminate between the impact of positive and negative shocks to tourist arrivals on volatility.

The asymmetric GJR(*p*,*q*) model is given as:

$$Y_t = E(Y_t \mid F_{t-1}) + \varepsilon_t$$

$$\varepsilon_t = h_t^{1/2} \eta_t$$

$$h_t = \omega + \sum_{l=1}^{p} (\alpha_l \varepsilon_{t-l}^2 + \gamma_l I(\eta_{t-l}) \varepsilon_{t-l}^2) + \sum_{l=1}^{q} \beta_l h_{t-l}$$

$$I(\eta_t) = \begin{cases} 1, \varepsilon_t \le 0 \\ 0, \varepsilon_t > 0 \end{cases}$$

where F_t is the information set available at time *t*, and $\eta_t \sim iid(0,1)$. The four equations in this asymmetric model of conditional volatility state the following:

(i) the growth in tourist arrivals depends on its own past values (namely, the conditional mean);

(ii) the shock to tourist arrivals, ε_t, has a predictable conditional variance (or risk) component, h_t, and an unpredictable component, η_t;

(iii) the conditional variance depends on its own past values, h_{t-l}, and previous shocks to the growth in the tourist arrivals series, ε_{t-l}^2; and

(iv) the conditional variance is affected differently by positive and negative shocks to the growth in tourist arrivals, as given by the indicator function, $I(\eta_t)$.

In this paper, $E(Y_t \mid F_{t-1})$ is modelled as a simple AR(1) process. For the case $p = q = 1$, $\omega > 0$, $\alpha_1 \ge 0$, $\alpha_1 + \gamma_1 \ge 0$ and $\beta_1 \ge 0$ are the sufficient conditions to ensure a strictly positive conditional variance, $h_t > 0$. The ARCH (or $\alpha_1 + \frac{1}{2}\gamma_1$) effect captures the short run persistence of shocks (namely, an indication of the strength of the shocks to international tourist arrivals in the short run), and the GARCH (or β_1) effect indicates the contribution of shocks to long run persistence or (or $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1$) (namely, an indication of the strength of the shocks to international tourist arrivals in the long run). For the GJR(1,1) model, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ is a sufficient condition for the existence of the second moment (that is, a finite variance), which is necessary for sensible empirical analysis. Restricting $\gamma_1 = 0$ in the GJR(1,1) model leads to the GARCH(1,1) model of Bollerslev (1986). For the GARCH(1,1) model, the second moment condition is given by $\alpha_1 + \beta_1 < 1$.

In the GJR and GARCH models, the parameters are typically estimated using the maximum likelihood estimation (MLE) method. In the absence of normality of the standardized residuals, η_t, the parameters are estimated by the Quasi-Maximum Likelihood Estimation (QMLE) method (for further details see, for example, Li, Ling and McAleer (2002) and McAleer (2005)). The second moment conditions are also sufficient for the consistency and asymptotic normality of the QMLE of the respective models, which enables standard statistical inference to be conducted.

Empirical Results

The variable of interest for the Maldivian Government is the number of tourists in residence on any given day as this figure is directly related to tourism revenue. As mentioned previously, every tourist is obliged to pay the tourism tax of USD 10 for every occupied bed night. In this section, the tourists in residence series are used to estimate the GARCH(1,1) and GJR(1,1) models described above. Estimation is conducted using the EViews 5.1 econometric software package, although similar results can be obtained using the RATS 6 econometric software package. The QMLE of the parameters are obtained for the case *p*=*q*=1.

The estimated GARCH(1,1) equation for the tourists in residence series for the full sample is given as follows:

$$\widehat{Y}_t = \underset{(0.054)}{0.001} + \underset{(0.017)}{0.1561} Y_{t-1}$$

$$h_t = \underset{(0.058)}{0.598} + \underset{(0.009)}{0.149}\varepsilon_{t-1}^2 + \underset{(0.012)}{0.799}h_{t-1},$$

where the figures in parentheses are standard errors.

The estimated GJR(1,1) equation for the tourists in residence series for the full sample is given as follows:

$$Y_t = \underset{(0.054)}{0.001} + \underset{(0.017)}{0.1561}Y_{t-1}$$

$$h_t = \underset{(0.058)}{0.592} + \underset{(0.011)}{0.121}\varepsilon_{t-1}^2 + \underset{(0.015)}{0.048}I(\eta_{t-1})\varepsilon_{t-1}^2 + \underset{(0.012)}{0.803}h_{t-1}.$$

All the parameters are estimated to be positive and significant, which indicates that both models provide adequate explanation of the data. As γ_1 is estimated to be positive and significant, volatility is affected asymmetrically by positive and negative shocks. In this sense, the asymmetric GJR model dominates its symmetric GARCH counterpart empirically. It is found that negative shocks (or a decrease in tourist arrivals) have a greater impact on volatility than do positive shocks (or an increase in tourist arrivals) of a similar magnitude. Furthermore, as the respective estimates of the second moment conditions, $\hat{\alpha}_1 + \frac{1}{2}\hat{\gamma}_1 + \hat{\beta}_1 = 0.948$ for GJR(1,1) and $\hat{\alpha}_1 + \hat{\beta}_1 = 0.948$ for GARCH(1,1), are satisfied, the QMLE are consistent and asymptotically normal. This means that the estimates are statistically adequate and sensible for purposes of interpretation.

Forecasting

A rolling window is used to forecast the 1-day ahead conditional variances and VaR thresholds for the tourists in residence, with the sample ranging from 7 January 1994 to 31 December 2003. In order to strike a balance between efficiency in estimation and a viable number of rolling regressions, the rolling window size is set at 1,000, which leads to a forecasting period from 3 May 1997 to 31 December 2003. A rolling window is a moving sub-sample within the entire sample data set. In the empirical example presented here, estimation starts from observations 1 to 1000 of the data set, which corresponds to the period 7 January 1994 to 7 May 1997. Then, rolling the sample to observations 2 to 1001, which corresponds to the period 8 January 1994 to 8 May 1997, estimation is undertaken again, followed by observations 3 to 1002, and so on until the last rolling sample is reached.

Using the notation developed above, the VaR threshold forecast for the growth rate of tourists in residence at any given time *t* is given by:

$$VaR_t = E(Y_t \mid F_{t-1}) + z\sqrt{h}_t ,$$

where $E(Y_t \mid F_{t-1})$ is the forecasted expected growth rate of total tourists in residence at time *t*, h_t is the forecasted conditional variance of the growth rate in total tourist arrivals, and $z = -2.33$ is the negative critical value from the normal distribution at the one-sided 1% level of significance.

Figures 7 and 8 give the forecasted variances for both models. As can be seen from the figures, the forecasts are quite similar, with a correlation coefficient of 0.98. The forecasted VaR thresholds are given in Figures 9 and 10, respectively. As discussed above, the forecasted VaR threshold represents the maximum expected negative growth rate that could be expected given a specific confidence level. As is standard in the finance literature, where many of these techniques were developed and refined, this paper uses a 1% level of significance to calculate the VaR. In other words, growth rates smaller than the forecasted VaR should only be observed in 1% of all forecasts, which is referred to as the correct "conditional coverage".

The empirical results show that, in using the GJR (GARCH) model, we observe 32 (30) instances where the actual daily growth rate is smaller than the forecasted VaR threshold. Based on a Likelihood Ratio test, both models display the correct conditional coverage. In addition, Figures 11 and 12 give the second moment conditions for each rolling window of both models. As the condition is satisfied for every rolling window, this provides greater confidence in the statistical adequacy of the two estimated models. Finally, both models lead to the same average VaR at -6.59%, which means that the lowest expected daily growth rate in tourists in residence, and hence in tourist tax revenues, is -6.59%, given a 99% level of confidence. In other words, it can be stated with a 99% degree of confidence that the daily growth rate will exceed -6.59%.

Conclusion

In Maldives, tourist arrivals and the growth in tourist arrivals translate directly into a financial asset for the government, as each international tourist is required to pay USD 10 for every tourist bed-night. This levy is called a tourism tax and enters directly into government revenue. Thus, tourism tax revenue is a principal determinant of development expenditure. As a significant financial asset to the economies of SITEs, and particularly so in the case of Maldives, the volatility in tourist arrivals and in their growth rates are conceptually equivalent to the volatility in financial returns, which is widely interpreted as financial risk.

This paper provided a template for the future analysis of earnings from international tourism, particularly tourism taxes for SITEs, discussed the direct and indirect monetary benefits from international tourism, highlighted tourism taxes in the Maldives as a development financing phenomenon, and provided a framework for the quantification of the risks associated with tourism tax receipts, which should facilitate the future design and implementation of tourism taxes in SITEs.

Daily international arrivals to Maldives and their associated growth rates were analysed for the period 1994-2003. This seems to be the first analysis of daily tourism arrivals and growth rates data in the tourism research literature. The primary purpose for analysing volatility was to model and forecast the Value-at-Risk (VaR) thresholds for the number of tourist arrivals and their growth rates. This would seem to be the first attempt in the tourism research literature to apply the VaR portfolio management approach to manage the risks associated with tourism revenues.

The empirical results based on two widely-used conditional volatility models showed that volatility was affected asymmetrically by positive and negative shocks, with negative shocks to the growth in tourist arrivals having a greater impact on volatility than previous positive shocks of a similar magnitude. The forecasted VaR threshold represented the maximum expected negative growth rate that could be expected given a specific confidence level. Both conditional volatility models led to the same average VaR at -6.59%, which meant that the lowest possible growth rate in daily tourists in residence, and hence in tourist tax revenues, was expected to be -6.59% at the 99% level of confidence. This should be useful information for the Maldivian Government and private tourism service providers in the Maldives.

In the Maldives Tourism Act (Law No: 2/99), it is stated that the tourism tax is USD 10 and is to be paid in USD, which increases foreign exchange reserves directly. Tourist establishments also typically hold large quantities of USD, which encourages the general public to follow suit, and causes the economy to become highly 'dollarized'. Such dollarization substantially changes the way in which a country conducts monetary policy. In the case of Maldives, in the event of a contraction of USD inflows, the authorities will have to change the way in which they conduct monetary policy. Therefore, understanding the extent to which tourism tax receipts, and hence foreign exchange reserves, can vary will aid the Maldivian Government in planning the conduct of future monetary policy operations.

Tourism taxes also have a significant influence on the Maldivian Government's budget. There are three main components of government expenditure, namely: (1) direct government expenditure on public projects; (2) transfer payments; and (3) debt servicing. In turn, these have to be funded by: (i) tax receipts; (ii) government borrowing; or (iii) money creation. The analysis presented in this paper shows that tax receipts in Maldives are highly variable. Therefore, if the Maldivian Government wishes to maintain a relatively constant level of government expenditure, it must compensate reductions in tax receipts with government borrowing or increases in the money supply. Hence, the analysis presented in this paper should assist the Maldivian Government in quantifying the extent to which they may have to borrow funds in the future. Such knowledge will be useful in aiding the Government in undertaking sustainable development projects that do not have to be interrupted, thereby improving the efficiency of government development projects.

This is precisely what has happened in the post-tsunami period. According to the Ministry of Tourism of the Government of Maldives, international tourist arrivals declined by 44% during the first 8 months of 2005 as compared with the same period in the preceding year. Furthermore, the average capacity utilization or occupancy rate was only 58% from January through to August 2005, as compared with the first eight months of 2004. The World Bank (2005e) has recently stated that there would be a budget shortfall of USD 96 million due to the decline in tourism, of which one-half would have to be raised locally, with the rest to be raised by international donors and development banks.

The analysis presented in this paper also quantified the potential fall in daily government tax receipts, which affects the ability of the Maldivian Government to service its debt obligations. Hence, potential creditors can use the analysis presented here to decide what should be the appropriate interest rate on loans to the Maldivian Government. Furthermore, VaR thresholds for tourism tax receipts could be incorporated into loan covenants to provide a greater level of protection for financial institutions that might provide loans to the Maldivian Government.

The commercial stability of the tourist resorts owned by local and foreign investors depends significantly on the tourists in residence figures, which will also determine the capacity utilisation rate. Working capital, as obtained in the form of an overdraft facility, is required for the smooth operation of these facilities. An extremely large negative shock, such as the 2004 Indian Ocean Tsunami, would reduce the asset value of some resorts below the constant debt level, which is the total amount borrowed to finance the purchase of the asset. Following the 2004 Tsunami, 19 resorts in the Maldives were closed completely due to extensive damage. In order to recover their asset value, certain occupancy or capacity utilisation rates would have to be achieved.

The VaR analysis presented in this paper could be used by resort operators in a ‘Real Options’ framework. Resort operators have the option to shut down, either wholly or in part, as this choice can help to minimise losses. Therefore, VaR thresholds have value and can be priced using identical principles as in the case of financial options. In pricing financial options, a crucial input is the volatility of the underlying asset which, in the case of tourist resorts, is the number of tourists in residence. Hence, modelling the conditional volatility of tourists in residence will aid resort operators in deciding whether to remain open, shut down a portion of the resort, or shut down operations in their entirety. Therefore, managing Value-at-Risk should assist significantly in achieving optimal risk management strategies.

References

Basel Committee on Banking Supervision (1988), International Convergence of Capital Measurement and Capital Standards, BIS, Basel, Switzerland.

Basel Committee on Banking Supervision (1995), An Internal Model-Based Approach to Market Risk Capital Requirements, BIS, Basel, Switzerland.

Basel Committee on Banking Supervision (1996), Supervisory Framework for the Use of "Backtesting" in Conjunction with the Internal Model-Based Approach to Market Risk Capital Requirements, BIS, Basel, Switzerland.

Black, F. (1976), Studies of Stock Market Volatility Changes, *Proceedings of the American Statistical Association*, *Business and Economics Statistics Section*, pp. 177-181.

Bollerslev, T. (1986), Generalized Autoregressive Conditional Heteroscedasticity, *Journal of Econometrics*, 31, 307-327.

Chan, F., S. Hoti, M. McAleer and R. Shareef (2005), Forecasting International Tourism Demand and Uncertainty for Barbados, Cyprus and Fiji, in A. Lanza, A. Markandya and A. Pigliaru (eds.), *Tourism and Sustainable Economic Development: Macro and Micro Economic Issues*, Edward Elgar, United Kingdom, pp. 30-55.

Chan, F., C. Lim and M. McAleer (2005), Modelling Multivariate International Tourism Demand and Volatility, *Tourism Management*, 26, 459-471.

Domroes, M. (1985), Tourism Resources and Their Development in Maldives Islands, *GeoJournal*, 10, 119-126.

Domroes, M. (1989), Tourism in the Maldives: The Potential of Its Natural Attraction and Its Exploitation, *Applied Geography and Development*, 36, 61-77.

Domroes, M. (1993), Maldivian Tourist Resorts and their Environmental Impact, in P.P. Wong (ed.), *Tourism Vs Environment: The Case for Coastal Areas,* Kluwer Academic Publishers, The Netherlands, pp. 69-82.

Domroes, M. (1999), Tourism in the Maldives: The Resort Concept and Tourist Related Services, *Insula: International Journal of Island Affairs*, 8, 7-14.

Engle, R.F. (1982), Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation, *Econometrica*, 50, 987-1007.

Glosten, L.R., R. Jagannathan, and D.E. Runkle (1993), On the Relation Between the Expected Value and Volatility of the Nominal Excess Return on Stocks, *Journal of Finance*, 46, 1779-1801.

Hoti, S. and M. McAleer (2004), An Empirical Assessment of Country Risk Ratings and Associated Models, *Journal of Economic Surveys*, 18(4), 539-588.

Hoti, S. and M. McAleer (2005), *Modelling the Riskiness in Country Risk Ratings*, Contributions to Economic Analysis, Volume 273, Elsevier, Amsterdam.

Hoti, S., M. McAleer and R. Shareef (2005), Modelling Country Risk and Uncertainty in Small Island Tourism Economies, *Tourism Economics*, 11(2), 159-183.

Jorion, P. (2000), *Value at Risk: The New Benchmark for Managing Financial Risk*, McGraw-Hill, New York.

Li, W.K., S. Ling and M. McAleer (2002), Recent Theoretical Results for Time Series Models with GARCH Errors, *Journal of Economic Surveys*, 16, 245-269. Reprinted in M. McAleer and L. Oxley (eds.), *Contributions to Financial Econometrics: Theoretical and Practical Issues*, Blackwell, Oxford, pp. 9-33.

McAleer, M. (2005), Automated Inference and Learning in Modeling Financial Volatility, *Econometric Theory*, 21, 232-261.

McAleer, M., R. Shareef and B. da Veiga (2005), ST@R: A Model of Sustainable Tourism@Risk, Unpublished paper, School of Economics and Commerce, University of Western Australia.

Ministry of Planning and National Development (2005), 25 Years of Statistics - Maldives, Government of Maldives, pp. 447.

Nicolau, J.L. (2005), Leveraging Profit from the Fixed-Variable Cost Ratio: The Case of New Hotels in Spain, *Tourism Management*, 26(1), 105-111.

Raab, C. and R.K. Schwer (2003), The Short- and Long-term Impact of the Asian Financial Crisis on Las Vegas Strip Baccarat Revenues, *International Journal of Hospitality Management*, 22(1), 37-45.

Shareef, R. (2004), *Modelling the Volatility in International Tourism Demand and Country Risk in Small Island Tourism Economies*, Unpublished PhD Dissertation, University of Western Australia, Perth, Australia, pp. 440.

Shareef, R. and M. McAleer (2005), Modelling the Uncertainty in International Tourist Arrivals to the Maldives, to appear in *Tourism Management*.

World Bank (2005a), Tsunami: Impact and Recovery, Joint Needs Assessment World Bank-Asian Development Bank-UN System. http://siteresources.worldbank.org/INTMALDIVES/Resources/mv-na-full-02-14-05.pdf

World Bank (2005b), Counting the Cost: Rebuilding Lives and Property in India after the Tsunami.

http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EXTTSUNAMI/0,,contentMDK:20326347~menuPK:621586~pagePK:64168445~piPK:64168309~theSitePK:621037,00.html

World Bank (2005c), Indonesia: Preliminary Damage and Loss Assessment, The 26 December 2004 Natural Disaster. http://siteresources.worldbank.org/INTINDONESIA/Resources/Publication/280016-1106130305439/damage_assessment.pdf

World Bank (2005d), Counting the Cost: A first look at what it will take to rebuild lives. http://www.worldbank.lk/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/SRILANKAEXTN/0,,contentMDK:20342271~pagePK:141137~piPK:141127~theSitePK:233047,00.html.

World Bank (2005e), Maldives: Tackling a Budget Crisis. http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20668908~pagePK:64257043~piPK:437376~theSitePK:4607,00.html

Figure 1: Daily Tourist Arrivals

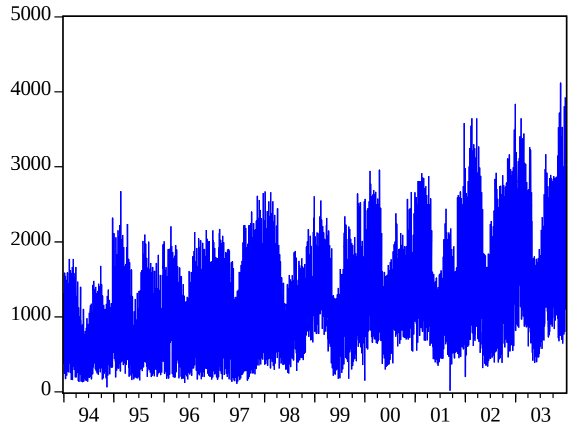

Figure 2: Weekly Tourist Arrivals

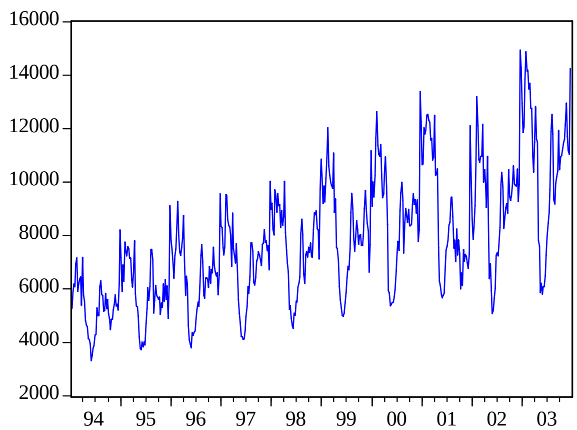

Figure 3: Daily Tourists in Residence

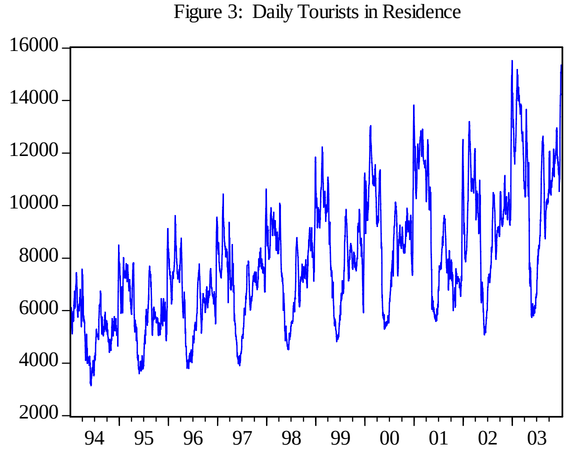

Figure 4: Growth Rates in Daily Tourist Arrivals

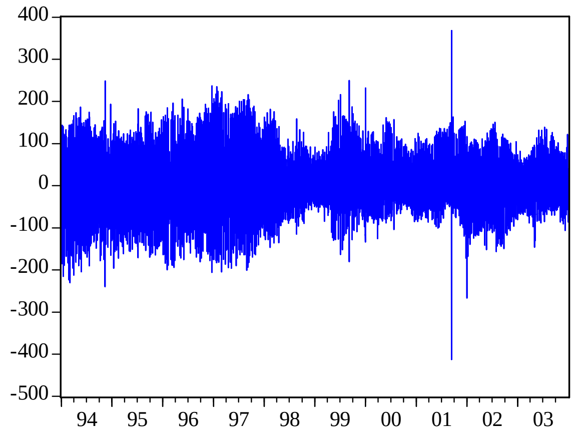

Figure 5: Growth Rates in Weekly Tourist Arrivals

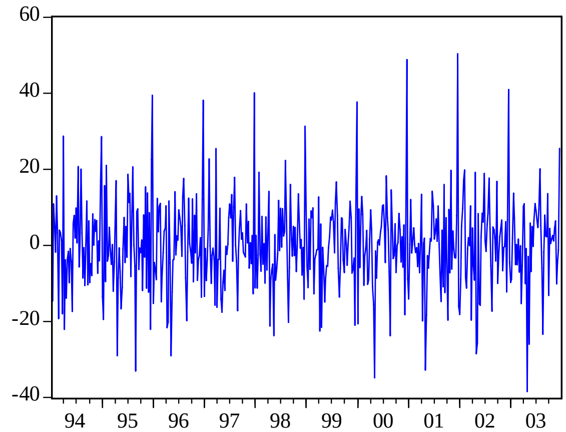

Figure 6: Growth Rates in Daily Tourists in Residence

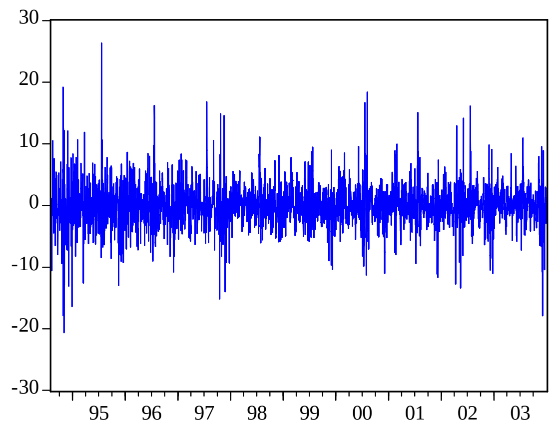

Figure 7: GJR Variance Forecasts for Tourists in Residence

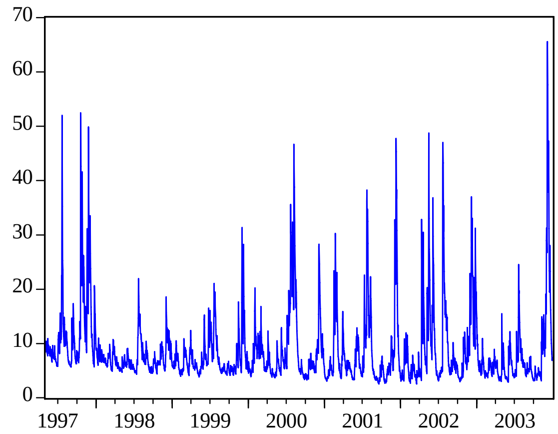

Figure 8: GARCH Variance Forecasts for Tourists in Residence

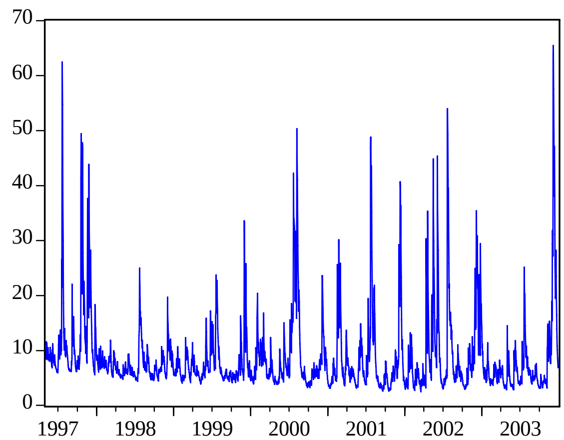

Figure 9: Growth Rates for Tourist in Residence and GJR VaR Thresholds

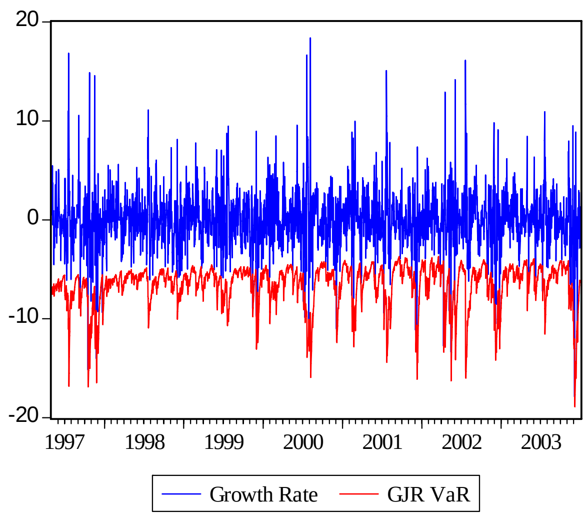

Figure 10: Growth Rates for Tourists in Residence and GARCH VaR Thresholds

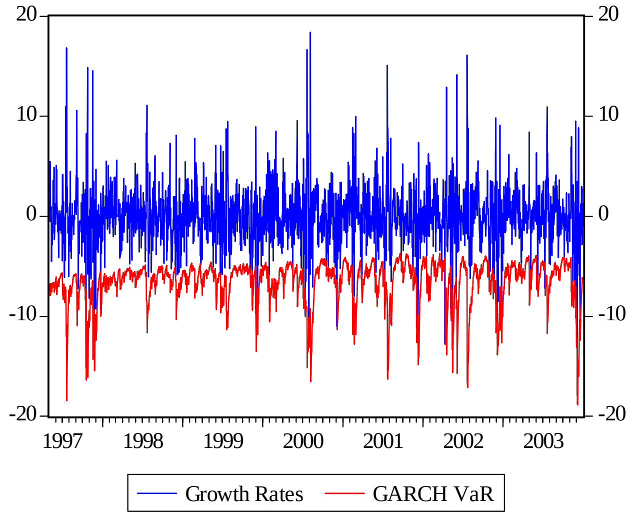

Figure 11: Rolling Second Moment Condition for GJR

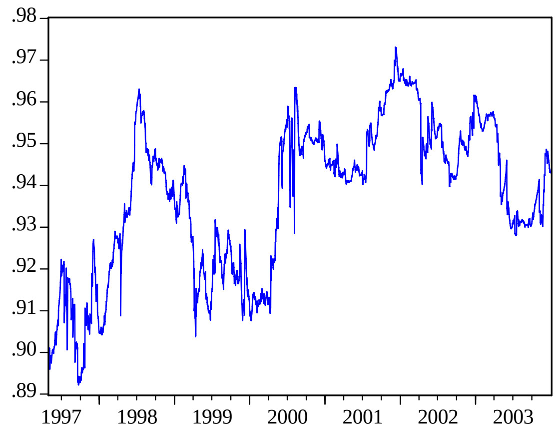

Figure 12: Rolling Second Moment Condition for GARCH