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# The Impacts of the Real Exchange Rate on the Volatility of International Tourist Arrivals to Thailand

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ABSTRACT

International tourism has an important role in Thailand's economy. This is because it can bring in a great amount of tourism revenue. Therefore, the promotion of the tourism industry is regarded as an important part of government policies. In fact, many factors such as political issue and the economic crisis, can affect a large number of international tourists. In this study, the real exchange rate is used because it has pervasive effects on the tourist budget. And it is considered to be a significant variable for the number of international tourist arrivals.

In this study, we will evaluate the change in the real exchange rate and its impact upon the volatility of international tourist arrivals to Thailand by using GARCHX model and GJR-X model.

International tourists are divided into three types which are short haul, medium haul and long haul. Malaysian tourists represent short haul tourists. Japanese tourists represent medium haul tourists and British and American tourists represent long haul tourists.

For the GARCHX model and GJR-X, the change in the real exchange rate can impact the volatility of Japanese tourist arrivals to Thailand. But this does not have an impact on the volatility of Malaysian, British and American tourist arrivals to Thailand.

Finally, we can conclude that the change in the real exchange rate impact only the volatility of medium haul tourists, not short and long haul tourists. There are significantly negative relationships between the real exchange rate and the volatility. If the real exchange rate increases, the volatility of medium haul tourists will decrease. If the real exchange rate decreases, the volatility of medium haul tourists will definitely increase.

## 1. Introduction

International tourism has experienced an overwhelming boom over the last two decades and has been called the largest industry in the world. Despite this positive outcome the rate of growth has varied unevenly from year to year.

In 2007, the growth of international tourists around the world was 6%, with 898 million international tourists (higher than in 2006, the growth of world tourism expanded by 5.5%). This was partly the result of the emergence of new destinations in Asia-Pacific, Africa, and Middle East regions. There were many obstacles to international travelling, such as increased expenses due to higher fuel cost, variance of currency exchange rates, as well as issues of economic stability, terrorism, unpredictable weather and epidemics.

International tourist arrivals to Thailand in 2007 experienced moderate growth at the rate of 4.65%, constituting 14,464,228 tourists. These figures were the result of political problems in the country which included several bombings in Bangkok and peripheral areas on New Year's Eve 2006. This brought on concerns over safety, especially in the East Asian market. Although these incidents did not have an impact on other regions' markets, there were also other factors which discouraged international inbound visits, such as the USA's economic downturn, unpredictable weather and terrorism in Europe. All of these problems resulted in a lower number of international tourists arrivals to Thailand during the first to the third quarter of the year than expected. However, in the fourth quarter the figures of inbound visitors recovered almost comparable with the target. Therefore, most markets had a higher growth rate as follows: Oceania (+16.59), South Asia (+13.27%), Middle East (+11.84%), Africa (+11.16), Europe (+11.08), and East Asia (+0.49%), whilst the US experienced a lower rate (-0.92%). The preliminary receipts from international tourist arrivals were 547,782 million baht, a 13.57% increase compared with the previous year. (Annual report of Tourism Authority of Thailand, 2007, 1)

## Situation of International Tourist Arrivals to Thailand

### East Asia:

The East Asian region had a very low growth rate with a total of 7,981,205 inbound tourists and a growth rate of 0.49%, only higher than that of the US region, since it was quite sensitive to crises, such as the several bombings in Bangkok and peripheral areas during the New Year celebrations. Therefore in the first half of 2007 the number of tourist arrivals decreased at a rate of 3.63%, which affected China, Hong Kong, Japan, Malaysia, Singapore, South Korea, Taiwan and Vietnam Markets. However, those markets' growth rate gradually adjusted to be positive in the second half of 2007, owing to the fact that political conflicts began to unravel and active market promotion was encouraged in many areas. As a result, almost all markets grew positively with a 4.47% increase in growth rate.

### Europe:

There were 3,689,770 inbound visitors with quite a high tourism growth rate of 11.08%, even though the slowdown remained from the second to the third quarter due to anxiety over safety after the bombings in the United Kingdom. In addition, this situation influenced the decision for most travelers to postpone their long-haul journeys, preferring to travel within the home region instead. However, the tourism situation recovered during the fourth quarter after people's anxiety decreased and global warming became one of the major social issues. The outstanding growing markets included East Europe, Russia, and Scandinavia. The main markets of Thailand, including Germany and France, still continued to grow while the United Kingdom market's growth rate was quite stable compared with the previous year.

### The Americas:

There were 817,564 inbound tourists, dropping 0.92% due to the USA's economic downturn during the second and the third quarter of the year, and the weak US dollar. It resulted in a decrease in the number of tourist arrivals in the North America market, the main market in the region including the USA and Canada with a decreasing growth rate of 2.66% and 0.1%, respectively. However, the situation recovered during the fourth quarter after people's anxiety was relieved and the government launched measures to deal with the country's economic crisis.

**Thailand:**

International tourists are divided into three types which are short haul, medium haul and long haul. Malaysian tourists represent short haul tourists. Japanese tourists represent medium haul tourists. And UK tourists and USA tourists represent long haul tourists.

This study covers conditional volatility of all tourist groups by taking changes in the real exchange rate into consideration. The reason is that the real exchange rate has a great effect upon international tourism demand.

According to the definition, the real exchange rate can be defined in the long run as the nominal exchange rate $(e)$ that is adjusted by the ratio of the foreign price level $(P_f)$ to the domestic price level $(P)$. Mathematically, it can be shown as

The Real Exchange Rate $(REER) = e\frac{P_f}{P}$

## 2. Tools for study and literature review

### 2.1 Unit root tests:

### 2.1.1 Augmented Dickey and Fuller tests

To test for the long run frequency, Dickey and Fuller (1979) proposed a procedure based on the following auxiliary regression:

$$\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{j=1}^{k} \gamma_j \Delta y_{t-k} + \varepsilon_t \quad (1.1)$$

where $\Delta y_t = (1-L)$ designates the first different filter, $\varepsilon_t$ is the error term and $\alpha$, $\beta$ and $\delta$ are the parameters to be estimated.

### 2.1.2 Phillips and Perron Tests

The Phillips-Perron test is a unit root test. It is used in time series analysis to test the null hypothesis that a time series is I (1). It builds on the Dickey-Fuller test, but unlike the Augmented Dickey-Fuller test, which extends the Dickey-Fuller test by including additional lagged variables as regressors in the model on which the test is based, the Phillips-Perron test makes a non-parametric correction to the t-test statistic to capture the effect of autocorrelation present when the underlying autocorrelation process is not AR(1) and the error terms are not homoscedastic.

### 2.2 Volatility Analysis

**For analyzing the volatility**, we use econometrics as follows:

### 2.2.1 Conditional Mean Model

The conditional mean model is to the autoregressive moving average, or ARMA (p, q) model that is proposed by Box-Jenkins (1970) combining the AR (p) and MA (q). Such a model states that the current value of some series $y$ depends linearly on its own previous values plus a combination of current and previous values of a white noise error term. The model could be written:

$$\beta(L) y_t = \mu + \theta(L)\mu_t \quad (1.2)$$

where

$\beta(L) = 1 - \beta_1 L - \beta_2 L^2 - \cdots - \beta_p L^p$ and

$\theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \cdots + \theta_q L^q$

or

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_p y_{t-p} + \mu_t + \theta_1 \mu_{t-1} + \theta_2 \mu_{t-2} + \cdots + \theta_q \mu_{t-q}, \quad (1.3)$$

with

$E(\mu_t) = 0$ ; $E(\mu_t^2) = \sigma^2$ ; $E(\mu_t \mu_s) = 0, t \neq s$

where $y_t, y_{t-1}, ..., y_{t-p}$ represent the current and lagged growth rate of tourist arrivals, $p$ is the lag length of the AR error term, and $q$ is the lag length of the MA error term.

If there are the seasonal effects, it will be the seasonal autoregressive moving average, or SARMA$(P,Q)_T$, model is given below:

$$y_t = \alpha + \beta_T y_{t-T} + \beta_{2T} y_{t-2T} + \cdots + \beta_{PT} y_{t-PT} + \mu_t + \theta_T \mu_{t-T} + \theta_{2T} \mu_{t-2T} + \cdots + \theta_{QT} \mu_{t-QT}, \quad (1.4)$$

where $y_t, y_{t-T}, ..., y_{t-PT}$ represent the current and lagged growth rate of tourist arrivals, $P$ is the lag length of the SAR error term, and $Q$ is the lag length of the SMA error term.

The series is described by an AR integrated MA model or ARIMA $(p,d,q)$ when $y_t$ is replaced by $\Delta_1^d y_t$ and an SAR integrated SMA model or SARIMA $(P,D,Q)_T$ when $y_t$ is replaced by $\Delta_1^D y_t$.

When we already construct the conditional mean model, after that we will construct the conditional volatility model latter.

### 2.2.2 Conditional Volatility Model

In this paper, we use the symmetric Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model of Bollerslev (1986) to measure the risk from growth of number of tourist arrivals.

The GARCH (p, q) model is given as $(i)\ Y_t = E(Y_t|F_{t-1}) + \varepsilon_t$ where $(ii)\ \varepsilon_t = h^{1/2}\eta_t$,

$$(iii)\ h_{it} = \omega_i + \sum_{l=1}^{p} \alpha_i \varepsilon_{i,t-1}^2 + \sum_{l=1}^{q} \beta_i h_{i,t-1} \quad (1.5)$$

And the asymmetric GJR model of Glosten, Jagannathan and Runkle (1992), which discriminates between positive and negative shocks to the tourist arrivals series, will be used to forecast the required conditional volatilities.

The GJR (p, q) model is given as $(i)\ Y_t = E(Y_t|F_{t-1}) + \varepsilon_t$ where $(ii)\ \varepsilon_t = h^{1/2}\eta_t$,

$$(iii)\ h_{it} = \omega_i + \sum_{l=1}^{p} (\alpha_i \varepsilon_{i,t-1}^2 + \gamma I(\eta_{i,t}) \varepsilon_{i,t-1}^2) + \sum_{l=1}^{q} \beta_i h_{i,t-1} \quad (1.6)$$

$$(iv)\ I(\eta_{i,t}) = 1, \varepsilon_{i,t} \le 0 \quad and \quad = 0, \varepsilon_{i,t} > 0$$

where $F_t$ is the information set variable to time t, and $\eta : iid(0,1)$. The four equations in the model state the following: (i) the growth in tourist arrivals depends on its own past values; (ii) the shock to tourist arrivals has a predictable conditional variance component, $h_t$, and an unpredictable component, $\eta_t$; (iii) the conditional variance depends on its own past values and the recent shocks to the growth in the tourist arrivals series; and (iv) the conditional variance is affected differently by positive and negative shocks to the growth in tourist arrivals.

For the GARCHX (p, q) model, we added an external factor such as real exchange rate, therefore:

$$h_{it} = \omega_i + \sum_{l=1}^{p} \alpha_i \varepsilon_{i,t-1}^2 + \sum_{l=1}^{q} \beta_i h_{i,t-1} + \delta X_i \quad (1.7)$$

where $X_i$ denotes external variables i.e. real exchange rate

For the GARCHX (1, 1) to be stationary, we need

$$\alpha_1 + \beta_1 < 1 \quad (1.8)$$

This model is called the GARCHX model since the constant in the GARCH models is replaced by an extra variable or extra term; for example, the real exchange rate. The GARCHX model is also a generalized version model by Braun, Nelson, and Sunier (1995) and Glosten, Jagannathan, and Runkle (1993). The GARCHX model may be considered a simplified version of Connor and Linton (2001).

For the GJR-X (p, q) model, we added an external factor such as real exchange rate, therefore:

$$h_{it} = \omega_i + \sum_{l=1}^{p} (\alpha_i \varepsilon_{i,t-1}^2 + \gamma I(\eta_{i,t}) \varepsilon_{i,t-1}^2) + \sum_{l=1}^{q} \beta_i h_{i,t-1} + \delta X_i \qquad (1.9)$$

$$I(\eta_{i,t}) = 1, \varepsilon_{i,t} \le 0 \quad and \quad = 0, \varepsilon_{i,t} > 0$$

where $X_i$ denotes external variables i.e. the real exchange rate

For the GJR-X (1, 1) to be stationary, we need

$$\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1 \qquad (1.10)$$

In equations (1.7) and (1.9), the parameters are typically estimated by the maximum likelihood method to obtain Quasi-Maximum Likelihood Estimators (QMLE) in the absence of normality of $\eta_t$, the conditional shocks (or standardized residuals). The conditional log-likelihood function is given as follows:

$$\sum_{t=1}^{n} \ell_t = -\frac{1}{2} \sum_{t=1}^{n} \left( \log h_t + \frac{\varepsilon_t^2}{h_t} \right)$$

The QMLE is efficient only if $\eta_t$ is normal, in which case it is the MLE. When $\eta_t$ is not normal, the adaptive estimation can be used to obtain efficient estimators, although this can be computationally intensive. Ling and McAleer (2003b) investigated the properties of adaptive estimators for univariate non-stationary ARMA models with GARCH (*r, s*) errors. The extension to multivariate processes is very complicated.

Besides, we hardly apply the GARCHX model and the GJR-X model to analyze the international tourist arrivals. This model is mostly used to analyze financial volatility. Therefore, by applying the GARCHX model and the GJR-X model to analyze the international tourist arrivals is very interesting.

### 2.3 Literature Review

In studies of the impact of other factors on the volatility, GARCHX models was introduced by Apergis (1998) to investigate how short-run deviations from the relationship between stock prices and certain macroeconomic fundamentals affect stock market volatility. In the Apergis model, the squared past error-correction term which represents the short run deviations is added to the GARCH conditional volatility.

Soosung Hwang (2001) introduced a simple new conditional volatility model called GARCHX using the cross-sectional market volatility. The model was simple, but could be used to explain the proportion of market volatility included in individual stock volatility. Using data of the UK and US markets, this consisted of individual asset returns included in the FTSE350 and the S&P500. Daily log-returns are calculated from 11 December 1989 to 9 December 1999. He found that in more than three-quarter of cases, the maximum likelihood values of the GARCHX (1, 1) model were larger than those of the GARCHX (1, 1) model and the coefficients on the cross-sectional market volatility were significant. Therefore, individual stock volatility seemed to be better specified with the inclusion of additional cross-sectional market volatility. Finally, he found that the proportion of the market volatility in an individual stock's conditional volatility ranges from 12% to 16%.

From details of literature reviews, we can conclude that because there were several external factors affecting volatility. Therefore, Apergis (1998) introduced GARCHX (1, 1) models to investigate how short-run deviations from the relationship between stock prices and certain macroeconomic fundamentals affect stock market volatility. Finally, Soosung Hwang (2001) introduced GARCHX using the cross-sectional market volatility. Their results also show that the GARCHX (1, 1) and the asymmetric GJR-X (1, 1) models provide an accurate measure of risk like the GARCH (1, 1) and the asymmetric GJR (1, 1).

In study from literature review, we will estimate and forecast by using the GARCHX (1, 1) and GJR-X (1, 1) in the conditional volatility model.

## 3. Objective of this Study

To study whether the change in the real exchange rate has any effect toward the volatility of international tourist arrivals or not.

## 4. Data Collection

Based on the above methodology, we can divide data collection as follows: we used the secondary data from 1985 to 2009. The data used to measure the independent and dependent variables are from the Tourism Authority of Thailand (TAT), the Bank of Thailand (BOT) and the Immigration Bureau (Police Department).

Note, there are three important dips in the tourism activities in the periods of 1991, 1997 and 2005, respectively. The first period is due to the negative impact of the Gulf war during 1991. The second is due to the "Tomyumkung" economic crisis during 1997 in which the Asian tourists market seemed to be the most affected. The third period is due to the Tsunami disaster of 2004.

## 5. Unit Root Tests

Standard unit root test based on the methods of Augmented Dickey-Fuller (1979) and Phillips and Perron (1988) are reported in Table 1.1.

The ADF tests for a unit root are used for logarithmic variable series over the full sample period. Note that the ADF tests of the unit root null hypothesis correspond to the following one-sided test:

$$H_0 : \delta = 0$$
$$H_1 : \delta < 0$$

The ADF test results are confirmed by the Phillip-Perron test and the coefficient is significant at the 5% level. The results of the ADF unit root tests are that when the ADF test statistics are compared with the critical values from the nonstandard Dickey-Fuller distribution, the former for all of variable series are less than the critical value at 5% significance level. Thus, the null hypothesis of a unit root is rejected at the 5% level, implying that the series are stationary. By taking first differences of the logarithm of variables, the ADF tests show that the null hypothesis of a unit root is clearly rejected. The ADF statistics for the series are less than the critical value at the 5% significance level. Thus, the first differences of the logarithmic variables are stationary. These empirical results allow the use of these data to estimate conditional mean and conditional volatility model.

## 6. Volatility Model

The number and graph for monthly Malaysian tourist arrivals, monthly Japanese tourist arrivals, monthly UK tourist arrivals, and monthly American tourist arrivals are given in figure 1.1-1.4 and table 1.2-1.4, respectively. All data display degrees of variability and seasonality. The highest levels of tourism arrivals to Thailand occur during the winter season in East Asia, Europe and North America, while the lowest levels occur during in the summer season in East Asia, Europe and North America. The descriptive statistics are given in table 1.3. The monthly Japanese tourist arrivals display the greatest variability with the mean of 69,475.25 arrivals per month, a maximum of 127,334 arrivals per month, and low minimum of 13,745 arrivals per month. The monthly Japanese tourist arrivals have a standard deviation of 30,539.43, which is the highest standard deviation of the others.

As the focus of this paper is not concerned with the behavior of international tourist arrivals to Thailand, but is on the managing the risk associated with the variability in tourist arrivals and the policy to use the real exchange rate to motivate tourism. Therefore; we use the change (growth rate) in the real exchange rate and the change (growth rate) in number of international tourist arrivals to explain the impacts of the real exchange rate on tourism volatility.

Malaysian tourist arrivals, Japanese tourist arrivals, United Kingdom tourist arrivals and American tourist arrivals are given in figures 1.5-1.8, respectively. The descriptive statistics for the growth rates are given in table 1.4. Monthly Malaysian tourist arrivals display the greatest variability, with standard deviation of 26.91%, a maximum of 95.79%, and a minimum of -59.65%. Each of the data is found to be non-normal distributed, based on the Jaque-Bera Lagrange multiplier statistics for normality.

**Table 1.1: the result of unit root tests**

| Variable | ADF Without trend | | PP Without trend | |
|---|---|---|---|---|
| | level | 1st difference | level | 1st difference |
| DNM | -4.7576*** | -12.6245*** | -43.8670*** | -281.2218*** |
| DREM | -18.3016*** | -12.8564*** | -18.3016*** | -236.8453*** |
| DNJ | -5.1206*** | -19.1764*** | -29.2884*** | -152.6287*** |
| DREJ | -11.6645*** | -9.7383*** | -11.5826*** | -91.8884*** |
| DNUK | -3.2006** | -17.9916*** | -18.3043*** | -62.9643*** |
| DREUK | -12.4235*** | -10.4795*** | -12.3958*** | -169.0407*** |
| DNUS | -4.5376*** | -17.0839*** | -24.4447*** | -41.1062*** |
| DREUS | -18.8233*** | -11.7248*** | -18.8460*** | -324.7082*** |

Notes:
1. DNM denotes the growth rate of Malaysian tourist arrivals, DREM denotes the growth rate of Malaysia's real exchange rate, LNJ denotes the growth rate of Japanese tourist arrivals, LREJ denotes the growth rate of Japan's real exchange rate, LNUK denotes the growth rate of United Kingdom tourist arrivals, LREUK denotes the growth rate of United Kingdom's real exchange rate, LNUS denotes the growth rate of American tourist arrivals and LREUS denotes the growth rate of USA's real exchange rate.
2. *** denotes the null hypothesis of a unit root is rejected at the 1% level.
** denotes the null hypothesis of a unit root is rejected at the 5% level.

**Table 1.2: Accumulation of the number of tourist arrivals to Thailand**

| Accumulation of Malaysia tourist arrivals (1979-2009) | Accumulation of Japanese tourist arrivals (1979-2009) | Accumulation of United Kingdom tourist arrivals (1979 -2009) | Accumulation of American tourist arrivals (1979-2009) |
|---|---|---|---|
| 25,975,942 | 20,587,357 | 8,793,307 | 9,140,592 |

**Table 1.3: Descriptive Statistics (monthly arrivals**

| Statistics | Malaysian (1985-2009) | Japanese (1985-2009) | UK (1985-2009) | American (1985-2009) |
|---|---|---|---|---|
| Mean | 84,581.67 | 69,474.25 | 30,377.21 | 30,574.87 |
| Median | 80,959.50 | 66,835.50 | 25,039.50 | 26,849.00 |
| Maximum | 182,982 | 127,334 | 86,210 | 67,176 |
| Minimum | 21,454 | 13,745 | 5,153 | 9,893 |
| Std. Dev. | 28,934.77 | 30,539.43 | 18,082.67 | 13,042.02 |
| Skewness | 0.7338 | -0.0061 | 0.7081 | 0.6650 |
| Kurtosis | 3.5056 | 1.8716 | 2.6931 | 2.5628 |
| Jarque Bera | 27.7088 | 14.6452 | 24.1499 | 22.5402 |
| Probability | 0.000001 | 0.00066 | 0.000006 | 0.000013 |

**Table 1.4: Descriptive Statistics for Growth Rate (monthly arrivals)**

| Statistics | Malaysian (1985-2009) | Japanese (1985-2009) | United Kingdom (1985-2009) | American (1985-2009) |
|---|---|---|---|---|
| Mean | 4.0549 | 2.3363 | 2.5390 | 2.0728 |
| Median | 1.1012 | 2.0238 | 1.7849 | -0.9065 |
| Maximum | 95.7910 | 49.2124 | 68.5057 | 85.3883 |
| Minimum | -59.6501 | -44.2007 | -48.0262 | -40.8867 |
| Std. Dev. | 26.9133 | 18.8799 | 18.0955 | 17.6721 |
| Skewness | 0.5279 | 0.0449 | 0.3468 | 1.2696 |
| Kurtosis | 3.3509 | 2.6287 | 3.4739 | 5.7943 |
| Jarque-Bera | 14.1880 | 1.6780 | 8.0866 | 163.3566 |
| Probability | 0.0008 | 0.4347 | 0.0175 | 0.0000 |

**Figure 1.1: Monthly Malaysian tourist arrivals from 1985-2009**

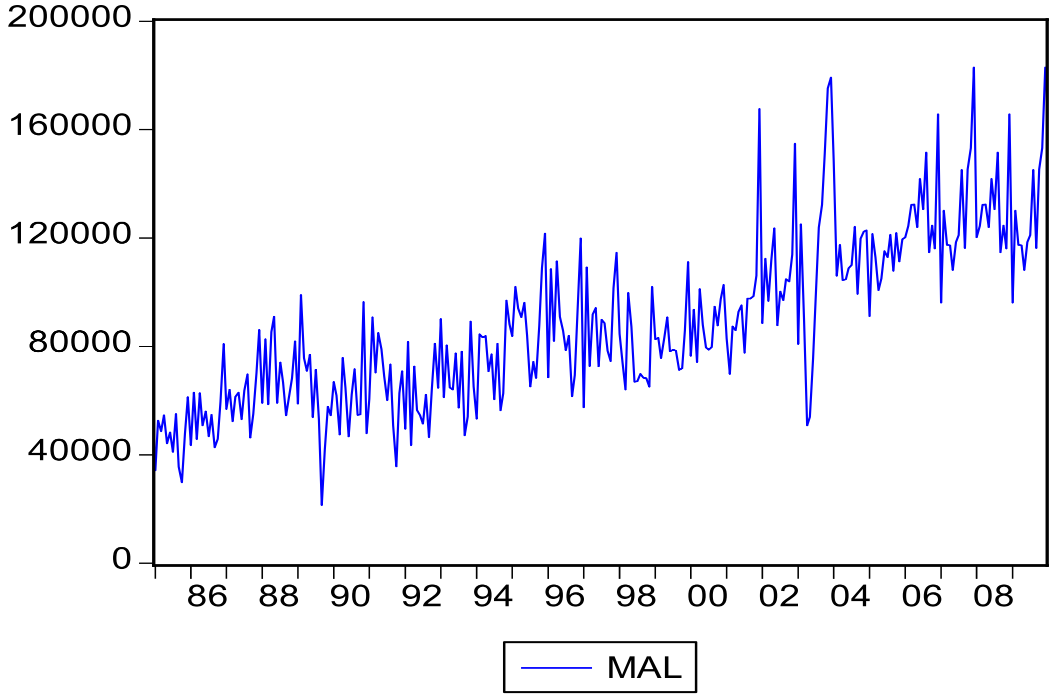



**Figure 1.2: Monthly Japanese tourist arrivals from 1985-2009**

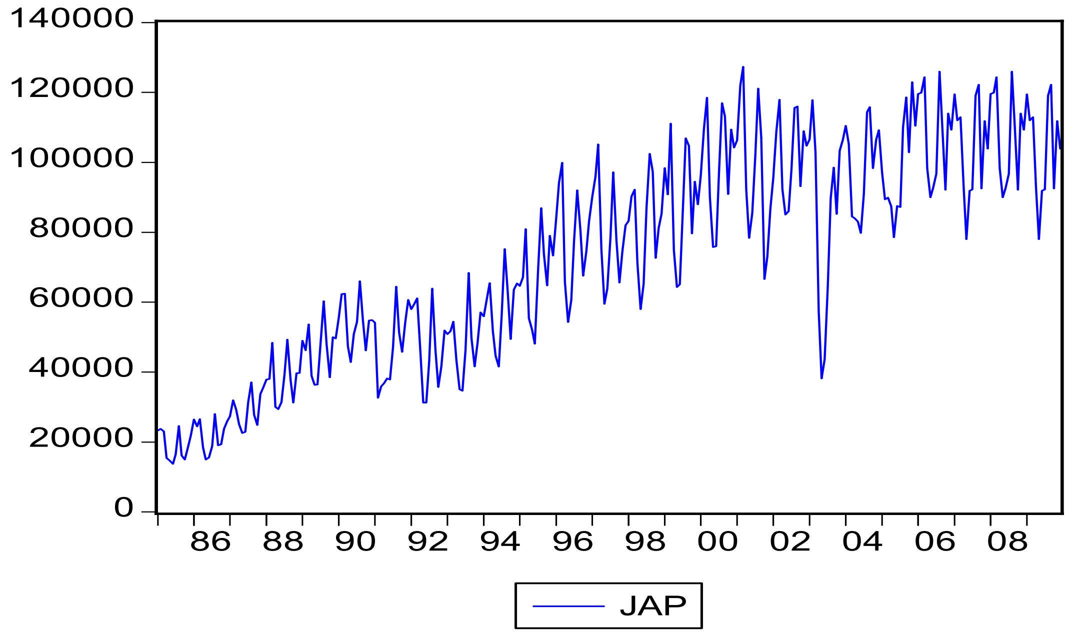


**Figure 1.3: Monthly UK tourist arrivals from 1985-2009**

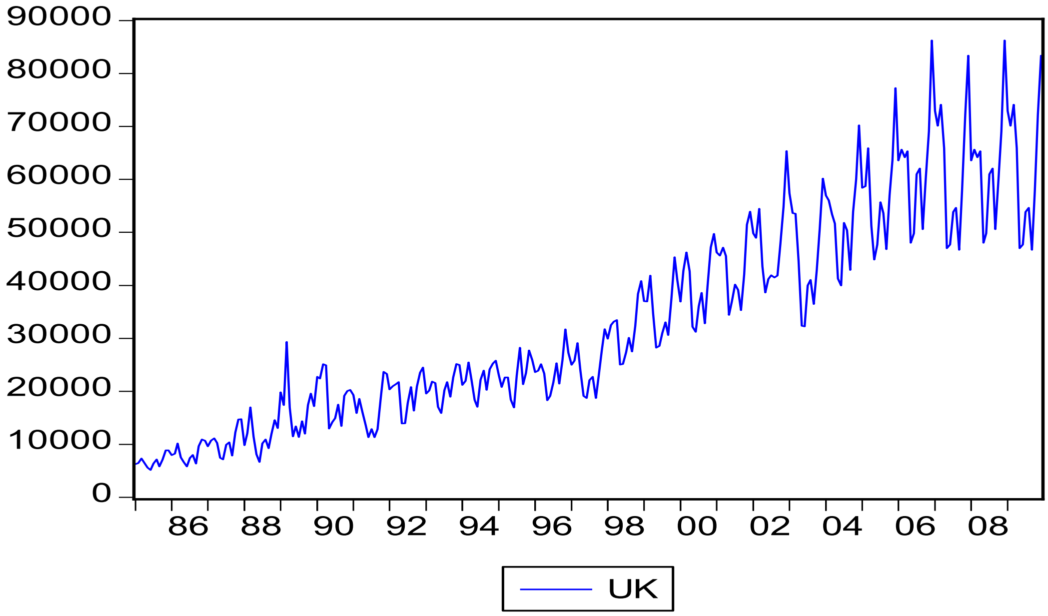



**Figure 1.4: Monthly American tourist arrivals from 1985-2009**

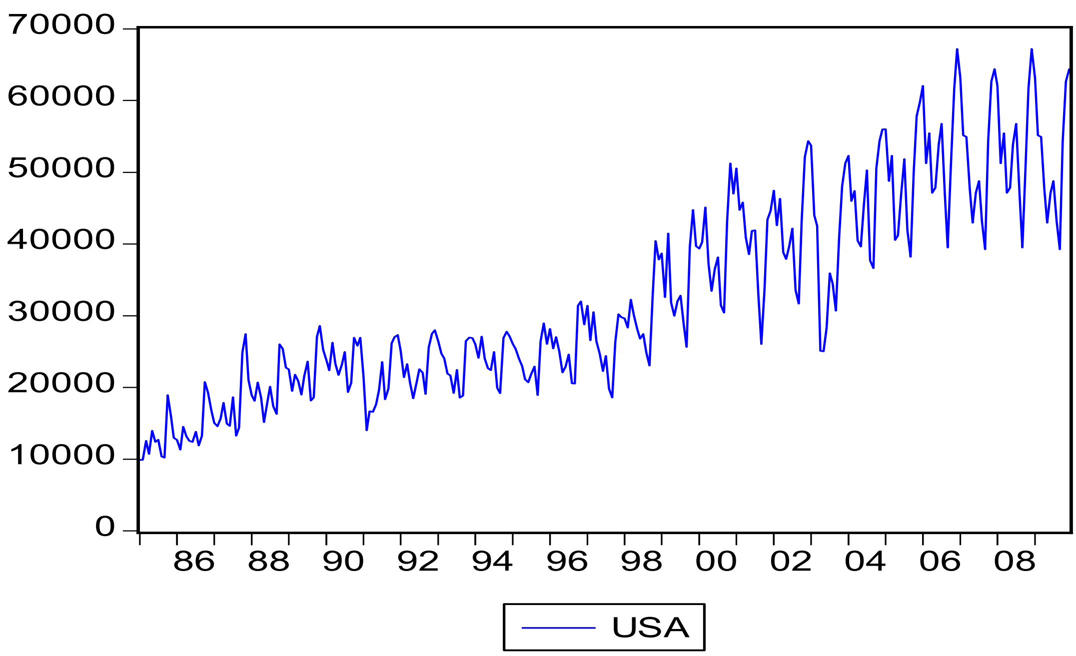


**Figure 1.5: Monthly Malaysian tourist arrival growth rates from 1985-2009**

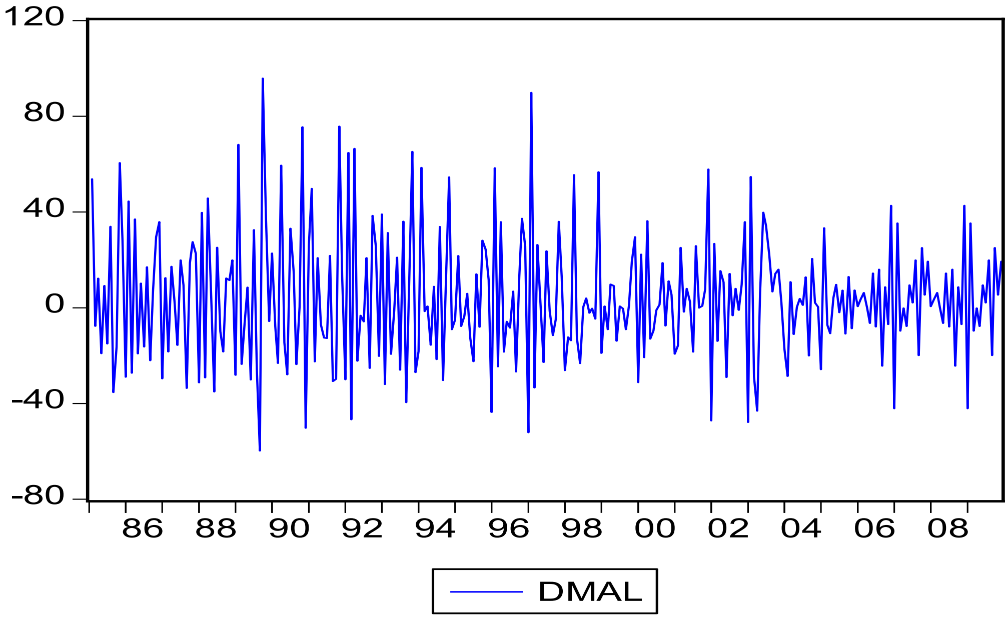



**Figure 1.6: Monthly Japanese tourist arrival growth rates from 1985-2009**

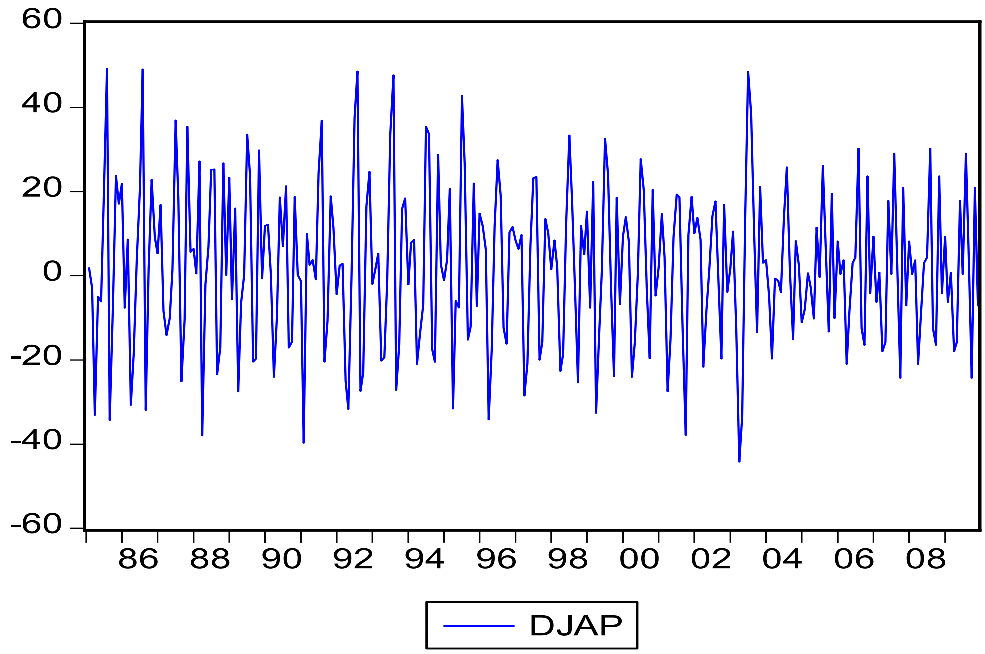


**Figure 1.7: Monthly UK tourist arrival growth rates from 1985-2009**

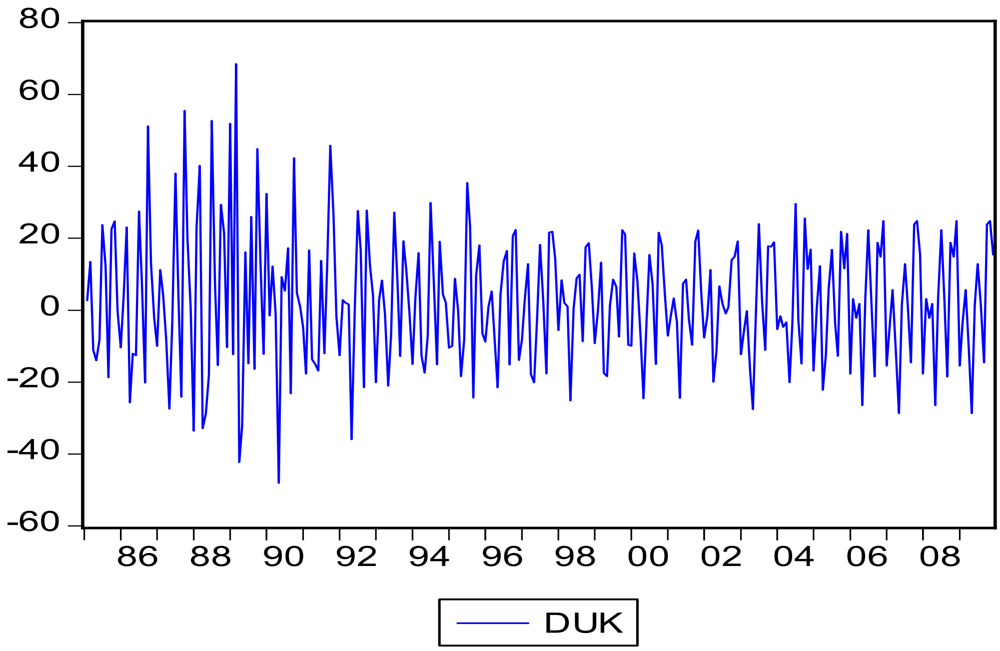
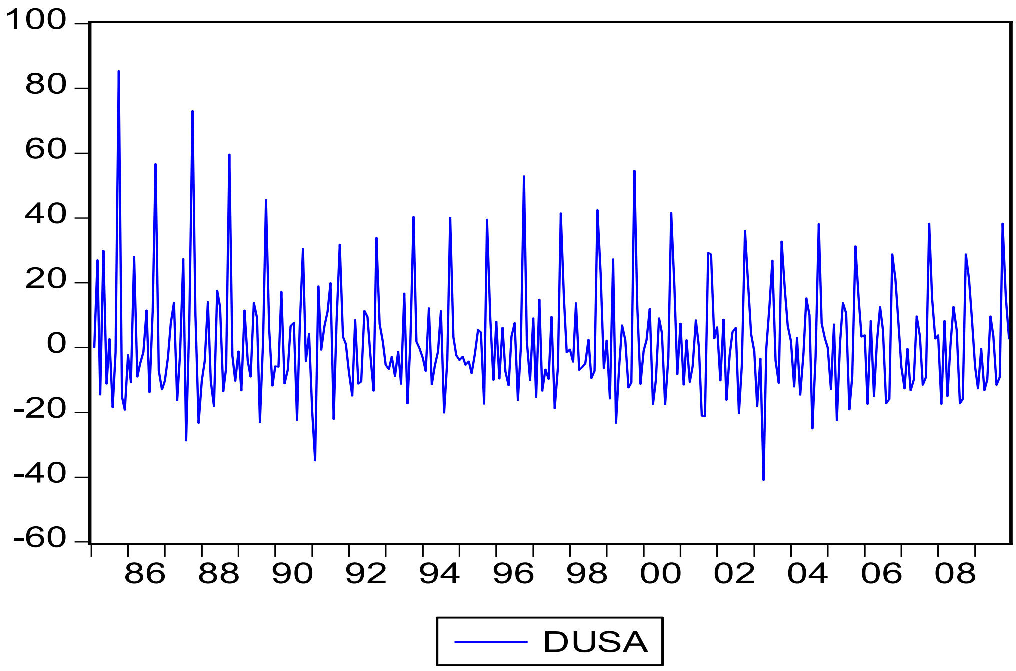



**Figure 1.8: Monthly American tourist arrival growth rates from 1985-2009**




## 7. ARMA or SARMA models for conditional mean model

Since the ADF test procedures show that the tourist arrival growth rate series are integrated of order zero, $I(0)$, the latter is used to estimate the Box-Jenkins models. The autoregressive moving average, or ARMA$(p,q)$ model and the seasonal autoregressive moving average, or SARMA $(P,Q)_T$ are used in conditional mean estimation.

Table 1.5 presents the results of ARMA model for monthly Malaysian tourist arrival growth rates, model is given below:

**Table 1.5: ARMA model for growth rates in monthly Malaysian tourist arrivals**

| Variable | Coefficient | t-Statistic | AIC/BIC | LM(SC) |
|---|---|---|---|---|
| C | 3.841 | 4.491 | AIC=8.977 | *F*=2.721 |
| AR(1) | -0.503 | -8.729 | BIC=9.045 | *p*=0.410 |
| AR(2) | -0.229 | -4.079 | | |
| AR(7) | -0.102 | -2.092 | | |
| AR(12) | 0.296 | 5.903 | | |

Table 1.6 presents the results of ARMA model for monthly Japanese tourist arrival growth rates, model is given below:

Table 1.7 presents the results of SARMA model for monthly UK tourist arrival growth rates, model is given below:

**Table 1.6: ARMA model for growth rates in monthly Japanese tourist arrivals**

| Variable | Coefficient | t-Statistic | AIC/BIC | LM(SC) |
|---|---|---|---|---|
| C | 2.433 | 3.940 | AIC=8.476 | *F*=0.495 |
| AR(2) | -0.350 | -6.522 | BIC=8.516 | *p*=0.482 |
| AR(3) | -0.286 | -5.315 | | |

**Table 1.7: SARMA model for growth rates in monthly UK tourist arrivals**

| Variable | Coefficient | t-Statistic | AIC/BIC | LM(SC) |
|---|---|---|---|---|
| C | 2.354 | 4.075 | AIC=7.720 | *F*=1.076 |
| AR(6) | -0.918 | -35.603 | BIC=7.775 | *p*=0.342 |
| SAR(6) | 0.653 | 13.552 | | |
| MA(1) | -0.455 | -8.197 | | |

Table 1.8 presents the results of SARMA model for monthly American tourist arrival growth rates, model is given below:

**Table 1.8: SARMA model for growth rates in monthly American tourist arrivals**

| Variable | Coefficient | t-Statistic | AIC/BIC | LM(SC) |
|---|---|---|---|---|
| C | 1.220 | 0.477 | AIC=7.729 | *F*=0.094 |
| AR(1) | -0.181 | -2.971 | BIC=7.329 | *p*=0.092 |
| SAR(12) | 0.812 | 25.551 | | |

We use the two most commonly model selection criteria are the Akaike Information Criterion (AIC) and the Schwarz Baysian Criterion (BIC), with the decision to base the model choice being to select the model for which the appropriate criterion smallest.

For ensuring that the estimated residuals do not have serial correlation at the 5% significance level, we use the Breusch-Godfrey Lagrange multiplier test of serial correlation, LM (SC). It can be used to test for higher-order ARMA or SARMA errors, and is applicable in the presence of lagged dependent variables. Using the Lagrange multiplier test, if the computed $F$ statistic exceeds the critical value at 5% level, this leads to the rejection of the null hypothesis of no serial correlation.

Furthermore, the computed $F$ statistics for the LM (SC) test are all less than the critical value. Thus, the null hypothesis of no serial correlation is not being rejected for these models.

## 8. GARCHX and GJR-X for conditional volatility model

In this section, the growth rates in tourist arrivals and real exchange rates are used to estimate the GARCHX (1, 1) model and the GJR-X model. All estimations were conducted using Eviews 5.1. The models are estimated using QMLE for the case p=q=1 in table 1.9-1.10.

The estimated GARCHX (1, 1) equation of monthly growth rates in Malaysian tourist arrivals is given as follows:

$$h_t = \underset{(18.128)}{25.546} + \underset{(0.050)}{0.102}\,\varepsilon_{t-1}^{2} + \underset{(0.075)}{0.843}\,h_{t-1} - \underset{(0.316)}{0.021}\,drm$$

where $drm$ is the growth rates in the real exchange rate of Malaysia

The estimated GARCHX (1, 1) model of monthly growth rates in Malaysian tourist arrivals to Thailand shows short run persistence lies at 0.102, while the long run persistence lies at 0.945. As the respective estimates of the second moment conditions, $\alpha_1 + \beta_1 < 1$ for GARCHX (1, 1), are satisfied. The QMLE are consistent and asymptotically normal. This means that the estimate is statistically adequate and sensible for the purpose of interpretation. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1, 1) equation for monthly growth rates in Malaysian tourist arrivals is given as follows:

$$h_t = \underset{(22.325)}{35.302} + \underset{(0.049)}{0.010}\,\varepsilon_{t-1}^{2} + \underset{(0.147)}{0.273}\,I\varepsilon_{t-1}^{2}$$

$$+ \underset{(0.079)}{0.807}\,h_{t-1} - \underset{(0.275)}{0.185}\,drm$$

The asymmetry coefficient is found to be positive and significant for the GJR-X (1, 1) model, namely 0.010, which indicates that decreases in monthly Malaysian tourist arrivals to Thailand increase volatility. As the respective estimates of the second moment conditions, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ for GJR-X (1, 1) and where the figures in parentheses are standard errors, indicating that the model provides an adequate fit to the data. As $\alpha_1 + \gamma_1 > \alpha_1$, it appears that volatility is affected asymmetrically by positive and negative shock, with previous negative shocks having a greater impact on volatility than previous positive shocks of a similar magnitude. Finally, the change in the real exchange rate is insignificant

The estimated GARCHX (1, 1) equation of monthly growth rates in Japanese tourist arrivals is given as follows:

$$h_t = \underset{(0.255)}{0.601} + \underset{(0.001)}{0.040}\,\varepsilon_{t-1}^{\;2} + \underset{(7.06E-05)}{0.945}\,h_{t-1} - \underset{(0.109)}{0.828}\,drj$$

where *drj* is the growth rates in the real exchange rate of Japan

The estimated GARCHX (1, 1) model of monthly growth rates in Japanese tourist arrivals to Thailand shows the short run persistence lies at 0.040, while the long run persistence lies at 0.985. As the respective estimates of the second moment conditions, $\alpha_1 + \beta_1 < 1$ for GARCHX (1, 1), are satisfied. The QMLE are consistent and asymptotically normal. This means that the estimate is statistically adequate and sensible for the purpose of interpretation. Finally, the change in the real exchange rate is negative and significant. It shows that when the real exchange rate increases, volatility will definitely decrease.

The estimated GJR-X (1, 1) equation for monthly growth rates in Japanese tourist arrivals is given as follows:

$$h_t = \underset{(51.191)}{563.163} + \underset{(0.036)}{0.134}\,\varepsilon_{t-1}^{\;2} - \underset{(0.039)}{0.068}\,I\varepsilon_{t-1}^{\;2}$$

$$+ \underset{(0.029)}{0.852}\,h_{t-1} - \underset{(4.617)}{1.522}\,drj$$

The asymmetry coefficient is found to be positive and significant for the GJR-X (1, 1) model, namely 0.134, which indicates that decreases in monthly Japanese tourist arrivals to Thailand increase volatility. As the respective estimates of the second moment conditions, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ for GJR-X (1, 1) and where the figures in parentheses are standard errors, indicating that the model provides an adequate fit to data. As $\alpha_1 + \gamma_1 < \alpha_1$, it appears that volatility is affected asymmetrically by positive and negative shock, with previous positive shocks having a greater impact on volatility than previous negative shocks of a similar magnitude. Finally, the change in the real exchange rate is insignificant.

The estimated GARCHX (1, 1) equation of monthly growth rates in United Kingdom tourist arrivals is given as follows:

$$h_t = \underset{(2.589)}{3.446} + \underset{(0.053)}{0.143}\,\varepsilon_{t-1}^{\;2} + \underset{(0.064)}{0.835}\,h_{t-1} + \underset{(0.977)}{0.957}\,druk$$

where *druk* is the growth rates in the real exchange rate of UK

The estimated GARCHX (1, 1) model of monthly growth rates in British tourist arrivals to Thailand shows the short run persistence lies at 0.143, while the long run persistence lies at 0.978. As the respective estimate of the second moment conditions, $\alpha_1 + \beta_1 < 1$ for GARCHX (1, 1), are satisfied. The QMLE are consistent and asymptotically normal. This means that the estimate is statistically adequate and sensible for the purpose of interpretation. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1, 1) equation for monthly growth rates in United

Kingdom tourist arrivals is given as follows:

$$h_t = \underset{(294.894)}{269.025} + \underset{(0.086)}{0.013}\,\varepsilon_{t-1}^{2} - \underset{(0.117)}{0.223}\,I\varepsilon_{t-1}^{2}$$

$$+\underset{(0.6375)}{0.475}\,h_{t-1} - \underset{(14.120)}{7.181}\,druk$$

The asymmetry coefficient is found to be positive and significant for the GJR-X (1, 1) model, namely 0.013, which indicates that decreases in monthly British tourist arrivals to Thailand increase volatility. As the respective estimates of the second moment conditions, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ for GJR-X (1, 1) and where the figures in parentheses are standard errors, indicating that the model provides an adequate fit to the data. As $\alpha_1 + \gamma_1 < \alpha_1$, it appears that volatility is affected asymmetrically by positive and negative shock, with previous positive shocks having a greater impact on volatility than previous negative shocks of a similar magnitude. Finally, the change in the real exchange rate is insignificant.

The estimated GARCHX (1, 1) equation of monthly growth rates in American tourist arrivals is given as follows:

$$h_t = \underset{(6.441)}{9.688} + \underset{(0.047)}{0.086}\,\varepsilon_{t-1}^{2} + \underset{(0.099)}{0.797}\,h_{t-1} - \underset{(0.262)}{0.098}\,drus$$

where *drus* is the growth rates in the real exchange rate of USA

The estimated GARCHX (1, 1) model of monthly American tourist arrivals to Thailand shows the short run persistence lies at 0.086, while the long run persistence lies at 0.883. As the respective estimate of the second moment conditions, $\alpha_1 + \beta_1 < 1$ for GARCHX (1, 1), are satisfied. The QMLE are consistent and asymptotically normal. This means that the estimate is statistically adequate and sensible for the purpose of interpretation. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1, 1) equation for monthly growth rates in American tourist arrivals is given as follows:

$$h_t = \underset{(27.798)}{109.694} + \underset{(0.181)}{0.303}\,\varepsilon_{t-1}^{2} - \underset{(0.161)}{0.269}\,I\varepsilon_{t-1}^{2}$$

$$+\underset{(0.273)}{0.432}\,h_{t-1} + \underset{(0.451)}{0.028}\,drus$$

The asymmetry coefficient is found to be positive and significant for the GJR-X (1, 1) model, namely 0.303, which indicates that decreases in monthly American tourist arrivals to Thailand increase volatility. As the respective estimates of the second moment conditions, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ for GJR-X (1, 1) and where the figures in parentheses are standard errors, indicating that the model provides an adequate fit to the data. As $\gamma_1$ is estimated significant and $\alpha_1 + \gamma_1 < \alpha_1$, it appears that volatility is affected asymmetrically by positive and negative shock, with previous positive shocks having a greater impact on volatility than previous negative shocks of a similar magnitude. Finally, the change in the real exchange rate is insignificant.

### 8.1 Forecasting

The forecast accuracies statistics were produced using Eviews 5.1 and are presented in table 1.11. Their forecasting performances are compared between the GARCHX model and the GJR-X models using the root mean squared error (RMSE). The estimated values of the RMSE show that the GARCHX model generates relatively accurate tourism volatility forecasts except for the Japan and the USA volatility, and the GJR-X model generates relatively accurate tourism volatility forecasts except for the Malaysia and the UK volatility.

**Table 1.9: Estimated GARCHX Models**

| Parameters | GARCHX | | | |
|---|---|---|---|---|
| | Malaysian | Japanese | UK | American |
| $\omega$ | 25.546* | 0.601** | 3.446* | 9.688* |
| | (18.128) | (0.255) | (2.589) | (6.441) |
| $\alpha$ | 0.102** | 0.041* | 0.143*** | 0.086* |
| | (0.050) | (0.001) | (0.053) | (0.047) |
| $\beta$ | 0.843*** | 0.945* | 0.835*** | 0.797*** |
| | (0.075) | (7.06E-05) | (0.064) | (0.099) |
| $\delta$ | -0.021 | -0.828* | 0.957 | -0.098 |
| | (0.316) | (0.109) | (0.977) | (0.262) |
| **Diagnostics** | | | | |
| Second moment | 0.945 | 0.986 | 0.978 | 0.883 |
| AIC | 8.924 | 8.453 | 7.498 | 7.290 |
| BIC | 9.046 | 8.546 | 7.606 | 7.386 |

Notes:
Numbers in parentheses are standard error.
The log-moment condition is necessarily satisfied as the second the moment condition is satisfied.
AIC and BIC denote the Akaike Information Criterion and Schwarz Criterion, respectively.
*** denotes the estimated coefficient is statistically significant at 1%.
** denotes the estimated coefficient is statistically significant at 5%.
* denotes the estimated coefficient is statistically significant at 10%.

**Table 1.10: Estimated GJR-X Models**

| Parameters | GJR-X | | | |
|---|---|---|---|---|
| | Malaysian | Japanese | UK | American |
| $\omega$ | 35.302* | 563.163*** | 269.025* | 109.694*** |
| | (22.325) | (51.191) | (294.894) | (27.798) |
| $\alpha$ | 0.010* | 0.134*** | 0.013* | 0.303* |
| | (0.049) | (0.036) | (0.086) | (0.181) |
| $\gamma$ | 0.207* | -0.068* | -0.223* | -0.269* |
| | (0.147) | (0.039) | (0.117) | (0.161) |
| $\beta$ | 0.807*** | 0.852*** | 0.475* | 0.432* |
| | (0.079) | (0.029) | (0.638) | (0.273) |
| $\delta$ | -0.185 | -1.522 | -7.181 | 0.028 |
| | (0.275) | (4.617) | (14.120) | (0.451) |
| **Diagnostics** | | | | |
| Second moment | 0.921 | 0.952 | 0.376 | 0.600 |
| AIC | 8.915 | 8.451 | 8.563 | 7.307 |
| BIC | 9.051 | 8.557 | 8.686 | 7.416 |

Notes:
Numbers in parentheses are standard errors.
The log-moment condition is necessarily satisfied as the second the moment condition is satisfied.
AIC and BIC denote the Akaike Information Criterion and Schwarz Criterion, respectively.
*** denotes the estimated coefficient is statistically significant at 1%.
** denotes the estimated coefficient is statistically significant at 5%.
* denotes the estimated coefficient is statistically significant at 10%.

**Table 1.11: the Forecasting Results**

| **Countries** | **Malaysia** | | **Japan** | | **UK** | | **USA** | |
|---|---|---|---|---|---|---|---|---|
| Model | GARCHX | GJR-X | GARCHX | GJR-X | GARCHX | GJR-X | GARCHX | GJR-X |
| RMSE | 25.938 | 26.087 | 18.845 | 18.825 | 14.472 | 18.057 | 14.089 | 14.086 |

## 9. Conclusion

The monthly number of international tourist arrivals to Thailand and their associated growth rates for the period 1985-2009 were analyzed. The main purpose is to analyze and compare the volatility among major tourists of Thailand such as Malaysian tourists and Japanese tourists including British and American tourists by considering with the real exchange rate and also use the GARCHX model and the GJR-X model.

Besides, we hardly apply the GARCHX model and the GJR-X model to analyze the international tourist arrivals. This model is mostly used to analyze financial volatility. Therefore; by applying the GARCHX model and the GJR-X model to analyze the international tourist arrivals is very interesting.

We can divide the tourists into 3 groups (1) short haul such as Malaysian tourists (2) medium haul such as Japanese tourists and (3) long haul such as British and American tourists.

The estimated GARCHX (1, 1) model of monthly growth rates in Malaysian tourist arrivals to Thailand shows the short run persistence lies at 0.102, while the long run persistence lies at 0.945. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1, 1) equation for monthly growth rates in Malaysian tourist arrivals reflects the asymmetry coefficient is found to be positive and significant for GJR-X (1, 1) model, namely 0.010, which indicates that decreases in monthly Malaysian tourist arrivals to Thailand increase volatility.

The estimated GARCHX (1, 1) model of monthly growth rates in Japanese tourist arrivals to Thailand reflects the short run persistence lies at 0.040, while the long run persistence lies at 0.985. Finally, the change in the real exchange rate is negative and significant. It shows that when the real exchange rate increases, volatility will definitely decrease.

The estimated GJR-X (1, 1) equation for monthly growth rates in Japanese tourist arrivals shows the asymmetry coefficient is found to be positive and significant for the GJR-X (1, 1) model, namely 0.134, which indicates that decreases in monthly Japanese tourist arrivals to Thailand increase volatility. Finally, the change in the real exchange rate is insignificant.

The estimated GARCHX (1, 1) model of monthly growth rates in British tourist arrivals to Thailand shows the short run persistence lies at 0.143, while the long run persistence lies at 0.978. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1,1) equation for monthly growth rates in British tourist arrivals shows the asymmetry coefficient is found to be positive and significant for the GJR-X (1,1) model, namely 0.013, which indicates that decreases in monthly British tourist arrivals to Thailand increase volatility. Finally, the change in the real exchange rate is insignificant.

The estimated GARCHX (1, 1) model of American tourist arrivals to Thailand shows the short run persistence lies 0.086, while the long run persistence lies at 0.883. Finally, the change in the real exchange rate is insignificant.

The estimated GJR-X (1,1) equation for monthly American tourist arrivals shows the asymmetry coefficient is found to be positive and significant for the GJR-X (1,1) model, namely 0.303, which indicates that decreases in monthly American tourist arrivals to Thailand increase volatility. Finally, the change in the real exchange rate is insignificant.

As there are forecasting performances between the GARCHX model and the GJR-X model using the root mean squared error (RMSE), the estimated values of the RMSE show that the GARCHX model generates relatively accurate tourism volatility forecasts except for the Japan and USA volatility, and GJR-X model generate relatively accurate tourism volatility forecasts except for the Malaysia and UK volatility. Moreover, the change in the real exchange rate impacts only the volatility of Japanese tourists, not Malaysian, British and American tourists.

Finally, we can conclude that the change in the real exchange rate impact only the volatility of medium haul tourists, not short and long haul tourists. There are significantly negative relationships between the real exchange rate and the volatility. If the real exchange rate increases, the volatility of medium haul tourists will decrease. If the real exchange rate decreases, the volatility of medium haul tourists will definitely increase.

## References


Amy, Y.F. Tan, McCahon, C., and Miller, J., 2002, Stability of inbound tourism demand model for Indonesia and Malaysia the pre and post-formation of tourism development organizations. Journal of hospitality and tourist research, 3, 361-378.

Athanasopoulos, G., and Hyndman, R.J., 2008, Modeling and forecasting Australian domestic tourism. Journal of Tourism Management, 29, 19-31.

Barry K., O'Hagan, J.W., 1972, An econometric Study of British Tourist Expenditure in Ireland Economic and Social Review, 3 (2), 143-161.

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

Box, G.E.P., and Jenkins, G.M., 1976, Time series analysis, forecasting and control. San Francisco, CA: Holden Day.

Brooks, C., 2004, Introduction Econometrics for Finance. Cambridge University Press, Cambridge.

Chan, F., Lim, C., and McAleer, M., 2005, Modeling Multivariate International Tourism Demand and Volatility. Journal of Tourism Management, 26, 301-479.

Chu, F.L., 1998, Forecasting Tourist Arrivals. Journal of Travel Research, 36, 79-84.

Chu, F.L., 2008, A fractional integrated autoregressive moving average approach to forecasting tourism demand. Journal of Tourism Management, 29,79-88.

Crouch, G.I., 1994, The Study of International Tourism Demand: a Survey of Practice. Journal of Travel Research, 32 (4), 41-55.

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

Enders, W., 2004, Applied Econometric Time Series. John Wiley & Son, New Jersey.

Frances, P. H., 1998, Time Series Models for Business and Economics Forecasting. Cambridge University Press, Cambridge.

Ghysels, E., and Osborn, D.R., 2001, The Econometric Analysis of Seasonal Time Series. Cambridge University Press, Cambridge.

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

Gray, H.P., 1966, The demand for international travel by the United State and Canada. International Economic Review, 13, 83-92.

Greene, W.H., 2000, Econometric Analysis. Prentice-Hall, Upper Saddle River, New Jersey.

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

Jeffrey, P. and Y. Xie (1995), The UK market for Tourism in China, Annals of Tourism Research, 22, 857-876

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

Kliman, M.L., 1981, A quantitative analysis of Canadian overseas tourism. Transportation Research, 15A (6), 487-497.

Lim, C., 1997, Review of International Tourism Demand Model. Journal of Tourism Research, 24, 835-849.

Lim, C., 2004, The major determinants of Korean outbound travel to Australia. Mathematics and Computers in Simulation, 64, 477-485.

Lim, C., and McAleer, M., 2000, Seasonal Analysis of Asian Tourist Arrivals to Australia. Journal of Applied Economics, 32, 499-509.

Lim, C., and McAleer, M., 2005, Analyzing the Behavior Trends in Tourist Arrivals from Japan. Journal of Travel Research, 43, 414-421.

Muňoz, T.G., 2006, Inbound international tourism to Canary Islands: a dynamic panel data model. Tourism Management, 27, 281-291.

Narayan, P.K., 2004, Fiji tourism demand: the ARDL approach to cointegration. Tourism Economics, 10 (2), 193-206.

Ouerfelli, C., 2008, Co-integration analysis of quarterly European tourism demand in Tunisia. Journal of Tourism Management, 29, 127-137.

Pesaran, M.H., 1997, The role of economic theory in modeling the long run. Economic Journal, 107, 178–191.

Phillips, P.C.B., and Ouliaris, S., 1990, Asymptotic properties of residual based tests for cointegration. Econometrica, 58, 165–193.

Shin, Y., 1994, A residual based test of the null of cointegration against the alternative of no cointegration. Econometric Theory, 10, 91–115.

Song H., and Witt, S.F., 2000, Tourism Demand Modeling and Forecasting: Modern Econometric Approaches. Elsevier Science, UK.

Song, H., and Witt, S.F., 2003, Tourism forecasting: the general-to-specific approach. Journal of Travel Research, 42, 65-74.

Uysal, M., and Crompton, J.L., 1984, The demand for international tourist flows to Turkey. Tourism Management, 5, 288-297.

Witt, S. F., and Martin, C. A., 1987, Econometrics models for forecasting international tourism demand. Journal of Travel Research, 23-30.

Witt, S. F., and Witt, C., 1995, Forecasting tourism demand: A review of empirical research. International Journal of Forecasting, 11 (3), 447-475.

Yu, L., 1992, Emerging markets for China's tourism industry. Journal of Travel Research, 31 (1), 10-13.