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# ON TESTS FOR LONG MEMORY PROCESS BEHAVIOR OF INTERNATIONAL TOURISM MARKET: THAILAND AND INDIA

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**Abstract:** In our research we examine the behaviour of both Thailand's and India's international tourism market by using long-memory analysis. The international tourism market of Thailand combined with seven groups such as East Asia, Europe, The Americas, South Asia, Oceania, Middle East and Africa. Similarly, the international tourism market of India combined with nine countries: USA, UK, Canada, Germany, France, Japan, Malaysia, Australia and Sri Lanka. Moreover, three statistical tests for long-memory process such as R/S test, Modified R/S test and GPH-test are employed to study these markets. The empirical findings in general provide more support for long memory process in international tourism market of Thailand and evidence for short-term dependence in international tourism market of India. Therefore, the policy makers of each country should understand the behaviour of long memory process in international tourism market before launching any stimulating campaign to this industry.

**Key words:** Thailand, India, Long-memory process, Tourism Market

## 1. INTRODUCTION

Time series with long memory process were appeared in many contexts such as financial economics, macroeconomics, hydrology, cardiac dynamics, network traffics, meteorology. Evidence for long memory process was first proposed by *Hurst* (1951) while testing the behaviour of the water levels of the Nile river. In 1971, Mandelbrot was among the first to consider the possibility of long range dependence or long memory process in asset returns. In 1998, *Wright* studied the evidence of long memory in stock returns in many emerging market such as in Korea, Philip-

pines, Greece, Chile and Colombia. Moreover, *Caporale and Gil-Ala* (2002), studied the S&P 500 daily returns and they found that the degree of dependence remains relatively constant overtime, with the order of integration of stock returns fluctuating slightly above or below zero. *Olan et al.* (2002) studied the long memory in stock returns from an international market perspective and also found no evidence for long memory in UK, U.S., Hong Kong, Singapore and Australian stock markets. However, evidence for long memory can be found in the German, Japan's, South Korean and Taiwan stock market. In connection with international tourism the long memory process analysis was begun by

*Gil-Alana* (2005). He examines forecasting properties of short-term arrivals at Auckland international airport and finds that the ARFIMA models outperform the non-ARFIMA ones in practically all case. After that *Chu* (2009) incorporates ARFIMA models into Singapore's tourism forecasting and compares the accuracy of forecasts with those obtained by earlier studies. In many articles authors have not yet tested the long memory process in international tourism market based on R/S Test, Modified R/S Test and GPH Test.

Tourism is a very important industry to Thailand's economy. It contributes to Thailand's gross domestic product (GDP), affects employment, investment, and foreign exchange earnings. In 2003, Thailand ranked the 15th in international tourism receipts (US\$7.9 billion), accounting for 1.7% of the world total or 4.4% of the country's national product (WTO 2005). International tourism is the fastest growing industry in Thailand. The country has continuously experienced the growth in the number of tourists and revenues from the industry. The number of international tourists in Thailand was increased from 7.22 million in 1997 to 13 million in 2005. The revenues were increased from 299 billion baht in 1997 to 450 billion baht in 2005. During 1997–2005, Thailand faced many challenges. For example, the Asian Economic Crisis in 1997, the effect of September 11, 2001, the outbreaks of Severe Acute Respiratory Syndrome (SARS), the US-Iraqi War in 2003, and the Avian Influenza (Bird Flu), the Tsunami in 2004, and high oil prices in 2005.

However, international tourism industry of Thailand is interested from both the government of Thailand and Thailand's private sector of tourism, as the number of international tourists and their expenditures are increasing every year. In 2006, the number of international tourists increased from 13.8 million in this year to 14.4 million in 2007. Moreover, the international tourists' expenditure in Thailand also increased from 482,319 million baht in 2006 to 533,952 million baht in 2007.

Moreover, the Indian international tourism industry is also very interesting because the number of international tourist arrivals to India was increasing every year between 2000 and 2005. In 2000, the number of international tourist arrivals to India was 2.6 million and in 2002 the number of international tourists increased to 2.38 million contributing an income of 2,923 million USD to the Indian economy. In 2004, the number of international tourists increased to 3.46 million and the income increased to 4,769 million USD. The following year there were 3.92 million tourists and the income was 5,731 million USD (*Ministry of Tourism, Government of India* 2010a). As it is clear from the above mentioned information the Indian international tourism industry could have high impact on the Indian economy in the near future. This research would like to test the Long-memory property of international tourism market of Thailand based on data between 1997 and 2009. Our second aim is to test the Long-term dependence of the Indian international tourism market between 1981 and 2007.

## 2. SCOPE OF THIS RESEARCH

Regarding Thailand, the scope of the research covers mostly secondary data from the period 1997–2009. The countries were used for testing the long memory behavior are all the countries have impact on the international tourism industry of Thailand (*Immigration Bureau, Police Department* 2010). The variables used in this research were the numbers of international tourist arrivals to Thailand from the period 1997–2009. Taking India into consideration, the scope of the study covers data from the period of 1981–2007 and mostly secondary data were used. The countries were used for testing the long memory behavior are all the countries have impact on the international tourism industry of India such as USA, UK, Canada, Germany, France, Japan, Malaysia, Australia and Sri Lanka (*Ministry of Tourism, Gov. of India* 2010b). The variables used in this study were the numbers of the Indian international tourist arrivals from the period 1981–2007.

## 3. METHODOLOGY

### 3.1. The research framework of Long Memory Tests

The concept of the long memory process was developed by Harold Edwin Hurst in 1906. He was a young English civil servant, came to Cairo, Egypt, which was then under British rule. As a hydrological consultant, Hurst's problem was to predict how much the Nile flooded from year to year. He developed a test for long-range dependence (Long Memory Test) and found significant long-term correlations among fluctuations in the Nile's outflows and described these correlations in terms of power laws. This statistic is known as the rescaled range, range over standard deviation or R/S statistic. From 1951 to 1956, Hurst published a series of papers describing his findings (*Hurst* 1951). Hurst's rescaled range (R/S) statistic is the range of partial sums of deviations of a time series from its mean, rescaled by its standard deviation. The definition of long memory process can be explained by the so called autocovariance function  $\gamma(k)$ , where  $k$  is the lag parameter. The long-memory process can be defined as follows:

$$\lim_{k \rightarrow \infty} \gamma(k) \sim k^{-\alpha} L(k)$$

where  $0 < \alpha < 1$  and  $L(x)$  is a slowly varying function at infinity. Because  $L(x)$  is a slowly function if  $\lim_{x \rightarrow \infty} L(tx)/L(x) = 1$  (see Embrechts et al. 1997). The degree of long memory is given by the exponent  $\alpha$ ; the smaller the  $\alpha$  is, the longer the memory is. The long memory is also discussed in terms of the Hurst exponent  $H$ , which is simply related to  $\alpha$ . For a long memory process  $H = 1 - \alpha/2$  or  $\alpha = 2 - 2H$ . The short memory processes have  $H = 1/2$ , and the autocorrelation function decays faster than  $k^{-1}$ . A positively correlated long-memory process is characterized by the Hurst exponent in the interval (0.5,1).

### 3.2. Test for Long Memory: R/S Test

The Long Memory test based on R/S test has been developed by *Hurst* (1951) and *Mandelbrot and Wallis* (1969) method allows computing parameter H, which measures the intensity of long rang dependence in time series. The time series of length T is divided into n sub-series of length m. For each sub-series  $m = 1, \dots, n$ , we have to find the mean ( $E_m$ ) and standard deviation ( $S_m$ ), and subtract the sample mean using the formula below:

$$Z_{i,m} = X_{i,m} - E_m, \text{ for } i = 1, \dots, m.$$

After that we could produce a time serie from the sample means as  $W_{i,m} = \sum_{j=1}^i Z_{j,m}$  where  $i = 1, \dots, m$  and the range is calculated as the below given formula:

$$R_m = \max\{W_{1,m}, \dots, W_{n,m}\} - \min\{W_{1,m}, \dots, W_{n,m}\}.$$

The rescaled range is calculated by  $\frac{R_m}{S_m}$  as well as in case of time series R, S and H can be defined according to the formulas below:

where R is the distance covered by the variable, k is a constant and T is the length of the time.

$$R = k \times T^{0.5}$$

where R/S is the rescaled range, m is the number of observations, k is a constant and H is the Hurst exponent, can be applied to a bigger class of time series.

$$\frac{R}{S} = k \times m^H$$

The Hurst exponent can be calculated as:

$$\log(R/S)_m = \log k + H \log m$$

and can be interpreted as:

- If H value = 0.5 then time series follow a random walk and are independent.
- If H value =(0, 0.5) then time series are anti-persistent, process covers only a small distance than in the random walk case.
- If H value =(0.5, 1) then time series are persistent series, process covers bigger distance than a random walk (long memory process).

### 3.3. Test for Long Memory: Modified R/S Test

The modified R/S test is developed from the classical R/S test which was proposed by *Hurst* (1951) while studying hydrological time series of the River Nile. For a return series ( $x_1, x_2, \dots, x_T$ ), *Lo* (1991) refined the classical test by defining (see equation (1))

$$Q_T = \hat{R} / \hat{\sigma}_T^{\hat{q}}(q) \tag{1}$$

where

$$\hat{R} = \text{MAX}_{0 \leq i \leq T} \sum_{t=1}^i (X_t - \bar{X}) - \text{MIN}_{0 \leq i \leq T} \sum_{t=1}^i (X_t - \bar{X})$$

$$\hat{\sigma}_T^{\hat{q}}(q) = \hat{\sigma}^{\hat{q}2} + 2 \sum_{j=1}^q w_j(q) \hat{\gamma}_j^{\hat{q}}$$

$$w_j(q) = 1 - |j/q|,$$

and define that:

$$\hat{\sigma}^{\hat{q}2} = \text{the usual sample variance of data}$$

$$\bar{X} = \text{the mean of data}$$

$$\hat{\gamma}_j^{\hat{q}} = \text{lag } -j \text{ autocovariance for the data and the truncation lag } q \text{ is determined by equation 2}$$

$$q = \text{int} \left[ ((3T)/2)^{1/3} ((2 \hat{\rho}^{\hat{q}})/1 - \hat{\rho}^{\hat{q}2})^{2/3} \right] \tag{2}$$

Where  $\hat{\rho}^{\hat{q}}$  is the first-order sample autocorrelation coefficient and  $\text{int} [ ]$  is the integer function. Under the null hypothesis of no long memory or no long rang dependence, *Lo* (1991) presented that the limiting distribution of the QT statistics in equation (1) is given by the distribution function of the difference between maximum and minimum of Brownian bridge on a unit interval. Therefore, it can easily obtain the p-value of the test.

### 3.4. Test for Long Memory: GPH Test

The GPH Test for Long Memory process was developed by *Geweke and Porter-Hudak* (1983) and they proposed to estimate of the OLS estimator of d from the regression: (equation 3)

$$\ln[I(\xi)] = a - \hat{d} \ln[\sin^2(\frac{\xi \lambda}{2})] + e_{\lambda}, \quad \lambda = 1, \dots, \nu \tag{3}$$

where

$$I(\xi) = \frac{1}{2\pi T} \left| \sum_{t=1}^T e^{it\xi} (x_t - \bar{x}) \right|^2 \tag{4}$$

And the equation 4 is the Periodogram (estimator of spectral density) of x at a frequency ( $\xi$ ) as well as the bandwidth  $\nu$  is chosen such that for  $T \rightarrow \infty$ ,  $\nu \rightarrow \infty$  but  $\frac{\nu}{T} \rightarrow 0$ .

*Geweke and Porter-Hudak* (1983) consider that the power of T has to be within (0.5,0.6) and for the null hypotheses of no long memory process, the slope of regression d equals zero and the usual t-statistics can be employed to perform the test.

## 4. DISCUSSION OF FINDINGS

Table 1 presents the data of Thailand's international tourism industry. For example, the number of international tourists, the average length of stay, the average of tourists' expenditures both per person and per day and the revenue of international tourist arrivals to Thailand from the period of 1997–2007. In 1997, the number of international tourist arrivals to Thailand was 7.22 million and the average length of stay in Thailand was 8.33 days. The majority of tourists have spent 3,671.85 baht averagely per day. Moreover, in the same year Thailand received 220,754 million baht revenue from the tourists. In 2000, the number of international tourist arrivals to Thailand was 9.51 million and most of them have averagely stayed in Thailand for 7.77 days. The majority of them have averagely spent 3,861.19 baht per day. Moreover, in the same year Thailand's revenue was 285,272 million baht in 2006, the number of international tourist arrivals to Thailand was 13.82 million and most of them have averagely stayed in Thailand for 8.62 days. Most of the tourists have averagely spent 4,048.22 baht per day. In the same year Thailand received 482,319 million baht revenue (see more detail of data in *Table 1*).

**Table 1.** The importance of the international tourist arrivals to Thailand during period of 1997–2007

Year	Tourists		Average	Average Expenditure		Revenue	
	Number	Change	Length of Stay	/person/ day	Change	Million	Change
	(Million)	(%)	(Days)	(Baht)	(%)	(Baht)	(%)
1997	7.22	0.41	8.33	3,671.87	-0.92	220,754	0.63
1998	7.76	7.53	8.4	3,712.93	1.12	242,177	9.7
1999	8.58	10.5	7.96	3,704.54	-0.23	253,018	4.48
2000	9.51	10.82	7.77	3,861.19	4.23	285,272	12.75
2001	10.06	5.82	7.93	3,748.00	-2.93	299,047	4.83
2002	10.8	7.33	7.98	3,753.74	0.15	323,484	8.17
2003	10.00	-7.36	8.19	3,774.50	0.55	309,269	-4.39
2004	11.65	16.46	8.13	4,057.85	7.51	384,360	24.28
2005	11.52	-1.15	8.2	3,890.13	-4.13	367,380	-4.42
2006	13.82	20.01	8.62	4,048.22	4.06	482,319	31.29
2007	14.40	4.19	9.00	4,120.00	1.77	533,952	10.70

Source: Office of Tourism Development 2010

In 2007 the number of international tourist arrivals to Thailand was 14.4 million with an average length of stay of 9 days. The average expenditure per day was 4,120.00 baht and Thailand received 533,952 million baht from tourists.

Regarding India, *Table 2* presents the number of international tourists arrived to India during 2003–2007. In 2003 the number of international tourists arrived to India was 2.7 million and in 2004 this number increased to 3.4 million comparing with last year. Moreover, in 2005 the number of international tourist arrivals to India also has increased continuously. In this year the number of tourists came to India was 3.9 million. *Table 2* clearly suggests that the number of

**Table 2.** Number of the international tourist arrivals to India between 2003 and 2007

Months	2003	2004	2005	2006	2007
January	274,215	337,345	385,977	459,489	532,088
February	262,692	331,697	369,844	439,090	498,806
March	218,473	293,185	352,094	391,009	444,186
April	160,941	223,884	248,416	309,208	333,945
May	141,508	185,502	225,394	255,008	267,758
June	176,324	223,122	246,970	278,370	310,104
July	225,359	272,456	307,870	337,332	377,474
August	204,940	253,301	273,856	304,387	360,089
September	191,339	226,773	257,184	297,891	325,893
October	260,569	307,447	347,757	391,399	440,715
November	290,583	385,238	423,837	442,413	510,987
December	319,271	417,527	479,411	541,571	575,148
Total	2,726,214	3,457,477	3,918,610	4,447,167	4,977,193

Source: Ministry of Tourism, Govt of India 2010b

international tourist arrivals to India has increased from year to year. *Table 3* presents the foreign exchange earnings from international tourist arrivals to India during the period of 2005–2007. In 2005 Indian economy received foreign exchange earnings from international tourism industry was 1.5 thousand million US Dollar. Moreover, in 2006 the India's economy received 1.7 thousand million US Dollar as foreign exchange earnings from this industry. Finally the foreign exchange earnings from this industry have increased 2.06 thousand million US Dollar in 2007 (*Table 3*). Based on these data we could clearly confirm that the international tourism industry of India will definitely become the potential industry for the future.

**Table 3.** Foreign exchange earnings from international tourist arrivals to India between 2005 and 2007 (Unit: US \$ Million)

Months	2005	2006	2007
January	532.19	632.43	744.58
February	536.07	594.67	680.41
March	505.74	547.17	636.05
Total	1,574.00	1,774.24	2,061.04

Source: Ministry of Tourism, Govt of India 2010b

### 4.1. The results of various tests for Long Memory Process

*Table 4* shows the results of various tests for long memory process regarding R/S Test, Modified R/S Test and GPH Test of Thailand international tourism market between 1997 and 2009. Several countries are international tourism markets of Thailand. For instance, countries from East Asia, Europe, America, South Asia, Oceania, the Middle East and from Africa (all countries were classified by Office of Tourism Development)

The test results are summarised in *Table 4*. For each test, the test statistics and the corresponding significances are given. If the value of R/S Test, Modified R/S Test and GPH Test are

**Table 4.** Results of Various Tests for Long Memory regarding R/S Test, Modified R/S Test and GPH Test of Thailand's international tourism markets

Area	R/S Test	Modified R/S Test	GPH Test
East Asia	4.3376**	2.2232**	3.3358**
Europe	3.4914**	1.8639*	1.5311
America	4.2419**	2.1439**	2.4942*
South Asia	4.9005**	2.3761**	4.2444**
Oceania	4.8295**	2.27**	4.9631**
Middle East	4.0744**	2.2532**	4.0389**
Africa	3.2821**	1.7812	3.1536**

Source: Own calculation

Null Hypothesis: no long-term dependence or no long memory process.

For GPH test, Null Hypothesis:  $d = 0$ , \* : significant at 5% level, \*\* : significant at 1% level

significant at 1% level or at 5% level then there is a long-term dependence or long memory process in the time series data. Otherwise no long-term dependence or no long memory process exists in the time series data. The empirical results of long memory process analysis based on all three tests proved tourist arrivals from East and South Asian, American countries and countries of Oceania and the Middle East have a long-term dependence or the time series are long memory processes. Tourist arrivals from the European and African countries have not a long-term dependence, because the value of the GPH Test or the Modified R/S Test is not significant at 1% or 5% level.

**Table 5.** Results of Various Tests for Long Memory based on R/S Test, Modified R/S Test and GPH Test of India's international tourism market

Country	R/S Test	Modified R/S Test	GPH Test
USA	2.010*	1.2659	1.4874
UK	2.0402*	1.2838	1.3577
Canada	2.0219*	1.2784	1.5063
Germany	1.1541	1.1392	0.6048
France	1.7879	1.1729	1.0971
Japan	2.1268**	1.3809	1.2209
Malaysia	2.0735*	1.294	1.6528
Australia	2.0369	1.323	1.2145
Sri Lanka	2.1529**	1.4117	1.3119

Source: Own calculation

Null Hypothesis: no long-term dependence or no long memory process.

For GPH test, Null Hypothesis:  $d = 0$ , \* : significant at 5% level, \*\* : significant at 1% level

Concerning India, *table 5* shows the results of various tests for long memory process regarding R/S Test, Modified R/S Test and GPH Test of India's international tourism market between 1981 and 2007. Several countries are international tourism markets of India. For instance, USA, UK, Canada, Germany, France, Japan, Malaysia, Australia and Sri Lanka.

The test results are summarised in Table 5. For each test, the test statistics and the corresponding significances are given. If the value of R/S Test, Modified R/S Test and GPH Test are significant at 1% level or at 5% level then there is a

long-term dependence or long memory process in the time series data. Otherwise no long-term dependence or no long memory process exists in the time series data. The empirical results of long memory process analysis based on both Modified R/S Test and GPH Test proved that all the international tourism markets of India have not a long-term dependence in themselves. Otherwise, based on R/S Test we can claim that most of the international tourism markets have a long memory process in themselves. On the other hand, we could not decide on direction of the arrival changes. However, the Modified R/S Test and GPH test have already confirmed that the international tourism markets of India have not a long-term dependence process in themselves, only the R/S Test has already confirmed that the international tourism markets of India have a long-term dependence process in themselves except Germany, France and Australia.

## 5. CONCLUSIONS AND IMPLICATIONS

Regarding Thailand, various tests have been conducted for studying the long memory property of Thailand's international tourism market between 1997 and 2009. We can conclude that most countries in Thailand's international tourism market have a long-term dependence. The long range dependence means that the information from "today" is not immediately absorbed by the price in the market and investors react with delay to any such information (*Dávid and Baros 2007; Bardos 2008*). This fact implies that the international tourism markets of Thailand are affected by any information slowly (*Chaitip and Chaiboonsri 2009*). This result was similar to the results of the previous empirical studies of long memory process in international tourism market (*Gil-Alana 2005*).

This research also provides various tests for long memory process (R/S Test, Modified R/S Test and GPH Test) to study the international tourism markets of India during the period 1981-2007. The empirical results of this research concluded that most international tourism markets of India are not long memory processes. This fact implies that the international tourism markets of India are affected by any information immediately or quickly. This finding was very different from the results of the previous empirical studies of long memory process in international tourism market (*Gil-Alana 2005; Chaiboonsri and Chaitip 2009*).

Taking Thailand and India into consideration, our results suggest that both the government sector and the private tourism industry sector need to develop both the tourism markets and the tourism products in a better way. In terms of the tourism market development, experts need to launch an active marketing campaign, promoting exclusive culture and natural beauty through every channel especially the internet, and keep high quality of accommodation, restaurants, and services in tourism market as well (*Tóth and Dávid 2010*). In terms of tourism product development, experts need to keep on improving both the quality and management of tourist products in both countries. For example, to develop tourist destinations, provide educational of tourism to people in the tourism industry and decrease the negative image of tourist destinations. Moreover, keeping tourist

destinations clean, beautiful, safety and to protect the environment of tourist destinations. Tourism industry should provide complex packages relating to attractions to visitors (Szabó *et al.* 1999). The private tourism sector and the government tourism sector should maintain good management of tourist destinations. Such as maintaining the amenities of the tourism products, keeping good accessibility, a good image, the right price and the competitiveness of tourism products (Chaiboonsri and Chaitip 2008).

Regarding India, the results suggest that both the Indian government sector and the private tourism industry sector of India need to protect the bad information of this industry and information can not go outside from India to other country. Moreover, the Indian government must promote the policy of international tourists' safety in India more effectively because if the international tourists' safety will be maximized in India then the number of international tourists' arrivals to India will be increased (Dhariwal 2005).

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