A PANEL COINTEGRATION ANALYSIS: AN APPLICATION TO INTERNATIONAL TOURISM DEMAND OF THAILAND

CHUKIAT CHAIBOONSRI, JITTAPORN SRIBOONJIT, THANES SRIWICHAILAMPHAN, PRASERT CHAITIP, SONGSAK SRIBOONCHITTA *

ABSTRACT: *This paper sought to find the long-run relationships between international tourist arrivals in Thailand and economic variables such as GDP, transportation cost and exchange rates during period of 1986 to 2007. Also this paper used five standard panel unit root tests such as LLC (2002) panel unit root test, Breitung (2000) panel unit root test, IPS (2003) panel unit root test, Maddala and Wu (1999) and Choi (2001) panel unit root test and Handri (1999) panel unit root test. Moreover, the panel cointegration test based on Pedroni residual cointegration tests, Kao residual cointegration tests and Johansen fisher panel cointegration test were used to test in panel among the variables. The OLS estimator, DOLS estimator and FMOLS estimator were used to find the long-run relationship of the international tourism demand model for Thailand.*

The long-run results indicated that growth in income (GDP) of Thai's Asia major tourist source markets (Malaysia, Japan, Korea, China, Singapore and Taiwan) have a positive impact on international tourists arrival to Thailand. In addition, the transportation cost of these countries has negative impact on the number of international tourist arrivals to Thailand. Finally Thailand's currency has positive impact on the number of international tourist arrivals to Thailand. Most of findings from this study were consistent with economic theory and the implications of the model can be use for policy making.

* *Ph.D., Researcher at Economic Research Park, Faculty of Economics, Chiang Mai University, Thailand, chukiat1973@yahoo.com*
Assist. Prof., Faculty of Commerce and Accountancy, Thammassat University, Thailand
Assoc. Prof., Faculty of Economics, Chiang Mai University, Thailand
Assoc. Prof., Faculty of Economics, Chiang Mai University, Thailand
Assoc. Prof., Faculty of Economics, Chiang Mai University, Thailand

This paper has already presented at The 3rd Conference Of Thailand Econometric Society 7 - 8 January 2010, Center For Quantitative Analysis, Faculty Of Economics, Chiang Mai University, http://www.econ.cmu.ac.th

KEY WORDS: *Thailand; tourism demand; Panel Unit Root Test; Panel Cointergration Test; long-run relationship*

JEL CLASSIFICATION: *C53, L83*

1. INTRODUCTION

In Thailand international tourism is the fastest growing industry and the earnings from international tourism in Thailand have increased substantially, rising from 220 billion baht in 1997 to 299 billion baht in 2001. Moreover, the earnings from international tourism in Thailand have risen from 323 billion baht in 2002 to 450 billion baht in 2005. While, the number of international tourist arrivals to Thailand was 7.22 million in 1997, by 2005 the number of international tourist arrivals to Thailand had increases to 13 million (source: Thailand's tourism organization).

Additionally, the domestic tourism industry in Thailand is also the fastest growing industry and the earnings of the domestic tourism industry has increases substantially, rising form 180 billion baht in 1997 to 223 billion baht in 2001. Furthermore, the earnings of the domestic tourism industry in Thailand have risen from 235 billion baht to 347 billion baht in 2005. In 2005 the numbers of tourists from East Asia's countries indicate 50% of international tourism market share of Thailand. Moreover, the top six countries from this area such as Malaysia, Japan, Korea, China, Singapore and Taiwan are import impact to the number of international tourism market of Thailand during period of 2000-2005 (source: Thailand's tourism organization).

Based on information above have inspired to produce this paper for education of Thailand's international tourism demand as well as this paper would like to study only tourists from these countries such as Malaysia, Japan, Korea, China, Singapore and Taiwan. For a long time now, economists have tried to understand the international tourist consumer behaviour through demand models.

For example, Barry and O'Hagan (1972): studied the demand of British tourists going to Ireland; Jud, G.D. and Joseph, H., (1974); studied the demand of international tourist going to Latin American; Uysal and Crompton (1984) studied the demand of international tourists going to Turkey. Summary (1987) studied the demand of international tourists going to Kenya, Kulendran, N. (1996) studied the demand of international tourists going to Australia; Lim C. and M.McAleer (2000) studied the demand of international tourist going to Australia; Durbarry (2002) studied the demand of international tourists (French) going to the UK, Span and Italy. As well as Narayan (2004) studied the demand of international tourists going to Fiji. The aim of this paper was to study about the international tourist consumer behaviour in coming to Thailand during period of 1968 to 2007 through the international tourism demand model. The consumer behaviour information gathered from this research will help in developing the international tourism industry in Thailand.

2. RESEARCH AIM AND OBJECTIVE

This research aimed to determine how various factors affect international tourist demand arrivals to Thailand in the long-run and to use the international tourism demand model to explain international tourist behaviour in Thailand.

3. SCOPE OF THIS RESEARCH

This research focuses on during period of 1998 to 2007. Most of the data was used in this research as secondary data and also the countries under analysis are Asia major tourism market of Thailand such as Malaysia, Japan, Korea, China, Singapore and Taiwan. All of these countries had a significant impacted on the international tourism industry of Thailand in the same period (source: Thailand's tourism organization). The variables were used in this research such as the numbers of international tourists arriving in Thailand, the GDP of the countries that the tourists were coming from, the international price of aviation fuel, and the exchange rate of Thai currency in comparison to foreign currencies.

4. THE METHODOLOGY AND RESEARCH FRAMEWORK

4.1. The theory of International Tourism Demand Model

The concept of international tourist demand has been applied since 1950 but the estimation of international tourist demand by the econometric method was first used by Artus (1972). Following that, a lot of studies on international tourist demand function used the econometric method. This researcher reviewed the work of Archer (1976), Crouch (1994), Walsh (1996), Lim (1997), Inclair (1998), Lise & Tol (2002), McAleer (2001,2003), Narayan (2004), Prasert, Rangaswamy and Chukiat (2006). Growth in international tourism is closely aligned to economic variables, which at both the microeconomic and macroeconomic levels influences the consumer's decision to undertake overseas travel.

Empirical research on international tourism demand has overwhelmingly been based on aggregate time series data which permits the estimation of income and price elasticity on inbound tourism (see Lim, 1997 and McAleer (2000, 2001) and Prasert, Rangaswamy and Chukiat (2006)). A simple origin-destination demand model for international tourism can be represented as follows:

$$D_t = f(\ Y_t \ \ TC_t \ \ P_t\ ) \tag{1A}$$

where:

D_t - is a measure of travel demand at time t ;

Y_t - is a measure of income of the tourist-generating or origin country at time t

TC_t - is a measure of transportation costs from the origin to destination country at time t

P_t - is a measure of tourism price of goods and services at time t

And assume that ($+Y_t$), ($-TC_t$), ($-P_t$) and explain that when income at time t is increasing then the demand for international tourism is increasing simultaneously. When the measure of transportation costs from the origin to destination country at time t is increasing then the demand for international tourism decreases. And when the measure of tourism price of goods and services is increasing then the demand for international tourism is decreasing. Equation (1A) can be expressed in log-linear (or logarithmic) form:

$$\ln D_t = \alpha + \beta \ln Y_t + \gamma \ln \{F1_t \text{ or } F2_t\} + \delta \ln \{RP_t , ER_t \text{ or } RER_t\} + \phi \ln D_{t-1} + \theta \ln CP_t + u_t \quad (2A)$$

where:
$\ln D_t$ - logarithm of short-term quarterly tourist arrivals (or demand) from the origin to destination country at time t
$\ln Y_t$ - logarithm of real GDP in original country at time t
$\ln F1_t$ - logarithm of real round-trip coach economy airfares in Neutral Units of construction (NUC) between original country and destination country at time t
$\ln F2_t$ - logarithm of real round-trip coach economy airfares in original country currency between original country and destination country at time t
$\ln RP_t$ - logarithm of relative prices (or CPI of destination country/CPI of original country) at time t
$\ln ER_t$ - logarithm of exchange rate (original country per destination country) at time t
$\ln RER_t$ = logarithm of real exchange rate [or CPI(destination country)/CPI(original country)*1/ER] at time t
$\ln CP_t$ - logarithm of competitive prices [using CPI(destination country) /(other destination country)]
u_t - independently distributed random error term, with zero mean and constant variance at time t
α , $\beta, \gamma, \delta, \phi, \theta$ - parameters to be estimated; $\beta > 0$, $\gamma < 0$, $\delta < 0$,
$0<\phi< 1$, $\theta > 0$ (substitutes) and $\theta < 0$(complements).

The above information mostly focuses on the international tourism demand function based on time series analysis. Recently a lot of research about international tourist demand function has used the econometric method based on the panel data analysis. This researcher reviewed the following studies which applied this technique: Durbary (2002), Chin and Pan (2005), and Chukiat Chaiboonsri, Prasert Chaitip and N. Rangaswamy (2008). Also the models were used in this research has modified from equation (2A) to be equation (3A).

$$\ln D1_{it} = \alpha + \beta \ln (GDP_{it}) + \gamma \ln (PO_{it}) + \theta \ln(ER_{it}) + u_{it} \quad (3A)$$

where:
i - cross-section-data (the number of country arrival to Thailand)
t - time series data
$\ln D1_{it}$ - logarithm of tourist arrivals (or demand) from the origin countries number i to destination country (Thailand) at time t

$\ln GDP_{it}$ - logarithm of real GDP in original countries number i at time t (Y_{it})
$\ln PO_{it}$ - logarithm of price of aviation fuel of original countries number i at time t (TC_{it})
$\ln ER_{it}$ - logarithm of exchange rate of original country number i per destination country (Thailand) at time t
u_{it} - independently distributed random error term, with zero mean and constant variance number i at time t
$\alpha, \beta, \gamma, \theta$ - parameters to be estimated
$\alpha > 0,\ \beta > 0,\ \gamma < 0,\ \theta < 0$

4.2. Panel Unit-Root Tests

Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. See Levin, Lin and Chu (2002), Im, Persaran and Shin (2003), and Breitung (2000) which mention test purchasing power parity (PPP) and growth convergence in macro panels using country data over time. This research focused on five types of panel unit root tests such as Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003), Fisher-Type test using ADF and PP-test (Maddala and Wu (1999) and Choi (2001), Hadri (1999). These method also see more detail in Chukiat Chaiboonsri, Prasert Chaitip and N. Rangaswamy. (2008).

4.3. Panel Cointegration Test

Kao (1999) uses both DF and ADF to test for cointegration in panel as well as this test similar to the standard approach adopted in the EG-step procedures. Also this test starts with the panel regression model as set out in equation 20I.

$$Y_{it} = X_{it}\beta_{it} + Z_{it}\gamma_0 + \varepsilon_{it} \tag{20I}$$

where Y and X are presumed to be non-stationary and :(see equation 21I)

$$\hat{e}_{it} = \rho \hat{e}_{it} + \nu_{it} \tag{21I}$$

where $\hat{e}_{it} = (Y_{it} - X_{it}\hat{\beta}_{it} - Z_{it}\hat{\gamma})$ are the residuals from estimating equation 20I. To test the null hypothesis of no cointegrarion amounts to test $H_0 : \rho = 1$ in equation 21I against the alternative that Y and X are conitegrated(i, e., $H_1 : \rho < 1$). Kao(1999) developed both DF-Type test statistics and ADF test statistics were used to test cointegration in panel also both DF-Type(4 Type) test statistics and ADF test statistics can present below that:

$$DF_\rho = \frac{\sqrt{N}T(\hat{\rho}-1)+3\sqrt{N}}{\sqrt{51/5}},$$

$$DF_t = \sqrt{\frac{5t_\rho}{4}} + \sqrt{\frac{15N}{8}}.$$

$$DF_\rho^* = \frac{\sqrt{N}T(\hat{\rho}-1) + \frac{3\sqrt{N}\hat{\sigma}_v^2}{\hat{\sigma}_{0v}^2}}{\sqrt{3 + \frac{36\hat{\sigma}_v^4}{5\hat{\sigma}_{0v}^4}}},$$

$$DF_t^* = \frac{t_\rho + \frac{\sqrt{6N}\hat{\sigma}_v}{2\hat{\sigma}_{0v}}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}},$$

$$ADF = \frac{t_{ADF} + \sqrt{6N}\hat{\sigma}_v/2\hat{\sigma}_{0u}}{\sqrt{\hat{\sigma}_{0v}^2/2\hat{\sigma}_v^2 + 3\hat{\sigma}_v^2/10\hat{\sigma}_{0v}^2}}$$

where:
N - cross-section data
T - time series data
$\rho^{\wedge}$ - co-efficiencies of 21I
t_ρ - $[(\rho^{\wedge} - 1)\sqrt{}(\Sigma^{N}_{i=1}\Sigma^{T}_{t=2} e^{\wedge*2}_{i\,t-1})]/Se$
Se - $1/NT)\,\Sigma^{N}_{i=1}\Sigma^{T}_{t=2}(e^{\wedge*}_{i\,t} - \rho^{\wedge} e^{\wedge*}_{i\,t-1})^2$
$\sigma_u^{\wedge 2}$ - variance of u
$\sigma_v^{\wedge 2}$ - variance of v
$\sigma_u^{\wedge}$ - standard deviation of u
$\sigma_v^{\wedge}$ - standard deviation of v
t_{ADF} - $[(\rho^{\wedge} - 1)(\Sigma^{N}_{i=1}(e^{/} Q_i e_i))^{1/2}]/S_v$

Pedroni (1995) provides a pooled Phillips and Perron-Type test and these test have the null hypothesis of no cointegration. The panel autoregressive coefficient estimator, $\gamma^{\wedge}_{N,T,}$ can be constructed as follow: (see equation 21.1I).

$$\gamma^{\wedge}_{N,T}{}^{-1} = [\Sigma^{N}_{i=1}\Sigma^{T}_{t=2}(e^{\wedge}_{i,t-1}\Delta e^{\wedge}_{i,t-1} - \lambda^{\wedge}_{i})] / \Sigma^{N}_{i=1}\Sigma^{T}_{t=2}(e^{\wedge 2}_{i,t-1}) \qquad (21.1I)$$

where:
N - cross-section data
T - time series data
$e_{i\,t-1}$ - error term of model
$\lambda^{\wedge}_{i}$ - a scalar equivalent to correlation matrix

And also Pedroni(1995) provides the limiting distributions of two test statistics as well as can be written in equation 21.2I:

$$\text{PP-statistic} = [T \sqrt{N} (\hat{\gamma}_{N,T}^{-1})] / \sqrt{2} \rightarrow N(0,1) \quad (21.2I)$$

And this research focus on ADF test statistic based on residual-based test follow concept of Kao(1999) to test cointegration in panel and also this research focus on PP-test statistic based on concept of Pedroni (1995) to test cointegration in panel. Both ADF-statistics and PP-statistic have same null hypothesis of no cointegration in panel. In term of combined individual test (Fisher/Johansen) also Maddala and Wu(1999) use Fisher's result to propose and alternative approach to testing for cointegration in panel data by combining tests from individual cross-sections to obtain at test statistics for the full panel. If Π_i is the p-value from an individual cointegration test for cross-section i , then under the null hypothesis fir the panel , (see formula 1a)

$$2\sum_{i=1}^{n} \log(\Pi_i) \rightarrow \chi^2 2n \quad (1a)$$

By default the χ^2 value based on MacKinnon-Haug-Michelis(1999) P-value use for Johansen's cointegration trace test and maximum eigenvalue test. And The Johansen's Maximum likelihood procedure. (see more detail at equation 11a)

$$\Delta Y_{i,t} = \Pi_i y_{i,t-1} + \sum_{k=1}^{n} \Gamma_k \Delta Y_{i,t-k} + u_{i,t} \quad (11a)$$

Ho : rank (Π_i) = $r_i \le r$ *for all i from 1 to n*
Ha : rank (Π_i) = *P for all i from 1 to n*

The standard rank test statistics is defined in terms of average of the trace statistic for each cross section unit and mean and variance of traces statistics.

4.4. Estimating panel cointegration model

The various (casually single equation) approach for estimating a cointegration vector using panel data such as the Pedroni (2000, 2001) approach, the Chiang and Kao (2000, 2002) approach and the Breitung (2002) approach. The various estimators available include with-and between-group such as OLS estimators, fully modified OLS (FMOLS) estimators and dynamic OLS estimators.

FMOLS is a non-parametric approach to dealing with corrections for serial correlation while OLS and DOLS are a parametric approach which DOLS estimators include lagged first-differenced term are explicitly estimated as well as consider a simple two variable panel regression model: (see detail calculated of OLS, FMOLS and DOLS in equation 23I, 24I and 26I).

$$Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \quad (22I)$$

A standard panel OLS estimator for the coefficient β_i given by :

$$\hat{\beta}_{i,OLS} = [\Sigma^N_{i=1}\Sigma^T_{t=1}(X_{it} - X^*_i)^2]^{-1} \Sigma^N_{i=1}\Sigma^T_{t=1}(X_{it} - X^*_i)(Y_{it} - Y^*_i) \quad (23I)$$

where:
i - cross-section data and N is the number of cross-section
t - time series data and T is the number of time series data
$\hat{ß}_{i\,OLS}$ - A standard panel OLS estimator
X_{it} - exogenous variable in model
X^*_i - average of X^*_i
Y_{it} - endogenous variable in model
Y^*_i - average of Y^*_i

To correct for endogeneity and serial correlation, Pedroni (2000) has suggested the group-means FMOLS estimator that incorporates the Phillips and Hanseri (1990) semi-parametric correction to the OLS estimator to adjusts for the heterogeneity that is present in the dynamics underlying X and Y. Specifically, the FMOLS statistics is : see equation 24I).

$$\hat{ß}_{i,FMOLS} = N^{-1} \Sigma^{N}_{i=1}[\Sigma^{T}_{t=1}(X_{it} - X^*_i)^2]^{-1} [\Sigma^{T}_{t=1}(X_{it} - X^*_i) Y^+_{it} - T\hat{Y}_i \qquad (24I)$$

where:
i = cross-section data and N is number of cross-section data
t = time series data and T is number of time series data
$\hat{ß}_{i\,FMOLS}$= Full modified OLS estimator
X_{it} = exogenous variable in model
X^*_i = average of X^*_i
Y_{it} = endogenous variable in model
Y^*_i = average of Y^*_i
$Y^+_{it} = (Y_{it} - Y^*_i) - [(\hat{\Omega}_{21i} / \hat{\Omega}_{22i})\Delta X_{it}]$ and $\hat{\Omega}$ is covariance
$\hat{Y}$ = act to correct for the effect of serial correlation due to the heterogeneous dynamics in the short-run process determining x and y

In contrast to the non-parametric FMOLS estimator, Pedroni (2001) has also constructed a between-dimension, group-means panel DOLS estimator that incorporates corrections for endogeneity and serial correlation parametrically. This is done by modifying equation 22I to include lead and lag dynamics: (see equation 25I).

$$Y_{it} = \alpha_i + ß_i X_{it} + \Sigma^{ki}_{j=-k} \gamma_{ik} \Delta X_{i,t-k} + \varepsilon_{it} \qquad (25I)$$

$$\hat{ß}_{i,DOLS} = [N^{-1} \Sigma^{N}_{i=1}(\Sigma^{T}_{t=1} Z_{it} Z^*_{it})^{-1}(\Sigma^{T}_{t=1} Z_{it} \hat{Z}_{it})] \qquad (26I)$$

where:
i - cross-section data and N is number of cross-section data
t - time series data and T is number of time series data
$\hat{ß}_{i\,DOLS}$ - dynamics OLS estimator
Z_{it} - is the 2(K+1) x 1
$\hat{Z}_{it}$ - $(X_{it} - X^*_i)$
X^*_i - average of X^*_i
$\Delta X_{i,t-k}$ - differential term of X

The above methods, used to estimate panel cointegration models, were mostly developed by Pedroni (2000, 2001). This research focused on the OLS estimator, the DOLS estimator and FMOLS estimator for estimating panel cointegration for modeling international tourism demand of Thailand.

5. THE EMPIRICAL RESULTS OF THE RESEARCH

5.1. The empirical results of the panel unit root test

This research used the panel unit root test of the variables by five standard method tests for panel data including Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003), Fisher-Type test using ADF and PP-test (Maddala and Wu (1999) and Choi (2001)) and Hadri (1999).

Table 1 present the results of the panel unit root tests based on the five methods test for all variables were used in modeling international tourism demand of Thailand. The Levin, Lin and Chu (2002) method test indicate that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ are at the level of insignificance for accepting the null of a unit root. The Breitung (2000) method test indicate that that lnD_{it}, $lnTC_{it}$ and $lnER_{it}$ is the level of significance for rejecting the null of a unit root but lnY_{it} have unit root. The Im, Pesaran and Shin (2003) method test indicate that lnD_{it}, $lnTC_{it}$ and $lnER_{it}$ have a unit root but lnY_{it}, have not unit root. Maddala and Wu (1999) and Choi (2001) method based on ADF-Fisher Chi-square test indicate that lnD_{it}, $lnTC_{it}$ and $lnER_{it}$ have a unit root but lnY_{it} have not unit root. And also Maddala and Wu (1999) and Choi (2001) method based on PP-Fisher Chi-square test indicate that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ have unit root.

The Hadri (1999) method test indicates that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ have a unit root because this method has a null hypothesis of no unit root. From the results of the panel unit root test, it can be concluded that most variables were used in this model have unit root. So all variables should be take first differing or take second differing as well as after take first differing in all variables then the results of the panel unit root test based on five methods are presented in table 2.

The Levin, Lin and Chu (2002) method test indicate that lnDit, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ are at the level of significance for rejecting the null hypothesis of a unit root. The Breitung (2000) method test indicates that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ are at the level of significance for reject the null hypothesis of a unit root. The Im, Pesaran and Shin (2003) method test indicate that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ are at the level of significance for rejecting the null hypothesis of a unit root. The Maddala and Wu (1999) and Choi (2001) method based on both ADF-Fisher Chi-square test and PP-Fisher Chi-square test indicated that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ are at the level of significance for rejecting the null hypothesis of a unit root. The Hadri (1999) method test indicated that lnD_{it}, lnY_{it}, $lnTC_{it}$ and $lnER_{it}$ have a unit root because this method has a null hypothesis of no unit root (see more detail in table 2).

Table 1. Results of panel unit root tests based on 5 method tests for all variables

Method test	Test statistic	Significance level for rejection
Null : unit root (assumes common unit root process)		
Levin,Lin and Chu (2002) t*- Statistics		
1. $lnD_{i\,t}$	0.57	0.71
2. $lnY_{i\,t}$	-0.49	0.30
3. $lnTC_{i\,t}$	3.73	0.99
4. $lnER_{i\,t}$	1.61	0.94
Breitung(2000) t*-Statistics		
1. $lnD_{i\,t}$	-2.73	0.00
2. $lnY_{i\,t}$	0.35	0.64
3. $lnTC_{i\,t}$	-4.51	0.00
4. $lnER_{i\,t}$	-1.69	0.04
Null : unit root (assumes individual unit root process)		
Lm, Pesaran and Shin (2003) W-Statistics		
1. $lnD_{i\,t}$	0.77	0.78
2. $lnY_{i\,t}$	-1.85	0.03
3. $lnTC_{i\,t}$	5.96	0.99
4. $lnER_{i\,t}$	2.04	0.97
Maddala and Wu (1999) and Choi (2001) ADF-Fisher Chi-square		
1. $lnD_{i\,t}$	11.36	0.49
2. $lnY_{i\,t}$	22.17	0.03
3. $lnTC_{i\,t}$	0.03	0.99
4. $lnER_{i\,t}$	2.04	0.97
PP-Fisher Chi-square		
1. $lnD_{i\,t}$	14.51	0.26
2. $lnY_{i\,t}$	12.02	0.44
3. $lnTC_{i\,t}$	0.79	0.99
4. $lnER_{i\,t}$	4.56	0.97
Null : No unit root (assumes common unit root process)		
Hadri (1999) Z-Statistics		
1. $lnD_{i\,t}$	5.36	0.00
2. $lnY_{i\,t}$	5.39	0.00
3. $lnTC_{i\,t}$	5.58	0.00
4. $lnER_{i\,t}$	4.18	0.00

From: computed

Table 2. Results of panel unit root tests based on 5 method tests for all variables after first differencing or second differencing into these variables.

Method test	Test statistic	Significance level for rejection
<u>Null : unit root (assumes common unit root process)</u>		
Levin,Lin and Chu (2002) t*- Statistics		
5. $lnD_{i\,t}$	-6.78	0.00
6. $lnY_{i\,t}$	-6.21	0.00
7. $lnTC_{i\,t}$	-8.00	0.00
8. $lnER_{i\,t}$	-6.61	0.00
Breitung(2000) t*-Statistics		
5. $lnD_{i\,t}$	-3.18	0.00
6. $lnY_{i\,t}$	-2.14	0.01
7. $lnTC_{i\,t}$	-8.82	0.00
8. $lnER_{i\,t}$	-5.48	0.00
<u>Null : unit root (assumes individual unit root process)</u>		
Lm, Pesaran and Shin (2003) W-Statistics		
5. $lnD_{i\,t}$	-7.35	0.00
6. $lnY_{i\,t}$	-5.30	0.00
7. $lnTC_{i\,t}$	-7.06	0.00
8. $lnER_{i\,t}$	-4.48	0.00
Maddala and Wu (1999) and Choi (2001) ADF-Fisher Chi-square		
5. $lnD_{i\,t}$	64.36	0.00
6. $lnY_{i\,t}$	46.66	0.00
7. $lnTC_{i\,t}$	62.84	0.00
8. $lnER_{i\,t}$	39.31	0.00
PP-Fisher Chi-square		
5. $lnD_{i\,t}$	72.48	0.00
6. $lnY_{i\,t}$	42.01	0.00
7. $lnTC_{i\,t}$	110.21	0.00
8. $lnER_{i\,t}$	42.82	0.00
<u>Null : No unit root (assumes common unit root process)</u>		
Hadri (1999) Z-Statistics		
5. $lnD_{i\,t}$	1.79	0.036
6. $lnY_{i\,t}$	2.35	0.009
7. $lnTC_{i\,t}$	24.23	0.00
8. $lnER_{i\,t}$	2.48	0.00

From: computed

5.2. The empirical results of panel cointegration test

Table 3 present the results of the panel cointegration test of the modeling international tourism demand of Thailand based on Pedroni Residual Cointegration Tests, Kao Residual Cointegration Tests and Johansen Fisher Panel Cointegration Test.

Table 3. Results from panel co integration test of the international tourism demand of Thailand

Test Name	Test statistic	Significance level for rejection of the null hypothesis (no cointegration)
(1) **Pedroni Residual Cointegration Tests**		
• Panel v-Statistic	0.703680	(0.3114)
• Panel rho-Statistic	0.280608	(0.3835)
• Panel PP-Statistic	-2.350831	(0.0252)
• Panel ADF-Statistic	-2.426043	(0.0210)
• Group rho-Statistic	1.031702	(0.2343)
• Group PP-Statistic	-2.103406	(0.0437)
• Group ADF-Statistic	-1.978332	(0.0564)
(2) **Kao Residual Cointegration Tests**		
• ADF-Statistic	-3.233149	(0.0006)
(3) **Johansen Fisher Panel Cointegration Test**		
• Fisher Statistics from Trace Test	30.7829	(0.0021)
• Fisher Statistics from Max-Eigen Test	18.4540	(0.1026)

From: computed

Most of these methods were used to test for this model indicate that all variables were used in this model are level of significant for rejecting the null hypothesis (no cointegration). The empirical results imply that all variables were used in the modelling international tourism demand of Thailand has cointegration with each other.

5.3. The empirical results of estimating panel cointegration model

Table 4 and Table 5 present the results of the long-run relationship for the modeling international tourism demand of Thailand based on OLS-estimator, DOLS-estimator and FMOLS-estimator (lnDit is the dependent variable). The empirical results of the long-run tourism demand models for Thailand were obtained by normalizing on visitor arrivals are presented in table 4.

All variables appear with both the correct sign and incorrect sign. Clearly, income of origin countries, travel costs of origin countries and exchange rate of origin countries are influential in determining international visitor arrivals to Thailand based on both the OLS-estimator and DOLS-estimator. The results of all variables were used in this research showed an impact on the international visitor arrivals to Thailand during period of 1968 to 2007.

In six countries as in long-run base on OLS-estimator to estimating panel cointegration model suggested that lnYit have positive impact on international tourist arrivals to Thailand at 1 percent level of statistical significance.

Table 4. Results of the long-run relationship of the modeling international tourism demand of Thailand based on OLS estimator and DOLS estimator ($lnD_{i\,t}$ is dependent variable)

Variables	OLS estimator	DOLS estimator
1. $lnY_{i\,t}$	2.05^{***} (19.60)	1.89^{***} (16.60)
2. $lnTC_{i\,t}$	$- 0.22^{***}$ (-2.54)	-0.17^{**} (-1.92)
3. $lnER_{i\,t}$	-0.10 (-0.57)	-0.08 (-0.44)
4. Δ(lnYi t(-1))	-	-0.42 (-0.44)
5. Δ (lnTC i t(-1))	-	0.05 (0.34)
6. Δ (lnER i t(-1))	-	0.15 (0.41)
7. Δ (lnD i t(-1))	-	0.29^{*} (1.74)

*Note: estimates refer to (fixed-effects) long-run elasticity of output with respect to the relevant regression. T-ratios are in parenthesis and a * denotes statistical significance at the 10 percent level and a ** denotes statistical significance at the 5 percent level and a *** denotes statistical significance at the 1 percent level.*
From: computed

In the six countries as in long-run base on DOLS-estimator to estimating panel cointegration model suggested that lnYit has a positive impact on international tourist arrival to Thailand at 1 percent level of statistical significance.

In the six countries (Malaysia, Japan, Korea, China, Singapore, and Taiwan) as in long-run based on FMOLS-estimator to estimating panel cointegration model suggested that lnYit has a positive impact on international tourist arrival to Thailand at 1 percent level of statistical significance.

Table 5. Results of the long-run relationship of the modelling international tourism demand of Thailand based on FMOLS-estimator ($lnD_{i\,t}$ is dependent variable)

INDIVIDUAL FMOLS RESULTS (t-stats in parentheses)

Asia-Country	Variable	Coefficient	t-statistic
No.1	LY	0.68***	(6.60)
No.1	LTC	0.18**	(3.28)
No.1	LER	0.77*	(1.91)
No.2	LY	2.67***	(4.74)
No.2	LTC	-0.07	(-0.91)
No.2	LER	0.72***	(4.84)
No.3	LY	3.07***	(9.85)
No.3	LTC	-0.25	(-0.63)
No.3	LER	1.04	(0.56)
No.4	LY	2.14***	(20.16)
No.4	LTC	-0.71***	(-5.14)
No.4	LER	-0.82***	(-3.19)
No.5	LY	0.12	(0.72)
No.5	LTC	0.20***	(5.95)
No.5	LER	1.23***	(8.75)
No.6	LY	0.08	(0.22)
No.6	LTC	-0.19*	(-1.37)
No.6	LER	1.48**	(2.28)

No.1=Malaysia, No.2=Japan, No.3= Korea, No.4= China, No.5=Singapore, No.6=Taiwan
From : computed

PANEL GROUP FMOLS RESULTS

	Coefficient	**t-statistic**
LY	1.46***	(17.26)
LTC	-0.14	(0.48)
LER	0.74***	(6.19)

Nsecs = 6 , Tperiods = 22 , no. regressors = 3

6. THE CONCLUSIONS OF RESEARCH AND POLICY RECOMMENDATIONS

This paper was motivated by the need for empirical analysis of international tourist behaviour arriving in Thailand and an analysis of the determinants of Thailand's international tourism demand from its six main source markets such as Malaysia, Japan, Korea, China, Singapore and Taiwan. In this article, five standard panel unit root test were used test for all variables. Namely, Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003), Fisher-Type test using ADF and PP-test (Maddala & Wu, 1999; Choi, 2001; Hadri, 1999). And in this article were used panel cointegration test base on Pedroni Residual Cointegration Tests, Kao Residual Cointegration Tests and Johansen Fisher Panel Cointegration Test.

Furthermore in this article also used the OLS-estimator, DOLS-estimator and FMOLS-estimator to investigate long-run equilibrium relationships between the numbers of international tourists arriving in Thailand with economics variables. These methods were suggested by Pedroni (2000, 2001). The economic variables such as the GDP of major countries of international tourists coming to Thailand, the world price of aviation fuel and the exchange rate of Thailand compared with the origin countries of international tourists.

This paper also has two important conclusions and recommendations that emerge from the empirical analysis of this research. Firstly, if income (GDP) of the Asia tourism markets of Thailand (Malaysia, Japan, Korea, China, Singapore and Taiwan) increase then it leads to an increase the number of international tourists traveling to Thailand. This result is consistent with economic theory and was similar to the results of previous empirical studies on tourist demand (Lim & McAleer, 2003), (Narayan, 2004), (Chaitip et al., 2006, 2008).

The long-run result for Thailand's international tourism demand implies that Thailand will receives the number of international visitors more when the income (GDP) of Asia tourism markets of Thailand will grow up more in the same of during period. If these results can be generalized for future years, then it argues well for the continued development of the Thailand tourism industry.

And secondly, if the transportation costs (price of aviation fuel) of the Asia tourism markets of Thailand (Malaysia, Japan, Korea, China, Singapore and Taiwan) increase then it will leads to decrease the number of international tourist arrivals from those countries to Thailand. This result is consistent with economic theory and it was similar to the results of previous empirical studies of tourism demand (Lim & McAleer, 2003), (Narayan, 2004), (Chaitip et al., 2006, 2008). If this results can be generalization for future years, then it suggests that the Thailand government should reduce cost of air ticket by reduce tax of aviation fuel for airplane fly from Asian countries to Thailand.

REFERENCES:

[1]. Archer, B.H. (1976) *Demand forecasting in Tourism*, Bangor Occasional Papers in Economics, 9, University Press

[2]. Banerjee, A. (1999) *Panel data unit roots and cointegration: an overview*, Oxford Bulletin of Economics and Statistics, Special issue, pp. 607-629

[3]. Banerjee, A.; Marcellino, M.; Osbat, C. (2001) *Some cautions on the use of panel*

[4]. Barry, K.; O'Hagan, J. (1972) *An econometric study of British tourist expenditure in Ireland*, Economic and Social Review, 3(2), pp.143-161

[5]. Basile, R.; Costantini, M.; Destefanis, S. (2006) *Unit root an cointegration tests for cross-sectionally correlated panels. Estimating regional production function*, Rom University

[6]. Breitung, J. (2000) *The Local Power of Some Unit Root Tests for Panel Data*, in B. Baltagi (ed.),: Nonstationary Panels, Panel Cointegration, and Dynamic Panels, Advances in Econometrics, Vol. 15, Amsterdam: JAI Press, pp.161-178

[7]. Breitung, J. (2002) *A parametric approach to the estimation of cointegration vectors in panel data, mimeo*

[8]. Chaiboonsri et. al. (2006) *Thailand's international tourism demand: The ARDL approach to cointegration*, working paper no. 5 LSDC Thailand

[9]. Chaiboonsri et. al. (2008) *A Panel Unit Root and Panel Cointegration Test of the Modeling International Tourism Demand in India*, Journal of Annals of University of Petrosani, Romania, 8(1), pp.95-124

[10]. Chiang, M.H.; Kao, C. (2002*) Nonstationary panel time series using NPT 1.3 - A user guide*, Center for Policy Research, Syracuse University

[11]. Choi, I. (2001) *Unit Root Tests for Panel Data*, Journal of International Money and Finance, 20, pp.249-272

[12]. Coudert, V.; Couharde, C. (2006) *Real equilibrium exchange rate in European Union new members and candidate countries*, Bank of France, University of Paris

[13]. Crouch, G.I. (1994) *The study of international tourism demand: a review of findings*, Journal of Travel Research, 33(1), pp.12-23

[14]. Dhariwal, R. (2005) *Tourist arrivals in India: how important are domestic disorders?*, Tourism Economics, Vol. 11(2), pp.185-205

[15]. Durbarry, R. (2000) *Tourism expenditure in UK: Analysis of competitiveness using a Gravity-Based Model*, Christel DeHaan Tourism and Research Institute, Nottingham University Business

[16]. Durbarry, R. (2002) *Long Run Structural Tourism Demand Modelling: An Application*, Nottingham: Christel DeHaan Tourism and Travel Research Institute

[17]. Fisher, R.A. (1932) *Statistical Methods for Research Workers*, 4th Edition, Edinburgh: Oliver & Boyd

[18]. Garin-Munoz, T.; Perez Amaral, P. (2000) *An econometric model for international tourism flows to Spain*, Applied Economics Letters, 7, pp.525-529

[19]. Hadri, K. (1999) *Testing the null hypothesis of stationarity against the alternative of a unit root in panel data with serially correlated errors, Manuscript*, Department of Economics and Accounting, University of Liverpool, Liverpool

[20]. Hamori, S. (2008) *Empirical Analysis of the Money Demand Function in Sub-Saharan Africa*, Economics Bulletin, 15(4), pp. 1-15

[21]. Hu, L. (2006) *A simple panel cointegration test and estimation in I(0)/I(1) mixed panel data*, The Ohio State University

[22]. Im, K.S.; Pesaran, M.H.; Shin, Y. (2003) *Testing for Unit Roots in Heterogeneous Panels*, Journal of Econometrics, 115, 53-74. Inc., 15, 93-130

[23]. Inclair, M.T. (1998) *Tourism and economics development: a survey*, The Journal of Development Studies, 31, pp.1-51

[24]. Jud, G.D. (1974) *Tourism and economic growth in Mexico since 1950,* Inter-American Economic Affairs, 28(1), 19-43

[25]. Kao, C. (1999) *Spurious regression and residual-based tests for cointegration in panel data*, Journal of Econometrics, 90, pp.1-44

[26]. Kao, C.; Chiang, M.H. (2000) *On the estimation and inference of a cointegrated regression in panel data*, in B.H Bltagi, T.B Fomby and R.C Hill (eds), Nonstationary Panels, Panel Cointegration, and Dynamic Panels, Advances in Econometrics, 15, Elsevier Science, Amsterdam

[27]. Kulandran, N. (1996) M*odeling quarterly tourist flows to Australia using cointegration analysis*, Tourism Economics, 2(3), 203-222

[28]. Kwan, Y. (2006) *The Direct substitution between Government and private comsumption in East Asia*, Department of Economics and Finance, City University of Hong Kong

[29]. Levin, A.; Lin, C.F.; Chu, **C.** (2002) *Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties*, Journal of Econometrics, 108, pp.1-24

[30]. Lim, C. (1997) *An econometric classification and review of international tourism demand models*, Tourism Economics, 3, pp.69-81

[31]. Lim, C.; McAleer, M. (2000) *A seasonal analysis of Asian tourist arrivals to Australia*, Applied Economics, 32, pp.499-509

[32]. Lim, C.; McAleer, M. (2001a) *Conintegration analysis of quarterly tourism demand by Hong Kong and Singapore for Australia*, Applied Economics, 33, pp.1599-1619

[33]. Lim, C.; McAleer, M. (2001b) *Monthly seasonal variations Asian tourism to Australia*, Annals of Tourism Research, 28(1), pp.68-82

[34]. Lim, C.; McAleer, M. (2001c) *Modelling the determinants of international tourism demand to Australia,* The Institute of Social and Economic Research Osaka University, Discussion Paper No.532

[35]. Lim, C.; McAleer, M. (2003) *Modelling International Travel Demand from Singapore to Australia*, Griffith University and University of Western Australia , Discussion Paper

[36]. Lise, W.; Tol, R.S.J. (2002) *Impact of climate on tourism demand*, Climatic Change, 55, pp.429-449

[37]. MacKinnon, J.; Haug, A.; Michelis, L. (1999) *umerical Distribution Functions of Likelihood Ratio Tests for Cointegration*, Journal of Applied Econometrics, 14, pp.563-577

[38]. Maddala, G.S.; Wu, S. (1999) *A Comparative Study of Unit Root Tests with Panel Data and A New Simple Test*, Oxford Bulletin of Economics and Statistics, 61, pp.631-52

[39]. Maloney, W.; Montes Rojas, G. (2005) *How elastic are sea, san and sun? Dynamic panel estimates of the demand for* tourism, Applied Economics Letters. Vol. 12, number 5/15, pp.277-280

[40]. McCoskey, S.; Kao, C. (1998) *A residual-based tests of the null of cointegration in panel data*, Econometric Review 17, pp.57-84

[41]. Narayan, P.K. (2004) *Fiji's tourism demand: The ARDL approach to cointegration*, Tourism Economics, 10(2), pp.193-206

[42]. Naude, W.A.; Saayman, A. (2004) *The determinants of tourist arrivals in Africa: A panel data regression analysis,* North-West University, South Africa

[43]. Pan, C.M. (2005) *Market structure and profitability in the international tourist hotel industry*, Tourism Management , 26, pp. 845-850

[44]. Pedroni, P. (1995) *Panel cointegration: Asymptotics and finite sample properties of pooled time series tests with an application to the PPP hypothesis*, Manuscript, Department of Economics, Indiana University

[45]. Pedroni, P. (1997) *Panel Cointegration: Asympotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. New Results*, Indiana University mimeo

[46]. Pedroni, P. (1999) *Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors*, Oxford Bulletin of Economics and Statistics, 61, pp.653-70

[47]. Pedroni, P. (2000) *Fully Modified OLS for Heterogeneous Cointegrated Panels*, in Baltagi, T.B. Fomby and R.C. Hill(eds), Nonstationary Panels, Panels Cointegration, and Dynamic Panels, Advances in Econometrics, Vol. 15, Elsevier Science, Amsterdam

[48]. Pedroni, P. (2001) *Purchasing power parity tests in cointegrated panels*, Review of Economics and Statistics, 83, pp.727-731

[49]. Pesaran, M.H.; Shin, Y. (1998) *Impulse Response Analysis in Linear Multivariate Models*, Economics Letters, 58, pp.17-29

[50]. Proenca, S.; Soukiazis, E. (2005) *Demand for tourism in Portugal: A panel data approach ,* Discussion paper No. 29 Coimbra University

[51]. Ramirez, M. (2006) *A panel unit root and panel cointegration test of the complimentarily hypothesis in the Mexican case, 1960-2001*, Trinity college, Economics Growth Center, Yale University, USA

[52]. Summary, R. (1987) *Estimation of tourism demand by multivariable regression analysis: evidence from Kenya*, Tourism Management, 8(4), pp.317-312

[53]. Uysal, M.; Crompton, J. L. (1984) *Determinants of demand for international tourist flows to Turkey*, Tourism Management, 5(4), pp.288-297

[54]. Walsh, M. (1996) *Demand analysis in Irish tourism*, Journal of the Statistical and Social Inquiry Society of Ireland, 27(4)

[55]. Westerlund, J.; Endgerton, D. (2006) *A panel Bootstrap Cointegration test*, Department of Economics, Lund University, Sweden

[56]. *Pooled Time Series Tests with an Application to the PPP Hypothesis*, Econometric Theory, 20, pp.597-625