A Panel Cointegration Analysis: An Application to International Tourism Demand of Thailand

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ABSTRACT

This paper seeks to establish the long-run relationships between international tourist arrivals in Thailand and economic variables such as GDP, transportation cost and exchange rates for the period 1986 to 2007. This paper also used standard panel unit root tests: LLC (2002), Breitung (2000), test IPS (2003), Maddala and Wu (1999) and Choi (2001), and Handri (1999). Moreover, The panel cointegration tests based on Pedroni residuals, Kao residuals, and Johansen Fisher panels were used to test for panel relationships among the variables. OLS, DOLS, and FMOLS estimators 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 Thailand's major Asian tourist source markets (Malaysia, Japan, Korea, China, Singapore and Taiwan) has a positive impact on international tourists arrival to Thailand. In addition, the transportation cost from these countries exerts a negative impact on the number of international tourist arrivals to Thailand. Finally Thailand's currency has a positive impact on the number of international tourist arrivals to Thailand. Since most of findings are consistent with economic theory, these the model can be used for policy making.

1. Introduction

International tourism is the fastest growing industry in Thailand. Earnings from international tourism increased from 220 billion baht in 1997 to 299 billion baht in 2001, and then 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 increased to 13 million (source: Thailand's tourism organization).

Domestic tourism industry is also the fastest growing industry in Thailand, earnings have increased substantially, rising from 180 billion baht in 1997 to 347 billion baht in 2005. In 2005 the numbers of tourists from East Asia's countries occupied 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 had an important impact on the number of international tourism market of Thailand during period of 2000-

2005(source: Thailand's tourism organization). The above information inspired this paper educate Thailand's international tourism demand and study tourists only from these countries such as Malaysia, Japan, Korea, China, Singapore and Taiwan.

Economists have long tried to understand the international tourist consumer behavior 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) analyzed Latin American; Uysal and Crompton (1984) explained Turkey, Summary (1987) studied Kenya, Kulendran, (1996) studied Australia; Lim C. and M.McAleer (2000) studied Australia; Durbarry (2002) studied French tourists going to the UK, Span and Italy. Narayan (2004) also studied the demand of international tourists going to Fiji. The aim of this paper is to model international tourist consumer choice and behavior in coming to Thailand during 1968 to 2007 through the international tourism demand model. The consumer behavior 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 longrun and to use on international tourism demand model to explain international tourist behavior in Thailand. It generated a policy presented estimating equation to help predict and adjust for predated arrivals from Thailand's six key source markets in Asia tourists.

3. Scope of this research

This research focuses on the period 1998 to 2007. Most of the data used in this research were secondary data on from Malaysia, Japan, Korea, China, Singapore

and Taiwan. All of these countries had a significant impact on the international tourism industry of Thailand in the same period (source: Thailand's tourism organization). The variables used in this research included 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). Since then numerous studies on international tourist demand function used the econometric method. 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 permit 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:

$$D_t = f (Y_t, TC_t, P_t) \qquad (1A)$$

Definitions:
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 ;

Assuming that $(+Y_t)$, $(-TC_t)$, $(-P_t)$, 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 ;

We defined α, β, γ, δ, ϕ, θ = parameters to be estimated such that $\beta > 0$, $\gamma < 0$, $\delta < 0$, $0 < \phi < 1$, $\theta > 0$ (substitutes) and $\theta < 0$ (complements).

The above information mostly focuses on the international tourism demand function based on time series analysis. Recent research on employee international tourist demand function has econometric 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}) ;

$lnER_{it}$ = 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 ;

And defined that

$\alpha, \beta, \gamma, \theta$ = 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 cointegation 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.

$$Y_{it} = X_{it}\beta_{it} + Z_{it}\gamma_0 + \varepsilon_{it} \qquad (20I)$$

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

$$\hat{e}_{it} = \rho \, \hat{e}_{it} + v_{it} \qquad (21I)$$

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 testing $H_0 : \rho = 1$ 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:

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

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

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

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

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

where

N = cross-section data
T = time series data
$\hat{\rho}$ = co-efficiencies of 21I
t_ρ = $[(\hat{\rho}-1) \sqrt{(\Sigma_{i=1}^N \Sigma_{t=2}^T \hat{e}_{it-1}^{*2})]/Se}$
Se = $(1/NT)\Sigma_{i=1}^N \Sigma_{t=2}^T(\hat{e}_{it}^* - \hat{\rho}\,\hat{e}_{it-1}^*)^2$
$\hat{\sigma}_u^2$ = variance of u
$\hat{\sigma}_v^2$ = variance of v
$\hat{\sigma}_u$ = standard deviation of u
$\hat{\sigma}_v$ = standard deviation of v
t_{ADF} = $[(\hat{\rho}-1) (\Sigma_{i=1}^N (e'Q_ie_i))^{1/2}]/ S_v$

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, $\hat{\gamma}_{N,T}$, can be constructed as follow: (see equation 21.1I).

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

where

N	=	cross-section data
T	=	time series data
$e_{i\,t-1}$	=	error term of model
$\hat{\lambda}_i$	=	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:

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

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)

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

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)

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

$Ho : rank\,(\Pi_i) = \quad r_i \leq r\ for\ all\ i$
$\quad from\ 1\ to\ n$
$Ha : rank\,(\Pi_i) \quad = \quad P \quad for\ all\ i$
$\quad from\ 1\ to\ n$

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 casual single equation approaches for estimating a cointegration vector using panel data were introduced by Pedroni (2000,2001) Chiang and Kao (2000,2002) and Breitung (2002). The various estimators available include with- and between-group 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. Consider a simple two variable panel regression model: (see detail calculated of OLS, FMOLS and DOLS in equation 23I, 24I and 26I).

$$Y_{i\,t} = \alpha_i + \beta_i X_{i\,t} + \varepsilon_{i\,t} \qquad (22I)$$

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

$X_{i\,t}$ = exogenous variable in model

X^*_i = average of X^*_i

$Y_{i\,t}$ = 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. This latter adjusts for the heterogeneity that is present in the dynamics underlying X and Y. Specifically, the FMOLS statistics is : see equation 24I).

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

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

$X_{i\,t}$ = exogenous variable in model

X^*_i = average of X^*_i

$Y_{i\,t}$ = endogenous variable in model

Y^*_i = average of Y^*_i

Y^+_{it} = $(Y_{i\,t} - Y^*_i) - [(\hat{\Omega}_{21i} / \hat{\Omega}_{22i})$ $\Delta X_{i\,t}]$ 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).

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

where

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

and 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

$Z_{i\,t}$ = is the 2(K+1) x 1

$\hat{Z}_{it}$ = $(X_{i\,t} - X^*_i)$

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 six 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 presents 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 indicates 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 indicates 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 indicates 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 indicates 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 a unit root. So all variables should be subject to first differencing or take second differencing as well. 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 indicates 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 indicates 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 indicates 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 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 (see more detail in table 2).

5.2 The empirical results of panel cointegration test

Table 3 presents the results of the panel cointegration test of modeling international tourism demand of Thailand based on Pedroni Residual Cointegration Tests, Kao Residual Cointegration Tests and Johansen Fisher Panel Cointegration Test. 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 used in the modeling international tourism demand of Thailand are cointegrated with each other.

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

Source: 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. $\ln D_{it}$	-6.78	0.00
6. $\ln Y_{it}$	-6.21	0.00
7. $\ln TC_{it}$	-8.00	0.00
8. $\ln ER_{it}$	-6.61	0.00
Breitung(2000) t*-Statistics		
5. $\ln D_{it}$	-3.18	0.00
6. $\ln Y_{it}$	-2.14	0.01
7. $\ln TC_{it}$	-8.82	0.00
8. $\ln ER_{it}$	-5.48	0.00
<u>Null : unit root (assumes individual unit root process)</u>		
Lm, Pesaran and Shin (2003) W-Statistics		
5. $\ln D_{it}$	-7.35	0.00
6. $\ln Y_{it}$	-5.30	0.00
7. $\ln TC_{it}$	-7.06	0.00
8. $\ln ER_{it}$	-4.48	0.00
Maddala and Wu (1999) and Choi (2001) ADF-Fisher Chi-square		
5. $\ln D_{it}$	64.36	0.00
6. $\ln Y_{it}$	46.66	0.00
7. $\ln TC_{it}$	62.84	0.00
8. $\ln ER_{it}$	39.31	0.00
PP-Fisher Chi-square		
5. $\ln D_{it}$	72.48	0.00
6. $\ln Y_{it}$	42.01	0.00
7. $\ln TC_{it}$	110.21	0.00
8. $\ln ER_{it}$	42.82	0.00
<u>Null : No unit root (assumes common unit root process)</u>		
Hadri (1999) Z-Statistics		
5. $\ln D_{it}$	1.79	0.036
6. $\ln Y_{it}$	2.35	0.009
7. $\ln TC_{it}$	24.23	0.00
8. $\ln ER_{it}$	2.48	0.00

Source: computed

Table 3: Results from panel cointegration 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)

Source: computed

5.3 The empirical results of estimating panel cointegration model

Table 4 and Table 5 present the modeling results of the long-run relationship for the international tourism demand of Thailand based on OLS-estimator, DOLS-estimator and FMOLS-estimator (lnD_{it} is the dependent variable). The empirical results of the long-run tourism demand models for Thailand were obtained by normalizing on visitor arrivals (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 used in this research showed an impact on the international visitor arrivals to Thailand during of 1968 to 2007.

The six country long-run base of the OLS estimators of the panel cointegration model suggest that lnY_{it} has a positive impact on international tourist arrivals to Thailand at the 1 percent level of statistical significance.

The DOLS-estimator to estimate the panel cointegration model suggests that lnY_{it} has a positive impact on international tourist arrivals to Thailand at the 1 percent level of statistical significance.

In the six study countries the long-run FMOLS-estimator to estimate the panel cointegration model suggests that lnY_{it} has a positive impact on international tourist arrivals to Thailand at the 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$_{it}$ is dependent variable)

Variables	OLS estimator	DOLS estimator
1. lnY_{it}	2.05*** (19.60)	1.89*** (16.60)
2. lnTC_{it}	- 0.22*** (-2.54)	-0.17** (-1.92)
3. lnER_{it}	-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 (ln$D$ 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.

Source: computed

Table 5: Results of the long-run relationship of the modeling international tourism demand of Thailand based on FMOLS-estimator($\ln D_{i\,t}$ 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

Source: 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 arrivals in Thailand and the determinants of Thailand's international tourism demand from its six main source markets Malaysia, Japan, Korea, China, Singapore and Taiwan. In this article, six standard panel unit root test were used test for all variables. Levin, Lin and Chu(2002), Breitung(2000), Im, Pesaran and Shin(2003), Fisher-Type test using ADF and PP-test (Maddala and Wu(1999), Choi(2001)) and Hadri(1999). Panel cointegration test based on Pedroni Residual Cointegration Kao Residual and Johansen - Fisher Panel Cointegration were also applied.

This article further used the OLS, DOLS and FMOLS-estimators to investigate the long-run equilibrium relationships between the numbers of international tourists arriving in Thailand and other macroeconomic variables. These methods were suggested by Pedroni (2000, 2001). The macro variables included 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.

Two important conclusions and recommendations emerge from the empirical analysis of this research. Firstly, income (GDP) increases in the Asia tourism markets of Thailand (Malaysia, Japan, Korea, China, Singapore and Taiwan) lead to a rise in the number of international tourists traveling to Thailand. The long-run result for Thailand's international tourism demand imply that Thailand will receive international visitors when the income (GDP) of Asia tourism markets of Thailand will grow up more in the same of during period.

Secondly, transportation cost (price of aviation fuel) increases in the Asia tourism

markets of Thailand (Malaysia, Japan, Korea, China, Singapore and Taiwan) lead to a decrease in the number of international tourist arrivals from those countries to Thailand. These two result, are both consistent with economic theory and similar to those of previous empirical studies of tourism demand (Lim & McAleer (2003), Narayan (2004) and Chaitip et al., (2006, 2008)). If these results can be generalized for future years, then it augurs well for the continued development of the Thailand tourism industry. However the Thai government should reduce cost the of air ticket by reduce tax of aviation fuel for airplane fly from Asian countries to Thailand.

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