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Joo Hwan Seo
Doctoral Students,
Department of Marketing
School of Business
The George Washington University,
Funger Hall, Suite 301,
Washington, D.C 20052, USA.
Phone: 217.766.1693, FAX: 202.994.1630
Joohwans@gwmail.gwu.edu

Sung Yong Park, Ph.D.
Assistant Professor
The Wang Yanan Institute for Studies in Economics,
Xiamen University, Xiamen,
Fujian 361005, China.
Phone: +86-592-2181675, FAX: +86-592-2187708
sungpark@sungpark.net

Soyoung Boo, Ph. D.
Assistant Professor
Department of Tourism and Hospitality Management
School of Business
The George Washington University
Funger Hall, Suite 301s, 2201 G Street, NW,
Washington, DC 20052
Phone: 202.994.6629, FAX: 202.994.1630
soyoungb@gwu.edu

Interrelationships Among Korean Outbound Tourism Demand: Granger Causality Analysis

This study investigated Korean outbound tourism demand and its determinants using the Granger causality (GC) analysis. In contrast to previous studies, which dealt only with internal factors, such as exchange rate and income, this study examined the effects of interactions among countries and, therefore, more complete and relevant results were found. Korean outbound tourism to the USA is causally related to Korean outbound tourism to the other six countries in this present study. These results can be applicable for the purpose of tourism marketing and strategies for industries and governments to allocate tourism resources more efficiently.

Key words: Korean outbound tourism demand, causality relationship, vector autoregressive model, interrelationship

JEL classification: C32, E62

Interrelationships Among Korean Outbound Tourism Demand: Granger Causality Analysis

In South Korea, the overall demand on the part of Koreans for outbound tourism is attributed to leisure, business, observation, meeting and conference, and official duty, respectively. The total number of tourism-related companies in Korea has increased rapidly since 2000 by 29%, and tourism-related income is at almost 5% of the total GDP (Gross Domestic Product) in Korea (Korean Tourism Organization, 2007). Before 1988, the Korean government controlled outbound travel by Korean citizens to restrict the flow of foreign currencies out of the country. As a result, inbound tourism grew quickly and contributed to a surplus in its balance of payment in the travel account. After the lifting of the outbound travel restriction by the Korean government in 1988, outbound travel by Korean tourists gradually increased. Thus, the balance of payments in the travel account has been significantly in deficit for eight consecutive years since 2000. For example, in 2007 the number of inbound tourists to Korea was 6.45 million while the number of Korean outbound tourists was 13.32 million, causing the tourism balance of payment to be in deficit by approximately $10 billion that year (Korea Tourism Organization, 2008). This illustrates the importance of strategic tourism planning among intermediaries for effectively responding to Korean outbound tourism demand.

Inaccurate analysis of tourism demand can potentially cause inconvenience and dissatisfaction for international visitors (Prideaux, Laws, and Faulkner, 2003). For example, the overestimation of tourism demand is likely to lead to an excessive supply of human resources and service facilities, inefficient allocation of resources, and unavoidable profit losses on investments. On the other hand, the underestimation of tourism demand results in inadequate transportation, low levels of service quality, and overcrowding at tourist entry places. These situations can lead to an increase in travel expenditure, thereby degrading tourist attractions (Kim and Wong, 2006).

Identifying whether causality relationships exist among countries can correct inaccurate demand analysis and provide important implications for policy planning, managerial decisions, and destination management. For instance, if country A has a direct causality relationship with country B, this would imply that the amount of outbound travel to country A will affect outbound travel to country B. Knowing this interrelationship can enable tourism organizations and facilities to avoid inaccurate analysis of tourism demand by efficiently allocating tourism resources and goods (i.e., airplane routes and travel), adjusting travel-related products (i.e., travel packages and services) and developing tourism policies (i.e., new open sky agreements).

In general, there are many articles that consider the relationship of tourism demand and macroeconomic variables, such as income and real exchange rate; however, there are few studies on the interrelationships among destinations. This study examines Korean outbound tourism demand for seven major countries during the monthly periods between 1993 and 2006 with the main purpose cited as leisure (Korea Tourism Organization, 2007)[1]. Specifically, this present study is is oriented towards ascertaining whether outbound travel to a particular country has a direct effect on travel to another. This curiosity is derived from the observation that Korean outbound tourists have been shown to be significantly biased toward a number of specific countries (Korea Tourism Organization, 2006). Although the countries preferred by Korean outbound tourists have changed since the mid-1980s, seven countries have been consistently ranked as top overseas destinations by Korean tourists in 2005: China (1^{st}), Japan (2^{nd}), Hong Kong (6^{th}), The Philippines (5^{th}), Singapore (8^{th}), Thailand (4^{th}), and USA (3^{rd}).[2]

The purpose of this study is to investigate causal relationships among these seven destinations regarding Korean outbound tourism demand using two procedures: the vector autoregressive (VAR) model and the Engle and Granger (1987) procedures. Past tourism articles have used the Granger (1980) causality method to analyze bi-directional causal relationships between international trade and tourism (Kulenderan and Wilson, 2000), tourism demand and exchange rate volatility (Webber, 2000), and tourism and economic growth (Oh, 2005; Kim, Chen and Jang, 2006). This study intends to use the Granger test to analyze the multi-directional causal relationships among seven countries for Korean outbound tourism demand. Results are expected to provide new insights into the following: (i) Does a causal relationship exist among countries visited by Korean outbound tourism demand? (ii) Which country visited by Korean outbound tourists is the most exogenous variable? (iii) How volatile is the effect of change in Korean outbound travel to one country on another country visited by Korean outbound tourists?

The contents of this paper are organized as follows: Section 2 presents the literature review and econometric model; Section 3 describes the methodology; Section 4 provides an empirical analysis of Korean outbound tourism demand given by the models in Section 3. Finally, Section 5 closes with conclusion and remarks.

Literature Review

Past studies have focused on causality relationships using variables such as exchange rate, the GDP in the country of origin, international trade, tourism demand, income, and economic growth (Kulendran and Wilson, 2000; Webber, 2000; Shan and Wilson, 2001; Oh, 2005). The research on tourism demand has become an important tool by using theoretical models for causal relationships as demonstrated in studies by Shan and Sun (1988), Kulendran (1996), Turner and Witt (2001), Khan, Toh and Chun (2005), and Oh and Ditton (2005).

Kulendran and Wilson (2000) investigated the relationship between international trade and international travel using time series econometric techniques. Using data for Australia and four important travel and trading partners (the USA, the United Kingdom, New Zealand and Japan), they test three specific hypotheses: business travel leads to international trade; international trade leads to international travel; and international travel, other than business travel, leads to international trade. Using co-integration and Granger-causality approaches, they conclude that a relationship exists between international travel and international trade, and suggest that this may be a fruitful area for further research.

Several tourism articles have focused on the bi-directional causality relationship using the GC test (Shan and Wilson, 2001; Balaguer and Jorda, 2002; Webber, 2000; Dritsakis, 2004; Khan, Toh and Chun, 2005; Oh, 2005; Kim, Chen and Jang, 2006). Shan and Wilson (2001) find a two-way causality between international travel and international trade and hence imply that trade does link with tourism in the case of China. Also, tourism expenditure and real exchange rate (RER) are weakly exogenous to real GDP. A modified version of the GC test shows that causality runs uni-directionally from tourism expenditure and RER to real GDP (Brida, Carrera, and Risso, 2008).

Balaguer and Cantavella-Jorda (2002) conducted a stable long-run relationship between tourism and economic growth using Spanish data from 1975 to 1997. They found that tourism affected Spain's economic growth in one direction, thereby supporting the tourism-led growth. Dritsakis (2004) investigated the impact of tourism on the long-run economic growth of Greece. His findings show that one co-integrated vector is found among GDP, real effective exchange rate, and international tourism earnings from 1960 to 2000. GC tests based on Error Correction Models indicate that there is a strong Granger causal relationship between international tourism earnings and economic growth; a strong causal relationship between real exchange rate and economic growth; and simply causal relationships between economic growth and international tourism earnings; and between real exchange rate and international tourism earnings. This study supports both tourism-led economic development and economic-driven tourism growth.

Khan, Toh and Chun (2005) examined co-integration and causal relationships between trade and tourist arrivals using Singapore data. Their findings are that co-integration between tourism and trade exists, but is not common. Oh (2005) investigated the causal relations between tourism growth and economic expansion for the Korean economy by using the Engle and Granger two-stage approach and a bi-variate vector autoregression (VAR) model. GC tests imply the one-way causal relationship of economic-driven tourism growth.

The hypothesis of tourism-led economic growth has not held in the Korean economy. Kim, Chen and Jang (2006) examined the causal relationship between tourism expansion and economic development in Taiwan. A GC test was performed following the co-integration approach to reveal the direction of causality between economic growth and tourism expansion. Test results indicated a long-run equilibrium relationship and a bi-directional causality between the two factors. In other words, in Taiwan, tourism and economic development reinforce each other.

However, many scholars introduced tourism demand using a causality test, but they only examined bi-directional relationships, such as tourism and trade, tourism and exchange, and tourism and economic growth. This study applies the multi-directional relationships among seven countries visited by Korean tourists.

Econometric Model

The vector autoregressive (VAR) model provides a convenient way to perform the GC test. Since the VAR model is represented by multiple autoregressive processes, $y_t = (y_{1t}, y_{2t,}, \ldots, y_{Nt})'$ should be stationary with $\mathrm{E}(y_t) = \mu < \infty$, and $\mathrm{E}[(y_t - u)(y_{t+h} - u)'] = \Gamma_y(h) < \infty$, for $\forall\ t$, where μ and $\Gamma(h)$ denote the mean vector and the autocovariance function. In general, a VAR model of order p (VAR (p)) can be written by

$$y_t = \Pi_0 + \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + \ldots + \Pi_p y_{t-p} + \Theta D_t + \varepsilon_t, \tag{1}$$

where D_t denotes dummy variables, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots, \varepsilon_{Nt})'$ is $N \times 1$ independent and identically distributed error vector with $E(\varepsilon_t) = 0$ and $N \times N$ variance-covariance matrix, $E(\varepsilon_t \varepsilon_t') = \Sigma$, and $\Pi_0 = (\pi_{10}, \pi_{20}, \ldots, \pi_{n0})'$, Θ and $\Pi, i = 1, 2, \cdots, p$ are

$N \times 1, N \times N$ and $N \times N$ parameter matrices, respectively. Since independent variables corresponding to each dependent variable in the VAR system are the same, the VAR(p) model in (1) can be estimated by the least square method. This means that the system-generalized least square (SGLS) estimators are essentially the same as OLS estimators of an individual equation, when each individual equation has identical independent variables.

Granger proposed a causality test which is the most frequently used causality test in the literature. Denoting Ω_t and G_t by sigma field generated from $\{Z_s\}_{s=-\infty}^{t}$ and $\{y_s\}_{s=-\infty}^{t}$, where $Z_t = (y_t', x_t'\}'$, respectively, "x_t Granger cause y_t" can be written by

$$E(y_{t+k} - E(y_{t+k} \left| \Omega_t \right.))^2 < E(y_{t+k} - E(y_{t+k} \left| G_t \right.))^2, \text{ for } k > 0, \qquad (2)$$

where $y_{t+k} - E(y_{t+k} \left| \Omega_t \right.)$ and $y_{t+k} - E(y_{t+k} \left| G_t \right.)$ are forecast errors conditional on Ω_t and G_t, respectively. The null hypothesis of GC test is that "x_t does not cause y_t" which is rejected if F statistic is significantly different from zero and, therefore, x_t causes y_t. The GC test can be performed within the VAR system given by (1). For example, consider the null hypothesis such that y_j does not Granger-cause y_i. This null hypothesis is nothing but $H_0 : \pi_{ij,1} = \pi_{ij,2} = \cdots \pi_{ij,n} = 0$. Thus, the joint F test yields GC test in the VAR system.

Using the lag-operator, L, the VAR(p) model in (1) can be represented in a matrix form by

$$\prod(L) y_t = \Theta D_t + \varepsilon_t, \qquad (3)$$

where $\prod(L)$ denotes $N \times N$ polynomial matrix of lag operators with

$\Pi(Z) = I - \Pi_1 Z - \cdots \Pi_p Z^p$. if $\Pi(Z)$ satisfying the invertible condition, $\det \Pi(Z) \neq 0$, for $|Z| < 1$, the VAR(p) model can have the moving average expression,

$$Y_t = \sum_{i=0}^{\infty} \psi_i \varepsilon_{t-1} = \Psi(L)\varepsilon_t, \tag{4}$$

where $\Psi(z) = \sum_{i=0}^{\infty} \psi_i z^i$ and $\Psi_0 = I$. However, since the contemporaneous variance-covariance matrix Σ of ε_t is not a diagonal matrix, it is hard to interpret the estimated model (4) economically. This problem can be resolved by replacing Σ with a diagonal variance-covariance matrix, say, Λ. The diagonal nature of Λ can be readily obtained by applying Cholesky decomposition to the Σ. One can, of course, consider the other way or different economic structures to make Λ diagonal matrix. The Cholesky decomposition,

$$\Sigma = LL', \tag{5}$$

is unique because L is given by the lower triangular matrix. From (5), we have $L^{-1} \Sigma L'^{-1} = I$, and, therefore, $A \Sigma A = \Lambda$, where $A = \Lambda^{1/2} L^{-1}$. Thus, the moving average expression in (4) can now be written by

$$Y_t = \sum_{i=0}^{\infty} \psi_i A^{-1} e_{t-i,} \tag{6}$$

where $e_t = A\varepsilon_t$. Define $e_t = \Lambda^{1/2} e_t^*$ so that all the elements in $\{e_t^*\}$ have unit-variance, and therefore, we can rewrite (6) by

$$Y_t = \sum_{i=0}^{\infty} \phi_i e_{t-i}^*, \tag{7}$$

where $\phi_i = \psi_i A^{-1} \Lambda^{1/2}$. Thus, a unit shock to $k-th$ element of $\{e_t^*\}$ that a one standard deviation shock to $k-th$ element of $\{e_t\}$. Denoting $\phi_i \equiv ({}_i\phi_{pq})$, ${}_i\phi_{pq}$, represents the response of $p-th$ variables at time i to the shock generated by $q-th$ structural innovation, e^*_{t-i}. The ${}_i\phi_{pq}$ is called by the orthogonal impulse response function. According to Enders (1995), the forecast error variance decomposition is enabled to understand the sequential proportion of the changeability in a series by its own shocks versus shocks from the other variables. In general, it is expected that variables can make clear almost all of its forecast error variance during the short run and smaller proportions in the long run. The proportion that $q-th$ element in the structural innovation contributes to forecast error variance of $p-th$ variable can be also written by,

$$\frac{\sum_{i=0}^{k-1} {}_i\phi_{pq}{}^2}{\sum_{i=0}^{k-1}(\sum_{j=1}^{N} {}_i\phi_{pj}^2)}, \quad \text{for} \quad k \geq 1. \tag{8}$$

The forecast error variance decomposition is used to explain the contribution of each structural innovation to forecast error variance of all variables in VAR model.

Data description

Few studies have considered the total expenditures as a proxy for tourism demand, but total expenditure data is difficult to obtain on the aggregate level and, moreover, may possess serious measurement error problems. Thus, the number of tourist departures is a proxy variable to measure tourism demand in this paper. This study does not include real exchanges, travel expenditures, and tourist income, since the Korean outbound demand patterns (1993 to 2006) depict outbound tourism that was made in consideration of these variables.

The numbers of Korean outbound tourists for seven countries, China, Hong Kong, Japan, the Philippines, Singapore, Thailand, and the USA, were obtained from the Korea Tourism Organization (KTO, 2007, www. knto.or.kr). Monthly data is available from January 1993 to June 2006, a total of 162 observations. Figure 1 shows the number of Korean outbound tourists visiting the seven countries identified above. Monthly tourist departures was highly volatile but shows an upward trend except for the following periods: the East Asian Monetary Crisis (1997), the September 11, 2001 terrorist attacks, and the Severe Acute Respiratory Syndrome outbreak (SARS, 2003). Since the East Asian Monetary Crisis, the pattern of Korean outbound tourism demand has changed and such causes are attributed to decreasing real income and an increasing rate of real exchange. In addition, international tourism demand for the seven countries have an upward time trend with a cyclical and seasonal pattern. Since 2000, outbound tourism to China has significantly increased due to its geographic proximity, improved political relationships, low travel expenditures, open sky agreements (2006), and vigorous promotions by Korean and Chinese tourism industries.

[Figure 1 Here]

As illustrated in the previous section, VAR(p) models should be stationary to make appropriate inferences for this study. The natural logarithm was taken for each stack variable. Engle and Granger (1987) explained that, if the variables are non-stationary, the procedure of a conventional econometric method can be inappropriate. Stationarity implies that the mean and variance of the series are constant throughout the time period. In addition, the auto-covariance of the series is not time-varying (Enders, 1995). Augmented Dickey-

Fuller (Dickey and Fuller, 1979) and Phillips-Perron (Phillips and Perron, 1988) tests are applied for unit root test. Table 1 illustrates the results of unit root tests. It is clear that all the outbound tourism demand figures do not have unit-root.

[Table1. Here]

Empirical analysis of results

In the GC tests, VAR(p) models are estimated to determine the number of lagged variables required in order to accept the best appropriate model. Once the appropriate number of lag lengths is chosen for GC test, the restricted and unrestricted regressions can be estimated to determine the F statistic. Table 2 shows the results of lag length selection with four criteria, such as FPE and Akaike Information Criteria (AIC), Schwarz Bayesian Criteria (SBC), and Hannan-Quinn (HQ). FPE and AIC choose the order 2, whereas SBC and HQ support the order 1.

[Table2. Here]

This study chooses order 2 as an optimal lag length selection according to AIC.[3] Although we do not provide other results with different lag truncation, the results were consistent with different lag selections.

Table 3 shows the results of the causality test for Korean outbound tourism demand among seven countries. These results show that some degrees of interrelationship were detected among seven countries.

[Table3. Here]

The results are reported in Table 3 and summarized in Figure 2. There is a difference between the two graphs: at the 1% significance level the edges – i) USA directly causes five countries, such as China, Hong Kong, The Philippines, Singapore, and Thailand, ii) Hong Kong directly causes Singapore, and iii) Japan directly causes The Philippines: at the 5% significance level the edges – i) China directly causes Japan and USA, ii) Hong Kong directly causes Thailand, iii) Singapore directly causes China and Thailand, iv) The Philippines directly cause Japan, and v) USA causes Japan.

[Figure 2. Here]

Given the causal structure summarized in Figure 2, Korean outbound tourism demand for the USA causes Korean outbound tourism demand for all other countries at the significance levels (either 1% or 5%), while only Korean outbound tourism demand for China is causally related to the demand for the USA at the 5% significance level but the other countries do not cause the demand for the USA at the significance level. In Japan's case, China, the Philippines, and the USA directly cause Japan at the 5% significance level, but only Japan causes the Philippines at the 1% significance level. Thus, there is a reciprocal relationship between China and the USA, and between Japan and the Philippines among the seven countries. In Thailand's case, the tourism demand does not affect other countries, but Hong Kong, Singapore, and the USA directly cause Thailand at the significance level (either 1% or 5%).

The results of the GC tests are used to examine forecasting error variance decomposition analysis. The variance decomposition is the sequential proportion of the movements because of its own shocks and shocks to other variables. This study used "Cholesky ordering" in this paper due to its simplicity and convenience.[4] As can be seen from Table 4, each country is shown to be largely autonomous in variance decomposition, while the Philippines, Singapore, and Thailand are seen to be mainly dependent on the USA. Also, the results of all the variance decompositions show that all countries are revealed to be influenced by the USA, with at least 20%. In China's case, China is shown to be mostly autonomous in variance decomposition. Hong Kong and the USA explain 19.50% and 20.26% up to 3 months, respectively: Hong Kong is decreasing 14.06 % but the USA is increasing 25.50% in the long run. In the Philippines' case, this country is shown to be mostly USA with an average about 44% in variance decomposition, and explained to Hong Kong with about 16.21% up to 3 months and about 11.64% in the long run, while the case of the Philippines is shown to be autonomous nearly 31.96% up to 3 months and about 23.28% in the long run.

[Table4. Here]

In the cases of Singapore and Thailand, the USA has a nearly 45% impact on these countries, although Singapore and Thailand are shown to be autonomous about 29% and 22% in the long-run, respectively. Also, Hong Kong affects Singapore and Thailand moderately, with nearly 17% and 22%, respectively. Although the USA is explained to be largely self-sufficient at least 81%, the variance of China has an effect with an average of 10%.

Unexpectedly, the USA is always shown to be largely autonomous for Singapore, the Philippines, and Thailand in variance decomposition. Among the seven countries, these three destinations have been popular with Korean tourists since the 1990s for leisure purposes, such as honeymoon, golf, and vacation. It is expected that Korean outbound tourism demand for the USA can explain variance decomposition since the USA is the most exogenous country. Additionally, it is well known that the average amount of travel expenditures for the USA by Korean outbound tourists is the highest among the seven countries. From the results, we can predict that Korean outbound tourism demand for the USA can affect more leisure destinations, since over 70% of Koreans traveled to Singapore, the Philippines, and Thailand for leisure purposes. For these three destinations, the real exchange rate is a better indicator for Korean outbound tourism demand, and Korean outbound tourists are more concerned with the price of tourism (Seo, Park and Yu, 2008). Thus, Korean outbound tourists are more inclined to visit Singapore, Thailand, and the Philippines when the exchange rate is to their advantage (Seo et al., 2008).

Concluding Remarks

This study investigated the relationships of Korean outbound tourism demand among seven countries using the Granger causality method and without direct consideration of tourist spending data, real exchange rates, and income. The results of the Granger causality are statistically significant and economically important. Top-ranked outbound destinations by Koreans showed causal relationships that were either uni-directional or multi-directional. Meanwhile, Korean outbound tourism for the USA directly caused Korean outbound tourism for the other six countries.

Therefore, a number of policy recommendations stem from this research. Firstly, Korean outbound tourism to the USA can be a good primary signal for developing appropriate tourism policies. If Korean outbound tourism to the USA changes, it is expected to also change in interrelated countries. Thus, Korean outbound tourism to the USA, an exogenous country, should be carefully monitored to foresee potential opportunities or threats in international travel. Secondly, leisure is the main purpose of visit for outbound Korean tourists willing to visit more endogenous countries such as Singapore, the Philippines, and Thailand. Moreover, these three countries for Korean outbound tourism demand can be explained by the USA tourism demand in variance decomposition. The travel industry in Thailand, for example, may consider forming a strategic alliance with Singapore to jointly develop tourism products and services due to their interrelationship. Thirdly, Korean outbound tourism to China and Japan may affect other countries in the future due to recent open sky agreements with China (2006) and Japan (2007), as well as the visa-free program (2006) between Korea and Japan.

In the future, government policymakers and travel-related product managers should reform their policies with regards to developing effective resources. Also, decision-makers and general managers involved in tourism-related issues can develop appropriate tourism projects. As far as policy implications are concerned, based on this evidence, one can argue that policy strategies need to be evaluated in conjunction with changes in Korean outbound tourism demand.

Endnotes

[1] Overall, Korean outbound tourism demand of leisure purpose for China, Japan, Hong Kong, The Philippines, Singapore, Thailand, and USA was 56%, 58%, 57%, 81%, 71%, 85%, and 38%, respectively in 2005 (Korean Tourism Organization, 2007).

[2] Vietnam (7th) was excluded as it started to gain popularity in 2004, whereas Singapore (8th) had consistently served as a top destination since 1993.

[3] The empirical results with log truncation order 2 are essentially very similar to those with log truncation order 1.

[4] The Cholesky ordering is from exogenous to endogenous, resulting in an ordering of USA Hong Kong, Singapore, China, Philippines, Japan, and Thailand, respectively.

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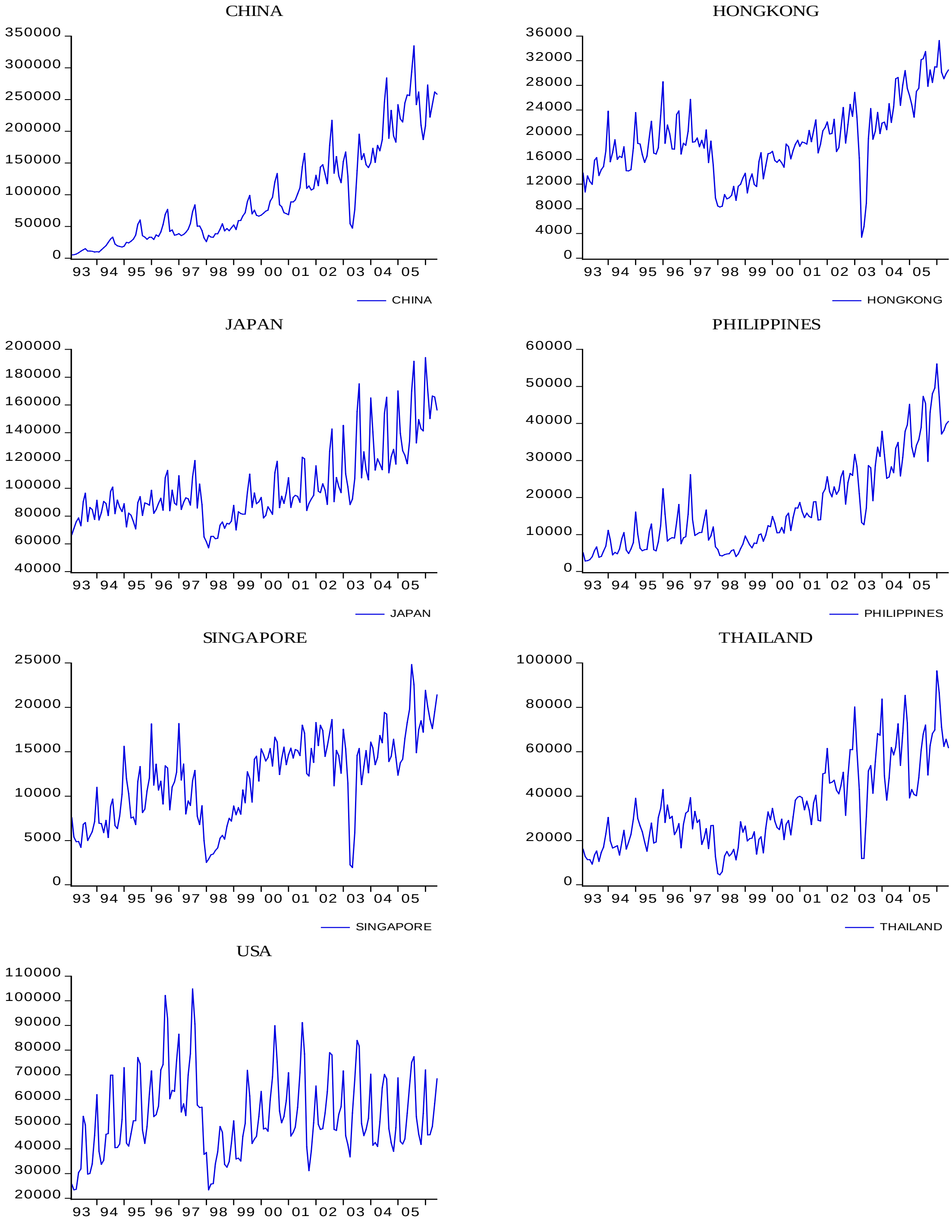
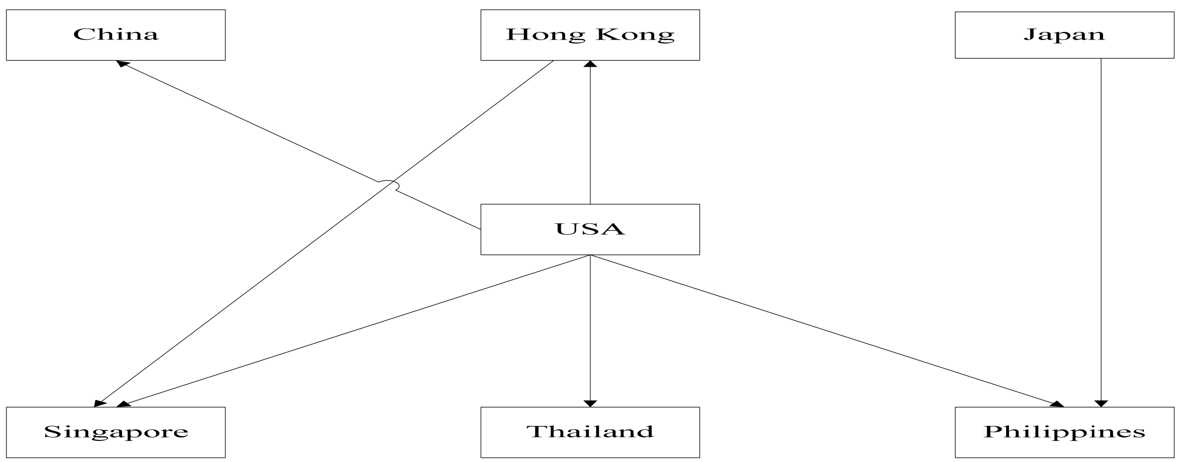


Figure 1. The number of Korean outbound tourists for seven countries

(A): 1% Significance level



(B): 5% Significance level

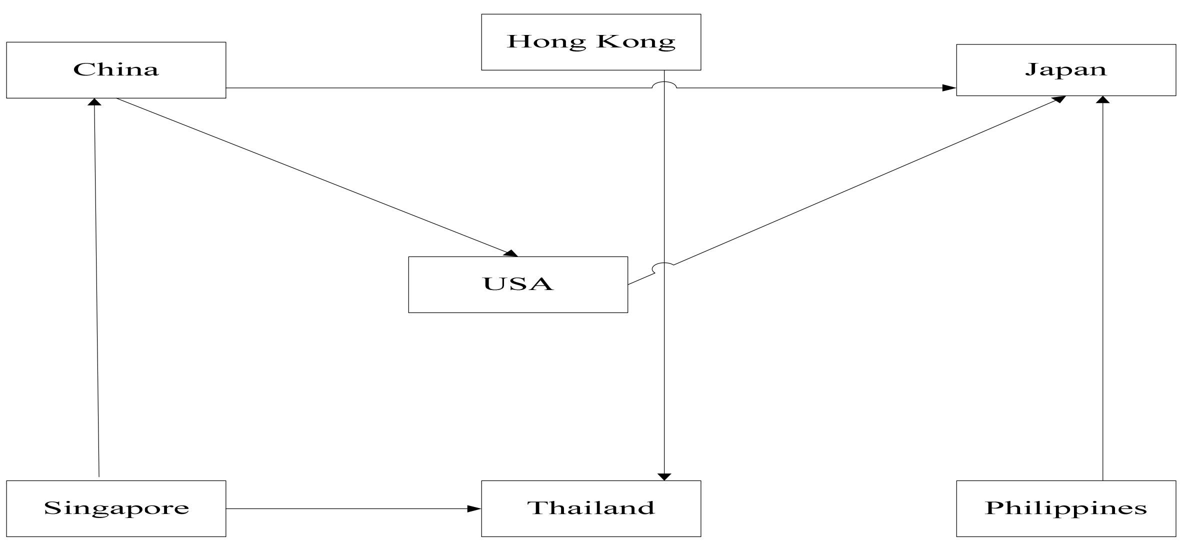


Figure 2. Pattern of Korean outbound tourism demand among seven countries 1993-2006, 1%(A) and 5% (B) significance levels.

Table 1. The results of unit root test

Country	Variables	
	ADF	P-P
China	-4.472402 (0.0000) [1]	-4.101712 (0.0001) [8]
Hong Kong	-3.05989 (0.0024), [3]	-3.80107 (0.0002), [8]
Japan	-2.04622 (0.0394), [7]	-3.81347 (0.0002), [19]
Philippines	-2.47669 (0.0133), [7]	-3.60218 (0.0004), [18]
Singapore	-3.61251 (0.0004), [2]	-3.80224 (0.0002), [6]
Thailand	-3.38896 (0.0008), [3]	-4.1614 (0.0000), [12]
United States	-3.03218 (0.0026), [0]	-3.07699 (0.0023), [1]

Notes: ADF and P-P denote augmented Dickey-Fuller and Philips-Perron unit-root test statistics, respectively. Numbers in ( ) and [ ] represent p–value and lag-order (or bandwidth).

Table 2. Lag selection

Lag	FPE	AIC	SBC	HQ
0	1.77E-12	-7.19782	-6.5076	-6.91745
1	2.22E-14	-11.5776	-9.921096*	-10.90474*
2	1.59e-14*	-11.91842*	-9.2956	-10.853
3	1.64E-14	-11.8986	-8.30949	-10.4407
4	1.96E-14	-11.743	-7.18755	-9.89258
5	1.88E-14	-11.8233	-6.30155	-9.58036

Notes: * indicates lag order selected by the criterion. FPE, AIC, SC, and HQ denote final prediction error, Akaike information criterion, Schwarz Bayesian criterion, and Hannan-Quinn information criterion, respectively.

Table 3. The Results of Granger causality test with monthly data (1993-2006)

	H.K $\nrightarrow$ CHN	JP $\nrightarrow$ CHN	PH $\nrightarrow$ CHN	SING $\nrightarrow$ CHN	THAI $\nrightarrow$ CHN	U.S $\nrightarrow$ CHN
Test	3.547187	1.514434	2.089027	6.247989	3.163012	24.45858
p-Value	0.1697	0.469	0.3519	0.044	0.2057	0
	CHN $\nrightarrow$ H.K	JP $\nrightarrow$ H.K	PH $\nrightarrow$ H.K	SING $\nrightarrow$ H.K	THAI $\nrightarrow$ H.K	U.S $\nrightarrow$ H.K
Test	3.665201	4.116748	1.751942	5.968548	2.286777	10.06194
p-Value	0.16	0.1277	0.4165	0.0506	0.3187	0.0065
	CHN $\nrightarrow$ JP	H.K $\nrightarrow$ JP	PH $\nrightarrow$ JP	SING $\nrightarrow$ JP	THAI $\nrightarrow$ JP	U.S $\nrightarrow$ JP
Test	8.854821	0.361545	7.232893	3.171508	2.684751	7.640431
p-Value	0.0119	0.8346	0.0269	0.2048	0.2612	0.0219
	CHN $\nrightarrow$ PH	H.K $\nrightarrow$ PH	JP $\nrightarrow$ PH	SING $\nrightarrow$ PH	THAI $\nrightarrow$ PH	U.S $\nrightarrow$ PH
Test	1.909751	1.649257	16.33037	1.45658	3.419979	11.36726
p-Value	0.3849	0.4384	0.0003	0.4827	0.1809	0.0034
	CHN $\nrightarrow$ SING	H.K $\nrightarrow$ SING	JP $\nrightarrow$ SING	PH $\nrightarrow$ SING	THAI $\nrightarrow$ SING	U.S $\nrightarrow$ SING
Test	0.422855	11.96327	4.037282	3.351114	1.605676	16.42177
p-Value	0.8094	0.0025	0.1328	0.1872	0.4481	0.0003
	CHN $\nrightarrow$ THAI	H.K $\nrightarrow$ THAI	JP $\nrightarrow$ THAI	PH $\nrightarrow$ THAI	SING $\nrightarrow$ THAI	U.S $\nrightarrow$ THAI
Test	0.201471	6.566345	0.883316	0.862924	8.377285	17.09011
p-Value	0.9042	0.0375	0.643	0.6496	0.0152	0.0002
	CHN $\nrightarrow$ U.S	H.K $\nrightarrow$ U.S	JP $\nrightarrow$ U.S	PH $\nrightarrow$ U.S	SING $\nrightarrow$ U.S	THAI $\nrightarrow$ U.S
Test	8.155104	5.133487	4.263272	1.853487	5.866451	2.137142

p-Value	0.0169	0.0768	0.1186	0.3958	0.0532	0.3435

Notes: The null hypothesis test, $H_0 : A \nrightarrow B$, implies "x_t does not cause y_t".

Table 4. The results of the forecast error variance decomposition

	Variance Decomposition						
Period	China	Hong Kong	Japan	Singapore	Philippines	Thailand	US
China							
3	55.41993	19.50411	0.521867	2.177901	0.87034	1.244086	20.26177
6	52.4007	15.70825	0.847521	1.760148	0.919483	3.621617	24.74227
9	51.93463	14.66074	1.07933	1.621488	0.890809	4.229245	25.58375
12	51.86628	14.24078	1.235843	1.577563	0.91108	4.541873	25.62658
15	51.80544	14.06932	1.35262	1.5665	0.924227	4.71599	25.56591
18	51.77299	13.99458	1.423041	1.56741	0.93255	4.805803	25.50362
Hong Kong							
3	1.26891	60.1112	1.708323	0.330775	0.715409	0.191269	35.67411
6	1.504198	52.1144	4.974097	2.613116	1.083589	1.019902	36.6907
9	1.594555	49.88802	5.837163	3.578389	1.050305	1.304266	36.7473
12	1.62375	49.22671	5.978284	3.981844	1.03736	1.352896	36.79916
15	1.652481	49.015	6.000018	4.122637	1.034233	1.360583	36.81505
18	1.670937	48.94775	5.997922	4.167312	1.034619	1.359735	36.82173
Japan							
3	5.460152	3.460032	57.44051	0.775642	1.778288	0.546684	30.5387
6	4.816803	3.143347	52.48504	2.35764	5.487661	1.842309	29.8672
9	4.597564	3.069533	52.32352	3.013429	5.254452	2.754391	28.98711

12	4.599054	3.038016	51.96455	3.425849	5.223548	3.00046	28.74853
15	4.588698	3.037648	51.83346	3.605827	5.19461	3.103198	28.63656
18	4.585704	3.038124	51.7779	3.680893	5.184146	3.135135	28.5981
Philippines							
3	2.494223	16.20859	3.788399	1.119523	31.96178	0.152039	44.27544
6	5.276252	12.72227	9.933494	1.523894	25.30809	0.648678	44.58732
9	5.4722	12.01435	10.19625	2.079251	24.01371	0.737615	45.48662
12	5.6434	11.76104	10.29665	2.363385	23.50934	0.758415	45.66777
15	5.730879	11.6747	10.27601	2.486222	23.33702	0.756808	45.73836
18	5.782269	11.64418	10.25718	2.529589	23.27742	0.755011	45.75434
Thailand							
3	1.312769	24.29993	1.927391	25.74545	0.322176	0.018241	46.37404
6	2.568932	19.40108	4.451795	28.29038	0.291445	0.778648	44.21772
9	3.122072	18.33799	4.54476	29.07213	0.378551	0.835467	43.70903
12	3.418232	18.03214	4.483896	29.22921	0.43035	0.823395	43.58278
15	3.604112	17.92261	4.461796	29.20291	0.464949	0.831535	43.51209
18	3.703996	17.87797	4.466025	29.15736	0.482174	0.849269	43.46321
Singapore							
3	0.444957	22.16999	0.61786	7.270299	0.437705	23.81384	45.24535
6	1.053789	20.50847	1.549551	9.61906	1.022137	22.4575	43.78949
9	1.262144	20.21334	1.826044	10.09892	1.131323	22.18945	43.27878

12	1.274794	20.15652	1.821523	10.26316	1.133552	22.1252	43.22525
15	1.294628	20.13998	1.820416	10.29435	1.143295	22.10618	43.20115
18	1.304006	20.13397	1.822931	10.29876	1.146754	22.10165	43.19192
USA							
3	2.840094	0.023139	1.708617	0.391885	0.394401	0.170678	94.47119
6	7.972185	0.1554	2.772273	1.265345	0.896574	0.274859	86.66336
9	10.57503	0.180873	3.067686	1.690303	0.780339	0.251107	83.45466
12	11.6425	0.213041	2.980512	1.91064	0.74409	0.277855	82.23136
15	12.20178	0.225436	2.924589	1.981599	0.742503	0.317642	81.60645
18	12.46985	0.233514	2.906377	1.995886	0.748644	0.358086	81.28764