A Tourism Conditions Index*

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Abstract

This paper uses monthly data from April 2005 to August 2013 for Taiwan to propose a novel tourism indicator, namely the Tourism Conditions Index (TCI). TCI accounts for the spillover weights based on the Granger causality test and estimates of the multivariate BEKK model for four TCI indicators to predict specific tourism and economic environmental indicators for Taiwan. The foundation of the TCI is the Financial Conditions Index (FCI), which is derived from the Monetary Conditions Index (MCI). The empirical findings show that TCI weighted by spillovers reveal greater significance in forecasting the Composite Index (CI), an economic environmental indicator, than the Tourism Industry Index (TII), which is an existing indicator for the tourism industry that is listed on the Taiwan Stock Exchange (TWSE). Moreover, previous values of the alternative TCI and TII are shown to contain useful information in predicting both tourism and economic environmental factors. Overall, the new Tourism Conditions Index is straightforward to use and also provides useful insights in predicting tourism arrivals and the current economic environment.

Keywords: Monetary Conditions Index (MCI), Financial Conditions Index (FCI), Tourism Conditions Index (TCI), BEKK, Spillovers, Granger causality.

JEL: B41, E44, E47, G32.

1. Introduction

Despite political upheaval, economic uncertainty and natural disasters around the world in recent years, the global travel, tourism and hospitality industry, which is one of the world's leading economic and financial industries, has experienced continued growth. According to the World Tourism Organization (UNWTO), international tourist arrivals worldwide have more than doubled since 1990, rising from 435 million to 675 million in 2000, to 940 million in 2010, growing by a further 4% in 2012 to reach 1.035 billion, and is forecast to increase by 3% to 4% in 2013. These figures are in line with the UNWTO long term forecast for 2030, namely 3.8% increase per year, on average, between 2010 and 2020. Moreover, tourism arrivals are expected to increase by 3.3% each year from 2010 to 2030, representing 43 million additional international tourist arrivals annually, reaching a total of 1.8 billion arrivals by 2030.

The latest annual findings from the World Travel and Tourism Council (WTTC) and Oxford Economics show that Travel & Tourism's contribution to GDP grew for the third consecutive year in 2012. The total contribution comprised 9% of global GDP (US $6.6 trillion) and generated over 260 million jobs, that is, 1 in 11 of global employment. With a stronger performance than the rest of the economy, the importance of the Travel &Tourism sector for economic growth and development is undisputed. In order to provide further support to enable accurate forecasts of the tourism and economic environments, a tourism index that is closely related to economic growth and development would be helpful to public and private decision makers, such as government, business executives and investors.

Recent years have seen increasing attention being paid to building tourism indexes for both the public and private sectors. For example, (i) the tourism industry stock index represents the performance of stocks of tourism-related firms listed on the stock market; (ii) the tourism climatic index (Mieczkowski, 1985) estimates world climates for tourism; (iii) the tourism index published by the World Economic Forum assesses the obstacles and drivers of Travel & Tourism development; (iv) the Travel and Tourism Competiveness Index (TTCI) (Blanke & Chiesa, 2013); and (v) the statistical information of tourism listed on Tourism Bureau Executive Information System available on the government's website, are just a few of the available tourism-related indexes.

However, from the global economic viewpoint, in general, tourism is sensitive to the impacts from the international economic environment, such as price levels, exchange rates, interest rates, and industry promotion policies. On the other hand, as foreign visitors who travel to a country will purchase that country's tourist experience, the tourism industry is considered to be an export industry. The impacts arising from both exchange rates and interest rates affect the tourism and economic environments, such as the growth in international visitor arrivals, and domestic and international of business investment.

Therefore, a composite tourism indicator, taking account of both the economic and tourism environments as a whole, is desirable to assist in decision making for public and private policy makers. However, such an analysis pertaining to tourism indicators is limited. In order to incorporate greater information for purposes of forecasting future tourism and economic environments in a straightforward manner, this paper proposes a new tourism indicator, namely the Tourism Conditions Index (TCI).

The premise underlying the TCI index is that it should be linked closely to both the economic and tourism environments. Therefore, three key components comprise the TCI, namely the tourism industry stock index, exchange rate, and interest rate, which represent tourism performance, tourism demand and tourism capital costs, respectively.

The foundation of the proposed TCI is an application of the Financial Conditions Index (FCI), which is derived from the Monetary Conditions Index (MCI). As stated by the Bank of Canada, the MCI is an index number calculated from a linear combination of two variables, namely the short-run interest rate and an exchange rate, that are deemed relevant for monetary policy. Based on the MCI, the FCI takes account of an extra factor, namely real asset prices, such as house prices and stock prices, to assess the conditions of financial markets (see Beaton, Lalonde, & Luu, 2009; Brave & Butters, 2011; Ericsson, Jansen, Kerbeshian, & Nymoen, 1997; Freedman, 1994, 1996a, b; Hatzius, Hooper, Mishkin, Schoenholtz, & Watson, 2010; Lin, 1999; and Matheson, 2012). Further details are given below in Section 4.

The aim of this paper is threefold: (i) construct a Tourism Conditions Index (TCI); (ii) use the Granger causality test to test causality from the TCI to two tourism environmental indicators, namely inbound arrivals (Arrivals) and inbound arrivals for pleasure (Tourists), and one economic environmental factor, namely coincident indicators (CI); and (iii) explore how spillover effects from exchange rates (EERI), interest rates (Interest), and stock prices (Stock) affect the possible Granger causality from the TCI to each of Arrivals, Tourists, and the CI.

The coincident indexes combine several indicators to summarize current economic conditions into a single statistic. The components of coincident indicators (CI) are the following: industrial production index (2006=100), electric power consumption (billion kWh), index of producer's shipment for manufacturing (2006=100), sale index of wholesale retail and food services (2006=100), nonagricultural employment (1,000), real customs-cleared exports (NT$ billion), and real machinery and electrical equipment import (NT$ billions) (Council for Economic Planning and Development, Taiwan) (Nieh & Chou, 2002).

The remainder of the paper is structured as follows. Section 2 explains the proxies for analyzing the tourism and economic environments. Section 3 describes the data used in the analysis, and presents descriptive and summary statistics. Section 4 discusses the methodology and methods used in the analysis. Section 5 discusses the empirical results. Section 6 concludes the paper by summarizing the key empirical results and findings.

2. Forecasting Environmental Indicators

This section describes the proxy variables for environmental indicators, the tourism and economic environments, which the TCI will be used to forecast, after using the Granger causality test.

2.1 Proxy Variables for the Tourism and Economic Environments

This paper uses two variables, namely inbound arrivals (Arrivals) and inbound arrivals for pleasure (Tourists), as proxies for the current tourism environment, while the Composite Coincident Index (CI) denotes the current economic environment.

2.2 Granger Causality Test

Granger causality is a statistical procedure that is based on predictability. The outcomes of Granger causality tests can be used to predict variable using the information set, namely the previous values of all the variables. In this sense, Granger causality is taken to be synonymous with predictability.

According to the Granger causality test, if X "Granger-causes" Y, then previous values of X contain useful information that can be used to predict Y (see Granger, 1969). A bivariate autoregressive process of y_t and x_t is given as:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots + \alpha_L y_{t-L} + \beta_1 x_{t-1} + \cdots + \beta_L x_{t-L} + \varepsilon_t$$

$$x_t = \gamma_0 + \gamma_1 x_{t-1} + \cdots + \gamma_L x_{t-L} + \delta_1 y_{t-1} + \cdots + \delta_L y_{t-L} + u_t$$

where L is the number of lags (or the model order) for all possible pairs of (x, y). In the empirical analysis below, $L = 10$. The reported F-statistics are the Wald statistics for the null hypotheses:

$$H_0: \beta_1 = \beta_2 = \cdots = \beta_L = 0$$

and

$$H_0: \delta_1 = \delta_2 = \cdots = \delta_L = 0$$

for each of the two equations. The null hypothesis is that x does not Granger-cause y in the first equation, and that y does not Granger-cause x in the second equation.

By using Granger causality, this paper explores whether previous values of TCI contain information that can be used to forecast the proxy variables, namely Arrivals, Tourists, and the CI, using the previous tourism and economic environmental indicators.

3. Data

In this section we present the data used for the empirical analysis. Monthly data are used from April 2005 to August 2013. The sources of data are the Taiwan Stock Exchange (TWSE), Taiwan First Bank and Taipei Foreign Exchange Market Development Foundation for the tourism industry stock index, one-year deposit rate, and the nominal effective exchange rate, respectively.

Furthermore, as mentioned in Section 1, one of the purposes of this paper is to explore how spillovers from exchange rate returns (EERI), interest rates (Interest), and stock prices (Stock) affect the Granger causality from the TCI to each proxy variable, namely Arrivals, Tourists, and the CI. For further analysis, here we define alternative TCI variables as TCI without and with spillovers, namely TCI_Origin, TCI_EERI, TCI_Interest, and TCI_Stock, as shown as Table 1.

4. Foundations of the Tourism Conditions Index (TCI)

In this section we describe the foundations of the Tourism Conditions Index (TCI). As mentioned above, the Tourism Conditions Index (TCI) is an application of the Financial Conditions Index (FCI), which is derived from the Monetary Conditions Index (MCI).

4.1 Definition of MCI

Freedman (1994, 1996a, b) discussed the units of measurement of the MCI in terms of real interest rate changes. The MCI is defined as:

$$\mathrm{MCI_t} = \theta_r(r_t - r_0) + \theta_e(e_t - e_0) \tag{4.1}$$

The subscripts t and 0 denote the current and base periods, respectively, and θ_r and θ_e are the weights attached to real interest rates (r) and real effective exchange rates (e) (in logarithms), respectively. Furthermore, the weights on the components of the MCI (that is, θ_r and θ_e) are the results of empirical studies that estimate the effect on real aggregate demand over six to eight quarters of changes in real interest rates and real exchange rates.

Based on equation (4.1), the MCI may be interpreted as the percentage point change in real interest rates equivalent to the combined change in real interest rates and real exchange rates since the base period. As the MCI is measured relative to a given base period, subtracting the MCI at two points in time gives a measure of the degree of tightening or easing between these two points. Lack(2003) discusses the experience of various countries, such as Canada and New Zealand, that have used the MCI as an operating target.

4.2 Definition of FCI

Owing to the recent high volatility in stock and property prices, the influence of asset prices on monetary policy has drawn greater attention of policy makers. Significant efforts have been made recently to extend additional asset variables, such as stocks and housing prices into the MCI as a new indicator, namely the Financial Conditions Index (FCI) (see Goodhart and Hofmann (2001) for the G7 countries, Mayes and Virén (2001) for 11 European countries, and Lack (2003) for Canada and New Zealand).

The FCI is defined as:

$$\mathrm{FCI}_t = \theta_r(r_t - r_0) + \theta_e(e_t - e_0) - \theta_a(a_t - a_0) \tag{4.2}$$

The subscripts t and 0 denote the current and base periods, respectively, and θ_r, θ_e, and θ_a are the weights attached to real interest rates (r), real effective exchange rates (e) (in logarithms), and real assets (a) (in logarithms), respectively. Furthermore, the relative weights on the components of the FCI, θ_r, θ_e, and θ_a, are the outcomes of empirical estimation.

Notice that FCI reveals the offsetting influences among real asset prices, real interest rates and real effective exchange rates. If the interest rate or exchange rate increases, in an opposite direction to foreign capital flows and investment, there will be a negative impact on the prices of domestic real assets.

4.3 Construct the TCI

As mentioned previously, the Tourism Conditions Index (TCI) proposed in this paper focuses on economic activities related to the tourism industry. Three components of TCI are as follows: nominal effective exchange rates, interest rates (namely, the one-year deposit rate), and the tourism industry stock index that is listed on the Taiwan Stock Exchange.

The TCI is defined as:

$$\mathrm{TCI}_t = \theta_a(a_t - a_0) - \theta_e(e_t - e_0) - \theta_r(r_t - r_0) \qquad (4.3)$$

where a, r, and e denote the assets–tourism industry stock index (in logarithms), effective exchange rates (in logarithms), and interest rates, respectively. The subscripts t and 0 denote the current and base periods, respectively, and $\theta_r, \theta_e,$ and θ_a are the weights attached to interest rates, effective exchange rates, and assets–tourism industry stock index, respectively.

This paper proposes four kinds of TCI that vary according to the weights attached to the TCI:

(i) TCI_Origin, which is weighted equally ($\theta_a = \theta_r = \theta_e = 1$), so that TCI ignores any spillovers; and

(ii) TCI_EERI, TCI_Interest, and TCI_Stock, which are weighted by ($\theta_a, \theta_r,$ and θ_e), and are derived from three types of volatility spillovers (namely, stock returns, exchange rate returns, and differences in interest rate), as estimated by the BEKK model, implying TCI with different spillovers. Further details are given in Section 5.3.

As indicated previously in Section 4.2, there are offsetting influences on the FCI from asset prices and economic variables, which also applied to the TCI. For example, if the interest rate rises (that is, raises the cost of capital) or the effective exchange rate rises (that is, an increase in the value of the domestic currency), the number of inbound tourists will fall, with a negative effect on revenues of the tourism industry. In other words, when the TCI rises, the tourism industry stock index also rises, but the nominal effective exchange rates and interest rates fall, implying the tourism industry experiences a boom.

5. Empirical Results

This section discusses how to construct the TCI and undertake diagnostic checking of the empirical results. Ten monthly time series shown as Table 1 are conducted. The empirical findings for each TCI model are discussed as below. Estimation of the models and calculation of the diagnostic checks were undertaken using the EViews and RATS econometric software packages.

[Table 1 here]

5.1 Descriptive Statistics of Monthly Data

This paper examines the six monthly time series data graphically. Figures 1 to 3 plot the log differences of stock prices (R_Stock) and exchange rates (R_EERI), the interest rate differences (D_interest) and CI differences (D_CI), followed by Arrivals and Tourists, respectively. Moreover, the basic descriptive statistics for six monthly series are shown in Table 2.

[Figures 1- 3 here]

[Table 2 here]

In general, all six series do not display significant leptokurtic behaviour, as evidenced by small kurtosis in comparison to the normal distribution. In addition, four of the six series show mild positive skewness, with only Stock and CI being negatively skewed. The Jarque-Bera Lagrange multiplier test statistics for normality indicate that none of these six series, except Stock, is normally distributed, which is not surprising for monthly data.

5.2 Unit Root Test of Monthly Series

A unit root test examines whether a time series variable is non-stationary. Two well-known tests, the GLS-detrended Dickey-Fuller test and the Phillips-Perron (PP) test, are used to test for unit root processes in stock price returns. The results of the unit root tests are shown in Table 3, and indicate that all ten series are stationary, which is not surprising. The unit root tests for each individual series reject the null hypothesis of a unit root at the 5% level of significance, except for D_CI (differences in CI), impling the D_CI series is stationary at the 5% level according to the GLS-detrended Dickey-Fuller test, but at the 10% level according to the Phillips-Perron (PP) test.

[Table 3 here]

5.3 TCI Models and Weights

This paper proposes four kinds of TCI, namely TCI without weights (TCI_Origin), and TCI with different weights derived from alternative volatility spillovers, namely exchange rate returns (TCI_EERI), differences in interest rates

(TCI_Interest), and stock returns (TCI_Stock), estimated using the BEKK model. The empirical results are given in Table 4.

The multivariate GARCH model is developed to examine the joint processes relating several different series (that is, Y_t). The following conditional mean equation at time *t* accommodates each variable's own past values at time *t-1* and the returns of other variables that are also lagged one period:

$$Y_t = \varphi + G \cdot Y_{t-1} + \varepsilon_t, \quad \varepsilon_t | I_{t-1} \sim N(0, H_t) \tag{5.1}$$

where Y_t is an $n \times 1$ vector of daily returns at time *t* for each returns series (in the empirical application, n= 3 for exchange rate returns, differences in interest rates and stock index returns), and the conditional distribution of returns is $\varepsilon_t | I_{t-1} \sim N(0, H_t)$. The $n \times 1$ vector of random errors, ε_t, represents the shocks for each series at time *t*, with corresponding $n \times n$ conditional covariance matrix, H_t. The public information available at time *t*-1 is represented by the information set, I_{t-1}. The $n \times 1$ vector, φ, represents the long-term drift coefficients.

The BEKK formulation of Baba et al. (1985) and Engle and Kroner (1995) (see also the caveats regarding the model given in McAleer (2005) and Caporin and McAleer (2013)), imposes positive definiteness on the conditional covariance matrix. The multivariate BEKK model is given as:

$$H_t = WW^{'} + A\boldsymbol{\varepsilon_{t-1}}\boldsymbol{\varepsilon'_{t-1}}_{A'} + BH_{t-1}B' \tag{5.2}$$

The diagonal elements of the parameter matrix, *B*, measure the own-effects of lagged conditional volatility, while the off-diagonal elements capture the cross-asset effects. With all the parameters entering through quadratic forms, changing the signs of all the elements of *W*, *A*, or *B* will have no effect on the conditional covariance. The stationarity condition is given by $\alpha^2{}_{ii} + \beta^2{}_{ii} < 1,\ i = 1,2$, where the notation is obvious. Furthermore, we need have only $\frac{n(n+1)}{2}$ free parameters as the BEKK specification is parameterized to be lower triangular.

The parameters of the model are obtained by maximum likelihood estimation (MLE) using a joint normal density function. When the matrix of returns shocks does not follow a joint multivariate normal distribution, the appropriate method is to use quasi-maximum likelihood estimation (QMLE) (see, for example, McAleer (2005) and Chang, McAleer, & Tansuchat, (2011)).

As mentioned in Section 4.3, equation (4.3) describes the structure of TCI, where θ_a, θ_e, and θ_r denote the weights of each component (see Table 4). There are three kinds of weights according to three different volatility spillovers arising from exchange returns (R_EERI), stock returns (R_Stock), and differences in interest rate (D_Interest), as estimated by the BEKK model. For example, in the column R_EERI, the coefficients 0.3912(β_{E_{t-1},S_t}), 1.5351(β_{E_{t-1},E_t}), and 5.5559(β_{E_{t-1},I_t}) denote θ_a, θ_e, and θ_r, the weights of each component of TCI_EERI, which refers to the TCI weighted by exchange rate returns spillovers.

Referring to the estimated coefficients of β in Table 4, most of the weights reveal significant volatility spillovers at the 5% level. However, two cases, β_{E_{t-1},I_t} and β_{E_{t-1},E_t}, show significant volatility spillovers at the 10% level, whereas β_{I_{t-1},E_t} and β_{S_{t-1},E_t} are insignificant at the 10% level.

According to the empirical findings, four TCI series denoted as follows:

$$\mathrm{TCI\_Origin}_t = (a_t - a_0) - (e_t - e_0) - (r_t - r_0) \tag{5.3}$$

$$\mathrm{TCI\_EERI}_t = 5.5590(a_t - a_0) - 0.3912(e_t - e_0) - 1.5351(r_t - r_0) \tag{5.4}$$

$$\mathrm{TCI\_Interest}_t = 0.5185(a_t - a_0) - 0.3494(r_t - r_0) \tag{5.5}$$

$$\mathrm{TCI\_Stock}_t = 0.4774(a_t - a_0) - 0.2248(r_t - r_0) \tag{5.6}$$

where a, e, and r denote the assets–tourism industry stock index (in logarithms), effective exchange rates (in logarithms), and interest rates, respectively. Additional information is provided in Table 4, and a comparison of the alternative Tourism Conditions Indexes (TCI) is shown in Table 5.

[Tables 4-5 here]

5.4 Granger Causality Tests

As all of the alternative TCI series and the differences in the proxy series (D_Arrival, D_Tourist, D_CI, and D_Stock), as in Table 3, are stationary, the Granger causality tests are based on the values of these variables.

The lag lengths for Granger causality tests may be based on information criteria, such as the Akaike information criterion (AIC) or the Schwarz information criterion (SIC). In this paper we used alternative lag lengths to check for robustness.

As mentioned in Section 1, the primary purpose of the paper is to examine whether previous values of the TCI contain information that can be used to predict the proxy variables, D_Arrival, D_Tourist and D_CI. Furthermore, it is also useful to check whether the alternative TCI values lead to greater significance in forecasting the Composite Index (CI), an economic environmental indicator, than the Tourism Industry Index (TII), which is an existing indicator for the tourism industry that is listed on the Taiwan Stock Exchange (TWSE). Therefore, we conduct the Granger causality test for all the series, as shown in Table 6.

The empirical results in Table 6 can be described as follows. For the tourism environmental indicators (D_Arrival and D_Tourist), the TCI does Granger-cause tourism environmental indicators for lag length 10 at the 5% level. The same holds for the existing tourism indicator, D_Stock, the difference in the monthly tourism index listed on the Taiwan Stock Exchange (TWSE) for the tourism industry.

For the economic environmental indicator (D_CI), and for lag lengths 6 and 10, the TCI without spillovers (TCI_Origin) does Granger-cause the proxy variables at the 10% and 5% levels, respectively, whereas TCI with spillovers (TCI_EERI, TCI_Interest, and TCI_Stock) also Granger-causes at the 5% and 1% levels, respectively.

Overall, the TCI with spillovers has greater significance for Granger causality for lags 8 and 10 than that the TCI without spillovers (TCI_Origin) at significance level 1%. Moreover, the Tourism Industry Index (TII), an existing indicator for the tourism industry, which is listed on the Taiwan Stock Exchange (TWSE), shows Granger causality at the 5% level. However, the TCI with spillovers shows greater Granger causality at the 1% level, for lag lengths 8 and 10, implying greater significance in forecasting the Composite Index (CI) than does an existing indicator for the tourism industry, namely the TII.

[Table 6 here]

6. Conclusion

This paper, used monthly data from April 2005 to August 2013 for Taiwan to propose a new tourism indicator, namely the Tourism Conditions Index (TCI), that accounted for spillover weights based on the Granger causality test and estimates of the multivariate BEKK model to predict specific tourism and economic environmental indicators for Taiwan.

The foundation for the TCI is the Financial Conditions Index (FCI), which is derived from the Monetary Conditions Index (MCI). The empirical findings showed that the TCI weighted by spillovers revealed greater significance in forecasting the

Composite Index (CI), an economic environmental indicator, than the Tourism Industry Index (Stock), which is an existing indicator for the tourism industry that is listed on the Taiwan Stock Exchange (TWSE). Moreover, previous values of the alternative TCI and Tourism Industry Index (TII) were shown to contain useful information in predicting both tourism and economic environmental factors for various lag lengths.

Overall, the empirical findings should be helpful for public and private decision makers, such as government, business executives and investors, as the Tourism Conditions Index (TCI) provides useful insights in predicting tourist arrivals and economic environments, based on straightforward calculations and interpretations of publicly available information.

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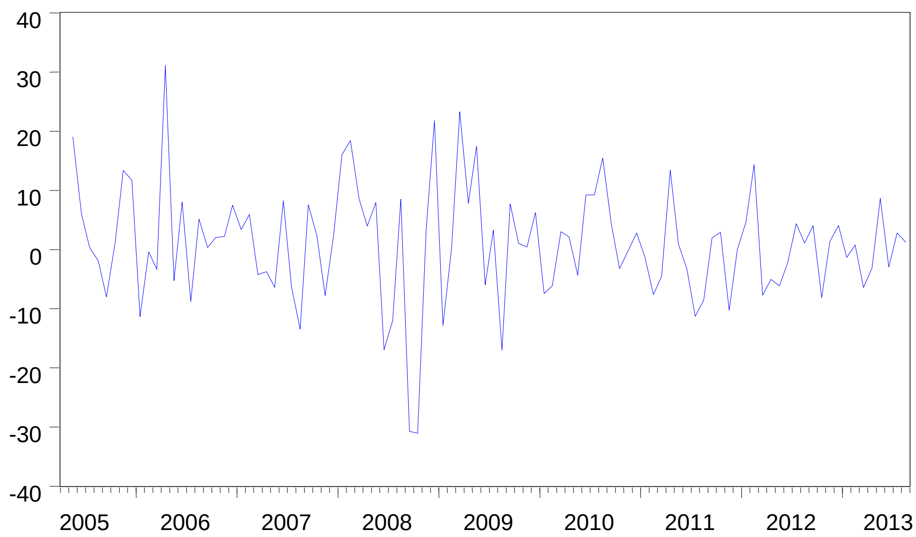
Figure 1. Time Series Plots for Monthly Returns (April 2005 – August 2013)

(a) Stock Returns (R_Stock)



(b) Exchange Rate Returns (R_EERI)

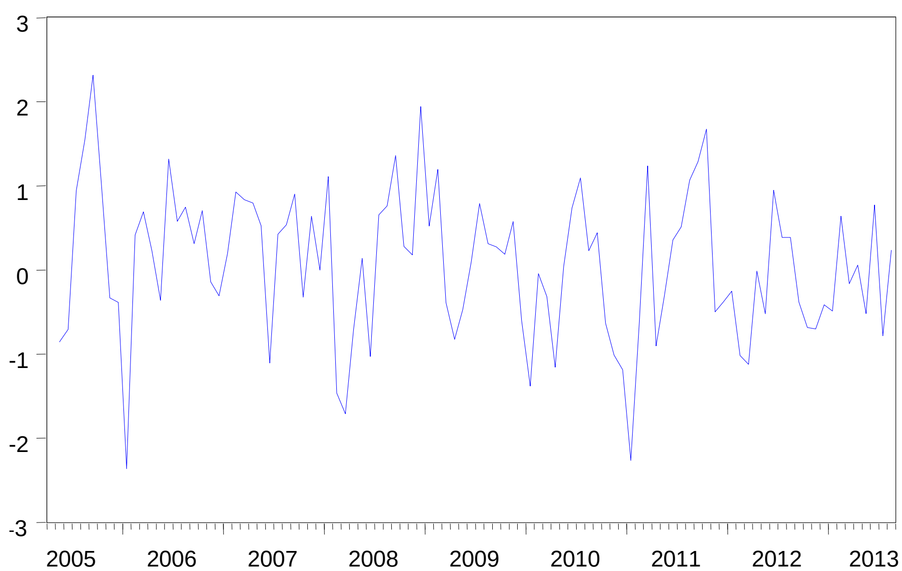
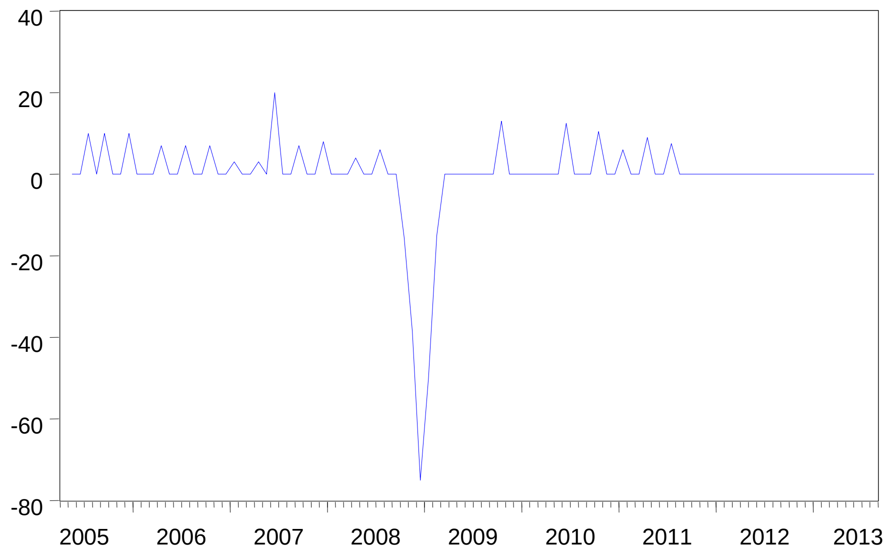


Figure 2. Time Series Plots of Monthly Differences (April 2005 – August 2013)

(a) Differences in Interest Rates (D_interest)



(b) Differences in Composite Coincidence Index (D_CI)

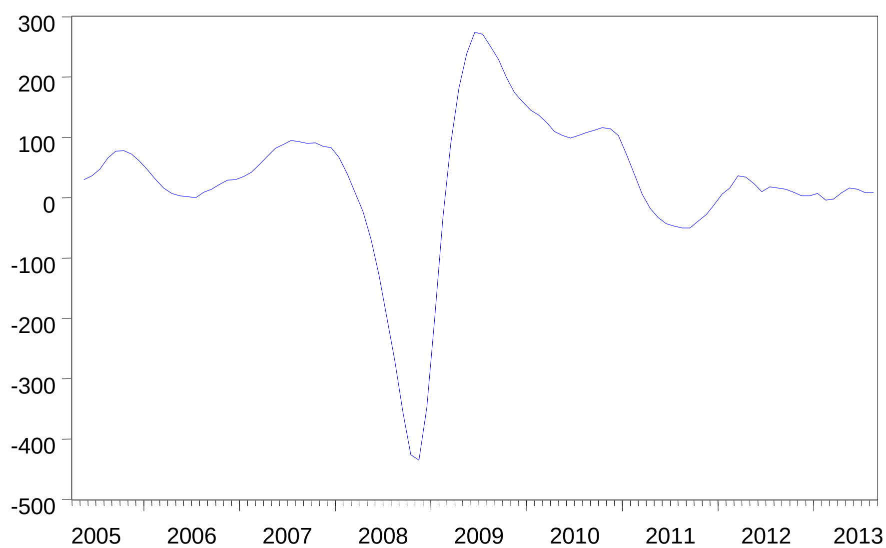
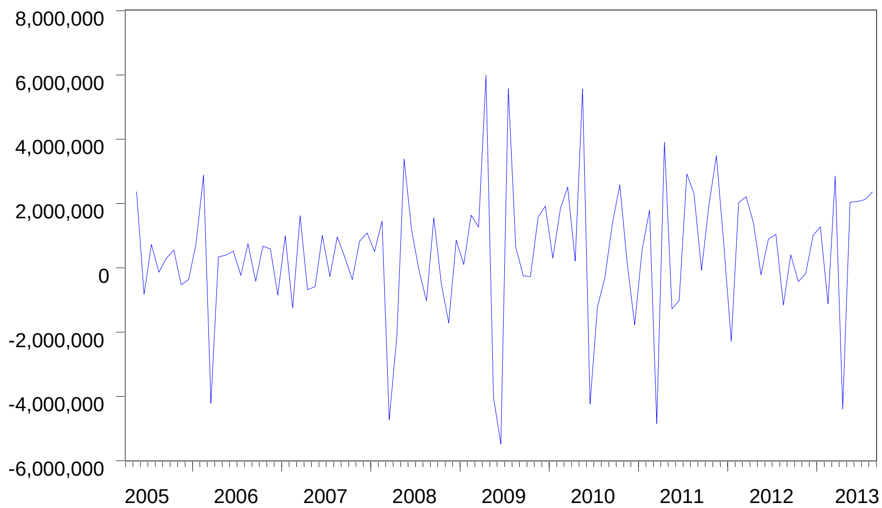


Figure 3. Time Series Plots of Monthly Differences (April 2005 – August 2013)

(a) Differences in Arrivals (D_Arrival)



(a) Differences in Tourists (D_Tourist)

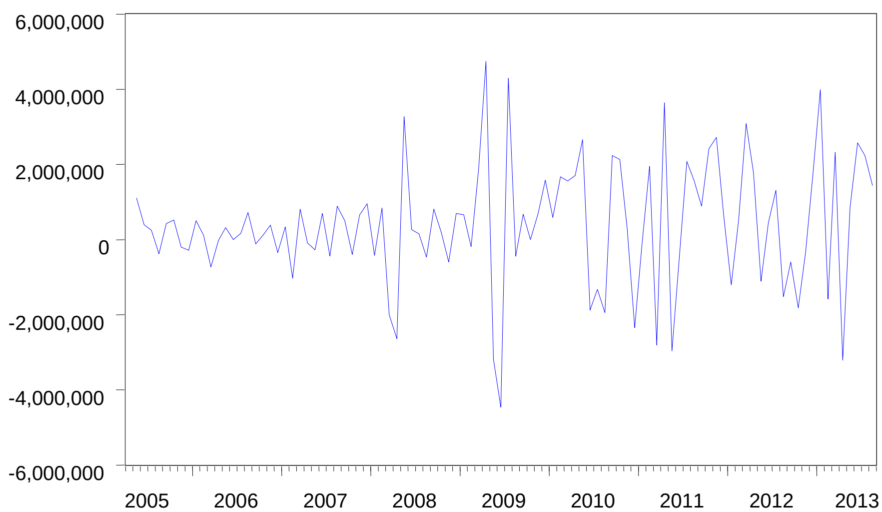
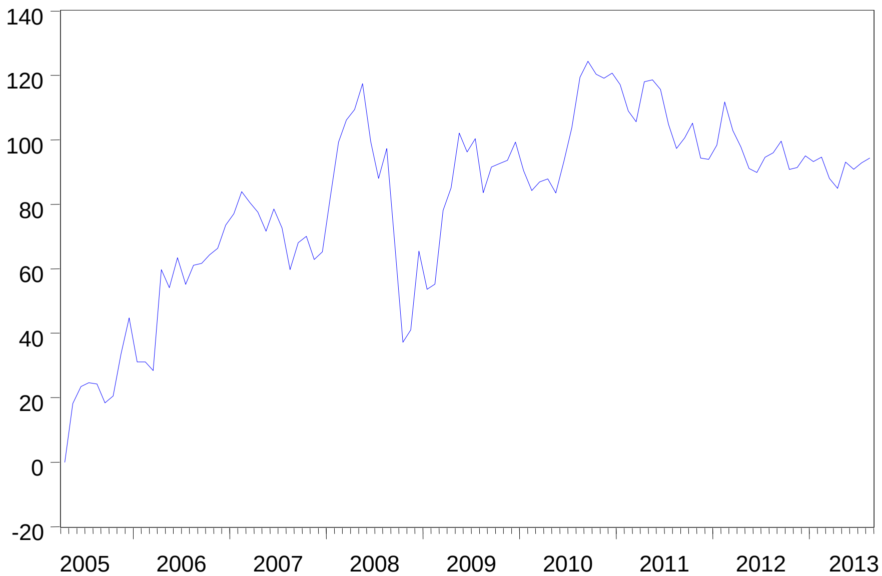


Figure 4. Time Series Plots of Monthly TCI (April 2005 – August 2013)

(a)Without Spillovers (TCI_Origin)



(b)With Exchange Rate Spillovers (TCI_EERI)

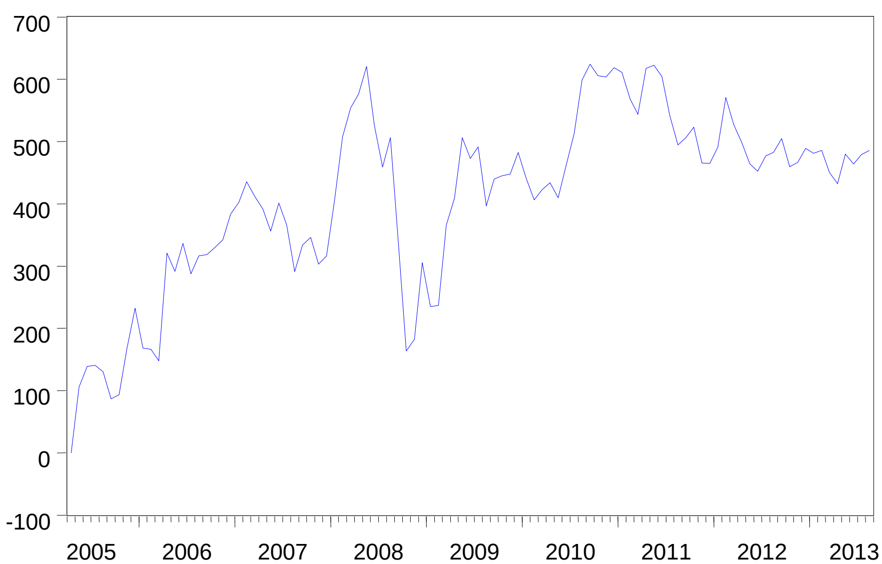
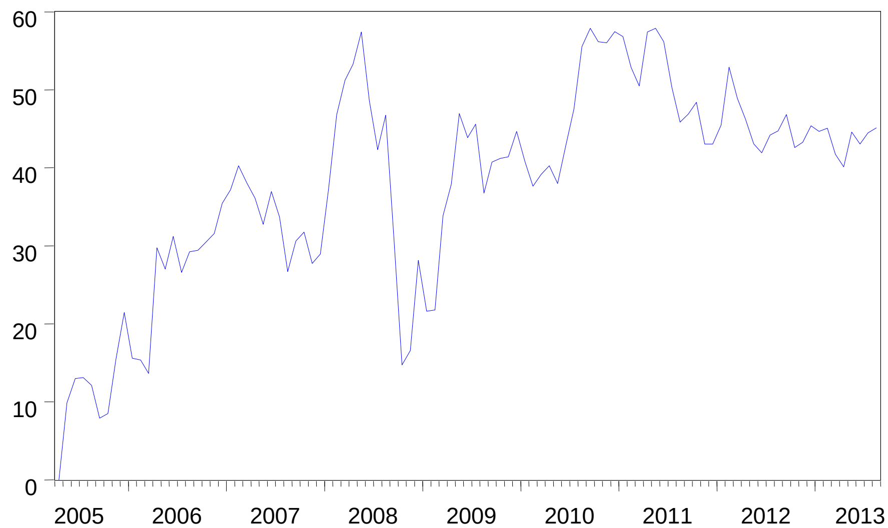


Figure 5. Time Series Plots of Monthly TCI (April 2005 – August 2013)

(a) With Interest Rate Spillovers (TCI_Interest)



(b) With Stock Spillovers (TCI_Stock)

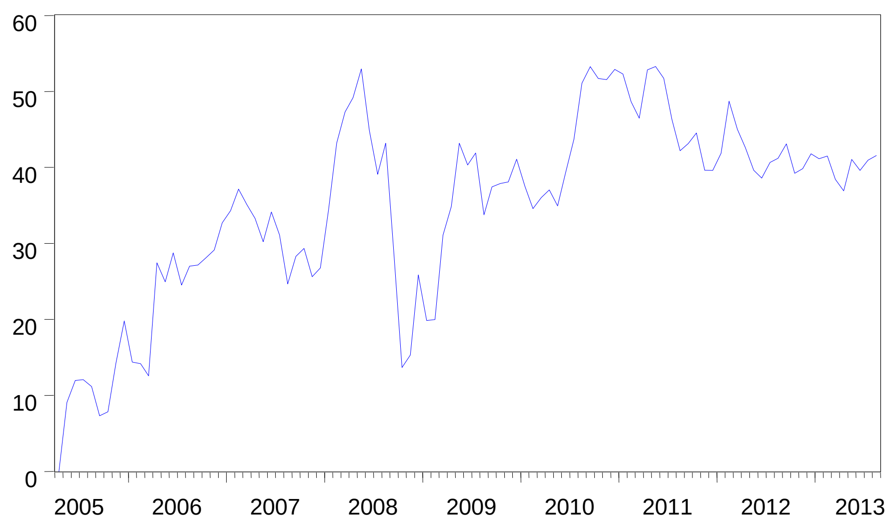


Table 1. Description of Variables

Variables		Description
Tourism Conditions Indicators	TCI_Origin	Monthly Tourism Conditions Index of Taiwan, without spillovers
	TCI_EERI	Monthly Tourism Conditions Index of Taiwan, weighted by spillovers from EERI returns
	TCI_Interest	Monthly Tourism Conditions Index of Taiwan, weighted by spillovers from Interest differences
	TCI_Stock	Monthly Tourism Conditions Index of Taiwan, weighted by spillovers from Stock Returns
Exchange Rate	EERI	Monthly effective exchange rate index, quoted as the foreign currency per unit of New Taiwan Dollar (indirect nominal rate)
Interest Rate	Interest	Monthly interest rate for one-year time deposits
Stock Index	Stock	Monthly Tourism Industry Indexes (TII) listed on the Taiwan Stock Exchange (TWSE) for large firms
Tourism Related Indicators	Arrivals	Monthly inbound visitors to Taiwan, adjusted by season
	Tourists	Monthly inbound visitors for leisure to Taiwan, adjusted by season
Economic Indicator	CI	Monthly Composite Coincident Index for Taiwan

Table 2. Descriptive Statistics for Monthly Time Series
(April 2005 –August 2013)

Variables	EERI	Interest	Stock	Arrivals	Tourists	CI
Mean	103.281	1.631	118.240	417306.7	230896.5	88.505
Median	103.081	1.355	121.860	363916	190285	88.980
Maximum	113.505	2.710	168.560	759233	537648	101.890
Minimum	97.690	0.770	55.330	261799	101799	66.290
Std. Dev.	3.559	0.608	27.697	135255.9	115814	10.546
Skewness	0.836	0.328	-0.191	0.740	0.796	-0.255
Kurtosis	3.361	1.820	2.454	2.303	2.469	1.828
Jarque-Bera	12.319	7.669	1.867	11.254	11.845	6.881
Prob-value	0.002	0.022	0.393	0.004	0.003	0.032
Sum	10431.39	164.71	11942.26	42147978	23320550	8939.01
Sum Sq. Dev.	1266.921	36.899	76713.67	1.83E+12	1.34E+12	11121.46
Observations	101	101	101	101	101	101

Notes:
EERI：Effective Exchange Rate Index, quoted as the foreign currency per unit of the domestic currency (indirect rate)
Interest：Interest Rate
Stock：Stock Index closing price for Tourism Industry
Arrivals：Inbound visitors, adjusted by season
Tourists：Inbound visitors for pleasure, adjusted by season
CI：Composite Coincident Index
Jarque-Bera: Lagrange multiplier test of normality.

Table 3. Unit Root Tests for Monthly Time Series
(April 2005 – August 2013)

Variables	ADF (GLS)	PP (Phillips-Perron)
TCI_Origin	-3.0567**	-3.0669**
TCI_EERI	-3.0654**	-3.0888**
TCI_Interest	-3.0547**	-3.0798**
TCI_Stock	-3.0598**	-3.0852**
R_EERI	-6.9396***	-6.9420***
D_Interest	-4.6234***	-4.4640***
R_Stock	-9.2125***	-9.1988***
D_Arrival	-10.002***	-13.5258***
D_Tourist	-10.9890***	-11.5995***
D_CI	-3.1118**	-2.7787*
D_Stock	-8.9448***	-8.9138***

Notes: ** and *** denote the unit root null hypothesis is rejected at the 5% and 1% levels, respectively.

TCI_Origin：Tourism Conditions Index without spillovers

TCI_EERI, TCI_Interest and TCI_Stock：Tourism Conditions Index weighted by spillovers from EERI returns, Interest differences and Stock returns, respectively

R_EERI： Exchange Rate Returns

D_Interest：Differences in Interest Rates

R_Stock： Stock Index Returns

D_Arrival：Differences in inbound arrivals, adjusted by season

D_Tourist：Differences in inbound arrivals for pleasure, adjusted by season

D_CI：Differences in Composite Coincident Index

D_Stock：Differences in tourism indexes

Table 4. BEKK Spillovers Effects (April 2005 – August 2013)

Portfolio (E, I, S)					
R_EERI；E		**D_Interest；I**		**R_Stock；S**	
Mean Spillovers					
Coefficient		Coefficient		Coefficient	
$C_{E,E}$	-1.2187	$C_{I,I}$	7.8211	$C_{S,S}$	108.3441***
φ_{E_{t-1},E_t}	0.3364***	φ_{I_{t-1},E_t}	-0.0012	φ_{S_{t-1},E_t}	0.0125
φ_{E_{t-1},I_t}	0.3671	φ_{I_{t-1},I_t}	0.1428	φ_{S_{t-1},I_t}	-0.0617
φ_{E_{t-1},S_t}	-0.6882	φ_{I_{t-1},S_t}	-0.2168	φ_{S_{t-1},S_t}	-0.0647
Volatility Spillovers					
Coefficient		Coefficient		Coefficient	
$W_{E,E}$	0.6395***	$W_{I,I}$	-0.0000	$W_{S,S}$	-0.0000
	-	$W_{I,E}$	-0.0191	$W_{S,E}$	-2.7640**
	-		-	$W_{S,I}$	-0.0000
α_{E_{t-1},E_t}	-0.3711***	α_{I_{t-1},I_t}	0.7803***	α_{S_{t-1},S_t}	0.5657***
α_{E_{t-1},I_t}	1.3304	α_{I_{t-1},E_t}	0.0226	α_{S_{t-1},E_t}	0.0069
α_{E_{t-1},S_t}	-2.4858	α_{I_{t-1},S_t}	-0.3001*	α_{S_{t-1},I_t}	0.3127***
β_{E_{t-1},E_t}	0.3912*	β_{I_{t-1},I_t}	-0.3494***	β_{S_{t-1},S_t}	0.4774***
β_{E_{t-1},I_t}	1.5351*	β_{I_{t-1},E_t}	-0.0092	β_{S_{t-1},E_t}	0.0136
β_{E_{t-1},S_t}	5.5590***	β_{I_{t-1},S_t}	-0.5185**	β_{S_{t-1},I_t}	-0.2248**

Notes:

Model is BEKK

E：Exchange Rate Returns

I：Interest Rate Differences

S： Stock Index Returns;

***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively

φ_{ij} for mean spillovers, i = E ; j = E, I, S

β_{ij} for volatility spillovers, i = E; j = E, I, S

Table 5. Comparison of Tourism Conditions Indexes (April 2005 – August 2013)

Variables	**TCI_Origin**	**TCI_EERI**	**TCI_Interest**	**TCI_Stock**
Mean	80.9126	408.575	37.8283	34.8326
Median	89.8108	445.160	41.2111	37.8772
Maximum	124.337	624.008	57.8980	53.2819
Minimum	-0.0033	-0.0013	0	0
Std. Dev.	27.7288	142.631	13.27260	12.2046
Skewness	-0.8472	-0.7312	-0.7179	-0.7194
Kurtosis	3.1034	2.9519	2.9236	2.931
Jarque-Bera	12.1276	9.0085	8.7001	8.7321
Prob-value	0.0023	0.0111	0.0129	0.0127
Sum	8172.18	41266.06	3820.66	3518.09
Sum Sq. Dev.	76888.78	2034352	17616.22	14895.1
Observations	101	101	101	101

Notes：

Definition：$\mathrm{TCI_t} = \theta_a(a_t - a_0) - \theta_e(e_t - e_0) - \theta_r(r_t - r_0)$, where a, r, and e denote the assets–tourism industry stock index (in logarithms), effective exchange rate (in logarithms), and interest rate, respectively;

subscripts t and 0 denote the current and base periods (April 2005), respectively;

θ_r, θ_e, and θ_a are the weights of the interest rate, effective exchange rate, and assets, respectively, derived from the estimates of BEKK volatility spillovers (β_{ij}) (see Table 4);

$\mathrm{TCI\_Origin_t} = (a_t - a_0) - (e_t - e_0) - (r_t - r_0)$

$\mathrm{TCI\_EERI_t} = 5.5590(a_t - a_0) - 0.3912(e_t - e_0) - 1.5351(r_t - r_0)$

$\mathrm{TCI\_Interest_t} = 0.5185(a_t - a_0) - 0.3494(r_t - r_0)$

$\mathrm{TCI\_Stock_t} = 0.4774(a_t - a_0) - 0.2248(r_t - r_0)$

which are given in the text as equations (5.3)-(5.6), respectively.

Table 6. Granger Causality Tests (April 2005 – August 2013)

Variables		Number of lags				
Y	**X**	**2**	**4**	**6**	**8**	**10**
D_Arrival	TCI_Origin	0.74917	1.18337	0.96531	1.43795	2.48131**
	TCI_ EERI	0.63834	1.07080	0.89444	1.35459	2.42633**
	TCI_ Interest	0.64652	1.06633	0.89579	1.35886	2.42929**
	TCI_Stock	0.63897	1.06423	0.89274	0.5043	2.42557**
	D_Stock	0.61073	0.94303	1.26512	0.89437	2.45527**
D_Tourist	TCI_Origin	0.41064	1.20488	0.96920	1.31414	2.38088**
	TCI_ EERI	0.38304	1.13307	0.92222	1.25995	2.31178**
	TCI_ Interest	0.38999	1.12699	0.92062	1.26239	2.31478**
	TCI_Stock	0.38607	1.12690	0.91956	1.25927	2.31050**
	D_Stock	0.48924	0.98381	1.18799	0.78302	2.46689**
D_CI	TCI_Origin	2.19965	2.21766*	2.18203*	2.54820**	2.57134**
	TCI_ EERI	2.88259*	2.49932**	2.42959**	2.7805***	2.77309***
	TCI_ Interest	2.88021*	2.50784**	2.43328**	2.77848***	2.76981***
	TCI_Stock	2.90880*	2.51341**	2.43899**	2.78618***	2.77688***
	D_Stock	1.64527	2.35653*	2.22132**	2.44616**	2.38176**

Notes：

H_0：X does not Granger cause Y；

entries are F-Statistics;

TCI_Origin：Tourism Conditions Index without spillovers

TCI_EERI, TCI_Interest and TCI_Stock：Tourism Conditions Index weighted by spillovers from EERI returns, Interest differences and Stock returns, respectively

D_Arrival：Differences in inbound arrivals, adjusted by season

D_Tourist：Differences in inbound arrivals for pleasure, adjusted by season

D _CI：Differences in Composite Coincident Index of Taiwan

D_Stock：Differences in tourism indexes

***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.