

Does Tourism sustain the Economic Growth? A Wavelet based evidence from United States of America

Arshian Sharif*

Lecturer and Assistant Manager
Research and Publications
Department of Management Sciences
Iqra University, Karachi, 75300
E-mail: arshian.aslam@gmail.com
+92-333-3274-879
(Corresponding Author)

Shrabani Saha

Senior Lecturer of Economics,
Lincoln International Business School
University of Lincoln
Brayford Pool, Lincoln, United Kingdom.
Email: ssaha@lincoln.ac.uk

Nanthakumar Loganathan

Associate Professor
Faculty of Economics and Management Sciences,
Universiti Sultan Zainal Abidin,
21300 Kuala Terengganu,
Terengganu, Malaysia
Email: n4nantha@yahoo.com

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- *Corresponding author:* Arshian Sharif, Email: arshian.aslam@gmail.com

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Abstract

This study explores the relationship between tourism development and economic growth in high tourist arrival country such as the United States of America (USA) by adopting the wavelet transform approach using monthly data over the period 1996M01-2015M08. Three innovative techniques that are continuous wavelet, wavelet coherence power spectrum and wavelet based Granger causality that consider the decomposition of time-series at different time frequencies, are utilized to conduct the study. The results of autoregressive distributed lag and combine cointegration tests show that there is a significant long-run relationship occurs between tourism development and economic growth in USA. Furthermore, the results indicate that there is a unidirectional causal influence of economic growth on tourism development in the short-run whereas, in the long-run the opposite causal relationship is evident in USA. Thus it can be recommended that government needs to increase and promote tourism demand and further providing and nurturing the expansion of tourism supply with the advancement of economic growth.

Keywords: Wavelet Analysis, Continuous Wavelet Transform, Wavelet Coherence, Tourism Development, United States.

Introduction

Recent developments in economic condition encourage government regulators to support productive sectors to resolve macroeconomic issues such as monetary instability, fiscal instability, unemployment and growth. Tourism is the foremost sector that assists policy makers to cater these issues by providing foreign exchange beneficial for creating provincial employment opportunities which are essential in managing unemployment and encouraging construction, accommodation, transportation and food/beverage sectors and bringing a rise in economic growth by adding value. Moreover, this sector also develops in conjunction with countries by transferring income from developed to developing countries. Accordingly, policy makers can reap the benefit generated from tourism for plummeting regional inequalities.

Furthermore, tourism revenue offers a vital source of foreign exchange which can be used for importing capital goods for production and in turn increases economic growth (Balaguer and Cantavella-Jorda, 2002). Tourism also brings large sum of money in a domestic economy in the form of payment for purchasing goods and services made by tourists. It also generates employment opportunity in the service sector, the most common beneficiary linked with tourism. These includes transportation services (such as taxicabs, cruise ships and airlines etc.) and the hospitality services (like hotels and resorts, entertainment venues like theatres, shopping malls, amusement parks, casinos etc). Gains from tourism generate growth in these industries which ultimately are reflected in the increase in income levels of a host country.

However, there is a debate in the tourism literature about the relationship between tourism and economic growth. Does economic growth promote tourism development or tourism development stimulates economic growth? Neither theoretical nor empirical studies provide a definite answer on the directional relationship between the two (see Tang and Tan, 2013; Ozturk, 2010; Lee and Chien, 2008; Payne and Mervar, 2010; etc.). Hence, the objective of this study is to provide evidence on the nature of the time scale relationship between tourism development and economic growth in high tourist arrival country such as the United States of America (USA) using a new analytical technique wavelet transform analysis, so as to provide a new empirical results as well as policy implications. The proposed technique is based upon the multiresolution decomposition properties of the wavelet transform that provides a time-scale representation of a given signal by describing its time evolution on a scale-by-scale basis. Such a multiscale decomposition approach provides a natural framework to exhibit frequency-dependent behavior for the analysis of relationship between economic growth and tourism.

Precisely, the study applies triple cross wavelet tools (i.e. the wavelet transform, the cross-wavelet power spectrum and the coherency of cross-wavelet) to identify the fleeting impacts, which sometimes the old method unable to carry. In other words, the nature of the causal relationship between two time series variables may vary in different time scale such as in the short-

run, medium-run and long-run. The wavelet-based exploratory analysis is performed by applying the continuous wavelet transform since tools such as wavelet power, coherency and phase can reveal interesting features about the structure of a process as well as information about the time-frequency dependencies between two time series. Hence, after decomposing both variables into their time-scale components the relationship between tourism and economic growth at the different time scales is analyzed.

This method can support to exhume a few economic time occurrence associations that is not been apprehended so far. This study explores the causal and reverse causal association between tourism development and economic growth in USA. The evidence gives provision to both cyclical and anti-cyclical association among the series using monthly data over the period 1996M01-2015M08.

The findings may provide a new understanding about the causal linkage between tourism and economic growth in USA. The methodologies support us to identify the causal relationship at various time spans. The study contributes to the existing literature in many ways. Firstly, this is the pioneer attempt to utilize the sophisticated methodology to certain economic time series data and in retreating traditional instruments. Secondly, to the best of our knowledge, this is the first study on USA in the light of worldwide attention. The USA is chosen for the purpose of the study because the Americas recorded the strongest growth with an 8% increase in international arrivals and the USA contributed to 7 percent increase (UNWTO, 2015). The USA continues to second ranking by both international arrivals and receipts. Moreover, according to the Travel and Tourism Competitiveness Index ranking 2015, The US is placed in the fourth rank. Furthermore, World Travel and Tourism Council 2015 reports the total contribution to travel and tourism to gross domestic product in US is 8 percent in 2014.

The remaining of the paper is prepared as follows: Section 2 elaborates the literature review; Section 3 explains the model framework and data; Section 4 discusses the results and findings; and Section 5 concludes with policy implications.

Literature Review

The theoretical literature on the role of tourism and economic growth is dominated by the *tourism-led* growth hypothesis, which is a simple replication of the *export-led growth hypothesis*. When focusing on tourism-growth hypothesis, it is a potential paradigm of the above hypothesis under four different lines (Ozturk, 2010). Initially, *the growth hypothesis* states a condition in which tourism play a significant contribution in the economic growth procedure both directly or/and as a supplement to further production aspects. The growth hypothesis is supported if unidirectional causal relationship is found between tourism and economic growth and this causality is running from tourism to growth. In this situation, policies designed at funding and supporting tourism should have a positive impact on economic growth. Next, *the preservation hypothesis* connotes

that economic growth reinforces tourism sector. The rationality of this hypothesis is established if there is a unidirectional causal relationship exists between economic growth and tourism indicating causality is running from economic growth to tourism. In this circumstance, transfer of the support and funds from tourism sector to another sector may not have a harmful effect on economic growth. Subsequent, the *feedback hypothesis* explains an equal relationship among tourism and economic growth. This hypothesis is sustained if there is a bidirectional causal relationship exists between these two variables. In this context, tourism protection policy can have adverse effect on economic growth and vice versa too. Finally, *the neutrality hypothesis* specifies that both variables (tourism and growth) have no effect on each other. The non-existence causality between the considered variables provides evidence towards the occurrence of the neutrality hypothesis.

A considerable body of empirical literature attempts to disentangle the connective strands and lines of causality between tourism and economic growth however, fails to conclude a definite relationship. Some studies maintain that tourism leads to economic growth (such as Tang and Tan, 2013; Tang and Abosedra, 2012; and Gunduz and Hatemi-J, 2005), while others support the preservation hypothesis (i.e. economic growth stimulates tourism growth) (see, Parrilla, Font, and Nadal, 2007; Matarrita-Cascante, 2010; Ivanov and Webster, 2012). There are also several studies which suggest either a bidirectional relationship (feedback hypothesis) between tourism and the economic growth or no relationship (neutrality hypothesis at all (see, among others, Tang and Jang, 2009; Seetanah, 2011).

Studies also show that tourism has significant positive effects on economic growth in EU countries (Holzner, 2011; Albalade & Bel 2010) suggesting that tourism enhances economic growth in the long run. Mihalic (2002) argues numerous benefit of tourism as a growing tactic via export of goods and services. International tourism generates the prime source of exports revenue and foreign exchange earnings. The foremost advantages achieve from tourism contain income, employment and foreign exchange earnings. Lee and Change (2008) suggest that tourism development encourages growth of the sector and produces overall progress of a country. Moreover, Holzner (2011), Tang and Jang (2009) and Sequeira & Nunes (2008) summarize that tourism enhances further improvement of businesses and overall economy too.

However, the literature on causal relationship is divided into two strands: unidirectional and bidirectional (Table 1). The review of above literature comprehends the existence of unidirectional causal relationship between tourism and economic growth in majority of countries however for some of them tourism illustrates bidirectional causal relationship with economic growth. This reflects the need of further examining the causality and the reasons behind the existence of such difference.

Table 1: Brief Summary of the Literature

Authors	Year	Region	Time frame	Variables	Causality
Ghali	1976	Hawaii	1953-1970	Tourism, growth, income	$T \rightarrow Y$
Demiroz & Ongan	2005	Turkey	1980-2004	GDP, exchange rate, tourism receipt	$T \leftrightarrow Y$
Kim et al.	2006	Taiwan	1956-2003	Tourist arrivals, GDP	$T \leftrightarrow Y$
Louca	2006	Cyprus	1975-2001	Tourist arrivals, income, hotels	$T \leftrightarrow \text{Hotel} \leftrightarrow \text{Income}$
Nowak et al.	2007	Spain	1960-2003	Tourist receipts, GDP, Capital imports	$T \leftrightarrow \text{Imports} \leftrightarrow Y$
Khalil et al.	2007	Pakistan	1960-2005	Tourism receipts, GDP	$T \leftrightarrow Y$
Brida et al.	2008	Mexico	1980-2007	Exchange rate, tourism receipts	$T \rightarrow Y$
Zortuk	2009	Turkey	1990-2008	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Kreishan	2010	Jordan	1970-2009	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Mishra et al.	2010	India	1978-2009	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Malik et al.	2010	Pakistan	1972-2007	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Gocovali	2010	Turkey	1985-2005	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Lean & Tang	2010	Malaysia	1989-2009	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Oludele & Braimoh	2010	South Africa	1980-2005	Tourist arrivals, GDP, exchange rate, exports	$T \rightarrow Y$
Arslanturk et al.	2011	Turkey	1963-2006	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Husein & Kara	2011	Turkey	1964-2006	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Jin	2011	Hong Kong	1974-2004	Tourist arrivals, GDP, exchange rate, capital, labour	$T \rightarrow Y$
Odhiambo	2011	Tanzania	1980-2008	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Obadiah et al.	2012	Kenya	1999-2012	Trade, GDP, tourist arrivals	$T \rightarrow Y$

Arslanturk & Atan	2012	Turkey	1987-2009	Tourist arrivals, GDP, exchange rate	$T \rightarrow Y$
Eeckels et al.	2012	Greece	1976-2004	Tourism receipts, GDP	$T \rightarrow Y$
Kumar & Kumar	2012	Fiji	1980-2008	Tourism earning, Capital, GDP	$K \rightarrow T \rightarrow Y$
Surugiu & Surugiu	2013	Romania	1988-2009	Tourism consumption, GDP, exchange rate	$T \rightarrow Y$
Hye & Khan	2013	Pakistan	1971-2008	Tourism receipts, GDP	$T \rightarrow Y$
Massidda & Mattana	2013	Italy	1987-2009	Trade, tourist arrivals, GDP	$Trade \rightarrow T \rightarrow Y$
Tang & Abosedra	2012	Lebanon	1995-2010	Tourist arrivals, GDP	$T \rightarrow Y$
Tang & Tan	2013	Malaysia	1991-2014	Tourist arrivals, GDP	$T \rightarrow Y$
Ridderstaat & Croes	2014	Aruba	1972-2011	Tourism receipts, GDP	$T \rightarrow Y$

The probable explanation of the inconclusive results is that the most studies are constricted to static analyses and country specific. However, recently, Tang and Tan (2013), Arslanturk, et al, (2011) and Lean and Tang (2010) question the stability of the tourism–economic growth association over time, only for Malaysia and Turkey and argue that the relationship between these two series may adjust due to the structural economic changes in the economy. Hence, it is crucial to extend this line of research in other countries. Specifically, it is important to explore if the recent economic events (such as financial crisis 2007–08) affect the tourism–economic growth relationship using dynamic approach. Therefore, the aim of this study is to examine the relationship between tourism and economic growth in US focusing on the time effect by wavelet analysis.

Data and Methodology

This section discusses the data and methodology used in examining the causal relationship between tourism development and economic growth.

Data

The data sets consider in this research comprises of monthly observation of tourism development (TD), which is measured by number of tourist arrivals and economic growth is measured through the index of industrial production (IPI) for USA. Usually, studies on economic growth employ growth rate of gross domestic product (GDP)/or GDP per capita as a measure of economic growth. However, GDP data is mostly available annually which limits the possibility of running this type of analysis which needs high frequency data at least in monthly frequency. On the other hand, IPI is compiled on a monthly basis to bring attention to short-term changes in industrial production. The data for both variables is gathered from the National Travel and Tourism Office, USA and

National Bureau of Economic Research. Our sample provides 236 monthly observations from 1996M01 to 2015M08. The data is converted into logarithmic difference series in order to acquire the return-series to make our conclusion more comparable.

Methodology

The long-run bivariate relationship between TD and IPI is evaluated by using two traditional cointegration methods¹ i.e. Autoregressive Distributed Lag (ARDL) method² and Bayer and Hanck (2013) combine cointegration method. The equation of the ARDL model is given below.

$$\Delta IPI_t = \psi_0 + \psi_1 \sum_{i=1}^p \Delta IPI_{t-i} + \psi_2 \sum_{i=1}^p \Delta TD_{t-i} + \gamma_1 IPI_{t-1} + \gamma_2 TD_{t-1} + \mu_t$$

where ψ_0 is a constant while, μ_t is a white noise error term. The error correction dynamic is reserved though variables related with the summing up signs, while further component of the equation specifies long-run connection. The Hatemi-J (2003) criterion is considered in this study to inspect the maximum numbers lags suites with the ARDL estimates. Usually, in cointegration analysis, there is numerous approaches to capture the long-run integration between the variables and each of them provides various interpretations. Recognizing this problem, we employ the most accurate, unique and powerful approach introduced by Bayer and Hanck (2013) to generate a joint test-statistic for the null of cointegration based on four test types, which is the Engle and Granger (1987), Johansen (1988), Boswijk (1994) and Banerjee et al. (1998) tests, and the combine cointegration Bayer-Hanck cointegration test. The computed significance level with probability values within this model is based on the following formulas:

$$EG - JOH = -2[\ln(P_{EG}) + (P_{JOH})]$$

$$EG - JOH - BO = BDM = -2[\ln(P_{EG}) + (P_{JOH}) + (P_{BO})(P_{BA})]$$

where, P_{EG} , P_{JOH} , P_{BO} , P_{BDM} are the Engle and Granger, Johansen, Boswijk and Banerjee's p -values of the individual cointegration tests. According to Bayer and Hanck (2013), if there is a rejection of the null hypothesis of no cointegration, indicating the presence of a long run cointegration relationship between the variables.

¹ A bivariate analysis is a common form of causality analysis which can explore the long-run relationship between two time series variables (Granger et al., 2000).

²See, Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran et al. (2000, 2001) for details.

A concise essay on wavelet approach

The wavelet transform approach is introduced to overcome the limitations of the Fourier³ transformation in terms that the time series under study should be cyclic and presumes that occurrences do not progress in the time etc. Conversely, in the wavelet transformation, its window is changed regularly to low or high frequency.⁴

The discrete wavelet transform (DWT) convert a times series data by separating it into sections of time sphere known as “scales” or frequency “bands”. These scales explain increasingly high and the biggest scale symbolizes improvably low frequency variations (Tiwari et al. 2013). The fundamental wavelets in any wavelet family are categorized into two main varieties specifically father wavelets φ and mother wavelet ψ , are represented as follows:

$$\int \varphi(t) dt = 1, \quad (1)$$

$$\int \psi(t) dt = 0. \quad (2)$$

First, the father wavelets are taken for the short frequency flat components part of a signal. Secondly, mother wavelets are taken for long frequency features components. Additionally, the father wavelet is taken for the trend mechanism and mother wavelets for variation from the trend. The attained wavelet foundation can be present correspondingly by the couple of functions:

$$\varphi_{j,k}(t) = 2^{j/2} \varphi(2^j t - k), \quad (3)$$

$$\psi_{j,k}(t) = 2^{j/2} \psi(2^j t - k). \quad (4)$$

where, the value of $j=1, \dots, J$ indicates the measure and $k= 1, \dots, 2^j$ indicates the transformation. The factor j is taken as the factor of expansion of waves’ functions. This factor j regulates the maintainance of $\psi_{j,k}(t)$ to locally confine the qualities of low or high frequencies. The factor k is taken to reposition the wavelets in the chronological scale. The optimum number of measures that could be taken in the analysis is based by the number of observation ($T \geq 2^J$).

The localization feature is one of the extraordinary features of the wavelet extension that the coefficient of $\psi_{j,k}(t)$ discloses the detail context of the role at estimated position $k2^{-j}$ and frequency 2^j . Whereas, the total count of wavelet family units have been established in the literautre, most of the studies is considered the orthogonal wavelet such as Coiflets, Symmlets and

³ Fan and Gençay (2010, p.1307) documented that "The Fourier approach is appealing when working with stationary time series. However, restricting ourselves to stationary time series is not appealing, since most economic/financial time series exhibit quite complicated patterns over time (e.g., trends, abrupt changes, and volatility clustering). In fact, if the frequency components are not stationary such that they may appear, disappear, and then reappear over time, traditional spectral tools may miss such frequency components. Wavelet filters provide a natural platform to deal with the time-varying characteristics found in most real-world time series, and thus the assumption of stationarity may be avoided. The wavelet transform intelligently adapts itself to capture features across a wide range of frequencies and thus is able to capture events that are local in time. This makes the wavelet transform an ideal tool for studying non-stationary time series."

⁴ It uses short window at high frequency and by developing time compression or dilatation, instead of a deviation of frequency in the adjusted signal which is attained by extrication the time axis into a series of consecutively short segments.

Daubelets. A time series $f(t)$ could be prolonged over the basis of wavelet, exclusively, as a linear grouping at arbitrary level $j \in \square$ diagonally different measure and articulated as follows:

$$f(t) = \sum_k s_{j,k} \phi_{j,k}(t) + \sum_j \sum_k d_{j,k} \psi_{j,k}(t), \quad j = 1, \dots, J.$$

Where $\phi_{j,k}$ is a measuring function with the analogous common measure coefficients $s_{j,k}$ and $d_{j,k}$ are the feature (excellent measure) coefficients provided correspondingly by $s_{j,k} = \int f(t) \phi_{j,k}(t) dt$ and $d_{j,k} = \int f(t) \psi_{j,k}(t) dt$. These coefficients provide a measure of the contribution of the resultant wavelet to the function. The fact coefficient $d_{j,k}$ symbolizes better enhancing measure variation, stating the smooth trend and $s_{j,k}$ which explains the smooth coefficient and confine the drift. The wavelet sequence estimate of the innovative series $f(t)$ is articulated as follows:

$$f(t) = S_J(t) + D_J(t) + D_{J-1}(t) + \dots + D_1(t). \quad (6)$$

This equation signifies the decomposition of $f(t)$ into orthogonal mechanism at various decisions and composes the so-called wavelet multi-resolution analysis (decomposition) (MRA); where the series $S_J(t) = \sum_k s_{j,k} \phi_{j,k}(t)$ provides a smooth original time series $f(t)$ and explains the estimation that detains the long run characteristics (i.e., the low-frequency dynamics), and the series $D_j(t) = \sum_k d_{j,k} \psi_{j,k}(t)$ refers to wavelet details and captures local fluctuations (i.e., the higher-frequency characteristics) over the whole period of $f(t)$ at each scale.

The continuous wavelet transform

This type of wavelet transform $W_x(m, n)$ is acquired by analyzing a definite wavelet $\psi(\cdot)$ against the time sequence $x(t) \in L^2(\mathbb{R})$, i.e.

$$W_x(m, n) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{n}} \overline{\psi\left(\frac{t-m}{N}\right)} dt.$$

An essential characteristic of the continuous wavelet transform is the capability to decompose and consequent seamlessly recreate a time series $x(t) \in L^2(\mathbb{R})$:

$$x(t) = \frac{1}{C_\psi} \int_0^\infty \left[\int_{-\infty}^\infty W_x(m, n) \psi_{m,n}(t) du \right] \frac{dn}{N^2}, \quad N > 0.$$

Moreover, the continuous wavelet transform reserves the power of the observed time sequence,

$$\|x\|^2 = \frac{1}{C_\psi} \int_0^\infty \left[\int_{-\infty}^\infty |W_x(m, n)|^2 dm \right] \frac{dn}{N^2}.$$

The study uses this characteristic for the description of wavelet coherence, which quantifies the size of the native connection among two time frameworks.

Wavelet Coherence

In order to examine the bivariate relationship, a bivariate structure termed as wavelet coherence is required. In support of the appropriate description of wavelet coherence, the cross wavelet transform and cross wavelet power require to be described first. According to Torrence and Compo (1988) cross wavelet transform can be explained by two time sequence $x(t)$ and $y(t)$ as:

$$W_{xy}(m, n) = W_x(m, n)W_y^*(m, n),$$

Where, $W_x(m, n)$ and $W_y(m, n)$ are two continuous wavelet transform of $x(t)$ and $y(t)$, separately, m is location index, and n represents the measure, whereas the sign * signifies a composite conjugate. The cross wavelet power can simply be calculated by the cross wavelet transform as $|W_x(m, n)|$. The cross wavelet power spectra discloses regions in the time sequence frequency space where the time sequence displays a massive mutual power that is symbolizes the confined covariance among the time sequence at every scale.

The wavelet coherence can identify areas in the time-frequency gap where the observed time series move simultaneously, but do not essentially have a massive common power. According to Torrence and Webster (1999) the equation of squared wavelet coherence coefficient is as follows:

$$R^2(m, n) = \frac{|N(N^{-1}W_{xy}(m, n))|^2}{N(N^{-1}|W_x(m, n)|^2) N(N^{-1}|W_y(m, n)|^2)},$$

where, S is a smoothing mechanism. The range of squared wavelet coherence coefficient is $0 \leq R^2(m, n) \leq 1$. If the value is found close to zero means that there is a weak correlation, whereas, if the value is close to one indicating a powerful correlation. Therefore, the squared wavelet coherence dealings with the local linear association among stationary series of two variables at every scale and is corresponding with the squared correlation coefficient in linear regression.

Meanwhile, Monte Carlo methods are used to identify the hypothetical allocation for the wavelet coherence (Torrence and Compo, 1999 & Grinsted et al., 2004).⁵

⁵ The usage of wavelet carries the trouble of dealing with edge situation on a data with predetermined interval when transformation is based on filters. This complexity is overcome by filling the time sequence with an enough digit of zeroes. The regions where the errors affected by breaks and gaps in the wavelet transform can be overlooked, i.e. where boundary impacts become essential, is called the shaft of control (Grinsted et al. 2004).

Results

This section discusses the impact of tourism development on economic growth in USA. Figures 1 and 2 plot the difference time series of TD and IPI.

<Insert Figure-1 and Figure-2 here>

The substantial fluctuations are evident in the real difference series of both TD and IPI indicating significant changes in both time series during the sample period. Augmented Dickey Fuller (ADF)⁶ and Phillips and Perron (PP)⁷ unit roots tests are performed to evaluate the stationary properties of both the series. The unit root tests results show that TD and IPI are non-stationary at level, but they become stationary at first difference (Table-2) suggesting that there is no issue of unit root in our both variables.

<Insert Table-2 here>

A result with mixed lag is a common issue when dealing with high frequency time series data. Both Akaike Information Criterion (AIC) and Hannan-Quinn Information Criterion (HQC) indicate the same lag order of 9; while Schwarz Information Criterion (SBC) indicates a lag order of 7. Therefore, the Hatemi-J (2003) criteria or known as HJC is employed to select lag order.⁸ The best lag order is captured by looking at the minimum value of the HJC estimated using VAR estimates. The best lag order used in this study is 9 (see Table 3).

<Insert Table-3 here>

Moreover, the long-run relationship between TD and IPI is tested by using the two cointegration approaches explicitly, autoregressive distributed lag (ARDL)⁹ and the Bayer and Hanck (2013) combine cointegration methods. Both the tests results show that there is a significant long-run relationship exist between tourism development and economic growth in the US (Table-4 and Table-5). Furthermore, all cointegration tests, including the combine cointegration test reject the null hypothesis of no cointegration and strongly confirm the acceptance of long-run cointegration between both the variables. Next, the relationship between TD and IPI is examined through wavelet analysis, after ratifying the valid long-run relationship between both the variables since tools such as wavelet power, coherency and phase can reveal interesting features about the

⁶See, Dicky and Fuller (1979)

⁷See, Phillips and Perron (1988)

⁸ Usually, the HJC lag order is created based on the HQC and SBC formulation as shown follow:

$$HJC = \ln(\det\hat{\Omega}) + j \left(\frac{n^2 \ln T + 2n^2 \ln(\ln T)}{2T} \right)$$

where, Ω represent the maximum likelihood estimate of the variance and covariance matrix and T is the total sample size.

⁹See, Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran et al. (2000, 2001)

structure of a process as well as information about the time-frequency dependencies between two time series.

<Insert Table-4 and Table-5 here>

In “Wavelets” approach, the various time horizons is examined in time series dataset. Wavelet studies the issue of non-stationarity as a basic property of time series rather than an issue to be answered by the pre-processing of the data. Figures 3 and 4 demonstrate the multi-resolution analysis (MRA) of pattern $J=6$ for the both time series i.e. TD and IPI by using Daubechies (1992) least asymmetric (LA) wavelet filter¹⁰. In both figures, the orthogonal components ($D_1, D_2 \dots D_6$ and A_6) is plotted to display the diverse frequency components and smooth series of the original series in particulars. The outcomes display that the high frequencies are established in the short period of both series. Additionally, the deviation in the two series is become further stable in the long periods and in very long period.

<Insert Figure-3 and Figure-4 here>

Continuous Wavelets Transform

The main role of wavelet transform analysis is the grouping of time and frequency analysis, but the explanation is not as easy as the frequency information has diverse resolution at each stage. The continuous wavelet analysis is relatively easier to interpret because it offers more observable and visible frequency evidence. Consequently, to establish the findings of wavelet transform we also use continuous wavelet analysis on the relationship of TD and IPI. Figures 5 and 6 display the continuous wavelet power spectrum of both series.

<Insert Figure-5 and Figure-6 here>

The continuous wavelet power spectrum shows the activities of the series in a three dimensions curve plot: time, frequency and color code. Figures 5 and 6 visibly specify that in both series of TD and IPI have diverse characteristics in different time frequency areas. It is evident that in the case of TD we observe comparatively a quite stable variance in the long and very long-run related to the short and medium-run. We also notice the strong variance for the medium scale. These findings suggest that the variance in the tourism development occur mostly in the medium-run than short-run. Likewise, in the case of IPI a low variance in the short-run and a stable variance in the medium-run is observed. Moreover, a strong variance is noticed in long run. So, these

¹⁰The Daubechies' (1992) “least asymmetric wavelet filter LA is a widely used wavelet, because it provides the most accurate time-alignment between wavelet coefficients at various scales and the original time-series, and it is applicable to a wide variety of data types”.

findings suggest that the variance in the IPI also occur confidently in the short and long-run as well.

Wavelet Coherence Transform

We use wavelet coherence transform to categorize the occurrence of cause and effect relationship between TD and IPI in the United States. The wavelet coherence offers the common power (features) and relative phase of various time series in present time-frequency space. The cone of influence (COI) test is also measured to investigate the anti-cyclical relationship between TD and IPI. Figure-7 displays the wavelet coherence power spectrum between TD and IPI in US.

<Insert Figure-7 here>

The outcomes of wavelet coherence are identified on the basis of four major periods, namely; (D_1+D_2) , (D_3+D_4) and (D_5+D_6) indicating short-run, medium-run and long-run, respectively. The results suggest that the significant causal relationship exist between tourism development and economic growth in short and long-run. In the short-run we notice some clusters for the period 1998-2006 in which some arrows are upside down reflecting that IPI is leading over TD (i.e. IPI has a causal influence over TD indicating that economic growth attracts tourists to visit US). However, no in-phase situation is observed throughout the medium-run.

In the long-run, we observe that the majority of the arrows are right-side down over the period 2000-2013 suggesting that TD is leading (there exists a unidirectional causality between TD and IPI). In other words, initially economic conditions attract tourist to visit US and then due to influx of tourists economic conditions improve. The findings of wavelet coherence approach confirm that initially economic growth has a causal relationship with tourist arrivals in the short-run and then a unidirectional influence of TD on IPI in long-run in USA. The results reveal that an increase in economic growth of a country enhances tourism industry in the short-run and that can lead to further economic growth in the long-run.

Wavelet Based Granger causality analysis

The wavelet based Granger causality is analyzed by using the time frequency band of wavelet transform to investigate the causal relationship between TD and IPI. Table-5 explains the results of Granger causality through frequency series and time-scales.

<Insert Table-5 here>

The wavelet granger causality test examines that each TD causes the change in high, medium and low frequencies of the IPI series. The results (Table-5) specify that the raw series of

tourism development has bidirectional causal influence with raw series of IPI in USA. The results confirm that there is a unidirectional causal influence of economic growth on tourism development in the short-run. However, the unidirectional causal relationship is reverse in the long-run.¹¹ These findings are consistent with the wavelet coherence transform. Overall, economic growth plays crucial role in enhancing tourism industry by providing improved infrastructure which in turn enhances further growth in a country.

Conclusions

The existing literature on the relationship between tourism development and economic growth provides mixed findings. Moreover, the analyses based on autoregressive, linear or cointegration models are mostly static which poses some limitations while analyzing non-stationary time series data. To surmount the issues, the most advanced dynamic wavelet transform framework is used to investigate the relationship between tourism development and economic growth in the United States of America. This new methodology empowers the decomposition of time-series at different time-frequencies and offers the precise results for the different time-frequencies based on short, medium, long-run. Using wavelet power spectrum, wavelet coherence spectrum and wavelet based granger causality this study examines the relationship between TD and IPI in Unites States with monthly data for the period 1996M01 to 2015M08.

The unit root test results (ADF and PP) show that there is no issue of stationarity in the series. The outcomes of ARDL and combine cointegration propose the significant long-run relationship between TD and IPI in USA. The results show that TD and IPI observe a substantial variance in the short and medium-run. Moreover, the findings of wavelet coherence approach confirm that economic growth has an influence on tourism development in short-run but the opposite is observed in the long-run. Finally, the results of wavelet based granger causality confirm that there is a unidirectional causal influence of economic growth on tourism development in the short-run but tourism development influences economic growth in the long-run. However, there is no evidence of causal relationship between the two in medium-run.

The findings suggest that a very warm hospitality must be provided to attract inbound tourists for further economic growth in USA. In other words, government can promote themselves as extremely remarkable tourist destinations through economic development. Government can also try to attract tourists from various countries or regions by producing tourist spots that garb the diverse taste of various nationalities. Additionally, the tax structure can play a significant part in tourism development i.e. the USA government can provide tax incentives to the tourism related products such as hotels and air fares. Furthermore, the traditional and cultural carnivals can be planned to attract overseas tourists. Finally, brochures, pamphlets and journals with maps and appropriate guidance should be located in entre hotels and tourists entries so that tourists from all

¹¹ The results suggest that preservation hypothesis holds in the short-run that economic growth amplifies economic growth but tourism-led-growth hypothesis applied in the long-run.

over the world can take assistances from it without any communication barrier. In a way development of tourism industry can be beneficial for enhancing economic growth in USA.

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Table 2: Stationary Test Results

Variables	Augmented Dickey-Fuller				Phillips-Perron			
	I(0)		I(1)		I(0)		I(1)	
	C	C&T	C	C&T	C	C&T	C	C&T
TD	-1.90	-2.04	-5.06	-5.15	-1.34	-1.48	-5.45	-5.48
IPI	-1.40	-1.63	-4.51	-6.10	-1.22	-1.85	-4.71	-6.10

Note: The critical values for ADF and PP tests with constant (c) and with constant & trend (C&T) 1%, 5% and 10% level of significance are -3.711, -2.981, -2.629 and -4.394, -3.612, -3.243 respectively.

Table 3: VAR Lag Length Selection Criterion

Lags order	AIC	HQC	SBC	HJC
0	-2.4647	-2.4525	-2.4345	-2.4435
1	-8.0355	-7.9988	-7.9447	-7.9718
2	-8.0609	-7.9998	-7.9096	-7.9547
3	-8.1624	-8.0769	-7.9505	-8.0137
4	-8.2099	-8.1000	-7.9375	-8.0187
5	-8.2519	-8.1175	-7.9189	-8.0182
6	-8.2770	-8.1182	-7.8835	-8.0008
7	-8.9133	-8.7300	-8.4592	-8.5946
8	-8.9373	-8.7296	-8.4227	-8.5761
9	-9.0092	-8.7771	-8.4341	-8.6056
10	-8.9821	-8.7255	-8.3464	-8.5360

Note: FPE - Final prediction error, AIC - Akaike information criterion, SBC - Schwarz information criterion, HQC - Hannan-Quinn information criterion and HJC – Hatemi-J criterion

Table 4: ARDL Bounds Cointegration Test Results

Function	Optimal lag	F-statistic	Diagnostic tests		
			$\chi^2_{Serial}(2)$	$\chi^2_{ARCH}(2)$	$\chi^2_{Normality}$
IPI=f(TD)	(9, 1)	3.8582***	0.9776	1.9891	1147.4410*

		(0.6134)	(0.2256)	(0.0000)
Significance level	Upper Bounds	Lower Bounds		
	<i>I</i> (0)	<i>I</i> (1)		
1%	4.94	5.58		
5%	3.62	4.16		
10%	3.02	3.51		

Note: *, ** and *** denotes significance level at 1%, 5% and 10%, respectively. Figures in () represent *p*-values and the critical values are based on Pesaran’s critical values.

Table 5: Combine Cointegration Test Results

	EG	JOH	BA	BO	EG-JOH	EG-JOH-BA-BO (Combine cointegration)
Test types	-2.8284*** (0.0540)	18.4874** (0.0243)	-2.9259*** (0.0951)	11.8582** (0.0254)	8.7311***	17.5892***
Cointegration	✓	✓	✓	✓	✓	✓
Significance level	Critical values					
	EG-JOH	EG-JOH-BA-BO				
1%	17.304	33.969				
5%	11.229	21.931				
10%	8.678	16.964				

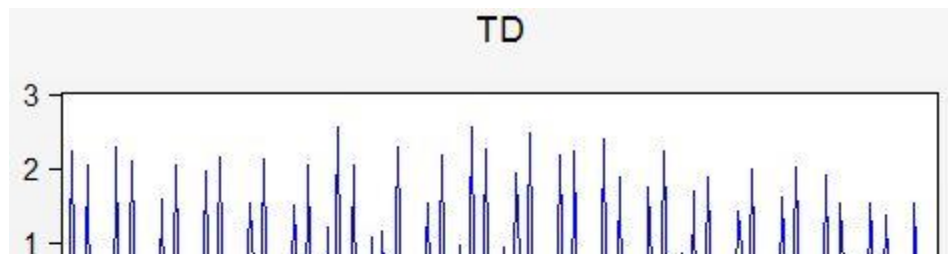
Note: *, ** and *** denotes significance level at 1%, 5% and 10%, respectively. Figures in () represent *p*-values. EG - Engle and Granger, JOH – Johansen, BA – Banerjee, and BO - Boswijk tests. The optimal lag length used for this estimation is based on HJC.

Table 6: Results of Wavelet based Granger causality test at different time scales

TD	Time Domain	Frequency bands (months)
	IPI	

Raw Series	D1 2-4M	D2 4-8M	D3 8-16M	D4 16-32M	D5 32-64M	D6 64-128M
Ho: Tourism development does not cause economic growth	0.0000	0.1521	0.2489	0.2059	0.1554	0.0000
Ho: economic growth does not cause Tourism development	0.0001	0.0045	0.0459	0.1368	0.2254	0.4973

Note: p-values for the F-test show the rejection of null hypothesis of no causality (i.e., if p-values < 0.10, we accept the causality at 10% significance level).



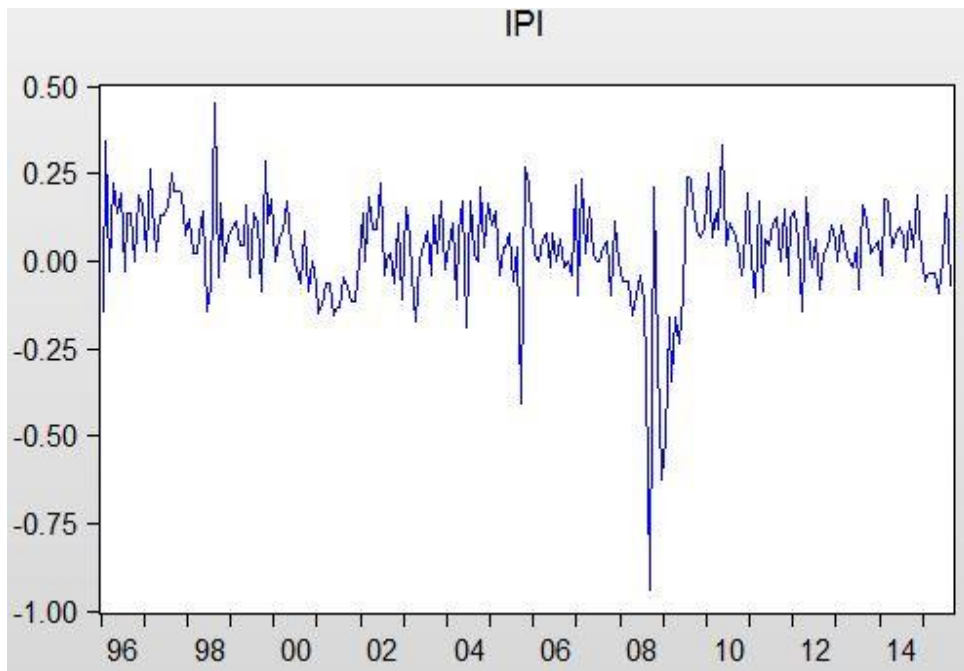


Figure 2: Real difference series of IPI for United States

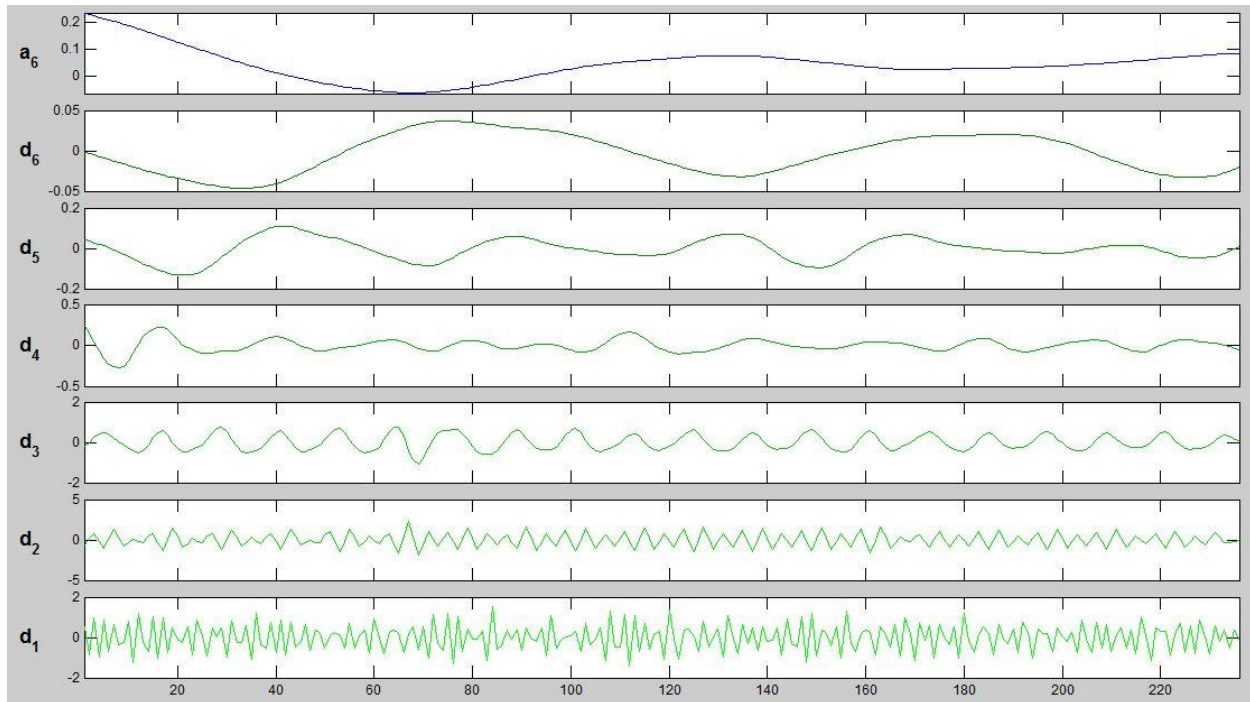


Figure 3: Orthogonal Component (decomposition series of TD on J=6 wavelet levels)

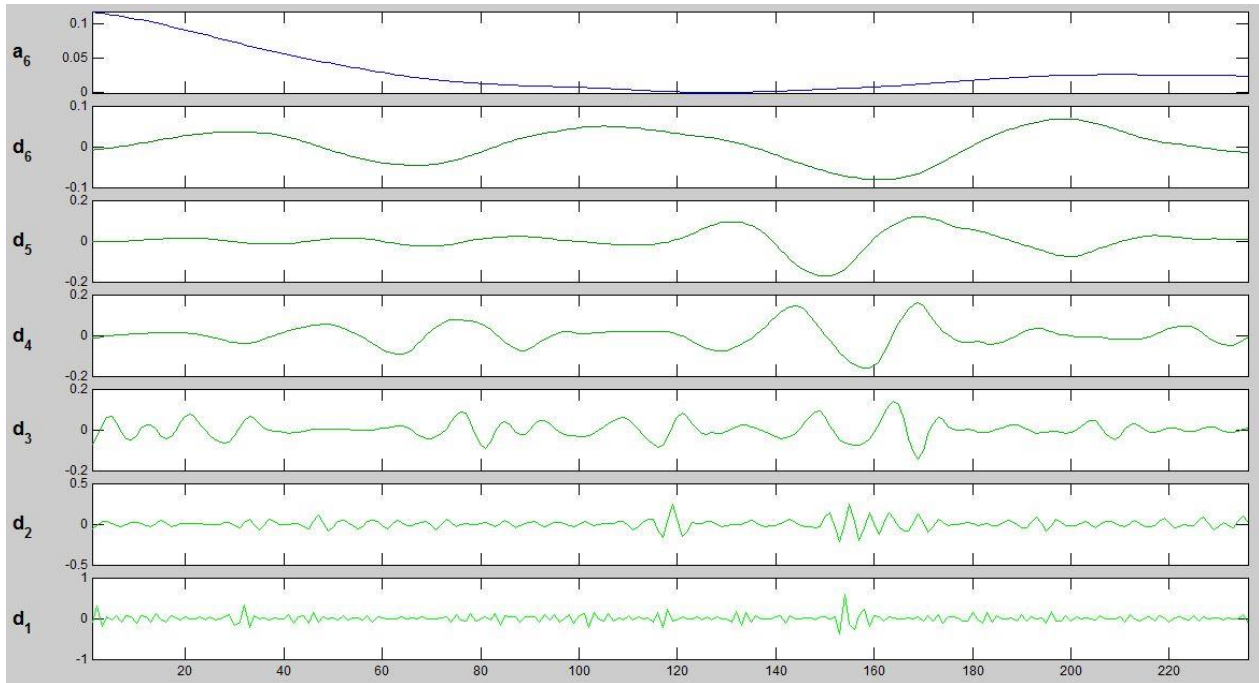
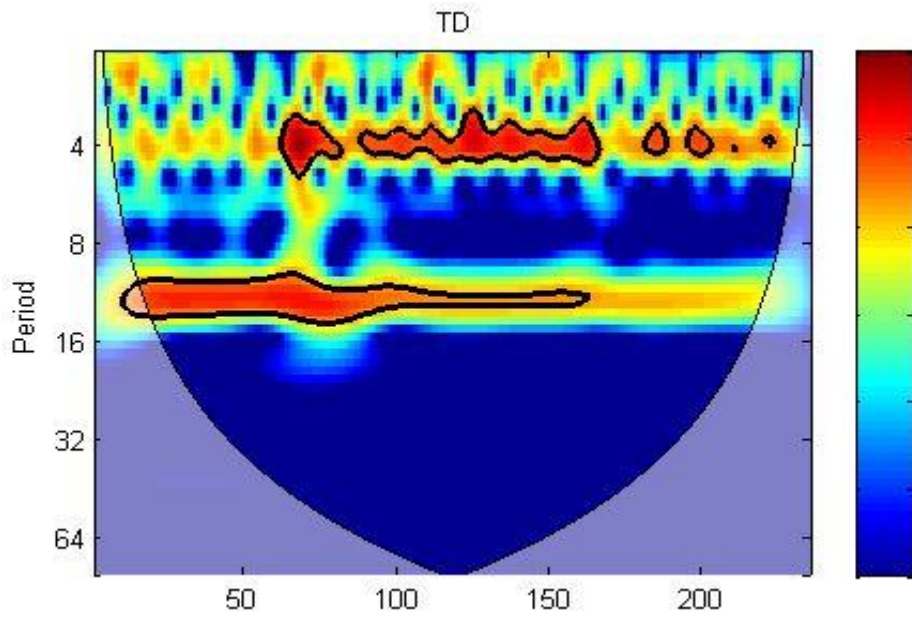
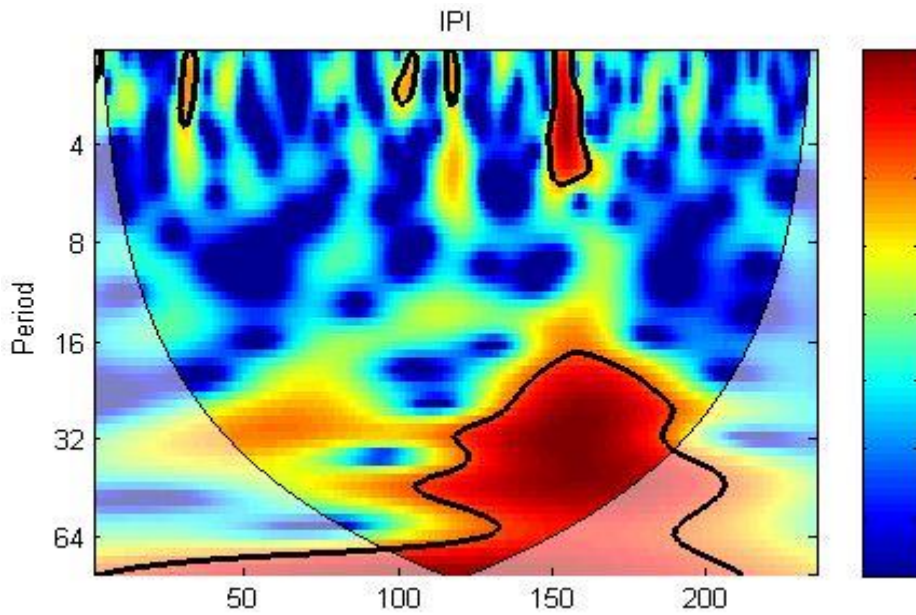


Figure 4: Orthogonal Component (decomposition series of IPI on J=6 wavelet levels)



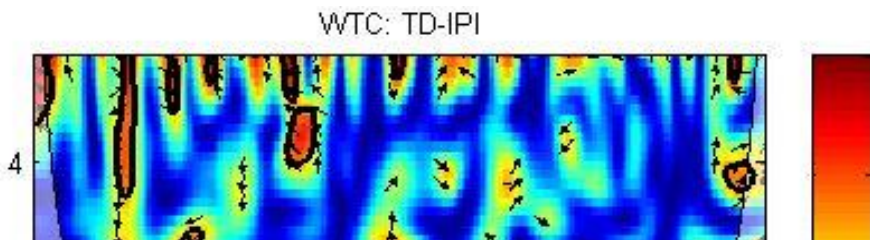
Note: The thick black contour represents the 5% significance level against the red noise. The color code for power ranges from blue (low power) to red (high power).

Figure 5: Continuous wavelet power spectra of the TD



Note: The thick black contour represents the 5% significance level against the red noise. The color code for power ranges from blue (low power) to red (high power).

Figure 6: Continuous wavelet power spectra of the IPI



25	1998-02-01
50	2000-03-01
75	2002-04-01
100	2004-05-01
125	2006-06-01
150	2008-07-01
175	2010-08-01
200	2012-09-01
225	2014-10-01

25	1998-02-01
50	2000-03-01
75	2002-04-01
100	2004-05-01
125	2006-06-01
150	2008-07-01
175	2010-08-01
200	2012-09-01
225	2014-10-01

Note: The thick black contour represents the 5% significance level against the red noise. The color code for power ranges from blue (low power) to red (high power).

Figure 7: Wavelet Coherence power spectra of TD-IPI