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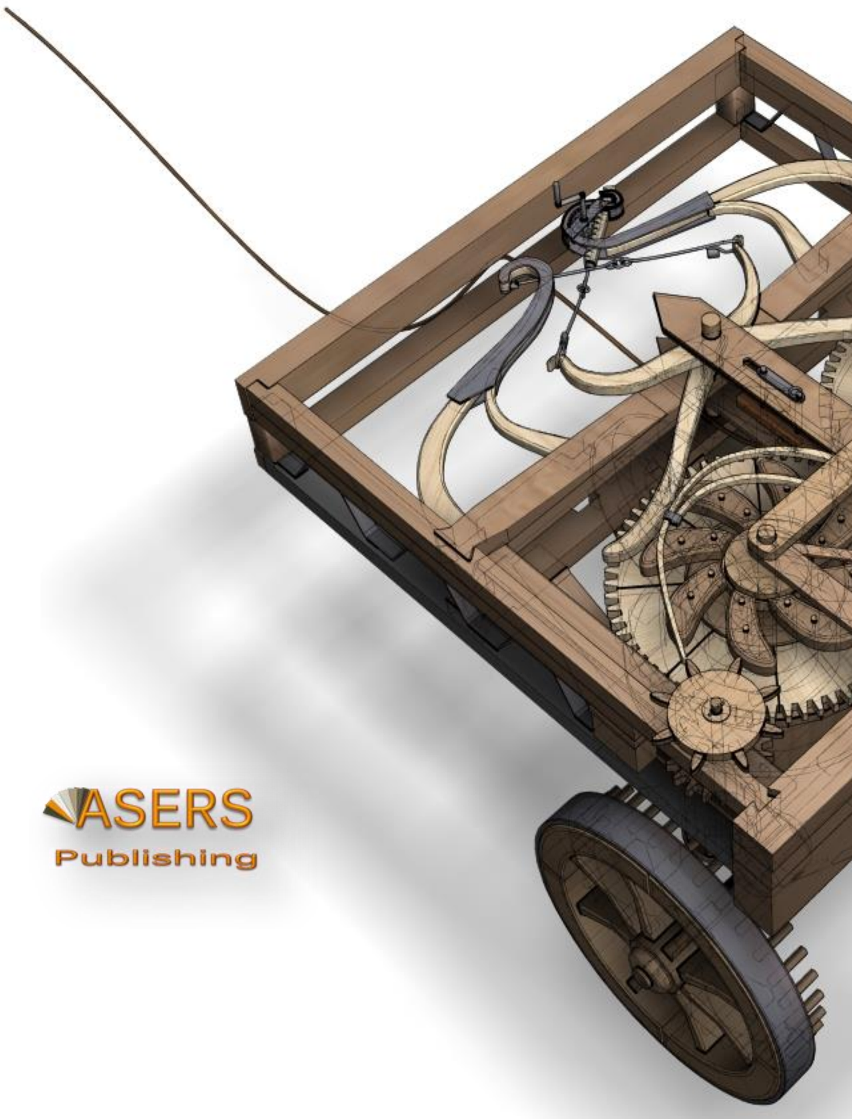

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TOURISM DEMAND AND EXOGENOUS EXCHANGE RATE IN CAMBODIA: A STOCHASTIC SEASONAL ARIMAX APPROACH

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Abstract:

Time series seasonally displays toward either an autoregressive or moving average process where persist in seasonality fluctuation. The paper examines the relationship of tourism demand with controlling an exogenous exchange rate using seasonal ARIMA model. The empirical results reveal that HEGY test for seasonal unit roots with lower and upper panel indicates the statistical significance which explains the failure of rejection of having unit roots at different frequencies. The estimated outcomes from tourism demand model specify that per capita income and exchange rate have the power in explaining tourism demand measured as tourist arrivals. In particular to forecasting model and due to the lower statistical value of RMSE and MAE displays that the SARIMAX (4, 1, 1) – $(1, 1, 1)_{12}$ model is the best accuracy model to perform the long run ex-ante forecasting of tourism demand. This suggests tourism policy maker to pay more reflection in formulating the policy toward the exogenous factors in line with the uncertainty and unobserved seasonality.

Keywords: seasonal unit roots test; seasonal ARIMAX model; tourism demand; exogenous exchange ratel Cambodia

JEL Classification: C15; C22; C53; Z32.

Introduction

In the first quarter of 2017, said Q1, the growth rate of Cambodia tourism statistics approximates 2.1% comparing to those of 2015 and 2016 about to 5% and 6.1% respectively. The tourism trend increases significantly due to the industry being considered as one of the crucial sectors in boosting economic growth and development. On the other hand, Tourism Development Strategic Plan 2012-2020 have been executed with the goal of attracting international tourists through the connectivity, safety and security, marketing and facilitation of tourist transportation. In 2000, tourist arrivals account for 2.51 million, the amount reaches to almost 5.01 million in 2016. The growth rate is approximated 11.9% in the first quarter of 2017/2016. According to the research, 80% have visited Cambodian land once per time and 20% are likely to return after the first enter.

Analysis the factors affecting tourism demand jumped to confirm the crucial function of social-economics and macroeconomics factors in determining the tourism flow to the host country. Within this, currency exchange rate has consistently been used in modelling international tourism demand (Song and Li 2008). Song and Li (2008) compiled more than 100 research papers on tourism demand modelling and forecasting has determined the most vital and popular tourism demand determinants such as income, prices, substitute prices, and exchange rates. Tourism price is a predominant factor in tourism demand literature travelers are sensitive to exchange rates (Crouch 1995; Dwyer *et al.* 2002; Önder, Candemir, Kumral 2009; Patsouratis, Frangouli, Anastasopouls 2005).

Most of the studies have focused on quantitative estimates the determinants of tourism demand function (Crouch, 1995; Johnson and Ashworth 1990; Lundberg, Krishnamoorthy, Stavenga 1995); (Lim 1997; Li *et al.* 2005; Song and Li 2008; Martin and Witt 1987).

In the empirical evidences, the relative price is normally employed in the tourism demand model is the ratio of the consumer price indexes (CPI) between the destination and origin countries, adjusted by the bilateral exchange rate. Empirically, an appreciation of the exchange rate, applying the higher of the exchange rate in favor of organizing country's currency resulted in an increasing number of tourists visiting the destination country from the country of origin. In this regard, the existing literature tends to confirm the negative link between relative prices and tourist arrivals; however, the magnitude of the effects is also reported to differ and is at times insignificant (Lim 1997). Therefore, in the case of Cambodia, how does exchange rate influence on the quantity of tourism demand due to seasonality trend?

The prime purpose of the study is to estimate and forecast tourism demand model with an exogenous exchange rate using seasonality approach. Secondly, it proposes to employ out of sample forecasting to quantum the measurement predictive accuracy. Therefore, the remainders of the study are structured as follows: 1st session is to present the introduction of the study whereas the 2nd one is to review some existing empirical research studies. The 3rd one is to design the empirical methodology and data collection. The 4th session is to interpret the empirical outcome and the last one 5th is to make the conclusion following by suggestions for the future research.

1. Reviewing Existing Empirical Studies

Time series usually establishes in the form of autoregressive (AR) and moving average (MA) or single trend of either AR or MA or the nonexistence. The so-called ARIMA models are, the most general models using to estimating or forecasting from which can convert to be "stationary" by differencing method. The class of methods is supplementary to nonlinear transformations such as logging or deflating. Particular attention is paid to explore the historical trends and patterns of the series such as random trend and walk, non-seasonality and seasonality in general. In particular, observed seasonality in economic and financial time series displays persistently and often changes in seasonal fluctuations (Breitung and Philip, 1998). This results in exhibiting the AR process with seasonal unit roots due to the observations periodically exhibit the seasonal patterns. Observation would appear seasonally if the spectrum of the process has peaks at certain frequencies, (Xiangli Meng, 2012). With this phenomenon, the seasonal unit roots of (Hylleberg, 1990) takes into account and detects the unit roots toward the seasonality trend. Time series models have been extensively employed in modelling and forecasting tourism demand with integrating between AR and MA, so-called an ARIMA model proposed by (Box and Jenkins, 1970). For the sake of the frequency, either simple ARIMA or seasonal ARIMA models can employ toward an increasing popularity over the last few years. Whilst the seasonality model is such a dominant feature of tourism analysis, decision makers are very much interested in the seasonal variation due to the presence of contradictory evidence. Xiaosheng Li (2013) confirmed that SARIMA model can perfectly fit the variation trend of the outpatient amounts.

In the line with tourism demand and exchange rate relationship, the empirical studies have suggested different evidences either the shock or volatility catalyst. The gap highlighted is important, although the number of the studies that actually examines the impact of exchange rate regimes on tourism demand can be counted, the evidence reveals the measurement of exchange rate plays an important role in determining international tourism flows. Some conversely find the non-impact of the exchange rate to tourism demand equally in various origin-destination scenarios (Zheng, 2011). In particular, there also exists the long run relationship between tourism demand and foreign exchange earnings, (Ruane, 2014), (Vita, 2014) and (Aktar, 2014). Multiple exchange rate regime effect and support the importance of maintaining a relatively stable price to attract tourism arrivals. The negative effect exchange rate of tourist inflows is detected as well (Agiomirgianakis, 2014). Thus, there is the broadband of either positive, negative or insignificant impact of the exchange rate to tourism demand.

To account for dynamism in tourism flows with a dynamic time series analysis, Seetanah (2015) employed the so-called vector autoregressive model (VAR) to study the impact of relative prices on tourism demand for Mauritius. The empirical outcomes reveal that relative price has a long run impact on international tourism flows which is indicated tourists are sensitive to price levels. The relative average cost in the different competing destination reports to be positive and significant. It is indicated that the impact of relative price changes in foreign destinations competing with Mauritius tourism matters. Tourism infrastructure, income of the origin country and the island's level of development are confirmed to be key factors in the tourist selection decision. Finally, overall, short-run estimates confirm the above results.

Martins, Gan and Ferreira-Lopes (2015) and Gan (2015) investigates the relationship between macroeconomic indicators and the tourism industry from 218 panel countries during the period of 1995 to 2012. Tourism demand is measured by the inbound visitors and the on-the-ground expenditure and the economic variables include exchange rate, relative CPI and the World GDP. Partial results confirm that a depreciation of the national currency and a decline of relative prices do help boosting the number of arrivals and the correspondent expenditure level. In particular, the exchange rate is not always positively related to tourism demand, which is not consistent to the previous researches. At the same time, the relative prices are always significant in the models and with the expected negative sign.

Quadri and Zheng (2010) using Italy's data to examine the connection between exchange rates and international arrivals suggests that exchange rates do not universally affect international tourism demand. It exhibits disparate levels of significance in determining international arrivals to Italy. In eleven of the nineteen nation pairs, exchange rates resulted in insignificance, contradicting previous studies (Crouch 1995) and prevailing assumptions.

Lee *et al*. (1996) estimates the demand from inbound tourism expenditures for South Korea from eight tourists-originating countries using annual time series data between 1970 and 1989. The log-log specification is applied and estimated by OLS estimation. Tourist income and prices and political unrest, economic recessions and mega events are considered as major determinants. The empirical results discloses that income has positive and significant influence, while prices have a negative and significant impact, and the exchange rates have positive signs for all the countries except for the UK. Conversely, the dummy variables turn to be insignificant connection.

2. Empirical Estimation Methodology

2.1. Data Calculation and Statistical Tests

To estimate the baseline specification equation in line with both simple OLS and seasonality model, the study employs tourist arrivals as the proxy of tourism demand, denoting as $\mathrm{TD_t}$, per capita real GDP as tourism incomes. Yet, since per capita real GDP is extracted annually, to obtain the quarterly one though, the study applies the interpolation method to expand it to quarter data. Exchange rate as the proxy of tourism price and an exogenous factor in the study, indicating as $\mathrm{EX_t}$. Indeed, $\mathrm{TD_t}$ is extracted from tourism statistic reports of Statistics and ICT Department, Ministry of Tourism, Cambodia. $\mathrm{EX_t}$ and tourism income are obtained from the Asian Development Bank (ADB). All variables are jumped from the 1st quarter of the 2000 to the 2nd quarter of 2017 and converted to the logarithm function. As the result, the descriptive statistics presents in table 1 as follows.

Table 1. Descriptive statistics of tourism demand and exchange rate

Description	With logarithm function $\mathrm{lnTD_t}$	$\mathrm{lnEX_t}$	$\mathrm{lnIncome_t}$
Observations	70	70	70
Percentiles (50%)	13.2069	8.3190	6.6043
Mean	13.0702	8.3160	6.4799
Standard Deviation (SD)	0.7688	0.0280	0.4861
Min	11.5436	8.2507	5.7061
Max	14.2232	8.3654	7.2368
Variance	0.5911	0.0008	0.23631
Skewness	-0.4023	-0.6666	-0.2052
Kurtosis	2.0611	3.1425	1.6766
Shapiro – Walk test	2.590 (0.0048)	2.700 (0.0035)	3.145 (0.0008)
Unit roots test with trend			
ADF test at level, I(0)	-4.542** (0.0013)	-2.652 (0.2568)	-0.455 (0.9006)
ADF test at first difference, I(1)	-8.275*** (0.0000)	-6.876*** (0.0000)	-10.536*** (0.0000)

*Source: Author's estimates and * p<0.05, ** p<0.01, *** p<0.001*

Table 1 indicates the total observations of all selected variables are 70, SD reports 0.7688, 0.0280 and 0.4861 for $\mathrm{lnTD_t}$, $\mathrm{lnEX_t}$ and $\mathrm{lnIncome_t}$ respectively. This indicates that the disparity of the dataset from TD is higher rather than those of tourism income and price. Furthermore, $\mathrm{lnTD_t}$, $\mathrm{lnEX_t}$ and $\mathrm{lnIncome_t}$ present 11.54, 14.22 and 5.7061 and 8.25, 8.36 and 7.24 for minimum and maximum value respectively. All variables have a negative value of Skewness statistics. This somehow suggests the non-normality of observation whereas Kurtosis flows in the gaps of 2.06, 3.14 and 1.68 for $\ln TD_t$, $\ln EX_t$ and $\ln Income_t$ respectively. The Shapiro-walk statistics for detecting normality assumption under the null hypothesis where the sample is normal distribution, can reject the null at 5% level of significance. It accordingly denotes that $\ln TD_t$, $\ln EX_t$ and $\ln Income_t$ are not come from the normal distribution. Moreover, to test whether data series is stationary at level, I(0) or first difference, I(1), Fisher unit roots based ADF with trend is employed. The results show that series at I(0) cannot reject at 5% level. It conversely rejects at 1% level of significant whereas it is transferred to I(1).

2.2. Baseline Regression Equation: Tourism Demand Model and Exogenous Exchange Rate

To estimate the relationship between tourism demand and exchange rate toward the seasonality trend, the study builds the baseline specification equation with respect to tourism demand model whereas tourism income and price is controlled as follows:

$$(\text{Tourism Demand}_t) = \alpha + \beta[\text{Income, Price}]_t^{(\frac{1}{T})} + \gamma\text{Seasonality}_t + \varepsilon_t \tag{1}$$

where, Tourism Demand_t indicates tourism demand, using total tourist arrivals and exchange rate respectively. $[\text{Income, Price}]_t$ refer to the tourism income and price. The subscribed of (1/T) refers to decomposing period in three different path. Equation (1) will estimate primarily by simple OLS estimator with robust standard error (SE). The dummy variables of seasonality are followed, (Jintanee *et al.*, 2011):

- $D_1 = 1, D_2 = D_3 = D_4 = 0 \Rightarrow Q_1 =$ January – March
- $D_2 = 1, D_1 = D_3 = D_4 = 0 \Rightarrow Q_2 =$ April – June
- $D_3 = 1, D_1 = D_2 = D_4 = 0 \Rightarrow Q_3 =$ July – September
- $D_4 = 1, D_1 = D_1 = D_3 = 0 \Rightarrow Q_4 =$ October – December

The decomposing period into three different path, namely the pre-global financial crisis (Pre-GFC), global financial crisis (GFC) and post-global financial crisis (Post-GFC). These three are decomposed by time length as follows:

- Pre – global financial crisis (Pre – GFC): 2000Q1 – 2007Q4
- Global financial crisis (GFC): 2008Q1 – 2009Q4
- Post – global financial crisis (post – GFC): 2010Q1 – 2017Q1

Theoretical and empirical time series models explain a variable toward either its own past or a random disturbance term. Sequentially, following the mathematical illusion of seasonal ARIMA with an k^{th} matrix of exogenous factors and its parameters of SARIMAX (p, d, q) – (P, D, Q)$_s$ – (b). The seasonal ARIMA model equates as follows:

Let's first consider a series TD_t as tourism demand to Cambodia with an autoregressive of 2 lags, say $(t-2)$ as below:

$$TD_t = \emptyset TD_{t-1} + \varepsilon_t \tag{2}$$

$$TD_t = \emptyset(\emptyset TD_{t-2} + \varepsilon_{t-1}) + \varepsilon_t \tag{3}$$

$$= \emptyset^2 TD_{t-2} + \varphi\varepsilon_{t-1} + \varepsilon_t \tag{4}$$

Consequently, the equation (4) can be rewritten into an infinite process of p and q lag between AR and MA order of parameters as follows:

$$TD_t = \emptyset^p TD_{t-p} + \varphi^{q-1}\varepsilon_{t-q} + \cdots + \varphi\varepsilon_{t-1} + \varepsilon_t \tag{5}$$

From equation (5), it can derive the full equation of SARIMAX (p, d, q) – (P, D, Q)$_s$ – (b). In the study of (Box and Jenkins, 1970), SARIMAX (p, d, q) – (P, D, Q)$_s$ with controlling of exogenous variables as suspected that residuals may exhibit a seasonal trend or pattern. It is presented that, let's consider though a matrix set of the exogenous variables as bellows:

$$\omega_t = TD_t - \beta_1 x_{1,t} - \beta_2 x_{2,t} - \cdots - \beta_b x_{b,t} \tag{6}$$

Thus, we get sequentially the following equation:

$$\left(1 - \sum_{i=1}^{p} \emptyset_i L^i\right)\left(1 - \sum_{j=1}^{P} \Phi_j L^{j\times s}\right)(1 - L^d)(1 - L^s)^D \omega_t - \eta$$

$$= \left(1 + \sum_{i=1}^{q} \varphi_i L^i\right)\left(1 + \sum_{j=1}^{Q} \Omega_j L^{j\times s}\right)\varepsilon_t \quad (7)$$

where,

- L is the lag operator
- D is the seasonal integration order of the time series
- s is the seasonal length, it is equaled to 4 as denoted as quarter within a year
- TD_t is the observed output at time t which is applied tourism demand to Cambodia
- $x_{k,t}$ is the kth exogenous input variable at time t which is used as dollarization variable
- β_k is the coefficient value for the kth exogenous (explanatory) input variable
- b is the number of exogenous input variables
- ω_t is the auto-correlated regression residuals
- p is the order of the non-seasonal AR component
- P is the order of the seasonal AR component
- q is the order of the non-seasonal MA component
- Q is the order of the seasonal MA component
- η is a constant in the SARIMA model
- ε_t is the innovation, shock or error term at time t and follow a Gaussian distribution, $\varepsilon_t \sim \text{i.i.d} \sim \Phi(0, \sigma^2)$

2.3. HEGY Seasonal Unit Roots Test

A stationary seasonal process can be denoted as an autoregressive model (Depalo, 2009). Therefore, the study denotes it in line with TD_t, EX_t and Income_t as follows:

$$\emptyset(L)[TD_t, EX_t, \text{Income}_t] = \varepsilon_t \quad (8)$$

With all the roots of $\emptyset(L)$ outside the unit circle (but some come in complex pairs). If $s = 4$, then a stationary seasonal process is $[TD_t, EX_t, \text{Income}_t] = p(L^4)[TD_t, EX_t, \text{Income}_t] + \varepsilon_t$, where L is the lag operator and $(L^4)[TD_t, EX_t, \text{Income}_t] = [TD_{t-4}, EX_{t-4}, \text{Income}_{t-4}]$. If some of the roots lie on the unit circle, the process is an integrated seasonal process, (Hylleberg, 1990). According to Depalo (2009), the test is based on the following equation:

$$\begin{aligned}\emptyset(L)[TD_t, EX_t, \text{Income}_t] = {} & \pi_1\left[TD_{1,t-1}, EX_{1,t-1}, \text{Income}_{1,t-1}\right] + \\ & \pi_2\left[TD_{2,t-1}, EX_{2,t-1}, \text{Income}_{2,t-1}\right] + \\ & \pi_3\left[TD_{3,t-2}, EX_{3,t-2}, \text{Income}_{3,t-2}\right] + \\ & \pi_4\left[TD_{4,t-1}, EX_{4,t-1}, \text{Income}_{4,t-1}\right] + \varepsilon_t \end{aligned} \quad (9)$$

where

- $\left[TD_{1,t}, EX_{1,t}, \text{Income}_{1,t}\right] = (1 + L + L^2 + L^3)[TD_t, EX_t, \text{Income}_t]$
- $\left[TD_{2,t}, EX_{2,t}, \text{Income}_{2,t}\right] = -(1 - L + L^2 - L^3)[TD_t, EX_t, \text{Income}_t]$
- $\left[TD_{3,t}, EX_{3,t}, \text{Income}_{3,t}\right] = (1 - L^2)[TD_t, EX_t, \text{Income}_t]$
- $\left[TD_{4,t}, EX_{4,t}, \text{Income}_{4,t}\right] = (1 - L^4)[TD_t, EX_t, \text{Income}_t]$

And $\pi_i s$ are the coefficient for seasonal unit roots, for example:

$$\begin{aligned}\left[TD_{1,t}, EX_{1,t}, \text{Income}_{1,t}\right] &= (1 + L + L^2 + L^3)[TD_t, EX_t, \text{Income}_t] \\ &= (1 - L)(1 + L + L^2 + L^3)[TD_t, EX_t, \text{Income}_t] \\ &= (1 - L^4)[TD_t, EX_t] \end{aligned} \quad (10)$$

It is worthy noted that at root $1 - L$ the test is on coefficient $\pi_1 = 0$, at seasonal root $1 + L$ the test is on coefficient $\pi_2 = 0$ and at seasonal root $1 + L^2$ the test is joint on coefficients $\pi_3 = \pi_4 = 0$.

2.4. Method of Measurement Predictive Accuracy

The most frequency adoptions of the measurement predictive accuracy are root mean squared error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE) and Theil's inequality index (U). Let's assume therefore the forecast sample is $j = T + 1, T + 2, \dots, T + h$, and denote the actual and forecasted value in the period t as TD_t and $\widehat{TD}_t$ respectively. The forecast evaluation measures are defined as follows:

$$\mathrm{RMSE} = \sqrt{\sum_{t=T+1}^{T+h}(\widehat{TD}_t - TD_t)^2/h} \tag{11}$$

$$\mathrm{MAE} = \frac{1}{T}\sum_{t=T+1}^{T+h}\left|\widehat{TD}_t - TD_t\right| \tag{12}$$

$$\mathrm{MAE} = \frac{1}{T}\sum_{t=T+1}^{T+h}\left|\frac{\widehat{TD}_t - TD_t}{|TD_t|}\right| * 100 \tag{13}$$

$$\mathrm{Theil's\ U} = \frac{\sqrt{\sum_{t=T+1}^{T+h}(\widehat{TD}_t - TD_t)^2/h}}{\sqrt{\sum_{t=T+1}^{T+h}(\widehat{TD}_t)^2/h} + \sqrt{\sum_{t=T+1}^{T+h}(TD_t)^2/h}} \tag{14}$$

3. Empirical Estimated Results and Discussions

This session is to interpret the empirical outcomes from estimating and forecasting towards the baseline regression and SARIMAX model. The study primarily detects the seasonal unit roots followed the method of (Hylleberg, 1990) and (Depalo, 2009). Secondly, examining the effect of exchange, tourism price and seasonal dummy variables through the SARIMAX model of (Gerolimetto, 2010), (Kritharas, 2013) and Peiris (2016). Exchange rate and tourism price are assumed to be an exogenous.

3.1. Primarily Analysis of Seasonal Unit Roots Tests

The HEGY test for seasonal unit roots and HEGY Quarterly seasonal unit root test are employed using 4 lags. The results are reported in table 2, 3 and 4 as bellows. Table 2 indicates the HEGY test of tourism demand, income and price variables.

The table displays the component of frequency in two main pieces, say the empirical test in the upper panel and the regression results table in the lower panel as reported in table 3 for tourism demand variable and table 4 for exchange rate variable. The sample of interpretation of this method can be found in Depalo (2009). Based on the study of Depalo (2009) specifies that from the lower panel it is helpful to have a look at regression results because there are four important components. Therefore, the results from table 3 and 4 is estimated from those of table 2. The first four regressors are crucial for the test statistics. The second component is the set of lagged values, which are included in an attempt to remove serial correlation in ε_{it}. Third are the deterministic components, namely a trend and a set of seasonal dummies. The set of seasonal dummies automatically drops the last quarter because of multicollinearity. Fourth, there is the constant term. According to Depalo (2009) the test for unit roots at all seasonal frequencies and the test for unit roots at all frequencies are also F-type; thus, the decision is based on the same rule of the annual frequency. Therefore, from table 3 and 4 empirical result from HEGY test for seasonal unit roots at lag (4) for tourism demand and exchange rate series respectively. For table 3 indicate that for tourism demand series, there is no significance of almost four components for tourism demand series. The test cannot reject at both frequency 0 with p – value of 0.6970 and also at the annual frequency with p-value of 0.9030. Thus, the evidence indicates that Cambodia tourism demand has a unit root at frequency zero, as could be inferred from the classical Dickey–Fuller test.

Conversely, table 4 discloses that there exists few for exchange rate series of regression result. For the exchange rate series, at frequency 0 and 1, it shows the significance, say the p-value is 0.0180 and 0.0190 respectively. The annual components also show the significance at level and at lag 1, say the p-value is 0.0040 and 0.420 respectively. Thus, the evidence indicates that the Cambodia exchange rate does not contain a unit root at frequency zero and also one at frequency 1/2 (or biannual) and the other at annual frequency.

Hence, due to the HEGY test for seasonal unit roots for both tourism demand and exchange rate series with lower and upper panel indicate the statistical significance explains the failure of rejection of time series has unit roots at frequency 0 for tourism demand and succeed for the exchange rate at both frequency zero and one at frequency 1/2 (or biannual) and the other at annual frequency.

Next, the study employs seasonal unit roots test using the HEGY quarterly. The study detects the seasonal unit roots by 4 lags. The result in table 4 shows that 62 observations and the time seasonality as a matrix from P_{i1}, P_{i2}, P_{i3} and P_{i4} towards F[4-1] statistics are reported as well. Seasonality is a significant component in tourism data series. Hence, HEGY test in equation (4) applied to monthly international tourist arrivals in order to obtain an accurate estimate about the seasonal component. Due to the empirical data demonstrates a trend component, trend variable is included in the estimation for the purpose of handling the deterministic trend. HEGY test though involves seasonal dummies, an intercept, lag and trend of the series.

Table 2. HEGY test for seasonal unit roots at lag(4)

Description	TA		EX		Income	
	Test statistics	5% critical	Test statistics	5% critical	Test statistics	5% critical
Z(t) – Frequency 0	-0.391	-3.53	-2.437	-3.53	-1.448	-3.53
Z(t) – Frequency 1/2	-1.378	-2.94	-2.428	-2.94	-0.803	-2.94
Z(t) - L.Annual	-0.367	-3.48	-0.738	-3.48	-0.902	-3.48
Z(t) – Annual	-0.122	-1.94	-3.015	-1.94	-0.745	-1.94
Joint Annual	0.076	6.6	4.943	6.6	0.689	6.6
All seasonal frequency	0.691	5.99	6.268	5.99	0.691	5.99
All frequencies	0.565	6.47	-2.437	-3.53	1.016	6.47
Number of observations	62		62		62	

Source: Author's estimates

Table 3. Estimated regression from seasonal unit roots test at lag(4)

Description	TD Estimated Coefficients	EX Estimated coefficients	Income Estimated coefficients
Frequency 0	-0.0151 (-0.39)	-0.0597* (-2.44)	-0.0239 (-1.45)
Frequency ½	-0.168 (-1.38)	-0.410* (-2.43)	-0.0560 (-0.80)
L.Annual	-0.0212 (-0.37)	-0.0910 (-0.74)	-0.0631 (-0.90)
Annual	-0.00705 (-0.12)	-0.368** (-3.02)	-0.0521 (-0.75)
LD.	0.529** (3.16)	0.408* (2.09)	0.738*** (4.88)
L2D.	-0.0770 (-0.41)	-0.154 (-0.78)	0.00831 (0.05)
L3D.	0.0432 (0.23)	-0.0367 (-0.20)	0.00973 (0.05)
L4D.	-0.215 (-1.39)	0.0412 (0.34)	-0.0558 (-0.39)
Trend	n/a	n/a	n/a
Q1	n/a	n/a	n/a
Q2	0.0477 (0.34)	-0.0211 (-1.51)	-0.0194 (-0.68)
Q3	0.0003 (0.05)	0.00001 (0.09)	0.0021 (1.31)
Constant term	0.866 (0.48)	1.988* (2.44)	0.561 (1.54)
Number of observations	62	62	62

*Source: Author's estimates * p<0.05, ** p<0.01, *** p<0.001, t – statistics in the parenthesis*

Table 4. HEGY Quarterly seasonal unit root test at lag(4)

Description	TA				EX	
	Test statistics	5% critical	Test statistics		Test statistics	5% critical
t[Pi1]	-0.76	-3.662	-2.422	-3.648	-1.165	-3.648
t[Pi2]	-3.96	-3.042	-3.984	-3.032	-4.416	-3.032
t[Pi3]	-2.947	-3.612	-2.386	-3.598	-4.506	-3.598
t[Pi4]	-3.146	-1.918	-6.115	-1.92	-4.274	-1.92
F[3-4]	12.063	6.563	26.463	6.567	29.122	6.567
F[2-4]	21.696	6.063	66.105	6.055	57.403	6.055
Number of observations	62		62		62	

Source: Author's estimates

3.2. Estimation of Baseline Specification Equation and Seasonal Model

Next, examination the correlation between tourism demand and exogenous exchange rate with an interaction of dummy multiplying of exchange rate towards three different periods is adopted using simple OLS with robust SE. Table 5 reports that model (1) to (5) estimate EX to TD with and without seasonality effect and control tourism price.

Table 5. Tourism demand regression with exchange rate

TA is an explained variable	Baseline regression model				
	(1)	(2)	(3)	(4)	(5)
Tourism income	1.461*** (23.33)	1.757*** (22.23)	1.537*** (36.23)	1.565*** (22.39)	1.460*** (36.93)
Exchange rate	2.157* (2.34)				2.296*** (3.84)
Exchange rate x Pre – GFC		0.0298*** (4.55)			
Exchange rate x GFC			-0.0120** (-3.30)		
Exchange rate x Post – GFC				-0.00495 (-0.77)	
Seasonality at D_1		-0.0617 (-1.80)	-0.0595 (-1.45)	-0.0587 (-1.38)	-0.0367 (-0.93)
Seasonality at D_2		-0.369*** (-7.27)	-0.367*** (-6.72)	-0.366*** (-6.54)	-0.352*** (-6.86)
Seasonality at D_3		-0.251*** (-7.79)	-0.251*** (-6.53)	-0.251*** (-5.92)	-0.257*** (-6.46)
Constant term α	-14.34 (-1.92)	1.746** (3.25)	3.295*** (11.61)	3.116*** (7.17)	-15.32** (-3.14)
F – statistic	417.97***	373.99***	313.84***	344.58***	408.24***
Adjust R^2	0.9356	0.9740	0.9700	0.9685	0.9731
Number of Observations	70	70	70	70	70

Source: Author's estimates

*Robust t statistics in parentheses and * p<0.05, ** p<0.01, *** p<0.001*

It is observed that tourism income and exchange rate still hold its statistical significance in explaining tourism demand even though the estimation considers with and without seasonality effect. F-statistic discloses that all proposed models are methodologically modified. More importantly, it is likely suggesting that for model (1), a 1% increase of EX and tourism income, making a change of TD by 2.16% and 1.46% respectively. The positive of EX to TD proposes that as income per capita is rising year-on-year, an increasing of exchange rate does not strongly affect to travel decision. Secondly, since Cambodia's' exchange rate moves in the lower gap towards low inflation, this presents exceptionally perception. Moreover, the exchange rate has a high magnitude in both estimating and forecasting tourism demand. Thus, any fluctuation of exchange rate can result in increasing tourism demand to Cambodia. But it may take some time to consider before or once they affect to tourist flow in Cambodia during the period of economic or financial crisis as showed in model (3), EX does negatively affect to TD. It reflects that 1% increase of EX, make a change of reduction TD by 0.012%. Indeed, Ex after crisis does not have any power in exerting TD. This somehow discloses the facts that after the crisis, the economy is recovered resulted of an increasing of tourist arrivals.

More importantly, closely capture to the regression with both seasonal and dummy, it indicates that the seasonality D1 does not affect TD whereas seasonality D2 and D3 do affect to TD. Seasonality D4 is dropped due to multicollinearity. It suggests the key policy between low and high season of tourist travel. Noteworthy, where the estimated regression interacted with seasonality, EX reveals insignificant impacts to TD.

Next, different SARIMAX models are employed. Herewith, the exchange rate is assumed to be exogenous. Parameter orders of AR and MA are detected differently toward the graphical method obtained from both ACF and PACF. The study estimates the seasonal trend at 12 lags resulting of 12 lags of seasonality containing in the models. From model (1) to (8), different orders of AR and MA parameter such as 1, 2, 3 or 4 are proposed.

Table 6. One-step ahead out of sample forecasting with seasonality model (>2013q4 – 2017q2)

Description	SARIMAX (p, d, q) – (P, D, Q, S)$_{12}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exogenous factor								
Tourism income	-1.038 (-0.95)	-0.855 (-0.84)	-0.914 (-1.41)	-0.837 (-1.04)	-0.711 (-1.09)	-0.745 (-1.05)	-0.721 (-1.00)	-1.474 (-1.37)
EX	-0.460 (-0.53)	-0.460 (-0.52)	-0.277 (-0.42)	-0.418 (-0.57)	-0.217 (-0.41)	-0.408 (-0.70)	-0.429 (-0.69)	0.0650 (0.10)
AR parameters								
$\emptyset_1$	-0.0602 (-0.49)	-0.0268 (-0.20)	-0.108 (-0.81)	-0.0621 (-0.44)	-0.192 (-1.28)	-0.128 (-0.83)	-0.0088 (-0.01)	-0.93*** (-5.83)
$\emptyset_2$			-0.333* (-2.20)	-0.314 (-1.82)	-0.380* (-2.36)	-0.343* (-2.02)	-0.334 (-1.74)	-0.96*** (-4.90)
$\emptyset_3$					-0.239 (-1.39)	-0.189 (-0.98)	-0.153 (-0.43)	-0.79*** (-4.26)
$\emptyset_4$								-0.405* (-2.31)
MA parameters								
φ_1	-1.000 (n/a)	-1.000 (-0.00)	-1.000 (n/a)	-1.000 (-0.00)	-1.000	-1.000 (n/a)	-1.124 (n/a)	
φ_2							0.124 (0.11)	
Seasonal parameters								
Φ_1	-0.67*** (-10.58)	-0.379* (-2.28)	-0.68*** (-10.76)	-0.45** (-3.12)	-0.71*** (-11.90)	-0.51*** (-3.77)	-0.51** (-3.21)	-0.71*** (-12.40)
Ω_1		-0.523 (-1.53)		-2.234 (-1.38)		-0.404 (-1.28)	-0.412 (-1.19)	
η	0.12*** (12.48)	0.115 (0.00)	0.12*** (11.17)	0.0492 (0.01)	0.11*** (10.65)	0.11*** (8.15)	0.107 (1.61)	0.12*** (9.84)
Constant	-0.0011 (-1.16)	-0.0013 (-0.81)	-0.001 (-1.05)	-0.001 (-0.86)	-0.001 (-0.96)	-0.001 (-1.19)	-0.001 (-1.15)	-0.001 (-0.35)
AIC	-51.55	-51.57	-54.60	-54.36	-55.03	-56.00	-54.04	-48.27
BIC	-39.39	-35.37	-40.43	-36.13	-38.83	-37.77	-33.79	-30.05
Log likelihood	31.77	33.79	34.30	36.18	35.52	37.00	37.02	33.14
Wald Chi(2)	126.85 [0.0000]	24.18 [0.0000]	147.52 [0.0000]	17.34 [0.0000]	184.37 [0.0000]	62.51 [0.0000]	61.57 [0.0000]	238.86 [0.0000]
Number of Obs.	56	56	56	56	56	56	56	56

*Source: Author's estimates and t statistics in parentheses and * p<0.05, ** p<0.01, *** p<0.001 and the statistical value inside the bracket refers to the p – value.*

As the result, table 6 shows that the suggested models are correctly modified due to the statistical significance of the Wald chi(2) at 1% with the total observations of 56. Capturing from ACF and PACF graphics, it reveals that the parameter orders of AR and MA should flow from 1 to 4 and/or 1 to 2 respectively. Model (1), (2), (3), (4), (5), (6), (7) and (8) replace SARIMA (1, 1, 1) – (1, 1, 0)$_{12}$, SARIMA (1, 1, 1) – (1, 1, 1)$_{12}$, SARIMA (2, 1, 1) – (1, 1, 0)$_{12}$, SARIMA (2, 1, 1) – (1, 1, 1)$_{12}$, SARIMA (3, 1, 1) – (1, 1, 0)$_{12}$, SARIMA (3, 1, 1) – (1, 1, 1)$_{12}$, SARIMA (3, 1, 2) – (1, 1, 1)$_{12}$ and SARIMA (4, 1, 0) – (1, 1, 0)$_{12}$ respectively. It is undoubtedly that sigma reveals a statistical significance for all models. It conversely, most of the AR and MA coefficient parameters do not reveal a significant explanation. It is as unexpected once exchange rate is assumed to be an exogenous, it discloses an insignificant explanation to tourism demand. Again, most of AR and MA coefficients of both non-seasonal and seasonal adjustment does not expose a statistical significance. More importantly, the study notifies that once AR and MA take place in order 1, the coefficient parameters reveal a significant relationship. Still, due to information criteria, namely AIC and BIC show that SARIMA (4, 1, 0) – $(1, 1, 0)_{12}$ is the best accuracy model. AIC and BIC report -48.27 and -30.05 respectively, for model (8). Shortly, to obtain measurement predictive accuracy, these models are employed in the next session.

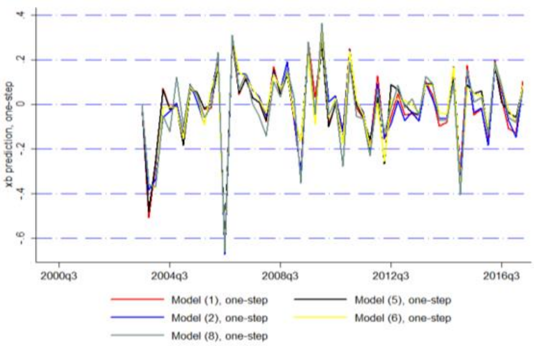
3.3. Robustness Checking of Out of sample Forecasting

This session, the study adopts the post-estimation method of seasonal model from 2000Q1 to 2013Q4, and then applies an out of sample ex-post forecasting from 2012Q4 to 2017Q2. Due to an availability of post-estimation models, only model (1), (2), (5), (6) and (8) are employed. The results show in table 7 that RMSE reports 13.9766, 13.9740, 1.005, 54.0624 and 13.9766 of the model (1), (2), (5), (6) and (8) respectively. This suggests accordingly model (5) or SARIMA (3, 1, 1) – $(1, 1, 0)_{12}$ is the best fitted model due to the smallest value of RMSE. Therefore, to perform long run ex-ante forecasting of tourism demand toward an exogenous factor of exchange rate and tourism price, tourism policy modeler in the case of Cambodia is persuaded to apply a seasonal model due to AR and MA parameters such as SARIMA (4, 1, 0) – $(1, 1, 0)_{12}$ since it produced the small gaps of error from estimation and prediction.

Table 7. One-step ahead out of sample forecasting with seasonality model (>2013q4 – 2017q2)

Description	RMSE	MAE	MAPE	U Index
Model (1)	13.9766	13.9741	13.9787	13.9755
Model (2)	13.9740	13.9715	13.9761	13.9730
Model (5)	1.0005	1.0003	1.0006	1.0004
Model (6)	54.0624	54.0525	54.0685	54.0561
Model (8)	13.9766	13.9741	13.9787	13.9755

Source: Author's estimates



Source: Author's estimates

Figure 1. Residual prediction from one step ahead (elaboration from table 6)

Conclusion

Time series persistently contains a seasonal process in the orders of the parameters, say an autoregressive and moving average process. Using simple OLS and seasonal ARIMAX model to estimate the relationship between tourism demand and exchange rate in Cambodia during the quarterly period from 2000Q1 to 2017Q2, the empirical outcomes reveal the explanatory power of both tourism income and exogenous exchange rate in exerting tourism demand. The exchange rate in the period of the global financial crisis, on the other hand, is negative affected to tourism demand. This suggests tourist travelling to Cambodia is sensitive to currency valuation during the crisis. Furthermore, the estimated parameters have the sign expected, the magnitude is consistent to most of the empirical study due to the significance of F-statistics and a high level of a goodness of fit. Again, the results suggest that tourism demand in Cambodia can be described by the fluctuation of exchange rate. Simply, the empirical results reveal the uninfluenced of tourist arrivals change of previous seasonality on the present seasonality is negatively and statistically insignificance, this suggests there does not exist the persistent effect of seasonality for tourism demand. The study comes up in providing some suggestions that tourism policy maker to focus on an uncertain factor which may affect to the past and current facts of tourism flows. On the other hand, modelling the seasonal ARIMAX with structural break, so far it will increase the accuracy of the model resulting in boosting the power of forecasting performance. More importantly, it should control more accuracy and conventional approach such as seasonal co-integration and seasonal VECM, (Hylleberg 1990) to analyses its long run equilibrium or relationship.

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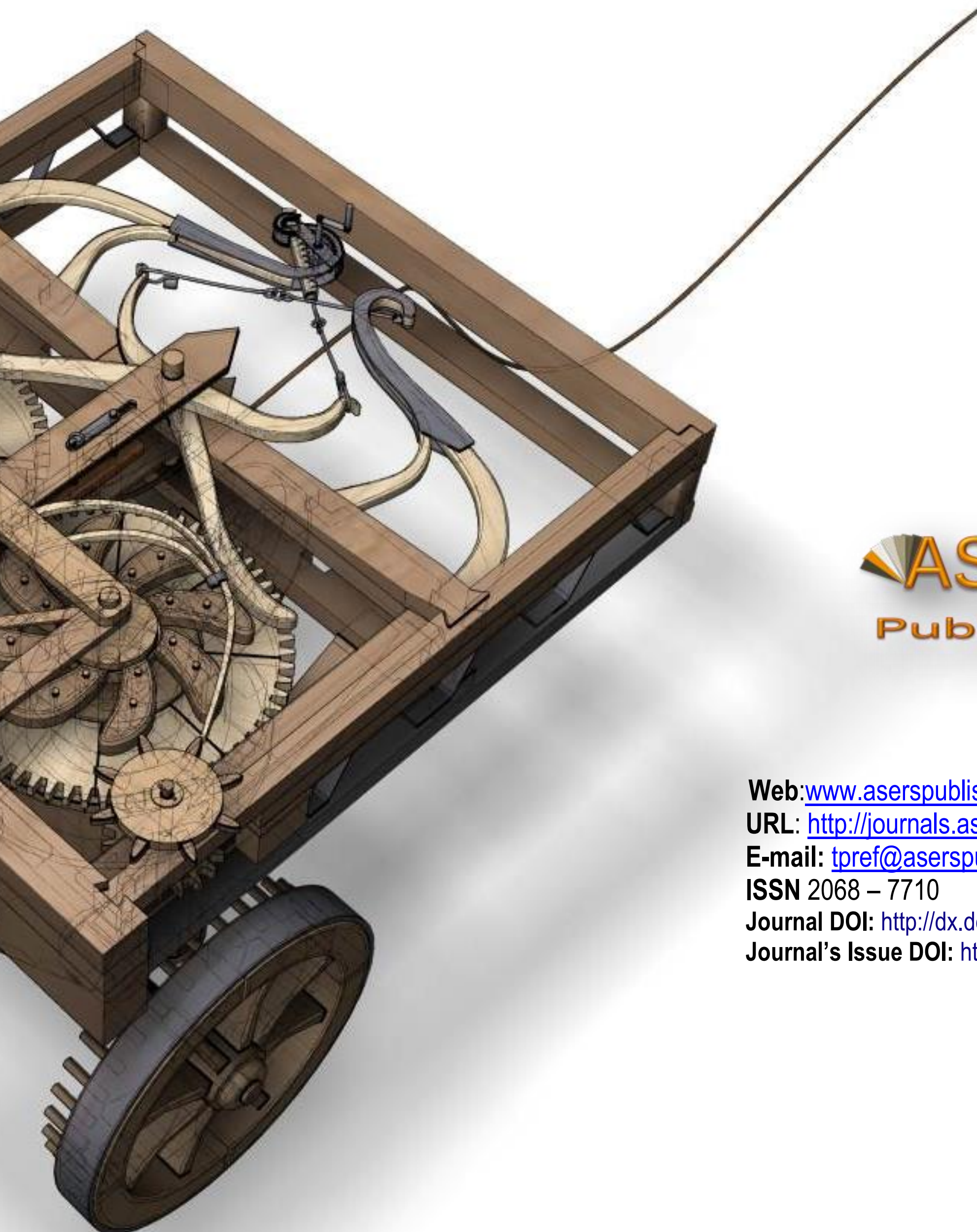

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