American Journal of Theoretical and Applied Statistics
2016; 5(5): 311-316
http://www.sciencepublishinggroup.com/j/ajtas
doi: 10.11648/j.ajtas.20160505.20
ISSN: 2326-8999 (Print); ISSN: 2326-9006 (Online)

Investigating Nepal's Gross Domestic Product from Tourism: Vector Error Correction Model Approach

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To cite this article:
Basanta Dhakal, Azay Bikram Sthapit, Shankar Prasad Khanal. Investigating Nepal's Gross Domestic Product from Tourism: Vector Error Correction Model Approach. *American Journal of Theoretical and Applied Statistics*. Vol. 5, No. 5, 2016, pp. 311-316.
doi: 10.11648/j.ajtas.20160505.20

Received: August 31, 2016; **Accepted**: September 9, 2016; **Published**: September 28, 2016

Abstract: This study tries to examine long run and short run relationship of foreign exchange earnings from tourism and average expenditure of international tourists towards share of gross domestic product (GDP) of Nepalese tourism by using Vector Error Correction Model (VECM). A multivariate time series analysis has been applied from the period of 1991 to 2014 tourism data of Nepal. The results of Johansen test of co-integration indicates there is one co-integrated vector under 4 lags of length among the share of gross domestic product of Nepalese tourism, foreign exchange earnings from tourism and average expenditure of international tourist. The long run relationship based on vector error correction model has indicated that coefficient of GDP elasticity with respect to average expenditure per visitor is more elastic as compare to coefficient of GDP elasticity with respect to foreign exchange earnings from tourism. The results of Granger causality analysis have depicted that there exists bidirectional causal relationship between GDP and expenditure per visitor and unidirectional causal relationship exists between GDP and foreign exchange earnings from tourism.

Keywords: Augmented Dickey Fuller Test, Co-integration, Error Correction, Granger Causality

1. Introduction

Tourism industry earns the gross revenue and foreign exchange earnings which play an important role in economic development of a nation. "Therefore it is a generator of foreign exchange at the national level and also fasted growing industry in the global economy[1]".Tourism is now rightly added the long list of established industries with tremendous economic and social potentiality. The income generation and employment capability of the industry are quite considerable. "In fact tourism industry especially for developing countries acts as a greatest leveler in time of economic recessions [2]". So, tourism is a vehicle for economic development for the developing countries. It creates a flow of foreign currency into the economy of host country. It directly contributes the current account of the balance of payment.

Tourism is many faceted phenomenons which strengthens the economies of tourism destinations and forges bonds of international-national and inter-regional relationship. "Travel and tourism have taken a place among the world industries and it offers a significant share in Gross Domestic Product (GDP), employment and different opportunities of developing countries for their better growth. Tourism destinations behave as dynamic evolving complex system, encompassing numerous factors and activities which are interdependent and whose relationships might be nonlinear [3]". "The success of tourism in any country depends on the ability of that country to sufficiently develop, manage and market the tourism facilities and activities in that country [4]". The development of tourism, especially developing countries like Nepal, requires the upgrading of infrastructure and other specific facilities related to tourism such as hotel and restaurants, tourist resorts, entertainment centers, transportation services, sales outlet of curios, handicraft, amusement parks, cultural activities etc. In the less developed country, tourism is more effective than other industries for generating income and employment because there is a limited alternative opportunities for the development of nation.

There are various empirical studies analyzing the tourism industry's contribution to the economic growth of Nepal. Some of significant works are Berger [5], Khadka [6], and Pradhananga [7] assessed the economic impact of tourism in Nepal using Input-Output Model. Similarly Shrestha [8], Sharma [9], and Upadhyaya [10] analyzed economic impact of tourism using simple regression model in their study. Gautam [11] and Dhungel[12] analyzed the relationship between tourism and economic growth in Nepal using Co-integration analysis and error correction method. Similarly Paudel [13] also examined the impact of tourism and other related macroeconomic variables on the economic growth of Nepal by deriving tourism income multiplier from the Keynesian macroeconomic model.

The several studies mention that tourism provides a significant contribution to national income along with generating employment sectors such as hotel, restaurant, traveling, handicraft etc as indirect contribution. Keeping in view of this reality, the present paper attempts to investigate the long run and short run relationship of foreign exchange earnings from tourism and average expenditure of international tourists towards share of Gross Domestic Product of Nepalese tourism by using Vector Error Correction Model (VECM) and Granger causality.

2. Methods

All analysis and discussion are based on published source of secondary data from the period of 1991 to 2014 obtained from Nepal tourism Statistics Published by Ministry of Tourism and Civil Aviation [14].All the statistical analysis has been performed by using STATA 9.0, College Station, Texas, USA.

The vector error correction model has been used to test the causality among the variables: share of gross domestic product of tourism (GDP), foreign exchange earnings from tourism (EARN) and average expenditure per visitor (EXPV).

$$U= (GDP, EARN, EXPV) \quad (1)$$

Where GDP is dependent variable and EARN and EXPV are explanatory variables.

Augmented Dickey[15, 16] Fuller test has been used to test the stationary or non-stationary of the data. The Augmented Dickey-Fuller test is referred to the t-statistics of δ_2 coefficient on the following regression:

$$\Delta Yt = \delta_0 + \delta_{1t} + \delta_{2t} Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-1} + \varepsilon_t \quad (2)$$

The ADF regression tests for the existence of unit root of Y_t namely in the logarithm of all model variable at time t, variable ΔY_{t-1} expresses the first difference with p lags and final ε_t is the variable that adjust the errors of autocorrelation. The coefficients δ_o, δ_1, δ_2 and α_i are being estimated. The null hypothesis and alternative hypothesis for the existence of unit root in variable Y_t are:

Null hypothesis (H_0): δ_2=0 against alternative hypothesis (H_1): $\delta_2 < 0$

This study has been used Akaike Information Criteria (AIC) or Schwartz Bayesian Information Criteria (SBIC) for selecting lags order to determine the optimal specification of equations [17]. The appropriate order of the model is determined by computing co-integrating equation over a selected grid of values of the number of lags p and finding that value of p at which the AIC or SBIC attain the minimum. AIC and SBIC has been computed using equation (3) and (4).

$$AIC= T \ln (\text{sum of square of residuals}) + 2n \quad (3)$$

$$SBIC=T \ln (\text{sum of square of residuals}) +n \ln T \quad (4)$$

Where n is number of parameters estimated and T is number of usable variables

Johansen Co-integration test [18] has been used to determine the number of co-integrating vectors among the variables and then the Johansen VECM framework can be expressed as:

$$\Delta Yt = V + \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Phi_i \Delta Y_{t-1} + \delta_i + \varepsilon_t \quad (5)$$

Where δ is the kx1 vector of parameter that implies the quadratic time trend. Similarly, β is coefficient of co-integrating equation and α is the adjustment coefficient. V is a kx1 vector of parameters.

Johansen's approach derives two likelihood estimators for determining the number of co-integration vectors: a trace test and a maximum Eigen value test

The Maximum Eigen value statistic tests the null hypothesis of r co-integrating relations against the alternative of r+1 co-integrating relations for r=0,1,2………n-1. It is computed as

$$R\boldsymbol{max}\left(\frac{r}{n}+1\right) = -T * \ln(1-\boldsymbol{\lambda}) \quad (6)$$

Where $\boldsymbol{\lambda}$ is the maximum Eigen value and T is the sample size.

Trace statistics investigates the null hypothesis of r co-integrating relations against the alternative of n co-integrating relations, where n is the number of variables in the system for r=0,1,2……..n-1. It is computed through the use of the following formula:

$$R\boldsymbol{trace}\left(\frac{r}{n}\right) = -T * \sum_{i=r+1}^{n} \ln(1-\boldsymbol{\lambda i}) \quad (7)$$

In this test, the null hypothesis of r co-integrating vectors is tested against the alternative hypothesis of r+1 co-integrating vectors.

Vector Error Correction Model (VECM) has been used to test the long run relationship between target variables and explanatory variables. For this purpose, consider a Vector Autoregressive (VAR) with lag order p which is expressed as

$$Yt = V + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots \ldots\ldots\ldots\ldots.. + A_p Y_{t-p} + \varepsilon_t \quad (8)$$

Where Yt is a Kx1 vector of variable, V is a kx1 vector of parameters, A_1, A_2, A_3,…………..A_p are k x k matrices of parameters, and ε_t is a kx1 vector of disturbances having mean 0 and sum of covariance matrix is identically and independently distributed (i.i.d.) normal over a time. Any Vector Autoregressive Model [19] can be rewritten as Vector Error Correction by using some algebra which can be expressed as

$$\Delta Yt = V + \Pi Y_{t-1} + \sum_{i=1}^{P-1} \Phi_i \Delta Y_{t-i} + \varepsilon_t \quad (9)$$

Where $\Pi = \sum_{j=1}^{P} A_j - I_k$ and $\Phi i = -\sum_{j=i+1}^{P} A_j$

If co-integration has been detected between the series, there exists a long term equilibrium relationship between them, and VECM is applied in order to evaluate the short run properties of the co-integrated series. In case of no co-integration, VECM is no longer required and directly proceeds to Granger causality test to establish causal links between variables [20].

Granger Causality [21] has been used to test the short run causality between bivariate variables. A general specification of the Granger causality test in bivariate (X, Y) context can be expressed as:

$$Xt = \lambda t + \sum_{i=1}^{p} a_{11} x_{t-1} + \sum_{i=1}^{p} b_{ij}\, y_{t-1} + \mu_t \quad (10)$$

$$Yt = \lambda_{2t} + \sum_{i=1}^{P} a_{21}\, x_{t-1} + \sum_{i=1}^{P} b_{2j} y_{t-1} + \mu_{2t} \quad (11)$$

In this model, t denotes time periods, μ is a white noise error and **λ** is constant parameters.

The null hypothesis and alternative hypothesis for the existence of Granger causality in variables X_t and Y_t expressed as:

H_0 :X_t does not Granger Cause of Y_t against H_1:X_t Granger causes of Y_t.

H_0:Y_t does not Granger Cause of X_t against H_1:Y_t Granger causes of X_t.

In this model, two tests of analysis can be obtained: the first examines the null hypothesis that the X does not Granger cause Y and second test examines the null hypothesis that Y does not Granger cause X.

Lagrange-Multiplier (L-M) test [22] has been used to test for autocorrelation as well as test for stability of the model. L-M test is not only suitable for testing for autocorrelation of any order but also suitable for models with or without lagged dependent variables. The formula for L-M test statistic of lag p is:

$$LM = (T - d - 0.5)\, ln[\frac{|\sum c|}{|\sum s|}] \quad (12)$$

Where T is the number of observations and d is the number of coefficients estimated in augmented VAR; $\sum_c$ is the maximum likelihood estimate of variance-covariance matrix ($\sum$)of the disturbances;$\sum_s$is the maximum likelihood estimate of $\sum$from augmented vector autoregressive[23].

Jarque-Bera (J-B) test has been applied for normality of disturbances distribution [24]. It is based on the fact that skewness and kurtosis of normal distribution equal to zero. Therefore the absolute value of those parameters could be a measure of deviation of the distribution from normal.

$$JB = \frac{n-k}{6}[(skew)^2 + \frac{(Kurt-3)^2}{4}] \quad (13)$$

Where n is number of observations and k is number of regressors.

3. Results and Discussions

The first step in co-integration analysis is to test the unit roots in each variable. For this purpose, Augmented Dickey Fuller test is applied on GDP, EARN and EXPV.

Table 1. *Results of ADF test.*

Before first differenced(at level)				After first differenced		
Variable	**Test statistics**	**5% critical value**	**p value**	**Test statistics**	**5% critical value**	**p value**
*ln*_GDP	-1.997	-3.00	0.288	-4.444	-3.000	0.000
*ln*_EARN	-0.985	-3.00	0.758	-4.912	-3.000	0.000
*ln*_EXPV	-1.883	-3.00	0.340	-4.503	-3.000	0.000

Table 1 reports the results of the ADF test for the level (before first differenced) as well as for the first differenced of the relevant variables. The results show that unit root test applied to the variables at level fail to reject the null hypothesis of non stationary of all the variables used. It implies that all the variables are non-stationary of all at level. The null hypothesis is accepted when the series are at first differenced i.e. all variables are stationary at first differenced. This implies that all the variables in the series are integrated of order one, i.e. I (1).For getting optimal lag length for co-integrating analysis, two criteria namely AIC and SBIC have been adopted as shown in Table2.

Table 2. *Results of lag order selection.*

Lag	df	p value	AIC	SBIC
0	.	.	1.738	1.887
1	9	0.000	-4.453	-3.855*
2	9	0.029	-4.481	-3.436
3	9	0.078	-4.357	-2.863
4	9	0.000	-5.487*	-3.546

*indicates lag order selected by the criteria

Table 2 shows that AIC suggested a lag length of 4 as optimal, while SBIC indicated 1 as optimal lag length. But in this series of GDP, EARN and EXPV for co-integration analysis 4lag length has been adopted because 4 lag of length could be found one co-integrating vector under both trace and maximum Eigen value statistics while one lag length could not be found the co-integrating vector. Co-integration relationship among GDP, EARN and EXPV has been investigated using the Johansen technique which is shown in Table 3.

Table 3. *Results of Johansen test of co-integration.*

Null Hypothesis	Eigen value	Trace statistic		Max Eigen value statistic	
		λtrace	**1% critical value**	**λmax.**	**1% critical value**
H0:r=0	.	61.602	35.65	41.674	25.52
H0:r≤1	0.875	19.929*	20.04	18.129*	18.63
H0:r≤2	0.596	1.800	6.65	1.800	6.65

*indicates co-integration vector.

Table 3 reports the results of co-integration test based on Johansen's Maximum likelihood method. Both trace statistic (**λ**trace) and maximum Eigen value statistics (**λ**max) indicate that there is at least one co-integrating vector among GDP, EARN and EXPV. It can reject the null hypothesis of no co-integrating vector against under both test statistics at 1 % level of significant. It also can not reject the null hypothesis of at most one co-integration vector against the alternative hypothesis of two co-integrating vectors for both trace and max Eigen value test statistics. Consequently, it can conclude that there is only one co-integrating relationship among GDP, EARN and EXPV. This implies the GDP, EARN and EXPV establish a long run relationship. It clearly opens the way for applying VEC model and the summary of long run relationship between GDP, EARN and EXPV under the Vector Error Correction Model (VECM) can be displayed in Table 4.

Table 4. *Results of Long Run Relationship between GDP, EARN and EXPV.*

Variable	Coeff. of Beta	S.E.	z	p value	95%C.I.
*ln*_GDP	1.0000				
*ln*_EARN	-0.0064	0.107	-0.06	0.952	(-0.216,0.203)
*ln*_EXPV	1.4278	0.181	7.90	0.000	(1.073,1.782)
CONS.	-9.982				

The long run relationship between number of international tourist and their average length of stay explaining share of GDP for one co-integrating vector for Nepal in the period of 1991-2014 is modeled below (Standard errors are displayed in parenthesis).

$$ln\_GDP = -\ 0.0064\ (ln\_\ EARN) + 1.4278\ (ln\_\ EXPV) - 9.983$$

$$(0.107) \qquad\qquad (0.181)$$

If all variables are logarithmic, it may interpret the coefficients in terms of elasticity. So it may say increasing EARN by 100% produces an impact of almost 0.64% of GDP. Similarly increasing EXPV by 100% produces an increment of almost 142.7% of GDP. Thus coefficient of GDP elasticity with respect to EXPV is more elastic as compare to coefficient of GDP elasticity with respect to EARN. All the variables have established in the model with I(1)and co-integrated, the VECM with one co-integrating relation and 4 lags in each equation has been estimated.

The VECM allows the long run behavior of the variables to converge to their long run equilibrium relationship as well as a wide range of short run dynamics which can be shown in Table 5.

Table 5. *Results of Coefficient of error correction terms (ECT).*

Variable	Coeff. OfECT_1	S.E.	Z	p value	95% C.I.
*Δ*_*ln*_GDP	-0.566	0.382	-1.48	0.139	(-1.315,0.183)
*Δ*_*ln*_EARN	-0.519	0.406	-1.28	0.201	(-1.316,0.276)
*Δ*_*ln*_EXPV	-1.036	0.156	-6.66	0.000	(-1.341,0.731)

Table 5 shows the coefficient of error correction term of GDP has the speed of convergence towards equilibrium of 56.6 percent (where *Δ* symbolize the difference operator). In the short run GDP are adjusted by 56.6 percent of past years deviation from equilibrium. The large absolute value of the coefficient of ECT shows the speed of adjustment is very rapid towards equilibrium and low absolute values are indicating of slow speed of adjustment. It means that speed of adjustment of EARN towards equilibrium is slow. The coefficient of error correction term of GDP has negative sign and it is statistically insignificant at 5% level. It implies that the system convergence towards equilibrium but unstable due to the any disturbance in the system. The coefficient of error correction term of EXPV carries negative sign and it is significant at 5% level. It depicts stability of the system and convergence towards equilibrium path in case of any disturbance in the system. The coefficient of error correction term of EARN is negative but statistically insignificant at 5% level. It implies that the system convergence towards the equilibrium path and the system will be unstable due to any disturbances.

Finally, in order to analyze short run causal relationship among GDP, EARN and EXPV for the equation in the

VECM, Granger Casualty Wald test is used for the significance of the lagged variables in that equation.

Table 6. *Results of Ganger Wald Causality test.*

Null Hypothesis(H_0)	Chi square	df	p value
GDP does not Granger cause EARN	2.321	4	0.677
GDP does not Granger cause EXPV	13.744	4	0.008
EARN does not Granger cause GDP	13.597	4	0.009
EARN does not Granger cause EXPV	9.409	4	0.052
EXPV does not Granger cause GDP	76.144	4	0.000
EXPV does not Granger cause EARN	34.967	4	0.000

Table 6 reports the results short run causality among the variable GDP, EARN and EXPV. GDP Granger causes EXPV and EXPV also Granger causes GDP. So bidirectional Granger causality exists between GDP and EXPV. Similarly, EARN Granger causes GDP but GDP does not Granger cause EARN. So, unidirectional Granger causality exists between EARN and GDP. Similarly, EXPV Granger causes EARN but EARN does not Granger cause EXPV i.e. there is unidirectional Granger causality between them

Lagrange-Multiplier test has been used to test for autocorrelation as well as stability of the model under H_o: There is no autocorrelation at lag order against H_1: There is autocorrelation at lag order.

Table 7. *Results of L- M Test of Autocorrelation.*

Lag	Chi square	df	p value	Decision
1	14.163	9	0.117	Not significant
2	8.296	9	0.505	Not significant
3	8.683	9	0.467	Not significant
4	13.120	9	0.157	Not significant

Table 7 shows that L –M test concludes it cannot reject the null hypothesis of no residual autocorrelation at lag order 1 through 4, so there is no evidence to contradict the validity of the model

Jarque –Bera Test has been applied to test the normality of disturbances distribution under Ho: The disturbances distribute normally against H_1: The disturbances do not distribute normally.

Table 8. *Results ofJ –B Test for Normality Distributed Disturbances.*

Variable	Chi square	df	p value	Decision
ln_EARN	0.459	2	0.79703	Not significant
ln_GDP	0.289	2	0.86559	Not significant
ln_EXPV	0.574	2	0.75048	Not significant
ALL	0.316	6	0.97074	Not significant

The J-B test clearly indicates that the disturbances are distributed normally.

4. Conclusion

The results of Johansen test of co-integration indicates there is one co-integrated vector that implies there exists long run relationship among the variables GDP, EARN and EXPV under 4 lag of length. The long run relationship based on vector error correction model has indicated that coefficient of GDP elasticity with respect to average expenditure per visitor is more elastic as compare to coefficient of GDP elasticity with respect to foreign exchange earnings from tourism. The results of Granger causality analysis have depicted that there exists bidirectional causal relationship between GDP and expenditure per visitor and unidirectional causal relationship exists between GDP and foreign exchange earnings from tourism. It clears that expenditure per visitor increases GDP and foreign exchange earnings also facilitates the expansion of GDP. The effort should be made to take into account the significant role of foreign exchange earnings in Gross Domestic Product of the country, not only focus on the total number of tourist arrival in the country. But, it is necessary to upgrade the infrastructure and other specific facilities related to tourism such as hotel and restaurants, tourist resorts, entertainment centers, transportation services, sales outlet of curios, handicraft, amusement parks, cultural activities etc. for increasing the expenditure per international visitor.

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