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Tourism demand in Bangladesh: Gravity model analysis

Abstract

This study analyzes the factors influencing tourism demand in Bangladesh following tourism potential of the country. The study estimates tourism demand in the form of tourist arrival (TA) based on key economic factors like distance, Gross Domestic Product (GDP) per capita, population, Consumer Price Index (CPI) and exchange rate. The paper applies Rodrigue's modified Gravity model through GLS regression analysis based on 4-year panel data from 2009-2012 of 30 origin countries. In considering the absolute purpose of tourism, the basic log-linear model has been revised with the actual volume of TA instead of government recorded gross TA. Derived log-linear equation indicates that TA is positively correlated with GDP per capita and population and negatively associated with distance, exchange rate, and CPI. Thus, the study findings direct to potential market for Bangladeshi tourism resulting from short distance, higher GDP per capita of origin country and lower inflation rate reflected through CPI in Bangladesh.

Key words: tourism demand; tourist arrival; Gravity model; regression; potential market; Bangladesh

Introduction

Services represent the fastest growing sector of the global economy and account for two thirds of global output, one third of global employment and nearly 20% of global trade (World Trade Organization). Tourism is one of the most significant service sectors in the world. Tourism has a significant influence on the economic development of a country, particularly in a least developed country with attractive tourist sites such as Bangladesh. Bangladesh has an enormous potential for developing tourism because of its attractive unadulterated natural beauty (Bangladesh Tourism Board), which can be experienced across the country. The country has many archaeological sites, historic monuments, pristine beaches, grandiose forests and amazing diversity of wildlife. Therefore, tourism can contribute to the development of the Bangladesh economy. However, such an influx of tourists can only be achieved through proper use of effective marketing plans and a long-term growth strategy.

We have found a considerable number of studies on Bangladesh focusing on its tourism sector potential, development and strategies for going forward (Shamsuddoha, 2005; Azam, 2010; Tuhin & Majumder, 2011; Afroz & Hasanuzzaman, 2012; Chowdhury & Shahriar, 2012; Islam, 2012; Honeck & Akhtar, 2014; Ferdaush & Faisal, 2014). However, these studies are mostly descriptive in nature. This analytical research will add value to the existing literature on tourism demand in Bangladesh. Here, we have applied the Gravity model for analyzing the key factors influencing tourism demand as well as a potential market. Policy makers of Bangladesh intend for a tourism friendly environment. This study is expected to guide the policy makers in undertaking suitable strategies for promoting tourism industry abroad.

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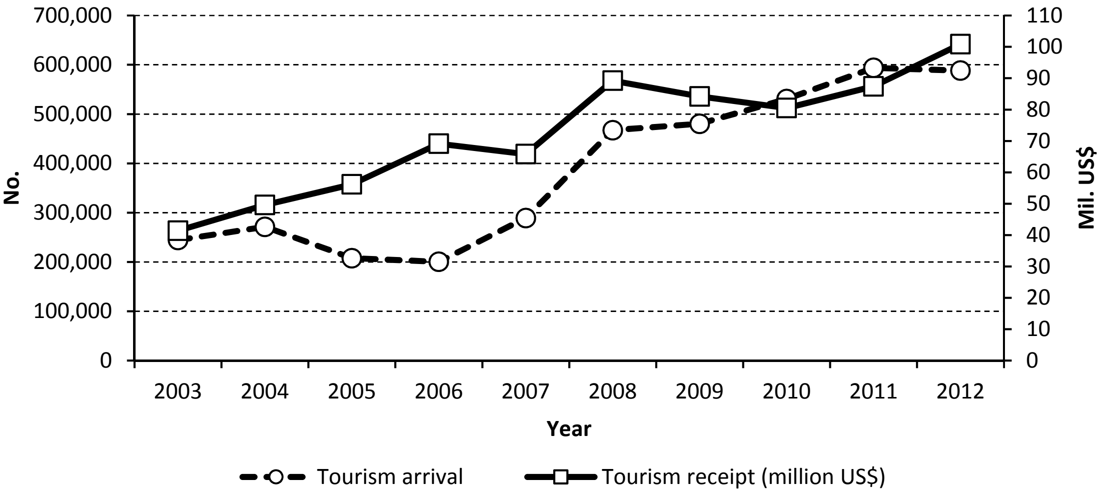
Tourism potential of Bangladesh

In Bangladesh, visitor arrivals have almost tripled within the last seven years. Tourism receipts have almost doubled during the period. Tourist arrivals reached 588 thousand in 2012 (Figure 1). Tourism receipt touched USD 100 million milestone for the first time in 2012 (Figure 1).

Figure 1
Trend of tourism demand in Bangladesh



Source: Bangladesh Parjatan Corporation and Bangladesh Tourism Board. Calculation Based on data from Special Branch of Police and Bangladesh Bank.

Visitor exports generated 0.5% of national total exports in 2013 whereas it generated 5.4% of the global total exports. However, visitor exports to Bangladesh was estimated to grow by 7.1 percent in 2014 period (Table 1).

Table 1
Economic contribution of travel and tourism (T&T): growth

Bangladesh growth(%)* in tourism	2008	2009	2010	2011	2012	2013	2014E	2024F**
Visitor export	-12.4	-12.6	31.5	-5.4	16.9	-2.4	7.1	5.7
Direct contribution of T&T to GDP	2.5	-5.2	3.1	5.3	5.0	7.9	7.7	6.1
Capital investment	53.7	3.8	6.8	5.9	6.3	0.7	3.4	6.5
Total contribution of T&T to GDP	4.7	-5.5	2.2	3.7	5.8	9.1	7.9	6.5
Employment impact ('000)	-1.6	-9.0	-0.4	1.1	1.4	4.4	4.0	2.7
Total contribution to employment	0.4	-9.2	-1.5	-0.6	2.1	5.6	4.2	3.0

Source: WTTC, Bangladesh (2014).
Note: * 2008-2013 real annual growth adjusted for inflation (%); **2014-2024 annualized real growth adjusted for inflation (%).

In Bangladesh, domestic travel spending generated 97.8% of direct T&T GDP in 2013 compared to 2.2% for visitor exports (foreign visitor spending or international tourism receipt). Domestic travel spending generated 71.3% of direct T&T GDP in 2013 compared with 28.7% globally for visitor exports. In Bangladesh, T&T GDP contribution was 4.4% and it generated 3.8% of total employment in 2013 (WTTC, World, 2014, p. 1). On the other hand, globally total contribution of T&T GDP was 9.5% and employment rate was 8.9% in the same year (WTTC, Bangladesh, 2014, p. 1). Morshed (2006) recognized this uneven growth trend and stated, "Despite enormous potentials, the tourism industry of Bangladesh still strives to reach a satisfactory level" (Mahbubur Rahman Morshed, 2006, p. vii). From the present data of tourist arrivals and tourism receipts (Figure 1) it is also clear that tourism receipts are not growing the way arrivals increased, and as per aggregate economic demand, it is a poor performing sector.

World Tourism Organization (UNWTO) indicates a prospect for Asia and the Pacific in 2014. Bangladesh belongs to this region. As a result, it is expected to obtain a regional advantage regarding this sector. Indian and Chinese economic growth indicates a positive sign for local tourism. Both these countries account for one third of tourist arrival in Bangladesh. The Asia Pacific region is a potential market for Bangladesh because of the short distance.

Bangladesh has some exclusive tourism products including the world's longest sea beach and the largest mangrove forest. It is part of travel circuits for cultural and religious tourism. Bangladesh lies in the middle of the fastest growing region with India, China and the Asia Pacific. Bangladesh can be transformed into a hub for this potential regional tourism. Most importantly, it is still unexplored and overall environment is supportive for tourism.

The Bangladesh government identified tourism as a highest priority sector (Bhuyan, 2010). They are keen to promote tourism. They have already taken short, medium and long-term plans for tourism development. Its potential is the driving force behind a rapid increase in domestic investment in this sector. A reported 22 percent rate of return on FDI (UNCTAD, 2013) is quite high in comparison to that of the other countries in this region. Bangladesh supplies the cheapest managerial and the second cheapest unskilled or low skilled labor (Japanese External Trade Organization, 2011). There are positive factors for labor-intensive tourism sector. Price competitiveness and hospitality are extra advantages for Bangladesh.

In 2004, a Bangladesh Tourism Vision 2020 (followed by a revised version in 2006) was set to achieve an estimated potential of 1.3 million visitors over the 0.5 million visitors predicted by the UNWTO. Both global and the Asia Pacific regional tourism growth respectively, indicate 0.792 million and 0.902 million tourist arrivals in Bangladesh. The historical growth rate (last 10 years) suggests that the projected demand will stand at 1.41 million. Discrepancies between one study and another is significant in terms of national tourism demand forecast. A better forecasting would be possible with a proper identification of tourism demand factors.

Literature review

The tourism literature comprises a large number of papers regarding tourism demand; including attempts to model it using various techniques starting from simple or multivariate regression (Garín-Muñoz & Amaral, 2000; Divisekera, 2003; Luzzi & Fluckiger, 2003; Allen & Yap, 2009; Halicioglu, 2010, etc.), panel or pooled data analysis (Proença & Soukiazis, 2005; Garín- Muñoz, 2006; Škuflić & Štoković, 2011; Surugiu, Leitão & Surugiu, 2011, etc.), and cointegration procedures (Lim & McAleer, 2001; Toh, Habibullah & Goh, 2006, etc.), to gravity models (Muhammad & Andrews, 2008; Leitão, 2010; Dilanchiev 2012, etc.). In 1962, Jan Tinbergen first explained the application of the gravity models in his seminal work stating that the size of bilateral trade flows between two countries can be approximated by a law called the 'gravity equation', analogous to the Newtonian theory of gravitation (Bacchetta et al., 2012). According to Tinbergen (1963), the volume of trade, capital flows and migration of people among the countries can be explained using the Gravity Model (Dilanchiev, 2012). In 2004, Rodrigue modified the Tinbergen Gravity Model to estimate tourism demand. He converted those variables to represent tourism related variables. The present study utilizes Rodrigue's modified Gravity model which is detailed at the methodology section.

The recent advances in tourism foresting literature or research are presented in the work of Li, Song and Witt (2005), Song and Li (2008), Hilaly and El-Shishiny (2008) and Hossain, Chowdhury and Ahmed (2012). Song and Li (2008) reviewed 121 post-2000 empirical studies, out of which 72 used econometric techniques in modelling the demand for tourism. More specifically, there are considerable number of literatures available analyzing the effect of selected variables on tourism demand through Autoregressive Distributed Lag-ARDL (Muchapondwa & Pimhidzai, 2011; Song, Wong & Chon, 2003; Aktürk & KÜÇÜKÖZMEN, 2006, etc.), Integrated Autoregressive Moving-Average Models-ARIMAs (Li et al., 2002), Simple ARIMA or Seasonal ARIMA (i.e. SARIMA) models suggested by Goh and Law (2002), Ordinary Least Squares-OLS (Crouch, Schultz & Valerio, 1992), Vector Autoregressive-VAR (Shan & Wilson, 2001; Lim & McAleer, 2001, etc.), Vector ARMA-GARCH model (Chan, Lim & McAleer, 2005) etc. In using multiple regressions, problems of misspecification in addition to heteroscedasticity, multicollinearity and autocorrelation arise, which are not always considered or resolved (Morley, 1993).

Song and Li (2008) found the number of tourist arrivals as the most popular measurement of tourism demand. It is used as a dependent variable in most studies on tourism demand (Crouch et al., 1992; Li, 2004; Song & Li, 2008; Salleh, Osman, Noor & Hasim, 2010). Salleh (2008) found that about 59 percent of the tourism demand model used this variable. Tourist arrival numbers are primarily preferred for estimating tourism demand to distinguish between the change in supply and expenditure in tourism related facilities and number of tourist arrivals (Dilanchiev, 2012).

In this study, against the dependent variable- 'tourist arrival', independent variables include the GDP per capita of tourist's origin country, population, distance, average exchange rate and CPI of Bangladesh. These variables are also supported by available literature. A survey of 100 empirical studies on tourism modelling by Lim (2004) found that income and price were the most commonly used explanatory variables. Salleh (2008) found the importance of income (81%), tourism price (65%), traveling cost (53%), exchange rate (39%) and population (13%) in tourism demand model used as explanatory variables. Distance is used as independent variable in Lim and McAleer (2001), Allen and Yap (2009) Hanafiah and Harun (2010) and Leitão (2009). Travelling expense or transportation cost is also found in Lim and McAleer (2002) and Dritsakis (2004). A population variable is accounted in Hanafiah and Harun (2010) and Leitão (2010). Income is the most popular variable included in the tourism demand function (Lim & McAleer, 2002; Dritsakis, 2004, etc.). The income variable may be GDP per capita. Normally, higher incomes in origin country increase total arrivals. The exchange rate is the ratio of currency between the destination country and the origin country. The change in exchange rate affects the currency affordability. Any change in exchange rate leads to an appreciation or depreciation of tourist purchasing power (Lim, 2004; Dritsakis, 2004; Garín-Muñoz & Amaral, 2000; Luzzi & Fluckiger, 2003; Hanafiah & Harun, 2010; Lim & McAleer, 2001; Song & Fei, 2007). Any appreciation in the tourist currency may encourage more people to travel. In this study, exchange rate is calculated based on a common currency: USD compared to Bangladeshi currency: BDT. Tourism price refers to the price of all goods and services consumed by tourists at the destination. Since most countries do not have the price index for goods and services consumed by tourists, the next best alternative is the general CPI of the destination for all origin countries (Lim, 2004; Dritsakis, 2004; Toh, Habibullah & Goh, 2006).

Methods

In this study, the Gravity model applied by Rodrigue (2004) has been modified to estimate the tourism demand of Bangladesh. Thus, the basic Gravity Model estimated for the explanatory variable Tourist Arrival (TA) has been developed as below:

$$TA_{ij} = k\,\frac{M_i\ M_j}{D_{ij}^2} \qquad (1)$$

Where, TA_{ij} is the total tourist arrivals from country 'i' to Bangladesh 'j', 'k' is constant. M_i is measured as a factor to generate flow of international tourism while M_j is measured as a factor to attract flow of international tourism. D_{ij} is the distance between the origin country 'i' and Bangladesh 'j'.

Deardorff (1998) showed that a gravity model may arise from a traditional factor-proportion explanation of trade. In general formulation, the developed gravity equation (1) has the following multiplicative form:

$$TA_{ij} = kM_iM_jD_{ij} \qquad (2)$$

Given the multiplicative nature of the gravity equation, the standard procedure for estimating the gravity equation (2) for Bangladesh's tourism demand is simply to take the natural logarithms of all variables and obtain a log-linear equation that can be estimated by generalized least squares (GLS) regression. This yields the estimated log-liner equation as follows:

$$\log(TA_{ij}) = \alpha + \hat{\beta}_1\log(DIS_{ij}) + \hat{\beta}_2\log(GDPpc_{ij}) + \hat{\beta}_3\log(PP_{ij}) + \hat{\beta}_4\log(CPI_{ij}) + \hat{\beta}_5\log(ER_{ij}) + \hat{\mu}_{ij}$$

Where,

α = constant

i = Origin countries where i =1, 2, ….30

j = Bangladesh along 4 years where the data of j is taken for Y1, …. Y4

TA_{ij} = Number of tourists' arrivals from origin countries to Bangladesh

DIS_{ij} = Distance of Bangladesh from origin countries

$GDPpc_{ij}$ = Gross domestic product (nominal) per capita of origin countries

POP_{ij} = Population of the origin countries

ER_{ij} = Exchange rate of USD with BDT

CPI_{ij} = Consumer price index of Bangladesh

Again, in the regression model, sub index 'i' denotes origin country and index 'j' stands for Bangladesh from financial year 2009 to 2012. The data collected from the Bangladesh Tourism Board (BTB), the World Bank and the Bangladesh Bureau of Statistics is used to estimate the movement of tourist arrivals relating to the key economic factors. The study has executed the data on all variables from 30 countries which are the most relevant for analyzing tourism demand of Bangladesh.

At the time of data collection, we found that the Bangladesh Government is not considering TA in original value. Collecting data on the original TA from SB Police compiled by Bangladesh Parjatan Corporation (BPC) and BTB, we have revised our basic log-linear model with the original tourist arrival:

$$\log(TAnew_{ij}) = \alpha + \hat{\beta}_1\log(DIS_{ij}) + \hat{\beta}_2\log(GDPpc_{ij}) + \hat{\beta}_3\log(PP_{ij}) + \hat{\beta}_4\log(CPI_{ij}) + \hat{\beta}_5\log(ER_{ij}) + \hat{\mu}_{ij}$$

Where, TAnew = Original number of tourist arrival in Bangladesh.

Results and discussion

We found positive autocorrelation (estimated autocorrelation coefficient = 0.12) with no hetero-skedasticity (P value for null hypothesis of homoskedasticity = 0.18 > 0.05 at White's tes\t) and no Multicollinearity (all variables' VIF scores less than 10) in the basic regression model. Later, the model has been corrected for autocorrelation applying the model for linear regression with 'Panels Corrected Standard Errors (PCSEs)'. However, we found the revised model (Table 2) more appropriate for the ease of decision making, because

- It presents a more logical coefficient in case of CPI variable as following the consumption theory: there is a negative relationship between price and consumption.
- It presents more logical coefficient in case of ER variable as following the economic assumption for ER: the stronger domestic currency discourages foreign visitors or investors to consider the country in their business planning.
- Under the model, there is high number of significant variables (with 95% confidence interval) to explain the expected situation after the addition of CPI at the 90% confidence interval.

Table 2
Summary of step wise regression results (dependent variable: tourist arrival)

Independent variables	Coefficients of main model	Coefficients of revised model
Distance	-0.66 (0.04)**	-0.91 (0.07)**
Per capita GDP of origin country	0.31 (0.03)**	0.44 (0.04)**
Population of origin country	0.52 (0.02)**	0.63 (0.02)**
CPI	0.08 (0.51)	-0.28 (0.17)*
Exchange rate	0.08 (0.65)	-0.13 (0.21)
Constant	1.38	0.99
R-squared	0.39	0.42

Number of observation = 112.
Standard errors are in the parenthesis.
* Represent significance at 10 percent and ** represent significance at 1 percent.
Source: Software result after GLS regression analysis.
Note: Detailed inference of analysis (on STATA software) results have been provided in Appendix with software output tables and descriptive deduction.

We have found significant relationships of tourism demand (tourist arrival) with Distance, GDP, population and CPI. Thus, the coefficients, found through running the revised model by STATA software version-12, have been utilized in subsequent discussion about the estimated coefficients of explanatory variables of the model.

A 1 percent increase in the distance between the origin country and Bangladesh would reduce tourist arrivals by 0.91 percent supporting that the greater the distance the higher the transportation cost to discourage the tourists. This variable is the most significant to be considered in policy making for encouraging more tourists to Bangladesh. Connectivity needs to be considered to explain the factor - distance. Realizing this phenomenon, Bangladesh can target the neighbouring countries with better connectivity to attract tourists from them.

There is a positive relationship between per capita GDP increase in the origin country and tourist arrivals in the destination country. The increase of per capita GDP in origin country by 1 percent would increase the tourist arrivals in Bangladesh by 0.44 percent. This is also a significant variable for policy makers to find out the suitable targets. The coefficient of this variable raises questions about Bangladesh's tourism marketing to the growing per capita GDP countries.

Population variable positively correlates with tourism demand and holds significant coefficient value of 0.63 percent. World's population is growing over the time and it clearly shows that entire tourism multipliers are positively correlated with natural log of population. Bangladesh needs to target the highly populated countries for attracting more tourists.

On the Consumer Price Index variable, there is a negative relationship between CPI of Bangladesh and tourist arrival. Here, 1 percent increase in CPI would decrease tourist arrivals by 0.13 percent. In other words, inflation will decrease tourist arrivals. This variable is significant at 10 percent level. Thus, Bangladesh should rein in inflation.

The exchange rates between the currency of Bangladesh and the origin country indicates tourist spending in real prices to be counted by a tourist in Bangladesh. There is a negative relation between exchange rate and tourist arrival. In other words, 1 percent increase in value of BDT over the origin countries' currency (here estimated common currency is USD) would decrease tourist arrival in Bangladesh by 0.28 percent making the services and goods relatively expensive. But this variable is insignificant even at 20 percent level of significance. Since 2003, the exchange rate of Bangladesh has been fixed by market factors, it would be better for Bangladesh to focus more on other factors rather than wasting time on this factor.

Potential market can be inferred following the acquired findings of the study. Bangladesh should focus on the nearer countries with growing per capita GDP as well as population. India, China etc. are such a potential market.

Conclusions

Historical data presented in the study reveals that Bangladesh may be heading into a reaches of double visitors while they cutline tourist arrivals contributing less into the receipts. Such aggregate economic demand puts tourism into a poor performing sector. Bangladesh should concentrate on increasing genuine tourists rather than gross visitor arrivals. Visitors, who enjoy tourism services of the country, should be considered as tourists.

The study has effectively applied Rodrigue's modified Gravity model to forecast the movement and pattern of international tourist to Bangladesh. Since the derivation of revised model is based on original value of tourist arrival, it contributes to obtain appropriate findings. Moreover, this model has clearer alignment between coefficients and logical assumptions. Present findings indicate that there is a strong relationship between the key economic factors and travelling decisions made by international tourists. Therefore, short distance, high GDP of origin country, growing population of origin countries, depreciated BDT and lower inflation as well as CPI in destination influence tourists to visit. Here, distance is aspectual. GDP and distance effect makes China and Thailand prominent origin countries for Bangladesh. Analyzing the trend of tourism demand in these places and groups of outbound hub, China becomes the most suitable target.

In view of highly potential neighbouring countries such as India, China, Thailand, Nepal etc., Bangladesh needs attract prospective tourists. Therefore, Bangladesh requires develop a destination branding strategy being realistic about the 'Crown Jewel' effect, need for a central attraction. It should have a strong distinctive theme 'CHN (Culture, History and Nature)' as promotion tool. Bangladesh can also utilize regional tourism opportunity. In addition, Bangladesh should develop a distinct strategy to attract tourists from China. Bangladesh requires finding more determinants of tourism demand and better strategies for attracting potential tourism markets. Thus, further research is suggested for forwarding the tourism industry in Bangladesh.

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Appendix: Regression Model Specification

$$\log(TA_{ij}) = \alpha + \hat{\beta}_1\log(DIS_{ij}) + \hat{\beta}_2\log(GDPpc_{ij}) + \hat{\beta}_3\log(PP_{ij}) + \hat{\beta}_4\log(CPI_{ij}) + \hat{\beta}_5\log(ER_{ij}) + \hat{\mu}_{ij}$$

Data summary:

```
. xtset origin year
       panel variable:  origin (strongly balanced)
        time variable:  year, 2009 to 2012
                delta:  1 unit

. sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
origin	112	14.64286	8.357828	1	30
year	112	2010.5	1.123059	2009	2012
ta	112	8.686786	1.18466	7.07	11.98
dist	112	8.496071	.686935	6.51	9.41
gdppc	112	9.850625	1.286042	6.18	11.51
pp	112	17.39375	1.454235	15.28	21.02
cpi	112	5.0225	.0937939	4.9	5.14
er	112	4.2975	.0722171	4.23	4.41
tanew	112	6.595446	1.347697	2.83	11.27

We can rewrite the error term u_{ij} under composite error term, $v_{ij} = \alpha_i + u_{it}$

Here α_i represents some origin countries' heterogeneity, which includes all unobserved time constant factors that affect tourist arrivals from each origin country. And this is sometimes called "unobserved heterogeneity". To eliminate this unobserved effect, the fixed effect (FE) is used. This applies when α_i is correlated with some explanatory variables which value is -0.9935 in this analysis as shown following regression result,

```
. xtreg ta dist gdppc pp cpi er, fe
note: dist omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       112
Group variable: origin                          Number of groups   =        28

R-sq:  within  = 0.0770                         Obs per group: min =         4
       between = 0.3457                                        avg =       4.0
       overall = 0.3364                                        max =         4

                                                F(4,80)            =      1.67
corr(u_i, Xb)  = -0.9786                        Prob > F           =    0.1657

------------------------------------------------------------------------------
          ta |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dist |          0  (omitted)
       gdppc |  -.1057922   .3175212    -0.33   0.740    -.7376796    .5260952
          pp |  -2.677057   2.956734    -0.91   0.368    -8.561145    3.207031
         cpi |   1.126064   .8259637     1.36   0.177    -.5176566    2.769784
          er |  -.3558194   .8805707    -0.40   0.687    -2.108211    1.396572
       _cons |   52.16644    49.3868     1.06   0.294    -46.11642    150.4493
-------------+----------------------------------------------------------------
     sigma_u |  4.6704449
     sigma_e |  .21150265
         rho |  .99795344   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(27, 80) =    82.23             Prob > F = 0.0000
```

But FE becomes ineffective when the composite errors v_{ij} is serially correlated. In such a case, random effect (RE) or pooled OLS can be used. So here has grown a need to test the appropriateness of using RE model for present analysis. The Breusch-Pagan Lagrange multiplier (LM) test helps decide between RE regression.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        ta[origin,t] = Xb + u[origin] + e[origin,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                      ta |   1.403418       1.18466
                       e |   .0447334      .2115027
                       u |   .9449223      .9720712

        Test:   Var(u) = 0
                             chibar2(01) =   150.81
                          Prob > chibar2 =   0.0000
```

The null hypothesis in this LM test is that variance across entities is zero representing no significant difference across units (i.e. no panel effect). Here as probability of chi^2 is 0.00, the null has been rejected and concluded that random effect is not appropriate for using in this regression analysis. A simple OLS regression estimated using RE will not work here.

```
. xtreg ta dist gdppc pp cpi er, re theta

Random-effects GLS regression                   Number of obs      =       112
Group variable: origin                          Number of groups   =        28

R-sq:  within  = 0.0554                         Obs per group: min =         4
       between = 0.3758                                        avg =       4.0
       overall = 0.3678                                        max =         4

                                                Wald chi2(5)       =     19.56
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0015
theta          = .89184842
```

ta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
dist	-.3293887	.3974723	-0.83	0.407	-1.10842	.4496426
gdppc	.0526719	.2088102	0.25	0.801	-.3565887	.4619324
pp	.4434508	.1465932	3.03	0.002	.1561335	.7307681
cpi	.5350493	.7287732	0.73	0.463	-.8933199	1.963418
er	-.1901419	.8439964	-0.23	0.822	-1.844344	1.464061
_cons	1.383023	3.98884	0.35	0.729	-6.434959	9.201006
sigma_u	.97207116					
sigma_e	.21150265					
rho	.95479906	(fraction of variance due to u_i)				

The basic assumption behind using RE is that the unobserved effect is uncorrelated with all the explanatory variables in the model subject to specification tests.

Test for multicollinearity:

The selected model has been tested for finding out any correlation between the explanatory variables (which is called multicollinearity).

```
. corr dist gdppc pp cpi er
(obs=112)
```

	dist	gdppc	pp	cpi	er
dist	1.0000				
gdppc	0.8064	1.0000			
pp	-0.3076	-0.5417	1.0000		
cpi	0.0000	0.0712	0.0065	1.0000	
er	0.0000	0.0598	0.0062	0.9394	1.0000

Here, from the above test it can be seen that there exist high degree of multicollinearity among the three above mentioned explanatory variables (as TRV, GDP & POP). This result has been verified further through estimating Variance Inflation Factor (VIF) where GDP and TRV are found collinear (for having VIF score more than 10) as below.

```
. vif
```

Variable	VIF	1/VIF
cpi	8.58	0.116592
er	8.52	0.117322
gdppc	4.02	0.248677
dist	3.11	0.321400
pp	1.53	0.653999
Mean VIF	5.15	

But these variables are very important in estimating tourism demand for Bangladesh. This is because all three variables have been retained in the model. Moreover, since the panel data has been considered, this kind of multicollinearity can make little change in coefficient of explanatory variables.

Test for heteroskedasticity:

The error terms of this model has been tested to find out whether they have common or constant variance (which is called homoskedasticity). If the error terms do not have common variance, they change over time and cause the problem of heteroskedasticity. The Breusch-Pagan test is performed here,

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of ta

        chi2(1)      =     3.02
        Prob > chi2  =   0.0823
```

The null hypothesis of this test is that the variance of the residuals is homogenous. However, the p-value is greater than 0.05 and we don't need reject the null hypothesis of common variance. Thus, the variance is homogenous.

```
. imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(18)     =     23.14
         Prob > chi2  =    0.1853

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	23.14	18	0.1853
Skewness	13.68	5	0.0178
Kurtosis	3.53	1	0.0604
Total	40.35	24	0.0196

Test for autocorrelation:

The regression model can be suffered from Autocorrelation when the error terms are serially correlated with each other. Such correlation can be arisen from the correlation of the omitted variables that error term captures. For detecting Autocorrelation, the Durbin Watson (DW) test is very well known.

```
. xtregar ta dist gdppc pp cpi er, re rhotype(dw)

RE GLS regression with AR(1) disturbances       Number of obs      =       112
Group variable: origin                          Number of groups   =        28

R-sq:  within  = 0.0535                         Obs per group: min =         4
       between = 0.3801                                        avg =       4.0
       overall = 0.3720                                        max =         4

                                                Wald chi2(6)       =     21.09
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0018

------------------------------------------------------------------------------
          ta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dist |   -.366535   .3835055    -0.96   0.339    -1.118192    .3851221
       gdppc |   .0821773   .2064548     0.40   0.691    -.3224667    .4868213
          pp |   .4543775   .1393766     3.26   0.001     .1812044    .7275507
         cpi |   .4721116   .7303458     0.65   0.518    -.9593399    1.903563
          er |  -.1303578   .8417686    -0.15   0.877    -1.780194    1.519478
       _cons |   1.276721   3.801361     0.34   0.737     -6.17381    8.727251
-------------+----------------------------------------------------------------
      rho_ar |  .12050646   (estimated autocorrelation coefficient)
     sigma_u |  .89632407
     sigma_e |  .21406719
     rho_fov |   .9460391   (fraction of variance due to u_i)
       theta |  .86976767
------------------------------------------------------------------------------
```

Here the estimated autocorrelation coefficient is 0.12 (rho_ar) in the main regression model.

Estimating through linear regression:

As there prevails some estimated autocorrelation in basic regression model, the model has been corrected for such problems applying the model for linear regression with 'Panels Corrected Standard Errors (PCSEs)' as below,

```
. xtpcse ta dist gdppc pp cpi er

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   origin                        Number of obs      =       112
Time variable:    year                          Number of groups   =        28
Panels:           correlated (balanced)         Obs per group: min =         4
Autocorrelation:  no autocorrelation                           avg =         4
                                                               max =         4
Estimated covariances      =       406          R-squared          =    0.3866
Estimated autocorrelations =         0          Wald chi2(5)       =   9282.93
Estimated coefficients     =         6          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
          ta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dist |  -.6603267    .039617   -16.67   0.000    -.7379747   -.5826787
       gdppc |   .3069083   .0284431    10.79   0.000     .2511609    .3626557
          pp |   .5246463    .017312    30.31   0.000     .4907155    .5585771
         cpi |   .0808086    .505602     0.16   0.873    -.9101531     1.07177
          er |   .0834384   .6540661     0.13   0.898    -1.198508    1.365384
       _cons |   1.383726   1.017628     1.36   0.174    -.6107876     3.37824
------------------------------------------------------------------------------
```

After resolving the problem regarding autocorrelation, the re-estimated basic model shows changed coefficients of the explanatory variables with very high significance level.

Regression with original TA

$$\log(TAnew_{ij}) = \alpha + \hat{\beta}_1\log(DIS_{ij}) + \hat{\beta}_2\log(GDPpc_{ij}) + \hat{\beta}_3\log(PP_{ij}) + \hat{\beta}_4\log(CPI_{ij}) + \hat{\beta}_5\log(ER_{ij}) + \hat{\mu}_{ij}$$

Regressing original tourist arrival, following regression result has been received and used in further explanation.

```
. xtpcse tanew dist gdppc pp cpi er

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   origin                       Number of obs      =       112
Time variable:    year                         Number of groups   =        28
Panels:           correlated (balanced)        Obs per group: min =         4
Autocorrelation:  no autocorrelation                          avg =         4
                                                              max =         4
Estimated covariances      =       406         R-squared          =    0.4235
Estimated autocorrelations =         0         Wald chi2(5)       =   9953.14
Estimated coefficients     =         6         Prob > chi2        =    0.0000
```

tanew	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
dist	-.90885	.0718422	-12.65	0.000	-1.049658	-.7680418
gdppc	.4374162	.0364783	11.99	0.000	.3659202	.5089123
pp	.6292886	.0240814	26.13	0.000	.5820899	.6764873
cpi	-.2773197	.1721118	-1.61	0.107	-.6146527	.0600133
er	-.1254743	.2135244	-0.59	0.557	-.5439745	.2930259
_cons	.9946524	.8355963	1.19	0.234	-.6430863	2.632391

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