

APPLYING GRAVITY MODEL TO ANALYZE TRADE ACTIVITIES OF BANGLADESH

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Abstract: Bangladesh agonizes from a long-lasting deficit in its potential trade. However, it has been trying to overcome this deficit since independence in 1971. Due to political and many other reasons, it could not trade at its potential level but the trade with its partner countries is not negligible. According to the World Bank and Asian Development Bank said that Bangladesh is currently one of the fastest growing economies and it has become possible because of its trade with other countries. The most significant factors accountable for this unfavorable trade balance of Bangladesh is going to be examined in this paper. In this paper gravity model has been applied to analyze trade activities of Bangladesh & 35 countries between time duration of 2000 to 2011. Panel data has been used on worldwide trade of Bangladesh which is taken from the International Trade Center, World Integrated Trade Solution, International Monetary Fund and World Bank. The final results expose that the economic size of Bangladesh & foreign partners, the distance between countries and exchange rate have significant effects on Bangladesh's bilateral trade flows with its partnering 35 countries.

Keywords: Gravity Model, International Trade, Panel Study, Bangladesh.

1. Introduction

After the independence in 1971 Bangladesh aimed to reform the economy and the most important intentions of the modification were to inspire development of the private sector along with to push up the bilateral trade activities of national firms. Therefore, trade activities of Bangladesh have been gradually opened and observed dramatic growth and also it contributed to the growth of national private firms.

The main question is how Bangladesh is taking its chances to effectively exploit the comparative advantages of its partnering countries and what are the factors backing up this exploitation. This paper applies the gravity model to evaluate the effect of some specific factors on the bilateral trade activities of Bangladesh. 35 partnering countries data have been collected from the period of 2000 to 2011 from the data banks of International Trade Center, World Integrated Trade Solution, International Monetary Fund and World Bank. The assessed outcomes expose that the Bangladesh's economic size, foreign countries economic size and the market size, the distance, the exchange rate, & the culture have significant effects on international trade flows of Bangladesh and its trading partners.

The structure of this paper is as follows. Section 2 reviews literature on the gravity model. Section 3 gives the theory behind the gravity model. Lastly, section 4 & 5 illustrate the methodology and empirical results. The conclusion is by far in the final section.

2. Literature Review

Tinbergen (1962) and Linnemann (1966) conducted research which showed that the trade flows follow the physical principles of gravity which is two opposite forces determine the volume of bilateral trade between countries - the level of their economic activity and income, and the extent of impediments to trade. After that in particular, the cost of transportation, various trade policies, uncertainty in trade, cultural gaps, geographical features, etc. There are impediments such as National borders, even for industrialized countries (Anderson and Van Wincoop, 2003).

Filippini (2003) conducted research by applying a gravity model to show the bilateral trade of East Asian developing countries. The study revealed that all factors signs (GDP, distance, population) were reliable with the model assumptions.

Not many studies on Bangladesh have been conducted in this sector. It is because of the lack of information about trade inflows and outflows with other countries. Md. Mahmudul Alam, Md. Gazi Salah Uddin Khan and Md. Raziuddin Taufique (2009) used a generalized gravity model to analyze import flows with its trading partners by using panel data techniques. The results were consistent with the model. The paper exposed that Bangladesh's trade is affecting by the economic size of countries', per capita GNP and size of the population.

Rahman (2004) also applied gravity model and found that trade flows of Bangladesh are positively affected by the size of the economies of trading partners, openness of trading partners and per capita GNP.

The literature shows that gravity model shares some common characteristics that can be customized for different purposes such as in the gravity model the equation is bilateral and it can be derived from various theoretical models of international trade and finally, it can be used to estimate the nature of trade flows.

3. Theoretical Framework

In 1776, a Scottish economist, Adam Smith published his renowned book "The Wealth of Nations" and he proposed the "Absolute Advantage" theory to explain the basis and gains from trade. However, his theory doesn't explain those countries who are getting benefit from bilateral trade but doesn't have an absolute advantage.

Another English economist, David Ricardo, in his comparative advantage theory states, "A nation, like a person, gain from international trade by exporting the goods or services in which it has the least comparative advantages." Later that, two Swedish economists Eli Heckscher and Bertil Ohlin gave a model which prolonged Ricardo's theory and established a new influential theory of international trade. H-O model said that, "A country will export commodities of which the abundant factors are needed intensively in production."

But on the other hand, classical trade concept indicates that the countries which are more dissimilar have a tendency to trade more. That's why it is hard to explain the massive amount of trade between countries those who have similar factors, which also dominates the trade of developed economies.

Recently, gravity model has been utilized for explaining international trade flows of two countries which can't be explained by other economic models. According to Newton's Law of Gravitation, "The gravitational attraction between two things is proportional of their masses and inversely related to the square of their distance."

This model is:

$$F_{ij} = G (M_i M_j / D_{ij}^2) \quad (1)$$

Where:

F_{ij} : Gravitational attraction between objects

D_{ij} : Distance between objects

M_i, M_j : Mass of two objects

G : Gravitational constant

The famous Dutch economist named Tinbergen first used gravity model in 1962 for analyzing overseas trade flows. In that model, he selects the trade flow between country A and B as the dependent variable and GDP and geographical distance as an independent variable.

His model was as follows:

$$T_{ij} = A (Y_i Y_j / D_{ij}^2) \quad (2)$$

Where:

T_{ij} : Total trade flow between the origin country i & the destination country j

D_{ij} : Distance between origin country i and destination country j

Y_i : GDP or GNP of origin country

A : Constant term

Y_j : GDP or GNP of destination country

Based on the theoretical framework, the given hypotheses are constructed:

Hypothesis 1: Positive impact of GDP or GNP on international trade.

Hypothesis 2: Negative effect of geographical distance on international trade.

Hypothesis 3: Positive connection between the devaluation of Bangladesh's currency.

4. Statistical Model and Variables

In the case of Bangladesh, a different gravity model which was proposed by 'Krugman and Obsfeldt' in 2005 has been applied. In their proposed model, they introduced just two variables which were distances and GDP. The model in this paper is additionally improved by accumulating the other variables such as culture, exchange rate, population which affects the international trade between Bangladesh and her companion countries. The proposed gravity model in logarithm form described below:

$$\log (T_{ijt}) = \alpha_0 + \alpha_1 \log (Y_{it} * Y_{jt}) + \alpha_2 \log (N_{it}) + \alpha_3 \log (N_{jt}) + \alpha_4 \log (D_{ij}) + \alpha_5 \log (EX_{ijt}) + \alpha_6 (C_{ij}) + e_{ijt}$$

Where:

$i = 1$ (Bangladesh)

N_{jt} : Population of partner country j in year t

$j = 2, 3, 4, \dots$ (partnering countries)

D_{ij} : Geographical distance between Bangladesh and partner country j (in kilometers)

$t = 2000, 2001, 2002, \dots, 2011$

T_{ijt} : Bangladesh's trade with partner country j in year t

EX_{ijt} : Real exchange rate between Bangladesh and partner country j in year t

Y_{it} : Bangladesh's Real GDP in year t

C_{ij} : Culture dummy variable between

Y_{jt} : Real GDP of country j in year t

Bangladesh and country j for the cultural gap

N_{it} : Bangladesh's population in year t

e_{ijt} : Error

Here, the dependent variable: Annual trade = (exports + imports of Bangladesh and partners). For this variable, data has obtained from the World Integrated Trade Solution (WITS) databank, the period from 2000 to 2011.

Economic size of Bangladesh and the partner countries have been measured by GDP. This variable is likely to have a positive effect on bilateral trade. The data of all countries GDP has been collected from the databank of the ‘International Monetary Fund (IMF)’.

Another factor affecting international trade is a market size which has been estimated by the population variable. It supposed to be more trade if the market place is larger. So, expectation is that the population variable will show positive sign. Bangladesh’s and partners population data has been obtained from the database of the World Bank (WB)

The real exchange rate has been calculated by the following formula described by Bergstand (1985) and Dell’Arricia (1999) and in Bangladesh’s context the formula will be:

$$EX_{ijt} = [(\text{Annual average of Bangladesh's national currency per USD}) / (\text{Annual average of partnering country's national currency per USD})] * (\text{in year } t)$$

By applying the formula mentioned above, real exchange rate between Bangladesh and partner country j in a particular year has been determined. Data of countries real exchange rate has been collected from the online data bank of World Bank (WB). If the real exchange rate increases that means currency of Bangladesh devalued which will have a consequence in to rise in imports and fall in exports. In a nutshell exchange rate will give a positive effect on trade.

Transportation cost has been represented by the distance variable in bilateral trade. This variable is measured in kilometers(KM) from the Dhaka(capital of Bangladesh), to the capital of other countries. This data has been taken from “Great Circle Distance between Capital Cities”. This variable is likely to give a negative sign on trade flows.

The last variable is a culture which is a control variable in this model. It is a qualitative variable. Culture variable is represented by religion. If the country’s religion is close to Bangladesh culture: Muslim, then the value is 1 and 0 for other religions. This variable is expected to cause a positive impact.

There are many models that can be applied to estimate results for panel data and they are, Pooled Model, Random Effects Model (REM), Fixed Effects Model (FEM), Between Effects Model (BEM) and so on. Considering the properties of the data the appropriate model has to choose.

The main problem of the pooled model is that individual effects must not exist. If exists, then Fixed Effects Model and Random Effects Model will likely to be more accurate. The main problem of Fixed Effects Model is that the variable has to be time variant. So, variables like culture, distance will not supporte by FEM.

However, in this study, the Between Effects Model (BEM) has been used for estimation. The BE estimator only uses the cross-sectional variation of the data. It doesn't take into account the time dimension under consideration. This is why BE is used to capture the effect of distance variable which is time-invariant and dropped out in both FE and WE estimator.

Table 1 represents the all variables applied in this study.

Table 1: Descriptive Statistics

No	Variable	Description	Obs	Mean	Std. Dev	Min	Max
1	T _{ijt}	Bangladesh's trade with partnering countries	420	658384	969622	2.291	6356510
2	Y _{it}	Bangladesh's real GDP	420	7.9e+10	2.4e+10	5.34e+10	1.29e+11
3	Y _{jt}	Real GDP of partner countries	420	1.2e+12	2.4e+12	4.39e+08	1.55e+13
4	N _{it}	Bangladesh's population	420	1.4e+08	7.0e+06	1.32e+08	1.54e+08
5	N _{jt}	Population of parter countries	420	1.2e+08	2.8e+08	573416	1.34e+09
6	D _{ij}	Distance between Bangladesh and partnering countries	420	5784.35	3471.63	426.33	14588.32
7	EX _{ijt}	Real Exchange rate between Bangladesh and partner countries	420	33.392	42.4672	.0054388	268.6886
8	C _{ij}	Culture gap between Bangladesh and partnering countries 0: For other religions 1: Religion of Muslim	420	0.223	.4204133	0	1

5. Estimation Results and Interpretation

The study finds that real GDP of Bangladesh and partnering countries ($Y_i * Y_j$), overseas market size (N_j), real exchange rate (EX_{ij}) and distance (D_{ij}) have influences on Bangladesh's bilateral trade. culture (C_{ij}). Market size (N_j) of Bangladesh & culture (C_{ij}) have no impact as estimated results of the coefficients are insignificant.

Table 2: Estimation Results

Dependent variable: T_{ij}

Independent variable	Coefficient	z-statistic	P-value
$Y_i * Y_j$	1.416785*	7.69	0.000
N_i	6.842038	1.99	0.055
N_j	.3147099	0.15	0.877
D_{ij}	-1.082097*	-3.27	0.003
EX_{ij}	.0050106*	3.59	0.000
C_{ij}	.2806748	1.40	0.161

*Note: * All the coefficients are statistically significant at 5% level*

Total trade value will increase if there is a sharp growth in real GDP of Bangladesh and partners. There is a statistical significance of the estimated coefficients of this variable and it shows positive impacts. A sharp increase of 1% in foreign partners real GDP will enlarge Bangladesh's real GDP by 1.42% on average. Bilateral trade will step up on average by 0.32% if there is an increase in population of partner countries by 1%. So, hypothesis 1 is supported.

The geographical distance variable is also statistically significant result confirming hypothesis 2. If distance increase by 1% on average the value of trade will tend to decrease by 1.08%. It affects bilateral trade negatively. The real exchange rate is also highly statistically significant thus supporting hypothesis 3 in this paper. Bangladesh's population size and culture have no effect on bilateral trade of Bangladesh.

6. Policy Implication

From the estimated result it is clearly visible that Bangladesh Government should consider a few things before doing bilateral trade with partner countries. Bangladesh should trade with those partner countries whose distance is minimum with Dhaka as distance has a negative impact on bilateral trade. Also, the partners market place should be considered in bilateral trade. Those partners who have large population have a large market place which is great for doing bilateral trade. By maintaining these conditions Bangladesh can achieve a sustainable bilateral trade.

7. Conclusion

Main purpose of this paper is to find out the factors those affect the international trade between Bangladesh and partnering countries all over the world. The gravity model has been applied and estimated by collecting data from 35 partner countries from 2000 to 2011. The final estimated results revealed that international trade flows of Bangladesh is mainly influenced by the foreign market size, economic size, exchange rate and geographical distance.

There is a positive impact of growth in the economic size of Bangladesh and partner countries on the bilateral trade flows. Geographical distance causes a negative effect on trade growth. On the other hand, exchange rate estimated to have a positive effect on bilateral trade.

This study has some limitations. There is some limitation in the data. In the future, research containing a large scale of data and time should be conducted which will give a strong result and fewer errors. There are some variables which couldn't measure because of lack of data and they are strategic partnership and infrastructure. These two variables have a significant impact on international trade but couldn't be measured.

References

- Kepaptsoglou, K., Karlaftis, M. G., & Tsamboulas, D. (2010). The gravity model specification for modeling international trade flows and free trade agreement effects: a 10-year review of empirical studies. *The open economics journal*, 3(1).
- Egger, P. (2002). An econometric view on the estimation of gravity models and the calculation of trade potentials. *The World Economy*, 25(2), 297-312.
- Oguledo, V., & MacPhee, C. R. (1994). Gravity models: a reformulation and an application to discriminatory trade arrangements. *Applied Economics*, 26(2), 107-120.
- Van Bergeijk, P. A., & Brakman, S. (Eds.). (2010). *The gravity model in international trade: Advances and applications*. Cambridge University Press.
- Batra, A. (2006). India's global trade potential: The gravity model approach. *Global Economic Review*, 35(3), 327-361.
- Martínez-Zarzoso, I., & Nowak-Lehmann, F. (2003). AUGMENTED GRAVITY MODEL: AN EMPIRICAL APPLICATION TO MERCOSUR-EUROPEAN UNION TRADE FLOWS. *Journal of applied economics*, 6(2).
- Rahman, M. M. (2003). A panel data analysis of Bangladesh's trade: the gravity model approach. In *Proceedings of the 5th Annual Conference of the European Trade Study Group (ETSG2003)*. European Trade Study Group.
- Westerlund, J., & Wilhelmsson, F. (2011). Estimating the gravity model without gravity using panel data. *Applied Economics*, 43(6), 641-649.
- De Benedictis, L., & Vicarelli, C. (2005). Trade potentials in gravity panel data models. *The BE Journal of Economic Analysis & Policy*, 5(1).—
- <https://wits.worldbank.org/CountryProfile/en/Country/BGD/Year/2011/Summary>
- <https://databank.worldbank.org/data/reports.aspx?source=2&country=BGD>
- <https://data.imf.org/regular.aspx?key=61545850>