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Gravity Model Analysis on Export and Import of Bangladesh with SAARC Countries: Panel data Approach

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Abstract

The purpose of this paper is to investigate the determinants of export and imports flows to Bangladesh with SAARC member countries using panel data estimation technique and applying with the Gravity Model Approach. Constructing two gravity models separately for exports and imports of Bangladesh with other SAARC countries, the study was conducted based on a Panel data set comprised of other 7 member countries of SAARC for total 11(eleven) years from 2006 to 2016. Being the workhorse of empirical international trade and its robustness with versatility makes the Gravity model essential tool to analyze policy issues regarding trade. Due to academic popularity of Gravity model, it has been used in the paper to assess the bilateral trade relation between countries. The Gravity Model has been estimated using three techniques of panel data Pooled OLS, fixed effects and random effects. Fixed effect model is used to find the impact of variables over time and random effect model is used to capture the effect of invariant variables. Applying F-test, Brusch-Pegan LM test and Hausman test, the study finds out, fixed effect is suitable for the export model and random effect for the import model. The estimated result shows that the significant determinants of Bangladesh's exports with SAARC member countries are: GDP, Real exchange rate, Distance and Border and except Border all other variables are found significant for imports.

Key words: Gravity model, Panel data, Bangladesh's export and import

JEL Classification: C12, C23, F10

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Section: 1. Introduction

Since the dawn of globalization regional integration has been prioritized in order to enhance the welfare of the countries by facilitating trade. South Asian Association for Regional Cooperation (SAARC) was established in 1985 with the aim to promote social and economic welfare. After three decades of the formation of SAARC, this region is still lagging behind than other Regional economic community. Historical, religious, geographical inter-country conflicts and distrust among the nations make it harder to bring out any significant outcome from SAARC. To accelerate economic growth and stable economy for this region intra-trade would be beneficial factor. This paper attempts to find out possible determinants of Bangladesh's trade with SAARC countries although these set of factors can be a long list. Government policies, bilateral issues, tariff rate can affect a country's trade flow despite any comparative advantage. The list of determinants is so long, however, empirical analysis showed that simple idea is very successful to show desired result and related economic phenomena. Remarkably, the Gravity model of trade has been so popular method to find out the determinants of trade flow of any nation. Home country's GDP, trade partners GDP and Distances between two countries have been the core determinants of the model. This paper has also added some additional factors and dummy variable for better estimation.

Recent developments in the SAARC region indicate that despite the global uncertainties and other economic downfalls, economic integration can make the progress further. On the basis of historical data, trends of intra-SAARC trade and economic integration in this region have been far below from potential. After the partition of British Indian territories, intra-regional trade was around 46% in 1948. However, it slowed down to only 2 % in 1967. Previous studies revealed that large trade deficit of Bangladesh with India have significant impact on the balance of payments of Bangladesh. Among SAARC countries, India has diversified export capability and receives the facilities regarding duty free access for raw material imports by Bangladesh. In this context, Bangladesh could utilize the idea of finding other neighbors to export its product.

With a view to finding trade scenario in this region Section 2 of this paper shows the previous intuitive and analytical arguments in support of the idea of the subject of this paper. Section 3 analyses the direction of trade flow of the SAARC region and compares among the SAARC member countries on the basis of several economic indicators. Section 4 helps to construct the structure of the model of this paper and illustrates the

data sources. Section 5 interprets the results and empirical analysis of Bangladesh's export and import with other SAARC countries. Section 6 represents the conclusion in which some policy reviews has been suggested and discusses the possible role of the policy makers that can be taken by in this regard. In this section, some shortcomings and limitations have also been taken account of.

Section:2. Literature Review

Indeed the focus of this study to measure the determinants of the export and import flows of Bangladesh with SAARC nations. Since the gravity equation for trade was introduced by Tinbergen in 1962 in his 'Shaping the world economy', the lack of its preliminary analysis of theoretical foundation was improved by later theoretical works by Linnemann (1966), Anderson(1979), Bergstrand (1985), Anderson and Wincoop (2003) and others. Anderson et al (2004) emphasized on importance of trade cost within the framework of gravity model and found significance of trade costs and trade flows.

The Gravity model has been used broadly in empirical literature. Some studies have used gravity model to analyze effect of economic integration on overall trade on certain region, some studies focused on country specific effect.

Zarzoso et al (2003) applied the gravity trade model to assess Mercosur-European Union trade, and trade potential following the agreements reached recently between both trade blocs. The model is tested for a sample of 20 countries, the four formal members of Mercosur plus Chile and the fifteen members of the European Union. This paper showed that exporter and importer income, as expected, have a positive influence on bilateral trade flows. Exporter's population has a large and negative effect in exports showing a positive absorption effect, whereas importer's population has a large and positive effect on exports, indicating that bigger countries import more than small countries. It also investigated that infrastructure variables, income differences and exchange rates are also statistically significant and present the expected sign. Random effect model is preferred than fixed effect model for bilateral trade as proved by Hausman test.

Rahman (2004) estimated the generalized gravity models of trade, export and import. This study shows that Bangladesh's trade is positively determined by the size of the economies, per capita GNP differential of the countries involved and openness of the trading countries. Author found the exchange rate, partner countries' total import demand and openness of the Bangladesh economy are the major determinants of

Bangladesh's exports, affecting the Bangladesh's exports positively. Although the exchange rate has no effect on the Bangladesh's import. Transportation cost is found a significant factor in influencing the Bangladesh's trade negatively which implies Bangladesh would do better if the country trades more with its neighbors. Moreover, Bangladesh's import is found to be influenced to a great extent by the border between India and Bangladesh.

Sohn(2005) applied the gravity model to explain South Korea's bilateral trade flows and to extract practical trade policy applications. Empirical results proved that the gravity model is very effective in explaining Korea's bilateral trade ?ows. Moreover, this study provided evidence that it is applicable to single country case. The coef?cient on the trade structure variable confirmed that Korea's trade pattern follows a Heckscher-Ohlin pattern. The study estimated that Korea's trade flows depend more on factors such as the product of GDP, distance variable, income difference. The significance of the coefficient of GDPs and insignificance of the per capita GDP indicated that Korea's inter-industry trade depends more on the exporting of quantity-based standardized products that are sensitive to overall market size than the exporting of quality based high value-added products that are more sensitive to the trading partner's income level.

Kien (2009) showed determinants of export flows of ASEAN 39 countries through estimations of panel data using gravity model and data for 24 years. Based on two way error component and Hausman-Taylor model, the estimations suggested that GDP, Population and Language can explain export.

Bhattacharyya et al (2006) applied the gravity model on India's bilateral trade with its entire trading partner using panel estimation. They used both traditional and augmented gravity model and contiguous trade partner, common language, colonial, same country in the past are the incorporating variables. They found India's trade responds less than proportionally to size and more than proportionally to distance. Moreover, this paper showed Population size has more determining influence on India's trade and India trades more with developed country than developing country.

Kabir (2010) applied an augmented gravity model to estimate the factors that influence bilateral trade of four founding BIMSTEC countries with their important global partners as well as other BIMSTEC members. The GDP and governance of both importers and exporters positively influence the bilateral trade. Distance elasticity is found negative in

both the specifications. The impact of Real Exchange Rate has also been found positive and significant, however Distance elasticity and Border dummy turned out to be negative.

Gul et al (2011) applied the gravity model of trade to estimate Pakistan's trade potential using Panel data for the period 1981-2005 across 42 countries is employed in the analysis. They found that the volume of trade between Pakistan and other members of the South Asian Association for Regional Cooperation (SAARC) is very low, despite the existence of significant potential. Particularly for India it showed Pakistan's trade is very low, however, this result should be interpreted with caution, taking into consideration the volume of underground trade.

Neogi (2014) explained the effect of economic corridor on the development of countries using data on bilateral trade of five South Asian countries- Bangladesh, India, Nepal, Pakistan and Sri Lanka for 22 years from 1987 to 2008. The paper found GDP and FDI statistically significant while distance is not significant for both export and import. Road infrastructure shows statistically significant positive sign for export and negative sign for import. Moreover, the sign of coefficient of Border is found insignificant and Hausman test showed Random effect model is suitable model for estimation of coefficients.

Elshehawy (2014) shows that Egypt's GDP, importer's GDP, importer's population and the border between Egypt and its trading partner are the main factors affecting Egypt's exports to its main trading partners. All these factors affect Egypt's exports positively. Transportation costs (distance variable) are found to have negative but insignificant effect on Egypt's exports.

Husain (2015) indicated that the bilateral trade flows between Bangladesh & her fifty two trading partners are driven by proxy for the stage of development or level of development (PCGDP), distance. According to the result of the gravity model, per capita GDP of both the exporter & importer countries have positive effects on the trade flows.

This paper compares three estimators of gravity model using panel data, part of them and variables used here have been used in previous studies. However, none of them used these three methods together which have been used in this paper with the group of variables used in the models.

Section: 3. Pattern of trade in South Asia

South Asian region is one of the most important regions in the world in context of the scope of economic development. In order to compare the economic situation and vulnerability among these countries, a table of data has been represented.Table-1 shows that SAARC region contains growing economy like India, Bangladesh, Sri Lanka, Pakistan. Besides, a large amount of youth labor force participation and its emerging demand make this region more crucial topic for developing world. Low external debt as percentage of GDP implies that a country's total production is sufficient to pay the debt. Bhutan has the highest percentage of external debt to GDP while Afghanistan has the lowest. Bangladesh is the second lowest shareholder in this rank and comparatively better than Nepal, Maldives, Pakistan, Sri Lanka and India. Bangladesh has higher National Debt to GDP ratio than Afghanistan, India and Nepal. Afghanistan has the lowest ratio of National Debt to GDP in this context.

A country keeps a part of its foreign exchange reserves to protect themselves from any internal or external risk. Reserves as a percentage to import means how many months can be covered by the total amount of reserves by importing goods and products demanded by that country. Hence, low ratio of reserves to import means country's economy is vulnerable. Maldives could pay for only 1.6 months' imports while the standard threshold level is keeping 3 months import liability in reserve. In this context, Nepal and Afghanistan are at comparatively stable position. Besides, Bangladesh could cover for 8 months import and it indicates good economic condition. A country's inflation rate should be in a stable state because it contributes to achieving high levels of economic activity and employment. In SAARC region, Nepal seems to have highest inflation rate at 9.9% while Maldives has the lowest rate at 0.50% in 2016.

The amount of intra-SAARC trade is very low compared to other regional organization. SAARC has the lowest intra-regional trade share in the world. Intra-SAARC export and import scenario can be seen in chart 1 and 2. In chart 1, India has the largest share of 73.26% within this little amount of export amount, whereas Bangladesh has only 3.30% share.

On the other hand, import scenario seems to be little different. India imports from other SAARC countries at a very low percentage (13%), compared to share percentage of export to the other countries of SAARC. Bangladesh imports 25% of total intra-SAARC imports while Nepal and Sri Lanka imports 22% and 17 % of total regional imports accordingly.

Section: 4. Methodology

Conventional gravity model generally uses cross-section data to analyze the nature of trading flows for a specific time period, e.g. one year. However, cross-section data observed over several time periods which is panel data methodology is more functional than using cross-section data only to explain gravity model. This paper uses three different panel data methods, such as Pooled OLS, Fixed Effect (FE) and Random Effect (RE). To select the appropriate method for the model, the Hausman test, F-test and Breusch- Pegan Lagrange Multiplier (LM) have been used in this paper.

If there is no individual effect (cross-sectional or time specific effect), ordinary least squares may be used as an efficient method. A fixed effect model analyses individual differences in intercept assuming the same slope and constant variance across individual. An error term is correlated with other regressors and individual specific effect is time invariant which is also a part of the intercept. A random effect model examines that individual effect (heterogeneity) is not correlated with any regressor and it also estimates error variance specific to groups or times.

To compare among these above models, at first the F test is examined, which investigate if there are fixed effects in the model. While, the random effects can be tested by Breusch-Pegan Lagrange Multiplier (LM) test. The F-test compares between fixed effect model and Pooled OLS and LM test compares random effect model with Pooled OLS. If the both null hypothesis is rejected then Hausman test can be adopted.

F-test: The null hypothesis of the F-test is that the observed and unobserved fixed effects in the model will be equal to zero, they are equal across all units. If the null hypothesis is rejected, then there is a significant fixed effect in the model i.e. the fixed effect model is better than the pooled OLS.

LM test: The LM test examines if any random effect exists. The null hypothesis is that individual-specific or time-specific variance components will be zero. If the null hypothesis is rejected, then there exists a significant random effect in the model and the data are able to deal with heterogeneity better than Pooled OLS.

Hausman test: The Hausman specification test compares between fixed and random effect model. The null hypothesis is the individual effects are uncorrelated with any regressor in the model. If the null hypothesis is rejected, the individual effects are significantly correlated with at least one regressor in the model and thus the random

effect model is not appropriate anymore. Rather, Fixed effect model is better than random effect model.

Choosing the best model:

In order to determine an appropriate model for panel, some techniques have been adopted using the hypothesis testing. In the Table 2, four possible outcomes have shown. If both null hypotheses of the F-test and B-P LM test are not rejected then the best model is the Pooled OLS.

If the null hoypothesis of F-test in FEM is rejected but not rejected in LM test, then Fixed Effect Model will be the right choice. In reverse, Random Effect will be preferred. If hypotheses test of both F-test and LM test are rejected, then Hausman test should be run. If Hausman test is significant, Fixed Effect model will be acceptable, otherwise Random Effect Model will be preferable. Park(2014) showed a suitable table for this model selection process(Table.2).

Section: 4.1. Model Specification and data

The Gravity model is parallel to the Newtonians Physics Law of Gravity. The theory is first proposed by JAN TINBERGEN and AUGUST HECKSCHER in their paper named 'Shaping The World Economy- Suggestions For An International Economic Policy'(1962). They described an economic model explaining international trade flows in which the value of total exports from one country to another is explained by a small number of variables:

a) The Gross National Product (GNP) of the exporting country;

b) The GNP of the importing country; and

c) The distance between the two countries.

The trade flow equation was written as :

$E_{ij} = \alpha_o Y_i^{\alpha 1} Y_j^{\alpha 2} D_{ij}^{\alpha 3}$ ……(1)

Where, E_{ij}= exports of country i to country j

Y_i = GNP of country i

Y_j=GNP of country j

D_{ij}= distance between country i and country j

The main factors which determine the size of the trade flow between two countries as below:

a) The supply of the amount of exports of a country depends on its economic mass(or GNP)

b) The amount of demand for imports to a particular country depends on size of that country's market (GNP of the importing country)

c) The volume of trade will depend on transportation costs (roughly with the geographic distance between the two countries)

Distance in contrast with the other two factors- has a negative influence on trade flows.

Therefore, a bilateral trade model can be described as: the trade flow between two countries is proportional to the product of each country's economic mass, generally measured by GDP, divided by the distance between countries respective economic centers of gravity, generally their capitals (Christie 2002).

The linear form of the model is as follows: $\alpha_o Y_i^{\alpha 1} Y_j^{\alpha 2} D_{ij}^{\alpha 3}$

By using natural logarithm,

$\log E_{ij} = \alpha + \alpha_1 \log Y_i + \alpha_2 \log Y_j + \alpha_3 \log (D_{ij})$ ……..(2)

Where, $\alpha = \log K$; $\alpha_1, \alpha_2, \alpha_3$ = parameters

This model has shown stable answers to many questions in previous research that can be studied with gravity model in bilateral trade relationship. However, there are many factors that influence bilateral trade between countries.

Most estimates of the gravity models done previously in different countries included some dummy variables to the stated (2) equation that analyze for individual effects i.e. being a member of organization, trade agreements, sharing a common language, cultural similarities or ethnicity etc. As the main concern of this paper is to study about the eight countries of the SAARC, in addition to core components of Gravity model, the bilateral trade flows into Bangladesh (i) are modeled as a function of ratio of real GDP of home country (i) and trade partners (j) , ratio of per capita GDP of country i and j, ratio of Real

Exchange Rate between home country and trade partners, distance between i (Bangladesh) and j (trading partners of other SAARC countries), and Land Border between country i and j.

The study estimates 2 (two) gravity models for Bangladesh's bilateral trade with other 7 SAARC countries: Afghanistan, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka for the period 2006- 2016:

a) The gravity model of exports of Bangladesh; and

b) The gravity model of imports of Bangladesh.

The gravity model of total exports for Bangladesh has the following view:

$$\log(Export_{ijt}) = \alpha_o + \alpha_1 \log(GDP_{ijt}) + \alpha_2 \log(PCGDP_{ijt}) + \alpha_3 \log(RER_{ijt}) + \alpha_4 \log(Distance) + \alpha_5(Border) + u_{ijt}$$

Following the gravity model of total imports for Bangladesh is :

$$\log(Import_{ijt}) = \beta_o + \beta_1 \log(GDP_{ijt}) + \beta_2 \log(PCGDP_{ijt}) + \beta_3 \log(RER_{ijt}) + \beta_4 \log(Distance) + \beta_5(Border) + u_{ijt}$$

where, i and j denote trade partners,

$Export_{ijt}$ = amount of exports of country i to j

$Import_{ijt}$= amount of imports of country i from j

GDP_{ijt} = Ratio of Gross Domestic Product of country i (Bangladesh) and Gross Domestic Product of trade partner (j)

$PCGDP_{ijt}$ =Ratio of Per Capita GDP of country I and j

RER_{ijt} = Ratio of Real exchange rate of Home country and trade partners(RER_i/RER_j).

Where, Real Exchange rate, $RER_i(d/f) = e.P_f/P_d$, where, e=Nominal exchange rate of home country in terms of dollar, P_f= Consumer price index of the US, P_d= Consumer price index of Home country,i

Distance = Distance between the capital of Bangladesh and capital of trade partners

Border = Dummy variable for countries which share Border with Bangladesh

(Dummy variables indicate an attribute that takes on values of 1 or 0, 1 indicating the presence of that attribute and 0 indicating the absence of that attribute). If there is border then it is 1, If not then 0.

u_{ijt} = Error term, t = time, α & β's = coefficients for corresponding independent variables

Hypothesis :

1. The larger the GDP of home country is, compared to its partner country's GDP, the more trade will take place between the countries. In other words, an increase in GDP of home country relative to the GDP of her trade partner(j) will increase the trade. Hence, there is positive relationship between trade and GDP. Therefore, we expect ?1and ?1will have positive signs for both export and import model.

2. The relationship between trade and ratio of per capita GDP (PCGDP) of the trade partner countries is indecisive. According to the Heckscher-Ohlin theory of trade (1933) by Bertil Ohlin and Eli Heckscher, countries export goods using their abundant factors of production. As capital intensive goods is associated with higher per capita GDP countries compared to labor intensive goods, implying countries with dissimilar per capita GDP will trade more.

This is contradicted by Staffan Linder (1961) where he suggested countries with similar per capita GDP produce and consume similar quality goods. Producer will produce goods according to home country's demand and exports the surplus to the country with a very similar demand patterns. Hence, the more the difference between country's per capita GDP (PCGDP), the less there will be trade.

Frankel (1997) showed, the positive sign of the coefficient of ratio of PCGDP implies country follows H-O theorem, if negative then the country follows Linder's theorem.

In consequence, we predict either positive or negative signs for α_2 and β_2.

3. It is expected that the effects of ratio of real exchange rate of taka in terms of trade partner's currency on home country's export is positive. The more the real exchange rate index rises compared to the foreign country the more there will be depreciation of the

home currency. Hence, export will rise for the home country and there will be a positive impact on export of Bangladesh. When the ratio of exchange rate of taka in terms of foreign currency declines, export will decrease too. In contrary, if the real exchange rate index declines in comparison to the foreign country (appreciation), import will increase.

Then, we may expect positive sign for $\alpha 3$ and negative sign for $\beta 3$.

4. Distance variable as a proxy for transportation cost has been taken in this model. It is expected distance will have a negative impact on trade balance. Therefore, the sign of the coefficient will be negative i.e. $\alpha 4$ and $\beta 4$ will be negative. The more there will be distance, the less there will be trade.

5. Border Dummy variable for countries which share Border with Bangladesh implies more trade flow both exports and imports. Therefore, $\alpha 5$ and $\beta 5$ will be positive.

Section: 4.2. Sample Size and data

This paper covers 7 SAARC member trading partners of Bangladesh including Afghanistan. The annual data from year 2006 to 2016 has been considered for this paper. The Bilateral export and import data have been collected from the direction of trade statistics (DOT) database from IMF(International Monetary Fund) website. There were some missing data which were filled in from Publication (Export Receipts and Import Payments) of the Bangladesh Bank website. Real GDP, per capita GDP, Real exchange rate data has been taken from the world Bank Database. Distance from capital to capital cities is collected from website of the CEPII (*Centre d'EtudesProspectives et d'Informations Internationales*) and measured in Kilo Meter. GDP data are calculated in constant 2010 U.S. dollars and PCGDP data are in current U.S. dollars. The econometric software package STATA has been used for the analysis.

Section: 5. Results and Interpretation

We have assumed that there are heteroscedasticity and autocorrelations problem in our model. We run the hetero-corrected regression test. Fixed effect model has been estimated with autocorrelated error structure and results have been shown in Table 3 and 4.There is no heteroscedasticity test for random effects model, we can only get standard errors robust to heteroscedasticity. After that error corrected model estimation, we can not apply Hausman test. When using the robust variance estimator in the Fixed and Random effects models, the Hausman Statistic no longer has a chi-square distribution.

Hence, Hausman refuses to test. We have taken Hausman test before the error correcting test as referred by Woolridge(2015).

The stated models may still suffer from the endogeneity problem. There are several ways to cope with this problem. One technique is instrumental variable-replacing your concerned variables with proxy with certain variables. In case of $logGDP_{jit}$ and $logPCGDP_{jit}$ variable, the endogeneity problem has been detected and the instrumental variable approach has been followed in this consequence. Each endogeneous variable used employment rate and tariff revenue of their respective countries as proxy variables. After using instrumental variable we retake the endogeneity test and found variables are exogeneous.

All variables are tested for multicollinearity and result proclaims that there is no multicollinearity problem (Table 5). The VIF is an index which measures how much variance of an estimated regression coefficient is increased because of multicollinearity. If any of the VIF values exceeds 5 or 10, it implies that the associated regression coefficients are poorly estimated because of multicollinearity (Montgomery, 2001).

One of the significant limitations of fixed effect model is that itcannot estimate directly the variables that do not change over time. Such time invariant variable in the paper represented as Border, Distance etc. In other words, they pick up the combined effect of all time invariant variables that differ across groups. This problem can be solved by the method as suggested by Zarzoso and Lehman(2002). Another regression can be run by taking individual effect as dependent variable and time fixed variable as independent variable as distance and border. Regression equation can be described as:

$$IE_{ij} = \beta_o + \beta_1 \log \text{Distance} + \text{Border} + u_{ij}$$

By estimating the country specific effect (Table 6 and 7), it is found that Maldives has the highest and India has the lowest propensity to Bangladesh's Export. Besides, Pakistan has the lowest propensity to Bangladesh's import and Bhutan has the highest propensity to Bangladesh's import. Time fixed variable is subject to the constant term in this method.

Now, according to the Table 3,results of pooled OLS, fixed effects and random effects for export model has been estimated.

Following by the method of choosing appropriate model, it is found F-tests are significant at 1% level. That confirms that country and time specific heterogeneity exist in the model or in other way, fixed effect is better for this model. LM test is found to be insignificant i.e., we cannot reject the null hypothesis. That concludes there are no random effects in the model. The Hausman test requires when null hypothesis of both F-test and LM-test are rejected. As we have reached at the decision from F-test and LM-test that fixed effect model is suitable method for this model that indicates it is not necessary to take the Hausman test. Even if we test the Hausman test, it gives significant result. That means, null hypothesis can not be rejected. Thus, fixed effects is preferable than random effects model which had been suggested by Hausman test as well.

Now, the coefficients of the ratio of Gross Domestic Product of Bangladesh (i) and trade partner (j) in time t are statistically significant at1% level for FEM. The GDP variable has expected positive sign and the elasticity of export to GDP is significantly less than 1 which implies that export increases when GDP of Bangladesh relative to GDP of trade partners increases but less than proportionately. That means, small economies have the tendency to export with large economies.(Frankel, 1997).

The elasticity of export to per capita GDP ratio is continued to be insignificant for all three (3) model along with fixed effect model. Although this variable has been kept in paper despite the presence of GDP variable for avoiding any misspecification problem according to Bergstrand (1989).It implies that Bangladesh's export depends on overall economy rather than individual's income level. According to Sohn (2005) per capita GDP variable is not a significant factor in explaining Korea's bilateral trade.

The coefficients from the ratio of real exchange rate of Bangladesh and partner countries for Pooled OLS, FEM and REM are found statistically significant and positively correlated with export. The more the real exchange rate of domestic currency rises in terms of partners' currency, the more depreciation of Taka in terms of other currencies. The elasticity of Positive export with respect to the ratio of real exchange rate is 1.22% implying that if the ratio of real exchange rate increases by 1%, export increases by 1.22% based on FEM.

The coefficients of distance variable provided expected negative sign and statistically significant at 1% level for all model. Elasticity of Import to distance are -1.48% suggesting if the distance between Bangladesh and its partner country increases by 1%,

import volume declines by more than proportionally corresponding to the fixed effect model. Martinez-Zarzos (2002) found the coefficient of the distance term is much higher (in absolute terms) and significantly negative. As stated in Egger and Pfaffermayr(2002), specification country pair fixed effects are required to get unbiased coefficient estimator. Wang et. al. (2010) suggested that the geographical distance in relative endowment has a negative sign and is highly significant which similar to this model.

The Border dummy variable is significant at 1% level with negative coefficient. It reveals that Bangladesh tends to export less with SAARC trade partner with common border. Bangladesh has common border with only India among SAARC nations. In case of exports of Bangladesh in the SAARC region, Border dummy is negatively correlated with exports. Kirkpatrick & Watanabe (2005) found it negative in the context of Sub-Saharan Africa. Feenstra, Markusen & Rose (2001) found negative but insignificant common border effect on exports of differentiated goods of the OECD for cross border. De and Iyengar (2014) found the border coefficient negative and proportionally more than 1(one).The authors explained that if the cost of trade or time of clearance at a border is high, the effect on volume of trade will be negative.

Following the table 4, pooled OLS, fixed effects and random effects model for import has been measured and in consonance with the method of choosing the appropriate model, F-tests are found to be significant at 1% level and LM test is significant at 1% level. Thereby, outcome remarks fixed and random effect model both are fit in the model. The Hausman test requires when both fixed and random effect models are fitted. Hausman test offers non-significant result which rejects null hypothesis. As a result, random effect is preferable than fixed effect model.

In case of import model, the coefficients of the ratio of Gross Domestic Product of Bangladesh (i) and trade partner (j) in time t are positively correlated with import for pooled OLS, fixed effect model and random effect model and all are statistically significant. The elasticity of import to GDP is significantly less than 1 which implies that import increases when GDP of Bangladesh relative to its trade partners increases but less than proportionately 1 in case of random effect model. Fratianni (2007) estimated the bilateral import elasticity with respect to GDP which is between 1.10 to 1.20 i.e. 1% increase in importer's GDP the volume of imports about more than

proportionately which mirrors the result indicating in FEM. As shown in Nguyen(2009), the coefficient of GDP implying 1% increase in country's GDP raises the trade volume by 1.50%.Controlling the heterogeneous effect in the error is likely to increase the estimates of error is likely to increase the estimates of GDP. Another possible reason was also reported by Nguyen(2009) that growth in trade is partially attributed to unobserved factors in errors that seem to be neglected which is Consistent with Chen and Wall (2002) as well.

The coefficient of per capita GDP variable is statistically significant at 1% level with positive sign for random effect model that reflects quite different result than export model. The positive sign of the coefficient indicates that when Bangladesh's GDP increases relative to the trade partner's GDP, import will also increase. Bangladesh tends to trade with higher income countries rather than lower income countries implying that trade flow supports the H-O theorem rather than Linder's theorem. The coefficients from the ratio of real exchange rate of Bangladesh and partner countries for REM are significant however they have positive relationship with import that rejects our hypothesis. The more the real exchange rate of domestic currency rises in terms of partners' currency, the more will be depreciation of Taka. In accordance with hypothesis if real exchange rate of home country increases, it will import less. Such results found to be similar to the result of the Thorbecke (2012), which explained an appreciation of Chinese currency renminbi reduces exports along with imports. The author clarified the reason that many imports into China are used for exports as well. The product using for re-exports has the positive influence on relationship with export and import when currency depreciates. In case of Bangladesh, data showed that the amount of imported raw materials in 2015 from SAARC countries is 1,341,467.02 thousands US Dollar which is 19.69% of total imports from this region(WITS-World integrated Trade Solution). The products are using for re-exports , probably using the imported raw materials.

The coefficients of distance variable present expected negative sign and statistically significant at 1% level for random effects model. Elasticity of Import to distance is -1.91% which refers that if the distance between Bangladesh and its partner country increases by 1%, import volume declines by more than proportionally. The Border dummy variable is negatively correlated and insignificant for random effects model. In view of this negative and insignificant relationship, it implicates that border has no

significant impact on import between Bangladesh and border sharing country. Bangladesh has common border with only India among SAARC nations. In case of imports of Bangladesh in the SAARC region, Border dummy has no positive considerable impact.

Taking into account both export and import model, country specific heterogeneity can be considered for one as well as other. For export model, intercept terms are fixed and slope coefficients are same for all countries. For import model, intercept terms are random and slope coefficients are same for all countries which implies the difference among countries lies in the country specific errors, not in their intercepts as it fits best with random effect model. Elshehawy (2014) explained the situation when fixed and random effect model both acknowledged heterogeneity of countries. The random effect model differs from fixed effect model when REM assumes that the effects are generated by a specific distribution.

Section: 6. Summary and Conclusion

a. Limitations

As Afghanistan and Bhutan have some limitations of data availability, they are not able to provide reliable data for longer period. In consequence, the paper was conducted based on data no longer than 11 years due to data unavailability of the stated countries. As the study covers SAARC region, the paper took consideration of their presence in this study. Traditionally Gravity model is one of the prominent and successful theories and it usually provides robust results using typical estimation methods as OLS, fixed effect and random effect model. Recently some studies are using some developed estimation method as PPML (Poisson Pseudo Maximum Likelihood), FGLS (Feasible Generalized Least Squares), Tobit (simple regression) etc. All these other criteria will be taken up in future study.

b. Policy recommendation

Some researchers of this region suggested that it will be a win-win situation for both traders and consumers if there is no or less trade barriers. Despite several economic constraints, Bangladesh has seen prosperity and if we want to improve the trade volume with other SAARC nations, we should rethink about trade negotiations with these countries as well. As India dominates the export market of this region and Bangladesh

has bilateral trade deficit with this country, policy makers should find out other opportunities to link with other nation. Since some policy makers contradicted with the idea of free trade area since they are concerned that Bangladesh has vulnerable infrastructure and lack of efficiency in manufacturing and industrial sector. This may lead to destruction of domestic industries as they cannot compete with global market. In these consequence, Bangladesh should concentrate on finding dimensions of export area as it is largely dependent on narrow export area with some developed countries. Diversification of export can boost the possibilities of raising export volume by executing incentive and effective policy.

Although this region has lack of homogeneity in terms of economic variables like GDP growth, inflation rate, exchange rate and others so on (according to table.1), still those countries have some similarities in infrastructure, social and cultural patterns. In order to implement economic integration, reducing the trade deficit and demolishing the dominance of big nation like India in the SAARC region would be major issues for policy makers. Geographical Distance measured in Kilo Meter is used in this paper as a proxy of approximate transportation costs. As geographical distance shows negative coefficient for both export and import, reducing the transportation cost could be an efficient way to improve the situation. If Bangladesh wants to find out alternative trade partners, it would be wise to look for the efficient ways to lessen the transport cost ignoring the distance.

c. Conclusion

The idea of this study was to investigate whether gravity model of the trade explains the scenario of export and import flow in perspective of Bangladesh. Applying F-test, Brusch-Pegan LM test and Hausman test, the study finds out, fixed effect is suitable for the export model and random effect for the import model. In the export model, GDP, exchange rate and Distance variable revealed expected result according to the theory of gravity model along with the hypothesis of the model. However, PCGDP has no significant effect suggesting Bangladesh's export depends on overall economy rather than individual's income level. Border exhibits negative relationship with export and considering the findings from De and Iyengar (2014) the reason can be explained as if the higher cost of trade or time of clearance at a border causes the less volume of trade.

On the other side, in the export model, GDP, PCGDP and Distance variable revealed expected result according to the theory of gravity model along with the hypothesis of the

model. Contrarily, exchange rate variable in augmented gravity model is found positively correlated for import model indicating contradiction with the hypothesis. A notable amount of imported raw materials and re-exports are noted to be the prevailing reason. Border variable has negative impact on our trade between SAARC partners which does not support the hypothesis as well. Implementing sufficient measures for reducing cross-border trade cost might have some remarkable implications for our policy makers.

In these circumstances, Bangladesh should concentrate on bilateral trade agreement between other SAARC nations along with India. Research study claims that border variable does not have positive effect on trade, some actions should be taken to increase the export amount. In order to reduce the trade imbalance in this region, reducing cost of trade by reforming the tariff regulations should be emphasized on.

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Appendices

Table. 1 Macroeconomic Vulnerability Indicators comparison of SAARC Countries (in 2016)

Indicators	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Growth(%)	2.4	7.1	6.49	8.0	3.9	0.4	4.5	4.4
External Debt as a percentage of GDP	0.27	11.9	118.60	20.2	22.52	17.0	26.59	57.3
Current Account Balance(as % of GDP)	-18.73	0.41	-27.91	-0.53	-24.44	-0.79	-2.54	-2.13
National Debt to GDP (%)	0.27	48.81	121.56	48.1	65.72	27.4	67.61	79.3
Reserves as percentage to Import (in months)	11.77	8.2	9.47	8.43	1.6	10.28	4.62	7.40
Inflation as percentage (12 month average)	-1.54	5.9	3.31	4.9	0.50	9.9	2.86	4.0

Source: Bangladesh Bank website, Official Website of other respective Central Banks and world bank database.

Table. 2 Choosing Appropriate model

Fixed vs Pooled OLS (F-test)	Random Effect vs OLS (Breusch-Pegan LM test)	Chosen Model
H_0 is not rejected (No Fixed Effect)	H_0 is not rejected (No Random Effect)	Pooled OLS
H_0 is rejected (Fixed Effect)	H_0 is not rejected (No Random Effect)	Fixed Effect Model
H_0 is not rejected (No Fixed Effect)	H_0 is rejected (Random Effect)	Random Effect Model
H_0 is rejected (Fixed Effect)	H_0 is rejected (Random Effect)	Fixed effect model if the null hypothesis of Hausman test is rejected; otherwise, will be fitted as a Random effect model.

Table.3 Gravity model on trade balance: Dependent Variable: log(Exportijt) = export of country i to j

Independent variables	Pooled OLS		Fixed Effect Model(FEM)		Random Effect Model(REM)	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
$Log(GDP_{ijt})$	0.78***	0.16	0.70***	0.15	0.67**	0.04
$Log(PCGDP_{ijt})$	0.18	0.14	0.87	0.54	0.22	0.64
$Log(RER_{ij})$	1.31**	0.39	1.22**	0.35	1.32*	0.30
log Distance	-1.31***	0.18	-1.48***	0.33	-1.35***	0.14
Border	-1.30**	0.47	-1.62*	0.63	-1.50***	0.23
Constant	13.13***	1.38	12.16***	3.55	13.47***	1.16
No of observation	77					
No. of Group	7					
R^2	0.87		0.73		0.87	
F-test	20.99***					
LM test					1.17	
Hausman test			40.07***			

*All variables are expressed in natural logarithms. *,**,*** statistical significance at 10%,5% and 1% level respectively. F-test, LM-test and Hausman test shows chi-square value.*

Table.4 Gravity model on trade balance: Dependent Variable: log(Importijt) = Import of country i from j

Independent variables	Pooled OLS		Fixed Effect Model		Random Effect Model	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
$logGDP_{ijt}$	0.90***	0.15	1.10***	1.25	0.31***	0.10
$logPCGDP_{ijt}$	0.53***	0.14	1.14***	0.18	0.38**	0.20
$logRER_{ijt}$	1.31**	0.38	1.22***	0.32	1.29***	0.22
logDistance	-1.98***	0.17	-1.88**	0.47	-1.91***	0.41
Border	-0.66*	0.46	-0.57	2.38	-0.57	0.71
Constant	19.05***	1.35	9.91	5.11	18.63***	3.16
No of observation	77					
No. of Group	7					
R^2	0.91		0.71		0.86	
F-test	50.66***					
LM test					64.76***	
Hausman test			1.13			

*All variables are expressed in natural logarithms. *,**,*** statistical significance at 1%, 5% and 10% level respectively. F-test, LM-test and Hausman test shows chi-square value.*

Table. 5 Multicollinearity test

Variable	VIF	1/VIF
$logGDP_{ij}$	3.80	0.263167
$logPCGDP_{ij}$	2.93	0.341454
$logRER_{ij}$	1.52	0.657727
logDistance	1.52	0.657891
Border	1.07	0.936441
Mean VIF	2.17	

Table. 6 Country specific effect test for export model

$logExport_{ij}$	Coefficient	Standard Error
Partner		
Bhutan	62.55384	9.851129
India	-67.8587	10.6237
Maldives	68.72117	11.70237
Nepal	2.087513	.3751771
Pakistan	-32.16693	5.178003
Sri Lanka	1.9184	2.477368

Table . 7 Country specific effect test for import model

$logImport_{ij}$	Coefficient	Standard Error
partner		
Bhutan	13.29523	9.031916
India	-8.600669	9.740242
Maldives	10.99343	10.72921
Nepal	1.747969	0.3439776
Pakistan	-3.065239	4.747404
Sri Lanka	0.8832423	2.271352

Chart : 1. Share (in percentage) in intra-SAARC exports in 2016

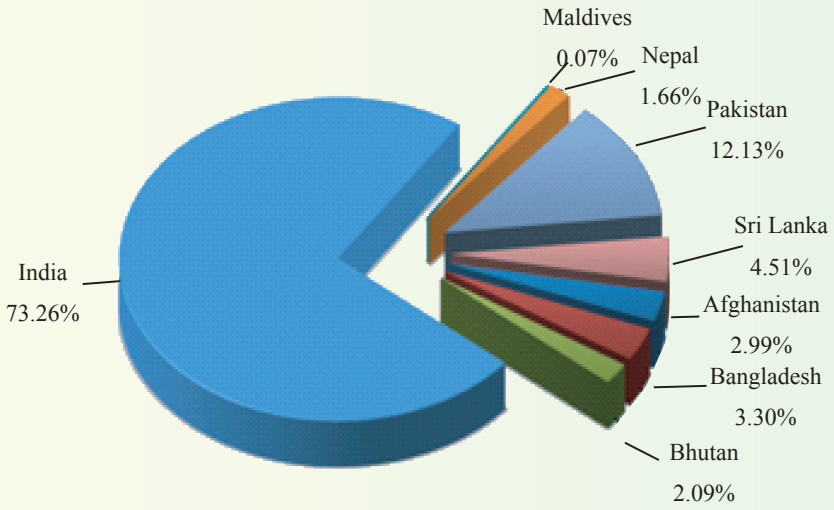

Chart : 2. Share (in percentage) in intra-SAARC Imports in 2016