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EXPORT POTENTIAL OF BANGLADESH IN BIMSTEC FREE TRADE AREA: EVIDENCE FROM GRAVITY MODEL

Abstract

Bangladesh has been striving hard to exploit SAFTA for boosting its trade and economic relations with the South Asian neighbours. But this free trade agreement is yet to bring sufficient dividends for Bangladesh. While the role of regional integration in the development process is undeniable, the slow progress of SAFTA in South Asia is a source of frustration for a developing nation like Bangladesh. Accordingly, in an effort to yield trade and economic gains, Bangladesh has become a member of BIMSTEC-FTA. This article uses augmented gravity equation to estimate Bangladesh's export potentials in BIMSTEC-FTA. It estimates an export equation for Bangladesh taking some relevant variables into account. Also, the model undergoes some diagnostic tests. On the basis of the tests the model is cleared of multicollinearity and heteroscedasticity problems. The results from the estimations show that Bangladesh has export potentials in BIMSTEC-FTA. Therefore, the country's economy might take advantages from boosting exports to developing economies of BIMSTEC, namely, India and Thailand.

1. Introduction

Regional integration, over the last few years, has occupied an important place in the development strategies and the policy debates. As an integral part of the overall integration process, regional trading agreements (RTAs) have also proliferated in the past few decades. Most of the countries of the world being members of such arrangements, it is obvious that an enormous amount of trade has taken place under RTAs. In fact, these agreements govern literally two-thirds of global trade.[1] Countries, in order to reap benefits from regional integration, are increasingly getting more inclined to be a part of such RTA. This trend leaves hardly any nation beyond such arrangements.

With its active engagement in South Asian Free Trade Area (SAFTA) – a multilateral intra-regional agreement in South Asia – Bangladesh is no exception in this regard. However, SAFTA has been subject to discussions, debates and criticisms

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[1] M. Schiff and L. A. Winters, *Regional Integration and Development*, World Bank and Oxford University Press: Washington DC, 2003, p. 1.

from academia and intelligensia in South Asia ever since its ratification in 2006. While a growing body of literature suggests that trade liberalisation under the framework of SAFTA would generate welfare and trade gains in South Asia, many still remain sceptical about the success of this RTA.[2] The fact is that progress of SAFTA has not gained much pace since its inception owing to some challenges – ranging from political to institutional - that encircled this trading bloc.

Hence, some South Asian countries have opted to follow the bilateral route in the form of India-Sri Lanka or Pakistan-Sri Lanka FTA deal. Formation of multilateral organisations such as the Bay of Bengal Initiative for Multi-sectoral Technical and Economic Cooperation (BIMSTEC) is also marked as an effort to boost trade and economic relations in the region and beyond. As a party to BIMSTEC, Bangladesh is also trying to make headway in negotiating trading arrangements regionally in order to intensify cooperation with the neighbouring nations.

Established in 1997, BIMSTEC is a multilateral sub-regional body, which is comprised of five South Asian nations, namely, Bangladesh, Bhutan, India, Nepal and Sri Lanka and two Southeast Asian nations, namely, Myanmar and Thailand. The sub-regional organisation, thus, literally connects South Asia with Southeast Asia - one of the most rapidly growing regions in the world. BIMSTEC has a combined GDP of US$ 2,454 billion, accounts for a trade volume worth US$ 1,154 billion and brings roughly 1.5 billion people under the same umbrella.[3] The organisation is aimed to foster cooperation in a number of areas and trade is one of those. To deepen the trade relations, BIMSTEC nations signed a free trade deal, known as BIMSTEC-FTA, in 2004. The agreement is expected to be implemented by the middle of 2023. Bangladesh as a party to BIMSTEC-FTA is likely to achieve trade gain, especially export. As such, studies on the impacts of BIMSTEC-FTA on Bangladesh trade are of great importance.

It needs to be noted that there is a relative dearth of literature on BIMSTEC-FTA. However, some studies resort to quantitative technique to measure the effect of this free trading area. Rahman and Rahman (2004)[4], in one of the early studies on BIMSTEC-FTA, reported untapped trade potentials amongst the BIMSTEC trading partners. The study calculated a gravity equation by using a set of pre-estimated parameters.[5] Banik

[2] See, for example, S. J. Bandara and W. Yu, "How Desirable is the South Asian Free Trade Area? – A Quantitative Economic Assessment", *SJFI-Working Paper No. 16,* 2001, available at http://www.foi.life.ku.dk/publikationer/~/media/migration%20folder/upload/foi/docs/publikationer/working%20papers/2001/16.pdf.ashx, accessed on 25 May 2014. Also see, U. Wickramasinghe, "Operationalizing SAFTA: Issues and Options", *South Asian Yearbook on Trade and Development***,** Center for Trade and Development, New Delhi, 2006, pp. 389-414; S. M. Hossain and I. Selim, "Regional Cooperation in South Asia: Future of SAFTA", *BIISS Journal*, Vol. 28, No. 2, 2007, pp. 163-183.

[3] T. K Premadasa, "BIMSTEC: Srilanka's next FTA?", 20 March 2014, available at www.ft.lk/2014/03/20/bimstec-sri-lankas-next-fta, accessed on 05 June 2014.

[4] AKM A. Rahman and S. Rahman, "Potentials of Trade Cooperation among the BIMST-EC Countries", *BIISS Journal*, Vol. 25, No. 2, 2004, pp. 140-158.

[5] These parameters were estimated by International Trade Commission's (ITC) market analysis section using export data from developing economies.

(2007)[6] estimated both export demand and export supply functions by using two stage least square (2SLS) and three stage least square (3SLS) methods. The study taking some geographical characteristics into account reveals that the prospect of intra-BIMSTEC trade is quite bright. Another study, by Kabir and Salim (2010)[7], applied augmented gravity model to analyse trade pattern among BIMSTEC members. The authors claimed that the member economies' exports would be positively affected by this sub-regional bloc. Also, Hossain (2012)[8] used computable general equilibrium (CGE) model to identify considerable welfare gains of BIMSTEC-FTA members. Some other notable studies have been conducted by Bhattacharaya (2007)[9], Chakraborty (2007)[10], Gilbert (2008)[11] and Strutt (2008)[12]. These studies generally depict positive gains from BIMSTEC-FTA.

This paper makes an attempt to examine the potential exports of Bangladesh in BIMSTEC-FTA. The paper, in deriving the trade potential, computes a typical gravity model by using ordinary least square (OLS) method of multi-variable regression analysis. The paper is divided into four sections. Section one is the introduction. Section two, gives a background of BIMSTEC-FTA. Section three estimates trade potentials of Bangladesh in the trading arrangement. In doing so, this section provides a theoretical background of gravity model and then covers the issues of estimation of gravity model. Finally, section four concludes.

2. BIMSTEC-FTA: A Brief Background

BIMSTEC has been regarded as the outcome of Thailand's "Look West" policy and India's "Look East" policy.[13] These policies were meant to extend extensive cooperation in some important areas between South Asia and Southeast Asia. BIMSTEC, therefore, as mentioned earlier, had bridged these two regions. The idea of forging economic ties between these two regions was first mooted by Thailand back in 1994. The Asian Development Bank (ADB) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) also came forward to assist

[6] N. Banik, "BIMSTEC-FTA and Its Relevance", *Discussion Paper No. 36*, Kolkata: Centre for Studies in International Relations and Development (CSIRD), 2007.
[7] M. Kabir and R. Salim, "Can Gravity Model Explain BIMSTEC's Trade?", *Journal of Economic Integration*, Vol. 25, No. 1, 2010, pp. 143-165.
[8] S. M. Hossain, "Impacts of BIMSTEC Free Trade Area: A CGA Analysis", *Journal of Economics and Sustainable Development*, Vol. 4, No. 13, 2013, pp. 16-27.
[9] S. K. Bhattacharya, "Does BIMSTEC-Japan Economic Cooperation Promote Intra-Regional Trade? The Case for Free Trade Arrangement", *Discussion Paper No. 23,* Kolkata: CSIRD, 2007.
[10] D. Chakraborty, "Trade Performance and Integration Experience of BIMSTEC: A Review of Issues", *Discussion Paper No. 30* Kolkata: CSIRD, 2007.
[11] J. Gilbert, "BIMSTEC-Japan Trade Cooperation and Poverty in Asia", *Discussion Paper No. 41,* Kolkata: CSIRD, 2008.
[12] A. Strutt, "Quantitatively Assessing a BIMSTEC-Japan FTA: A CGE Analysis", *Discussion Paper No. 40*, Kolkata: CSIRD, 2008.
[13] See, Official Website of BIMSTEC, available at www.bimstec.org, accessed on 25 May 2014.

the initiative of establishing this sub-regional platform.[14] On 6 June 1997, Bangladesh, India, Sri Lanka and Thailand formed BIST-EC after a meeting held in Bangkok. A few months later on 22 December 1997, Myanmar became a new party to this organisation; thereafter it was renamed as BIMSTEC and in 2003, two other countries of South Asia, Nepal and Bhutan, joined the organisation.

The main objective of BIMSTEC is to create a conducive environment for fostering cooperation among the members in order to work on issues of mutual interests. It would enable the BIMSTEC countries to reap benefits from various areas ranging from trade and investment to tourism and agriculture. As many as six areas, namely, trade and investment, transport, energy, technology, fishery and tourism, were earmarked for cooperation.

The idea of launching a free trade area within the BIMSTEC region was proposed in its first meeting of economic and commerce ministers held in Bangkok in August 1998. On 8 February 2004, BIMSTEC nations signed the framework agreement on FTA. Bangladesh signed the pact on 25 June 2004. The FTA agreement encompasses three areas, namely, trade in goods, trade in services and agreement on investment. Although agreement on goods is finalised, the member nations are yet to conclude the agreement on trade in services and investment.

The BIMSTEC members also agreed on a trade liberalisation schedule, which pointed out that full implementation of the FTA will be realised by 2017. The elimination of tariff will follow two tracks, namely, the fast track and the normal track. Products included in the fast track are roughly 10 percent of all products. The normal track products are divided into normal track elimination (NTE) and normal track reduction (NTR). The tariff will be completely eliminated in NTE, whereas tariff will be reduced to 1 percent to 5 percent in NTR.[15] The FTA agreement provides the least developed countries (LDCs) of BIMSTEC, which are Bangladesh, Bhutan, Myanmar and Nepal, with the much needed "breathing space"[16] for they have to reduce tariffs at a slower rate than that of the developing nations.

The initial date to commence the liberalisation procedure had been set on 1 July 2006; however, it was missed due to some divergence among the BIMSTEC members on some pertinent issues such as negative list and rules of origin.[17] The launching of FTA in the subsequent years did not receive much impetus owing to unfavourable political developments in Thailand, Nepal and Bangladesh. It was in

[14] R. Mehta, "Establishing of Free Trade Arrangement among BIMST-EC Countries: Some Issues", *RIS Discussion Papers No. 23*, Research and Information System for the Non-aligned and Other Developing Countries, New Delhi, 2002, p. 1.

[15] See, "Framework Agreement on BIMSTEC Free Trade Area", available at www.thaifta.com/Engfta/Portals/0/File/fa_bimstec.pdf, accessed on 26 April 2014.

[16] A. R. Khan, "Introduction", in A. R. Khan (ed.), *Towards BIMSTEC-Japan Comprehensive Economic Cooperation: Bangladesh Perspective*, BIISS, Dhaka and CSIRD, New Delhi: Bookwell, 2007, p. 4.

[17] D. Chakraborty, *op. cit*., p. 23.

the 19th Trade Negotiating Committee (TNC) meeting the members came up with a revised trade liberalisation schedule. Following this new schedule, complete tariff elimination will be achieved by 30 June 2023. The trade liberalisation programme for the non-LDCs and LDCs are presented in the following tables:

Table 1: Liberalisation Schedule for the Fast Track Products[18]

Countries	For Non-LDC Members	For LDC Members
India, Sri Lanka and Thailand (Non-LDCs)	1 July 2012 to 30 June 2015	1 July 2012 to 30 June 2013
Bangladesh, Bhutan, Myanmar and Nepal (LDCs)	1 July 2012 to 30 June 2017	1 July 2012 to 30 June 2015

Table 2: Liberalisation Schedule for the Normal Track Products[19]

Countries	For Non-LDC Members	For LDC Members
India, Sri Lanka and Thailand (Non-LDCs)	1 July 2013 to 30 June 2018	1 July 2013 to 30 June 2016
Bangladesh, Bhutan, Myanmar and Nepal (LDCs)	1 July 2013 to 30 June 2023	1 July 2013 to 30 June 2021

The tables (1 and 2) depict that for products included in the fast track, most favoured nation (MFN) tariff is supposed to be reduced or eliminated by 30 June 2017 by the non-LDC members of BIMSTEC, while for products listed in normal track, the stipulated deadline for tariff elimination is 30 June 2023. During the 19th TNC meeting, each member agreed on a negative list including products which are 23 percent of the tariff lines. As far as rules of origin is concerned, the bloc members decided that at least 30 percent local value addition for developing economies would be required, while for LDC members it would be 35 percent. The FTA agreement also includes, among other things, dispute settlement mechanism, safeguard measures, a provision of cooperation and mutual assistance in customs matter.

3. Trade Potential of Bangladesh in BIMSTEC-FTA: Evidence from Gravity Model

This section makes an attempt to find out the export potential that Bangladesh can tap within the framework of BIMSTEC-FTA. In the process of doing so, it employs 'gravity model'. Theories behind the model, before dealing with the issues of model specification and estimation, are presented first.

[18] See, Report of the Nineteenth Meeting of the BIMSTEC Trade Negotiating Committee (BIMSTEC TNC) held from 21-23 February 2011 in Bangkok, Thailand.
[19] *Ibid.*

3.1 *Gravity Model: Theoretical Foundation*

In recent years, gravity model or equation has been used as an instrument by economists in the policy making process of international trade. The model is regarded as a work horse in quantitative technique used for trade analysis.[20] Derived from Newton's law of gravitation, gravity model was introduced by James Stewart in social sciences in the 1940s.[21] The Dutch economist Jan Tinbergen (1962) first applied this model to international trade. The gravity equation, since then has become the focus of a vast body of literature on trade, migration and foreign direct investment (FDI).

Gravity model mainly calculates the potential trade flows between two trading partners on the basis of some relevant macroeconomic variables as suggested by Linnemann (1966). The two most important variables are GDPs of the respective nations and distance between these countries. The GDPs are in fact substitutes of demand and supply of importers and exporters respectively while the distance variable represents the transaction cost related to trade.[22] These two key variables explain a fair share of trade between the two countries. Trade flows are directly related to the GDPs of both nations and inversely related to the distance between the two. This relationship can be expressed by the following equation for two trading partners i and j:

$(Trade\ Flow)_{ij} = k*(GDP_i * GDP_j / Distance_{ij})$, where k is a constant of proportionality.

To augment this model, some other variables such as population size, real exchange rate and tariff rate are frequently incorporated. The model also includes binary or dummy variables such as free or regional trading agreement, common border, common language, colonial past, governance, etc. To sum up, in the classical gravity equation, trade flows between the two nations are determined by their GDPs, distance between the nations, populations of the two nations and a number of dummy variables enhancing or restricting trade flows.

The original gravity equation was stated in a multiplicative form, but many empirical researches adopted the additive log-linearised form of the gravity model to estimate the necessary parameters. The preference of the latter design to the former could be attributed to the fact that in the 1960s, estimation of the multiplicative form was time consuming. Even with the advent of modern computing system in the form of software, the log-linearised structure of the gravity equation remained popular with the economists.[23] The most common design of the gravity model is the following:

[20] "Prospects for Greater Global and Regional Integration in the Maghreb", Washington DC: Peterson Institute for International Economics (PIIE) , 2008, p. 2.
[21] S. R. Pradhan, "India's Export Potential to the Gulf Cooperation Council (GCC) Countries: A Gravity Model Analysis", *Post Workshop Reports*, Asia-Pacific Research and Training Network on Trade, 2006, pp. 1-33.
[22] *Ibid*., p. 20.
[23] B. Silverstovs and D. Schumacher, "Estimating Gravity Equations: To Log or Not to Log?", *Discussion Papers No. 739*, DIW Berlin, 2007.

$Log(Xij)=a+\beta log(Y^*iYj)+\gamma log(Dij)+ \epsilon ij$

Here, X_{ij}= Trade flows between country i and j;

Y_i and Y_j= GDPs of country i and j respectively;

D_{ij}= Distance between country i and j;

ϵij = Normal random error or disturbance term;

α = Volume of trade taken place between country i and j irrespective of the concerned variables.

It should be noted here that dummy variables explaining trade between the countries usually play a substantive role in explaining bilateral trade flows and hence are included in the standard gravity models.

Nevertheless, in its early stage, gravity model was characterised by its questionable theoretical basis.[24] Only the empirical studies helped researchers to stress on GDP size and distance as the main explanatory variables which led to bias in the results from a computed gravity equation. Efforts were made during the 1970s to provide a theoretical foundation to this frequently used model.

Anderson (1979) could be regarded as the pioneer of giving theoretical justification to the gravity model. He related gravity model to product differentiation by the origin nation.[25] Helpman and Krugman (1985) also provided a theoretical basis to the model by employing "a differentiated product framework with increasing returns to scale".[26] A connection between gravity models and monopolistic competition was established by Bergstrand (1989) and Helpman (1987).[27] Various economists also deduced this model from different theory. For instance, Ricardian framework was used by Eaton and Kortum (1997) in deriving gravity equation. Deardroff (1998), on the other hand, produced it from the so-called Heckser-Ohlin theory.[28]

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[24] See, I. Martinez-Zarzoso and F. Nowak-Lehmann, "Augmented Gravity Model: An Empirical Application to Mercosur-European Union Trade Flows", *Journal of Applied Economics,* Vol. 6, No. 2, 2003, p. 295. Also see, M. Rahman, W. B. Shadat and N. C. Das, "Trade Potential in SAFTA: An Application of Augmented Gravity Model", *Paper No. 61,* Dhaka: Centre for Policy Dialogue (CPD), p. 3.

[25] S. R. Pradhan, *op. cit.,* p. 21.

[26] I. Martinez-Zarzoso and F. Nowak-Lehmann, *op. cit.*

[27] *Ibid.*

[28] See for details, C. Carrillo and C. A. Li, "Trade Blocs and the Gravity Model: Evidence from Latin American Countries", *Discussion Paper,* University of Essex, 2002, p. 8, available at https://www.essex.ac.uk/economics/research/discussion-papers/papers-text/dp542.pdf, accessed on 26 May 2014.

Theoretical ground of distance variable in the gravity equation was given by Frankel (1997) and Krugman (1991). Krugman showed that geographical proximity could lead to the rise of regional trade flows because the more closer the trading partner is the lesser would be the cost of transportation.[29] In the same vein, Frankel postulated that geographical proximity and preferential trading agreements could explain higher trade flows.[30]

3.2 *Methodology and Data*

3.2.1 *Specification of the Gravity Models*

The study tries to calculate the potential export flows from Bangladesh, as indicated earlier, to the members of BIMSTEC-FTA. Here, efforts have been made to estimate an augmented gravity model for Bangladesh, which will be mentioned hereafter as the export model. The model is designed to calculate the potential export flows from Bangladesh in the economies belonging to BIMSTEC-FTA. The export equation has taken into consideration the GDPs and distance variable and a dummy variable (RTA). It also includes exchange rate, tariff rate and population variables. The article considers the real effective exchange rate (REER) and weighted average Most Favoured Nation (MFN) tariff rate for the trade. The export model is specified by the following equations:

$$log(Expij) = a + \beta log(GDPi*GDPj) + \gamma log(Distij) + \theta log(REER_i*REER_j) + \phi log(MFNTrf_i* MFNTrf_j) + + \delta \log(POP_i*POP_j) + \Psi RTAij + \epsilon ij \quad (1)$$

Here, Exp_{ij} = Potential exports from Bangladesh (denoted as i) to partner country j;

GDP_i = GDP of Bangladesh;

GDP_j = GDP of partner country j;

$Dist_{ij}$ = Distance between Bangladesh and partner country j;

$REER_i$ = Real Effective Exchange Rate of Bangladesh;

$REER_j$ = Real Effective Exchange Rate of partner country j;

$MFNTrf_i$ = MFN Tariff (weighted average) Rate of Bangladesh;

[29] *Ibid.*
[30] *Ibid.*

MFNTrfj= MFN Tariff (weighted average) Rate of partner country j;

POP_i= Population of Bangladesh (in millions);

$POP_{j=}$ Population of partner country j (in millions);

RTA_{ij}= Dummy for RTA between Bangladesh and country j (partner country);

RTA_{ij} = Taking the value of 1 if Bangladesh and its trade partner are members of BIMSTEC

= Taking the value 0, if otherwise;

ϵij = Stochastic disturbance term.

As mentioned earlier, GDPs of country i and j in the above equation is the proxy variable of income or economic size. On the other hand, distance between Bangladesh and its trade partner is the proxy variable of transportation cost involved with trade.

3.2.2 *Expected Sign of the Coefficients*

The coefficients of the explanatory variables, namely β, γ, θ, Φ, ψ and δ will respectively measure the *ceteris paribus* effects of product of GDPs, distance, product of exchange rate, product of MFN tariff rate, RTA and population on natural log of export. In other words, keeping the effects of other variables unchanged what would be the increase of product of Bangladesh and partner nation's GDPs on the former's exports and so on. The first coefficient β of all three models is expected to attain positive sign indicating that with the rise of GDP in Bangladesh and its trade partners, more exports from Bangladesh will take place. It is obvious that high level GDP or income can attract more import or can lead to the supply of more exportable production from Bangladesh. Conversely, distance, the second explanatory variable, is predicted to have a negative sign. Naturally, Bangladesh supposes to maintain higher trade with its neighbours due to lower transportation cost *vis-à-vis* those countries which are far away from the former. The coefficient of third explanatory variable (real effective exchange rate) θ, is expected to obtain positive sign. REER is an index of real exchange rate basically showing how domestic currency performs in relation to the rest of the world as a whole. As such, an increase in the REER index implies devaluation of local currency which would spur exports. The fourth explanatory variable, MFN tariff rate is supposed to have a negative effect on export, because, if Bangladesh and partner nations hike its MFN tariff rate, then exports from Bangladesh would be hampered. Increase of population in both Bangladesh and partner nations

would positively impact the exports from Bangladesh, thereby δ is expected to take positive sign. Likewise, the RTA variable is likely to have a positive impact on trade. If Bangladesh and its partners are belonging to a same trading bloc which in this case is BIMSTEC-FTA, then trade between the two nations supposes to increase.

3.2.3 *The Data*

Cross-sectional data for 2012 have been used to compute the gravity model. The study considers 117 trading partners of Bangladesh, hence, the sample size is 117. The relevant data on exports, distance, GDP, tariff rate and exchange rate of these 117 countries are collected from various sources. Country-specific annual exports (in million US$) of Bangladesh, for example, are obtained from the IMF's Yearly *Direction of Trade Statistics*. Bangladesh's exports with all the BIMSTEC members have been incorporated. World Development Indicators (WDI) of World Bank is the source of the GDP figures (in million US$). The same source has been explored for the exchange rate and MFN tariff rate, REER and population (in million) data. Distance data, measured by kilometre, were extracted from a website[31]. The paper takes into account the distance between capital of Bangladesh and that of its partner nations.

3.3 *Estimation of the Gravity Models*

The study had to drop both MFNTrf and RTA variables from the model as both of their impacts on Bangladeshi exports have been found statistically insignificant. Hence, the paper estimated the following export model:

$$log(Expij) = a + \beta log(GDPi*GDPj) + \gamma log(Distij) + \theta log(REER_i*REER_j) + \delta log(POP_i*POP_j) + \epsilon ij \quad (2)$$

The estimation of the slope coefficients or the parameters, β, γ, θ, *q,* δ and intercept term, is based on a classical estimation procedure, namely ordinary least square (OLS) method. At first, the export model is estimated and then the estimated model is checked for heteroscedasticity and multicollinearity. Lastly, Bangladesh's export potential with the BIMSTEC members are computed.

The summary results of the regression model are reported in Table 3. The results show that the variables in the models are statistically significant at 5 percent level and yield the expected signs. The values of coefficient of log(GDPi*GDPj) are estimated as 1.215116 implying *ceteris paribus* if, Bangladesh and its partner nations' GDPs are increased by 1 percent, then Bangladesh's potential export will also rise by 1.22 percent. The estimate of distance variable also has the desirable implications for

[31] "Distance Calculator – How Far Is It"?, available at www.timeanddate.com/worldclock/distance.html, accessed on 12 December 2013.

Bangladesh's exports. The negative value of this variable indicates that a 1 percent decrease in transportation cost will have an incremental effect on the export from Bangladesh. For BIMSTEC-FTA, these results are of importance as they reveal that if the income rises in the member nations and transportation cost falls there, then Bangladesh's bilateral trade will also increase. Similarly, it has been reported that real effective exchange rate would have desired effect on Bangladesh's exports. And, the positive coefficient values of population variable is in accordance with the expectation showing that rise in population in both Bangladesh and its trade partner would enhance potential of country's exports.

Table 3: Summary Results of the Gravity Models

Models	Explanatory Variables and R^2	Values of Coefficients
Export model with dependent variable log (Expij)	Constant	-19.10758 (10.12568) *
	log (GDPi*GDPj)	1.215116 (0.109965)*
	log (Distij)	-1.673857 (0.273529) *
	log($REER_i$*$REER_j$)	0.429103 (0.203373)*
	log(POP_i*POP_j)	1.169066 (0.531957)*
	R^2	0.763405
	Adjusted R^2	0.746198

Source: Author's Own Calculation. *Statistically significant at 5 percent level. Figures in the parentheses are the standard errors of the respective estimated parameters.

Next, the study looks into the issue of goodness of fit measured by R^2. Typically, R^2 measures the percentage of variation in the dependent variable explained by the independent or the explanatory variables.[32] In the current study, the R^2s obtained from the gravity equations of export is quite impressive as it possesses a value of 0.76. Hence, the explanatory variables included here have been accounted for roughly 76 percent variations in Bangladesh export model.

The study also performed a couple of tests to detect whether these models have violated the assumption of no multicollinearity and no homoscedasticity. Perfect linear relations between all or some explanatory variables result in multicollinearity in a regression model. With the presence of multicollinearity, accurate or precise estimation becomes a troublesome affair.[33] To check the presence of multicollinearity, the present study computes auxiliary regressions.[34] The auxiliary regressions have been run by regressing each explanatory variables on the remaining explanatory variable(s) belonging to the model. For example, a model is specified as follows:

$$Y = \alpha_0 + \beta_i X_1 + \beta_2 X_2 + \beta_3 X_{3+} U$$

[32] See for details, D. N. Gujarati, *Basic Econometrics,* Fourth Edition, New York: McGraw-Hill, 2003, p. 87.
[33] *Ibid.,* p. 350.
[34] *Ibid.,* p. 361.

The auxiliary regressions of this model are:

$$X_1 = \alpha_0 + \beta_2 X_2 + \beta_3 X_{3+} U;$$

$$X_2 = \alpha_0 + \beta_1 X_1 + \beta_3 X_{3+} U; \text{ and so on.}$$

Each auxiliary regression generates a R^2, notified as Ri^2, which is compared with the R^2 of the original gravity equations. A higher Ri^2 would indicate the presence of multicollinearity in the models. This very rule is known as Klien's rule of thumb. The result of this test is reported in Table 4 in showing Ri^2 of each auxiliary regression is smaller than original R^2 and hence, the gravity models in question do not suffer from the multicollinearity problem.

Table 4: Results of Klien's Rule of Thumb to Detect Multicollinearity

R^2 of Original Model	Dependent Variables	Ri^2 of Auxiliary Regression	Conclusion
0.763405	log (GDPi*GDPj)	0.56242	$R^2 > Ri^2$ No multicollinearity problem
	log (Distij)	0.138770	
	log($REER_i$*$REER_j$)	0.189409	
	log (Distij)	0.093444	

Source: Author's Own Calculation

Table 5: Result of Breusch-Pagan-Godfrey Test to Detect Heteroscedasticity

Model	F-Statistic	Probability	Conclusion
Export Model	2.580901	0.041173	No heteroscedasticity problem

Source: Author's Own Calculation

Finally, the results are checked for heteroscedasticity, which is a problem that arises when the variance of residuals of disturbance terms is not same across individual. The presence of heteroscedasticity results in misleading inference with biased and inconsistent OLS estimators and invalid t-and F-tests.[35] The present study employs the Breusch-Pagan-Godfrey (BPG) F-test to find out whether the models suffer from heteroscedasticity. To run this test, the squared residual needs to be regressed on the explanatory variable. For a model, $Y = \alpha_0 + \beta_1 X1 + \beta_2 X_2 + \beta_3 X_{3+} u$, u^2 is regressed on X_1, X_2 and X_3 to find the existence of heteroscedasticity. Then one needs to test the overall significance with an F-test. If the probability of F statistic is higher than the F-statistic itself, then, it can be inferred that the model does not suffer from heteroscedasticity problem. The BPG test results for this study are presented in Table 5. The results reveal in all three models probability of F statistic is greater than F statistic, which indicates that the gravity models do not have heteroscedasticity problem.

[35] *Ibid.,* p. 399.

3.4 *Trade Potential in BIMSTEC-FTA for Bangladesh*

The current sub-section of the paper computes potential export of Bangladesh to the BIMSTEC nations, from the gravity equations. By plaguing the values of the slope coefficients in the gravity models stated by equation 2, one can get Bangladesh's potential export flows to the BIMSTEC members. In other words, potential figures are simply the forecasted values of export from the gravity equations. However, the gravity model is estimated for 117 trading partners for most of which Bangladesh has tariff in place; hence, putting in GDP and distance for the BIMSTEC partners do not provide an estimate for potential exports once trade barriers are removed. Instead, what one gets is an estimate for potential exports once trade barriers are lowered to the same level as for the average of the rest of the world. Keeping this in mind, one can safely say that even if the actual exports exceed the computed potential trade, one might see an increase in an FTA, because by definition, trade barriers would eventually become zero in this arrangement.

Table 4 presents the potential and actual figures of trade, export and import and ratio of potential to actual trade of Bangladesh within BIMSTEC. This ratio is an important indicator for making an evaluation of a trade partner or a trade bloc. One can intuitively figure out that if a nation's ratio of potential to actual trade is greater than unity for a trading partner then there remains untapped trade potential for that nation with this partner country. Conversely, with a ratio less than unity, one can infer that the nation has already exceeded the potential trade level with the partner. But for the reason mentioned above, potential trade could turn out to be greater than the actual trade if the countries' trade is governed by FTA. For export and import, the ratio gives the similar interpretation. It is more viable for a nation to join an RTA that clubbed those nations with which its potential to actual ratio is greater than one.

Table 6: Bangladesh's Export Potential in BIMSTEC-FTA

BIMSTEC Partners	Actual Export (in million US$)	Potential Export (in million US$)	Potential: Actual
Bhutan	1.82	1.26	0.69
India	563	1808.04	3.21
Myanmar	13.67	12.30	0.90
Nepal	26.41	40.7	1.54
Sri Lanka	23.69	19.29	0.81
Thailand	51.43	280.03	5.44
Total	680.02	2161.62	3.17

Source: Author's Own Calculation

From Table 4, it is observed that Bangladesh's potential exports with the BIMSTEC members have gone beyond the actual volume. However, it has limited

export potentials in economies like Bhutan, Myanmar and Sri Lanka. That does not mean that Bangladesh has little scope to further the existing export to these BIMSTEC members. When the BIMSTEC-FTA would be fully implemented, Bangladesh's expected export to these economies could well exceed its actual level.

By contrast, export potentials to two of bigger economies, namely, India and Thailand, are quite substantial for Bangladesh. In fact, potential export volume is literally three times and five times higher than the actual exports to Indian and Thai economies respectively. The result reflects the fact that current Bangladeshi exports to these two markets have been by and large under-explored. Therefore, both India and Thailand, as the results suggest, would be the two prominent destinations of Bangladeshi exports. As a result, total BIMSTEC exports are likely to be hiked by nearly three folds.

4. Concluding Remarks

The present paper has applied augmented gravity equations to estimate Bangladesh's export potentials in BIMSTEC-FTA. The results from the gravity models have been found quite reasonable with the included variables being statistically significant. Also, a couple of diagnostic tests have been applied to detect whether the models suffer from multicolliniearity and heteroscedasticity. The tests confirm that the models do not violate the assumptions of no multicolliniearity and no heteroscedasticity. Finally, the export potential for Bangladesh in BIMSTEC has been found quite encouraging, with the overall flows of Bangladeshi exports are predicted to increase quite significantly to the BIMSTEC countries. The relatively affluent economies of BIMSTEC, namely, India and Thailand, are likely to be accounted for a larger chunk of Bangladesh's exports. Hence, the country might gain considerably from its exports to this bloc as big opportunities could be tapped by exporting more to economies like India and Thailand.