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EXAMINING TRADE POTENTIAL IN BIMSTEC: A TRADE FRONTIER APPROACH

Abstract

The body of theoretical and empirical literature suggests that economic regionalism is beneficial for trade flows. The fundamental analytical questions are whether the groups demonstrate significant impetus to expand intra-bloc trade and whether trade liberalisation within the regional arrangement results in non-trivial mutual gains. To address these queries, this paper investigates the trading pattern and potential of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). It adopts a stochastic trade frontier approach to an augmented panel gravity model. The results reveal that imports of the member countries follow the Linder hypothesis, while exports can be explained by Heckscher-Ohlin-Samuelson theorem. Controlling for behind and beyond the border constraints, the results of a stochastic frontier gravity model also support these findings. Such constraints are found to explain most of the total variation in imports and exports. The results also suggest that the highest trade potential, estimated by the frontier gravity model, turns out to be significant. Also, members of the group can substantially expand intra-BIMSTEC trade if the constraints are either removed or kept at the minimum.

1. Introduction

Regional integration among the South Asian countries is one of the weakest in the world. Any attempt of intra-regional economic cooperation through Preferential Trading Arrangements (PTAs) remains unsuccessful mainly due to political divide, lack of comparative advantage and deficiency of hard and soft infrastructure. As the first step of enhancing regional economic cooperation in 1985, South Asian Association for Regional Cooperation (SAARC) countries thought to conclude preferential trading arrangement among them. Due to inherent weakness of SAARC to emerge as a vibrant regional trading bloc, India had been looking for other options of forming regional bloc.[1] Having realised the importance of economic cooperation between South and Southeast Asia, Thailand took the initiative in 1994 to explore the possibility of formation of a sub-regional group. Then, BIMSTEC was established after a series of

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[1] One of the major long-standing drawbacks of SAARC is Indo-Pakistan political tensions. India has so far explored other options, such as Bhutan, Bangladesh, India and Nepal-Growth Quadrangle (BBIN-GQ) and Mekong-Ganga Cooperation (MGC) incorporating five ASEAN countries, *viz*. Cambodia, Lao PDR, Myanmar, Thailand and Vietnam.

deliberations of Inter-Ministerial consultations and with the active support of Asian Development Bank (ADB) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).[2]

With the unprecedentedly growing trend of economic regionalism, currently about 60 per cent of the world trade is being conducted through regional trading blocs. Up to 2015, more than 400 bilateral and regional trading agreements have been enlisted in the World Trade Organisation (WTO). The process of speedy regionalism is spurred mainly due to the slowdown of the WTO. Since BIMSTEC was established as the bridge between South and Southeast Asian countries, it is naturally expected to bring in non-trivial mutual gains. However, the body of theoretical and empirical literature suggests mixed results of economic regionalism in terms of trade flows, welfare and macroeconomic effects. Now, there are fundamental questions pertaining to the benefits of trade among BIMSTEC countries. First, what are the major drivers of bilateral trade flows of the bloc? Second, is there any significant potential of expanding intra-bloc trade, which can serve as an economic incentive behind it if the constraints can be effectively removed?

The present paper tries to address these two fundamental research questions by adopting a trade frontier approach. The contribution of the paper is threefold. *First*, it provides a formal trade frontier approach to analyse the trading pattern of BIMSTEC countries. *Second*, it works out the realised potential of bilateral trade of its member countries. *Third*, it indicates the unrealised trade which can be tapped by addressing behind and beyond the border constraints. Thus, the paper is organised as follows. After this brief prelude, Section 2 provides an account of BIMSTEC, socio-economic profile of the members and their trade performance. Section 3 summarises the literature on trade frontier approach. Section 4 describes the methodology and data of the study. Section 5 presents the findings while Section 6 concludes the paper.

2. Origin and Performance of BIMSTEC

2.1 *Aims and Purposes*

BIMSTEC was originally formed on 06 June 1997, with the name Bangladesh, India, Sri Lanka and Thailand Economic Cooperation (BIST-EC). Myanmar was an observer in the inaugural meeting and joined the bloc as a member on 22 December 1997, which led to change its name to BIMST-EC. Nepal was an observer since 1998 and in 2003 both Nepal and Bhutan were granted full membership. In the first Summit on 31 July 2004, leaders of the group renamed it as BIMSTEC. Thus, the formation of BIMSTEC can be attributed to mainly two reasons. *First*, is the failure

[2] S. K. Bhattacharya, "Does BIMSTEC-Japan Economic Cooperation Promote Intra-Regional Trade? The Case for Free Trade Arrangement", *Discussion Paper 23*, Kolkata: Centre for Studies in International Relations and Development, 2007.

of SAARC to form a vibrant regional forum for trade and economic cooperation. *Second*, ongoing process of liberalisation in economies in this region, which required discovering markets in the Association of South East Asian Nations (ASEAN) region as a substitute of SAARC. Also, Thailand has the desire to establish strong foothold on the Indian subcontinent because of increasing competition within the ASEAN market. Furthermore, the approach of South Asian countries to establish link and enhance economic cooperation shows their intension to strengthen economic relations with the ASEAN countries.[3]

The aims and purposes of the group, as per the Bangkok Declaration of forming BIST-EC, are to foster rapid economic development in the member countries, speed up social progress, promote active collaboration and mutual assistance in the areas of common interests, maintain cooperation with international and regional organisations and cooperation in projects that optimally utilise available economic, political and social strengths. BIMSTEC aims at combining the 'Look West' policy of Thailand and ASEAN, and 'Look East' policy of India and South Asia, thereby linking the ASEAN and the SAARC. It covers 13 priority sectors, namely (i) trade and investment, (ii) technology, (iii) energy, (iv) transport and communication, (v) tourism, (vi) fisheries, (vii) agriculture, (viii) cultural cooperation, (ix) environment and disaster management, (x) public health, (xi) people-to-people contact, (xii) poverty alleviation and (xiii) counter-terrorism and transnational crimes.[4]

The bloc is currently heading towards a Free Trade Area (FTA). The Framework Agreement for BIMSTEC-FTA was signed in the Sixth Ministerial Meeting in 2004. The Agreement provided for undertaking negotiations on trade in goods, trade in services and investment. A Trade Negotiating Committee (TNC) was formed with representatives from member countries to conclude the subsidiary agreements. The TNC was expected to settle down the Agreement on Trade in Goods by December 2005 in order to operationalise the Agreement from 01 July 2006. However, it could not complete the negotiations timely due to divergence in negative lists and Rules of Origin (ROOs). Later, the Agreement has been finalised in the 18th TNC Meeting in Thailand on 04 June 2009, in which the ROOs and Operational Certification Procedures for the ROOs have been agreed. The Agreement on Cooperation and Mutual Assistance in Customs Matters for the FTA has also been finalised in the Meeting.[5]

In case of First Track products, non-LDCs would open up their markets for the products of LDCs in one year and LDCs will do the same for non-LDCs in five years on the onset of the FTA regime. For Normal Track products, non-LDCs would

[3] S. Kelegama, "Bangkok Agreement and BIMSTEC: Crawling Regional Economic Groupings in Asia", *Journal of Asian Economics*, Vol. 12, No. 1, 2001, pp. 105-121.

[4] For further details, see http://www.bimstec.org.

[5] Previously, all the BIMSTEC members exchanged their negative lists but the lists were overly long. Now the countries are preparing new negative lists that contain 19 per cent of the traded items according to the tariff line.

open up their market for the products of LDCs in 3-years and the LDCs would follow 10-years schedule in order to open up their markets for the products of non-LDCs. LDC members would enjoy "special and differential treatment". The TNC conducts negotiations on trade in goods, trade in services and investment. There were about 19 meetings on BIMSTEC-FTA and the meetings have decided to keep their respective negative lists at 23 per cent of their tariff line of products.

2.2 *Country Profile and Trade Policies*

As of July 2015, Bangladesh, Bhutan, India, Myanmar and Sri Lanka are included in the list of lower middle-income countries, while Thailand is an upper middle-income country among the BIMSTEC countries. Nepal is the only low-income country in the bloc. India is the biggest economy in terms of its macroeconomic indicators while Bhutan is the smallest in the bloc. In between these two, only Thailand can be noticed as an influential country in the group. The combined Gross Domestic Product (GDP) of BIMSTEC member economies is nearly US$ 1.6 trillion with a population of around 1.44 billion as of 2007. Currently, the countries are at different levels of economic and industrial development (Table 1).

Table 1: Key Characteristics of BIMSTEC Member Countries

	Bangladesh	Bhutan	India	Myanmar	Nepal	Sri Lanka	Thailand
GDP (US$ billion, constant 2005)	97.26	1.49	1,458.73		11.37	41.05	230.37
GDP per capita (US$ const. 2005)	621	1,977	1,165		409	2,004	3,438
GDP growth (annual %)	6.01	2.04	5.02	5.65	3.78	7.25	1.77
Trade % of GDP	46	104	53		48	54	144
Export Diversification Index	0.827	0.783	483	0.824	0.70	0.753	0.386
Applied tariff rate*	14.45 (2008)	16.4 (2007)	9.3 (2009)	5.1 (2008)	12.4 (2012)	7.7 (2012)	8.9 (2009)
WTO Membership	1995	Accession	1995	1995	2004	1995	1995

*On manufactured goods

Source: World Bank, *World Development Indicators and World Trade Indicators,* www.worldbank.org; *UNCTAD Stat*, www.unctad.org.

The intra-BIMSTEC trade potential remains untapped due to tariff and non-tariff barriers, and to the absence of agreements on liberalisation of services and investment (Table 1). The economies are also incurring significant loss in terms of its volume and share in the economy due to the existing tariff structure. Kee *et al.*[6]

[6] H. L. Kee, A. Nicita and M. Olarreaga, "Import Demand Elasticities and Trade Distortions", *Review of Economics and Statistics*, Vol. 90, No. 4, 2008, pp. 666-682.

demonstrate that the linearly approximated dead weight loss (DWL) associated with the existing tariff structure ranges between 0.43 to 0.71 per cent of the total GDP of important member countries.[7] The proportion of estimated DWL is much lower in more liberalised East Asian countries, such as Japan (0.02 per cent), South Korea (0.09 per cent) and Indonesia (0.11 per cent).

Bangladesh underwent substantial changes in economic policies in the 1980s and 1990s, and experienced an increased degree of integration with the global economy.[8] Still, the country is characterised by one of the least liberal trade policy regimes in the world in terms of Trade Tariff Restrictiveness Index (TTRI), leading to low trade integration amongst BIMSTEC countries (Figure 1). The recent Most Favoured Nation (MFN) applied simple tariff average is much higher than the other members except for Bhutan.[9] The tariff overhang is very high, which demonstrates its reluctance to bind the trade policy regime at rates close to the MFN applied rates (Table 1). The non-tariff measures frequency ratio is higher than that of Bhutan and Thailand, but much lower than that of India. Recent measures against corruption and the introduction of automation in customs clearance is expected to improve trade facilitation and institutional environment measures in near future.

Despite being the smallest member of the group, Bhutan's per capita GDP and economic growth are impressively high. Its trade policy is all about the FTA with India since 1949 that covers nearly 90 per cent of its trade; an FTA with Bangladesh covers certain product lines to another 5 to 8 per cent.[10] The country's MFN applied simple tariff average is the highest in BIMSTEC. The stable political environment and governance situation help in facilitating its trade performance.

After nearly four decades of *de facto* autarchy, India moved towards a market-driven trade regime in the early 1990s, which encompassed a significant series of reforms in industrial policy, the removal of most of the licensing and other nontariff barriers, domestic deregulation of private industry, and simplification of the trade regime.[11] Its tariff protection has been substantially reduced in recent years. Large tariff reduction took place in 2004-05 and 2005-06 for most industrial products, which led to significantly lower and more uniform industrial tariff structure. The country's trade

[7] DWL is divided into three components associated with the contributions of import-weighted tariff, tariff variance and the covariance between tariffs and import demand elasticities. A positive contribution of the covariance indicates that countries impose higher tariffs on more elastic imports.

[8] R. Jenkins and K. Sen, "International Trade and Manufacturing Employment in the South: Four Country Case Studies", *Oxford Development Studies,* Vol. 34, No. 3, 2006, pp. 299-322.

[9] MFN is the principle of treating imports from a country on the same basis as that given to the most favoured other nation. It is fundamental to GATT. With some exceptions, every country gets the lowest tariff that any country gets, and reductions in tariffs to one country are provided also to others. MFN tariff is the tariff level that a member of the GATT/ WTO charges on a good to other members.

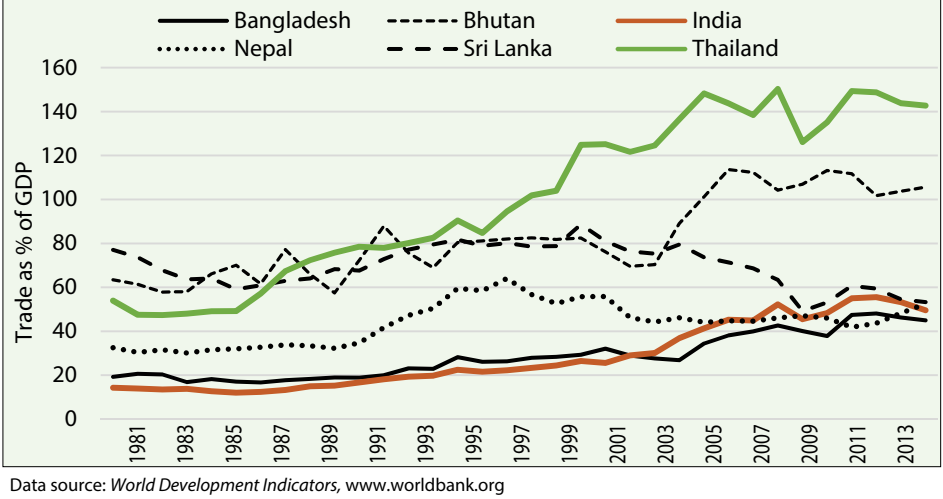
[10] H. Oura and P. Topalova, "Bhutan: Selected Issues and Statistical Appendix", *Country Report 07/349*, Washington, DC: International Monetary Fund, 2007.

[11] R. Hasan, D. Mitra and K. V. Ramaswamy, "Trade Reforms, Labor Regulations and Labor-Demand Elasticities: Empirical Evidence from India", *Review of Economics and Statistics*, Vol.89, No.3, 2007, pp. 466-481.

regime is still much restrictive with respect to the ranking in trade policy compared to other members of the group such as Bangladesh, Sri Lanka and Thailand. This might have resulted in the lowest share of merchandise trade in GDP over the years in BIMSTEC (Figure 1). General Agreement on Trade in Services (GATS) commitments index suggests that there is ample room for greater multilateral commitments to liberalisation of service sector. The country is a beneficiary of the Generalised System of Preferences (GSP) with a number of advanced economies. However, political tensions with Pakistan limit the bilateral trade between two countries, and adversely affect regional integration in South Asia.

Myanmar possesses a relatively less restrictive trade regime.[12] Its MFN applied simple and trade-weighted average tariffs are the lowest among the members. The country took an 'open-door policy' in the late 1980s that considerably increased its trade with the neighbours later on.[13] Its currency has appreciated in the recent years, but the government maintains restrictions on exchange rate and practices multiple currency.

Figure 1: Trade Integration of BIMSTEC Countries



Data source: *World Development Indicators,* www.worldbank.org

Nepal also undertook a series of market-oriented reforms in the 1980s and 1990s.[14] However, the country has one of the most protectionist trade policy regimes in the world, which has perhaps led to a low share of trade in the economy (Figure 1). Its MFN applied simple tariff average is around the BIMSTEC average. The overall GATS commitment index is the highest among BIMSTEC members. The country's MFN

[12] ADB, *Economic Update: Myanmar*, Manila: ADB, 2001.
[13] T. Kudo and F. Meino, "Trade, Foreign Investment and Myanmar's Economic Development during the Transition to an Open Economy", *Discussion Paper 116*, Chiba: Institute of Developing Economies, 2007.
[14] K. Sharma, "The Political Economy of Civil War in Nepal", *World Development*, Vol. 34, No. 7, 2006, pp. 1237-1253.

duty-free exports remain lower than BIMSTEC countries except Bangladesh. A PTA with India signed in 2002, granted Nepal a preferential access to the highly restricted Indian market, although the arrangement still depends on stringent ROOs, tariff rate quotas, and safeguard clauses.[15]

Started in the early 1980s, economic reforms in Sri Lanka picked up in 1990s, which encompassed, *inter alia*, structural adjustments, liberalising trade and payments, lowering control on prices and interest rates, and reforming the financial sector.[16] The country's trade regime is considerably more liberal than average BIMSTEC country. Its MFN tariff simple and trade-weighted applied tariff averages are noticeably lower than the group's average. Its exporters face lower trade barriers to foreign markets than the bloc average. The country's trade performance is affected by its inadequate port and infrastructure, poor delivery of basic services and cumbersome customs procedures.

The general trait of Thailand's trade policy regime has been liberal and outward oriented.[17] The country undertook strong unilateral liberalisation in the 1980s and 1990s, especially in the manufacturing sector.[18] Initiatives are taken in recent years to foster trade and market access, although the recent tariff structure remains relatively complex, involving a multiplicity of rates.[19] However, the country's MFN simple and trade weighted average tariffs are notably lower than BIMSTEC averages. The country faces higher tariff barriers on its exports. It's MFN zero duty export is the highest among the members and nearly double of the group's average. It is a member of the ASEAN, the ASEAN Free Trade Area (AFTA), the Asia Pacific Economic Cooperation (APEC) and the East Asian Economic Caucus (EAEC). It is a GSP beneficiary with a number of advanced economies and is a signatory to FTAs with Australia, New Zealand, Japan and China. Trade integration of the country is the highest in BIMSTEC, which is due to a higher degree of liberalisation of its external sector.

2.3 *Trend of Intra-BIMSTEC Trade*

Intra-BIMSTEC trade is hovering at nearly six per cent while major intra-bloc importers are India, Thailand and Bangladesh and exporters are India, Thailand and Myanmar, respectively. The main import sources and export destinations of most of the BIMSTEC countries remain outside the bloc, although the recent trend in trade

[15] S. Karla, S. Singh, A. Aisen, N. Wandwasi and C. Beddies, *Nepal: Selected Issues and Statistical Appendix*. Washington, DC: International Monetary Fund, 2006.
[16] N. Duma, *Sri Lanka's Sources of Growth*, Working Paper 07/225, Washington, DC: International Monetary Fund, 2007.
[17] X. Diao, J. Rattso and H. E. Stokke, "International Spillovers, Productivity Growth and Openness in Thailand: An Intertemporal General Equilibrium Analysis", *Journal of Development Economics*, No. 76, No. 2, 2005, pp. 429-450.
[18] R. Sally, "Thai Trade Policy: From Non-Discriminatory Liberalisation to FTAs", *World Economy*, Vol. 30, No. 10, 2007, pp. 1594-1620.
[19] WTO, *Trade Policy Review: Report by the Secretariat - Thailand*, Geneva: WTO, 2008.

growth is higher within the group than that with the world. Bangladesh, India and Nepal initiated comprehensive trade reforms in the 1990s that included a substantial decline in tariff and removal of quantitative restrictions. However, the markets of most of the members are normally restrictive.

The share of intra-BIMSTEC trade remains meagre in the world trade. In 1997, the intra-bloc import was 2.81 per cent of the world import, which increased to about six per cent in 2013. The figures for export were 2.80 and 5.27 per cent, respectively. However, there is an implicit positive trait in the trading pattern, which is missing in the literature.[20] After the formation of BIMSTEC, there has been a proportionate increase in the intra-group trade compared to trade with the world. This can be expressed in terms of increase in individual member's trade with BIMSTEC compared to their trade with the world during 1997-2013.

Table 2: Official Trade in BIMSTEC (Million US$), 2013

	Export	Import	Trade
Bangladesh	554.75	6,980.34	7,535.09
Bhutan*	371.06	766.86	1,137.92
India	19,032.48	8,401.50	27,433.98
Myanmar***	4,218.63	646.75	4,865.38
Nepal	600.27	118.21	718.48
Sri Lanka	687.99	3,587.86	4,275.85
Thailand	10,320.48	7,636.85	17,957.32
Total	35,785.66	28,138.36	63,924.02

** Data of 2011, and *** Data of 2010
Source: COMTRADE database.

The increase in the intra-BIMSTEC trade compared to its trade with the world does not necessarily indicate that the countries are utilising their existing capacity of trade. The literature suggest that there are 'behind' and 'beyond' the border constraints on trade due to institutional, infrastructural and policy rigidities that restrain countries from trading optimally.[21] These constraints are more likely to prevail in BIMSTEC countries, which are developing and least developed, and suffer from a variety of economic, social, political and institutional difficulties. Therefore, understanding the magnitude of trade potential would help the policymakers in removing these barriers.

[20] A. Strutt, "Quantitatively Assessing a BIMSTEC-Japan FTA: A CGE Analysis", *Discussion Paper 40,* Kolkata: Centre for Studies in International Relations and Development, 2008.
[21] K. Kalirajan and K. Singh, "A Comparative Analysis of China's and India's Recent Export Performances", *Asian Economic Papers*, Vol. 7, No. 1, 2008, pp. 1-28.

3. Conceptualising Trade Frontier: A Review of Literature

Examining trade potential of a regional bloc can be carried out by either an equilibrium or a disequilibrium approach. In the equilibrium models, a home country's imports from and exports to all its partners can be exhaustive and represent a general equilibrium framework, and would be estimated to arrive at total trade values. In the disequilibrium framework, a home country's actual trade is assumed to differ from potential exports with respect to each trading partner. Following this framework, some further studies have been conducted recently that examine the trade performance by estimating trade potential in the context of either regional bloc or bilateral cases.[22]

The usual assumption in the standard gravity model is that the trading environment in the home country does not impose any restrictions on its imports and exports. Despite admitting that the home country possesses behind the border constraints and it faces beyond the border constraints from the partners, these constraints are assumed to be insignificant and are randomly distributed across observations in standard models. However, such an assumption would be strong and may not reflect the real world circumstances.

The traditional gravity model normally ignores the effect of multilateral trade resistance on trade flows. However, some empirical models use multilateral trade resistance indices based on cross-section data, which is not suitable in panel data that encompass importer, exporter and time dimensions. Country dummies are also incapable of capturing such indices that varies over time.[23] Therefore, Carrère[24] replace multilateral trade resistance indices by remoteness indices for importers and exporters, and estimates multilateral trade resistance ($R_{i(j),t}$), measured by indices of remoteness for countries *i* and *j* as

$$R_i = \left[\sum_{k=1,k\neq i}^{N} Y_k (D_{ik})^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \text{ and}$$

$$R_j = \left[\sum_{k=1,k\neq j}^{N} Y_k (D_{jk})^{1-\sigma}\right]^{\frac{1}{1-\sigma}},$$

[22] K. Kalirajan, "Regional Cooperation and Bilateral Trade Flows: An Empirical Measurement of Resistance", *International Trade Journal*, Vol. 21, No. 2, 2007, pp. 85-107; S. Armstrong, P. Drysdale and K. Kalirajan, "Asian Trade Structures and Trade Potential: An Initial Analysis of South and East Asian Trade", *EABER Working Paper 32*, Canberra: Australian National University, 2008.

[23] J. Brun, C. Carrère, P. Guillaumont and J. Melo, "Has Distance Died? Evidence from a Panel Gravity Model", *World Bank Economic Review*, Vol. 19, No. 1, 2005, pp. 99-120.

[24] C. Carrère, "Revisiting the Effects of Regional Trade Agreements on Trade Flows with Proper Specification of the Gravity Model", *European Economic Review*, Vol. 50, No. 2, 2006, pp. 223-247.

respectively, where *Y* means GDP, *D* indicates distance. σ is the elasticity of substitution in consumption in goods, which is known to be the Dixit-Stiglitz preference. This definition is an improvement over the definition of remoteness index as the weighted distance to all trading partners of country *i* and *j* as

$\sum_j w_{j,t} D_{ij}$ for $i \neq j$, and $w_{j,t} = Y_{j,t} \Big/ \sum_j Y_{j,t}$, and

$\sum_i w_{i,t} D_{ij}$ for $j \neq i$, and $w_{i,t} = Y_{i,t} \Big/ \sum_i Y_{i,t}$

respectively. Both of the studies find positive and significant impact of resistance on the import flows. Nevertheless, the index of remoteness cannot capture the effects of multiplicity of unobservable restraining factors like implicit rigidities in institutional and bilateral trade policies. Furthermore, Anderson and van Wincoop[25] demonstrate that the functional form of the remoteness variable does not comply with the theory and thus can lead to biased estimates.

The empirical gravity models often ignores the economic distance between the trading partners *i* and *j* relative to a trade weighted average of the economic distance between a partner *i* and all points in the linear expenditure system explained in Anderson.[26] It is represented by

$$\left[\sum_j \frac{\varphi_j Y_j}{\sum_j \varphi_j Y_j} \cdot \frac{1}{f(d_j)}\right]^{-1}$$

Kalirajan[27] argues that ignoring this term in the empirical gravity model results in incorrect estimates. In the traditional gravity models, the economic distance between countries *i* and *j* are often replaced by geographical distance. This can lead to biased estimates since economic distance includes geographical distance as well as other country-specific factors such as historical and cultural ties. Differences of some other country-specific factors such as state of governance, functioning of the institutions, political stability, etc. are also typically left out in the standard models mainly due to the unavailability of data, which may result in correlation between the residual term and some of the regressors.[28]

[25] J. E. Anderson and E. van Wincoop, "Gravity with Gravitas: A Solution to the Border Puzzle", *American Economic Review*, Vol. 93, No. 2, 2003, pp. 170-192.

[26] J. E. Anderson, "A Theoretical Foundation for the Gravity Equation", *American Economic Review*, Vol. 69, No. 1, 1979, pp. 106-116.

[27] Kalirajan, 2007, *op. cit.*

[28] K. Kalirajan, "Gravity Model Specification and Estimation: Revisited", *Applied Economics Letters*, Vol. 15, No. 13, 2008, pp. 1037-1039.

Some of the above-mentioned factors, such as the state of governance, can be broadly measured by the ratio scale or be indexed based on perception of the key respondents. However, the overwhelming socio-political and institutional factors are still beyond comprehensive quantification, which gives rise to imprecise specification of the empirical gravity model. The stochastic frontier gravity model can handle this quandary by virtue of its single-sided error term that exemplifies the combined effects of the intrinsic economic distance bias.

The omission of economic distance term in standard gravity model also leads to incorrect estimates and to heteroscedastic error terms. The log-linear standard gravity model in the presence of heteroscedasticity leads to inconsistent estimates as the expected value of the log of a random variable depends on higher-order moments of its distribution.[29] Moreover, it affects the normality assumption of the error term.

According to Baldwin and Taglioni,[30] Kalirajan and Singh[31] and Salim *et al*.[32] trade flows can be affected by three factors. *First*, natural constraints, such as geographical distance or transport cost. *Second*, behind the border constraints, which stem from socio-economic, institutional and political factors, and infrastructure rigidities prevailing in exporting countries. *Third*, beyond the border constraints, which include institutional and infrastructure rigidities in importing countries. These can be removed through various trade facilitating measures.

Wilson *et al*.[33] try to assess the impact of trade facilitation efforts on the flow of manufacturing exports of the APEC member countries for the period 1989-2000. They use four trade facilitation indicators: port efficiency, customs environment, regulatory environment and *e*-business usage. The study reveals that if the APEC members with below-average indicators improve capacity half way to the bloc's average, the intra-APEC trade would increase by one-fifth of the trade among these countries. The improved port efficiency explains nearly half of such increase. The indicators are, however, based on qualitative responses in a rating scale, which is likely to be biased due to the subjective judgment of respondents. Trade facilitation variables are indeed difficult to quantify.

Kalirajan and Singh[34] argue that beyond the border constraints include 'explicit' constraints such as tariffs and exchange rate, which can be measured by variables such as average tariffs and real exchange rate. Implicit beyond the border

[29] S. J. M. C. Silva and S. Tenreyro, "Gravity-Defying Trade", *Working Papers 03-1*, Boston: Federal Reserve Bank of Boston, 2003.
[30] R. E. Baldwin and D. Taglioni, Gravity for Dummies and Dummies for Gravity Equations, *Working Paper 12516*, Massachusetts: National Bureau of Economic Research, 2006.
[31] Kalirajan and Singh, 2008, *op. cit.*
[32] R. Salim, M. Kabir and N. Mawali, "Does More Trade Potential Remain in Arab States of the Gulf?" *Journal of Economic Integration*, Vol. 26, No. 2, 2011, pp. 217-243.
[33] J. S. Wilson, C. L. Mann and T. Otsuki, "Trade Facilitation and Economic Development: A New Approach to Quantifying the Impact", *World Bank Economic Review*, Vol. 17, No. 3, 2003, pp. 367-389.
[34] Kalirajan and Singh, 2008, *op. cit.*

constraints originate from institutional and policy rigidities of importing countries. Bilateral, regional and multilateral trade agreements aim to eliminate both 'behind' and 'beyond' the border constraints. These are difficult to measure by standard variables of the gravity model. The alternative gravity estimation considers these factors as given (*e.g.*, Kalirajan[35]). The combined effects of behind the border constraints on exports and beyond the border constraints to imports can be measured by decomposing error term of the standard gravity model into two. One incorporates the above-mentioned constraints, and the other includes residual factors.

In the stochastic frontier analysis of bilateral trade flows, higher variation in trade performance explained by behind and beyond the border constraints indicates greater distance from the trade frontier, given the core determinants of trade. The trade frontier shifts outwards due to an improvement in trade technology. Trade potential can be measured in the context of achieving it at a 'frontier', which estimates a level of trade that might be attained in the case of the most open and frictionless trade possible given current trade, transport and institutional efficiencies or practices.[36] This approach is appropriate to assess the impact of reforms in trade policy, infrastructure and institutions on trade performance particularly of developing and least developed countries who suffer the most from institutional rigidities, social and political constraints. Thus, it is applicable to examine the efficacy of regional trade integration, such as BIMSTEC.

However, gravity models of trade potential have some limitations. More specifically, these models cannot specifically disentangle the inefficiency factors into different components of behind and beyond the border constraints like bureaucratic rigidness, infrastructural and energy deficiency, and non-tariff barriers. In addition, the welfare effects from trade potential cannot be properly established using this model.

4. Empirical Specification and Data

The stochastic frontier gravity model captures trade resistances beyond and behind the border by bifurcating the error term of an augmented gravity model. The inclusion of a non-negative unobservable term in this model helps capture unobservable and manmade resistances to trade and barriers to regional economic integration. Kalirajan[37] suggests that the stochastic frontier approach can be adopted in circumstances when the information on all restrictive policy induced constraints in home and in partner countries is fully available.

[35] As Armstrong (2007) observes, some of the objective resistances, such as distance and official barriers to trade, can be controlled for in gravity models but the majority are difficult to quantify, leading them to lump into the idiosyncratic disturbance term. Standard gravity models, however, do not control for subjective resistances, for example asymmetric and imperfect information and internal constraints, at all.

[36] Armstrong *et al.*, 2008, *op. cit.*

[37] Kalirajan, 2007, *op.cit.*

Stochastic production frontier models are regarded to be the momentous contribution to econometric modelling of production function and estimating of technical efficiency of the production units involved in producing a particular output.[38] Examining the determinants of bilateral trade and calculating trade potential are also possible in this approach, as the trading process is subject to inefficiency due to various structural restraints such as political, social, infrastructural and institutional characteristics identified above along with exogenous shocks like business cycles.

To understand the nature of the stochastic frontier problem of bilateral trade, suppose that the trade function is $f(x_{ij,t}, \beta)$, where $x_{ij,t}$ is the vector of economic, geographic, social and institutional factors that influence traders *i* and *j* at time *t*, and β is the vector of unknown parameters. In the absence of any error or inefficiency, countries *ij* would trade

$$y_{ij,t} = f\left(x_{ij,t}, \beta\right) \tag{1}$$

where $y_{ij,t}$ is the scalar of observed bilateral trade between countries *i* and *j* at time *t*. A fundamental building block of the stochastic frontier gravity model is that each country potentially trades lower due to a degree of inefficiency arising from behind and beyond the border constraints, such that

$$y_{ij,t} = f\left[(x_{ij,t}, \beta).\tau_{ij,t}\right] \tag{2}$$

where $\tau_{ij,t}$ is the level of trade efficiency of the traders and $0 \leq \tau_{ij,t} \leq 1$. $\tau_{ij,t} = 1$ implies that the trade is optimal with the technology embodied in $f(x_{ij,t}, \beta)$, while $\tau_{ij,t} < 1$ indicates that the trade is non-optimal due to inefficiency. In the case of $\tau_{ij,t} = 0$, the trade is completely inefficient.

Assuming that trade is subject to random shocks, the stochastic frontier gravity model in a general form can be written as

$$y_{ij,t} = f\left[(x_{ij,t}, \beta).\tau_{ij,t}.\exp(v_{ij,t})\right] \tag{3}$$

where the stochastic error term, $v_{ij,t}$, represents the random exogenous shocks to the trading processes. Although trade is subject to different kind of shocks, the term is assumed to follow a common distributional pattern. Thus, $v_{ij,t}$ is a two-sided normally distributed variable. Assuming $\tau_{ij,t}$ to be an exponential as $exp(-u_{ij,t})$, where $u_{ij,t}$ is a stochastic variable that follows a non-negative distribution, Equation (3) can be written in the following log-linear Cobb-Douglas form

[38] G. E. Battese and T. J. Coelli, "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data", *Empirical Economics*, Vol. 20, No. 2, 1995, pp. 325-332.

$$\ln y_{ij,t} = \beta_0 + \sum_{k=1}^{m} \beta_k \ln x_{ij,t} + v_{ij,t} - u_{ij,t} \quad (4)$$

where the technical efficiency term $u_{ij,t}$ is time-varying.

Equation (4) provides estimates for two different specifications of the non-negative error $u_{ij,t}$: time invariant (TI) and time varying. In the simplest specification, $u_{ij,t}$ is a time-invariant truncated normal random variable, and $u_{ij,t}$ and $v_{ij,t}$ are distributed independently. In the time-varying decay (TVD) specification,

$$u_{ij,t} = \left[\exp\left\{-\eta\left(t - T\right)\right\}\right]u_{ij}$$

where T is the last period in the panel, η is the decay parameter and $u_{ij,t}$ and $v_{ij,t}$ are distributed independently of each other. A non-zero η indicates that behind the border constraints on trade have been varying over time, either increasing or decreasing. More specifically, this assumption implies that if the estimate of η is positive, then behind the border constraints decline exponentially to its minimum value, u_{ij}, at the last period.[39]

The stochastic frontier gravity model provide estimates of the trade potential that can be obtained if the bilateral trade operates at the frontier or maximum level when the trade resistances are at minimum or absent. Thus, the bilateral trade potential can be envisioned as the maximum possible trade which can take place if there is no resistance between them given the determinants. As most of the trade resistances cannot be quantified and thus remain unobserved, these together constitute the non-negative disturbance term.[40]

Following the functional form of the trade frontier discussed above, the stochastic frontier gravity equation for BIMSTEC can take the general form of

$$TRA_{ij,t} = X\beta_k + v_{ij,t} - u_{ij,t} \quad (5)$$

where $TRA_{ij,t}$ indicates value of flow of commodities between country *i* and *j* in period *t*, *X* imply the regressors that include the variables, which possess time-invariant and time-varying bilateral, importers and exporters characteristics, β_k denotes the *k* number of unknown parameters, $v_{ij,t}$ is the idiosyncratic error term that represents random shocks to bilateral trade flow, and $u_{ij,t}$ measures the performance of a country relative to best practice. In other words, the later represents the degree to which the actual trade falls short of the potential, due for example to unmeasured socio-

[39] Kalirajan and Singh, 2008, *op. cit.*

[40] K. Kalirajan, "Stochastic Varying Coefficients Gravity Model: An Application in Trade Analysis", *Journal of Applied Statistics*, Vol. 26, No. 2, 1999, pp. 185-193.

economic and political infrastructure.

Kalirajan[41] estimates the basic gravity equation where the explanatory variables are GDP, population and geographical distance. However, Kalirajan[42] notes that there are other important factors than GDP and geographical distance that explains trade potentials, and to include such factors offers a more reliable and acceptable estimates.

Following theoretical underpinnings of the stochastic frontier model and its applications to gravity model, the augmented gravity model can be specified below.

$$\ln TRA_{ij,t} = \alpha_0 + \alpha_1 \ln TGDP_{ij,t} + \alpha_2 RFE_{ij,t} + \alpha_3 SIM_{ij,t} + \alpha_4 \ln DIST_{ij} + \alpha_5 \ln RER_{ij,t} + \alpha_6 GOV_{i,t} + \alpha_7 GOV_{j,t} + \beta_1 BTA_{ij,t} + \beta_2 BOR_{ij} + \beta_3 CL_{ij} + \beta_4 BIM_{ij,t} + v_{ij,t} - u_{ij,t} \quad (6)$$

where

$$TGDP_{ij,t} = GDP_{i,t} + GDP_{j,t}$$

$$RFE_{ij,t} = \left| \ln GDP_{i,t} - \ln GDP_{j,t} \right|$$

$$SIM_{ij,t} = 1 - \left(\frac{\ln(GDP_i)}{\ln(GDP_i + GDP_j)} \right)^2 - \left(\frac{\ln(GDP_j)}{\ln(GDP_i + GDP_j)} \right)^2$$

Adding up of GDP of *i* and *j* provides Total GDP (TGDP) that measures the overall economic space of the two countries, where the larger the TGDP the higher the volume of trade between the two countries for given relative size and factor endowments. *RFE* indicates the relative factor endowment and *SIM* is the similarity index. $DIST_{ij}$ indicates the distance between *i* and *j*, *GOV* indicates a governance indicator, *RER* indicates real exchange rate, *BTA* means bilateral trade agreement between the importers and exporters, *BOR* implies shared border, CL is the common language between the two countries and BIM means the membership of BIMSTEC.

Data on trade volumes come from International Monetary Fund's (IMF) Direction of Trade Statistics (DOTS). Data on GDP, official exchange rate and GDP deflator data come from World Bank's World Development Indicators. Data on geographical distance, common border and common language between two trading countries come from French Research Centre in International Economics (CEPII). The governance data is taken from World Bank's World Governance Indicators, and

[41] *Ibid.*

[42] Kalirajan, 2008, *op. cit.*

finally, BTA data come from World Trade Organization (WTO). To determine the sample counties, a quantitative restriction is set so that important trading partners of BIMSTEC countries can be identified. At the first stage, the sample countries are drawn from all the trading partners of the BIMSTEC countries by assuming that they should have 0.2 per cent of its total world imports and with the individual importing country.

5. Findings and Analysis

5.1 *Determinants of Intra-BIMSTEC Trade*

Maximum likelihood estimator (MLE) has been applied on the panel data to estimate Equation (6) and examine the importance of the factors identified above that are constraining trade reaching from their potential. The advantage of MLE is that it is not suffered from a loss of estimation efficiency. It estimates the influence of the economic distance term that leads to heteroscedasticity and non-normality, isolating it from the idiosyncratic error term. The estimation also provides potential estimates of intra-BIMSTEC imports and exports that are closer to frictionless trade estimates, which is determined by the upper limit of the data sets. The potential trade can be defined as the maximum level of trade given the existing level of determinants of trade and the minimum level of restrictions within the system.[43] This approach of estimation bears important implications for trade policy reforms to improve the performance of the socio-political and institutional factors.[44]

The Maximum Likelihood estimates of Equation (6) have been presented in Table 3 for both the TI and the TVD models. The results help choose between two models based on the sign and significance of the coefficients from diagnostic tests. On the imports side, *TGDP* turns out to be positive as expected. The negative sign of *RFE* and *SIM* indicates the presence of *Linder* effect in imports of BIMSTEC counties at the aggregate level, rejecting the Heckscher-Ohlin-Samuelson theorem as well as the New Trade Theory. The coefficient of *SIM* is not significant either.

The sign of *DIST* is negative and significant for both the model, although *RER* takes the desirable sign but not significant in the TVD model. The variables *BOR, CL, BTA* and GOV_j all take the expected sign. GOV_i takes negative sign as opposite to the expectation but as it is not significant, the influence of governance in importing countries can be ignored.

[43] Potential trade does not indicate the free trade.
[44] Kalirajan, 2007, *op. cit.*

Table 3: Maximum Likelihood Estimates of Gravity Equation

	IMPORTS		EXPORTS	
	TI	TVD	TI	TVD
$lnTGDP_{ij}$	0.796*** (0.106)	0.816*** (0.108)	0.371** (0.154)	0.453*** (0.148)
RFE_{ij}	-0.433* (0.262)	-0.425* (0.258)	0.737** (0.327)	0.730** (0.312)
SIM_{ij}	-0.359 (2.084)	-0.743 (2.141)	2.783 (2.452)	1.995 (2.394)
$lnDIST_{ij}$	-0.675*** (0.217)	-0.735*** (0.233)	-0.590 (0.369)	-0.773** (0.364)
$lnRER_{ij}$	-0.032* (0.019)	-0.029 (0.019)	0.040** (0.019)	0.039** (0.019)
BOR_{ij}	0.438 (0.638)	0.353 (0.650)	1.105 (1.151)	1.115 (1.107)
CL_{ij}	2.182*** (0.565)	2.073*** (0.587)	-0.542 (0.943)	-1.009 (0.925)
BTA_{ij}	0.287** (0.119)	0.269** (0.122)	0.276** (0.120)	0.235* (0.121)
GOV_{i}	-0.025 (0.050)	-0.029 (0.050)	-0.110** (0.054)	-0.049 (0.057)
GOV_{j}	0.143*** (0.054)	0.149*** (0.054)	0.101* (0.057)	0.121** (0.057)
BIM_{ij}	-0.048 (0.117)	-0.041 (0.118)	0.216* (0.119)	0.221* (0.120)
Constant	4.225* (2.207)	4.690** (2.306)	12.766*** (3.487)	14.046*** (3.468)
Theoretical model rejected	HOS, NTT	HOS, NTT	Linder, NTT	Linder, NTT
N	140		127	
μ	3.828*** (0.439)	4.035*** (0.523)	8.575*** (0.983)	9.305*** (1.170)
η	--	-0.003 (0.003)	--	-0.006*** (0.001)
$\ln \sigma^2$	1.023*** (0.123)	1.058*** (0.134)	1.983*** (0.134)	2.061*** (0.136)
ilgt γ	2.103*** (0.143)	2.144*** (0.156)	3.146*** (0.147)	3.237*** (0.149)
Wald χ^2	1045.800***	297.240***	963.470***	197.710***
Log Likelihood	-1697.766	-1697.527	-1601.324***	-1596.384***

Note: ***, ** and * indicate that the particular coefficient is significant at 1, 5 and 10 per cent level respectively.

The results of the exports side present the positive sign of *TGDP*, *RFE* with statistically significant coefficients, but *SIM* turns out to be insignificant. It is the evidence of rejecting *Linder* hypothesis as well as New Trade Theory, suggesting that Heckscher-Ohlin-Samuelson theorem can explain the pattern of BIMSTEC's exports. The sign of *DIST* is according to our expectation and it is significant in the TVD model. *RER* turns out to be positive. The sign of *BTA*, GOV_j and *BIM* are positive and they are statistically significant, which indicate, as expected, their export-enhancing impacts.

Statistically insignificant coefficients suggest no influence of respective explanatory variables in import and export flows, these can be omitted to obtain more meaningful results of Equation (6). Table 4 presents the results after dropping such variables. In the re-estimated regression, *RFE* of imports in TI model is now significant at 1 per cent level, which was significant at 10 per cent level in Table 3 that keeps all the explanatory variables. This indicates that *Linder* hypothesis can more strongly explain the pattern of BIMSTEC's imports when we drop insignificant variables from our estimation. Also for exports panel, the statistical significance of *RFE* increased from 5 per cent to 1 per cent level. It is an indication of stronger relevance of Heckscher-Ohlin-Samuelson theorem in explaining the pattern of the bloc's exports. This implies that even if the behind and beyond the border constraints are removed or kept at the minimum, the pattern of imports and exports would remain intra- and inter-industry, respectively.

The distance elasticity is negative and significant at 1 per cent level in imports panel. It is negative and significant at 5 per cent level in the exports panel, which supports Kalirajan, and Kalirajan and Singh.[45] The negative distance elasticity concurs with the theory of gravity model.

The sign and significance of the other significant variables in imports panel do not notably alter. In the exports panel, the significance of *BTA* has improved from 10 per cent to 5 per cent level, which indicates that bilateral trade agreements enhances both imports and exports of BIMSTEC countries. The coefficient of *BIM* turns out to be positive and significant in exports panel, which reinforces the fact that the membership of this group has an export facilitating impact. This impact is 25.36 in the present estimate.

[45] Kalirajan, 2007, *op. cit.*; and Kalirajan and Singh, 2008, *op. cit*.

Table 4: Results of the Re-estimated Gravity Equation

	IMPORTS		EXPORTS	
	TI	TVD	TI	TVD
$lnTGDP_{ij}$	0.789*** (0.102)	0.820*** (0.103)	0.377** (0.156)	0.428*** (0.142)
RFE_{ij}	-0.382*** (0.111)	-0.322** (0.128)	0.395** (0.155)	0.509*** (0.144)
$lnDIST_{ij}$	-0.692*** (0.211)	-0.797*** (0.218)	-0.723** (0.364)	-0.878** (0.352)
$lnRER_{ij}$	-0.031* (0.019)		0.039** (0.019)	0.038* (0.019)
CL_{ij}	2.197*** (0.561)	2.003*** (0.591)		
BTA_{ij}	0.278** (0.118)	0.260** (0.121)	0.291** (0.119)	0.241** (0.120)
GOV_j			-0.121** (0.053)	
GOV_j	0.145*** (0.054)	0.153*** (0.054)	0.106* (0.057)	0.130** (0.057)
BIM_{ij}			0.219* (0.119)	0.226* (0.120)
Constant	4.301** (1.684)	4.761*** (1.697)	15.287*** (3.070)	16.415*** (3.001)
Theoretical model rejected	HOS, NTT	HOS, NTT	Linder, NTT	Linder, NTT
N	140		127	
μ	3.777*** (0.425)	4.019*** (0.484)	8.688*** (0.958)	9.409*** (1.167)
η	--	-0.003 (0.003)		-0.006*** (0.001)
ln σ^2	1.026*** (0.124)	1.089*** (0.131)	2.024*** (0.132)	2.083 (0.132)
ilgt γ	2.106*** (0.144)	2.179*** (0.152)	3.191*** (0.144)	3.259*** (0.144)
Wald χ^2	1043.760***	295.920***	951.210***	190.810***
Log Likelihood	-1698.209	-1698.970	-1605.047	-1598.163

Note: ***, ** and * indicate that the particular coefficient is significant at 1, 5 and 10 per cent level respectively.

5.2 *Diagnostic Tests*

Three tests assess the aspects of u_{ij} and the time dimension of the estimator, which are *gamma (γ)*, *mu* (μ) and *eta* (η) (reported in the bottom of Tables 3 and 4). *Gamma* examines the appropriateness of u_{ij} in the data. More specifically, the γ

coefficient presents a measure of the total variation that is due to country specific behind and beyond the border constraints on exports and imports, respectively. It is an average over the period, that is,

$$\gamma = \frac{\sum_t \sigma_{ut}^2 / \left(\sum_t \sigma_{ut}^2 + \sigma_{vt}^2\right)}{T}$$

where σ^2 is the variance of u_{ij} at period *t*, σ^2 is the variance of v_{ij} at period *t*, and *T* is the total number of periods.[46] It means that the decomposition of the error term into *u* and *v* is valid for the present data sets and the deviation of actual trade from the potential is due to behind and beyond the border constraints, and not merely by random chances.

Here, the null hypothesis is that $\gamma = 0$ and the alternative is $\gamma > 0$. After the time invariant and time varying decay estimation of import and export panels, the γ coefficient turns out to be significantly different from zero. This is confirmed by the 95 per cent confidence interval. As γ lies between 0 and 1, the optimisation is parameterised with respect to its inverse logit (*ilgt* γ). The coefficients of *ilgt* γ are significant at 1 per cent level in both the panels, which is reported in Table 5. The large and significant γ coefficients in both import and export panels indicate that the influence of such country-specific factors explain a large proportion of mean total variation (σ^2) of the model.[47] According to results presented in Table 5, the estimated γ explains 89 per cent of total variation in imports panel, which captures the influence of beyond the border constraints on imports. For exports, behind the border constraints explain around 96 per cent of total variation, which is expressed by estimated *γ* for exports. That is, behind the border constraints contribute a larger and significant proportion to the variation in the gaps between potential and actual exports of BIMSTEC members.

The results support the use of a stochastic frontier in our estimation. These are also in accordance with previous findings. For instance, Drysdale *et al*.[48] find that 78 per cent of the variation in trade flows is due to the variance in the inefficiency term, which dominates the rest of the variation, from the stochastic disturbance term. Kalirajan[49] finds it to be 79 to 81 per cent, and it turns out to be 83 per cent for China and 87 per cent for India in Kalirajan and Singh.[50]

[46] Kalirajan and Singh, 2008, *op. cit.*
[47] *Ibid.*
[48] P. Drysdale, Y. Huang and K. Kalirajan, "China's Trade Efficiency: Measurement and Determinants", in P. Drysdale, Y. Zhang and L. Song (eds.), *APEC and Liberalisation of the Chinese Economy*, Canberra: Asia Pacific Press, 2000, pp. 259-271.
[49] Kalirajan, 2007, *op. cit.*
[50] Kalirajan and Singh, 2008, *op. cit.*

Table 5: Diagnostic Tests

IMPORTS					
		Coefficient	*Standard Error*	*95% Confidence Interval*	
TI	σ^2	2.792	0.346	2.189	3.561
	$\sigma^2(u)$	2.489	0.346	1.810	3.168
	$\sigma^2(v)$	0.302	0.010	0.281	0.324
	γ	0.891	0.013	0.861	0.915
EXPORTS					
TVD	σ^2	8.033	1.066	6.193	10.420
	$\sigma^2(u)$	7.736	1.066	5.645	9.827
	$\sigma^2(v)$	0.297	0.011	0.274	0.319
	γ	0.963	0.005	0.951	0.971

Mu is used to assess the distributional pattern of u_{ij}. The null hypothesis is that the mean $\mu = 0$ against the alternative $\mu \neq 0$. Here, μ also turns out to be statistically significant in both import and export panels, which indicates that a truncated normal distribution fits the u_{ij} better than the half-normal distribution.

It may be interesting to see how the γ coefficients vary over time. In other words, whether policy reforms toward promoting trade have been effective during the sample period can be investigated. The η coefficient provides the information on the temporal behavior of γ. It considers whether the impact of country-specific beyond the border constraints have been decreasing over the period or not. If the η coefficient turns out to be positive, the impact of such constraints would be decreasing over time. Conversely, if the sign of η becomes negative, it implies that the constraints are increasing over time. If η turns out to be zero or insignificant, it indicates that the impact of country-specific constraints remains constant over time.

The maximum likelihood estimates of imports panel provides a negative but insignificant coefficient of η, which indicates that the impact of country-specific behind the border constraints remains constant over time. Hence, the correct model in estimating the gravity equation is the TI model for imports. Conversely, it becomes negative and significant at 1 per cent level for exports panel, which indicates that the constraints are increasing over time. Thus, the TVD model is appropriate in estimating the gravity model for exports.

5.3 *Realisation of Trade Potential*

Trade potential measure provides useful insight to examine the scope of the highest possible trade expansion between the bilateral partners. In the conventional gravity model, trade potential or the performance of bilateral trade flow can be measured using the mean prediction.[51] As opposed to such exercise, an estimate of

[51] R. E. Baldwin, *Towards an Integrated Europe*, London: CEPR, 1994.

the highest potential can be worked out from the linear predictions of the estimated regression coefficients of the trade frontier from the augmented gravity model.

The focus of the stochastic frontier gravity model is to work out the impact of resistance to bilateral trade flows with respect to potential. Kalirajan[52] defines potential trade to be the maximum possible trade that can take place, given the determinants, when no (beyond and behind the border) constraints are imposed on trade between the two countries. This potential may be constantly changing as countries either increase or decrease the impediments on trade. In this way, suppose that β_k^* are the estimates of parameters of the potential gravity function that yields the highest possible trade between two countries. The β_k coefficients are chosen to represent the trade responses following minimum constraints, beyond and behind the border, by the trading partners. These can be obtained from the individual response coefficients in the following way:

$$\beta_{k,t}^{*} = \max_j \left(\hat{\beta}_{kj,t}\right), \qquad j = 1, 2, \ldots, n; t = 1, 2, \ldots, T; k = 1, 2, \ldots, K \qquad (7)$$

If the response coefficients are selected using Equation (7), the highest possible trade between trading partners *i* and *j* if they face fewer restriction on trade can be determined by the gravity equation (6). Based on the regression estimates, trade potential between countries, *i* and *j*, can be worked out by the following ratio:

$$PT_{ij,t} = \frac{TRA_{ij,t}}{\exp(\ln TRA^{*}_{ij,t})} \qquad (8)$$

where $TRA_{ij,t}$ is the realised trade and $exp\ (\ln TRA^{*}_{ij,t})$ is the trade predicted from the significant coefficients of Equation (6) that yields the maximum possible trade following 'fewer' behind and beyond the border constraints. $PT_{ij,t}$ denotes the index of potential trade that varies between 0 and 1. Equation (8) provides useful information about the realisation of actual trade towards the highest possible trade measured at the frontier.

[52] Kalirajan, 1999, *op. cit.*

Table 6: Mean Realisation of Trade Potential (1996-2013)		
Country	Imports	Exports
BANGLADESH		
Bhutan	18.63	29.95
India	88.34	75.92
Nepal	20.80	53.76
Sri Lanka	27.45	56.72
Thailand	59.60	60.69
INDIA		
Bangladesh	53.02	48.77
Bhutan	37.16	20.43
Nepal	67.47	39.28
Sri Lanka	55.99	46.22
Thailand	71.54	42.16
SRI LANKA		
Bangladesh	17.52	17.26
India	81.15	32.85
Thailand	54.05	22.15
THAILAND		
Bangladesh	36.42	34.55
India	76.78	41.92
Nepal	0.02	20.78
Sri Lanka	33.53	33.66

The trend of realisation of intra-BIMSTEC trade potential over time has been displayed in Table 6. The realisation of Bangladesh's import potential has been around 90 per cent from India after forming BIMSTEC. This is perhaps due to the fact that smaller country Bangladesh is surrounded by large India and one of the major sources of its imports is India. Realisation of imports potential from Bhutan has been increasing since 2003 when the country joined BIMSTEC. Realisation of potential from Sri Lanka is fluctuating in a smaller band, from 24 to 31 per cent although an increasing trend is prevailing for the last three years. The realisation from Nepal is slightly increasing after joining the bloc. Thailand's trend is normally increasing, with around 70 per cent on average.

India's realisation of import potential shows normally positive trend with minor temporary fluctuations. Its realisation of imports from Bangladesh has been more than 50 per cent after the formation of BIMSTEC, while it has been mostly increasing in imports from Sri Lanka, from 47 per cent of 1997 to 71 per cent on average. It is notably increasing for Thailand as well, with 81 per cent realisation of import potential. The trend of Nepal and Bhutan is increasing since they have joined the bloc in 2003.

To put it more simply, the core findings are as follows. First, the trade between the partners and BIMSTEC countries increases with the economic space

(measured by total GDP) of the countries. Imports of the BIMSTEC countries from their partners increase if their preferences are similar, while exports may be increased without any similarity of preferences (supporting Linder hypothesis). It implies that export destination of the group are likely to be the countries having very high GDP and located outside the group (supporting Heckscher-Ohlin-Samuelson theorem). Second, higher geographical distance acts a disincentive for both imports and exports for the group. It implies that intra-bloc trade potential can be utilised with active interest by the members. Third, bilateral trade agreement of the members of the bloc have positive impact on both imports and exports. It means that in order to increase intra-bloc trade the member countries can go for bilateral trade agreement. Fourth, considerable proportion of intra-BIMSTEC trade potential is yet to be realised. It can be tapped through removing non-tariff barriers, institutional and infrastructural rigidness, and coming up with a free trade area within the bloc.

6. Concluding Remarks

This paper is an attempt to adopt stochastic frontier gravity model to examine the determinants of trade for BIMSTEC and calculating trade potential by taking into account the other important bilateral trading partners of the countries. Time invariant and time varying decay models have been adopted to work out trade potential for BIMSTEC. The results show that most of the parameters take the expected sign in the gravity model. The Linder hypothesis can explain the pattern of the bloc's imports, whereas Heckscher-Ohlin-Samuelson theorem explains its exports. The non-negative error component explains most of the total variation, which captures behind and beyond the border constraints. It indicates that stochastic frontier specification was correct for estimating both import and export panels. The estimation of individual and mean trade potential suggests that BIMSTEC countries can substantially expand both imports and exports among themselves if they can minimise various behind and beyond the border constraints, which need for addressing bilateral trade policies at the outset.

Thus, the process of a meaningful economic integration within the bloc should be aimed primarily at policy liberalisation, policy reforms and policy coordination amongst member countries. This can be initiated through a comprehensive tariff liberalisation by forming an FTA. The introduction of a preferential liberalisation scheme would be beneficial for the members through substantial trade and welfare effects as results indicate that the significant import and export potential remain untapped. However, an important fact of trading regimes prevailing among the BIMSTEC members is that the unobserved export policies and infrastructural rigidities are perhaps more restrictive towards this bloc than that of imports except for Bangladesh. This is indicated by the higher magnitude of total variation in exports due to behind the border constraints than the constraints of imports. These aspects can be examined further with an in-depth study of trade policies, institutional and socio-political barriers in future.