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Can Gravity Model Explain BIMSTEC's Trade?

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Abstract

This paper examines the trading pattern of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) by employing an augmented gravity model. The econometric specification followed Egger (2000, 2002), Baltagi et al. (2003) and Serlenga and Shin (2007). Diagnostic checks imply the presence of serial correlation, heteroscedasticity and contemporaneous correlation in both import and export panels, which are allowed for in the Prais-Winsten regression with panel-specific AR(1). Regression estimates show that BIMSTEC's imports follow the Linder hypothesis, while the exports exhibit Heckscher-Ohlin-Samuelson prototype. Results also suggest that distance elasticity is negative and significant. Real depreciation is import-reducing and export enhancing. Common language and bilateral trade agreement are found to be import and export enhancing, respectively. Governance of both local and destination countries impact trade of the bloc positively. Finally, belonging to the bloc accounts for about 29% of its exports, which is an indication of good prospect if trade policies are liberalised within the bloc. Thus, gravity model can successfully explain the pattern of the bloc's trade.

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I. Introduction

Regional cooperation, whether market-driven or policy-induced, is a catalyst of economic integration. Free trade maximises global welfare but such a Pareto optimal state is impossible in practice due to multiple distortions, which leads to economic regionalism. It has become so widespread that at present sixty % of world trade is conducted among the members of trading blocs. The body of theoretical and empirical literature suggests mixed results of economic regionalism in terms of trade flows, welfare and macroeconomic effects. In recent years, a number of gravity models have been applied in examining the determinants of bilateral trade flows and estimating trade potential of various trading blocs as well as in country cases. Recent studies apply established panel-data methods, such as fixed and random effects estimators. While some of the most cited works specifically consider the appropriateness of applying various methods (Egger, 2002; Papazoglou *et al.*, 2006; Serlenga and Shin, 2007), others propose the design of bilateral trade flow models and discuss various aspects of following a desirable empirical strategy (Mátyás, 1997; Baltagi *el al*., 2003; Baier *et al*., 2007). Now, the question is: can gravity model successfully explain the pattern of bilateral trade flows of regional blocs? A body of theoretical and empirical literature try to respond to such queries in the context of various economic blocs across the world. However, substantive empirical examination is absent in the context of a comparatively new but promising economic bloc, Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC).

BIMSTEC was formed on 6 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 until 2003 when both Nepal and Bhutan were granted full membership. In the first Summit on 31 July, 2004, leaders of the group renamed it as BIMSTEC. 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 interest including national development plans of the members, maintain cooperation with international and regional organisations and in projects that optimally utilise available economic, political and social strengths. BIMSTEC aims at combining the 'Look West' policy of Thailand and Association of Southeast Asian Nations (ASEAN), and 'Look East' policy of India and South Asia, thereby linking between the ASEAN and the South Asian Association for Regional Cooperation (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 contract, (xii) poverty alleviation, and (xiii) counter-terrorism and transnational crimes.[1]

The bloc is currently heading towards an 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 1 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 4 June, 2009, in which the ROOs and Operational Certification Procedures for the ROOs are agreed. The Agreement on Cooperation and Mutual Assistance in Customs Matters for the FTA has also been finalised in the Meeting. The negotiation of agreements on services and investment is in progress as well. However, the negative lists of only Bhutan and Thailand are exchanged thus far and the rest are expected to be finalised by the end of 2009. The FTA is scheduled to commence from 1 July, 2010.

The objective of this paper is to examine the pattern of BIMSTEC's trade by adopting an augmented gravity model, which includes the influence of this bloc in trade flow of the members besides other factors. The contribution of the present paper is threefold. First, by adopting an augmented gravity model it examines the trading pattern of BIMSTEC, which is currently absent. Second, it adopts

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

appropriate estimation strategy of the gravity model based on formal tests of panel data econometrics. Third, it incorporates governance of source and destination countries vis-à-vis other commonly used variables, which is new in the literature.

The rest of the paper is organised as follows. Section II discusses the trade policies and performance of BIMSTEC countries. The econometric specification and data sources are presented in Section III, while the analyses are performed in Section IV. Finally, concluding remarks are made in Section V.

II. Trade Policies and Performance of BIMSTEC Members

Among the members, 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.

Of South Asian members, Bangladesh underwent substantial changes in economic policies in the 1980s and 1990s, and experienced an increased degree of integration with the global economy (Salim, 2003). 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. The recent Most Favoured Nation (MFN) applied simple tariff average is much higher than the other members except for Bhutan (World Bank, 2008). Conversely, Bhutan's trade policy is all about the FTA with India since 1949 that covers nearly 90 percent of its trade; an FTA with Bangladesh covers certain product lines to another 5 to 8 percent (Oura and Topalova, 2007). The country's MFN applied simple tariff average is the highest in BIMSTEC (World Bank, 2008). Like Bangladesh, India moved towards a market-driven trade regime in the early 1990s after nearly four decades of *de facto* autarchy, which encompassed a significant series of reforms in industrial policy, the removal of most licensing and other non-tariff barriers, domestic deregulation of private industry, and simplification of the trade regime (World Bank, 2006; Hasan *et al.*, 2007). The country's trade regime is still much restrictive compared to other members such as Bangladesh, Sri Lanka and Thailand. Nepal also undertook a series of market-oriented reforms in the 1980s and 1990s (Sharma, 2006). A

Table 1. Key Characteristics of BIMSTEC Member States

	Bang-ladesh	Bhutan	India	Myan-mar	Nepal	Sri Lanka	Thailand
1997							
Population (million)	131.52	0.52	965.43	44.29	22.76	18.37	58.83
GDP (US$ billion)	42.32	0.37	410.92	..	4.92	15.09	150.89
GDP per capita (US$)	322	721	426	..	216	821	2,565
GDP growth (annual %)	5.39	5.31	4.05	5.65	5.05	6.41	-1.37
Shares of GDP							
Agriculture	25.78	32.48	26.12	59.45	41.43	21.87	9.45
Manufacturing	15.61	10.04	16.38	7.10	9.45	16.41	30.17
Services	49.07	34.36	47.11	30.28	35.70	51.23	50.39
% of World Trade	0.10	..	0.68	0.04	0.02	0.09	1.11
Trade per capita (US$)	82	..	78	90	90	540	2,098
2007							
Population (million)	158.57	0.66	1,124.78	48.78	28.11	20.01	63.83
GDP (US$ billion)	68.42	1.10	1,176.89	..	1,0.32	32.34	245.35
GDP per capita (US$)	431	1,668	1,046	..	367	1616	3,844
GDP growth (annual %)	6.43	19.11	9.06	..	3.19	6.78	4.75
Shares of GDP							
Agriculture	19.24	20.86	18.11	..	33.58	11.69	11.42
Manufacturing	17.77	5.12	16.32	..	7.72	18.50	34.83
Services	52.37	36.26	52.38	..	49.32	58.38	44.68
% of World Trade	0.10	..	1.66	..	0.01	0.06	1.01
Trade per capita (US$)	213	..	491	..	170	1,044	5,246
Membership							
GATT	1972	No	1948	1948	No	1948	1982
WTO	1995	Accession	1995	1995	2004	1995	1995

Note: ..denotes that data not available. GATT and WTO stand for the General Agreement on Tariffs and Trade and the World Trade Organisation, respectively.

Source: World Bank. *World Development Indicators* (online, http://ddp-ext.worldbank.org); *World Trade Indicators* (online, http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/TRADE).

preferential trade agreement (PTA) with India, signed in 2002, granted Nepal a preferential access to the highly restricted Indian market, although the arrangement still depends on stringent Rules of Origin (RoOs), tariff rate quotas, and safeguard clauses (Kalra *et al.*, 2006). Likewise, 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 (Duma, 2007). The country's trade regime is considerably more liberal than

in an average BIMSTEC country.

Conversely, Myanmar, Southeast Asian member of BIMSTEC, possesses a relatively less restrictive trade regime (ADB, 2001). Its MFN applied simple and trade-weighted average tariffs are the lowest among the other members. The country took an 'open-door policy' in the late 1980s that considerably increased its trade with the neighbours later on (Kudo and Mieno, 2007). The general trait of the other Southeast Asian member Thailand's trade policy regime has been liberal and outward oriented (Diao *et al*., 2005). The country undertook strong unilateral liberalisation in the 1980s and 1990s, especially in the manufacturing sector (Sally, 2007). 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 (WTO, 2008).

The share of intra-BIMSTEC trade remains meagre in the world trade. The main import sources and export destinations of most of the BIMSTEC countries remain outside the bloc. In 1997, the intra-bloc import was 2.81 percent of the world import, which increased to 4.42 percent in 2007. The figures for export were 2.80 and 5.27 percent, respectively. However, the rate increase in intra-bloc trade is substantially higher than that of the bloc with the world, which is encouraging. Bangladesh's value of imports from BIMSTEC was 17.09 percent of that from the world. Its imports from the bloc increased by 275 percent compared to that of 1997, whereas it increased by 180 percent with the world. Its volume of exports to the bloc was 1.95 percent of exports to the world. Still, the increase in its export to the bloc during the same time period was higher (307 percent) than that to the world (283 percent). Most of its increase in intra-bloc trade could be explained by its trade with India. India's imports from the bloc increased by 781 percent compared to that of 1997, whereas it increased by 502 percent with the world. Its exports to the bloc increased by 385 percent by that period, which was higher than the exports to the world (336 percent). Myanmar's imports from the group increased by 2,068% in 2007 compared to that of 1998, while imports increased by 70% from the ROW during this period. Its exports to the bloc increased by 1,458%, which was also substantially higher than the exports to the world (345%). Nepal's imports from the bloc increased by 97% compared to that of 2003, whereas the imports from the world increased by 104% with the world. Conversely, its exports to the bloc increased by 103% by that period, while its export growth to the world was negative (-0.26%). Sri Lanka's imports from the bloc increased by 332% during 1997-2007, although imports increased by 112%

with the world. It exports to BIMSTEC increased by 921% by that period, while its exports to the world increased by 67% only. Thailand's case was also the same to other members. Its imports from BIMSTEC increased by 598% compared to that of 1997, although it increased by 116% with the world. It exports to the bloc increased by 655%, while exports growth was 152% to the world.

Amongst the member countries, trade baskets of Bangladesh and Sri Lanka is highly skewed towards a few product lines than that of India and Thailand, which is revealed from lower trade complementarity index. The overall intra-industry trade (IIT) index is low for Bangladesh with the other partners, which implies a lower trade across industry categories including intermediate products. Conversely, the higher IIT between Thailand and Sri Lanka and between Thailand and India indicates a greater trade within same product categories among them. However, the export and import concentration indices are substantially higher than that of the bloc's trade with the rest of the world (ROW), which suggests that the bloc's trade is skewed towards a few product categories in the trade basket. Thus, the preferential tariff elimination in the major traded items would increase intra-bloc trade of the existing items substantially (Chakraborty, 2007).

III. Methodology and Data

A. Econometric Specification

Gravity model is widely used to explore the drivers and potential of bilateral trade of various RTAs. The extensive use of this model is due to more systematic efforts to reinforce its theoretical underpinnings, due, among others, to Anderson (1979), Deardorff (1998) and Anderson and van Wincoop (2003). Recent derivations of the gravity model mainly enclose complete and incomplete specialisation and firm heterogeneity (Deardorff, 1998; Feenstra *et al*., 2001; Haveman and Hummels, 2004; Helpman *et al.*, 2008).

Drawing on econometric specification of Egger (2000, 2002), Baltagi *et al.* (2003), and Serlenga and Shin (2007), we specify the following augmented gravity model to estimate bilateral trade for BIMSTEC countries:

$$\begin{aligned}\ln VFC_{ij,t} = {} & \alpha_0 + \alpha_1 \ln TGDP_{ij,t} + \alpha_2 RFE_{ij,t} + \alpha_3 SIM_{ij,t} + \alpha_4 \ln DIST_{ij} + \\ & \alpha_5 \ln RER_{ij,t} + \alpha_6 BOR_{ij} + \alpha_7 CL_{ij} + \alpha_8 BTA_{ij,t} + \alpha_9 GOV_{i,t} + \\ & \alpha_{10} GOV_{j,t} + \alpha_{11} BIM_{ij,t} + \varphi_i + \gamma_j + \lambda_t + (\varphi\gamma)_{ij} + (\varphi\lambda)_{i,t} + (\gamma\lambda)_{j,t} + \varepsilon_{ij,t}\end{aligned} \quad (1)$$

Table 2a. Intra-BIMSTEC Trade Flows (US$ million)

IMPORTS																
From	Bangladesh		Bhutan		India		Myanmar		Nepal		Sri Lanka		Thailand		BIMSTEC	
To	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007
Bangladesh	--	--	4.14	10.43	795.62	2,646.58	2.66	29.66	10.99	15.67	9.25	13.45	86.00	442.02	908.64	3,157.81
Bhutan			--	--												
India	53.65	211.05	18.50	129.44	--	--	212.30	757.76	87.43	768.52	33.95	566.81	224.28	2,930.53	630.10	5,364.11
Myanmar	0.42	6.35			50.16	186.85	--	--	0.00	0.00	0.00	0.56	0.00	1,054.64	50.57	1,248.40
Nepal	7.70	4.93			435.80	1,838.55	0.00	0.00	--	--	1.60	0.20	28.60	41.87	473.70	1,885.55
Sri Lanka	2.00	10.92			560.00	2,610.14	6.00	5.49	5.00	0.08	--	--	153.00	230.81	726.00	2,857.44
Thailand	14.02	14.37			594.00	2,085.01	0.00	2,315.38	0.04	0.73	30.23	36.61	--	--	638.29	4,452.09
BIMSTEC	77.78	247.62	22.64	139.86	2,435.58	9,367.13	220.96	3,108.30	103.45	784.99	75.02	617.63	491.88	4,699.86	3,427.30	18,965.39
EXPORTS																
To	Bangladesh		Bhutan		India		Myanmar		Nepal		Sri Lanka		Thailand		BIMSTEC	
From	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007
Bangladesh	--	--	0.33	4.85	37.22	209.71	0.38	5.77	0.93	4.48	3.91	10.15	10.77	12.70	53.54	247.67
Bhutan			--	--												
India	807.13	2,405.98	15.48	146.48	--	--	48.28	169.86	168.93	1,671.41	486.25	2,372.86	369.78	1,895.47	1,895.83	8,662.06
Myanmar	2.41	26.97			168.62	688.87	--	--	0.00	0.00	5.45	4.99	0.00	2,104.89	176.49	2,825.72
Nepal	8.70	14.25			91.60	698.65			--	--	0.10	0.07	0.00	0.66	100.40	713.63
Sri Lanka	11.00	22.75			44.00	515.28	0.00	0.51	2.00	0.18	--	--	34.00	44.70	91.00	583.42
Thailand	127.04	511.00			294.48	2,664.12	0.00	958.76	19.41	38.06	147.76	273.55	--	--	588.69	4,445.49
BIMSTEC	956.28	2,980.95	15.81	151.33	635.92	4,776.64	48.65	1,134.91	191.27	1,714.14	643.47	2,661.62	414.55	4,058.42	2,905.95	17,478.00

Note: The total value of exports and imports shows discrepancy, which is due to exclusion of transport and other costs of trade from the exports data.
Source: IMF. *Direction of Trade Statistics* (online).

Table 2b. BIMSTEC's Trade with the World (US$ million)

IMPORTS

From / To	Advanced Economies		Euro Area		Emerging & Dev. Economies		Developing Asia		Central and Eastern Europe		Middle East		Western Hemisphere		World	
	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007
Bangladesh	3,381.6	6,516.5	585.3	1,087.2	2,766.0	10,583.5	2,273.6	6,897.2	37.2	163.8	260.0	2,376.9	101.0	377.7	7,129.6	18,476.3
Bhutan																
India	24,060.2	110,110.0	7,914.2	34,348.6	16,779.4	76,842.6	3,607.8	44,697.8	312.6	2,001.2	8,706.9	14,215.4	577.6	6,100.6	40,896.6	249,566.0
Myanmar	1,552.2	1,723.2	166.8	235.4	1,296.7	4,673.6	1,266.4	4,578.7	15.1	2.7	11.7	12.6	0.2	2.4	2,861.5	5,520.1
Nepal	856.7	356.2	58.2	90.7	737.1	2,435.2	569.5	2,341.9	0.8	3.2	148.7	71.8	15.4	1.2	1,640.4	3,123.3
Sri Lanka	3,159.0	5,050.6	453.0	768.0	2,094.0	6,173.1	1,259.0	4,534.0	19.0	84.5	569.0	1,471.3	183.0	43.0	5,282.0	11,301.0
Thailand	45,884.5	76,185.9	6,823.2	9,556.9	16,368.2	62,594.6	9,157.5	37,954.4	879.2	418.2	4,365.8	18,113.7	1,155.2	2,373.7	64,127.3	141,346.0
BIMSTEC	78,894.2	199,942.4	16,000.6	46,086.9	40,041.4	163,302.5	18,133.8	101,003.9	1,263.9	2,673.5	14,062.1	36,261.7	2,032.2	8,898.8	121,937.4	429,332.7

EXPORTS

To / From	Advanced Economies		Euro Area		Emerging & Dev. Economies		Developing Asia		Central and Eastern Europe		Middle East		Western Hemisphere		World	
	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007	1997	2007
Bangladesh	3,133.5	9,743.5	1,081.6	4,375.3	474.9	1,180.1	194.3	465.4	44.3	266.1	124.4	179.0	25.1	101.8	3,627.6	12,718.9
Bhutan																
India	23,051.6	81,392.6	6,651.2	23,774.3	11,149.1	71,234.2	4,108.1	28,483.0	443.7	3,784.3	3,367.4	22,619.8	630.2	5,269.7	34,624.4	153,130.0
Myanmar	615.6	823.8	107.0	255.2	498.2	3,841.4	333.3	3,443.4	1.3	13.7	14.1	49.6	17.1	49.1	1,132.1	4,753.7
Nepal	286.7	235.5	160.2	90.0	102.5	748.1	100.8	733.0	0.4	7.6	0.0	3.7	0.6	2.4	396.9	1,008.5
Sri Lanka	3,601.0	5,417.4	619.0	1,312.3	925.0	1,943.9	210.0	827.9	129.0	131.5	321.0	593.4	67.0	135.6	4,629.0	7,740.0
Thailand	44,008.7	91,448.3	6,821.6	15,075.5	13,635.9	60,490.9	10,177.0	42,415.0	517.1	2,569.4	1,635.0	6,733.8	659.8	3,909.9	59,302.9	152,460.0
BIMSTEC	74,697.1	189,061.1	15,440.6	44,882.7	26,785.6	139,438.6	15,123.5	76,367.6	1,135.9	6,772.6	5,461.9	30,179.4	1,399.8	9,468.5	103,712.8	331,811.1

Note: The total value of exports and imports shows discrepancy, which is due to exclusion of transport and other costs of trade from the exports data.
Source: IMF. *Direction of Trade Statistics* (online).

where *VFC* denotes the value of flow of commodities from local (*i*) to destination (*j*) countries; and *TGDP* is the sum of their GDP with the expected sign of $\alpha_1>0$. *RFE* indicates relative factor endowment, and SIM stands for similarity index. The later two variables can be defined as follows:

$$RFE_{ij,t} = \left|\ln PGDP_{i,t} - \ln PGDP_{j,t}\right| \tag{2}$$

$$SIM_{ij,t} = 1 - \left(\frac{\ln(GDP_i)}{\ln(GDP_i + GDP_j)}\right)^2 - \left(\frac{\ln(GDP_j)}{\ln(GDP_i + GDP_j)}\right)^2 \tag{3}$$

RFE_{ij} takes a minimum of zero if both countries exhibit equal GDP or production. The range of *SIM* is given by, $0 \le SIM_{ij} \le 0.5$; where 0.5 means 'equal' and zero implies 'absolute divergence' in country size.[2] In a 'factor box representation' of trade model[3], *TGDP* can be related to the length of the diagonal of the box, *SIM* with the location of the consumption point along the diagonal, and *RFE* to indicate the distance between production and consumption points along the relative price line (Egger, 2000). *RFE* is defined to be the absolute value of the difference between natural logarithm of capital-labour ratio in Egger (2000) to represent the factor endowments of production. However, it is more simplified in Egger (2002) by defining as the absolute value of the difference between natural logarithm of per capita GDP[4]. Baltagi *et al*. (2003) and Serlenga and Shin (2007) also follow Egger's (2002) definition of the *RFE*.

$DIST_{ij}$ indicates the distance between *i* and *j*. As distance increases trading costs, is sign is supposed to be negative. *BTA* indicates bilateral trade agreement between the importers and exporters, BOR_{ij} and CL_{ij} imply common border and language, respectively, GOV_i and GOV_j indicate the governance situation of the source and destination countries, respectively, *BIM* means the membership of BIMSTEC for both the countries, and *e* is the error term.

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[2]Breuss and Egger (1999), Egger (2000, 2002), and Serlenga and Shin (2007) define *SIM* in the following way:

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

In this definition, the index does not range between zero and 0.5 because the value under the bracket is a fraction, and the natural log of a fraction is something negative.

[3]The $2 \times 2 \times 2$ trade model that is due to Helpman and Krugman (1985) and Helpman (1987) is comprised of two goods (differentiated and homogenous), two factors (capital and labour), and two countries (importer and exporter).

[4]As he notes, per capita GDP is widely used as a proxy for a country's capital-labour ratio (Egger, 2002; p.300).

RER_{ij} stands for real exchange rate between two countries, which is calculated as the product of the nominal exchange rate and relative price levels in each country. Following Carrère (2006) and Serlenga and Shin (2007), it is expressed as

$$RER_{ij,t} = ER_{ij,t}(P_{j,t}/P_{i,t})$$

where $P_{i,t}$ and $P_{j,t}$ are price levels of home and partner countries respectively. $ER_{ij,t}$ is the bilateral nominal exchange rate between the currencies of foreign country j and the home country i[5]. Carrère (2006) and Serlenga and Shin (2007) argue that an increase in the bilateral real exchange rate reflects depreciation of the importer's currency against that of the exporters. Thus, the coefficient of *RER* is expected to be negative in the imports panel and positive in the exports panel.

In Equation (1), the following binary variables are included:

$BTA_{ij,t}$ = 1 if a country pair (ij) has a bilateral trade agreement at period t
= 0 if otherwise
BOR_{ij} = 1 if a country pair (ij) has a common border
= 0 if otherwise
CL_{ij} = 1 if a country pair (ij) has a common language
= 0 if otherwise
$BIM_{ij,t}$ = 1 if the exporter (j) is a member of BIMSTEC
= 0 if otherwise

In Equation (1), φ, γ and λ are exporter, importer and time or business cycle effects, respectively. The interaction effects are exporter-by-importer ($\varphi\gamma$), exporter-by-time ($\varphi\lambda$) and importer-by-time ($\gamma\lambda$).

The Linder (1961) hypothesis implies that the greater the difference in per capita income between two countries, the lower the share of the bilateral intra-industry trade. Higher average per capita income indicates a higher level of economic development, which increases the demand for differentiated products and increases the intra-industry trade (Bergstrand, 1990). The capital intensive industries tend to produce differentiated products in greater amount, and the countries with higher average capital-labour ratio come up with a greater share of intra-industry specialisation. Thus, capital-rich countries are supposed to have a greater share of intra-industry trade. Bergstrand (1990) shows that the gravity equation can explain the impact of differences of national and per capita income and capital-labour ratio on the degree of intra-industry trade between two countries.

[5]The formula of calculating bilateral exchange rate is $ER_{ij,t} = LC_{i,t}/LC_{j,t}$, where *LC* is the local currency units per US dollar.

Greater similarity with respect to GDP per capita implies increased similarity in size of the country-specific product diversity in the differentiated goods sector (Breuss and Egger, 1999). Due to variety in consumers' taste, increased similarity yields an increased trade volume and therefore $\alpha_3 > 0$. The *Linder* hypothesis predicts that an increased difference between per capita GDP of source and destination countries will decrease trade of monopolistically competitive products under the assumption of differentiated tastes, and thus $\alpha_2 < 0$. Bergstrand (1990) reveals that within the developed world, bilateral trade is inversely related to the difference in *RFE* or positively related to the similarity in preferences, which supports the *Linder* hypothesis. Krugman (1981) shows that the nature of trade depends on similarity of countries in terms of factor endowment (which supports the *Linder* hypothesis), and trade between countries increasingly becomes intra-industry as they become more similar.

Baltagi *et al.* (2003) observe that the Heckscher-Ohlin-Samuelson theorem imply that $\alpha_2 > 0$. Helpman (1999, p.139) argues that its failure in explaining modern trade is due to ignoring economies of scale, product differentiation and transportation costs, laying the foundation of New Trade Theory. In the gravity model, $\alpha_1 > 0$ and $\alpha_3 > 0$ support this theory.

As mentioned above, $\alpha_5 < 0$ for imports and $\alpha_5 > 0$ for exports. Binary variables such as BTA, shared border and similar language are supposed to have trade enhancing impact. A common border implies lower transport cost and easier access to markets, which effects positively on trade flows. A bilateral trade agreement lower costs of trade mainly through reduction of trade barriers and thus increases trade (Papazoglou *et al.*, 2006).

Governance plays important role in bilateral trade mainly in two ways. First, good governance has a positive relationship with per capita real GDP (Quibria, 2006), which implies that it influences trade enhancing factor, GDP, of source and destination countries. Second, ineffectiveness of domestic institutions to secure and enforce property rights in economic exchange increases trade costs by impacting adversely on risk perceptions and preferences in international transactions. Poor governance involves negative spill-over for transactions, and accordingly increases trade-related transaction costs of international trade that involves manifold governance systems (Anderson and Marcouiller, 2002). Thus, good governance helps increase bilateral trade and $\alpha_9 > 0$ and $\alpha_{10} > 0$.

B. Selecting Appropriate Estimator

Panel gravity models are commonly estimated by fixed effects estimator (FEE) and random effects estimator (REE). FEE suffers from several drawbacks if applied in the gravity model. It fails to recognise the impact of time invariant regressors, such as distance, common language, common border, etc., which is evident from Egger (2002). Furthermore, unless otherwise stated, the FEE follows $u_{ij,t} \sim iid(0,\sigma^2)$, which implies homoscedasticity, no autocorrelation and no contemporaneous correlation within the panel since *iid* stands for independently and identically distributed. In practice, panels often witness these problems, which necessitate making explicit assumptions about the presence of unequal error variance and the structure of error correlation. Conversely, REE can accommodate time invariant explanatory variables. However, if heteroscedasticity and autocorrelation are present in the panel but not addressed, the resulting estimates will be inefficient.

Hausman-Taylor estimator for REE assumes that some of the regressors are correlated with the unobserved u_{ij}, but none of the regressors are correlated with $\varepsilon_{ij,t}$. This estimator removes the possible correlation between explanatory variables and u_{ij} in the instrumental variables approach for panel data. However, the main problem of this estimator is the assumption that the random effects u_{ij} are *iid*. Conversely, REE does not allow for the contemporaneous correlation among the residuals. If the panel suffers from cross-sectional dependence, the model does no longer valid. In that case the results Prais-Winsten regressions with panels-corrected standard errors (PCSE) will be suitable particularly when the size of the panel is not large enough.

The Prais-Winsten PCSE regression is suitable when the residual terms do not follow the *iid* assumption. In particular, residuals can be either heteroscedastic across panels or heteroscedastic and contemporaneously correlated across panels. Here, two other assumptions may also be made for the estimator: errors are autocorrelated within panel and the autocorrelation coefficient remains constant or varies across panels. Two cases of serial correlation can be considered: common $AR(1)$ for all the panels and panel-specific $AR(1)$ where the correlation parameter is unique for each panel. The restriction of a common $AR(1)$ is realistic if the individual correlation in almost equal and the time period is short. Otherwise, panels-specific $AR(1)$ will produce a more reasonable estimate. Panel-specific $AR(1)$ assumes that the degree of correlation varies across country pairs and

corrects for contemporaneous error correlation across the cross-section units (Papazoglou *et al*, 2006; p.1081). Thus, assuming varying *AR*(1) for cross-section units as well as controlling for it provides consistent and efficient estimates of the gravity equation.

C. Data Sources

At the first stage, the sample countries are drawn from all the trading partners of the BIMSTEC countries by posing a quantitative criterion - the countries should have 0.2% of its total world imports and exports with the individual partner country. The primary selection indicates that most of the major trade partners lie outside BIMSTEC. To address this problem, the remaining member countries are included in the second stage to obtain the country panels and the panel for BIMSTEC. Thus, the data have been gathered for the founding members of BIMSTEC, namely Bangladesh, India, Sri Lanka and Thailand. We take data for 1996-2007 by assuming that recent bilateral trade data bear more significance than the data of the distant past.

The annual data on aggregate imports and exports are gathered from the IMF DOTS. Data on GDP and per capita GDP are collected from the World Development Indicators (WDI). The data on distance, common border and common official language come from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

Bilateral exchange rate data are not available in the standard secondary sources. Therefore, it is calculated from official exchange rates of individual countries, which are collected from the WDI. We use the GDP deflator as the price indicator, which is an overall measure of price level of domestically produced items. In an increasingly interdependent world, trade does not take place only on some specific bundles of consumer items on which the CPI is constructed. Rather, many capital and intermediate products are traded as well, the prices of which are embedded in GDP deflator. These are collected from the World Bank World Tables. Data on the presence of a common border are taken from CEPII. Data on *BTA*s come from the WTO and the Focus on the Global South[6].

Data on governance (GOV) come from Kaufman *et al.* (2008). They provide six indices of governance such as (i) voice and accountability, (ii) political stability and absence of violence/terrorism, (iii) government effectiveness, (iv) regulatory

[6]See, http://focusweb.org/india-bilateral-and-regional-trade-agreements-an-update.html.

quality, (v) rule of law and (vi) control of corruption. We take (ii) as an overall index of governance related directly with trade, that is, political instability and presence violence and terrorism disrupts normalcy of human life and thus discourages trade[7]. Kaufman *et al.* provide governance indices for the period 1996-2007, with gaps for 1997, 1999 and 2001. We take the simple average of the index values of preceding and subsequent year to fill in the missing values by assuming an average overall governance situation in the missing years.

A very small of observations has zero values in the panels of both imports and exports. To address this problem, the standard procedure is followed by adding 1 with zero and then log-transform to get zero values again in the panel.

IV. Analyses and Findings

Panel data commonly exhibit substantial cross-sectional dependence (CSD). This is mainly due to three factors: (i) the presence of common shocks and unobserved components that eventually become part of the error term; (ii) spatial dependence; and (iii) idiosyncratic pair-wise dependence in the error term without any specific pattern of common components or special dependence (Pesaran, 2004). The consequence of CSD in estimation hinges on the nature of CSD and the extent of cross-sectional correlations. Assuming that CSD stems from common factors that are unobserved but uncorrelated with the explanatory variables, the estimators that assume *iid* of disturbances turn out to be consistent but inefficient and produce biased standard errors. Conversely, if the unobserved components that create interdependencies across the cross-section are correlated with the explanatory variables, the FEE will be biased as well as inconsistent.

The estimated CSD and R^2_{AVE} statistics, proposed by Pesaran (2004) and Frees (1995), respectively, imply that whether FEE or REE is applied, both the import and export panels suffer from cross-sectional dependence. This indicates that the errors are contemporaneously correlated across panels, *i.e.*, the disturbances are no longer distributed independently and identically. The modified Wald (W') statistic, proposed by Greene (1993, pp. 451-452), suggests that both the import and export panels suffer from the problem of heteroscedasticity at 1% level of significance.

[7]It is an outcome of all other indices. For example, if there is an environment of raising voice for different sections of the society and if the institutions are accountable, political stability exists and there is less scope for terrorism and violence. In the same fashion, effective governance, rule of law and lower corruption also helps attain a stable political environment wherein various political entities usually turn out to be less conflicting.

Thus, the regression results will be inefficient if the panels are not estimated by addressing heteroscedasticity. Also, the estimated Bera *et al.* (2001) statistic for serial correlation indicates that both import and export panels suffer from serial correlation at 1% level of significance, which is again confirmed by Bhargava *et al.* (1982) modified Durbin-Watson (DW) statistic.

Allowing for the problems of contemporaneous correlation across country units, heteroscedasticity and panel-specific serial correlation, the estimated gravity equation has been reported in Table 3. In the first case, the equation has been estimated by keeping all the explanatory variables for export and import panels. In the second case, insignificant variables are dropped to assess whether the main findings of the earlier estimation are significantly altered, which serves as a sensitivity analysis in the present exercise. Case three reports the results by further dropping the insignificant variables if any.

In the imports panel, all the variables except *BTA* and *BIM* turn out to be significant in the first case. An insignificant coefficient indicates that it accepts the null hypothesis, *i.e.*, it is statistically zero. Thus, dropping insignificant variables from the model would provide a more meaningful outcome. Results of Case II of the imports panel resemble the findings of Case I with respect to the magnitude of regression coefficients, standard errors, signs and statistical significance.

The negative sign of *RFE* is in accordance with our expectation, which indicates that the *Linder* hypothesis can explain the pattern of BIMSTEC's imports, not the Heckscher-Ohlin-Samuelson model. This strongly supports Breuss and Egger (1999), Egger (2000, 2002) and Baltagi *et al.* (2003). The opposite sign of *TGDP* and *SIM* suggests that our evidence from the imports panel does not support the New Trade Theory and contradicts with the previous evidence. This also supports Krugman (1981), who argues that countries with similarity in factor endowments will engage in intra-industry trade but with very different endowment will engage in Heckscher-Ohlin or inter-industry trade[8].

The sign of distance elasticity is negative, which indicates that a 100% decrease in distance between traders results in 109% increase in volume of imports. The sign and magnitude of the *RER* elasticity indicate that a 100% real depreciation results in 4.6 to 4.7% decrease in volume of imports of BIMSTEC countries. The positive and significant coefficients of *CL*, GOV_i and GOV_j indicate import-enhancing influence of these variables, which strongly support our presupposition.

[8]Krugman (1981) shows that the index of intra-industry trade equals the index of similarity of factor proportions.

In exports panel, *SIM* and *CL* have been found to be insignificant for the first case. These are dropped in Case II, which results in minor changes. In Case I, *TGDP* is negative and significant, while it is positive but insignificant in Case II. But both the results bear the same meaning - rejection of the New Trade Theory. The positive and significant *RFE* in both the cases reject *Linder* hypothesis, which indicates that Heckscher-Ohlin-Samuelson theorem successfully explains the pattern of BIMSTEC's exports. Serlenga and Shin (2007) find *TGDP*, *RFE* and *SIM* to be positive and significant in the traditional OLS, FEE, REE and Hausman-Taylor estimation. The positive *TGDP* is consistent with the theory as well as our finding in the imports panel. The positive *RFE* also support the same of our

Table 3. Regression Estimates with Panel-Specific *AR*(1)

	IMPORTS		EXPORTS		
	Case I	Case II	Case I	Case II	Case III
$\ln TGDP_{ij,t}$	1.099***	1.099***	-0.512*	0.060	
	(0.172)	(0.172)	(0.269)	(0.190)	
$RFE_{ij,t}$	-1.280***	-1.277***	1.273***	0.479**	0.536***
	(0.268)	(0.273)	(0.386)	(0.234)	(0.090)
$SIM_{ij,t}$	-5.561***	-5.504***	1.895		
	(1.966)	(1.966)	(2.481)		
$\ln DIST_{ij}$	-1.091***	-1.091***	-0.504*	-0.461*	-0.449*
	(0.117)	(0.117)	(0.267)	(0.268)	(0.252)
$\ln RER_{ij,t}$	-0.046**	-0.047**	0.068**	0.064**	0.066**
	(0.018)	(0.019)	(0.032)	(0.030)	(0.030)
BOR_{ij}	-1.022***	-1.049***	-0.485**	-0.421**	-0.411**
	(0.257)	(0.265)	(0.205)	(0.183)	(0.174)
CL_{ij}	0.572**	0.551**	-0.011		
	(0.253)	(0.236)	(0.137)		
$BTA_{ij,t}$	0.051		0.179*	0.201**	0.202**
	(0.093)		(0.098)	(0.100)	(0.100)
$GOV_{i,t}$	0.520***	0.518***	1.454***	1.081***	1.117***
	(0.181)	(0.182)	(0.218)	(0.174)	(0.149)
$GOV_{j,t}$	0.158*	0.155*	0.116*	0.105*	0.105*
	(0.086)	(0.087)	(0.066)	(0.063)	(0.063)
$BIM_{ij,t}$	-0.072		0.198*	0.249**	0.251**
	(0.152)		(0.118)	(0.107)	(0.107)
Constant	--	--	--	8.043***	8.859***
				(1.694)	(2.326)
Theoretical model rejected	HOS, NTT	HOS, NTT	Linder, NTT	Linder, NTT	Linder, NTT
No. of Observations	1,680		1,524		
Cross-Sectional Units	140		127		

(Continued)

Table 3. Regression Estimates with Panel-Specific *AR*(1) (Continued)

	IMPORTS		EXPORTS		
	Case I	Case II	Case I	Case II	Case III
φ_i	597.85***	623.09***	107.22***	294.69***	243.61***
γ_j	150.66***	174.88***	244.60***	442.20***	240.52***
λ_t	48.61***	64.67***	20.29**	136.06***	325.67***
$(\varphi\gamma)_{ij}$	156.25***	155.52***	89.23***	102.04***	174.85***
$(\varphi\lambda)_{i,t}$	138.87***	139.03***	157.54***	149.35**	199.55***
$(\gamma\lambda)_{j,t}$	94.43***	93.84***	163.53***	158.61***	157.44***
R^2	0.890	0.890	0.969	0.969	0.969
Wald x^2	75228.13***	72858.45***	11815.90***	11511.13***	11448.91***
Bera *et al*. *AR*(1) test	1680.40*** (REE)		1467.36***(REE)		
Bhargava *et al.* DW	0.805(REE)		1.106 (REE)		
Heteroscedasticity W'	80710.87***		1.1e+05***		
CSD Pesaran (*N*)	8.115*** (FEE)	3.368*** (REE)	6.134*** (FEE)	5.912*** (REE)	
CSD Frees (*Q*)	16.964*** (FEE)	17.985*** (REE)	22.560** *(FEE)	26.241*** (REE)	

Note: ***, ** and * indicate that the particular coefficient or test statistic is significant at 1, 5 and 10% level, respectively. Numbers in the parentheses are the standard errors. The reported main and cross effects are x^2-values. In the imports panel, exporters are Bangladesh, Bhutan, India, Nepal, Sri Lanka and Thailand. Importers are Bangladesh, India, Sri Lanka and Thailand. In the exports panel, importers are Bangladesh, Bhutan, India, Nepal, Sri Lanka and Thailand. Exporters are Bangladesh, India, Sri Lanka and Thailand. NTT and HOS stand for New Trade Theory and Heckscher-Ohlin-Samuelson, respectively.

exports panel.

The Heckscher-Ohlin model predicts that two countries in a complementary trade structure are more likely to expand their bilateral trade volume through inter-industry trade. To be more precise, the model suggests that BIMSTEC's export flows depend more on factors such as comparative advantage, income difference and the level of development stage gap than on economies of scale or product differentiation. Kandogan (2003) argues that in the gravity model, the Heckscher-Ohlin theory determines a small degree of vertical intra-industry trade. Thus, the positive and significant *RFE* in exports panel would also indicate that BIMSTEC follows a Heckscher-Ohlin pattern with dominant inter-industry and minor vertical intra-industry exports.

Distance elasticity turns out to be negative and significant in both the cases and their magnitudes are nearly equal in our study. It indicates that a 10% decrease in distance between traders would increase BIMSTEC's exports by nearly 4.5 to 5%. Conversely, the *RER* elasticity is positive and significant, which indicates that a

real depreciation encourages exports of this group. The magnitude of the proportionate change is found to be meagre in both import and export panels, which supports Carrère (2006).

The sign of *BOR* is negative and opposite of our hypothesis in both importer and exporter panels, as well as most of the recent evidences (Baier *et al*., 2007; Carrère, 2006). However, Kirkpatrick and Watanabe (2005) find it negative in the context of Sub-Saharan Africa; but it was small and insignificant in their estimation. This indicates, for example, that common border between India and Bangladesh, India and Nepal, and India and Bhutan exert a trade discouraging influence. Nevertheless, our result supports Feenstra *et al*. (2001), who find negative and significant common border effect on exports of differentiated goods of the OECD for cross-section data of 1970, 1980 and 1990. They also reveal the negative but insignificant common language effect on exports of homogenous goods of Organisation of Petroleum Exporting Countries (OPEC) to non-OPEC countries for 1990. The influence of *CL* has been found to be positive and significant in our imports panel. This supports, *inter alia*, Frankel and Rose (2002) and Melitz (2008) who find it positive and significant at 1% level. It, however, turned out to be insignificant in exports panel in our study, which supports Feenstra *et al.* (2001).

The sign of *BIM* is negative and insignificant in imports panel, but it turns out to be positive and significant at 10% level in Case I in exports panel. When insignificant variables are dropped, it still remains positive and its level of significance increases to 5%. This strongly suggests that belonging to BIMSTEC has an encouraging influence on exports of the group members. This is an important finding because it is insignificant with negative sign in the FEE and REE estimates of exports panel. The export enhancement effect of BIMSTEC, calculated by $[exp(\alpha_{11}) - 1]*100$ turns out to be 28.53%.

The importers' and exporters' effects are significant in both import and export panels. Time effects are significant in all the estimates. In both the panels we consider only the BIMSTEC countries to understand the importer and exporter specific effects. Interaction effects are also found to be significant. These indicate that exogenous exporter- and importer-specific shocks that vary over time, such as business cycle and unobserved factor endowment, influence trade of BIMSTEC members. Importer and exporter specific effects indicate that their trading efficiencies significantly influence bilateral trade over time. All these resemble the findings of Egger (2002) and Baltagi *et al*. (2003).

V. Conclusion

This paper applies an augmented gravity model to estimate the factors that influence bilateral trade of four founding BIMSTEC countries with their important global partners as well as other BIMSTEC members. The analysis of the trade determinants has been performed allowing for the main and interaction effects. The regression results provide interesting results that mostly support the gravity estimates conducted on other economic blocs. Due to the presence of cross-sectional dependence as well as heteroscedasticity and serial correlation, Prais-Winsten PCSE regression has been adopted that allows for cross-sectional dependence, panel-specific serial correlation and heteroscedasticity.

The results are meaningful in terms of explaining the pattern of BIMSTEC's trade, which support the theoretical model. The *GDP* and governance of both importers and exporters positively influence the bilateral trade. Distance elasticity is negative in both the specifications. The impact of *RER* has also been found consistent with the expectation. Moreover, the *Linder* hypothesis and Heckscher-Ohlin-Samuelson theorem explain the pattern of imports and exports of the bloc, respectively. A positive effect of belonging to BIMSTEC in members' exports has been found, which indicates a strong evidence of positive trade response to the bloc even before the forming an FTA.

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