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EVALUATING ASIAN FTAS: WHAT DO GRAVITY EQUATION MODELS TELL US?

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Evaluating Asian FTAs: *What do Gravity Equation Models Tell Us?*

Sunder Ramaswamy, Abishek Choutagunta and Santosh Kumar Sahu

Abstract

This research evaluates the performance of free trade agreements by analyzing the determinants of trade flows of Asian economies for a panel of thirty-one countries during 2007-2014 using a Gravity model. The estimated results suggest that certain Free Trade Agreements (FTAs) negatively contribute to trade flows across the region and that GDP and population, among other factors, can explain the total trade flows. The study also finds that trade costs which uses distance as a proxy, has a significant and negative effect on trade. The results are in-line with the expectations which can be drawn by looking at trends of trade flows in Asia and thus, a case is made for smoothening trade-flows across the region by reducing tariff and non-tariff barriers; pumping in investments on transport infrastructure, and improving productivity of the partners as a whole which has positive effects on GDP and thus trade.

Keywords: *International Trade Flows, Gravity Model, Asia, PPML*
JEL Codes: *F13, F14, C23*

INTRODUCTION

The regionalism of trade in Asia has often been talked about due to its potential and resilience even under economically gloomy circumstances. The booming trade in Asia has been attributed to specialized production chains that boast of increasingly sophisticated export products and is considered to be the push in driving growth of the regional economy. Many have credited the growth story of Asia to the signing of multilateral Free Trade Agreements (FTAs) which have been rapidly spreading and facilitating better trade all across Asia (Kawai and Wignaraja 2010). Led by the emerging markets, Asian exports now comprise 30 percent of world trade. Besides, all these efficiency gains have also helped to raise the technological sophistication of the regions' exports. With Asia's trade patterns evolving and an increase in the number of FTAs that are being entered into, the more advanced economies are specializing in manufacturing of high-end inputs and exporting these to less advanced economies, such as India, China, Thailand etc., for assembly and further export to final markets (Anderson and Strutt 2011). In the past, newly industrialized economies of East Asia exported low-end consumer goods mainly to developed countries outside the region. However, these economies now export fewer goods outside Asia - instead, they ship more advanced components to other economies inside Asia, this applies especially in the case of India and China. The Asian giants - China and India have evolved from small exporters to global giants; also, India is one of the world's largest exporters of services. However, Asia's production chains suggest that there is increasing evidence of intra-regional competition. We also observe that the region's economies are producing complementary goods. From a very broad perspective, the recent years, even with strong fundamentals countries in Asia have experiencing slumps in trade which have seemingly not recovered post 2008 world financial crisis. Understanding these slumps and looking at how these multilateral FTAs have contributed towards the development of trade patterns over recent years would help us understand better, the problems with exports.

This work first discusses the background and motivation of the study and builds an intuition for the applicability of the Gravity model. We use appropriate econometric techniques for the select countries of Asia and the results are in line with the earlier studies and thus, smoothening trade flows across the region by reducing tariff and non-tariff barriers, increasing investment opportunities for transport infrastructure and productivity of partner economies will bring expected positive effects on GDP, and thence, trade.

THE ASIAN TRADE SCENARIO

Regional integration can be a very strong driver in the economic growth of the Asian region. Clearly, the regional integration agenda is particularly important in South Asia because the region is one of the least integrated regions in the world in terms of trade. About 5 percent of goods and services, produced in the region are traded within South Asia, in contrast to 25 percent within the Association of Southeast Asian Nations (ASEAN) region. The other set of problems which the region faces are trade barriers. Given the presence of traditional trade regimes in the region, which are inward looking and very autarkic trade resistance among countries (region specific) is very high, trade of commodities produced in the region being exported outside the same region is relatively lower. This is a problem occurring within the region and needs desperate fixing through reforms of trade and regulatory policies. Additionally, the problem of cross-investments is being reformed with better regulatory structures in the economies.

Connectivity is another great barrier which the region has to face in the pursuit of smoothening trade across the region[1]. A recent study has also reported that the average speed of freight movement in India is

[1] For example, it takes about 35 days to send a consignment from New Delhi to Dhaka - which takes a round route through Mumbai - Colombo and finally reaches Dhaka; typically, this should take a straight forward route from Kolkata to Dhaka.

around 25 kilometers per hour which is far below many developing countries – this causes a huge, unobservable increase in the trade costs of the region (KPMG 2010)[2]. The above set of trade barriers are a problem the region has been facing for a long time now. Although non-tariff barriers (NTBs) seem to look like a major deterrent in the region, it cannot explain the dismal statistic of 5 percent intra-regional trade. It is observed that resistance from tariffs and taxes are very high. Thus, the biggest set of barriers which the South Asian region faces in terms of smoothening trade facilitation is that of taxes and tariffs. Taxes and tariffs on trade flows as a percentage of revenue in the South Asia is about 3 times that of other comparable averages across the region and the world. Many studies by multilateral agencies (Kardar 2011) have shown that lowering these rates have to be another prime priority for the policy makers in the region or else the potential trade flows and integration will merely remain on paper.

There have also been studies which show trade as a major facilitator in reduction of poverty. Stoler *et. al.* (2009) stress that private-public sector cooperation in the areas of infrastructure and manufacturing are important in realizing the benefits of membership in multilateral organizations. They also add that greater politico-institutional commitments and cooperation are required at all levels (locally, domestically, regionally and internationally) to support the practical aspects of trade and development strategies. In all, studies across the South Asia region show that there is a strong positive correlation between liberalization, robust competition policies and poverty programs if a few pre-condition such as openness and liberalization of trade, institutional reform domestically and adjustment cost support are in place. Thus, a mix of well-thought through reforms - trade facilitation at

[2] Another good example of a similar scenario can be the case of Pakistan and India – which share a huge common border, but it has been observed that trade costs between India and Pakistan are 20 percent more than the costs between India and Brazil, a country which is about 9000 kilometers away from India.

border posts, infrastructure improvement of railways, roadways and ports can have a massive impact on economic activity and job creation - this would be a very strong driver of growth and elimination of poverty in the region.

Proponents say that FTAs make it easier and cheaper for countries to export goods and services while creating jobs and boosting the economy. The principal argument is that when a country reduces trade barriers, goods become cheaper for consumers, inputs become cheaper for businesses – so, the question which really requires answering is that, why is there a need to negotiate trade agreements and barrier reductions if they are so beneficial to the country doing the trade reductions. The basic strand of the debate's narrative has a political argument, in that, there need to be gains from trade in the constituencies which are participating in the exercise; because otherwise, some of the losses which are going to be concentrated in particular sectors are going to lead to those sectors mobilizing against doing any trade liberalization.

There have been specific sectors in an economy which have traditionally existed behind high tariff barriers, non-tariff barriers and other forms of protection; these sectors might find it difficult to compete with the imports coming in; but at the same time, the economic benefits of the trade flows are positive – there are efficiency improvements for the producer and choice based improvements for the consumers. The counter argument to this is that free trade agreements open markets up, and help boost the economy. A lot of imports coming in are not actually imports into the production processes (not actually consumer goods); thus, for the domestic businesses, reducing tariffs means that there are cheaper goods and cheaper production processes and thus be more competitive with the world markets. In one sense, FTAs might look like they are directly contravening a directive principle of the World Trade Organization (WTO) which gives the Most Favored Nation (MFN) clause about non-discriminatory handling of trade. But, article 24 in WTO (WTO 1994) allows for FTAs to go through; the problem then, is that, FTA proliferation has become a systemic problem for the WTO. Economists do realize that the scale to which they have grown now (419 FTAs are in force), have brought in complications in the trading system by deepening the rules of origin and tariff complexities.

Given that the whole purpose of trading systems is to lower barriers to trade and that the global trading systems have ballooned tremendously over the last few decades, multilateral agencies such as the WTO have not been able to cope with the spurt in the number of trading member nations of the organization. Having to reduce tariffs across the board on a level basis requires all members (162 FTAs in total) to agree to the said reduction, and achieving this level of cooperation is increasingly difficult. This is evident through duration of each successive General Agreements on Tariffs and Trade (GATT) and WTO rounds such as the Tokyo Round[3] of GATT in 1974 lasted for 6 years, the Uruguay Round of the WTO in 1986[4] lasted for around 8 years and the current Doha Round has been going on for more than 14 years and counting. This is the reason why groups of nations in agreement with terms of trade have been coming together and signing pacts such as the Association of Southeast Asian Nations in the ASEAN FTA (AFTA), the North American FTA (NAFTA) etc. This multilateral behavior has not only allowed for faster resolution of tariff related issues among countries but has also stalemated many WTO activities (Krugman *et. al.* 2011). In the Asian scenario, the massive proliferation of FTAs has caused a *Spaghetti-*

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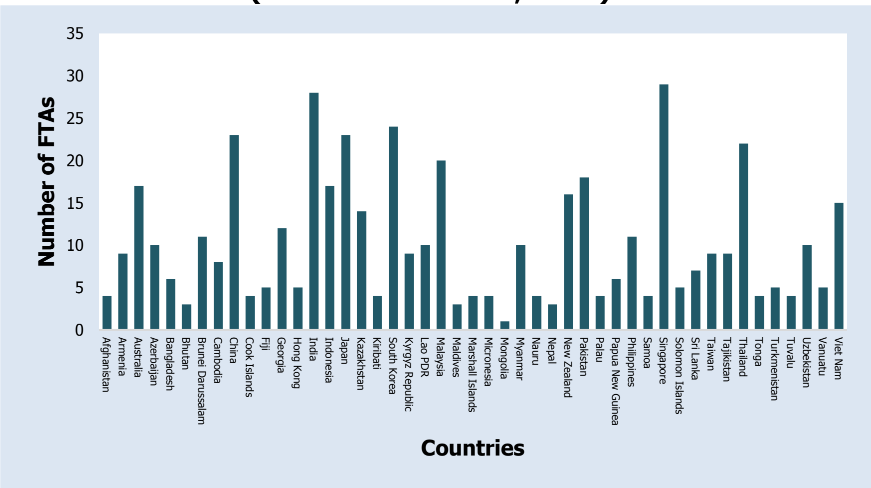
[3]The Tokyo Round of GATT which was held in 1974 had the participation of 102 countries and was predominantly focused on coming to a consensus on reducing trade and non-trade barriers by about 33 percent on a level basis. The round was also successful in bringing down custom duties on several industrialized nations. However, it failed to provide solutions on farm imports and countervailing measures. For a detailed note see Meier (1980).

[4] For a detailed note see WTO (1994).

bowl effect (Krugman *et. al.* 2011) through the intertwined mass of preferential trading arrangements among FTA country members. But the fact that these have been created specifically for the purpose of handling delays caused by arbitration entailed in the WTO process also remains valid.

Figure 1: Free Trade Agreements Signed by Countries in Asia (As of 30 November, 2015)

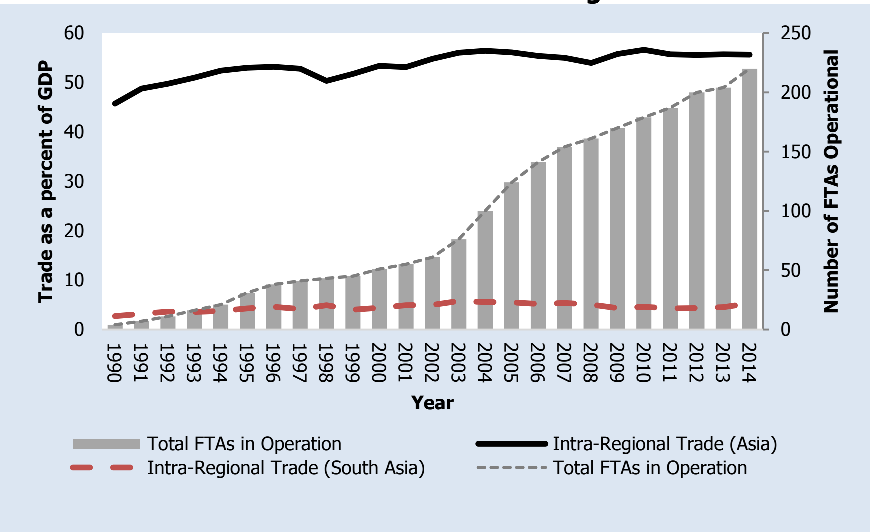


Source: Asian Regional Integration Centre FTA Database, Asian Development Bank.

From Figure 1, we see the current state of the FTA signing in Asia (which stands at 140 FTAs signed and in effect). This is in addition to a slew of a whole new line of FTAs which are still being negotiated amongst South Asian countries and those which have been signed, but are still not in effect – this amounts to 75 FTAs in total (Asian Development Bank 2016)[5]. This stalemate nature and the South Asian trade conundrum, is presented in Figure 2.

[5] This amount of proliferation of FTAs may be good at in the beginning, but may be a stalemate in terms of getting further agreements signed mainly because of the stalemate preferential nature of these agreements. If country *x* signs an agreement with *y*, but *x* has not signed an agreement with *z*, which happens to be *x*'s main trading partner; it would lead to distortions in the trade flows between all three countries *x, y* and *z.*

Figure 2: Inter-Regional Trade (Percent of Total Trade) and Number of Bilateral FTAs Signed



Source: Asia Regional Integration Centre FTA Database, Asian Development Bank.

It can be observed that for the past two and a half decades, the intra-regional trade within Asia has remained relatively constant at about 50 percent of total trade volume. The South Asian specific intra-regional trade share values are dismal, at about 4 percent of the total trade value. Given the *Spaghetti-bowl effect*, the feeling within Asia and many economic commentators is that very few organizations in Asia actually benefit from the FTAs. Kawai and Wignaraja (2010) find that FTAs are dramatically underutilized given their trade potential. A survey conducted by them found that the 609 exporting firms surveyed from Singapore, Thailand, Korea and Japan utilized only 22 percent of the FTA preferences and when planned FTA preferences are taken into in, 44 percent of all East Asian firms either use or plan to use FTA preferences. It is not that the choices of FTAs are too shallow; it is that using these FTAs in trade provides no added benefit in facilitating trade within the region.

The case of the South Asian Association for Regional Cooperation (SAARC) is a particularly striking one; this geopolitical organization of eight South Asian countries based predominantly in the Indian subcontinent has huge trade potential but has very little intra-regional trade. This is partly because of the very high tariff rates and poor infrastructure in facilitating trade. The SAARC FTA (SAFTA) aims to bring down tariffs between the member nations to zero, but seemed to not have worked in the strictest of ways and there is a long way to go in terms of smoothening trade in the Indian subcontinent. A study by Baier and Bergstrand (2007) has found some comprehensive results in understanding how multilateral agencies and FTAs have promoted trade in regions but in a vague sense. The general equilibrium effects of FTA member trade with non-members are still not well defined. The work of Rose (2004) and Subramanian and Wei (2007) also find specific evidences on part of the WTO and how they seem to have promoted trade amongst member nations of a multilateral pact. But the Asian specific scenario still seems very vague, given the fact that many operational FTAs are still quite dysfunctional in nature. The Asian trade scenario in general and trade scenario linking with the FTAs in particular directs us to a Gravity-type model as discussed and estimated in the existing reviews and policy papers. The theoretical understanding of this model with appropriate econometric tools, are presented in the next section.

THEORETICAL FRAMEWORK

Over the last few decades, the Gravity equation has become one of the most important tools for trade economists. Most theoretical and empirical advances today have been made in the context of the Gravity model. The model was first specified by Tinbergen (1962) and has since taken on thousands of variations. The model was first proposed to serve as an intuitive means of understanding trade flows. The basic model is written as follows:

$$log\, X_{ij} = c + \beta_1\, log\, GDP_i + \beta_2\, log\, GDP_j + \beta_3\, log\, d_{ij} + \varepsilon_{ij} \qquad (1)$$

where, $d_{ij} = \log\left(distance_{ij}\right)$

Here X_{ij} indicates a trade flow from country *i* to *j*, and GDP indicates the country's gross domestic product. d_{ij} is log of distance which would serve as the proxy for trade costs occurring between the two countries. For the measurement of the trade impact between two countries *i* and *j* with respect to the change in trade costs in the countries *j* and *k* a more dynamic model would be required. Effects in scenarios like the inclusion of FTAs, border effects, areas and other dynamic aspects of the global trading scene can be econometrically estimated only after correctly specifying an augmented Gravity equation model. The Gravity equation would clearly have to be altered to suit and fit needs expected out of the Gravity model – which is to evaluate FTAs. Many economists have theoretically arrived at Gravity-like trade equation through economic theory (Anderson 1979). He uses the *Armington assumption* where products are differentiated on the basis of the place of origin; this also gives rise to an elasticity equation, where the elasticity of substitution between products of different countries is defined and countries maximize their utilities over non-traded goods, modeled as the *seperability assumption*.

We work with the theoretical development of the Gravity model in terms of added features which is mainly the work of (Anderson and van Wincoop 2003) which is the basis of the augmented Gravity model estimated. The Augmented Gravity model of Anderson and van Wincoop (2003) – AvW henceforth; in its most basic form is a demand function derived out of the constant elasticity of substitution (CES). The model assumes that the consumers' preferences are defined by a "love of variety" – where the consumption of a wider variety of products leads to higher increases of utility rather than the quantity of consumption alone[6]. The model AvW also allows for the computation of the multilateral resistance (MTR) occurring due to trade, which is basically a modification of the argument for border-cost through the home bias in a country's trade made by McCallum (1995). The MTR consideration essentially derives from the fact that a remote country would always diversify production capabilities domestically owing to the high trade costs involved in consumption. But, if a country is near another country there would be a higher degree of specialization and thus, there would be higher trade flows. The basic CES function of the AvW model is

$$U_j = \left(\sum_i \beta_i^{1-\sigma/\sigma} c_{ij}^{1-\sigma/\sigma} \right)^{\sigma/(\sigma-1)} \tag{2}$$

where, c_{ij} denotes the consumption of the agent(s) in country *j* through the production of goods by the agent(s) in country *i*. β is a positive constant and σ is the elasticity of substitution in the CES function – between countries *i* and *j*. The constraints faced by the consumer is given by

$$y_j = \sum_i x_{ij} = \sum_i p_{ij}\, c_{ij} \tag{3}$$

Here, y_j is the income of the country *j* in nominal terms, p_{ij} is the price of country *i* goods for country *j*, where *i* is the exporter and *j* is the importer. We take nominal prices in c.i.f. (cost, insurance and freight) terms because of price differences occurring unobservable trade cost

[6] The AvW model also makes the following considerations: that producers can sell goods in any country and that local sales of goods involve no transport costs and international sales of goods involves transport costs. Thus, consumers have the choice to consume a variety of products from all over the world but with adjustments made with respect to the transport costs involved in the movement of the products. These considerations allow for the derivation of the equilibriums of productions, prices and export volumes. Further aggregations and adjustments give the total values and the marginal increases in trade costs/volumes etc.

differentials. These c.i.f. trade costs are modeled as *iceberg costs* from Krugman (1991); it basically implies that t_{ij} units of goods from the country *i* need to be exported for one unit of the good to reach country *j*. The price of exports $p_{ij} = p_i t_{ij}$ where p_i is the supply-price in country *i*. Thus, for each unit of flow from *i* to *j* the trade cost would be $t_{ij} - 1$ in terms of good *i* lost to shipping. These sunk costs are passed on to the importer. As noted before, if $i = j$ then $t_{ij} = 1$ and $p_{ij} = p_i$. Further, solving a Lagrangian for the maximization problem of the importer, we get the demand function x_{ij} as:

$$x_{ij} = \left(\frac{\beta_i p_i t_{ij}}{p_j}\right)^{1-\sigma} y_j \quad (4)$$

Here, p_j is a function of *j's* bilateral resistance terms and is given by,

$$p_j = \left[\sum_i \left(\beta_i p_i t_{ij}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \quad (5)$$

We now impose the market clearing condition

$$y_{ij} = \sum_j x_{ij} = \sum_j \left(\frac{\beta_i p_i t_{ij}}{p_j}\right)^{1-\sigma} \quad (6)$$

$$y_j = (\beta_i p_i)^{1-\sigma} y_w \sum_j \left[\left(\frac{t_{ij}}{p_j}\right)^{1-\sigma} \frac{y_j}{y_w}\right] \quad (6.1)$$

Defining world income, $y_w = \sum_j y_j$ and $(\beta_i p_i)$ as the scaled prices for trade, we solve for $(\beta_i p_i)$ and substitute them in equation (4) and arrive at

$$x_{ij} = \frac{y_i y_j}{y_w} \left(\frac{t_{ij}}{\Pi_i p_j}\right)^{1-\sigma} \quad (7)$$

Where, $\Pi_i \equiv \left(\sum_j (t_{ij}/P_j)^{1-\sigma} \theta_j\right)^{1/(1-\sigma)}$, and the world income shares denoted by $\theta_j \equiv \frac{y_j}{y_w}$.

Solving for $\Pi_i$and p_i in terms of θ_j and the bilateral trade barriers t_{ij} and σ keeping $t_{ij} = t_{ji}$ (symmetric trade costs) from equation (6) and (7) we arrive the price of exports as:

$$p_j^{1-\sigma} = \sum_i p_i^{\sigma-1} \theta_i t_{ij}^{1-\sigma} \tag{8}$$

This finally boils down to the AvW's final equation if solved for price indices as a function of all bilateral trade barriers and income shares, which is;

$$x_{ij} = \frac{y_i y_j}{y_w} \left(\frac{t_{ij}}{p_i p_j}\right)^{1-\sigma} \tag{9}$$

Equation (9) derived out of the CES function by AvW is specifically important since it makes it possible to compute the bilateral trade costs with respect to the overall index of trade costs (*i.e.,* a comparative static between bilateral and multilateral trade resistance). If these were in real terms as opposed to nominal terms through relative prices, we can observe the dynamics of the reduction of trade barriers between large countries trading versus small ones. Also since t_{ij} is not observed directly, a log-linear function of the observable variables is defined. This is basically the bilateral distance between *i* and *j* and a series of dummies which are specific to *i* and *j* respectively. Thus;

$$t_{ij} = b_{ij} d_{ij}^{\rho} \text{ and} \quad (10)$$

$$x_{ij} = \frac{y_i y_j}{y_w} \left(\frac{b_{ij} d_{ij}^{\rho}}{p_i p_j} \right)^{1-\sigma} \quad (11)$$

Substituting equation (10) in parts of (11) and after log-linearizing, we get

$$\ln T_{ij} = \ln y_i + \ln y_j + (1-\sigma)\rho \ln d_{ij} + (1-\sigma) \ln b_{ij} - (1-\sigma) \ln p_i - (1-\sigma) \ln p_j + \varepsilon_{ij} \quad (12)$$

Which is an econometrically estimable equation, and the exact specification of the Gravity model which is used is as follows:

$$\ln \ \mathrm{T_{ijt}} = \beta_0 + \beta_1 GDP_{EXP_t} + \beta_2 \ln GDP_{IMP_t} + \beta_3 \ln AREA_{EXPt} + \beta_4 \ln AREA_{IMP_t} + \beta_5 + \beta_6 \ DIST_{EXP-IMP} + \beta_7 POP_{EXP_t} + \beta_8 POP_{IMP_t} + \beta_9 \ COMLANG_{IMP-EXP} + \gamma_1 AFTA_{EXP} + \gamma_2 APTA_{EXP} + \gamma_3 GCC_{EXP} + \gamma_4 SAFTA_{EXP} + \gamma_5 CISFTA_{EXP} + \sum \delta_t \varphi_t + \varepsilon_{ijt} \quad (13)$$

where, *EXP* and *IMP* denote the exporting and importing country respectively and *t* denotes time. $\mathrm{T_{ijt}}$ is the value of bilateral trade between *EXP* and *IMP* at time *t.* GDP is the Real Gross Domestic Product country *EXP* or *IMP.* Area is the country *EXP* or *IMP*'s area in square kilometers. Contiguity is a dummy which takes the value unity if *EXP* and *IMP* share a land border, else 0. Distance is the circular distance between the capitals of *EXP* and *IMP.* Population is the population of country *EXP* and *IMP.* φ_t and δ_t are the time and country fixed effects generated while estimating equation (13). The AFTA (ASEAN Free Trade

Agreement), APTA (Asia Pacific Free Trade Agreement), GCC (Gulf Cooperation Council), SAFTA (SAARC Free Trade Agrement) and the CISFTA (Commonwealth of Independent States Free Trade Agreement) variables are FTA dummies where they are equal to 1 if both *EXP* is a member of the FTA at time *t,* else 0. Finally, ε_{ijt}, is a log-normally distributed error-term.

EMPIRICAL RESULTS OF THE GRAVITY MODEL

This section discusses the methods employed to estimate the Gravity equation model as presented in equation (13). As it stands, a simple pooled Ordinary Least Squares (OLS) estimator can only estimate the performance and β-efficiencies of each of variables estimated in the equation and not any of the comparative statics discussed. The AvW Augmented Gravity Model is best estimated using the panel fixed effects estimator to accommodate the computation of the resistance terms which are vital in understanding the multilateral effects of trade in Asia. Here, the exporter and importer terms are grouped and the Gravity model from equation (13) is rewritten as;

$$\ln(T_{ij}) = c + \psi_i + \omega_j + (1-\sigma)\ln\xi_{ij} \tag{14}$$

where, $c = -\ln y_i y_j$, $\psi_i = \ln y_i - \ln \Psi_{\mathrm{i}}$, $\omega_i = \ln y_j - \ln \Omega_j$

and, $\ln \xi_{ij} = b_1 \ln dist_{ij} + b_2\, contig_{ij} + b_4\, comlang_{ij}$

where T_{ij} is the total trade flows, $\psi_i\ and\ \omega_j$ are the terms explaining the exporter and importer costs (fixed effects dummies) respectively, within which $\Psi_{\mathrm{i}}\ and\ \Omega_j$ are the unobserved heterogeneities explaining the multilateral resistance (MR) terms. The constant c is the regression constant which in terms of theory is equal to the total world GDP; when econometrically estimated this is captured as a coefficient multiplied by a constant term which remains the same across exporters and importers. This is relatively straight forward which differs from the normal

Generalized Least Squares (GLS) based fixed and random effects. The second set of estimations, are the random effect (RE) estimators – these are being estimated to keep in line with consistency in estimation[7]. Although the literature does tell us about the use of RE in the estimation of Gravity equation models, a majority of the studies avoid it since it is used only in a very restrictive sense. The two main reasons behind doing this is firstly that RE is consistent on severe assumptional restrictions on the unobserved heterogeneity and secondly the RE estimates would require the MR terms to be normally distributed (Fratianni and Hoon Oh 2007). A problem which the Gravity model estimations face is the endogeneity bias which normal OLS based models suffer given the high dependence on dummies. Many variables which depict policy stances of particular countries usually present the problem of endogeneity. The standard method to deal with this issue is to use an instrument which is partially endogenous with the independents but is not well correlated with the dependent variable. The other problem with the standard method of estimating Gravity models is the problem of log-linearizing the model. The transformation of equation (14) gives a logarithmic error term as well. In simple terms, consider;

$$\ln T_{ijt} = \ln \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 Dist + \ln \varepsilon_{ijt} \tag{15}$$

The expectations of the equation would then be;

$$\begin{aligned} E[\ln T_{ijt}] = {} & \mathrm{E}\,[\ln \beta_0] \\ & + \beta_1\, \mathrm{E}\,[\ln GDP_i] \\ & + \beta_2 E\,[\ln GDP_j] + \beta_3\, E[Dist] + \mathrm{E}\,[\ln \varepsilon_{ijt}] \end{aligned} \tag{15.1}$$

Given Jensen's inequality[8], we know that, $\ln E[\varepsilon_{ijt}] \neq E\,[\ln \varepsilon_{ijt}]$, and thus the distributional property of T_{ijt} is altered which results in

[7] See Appendix 3.

[8] For a detailed explanation see Wooldridge (2002).

inconsistent OLS estimates. This affects the variance of the parameters, making OLS inefficient. Additionally, the matrix of dummies created due to the control variables in the Gravity equation and the dummies of the FTAs skews the normality of the data. Silva and Tenreyro (2006) developed an estimator for consistently estimating the model. The Pseudo-Poisson Maximum Likelihood (PPML) estimator corrects for the biased errors and the dummies which is also estimated for a robust analysis. The equation to be estimated is being done for 31 countries in total sharing 5 multilateral FTAs for a period of 2007 to 2014. The sources of data are presented in Appendix 1. List of countries which have been included in the study are presented in Appendix 2. The database compiled from the sources presented in Appendix 1 is constructed and set as a panel dataset consisting of 15 variables over a time period of 8 years from 2007 to 2014. The dataset has 4,808 observations[9]. As reported in Table (1), modification in the estimation process results in different estimates for some of the variables. The dependent variable captures total trade flows which include only merchandise trade since data on services trade is not quite robust in the case of Asian economies and the barriers in the trade of services is not well documented. Row (1) in Table (1) presents the benchmark estimates of the Gravity model using OLS technique. As one moves from row (1) to (5), the sign and the magnitude of independent variables changes in some cases. From the benchmark results, we see that total trade is quite well explained by the log of exporter's GDP and log of importer's GDP, resulting in a positive and statistically significant relation with trade flows. Therefore, higher GDP from either of the economies results in higher trade potential.

In a Gravity model, distance is one of the major indicators of trade barriers. In Table (1), for rows 1 to 3, this variable is negatively related to log of total trade that explains, shorter the distance between the capitals of trade partners, higher the probability of trade. However,

[9] A dyadic dataset of all country pairs has not been created since trade flows and GDP have not been reported, thus becoming an unbalanced panel dataset.

including other Gravity variables such as contiguity and common language significantly affects the behavior of distance as explained in rows (4) and (5). For rows (4) and (5) in Table (1) both contiguity and common language dummies are positively associated with trade, making the distance variable insignificant. One can argue that, as the direction of the coefficients of distance does not change, the results are robust. However, we assume there is a possibility of geographical dependency between distance and contiguity, and hence, they are correlated. As we estimate equation (13) with different compositions of variables, the model is explained better, both in terms of economic and statistical significance except for the distance, other variables of interest such as population of both exporters and importers behave consistently in terms of magnitude and direction with trade. The result for population (either higher consumption capability or bigger markets) is positively associated with trade behavior. The most preferred model for population however, remains row (5) in Table (1) since the coefficients of both exporters' and importers' population are high compared to row (1) to (4) in Table (1). Thus, *densely populated* countries have better compatibility in becoming trade partners. We link log of population with density in connection with the results arrived from geographical area of importers and exporters. The coefficient associated with area of importers and exporters as presented in row (3) to (5) are negatively related to trade hence, smaller geographical area and bigger population size attract higher trade potential.

Variables representing economic and geographical parameters are important determinants in a Gravity framework, however, FTAs and group affiliations related to trade behavior may be considered as distorters of trade patterns. Therefore, it is important to include dummies that represent FTAs. The dummies used in this case capture a country's affiliation in AFTA, APTA, GCC, SAFTA and CISFTA. The partner countries related to AFTA and APTA have similar and positive relationship with the volume of total trade whereas SAFTA is negatively related. The importance of GCC and CISFTA with FTAs for this sample does not explain trade dependency based on agreements. As discussed in the earlier part of this section, OLS may not be the best possible estimation technique in explaining the Gravity model, as distance is not well explained consistently in Table (1); therefore, the next step of estimation involves fixed and random effects models for panel data. The results are presented in Appendix 3. Efficiency of the result estimated through FE and RE are verified using standard Hausman test, where the Hausman χ^2 being significant, hence, FE is accepted over RE estimates. When we compare the results of the fixed effects with row (5) in Table (1) the distance variable has a consistency in explaining trade volume as presented in row (1) to (4) in Table (1). However, the results of geographical area are not well explained in the FE estimates.

As argued by Silva and Tenreyro (2006), PPML is an appropriate technique as compared to OLS and fixed effects estimates. The results of PPML are presented in Table (2). A similar approach is followed in estimating equation (13) for the PPML case where we introduce variables related to economic activity, geographical indicators and group dummies to check consistency of the estimator and robustness. Results from Table (2) are similar in direction as given in Table (1) except for distance where distance has a negative coefficient; this is consistent with row (1) to (4) of Table (1). Hence, we conclude that, distance and geographical area are negatively related whereas population, contiguity and common language, are positively related to trade volumes. Consistent with the earlier estimates of OLS, PPML gives a similar but a robust result for all of the variables. In case of the group dummies related to the FTAs, the coefficient of GCC has turned out to be significant and negatively related to trade volumes. Whereas, CISFTA has positive and significant coefficient attached to trade volume. This result of PPML which is mostly in the line with OLS and FE points at the importance of FTAs where affiliation with a certain trade agreement(s) increase trade potential and hence, bilateral trade activities which enhance an economy to increase the trade volume. Given that the amount of intra-regional trade occurring in the Indian subcontinent is highly influenced by regional socio-political complexities and geographical constraints apart from the highly un-operable status of the FTA itself, dummies such as SAFTA even negatively influence trade volumes, does not qualify to be a determinant of trade as presented in Table (2).

CONCLUSIONS

This study examines the nature of trade flows in South Asia and some of its neighboring countries. A Gravity model is estimated using different techniques for the period of 2007 until 2014. This period covers a phase in world trade that experienced the post financial crisis contractions, with the added impediment of strict complementarities existing in the Asian production networks. This study adds to the literature by providing comparative performance of the Asian Free Trade Agreements by accommodating the dynamic linkages between trading partners. The results reveal that there are certain distortions which exist in the operation of FTAs within Asia, and in the performance of GCC and SAFTA in particular. Variables such as GDP and population are significant in the explanation of total trade flows in the region. Our results indicate that increases in trade flow with increase in GDP would positively affect utilization of inputs. Thus, allowing for the creation of economies of scale could possibly result in the lowering of the multilateral resistance enabling lesser trade costs and more efficient trade flows, which could then result in a higher level of intra-regional trade within the Asian region. Another feature that can be inferred from the results is that high trade costs occur due to "distance" between two trading partners; if there is better connectivity routes developed within these trading partners in Asia, there could be better realization of the trade potentials within the region. Our findings are similar in some ways to studies attempted in the South-Asian and the Indian context as studied by Batra (2004), Bhattacharyya and Banerjee (2006) and Kumar and Ahmed

(2015) where we also arrive similar relationship of distance and GDP with total trade. The use of PPML as an alternative method of estimation, and including variables such as FTA dummies, make this study robust from a policy stand point. In conclusion, we suggest, that if efforts are made to make FTAs more structured and operational, countries will involve themselves in increasing bilateral trade. This will help in achieving higher productivity, better infrastructure, and sustainable growth in GDP. Therefore, increasing the operational capabilities of FTAs among the participating countries will not only help in the growth of economic indicators such as GDP, but also help welfare maximizing efforts through reducing poverty and increasing the quality of life.

Table 1: Results of the OLS Regressions

Variables	(1)	(2)	(3)	(4)	(5)
ln GDP_{EXP}	0.866***	0.669***	0.640***	0.602***	0.521***
	(0.040)	(0.050)	(0.050)	(0.049)	(0.062)
ln GDP_{IMP}	0.943***	0.815***	0.798***	0.762***	0.805***
	(0.040)	(0.051)	(0.050)	(0.051)	(0.053)
ln POP_{EXP}		0.406***	0.650***	0.690***	0.709***
		(0.055)	(0.071)	(0.070)	(0.103)
ln POP_{IMP}		0.325***	0.503***	0.549***	0.528***
		(0.056)	(0.073)	(0.072)	(0.071)
ln $AREA_{EXP}$			-0.230***	-0.270***	-0.272***
			(0.051)	(0.049)	(0.057)
ln $AREA_{IMP}$			-0.176***	-0.217***	-0.224***
			(0.051)	(0.049)	(0.048)
ln $DIST_{EXP-IMP}$	-0.868***	-0.892***	-0.864***	-0.25	-0.337
	(0.214)	(0.209)	(0.216)	(0.247)	(0.267)
$CONTIG_{EXP-IMP}$				1.880***	1.795***
				(0.389)	(0.396)
$COMLANG_{EXP-IMP}$				2.334***	2.244***
				(0.421)	(0.443)
$AFTA_{EXP}$					0.783***
					(0.284)
$APTA_{EXP}$					0.871***
					(0.245)
GCC_{EXP}					0.157
					(0.293)
$SAFTA_{EXP}$					-0.794***
					(0.279)
$CISFTA_{EXP}$					0.0355
					(0.192)
Constant	-28.07***	-31.83***	-33.07***	-36.94***	-35.31***
	(2.071)	(2.047)	(2.089)	(2.111)	(2.251)
Observations	4,648	4,648	4,648	4,648	4,648
R^2	0.65	0.61	0.63	0.64	0.66

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2: Results of the PPML Regressions

Variables	(1) PPML	(2) PPML	(3) PPML	(4) PPML	(5) PPML
ln GDP_{EXP}	0.102***	0.107***	0.103***	0.100***	0.106***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.004)
ln GDP_{IMP}	0.106***	0.108***	0.107***	0.105***	0.104***
	(0.002)	(0.002)	(0.00274)	(0.003)	(0.003)
ln POP_{EXP}		-0.005**	0.0263***	0.028***	0.011*
		(0.003)	(0.003)	(0.003)	(0.005)
ln POP_{IMP}		-0.002	0.0130***	0.014***	0.014***
		(0.002)	(0.003)	(0.003)	(0.002)
ln $AREA_{EXP}$			-0.0275***	-0.029***	-0.022***
			(0.002)	(0.002)	(0.003)
ln $AREA_{IMP}$			-0.0154***	-0.017***	-0.017***
			(0.001)	(0.001)	(0.002)
ln $DIST_{EXP-IMP}$	-0.094***	-0.094***	-0.092***	-0.070***	-0.071***
	(0.007)	(0.006)	(0.007)	(0.010)	(0.010)
$CONTIG_{EXP-IMP}$				0.096***	0.093***
				(0.015)	(0.014)
$COMLANG_{EXP-IMP}$				0.036**	0.055***
				(0.015)	(0.015)
$AFTA_{EXP}$					0.068***
					(0.011)
$APTA_{EXP}$					0.027**
					(0.011)
GCC_{EXP}					-0.077***
					(0.013)
$SAFTA_{EXP}$					-0.005
					(0.012)
$CISFTA_{EXP}$					0.018**
					(0.008)
Constant	-2.153***	-2.183***	-2.374***	-2.428***	-2.364***
	(0.087)	(0.087)	(0.089)	(0.087)	(0.090)
Observations	4,648	4,648	4,648	4,648	4,648
R^2	0.59	0.59	0.62	0.63	0.64

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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Appendix 1: Data Sources for Equation (15)

Indicator(s)	Data Source(s)
Total trade flows between country pairs	World Integrated Trade Solution (WITS), (World Bank 2016a)
Real GDP and Population for country pairs	World Development Indicators, (World Bank 2016b)
Area (in square kilometers)	Rose (2004)
Contiguity, Common Language	CEPII (2010)
FTA Dummies	Asian Development Bank (2016)

Appendix 2: List of Countries

Countries			
United Arab Emirates	Kazakhstan	Mongolia	Singapore
Armenia	Kyrgyzstan	Malaysia	Thailand
Bangladesh	Cambodia	Nepal	Ukraine
Bahrain	South Korea	Oman	Viet Nam
Belarus	Kuwait	Pakistan	
Brunei	Sri Lanka	Qatar	
Bhutan	Moldova	Russia	
China	Maldives	India	
Indonesia	Myanmar	Saudi Arabia	

Appendix 3: Fixed and Random Effects Estimates

Variables	Country Fixed Effects	Random Effects
ln GDP_{EXP}	0.486***	0.521***
	(0.112)	(0.062)
ln GDP_{IMP}	0.621***	0.805***
	(0.098)	(0.054)
ln POP_{EXP}	0.436	0.709***
	(0.514)	(0.103)
ln POP_{IMP}	0.418	0.528***
	(0.330)	(0.071)
ln $AREA_{EXP}$	-0.417*	-0.272***
	(0.247)	(0.057)
ln $DIST_{EXP-IMP}$	-0.660**	-0.337
	(0.306)	(0.267)
$CONTIG_{EXP-IMP}$	1.647***	1.795***
	(0.455)	(0.396)
$COMLANG_{EXP-IMP}$	1.359***	2.244***
	(0.502)	(0.443)
ln $AREA_{IMP}$	-0.752	-0.224***
	(0.625)	(0.048)
$AFTA_{EXP}$	1.044*	0.783***
	(0.624)	(0.284)
$APTA_{EXP}$	-0.043	0.871***
	(1.954)	(0.245)
GCC_{EXP}	-0.045	0.157
	(0.720)	(0.293)
$SAFTA_{EXP}$	-0.060	-0.794***
	(0.797)	(0.279)
$CISFTA_{EXP}$	0.746	0.035
	(0.584)	(0.192)
Constant	-10.74	-35.31***
	(7.311)	(2.251)
Observations	4,648	4,648
R^2	0.75	0.66

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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