Impact of AIFTA on Agriculture Trade Creation & Trade Diversion: Gravity Model Analysis

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Abstract:

The prime objective of the paper is to estimate the trade creation and trade diversion effect of ASEAN-India Free Trade Agreement (AIFTA) on member's agricultural trade. The model includes 50 countries with five major FTAs and estimated with panel data regression over the period 2005-2014. We used OLS (Ordinary Least Square) and PPML (Poisson Pseudo-Maximum Likelihood) estimation method to accomplish the above-said objective. The PPML method deals with hetroskedasticity bias encountered as usual OLS method. Further, the paper has included two dummy variables Time and Country-specific effect which control the endogeneity bias in explanatory variables. The paper found that PPML results are more promising than the conventional method (OLS). Further, estimate reveals purely trade creation effect for AIFTA, MERCOSURE, and EU_15 under time fixed effect model. Under the time and country fixed effect model; AIFTA, SAPTA, and NAFTA found trade creation. In contrast, the paper also noticed purely trade diversion effect for SAPTA and EU_15 and MERCOSURE under time fixed and time and country fixed effect model respectively. The study noted that FTAs are not hampering but positively associated with the free multilateral trade.

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1.1 INTRODUCTION

The world is witnessing a rapid spread of economic regionalism, especially in the last 25 years. Regionalism is taking place through the formation of FTAs. It is interesting that every month brings news of yet another agreement among a group of countries, or between one group and another (Frankel, et. al. 1997). The number of FTAs has been increasing steadily after the World Trade Organization (WTO) came into existence in 1995. For instance, from 1948 to 1994, there were only 124 FTAs notified to the General Agreement on Tariff and Trade (GATT). Subsequently, over 400 additional FTAs covering trade in goods and services have been notified to the WTO/GATT, out of which 300 FTAs are in force and the remaining are in process during the year 2015[1]. Basically, FTAs are formed to increase economic strength by removing barriers to trade and investment among members. Some, however, argued that they hamper multilateral trade negotiation (Levy 1997), while others said that FTAs are a positive path towards freer multilateral trade (Freund 2000).

With this background, the present paper examine the impact of free trade agreement in detail on Indian agriculture sector, study has selected AIFTA (ASEAN-India Free Trade Agreement) keeping in the mind that during the early 1990s, the general trend towards regionalism emerged globally. At the time, ASEAN‟s importance has been realized for politics, economy and diplomacy perspective. Consequently, India initiated Look East Policy in 1991 with focus on India's active engagement in South East Asian affairs. India and ASEAN looked upon FTAs as a complement to the multilateral trading system by ensuring the compatibility of FTAs under the rules laid down by WTO. As a part of the Look East Policy, India is progressing on closer economic and strategic ties with South East Asian countries. Therefore, there is a need to study whether these countries have benefitted from FTAs, considering pre and post AIFTA data. Hence, the study is one step forward to identify the areas which were neglected and to suggest ways to improve trade between the member countries.

1.2 DETERMINANTS OF AGRICULTURAL TRADE

In applied international trade analysis, the gravity model has been extensively used to determine bilateral trade flows between countries. The model has been used in other areas such as the study of determinants of trade flows, estimation of the impact of FTA, exchange rate volatility, Currency Unions, border effect, common language, colony, and religion on trade. The gravity model has attained popularity in empirical fields and there are three reasons as to why. First, international trade

[1] http://rtais.wto.org/UP/PublicMaintainRTAHome.aspx.

flows are a key element in all economic relationships and decision making, there is thus a large demand for assessing the normal or potential trade flows. Second, the data needed for such analysis are easily accessible. Finally, a number of important papers have been published using the gravity model, which establishes it as a standard practice (Baldwin & Taglioni 2006).

The gravity model is a well-accepted tool for analysis of trade liberalization (Egger & Pfaffermayr, 2004), the effects of currency unions on trade (Rose, 2000), trade in services (Kimura & Lee, 2006), intra-firm trade (Egger & Pfaffermayr, Dec. 2005), and FDI (Egger & Pfaffermayr, 2004).

1.3 GRAVITY MODEL

The economists have debated for long over the issues of, whether FTAs benefit member countries and the rest of the world (Bhagwati and Krueger 1995). The group led by Bhagwati supported the Trade Creation (TC) effect of FTAs, while the other group supported the Trade Diversion[2] (TD) effect of FTAs. The former group emphasised that TC effect outweighed the TD effect. According to them, FTAs can improve recourse allocation and income among members through the reduction of trade barriers. Also, the production shifts towards most efficient producers and consumer wills are better off because they can purchase goods at lower price. Overall, FTAs induce welfare improvement for members as well as ROW. The latter group emphasised TD effect of FTAs. By definition, FTAs are discriminatory in nature because members are always granted preferences, while subjecting non-members to barriers. Hence, the extent of TC and TD effects is an empirical question. This paper focuses on the effect of FTAs on agricultural TC and TD.

Research studies dealing with the impact of FTAs on agricultural trade flows among members are scanty. Jayasinghe and Sarker (2008) estimated the TC and TD effects of North American Free Trade Agreement (NAFTA) for six major agricultural commodities. They found that intra-NAFTA trade increased. They did not, however, analyse whether this impinged on the trade with regard to ROW. Koo, Kennedy, and Skripnitchenko (2006) studied selected regional preferential trade agreements and examined their effect on agricultural trade volume through TC and TD. Another important study by Lambert and McKoy (2009) investigated the intra-and extra-bloc effects of FTAs on agricultural and food products. They noticed that members of FTAs experienced increased trade in agriculture and food items. For instance, analysis of NAFTA members' agricultural trade indicated an increase of 145 per cent (TC effect). They also noticed a TD effect in the Caribbean Community and Common

[2] *In general, trade creation means that a free trade area creates trade that would not have existed otherwise. As a result, supply occurs from a more efficient producer of the product. On the other hand, trade diversion means that a free trade area diverts trade, away from a more efficient supplier outside the FTA, towards a least efficient supplier within the FTA (Suranovic, S. M.2010).*

Market, the Central American Common Market, the Andean Community, and the Common Market for Eastern and Southern Africa (COMESA).

A study by Lin and Reed (2010) estimated the impact of FTAs on members' agricultural trade. They found that ASEAN-China PTAs, EU-15, EU-25 and Southern African Development Community (SADC) agreements increased agricultural trade among the members. There was significant export and import diversification for EU-15, but the creation of SADC increased agricultural exports to non-member countries. Less evidence was found for trade creation among NAFTA, whereas on the contrary results supported export diversion theory.

Overall, very few studies have focused on the impact of FTAs on agriculture trade as the agriculture sector has been excluded from most of the FTA agreements. Since the Doha Round of development (2001)[3], however, the agriculture sector has risen in prominence among FTAs. Earlier, studies were concentrated mostly only on NAFTA, EU, etc, and no empirical study has been conducted for ASEAN-India Free Trade Agreement (AIFTA). Hence, an attempt is made to study the effect of AIFTA on members' agricultural trade using the Gravity Model.

1.3.1 BASIC GRAVITY MODEL

The basic Gravity Model is in multiplicative form as follows

$$Xij = \alpha \, Yi \, Yj / Dist_{ij} \quad \text{----------1}$$

Where X_{ij} is the monetary value of trade between i and j, Yi an Yj represents the income of countries i and j respectively. $Dist_{ij}$ represent the distance between country i and j. It implies that the bilateral trade between countries i and j is proportional to their respective income and inverse to distance. In the basic Gravity Model, only income and distance variable were included, while in the standard Gravity Model, apart from these two variable, some more variables are incorporated such common border, common language and per capita income (Frankel 1197). The notation of the standard Gravity Model is explained in detail in a subsequent section. Moreover, initially cross-section data was more common in the estimation of the classical gravity model, but nowadays panel data has become a more popular instrument to estimate the augmented Gravity Model. The following section describes the advantage of panel data over cross-section data.

1.4 IMPORTANCE OF PANEL DATA

Most of the empirical studies of the Gravity Model are based on cross-section data - e.g. Wang & Winters (1991), Hamilton & Winters (1992), Brulhart & Kelly (1999) or Nilsson (2000). Later, the focus shifted from cross-section data to panel data due to its informative nature. Many researchers

[3] The agriculture sector was a cornerstone of Doha Round of WTO negotiation.

used panel data framework for their analysis - e.g. Baldwin (1994), Gros & Gonciarz (1996), Matyas (1997), Egger (2000), Wall (2000), and Rose & van Wincoop (2001). The advantage of panel data over cross-sections or time series is that it is more informative (less collinearity) and thus allows for more degrees of freedom, which makes the estimates more efficient. Furthermore, longitudinal data allows for the control of individual unobserved heterogeneity (Bruderl, 2005).

According to Gomez & Milgram (2009), the results from cross-section data analysis might very substantially depending on the group selected, which leads to an estimation bias. The cross-section estimation results are misspecified because of inability to deal with bilateral heterogeneity; probably it will be present in bilateral trade flows (Serlenga & Shin, 2007). In these circumstances, the panel data approach is best option to deal with heterogeneity issues and it could be controlled by adding time and country specific dummies. Matyas, (1997) also opined that the correct econometric specification of the Gravity Model shall include time, exporter and importer fixed effects in the analysis. For this study, panel data was used, and time and country specific fixed effect dummies were included in the estimation equation.

1.5 PROBLEM OF ENDOGENEITY AND ZERO TRADE OBSERVATIONS

Researchers often face the problem of endogenity when estimating the impact of trade policies using the Gravity Model. According to Baier and Bergstrand (2007), an important source of endogeneity relationship arises due to the omitted variable bias. The problem of endogeneity is common when estimating the impact of FTAs with the Gravity Model. Countries are forming FTAs among them because they already trade a lot. In addition, countries are signing FTAs because they have common characteristics such as common language, culture, colonial relationship, etc. If this is the case, the FTA dummy on the right hand side of the gravity equation is correlated with the error term. An alternative method of dealing with the endogeneity problem is 'instrumental variable' (IV) technique for cross-section data and fixed effect model or first-differencing model for panel data (Urata & Okabe, 2010, Lin & Reed, 2010).

Another issue in the Gravity Model is how to handle zero trade flows between two given countries. This is an estimation issue because it directly affects the estimation result. The standard way of estimating the Gravity Model is to take log of both sides and estimate its log-log form. Thereby, zero trade flows will be dropped out of the estimation as the log of zero is not defined. However, omitting zero value observation causes serious problems by deleting important information on low level of trade (Eichengreen and Irwin 1998). This can lead to biased results, particularly when zeros trade flows are non-randomly distributed (Burger, Oort, and Linders 2009). In the past, three alternative approaches have been used to handle zero trade flows. 1. Truncating the sample by dropping the observation with zero trade flows. 2. Adding a small constant one because the log of one is zero. 3. Estimating the model in levels. Santos Silva and Tenreyro (2006) showed that deleting zero trade

flows in these way leads to inconsistent coefficient estimates if the constant elasticity functional form is used. They proposed a Poisson Pseudo-Maximum Likelihood (PPML) method and found that it performs better than other estimators in the presence of hetroskedasticity. Further, they argued that the PPML method provides a natural way to deal with zeros in trade data while providing consistent parameter estimates.

In this study, we applied both OLS (Ordinary Least Square) and PPML methods. For endogeneity bias, we used panel data and added fixed effect to cope with unobserved heterogeneity of country-pairs. Further, we applied the PPML method suggested by Santos Silva and Tenreyro (2006) to deal with zero trade problems.

1.6 SELECTION OF MODEL

There are two models for estimating the panel data regression: random effect and fixed effect models. Both the models have some advantage and disadvantages. One of the major disadvantages of the fixed effect model is that it cannot estimate the time invariant variables such as distance and common border. If the purpose of the study is to evaluate both time-variant and time invariant variables on bilateral trade between countries, then random effect model is more suitable than the fixed effect model (Ozdeser & Ertac, 2010). The present paper includes some time invariant variables, namely, distance, common border, common language, and FTA dummy variable. These variables may be correlated with error-term and therefore the current study chose the random effect model rather than the fixed effect model.

In order to control the individual effects of time and country (reporter and partner), we added two different dummies for panel estimation. Using equation 3 and 4, we estimated the model (provided in 4.9 below). First with time fixed effect (α_t), another with reporter and partner fixed effect, which add α_i and α_j to the equation. In panel estimation, the time fixed effect control the time trend in trade and global turmoil in the form of booms and slowdowns that could affect global trade flows. It is very difficult to measure the country specific factors such as infrastructure, level of development, trade facilitation, multilateral resistance term, etc. In order to control all these factors, we added reporter and partner fixed effect dummy variables.

1.7 DATA SOURCES FOR ESTIMATION OF GRAVITY MODEL

The sample size consisted of 50 countries spread across the continents of Asia, European Union, United States and South America, and who also happen to be members of the regional trade agreements SAFTA, AIFTA, NAFTA, MERCOSURE and EU. These countries were selected on the basis of export and import share among major AIFTA members. The major AIFTA members are Cambodia, India, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. These countries

were selected for the analysis and the other three nations, namely, Brunei, Laos PDR and Myanmar were excluded due to non-availability of data.

The study covered 10 years of data from 2005 to 2014, i.e., five years prior to and an equal number of years after AIFTA came into force in the year 2010. The total number of observations during the said period was 24500 [50*49*10]. It contained 2183 zeros and accounted for around 9 per cent of total observations. It included six SAFTA countries, seven ASEAN countries, three NAFTA countries, six MERCOSURE countries, fifteen EU countries and 13 countries from ROW.

The definition of agriculture sector for this analysis was based on the Uruguay Round of Agreement on Agriculture (URAoA) and Harmonized Commodity Description and Coding System (HS)[4]. Bilateral trade data was compiled from the World Integrated Trade Solution (WITS) and sourced from UN Comtrade data base. Gross Domestic Products (GDP), per capita GDP and population data were obtained from the World Development Indicators database. Bilateral trade flows and GDP are at current prices. Earlier studies found that there exists only a marginal difference while using real prices. For instance, Srinivasan (1995) showed that purchasing power parity rates are subject to large measurement errors. Frankel (1997) found minor difference in the gravity equation results using real data. Data on common language, common border and distance were obtained from the Centre d'Etudes Prospective et d'Informations Internationals (CEPII).[5] CEPII uses the great circle formula to calculate the geographic distance between countries, which are referenced by latitudes and longitudes of the largest urban agglomerations in terms of population.

1.8 ESTIMATION FRAMEWORK

The standard Gravity Model was estimated using the panel data regression model. The model was specified as.

$$X_{ijt} = \alpha\, GDP_{it}^{\beta 1}\, GDP_{jt}^{\beta 2}\, POP_{it}^{\beta 3}\, POP_{jt}^{\beta 4}\, Dist_{ij}^{\beta 6}\, e^{ijt} \quad \text{----------(2)}$$

[4] *It follows HS code 01 to 24 (excluding fish and fish products). It also include HS code 2905.43(mannitol), HS Code 2905.44(sorbitol), HS Code 33.01(essential oils), HS code 35.01 to 35.05(albuminoidal substances, modified starches, glues), HS Code 3809.10(finishing agents), HS Code 3823.06(sorbitol n.e.p.), HS Code 41.01 to 41.03(hides & skins), HS Code 43.01(raw fur skins), HS Code 50.01 to 50.03(raw silk & silk waste), HS Code 51.01 to 51.03(wool & animal hair) HS Code 52.01 to 52.03(raw cotton, waste and cotton carded or combed), HS Code 53.01(raw flax) and HS Code53.02(raw hemp).*

[5] *http://www.cepii.fr/CEPII/en/bdd/_modele/download.asp?id=6.*

Where X_{ijt} is the bilateral trade (export plus import) between pairs[6] of country i and country j. All other variables were defined and expected signs are provided in table 4.1. Taking the logarithm of equation (2) and incorporating the dummy variables listed below in table 4.1.

$$\mathbf{lnX_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln POP_{it} + \beta_4 POP_{jt} + \beta_5 lnDist_{ij} + \beta_6 Coml_{ij} + \beta_7 Border_{ij} + \sum + \sum \gamma_k FTA^k bothin_{ijt} + \sum \delta_k FTA^k onein_{jt} + \varepsilon_{ijt} \text{ --------(3)}}$$

Where ε_{ijt} = is the error term,

The log-log model is only valid when Xij>0. The estimation of log-log gravity model creates an instant problem when trade is zero. Moreover, the log of zero was undefined. Considering the problem of zero trade, we used the PPML model to estimate the Gravity Model. We borrowed the methodology used by Lin Sun and Reed M.R. (2010) and Satos and Tenreyro (2009).

The model can be specified in the following equation,

$$\mathbf{X_{ij} = exp\{ \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 lnDist_{ij} + \beta_6 Coml_{ij} + \beta_7 Border_{ij} + \sum \gamma_k FTA^k bothin_{ijt} + \sum \delta_k FTA^k onein_{jt} + \varepsilon_{ijt}\} \text{----------}(4)}$$

1.8.1 VARIABLE DESCRIPTIONS

There are two ways of measuring the economic size of a country in the Gravity Model: GDP or population. A high level of income (GDP) in reporting country (i) indicates a high level of production, which increases the availability of goods for trade. Therefore, we expect the coefficient sign of reporter country's GDPi to be positive. The coefficient sign of partner country's GDPj is also positive because a high level of income (GDP) in the partner country, which indicates higher purchasing power.

Table 1.1: Description of Variables and Expected Signs

Variables	Descriptions	Expected Sign
Dependent Variable		
$\ln X_{ij}$	Log* of agriculture bilateral trade flows from country *i* to country *j*	
Independent variable		
$\ln GDP_i$	Log of GDP of the reporter country *i*	+
$\ln GDP_j$	Log of GDP of the partner country *j*	+

[6] The unit of observation is a pair of countries, not a single country.

$lnPOP_i$	Log of Population of reporter country *i*	+ or -
$lnPOP_i$	Log of Population of partner country *j*	+ or -
$lnDist_{ij}$	Log of distance from country i to j	-
$Comlang_{ij}$	Dummy variable =1 if country *i* and *j* have a common official language; =0, Otherwise	+
$Comborder_{ij}$	Dummy variable =1 if country *i* and *j* have a common border; =0, Otherwise	+
$FTAbothin_{ij}$	Dummy variable =1 if country *i* and *j* both are the member of same FTA; =0, Otherwise	
FTAonein	Dummy variable =1 if country j is the member of FTA but country i isn't ; =0, Otherwise	

**Natural Log.*

The estimated coefficient sign of population of the reporting country may be positive or negative (Oguledo and Macphee 1994) depending on whether a big country trades more than a small country (economies of scale effect) or whether the country trades less when it is big, the absorption effect, (Martinez & Lehmann 2003). Another factor which also influences the estimated coefficient sign of population in the gravity equation is the composition effect of population. It affects the supply and demand of goods, or the mix of goods, which is different for each country. The estimated coefficient sign on population of the partner country may be positive or negative for similar reasons.

The estimated coefficient sign of distance variable is expected to be negative since it is a proxy of all possible resistance factors to trade. The geographical proximity of any country will have positive influence on trade flows between countries. Geographical proximity is captured through common border dummy variable. Countries having common border will trade more than distant ones. It will reduce the transaction cost of trade between them. Moreover, the coefficient of common border variable is expected to be positive. Since the basic gravity model is log-linear form, the coefficient of dummy variable is interpreted by taking its exponent (Frankel, 1997). For instance, if the value of common border coefficient is 0.60, it indicates that two countries have a common border trade 82 [exp (0.60)-1*100] per cent more than those without a common border.

Another important factor affecting trade flows is cultural link among countries. The presence of common language will lead to cultural familiarity between members. As a result, the cultural link will reduce the transaction cost among countries. The cultural link is captured through the official common language dummy variable. The estimated coefficient of common language variable is also expected to be positive.

1.9 RESULTS OF ESTIMATED GRAVITY MODEL

The impact of FTAs on members' agricultural trade through TC and trade TD is assessed and presented here. To capture the trade creation and diversion effect, we introduced two dummy variables, i.e., intra-dummy and extra-dummy variable. Intra-dummy captured TC and extra-dummy captured TD for agricultural trade between partners. This study used panel data from 2005 to 2014 to estimate the Gravity Model. The gravity model was estimated using OLS and PPML estimation techniques in order to correct the hetroskedasticity and deal with zero trade observations. Equation 3 was used for OLS estimation and equation 4 for PPML estimation. Furthermore, equation 3 estimated using the random effect model (OLS), which excludes zero trade flows observation, and equation 4 estimated using PPML which include zero observations.

1.9.1 Gravity Model with Time Fixed Effect (OLS)

Estimated results of the Gravity Model with time fixed effect are presented in Table 4.2. In this model, the dependent variable is agriculture bilateral trade flow between country *i* and *j* and is in log form. The time fixed effect captures global turmoil such as booms and slowdowns in a particular year, and time trends in trade that could affect global trade flows. The ordinary least square technique is used to estimate equation 3 and it does not include zero trade observations. The model with time fixed effect show estimated GDP coefficient for both reporter and partner country have the expected positive sign. They are statistically significant at 1 per cent level. The magnitude of GDP coefficient for reporter country is greater than partner country. The coefficient of GDP indicates that a 1 per cent increase in reporter country's GDP will increase the agriculture bilateral trade flows on an average by about 0.78 per cent. The coefficient of partner country's GDP found that a 1 per cent increase in GDP will tend to increase the agriculture bilateral trade flows on an average by about 0.47 per cent, which implies that there is a positive relationship between country's income and bilateral trade flows.

The estimated coefficient of population for partner country was found to be statistically insignificant. The coefficient of population for reporter country was statistically significant at 1 per cent level. The coefficient of population for reporter country indicates that a 1 per cent grows in reporter country's population raises the agriculture bilateral trade flows on an average by about 0.24 per cent. It implies that a larger foreign (reporter country) market demanded a variety of goods and provided an opportunity for domestic firms to boost supply of exports.

The coefficient of distance had an expected sign and statistically significant at 1 per cent level. The coefficient of distance demonstrated that a 1 per cent increase in distance between trading partners tended to decrease agriculture bilateral trade flows by -0.42 per cent. This study assumed that distance is a proxy for trade cost, which means that increase in trade cost it will reduce bilateral trade flows between countries. Similarly, if both the countries shared a common border it would trade more than distant ones. The coefficient of common border was 0.93, which meant that common border trading partners would have 154.47 per cent more trade than distant partners [exp. (0.93)-1*100) =154.47].

Other coefficients, namely, common language and common border were also found to be statistically significant at 1 per cent level. The coefficient of common language was 0.75, suggesting that if both trading partners shared a common language, they would trade 111.92 per cent more when compared with no common language [exp. (0.751)-1*100) =111.92].

Furthermore, the study introduced two dummy variables: intra-dummy ($AIFTA_{ij}$) variable to capture TC effect and extra-dummy ($AIFTA_{j)}$ variable to capture TD effect. The estimated coefficient of $AIFTA_{ij}$ was found to be positive and statistically significant at 5 per cent level. The coefficient of $AIFTA_{ij}$ was 1.162 [exp.(1.162)-1*100]= 219.63. The results indicated that if both trading partners were members of AIFTA, the intra-regional agricultural trade would increase by 219.63 per cent more than trade with ROW. It showed pure TC effect. On the other hand, the coefficient of $AIFTA_j$ was also found to be statistically significant at 5 per cent level. The coefficient of $AIFTA_j$ was 0.163 [exp. (0.163)-1*100]=17.70. The results indicated that extra-regional agricultural trade with non-AIFTA members increased by 17.70 per cent. However, the magnitude of TC was higher than TD for AIFTA.

The other intra-dummy coefficient, namely, $SAFTA_{ij}$ was found to be statistically significant at 10 per cent level. The coefficient of $SAFTA_{ij}$ was 0.94 [exp. (0.94)-1*100] = 156.00, implying that if both trading partners were members of SAFTA, the intra-regional agriculture trade would tend to increase by 156.00 per cent more than trade with non-SAFTA members. On the other hand, the coefficient of $SAFTA_j$ was negative and statistically insignificant under the time fixed effect model. The coefficient of both $NAFTA_{ij}$ and $NAFTA_j$ were positive and statistically insignificant during the study period.

Coefficient of $MERCOSURE_{ij}$ was found to be statistically significant at 1 per cent level. The coefficient of $MERCOSURE_{ij}$ was 2.00 [exp. (2.00)-1*100] = 638.91, suggesting that the intra-regional agriculture trade would increase by 638.91 per cent more than ROW. On the other hand, the coefficient of $MERCOSURE_j$ was statistically significant at 10 per cent level. The coefficient of $MERCOSURE_j$ was 0.381, implying that the extra-regional agriculture trade would increase by 46.37 per cent more than with non-MERCOSURE partners. The coefficient of EU_{ij} was found to be positive and statistically significant at 1 per cent level. The coefficient of EU_{ij} was 1.750 [exp. (1.750)-1*100] = 475.46, implying that the intra-regional agriculture trade would tend to increase by 475.46 per cent more than ROW. On the other hand, the coefficient of EU_j was positive and statistically insignificant.

Table 1.2: Estimation Result of Gravity Model with Time Fixed Effect: OLS

Variables	***OLS***
Constant	-10.3482*** (0.86)
log_GDP_R	0.784*** (0.04)
log_GDP_P	0.476*** (0.03)

log_POP_R	0.062 (0.04)
log_POP_P	0.242*** (0.03)
log_Distij	-0.420*** (0.06)
Comm_langij	0.751*** (0.11)
CBorder_ij	0.934*** (0.17)
AIFTAij	1.162** (0.39)
AIFTAj	0.1632** (0.06)
SAFTAij	0.914* (.037)
SAFTAj	-0.173 (0.15)
NAFTAij	-1.358 (1.89)
NAFTAj	0.0288 (0.18)
MERCOSUREij	2.004*** (0.24)
MERCOSUREj	0.381* (0.15)
EUij	1.750*** (0.15)
EUj	-0.0538 (0.13)
Observation	22317
P> chi 2	0.0000
R^2	0.52

Note: Standard errors in Parentheses; Standard errors were calculated using White's heteroskedastic robust standard errors.

** Significant at 10 % level, ** Significant at 5 % level, *** Significant at 1 % level.*

Source: Author's Estimation

1.9.2 Gravity Model with Time and Country Fixed Effect (OLS)

The result of the estimated Gravity Model with time and country fixed effect is presented in Table 4.3. The results were identical with time fixed effect model (OLS) presented earlier. However, there were a few coefficients which indicated different magnitude and direction. In this model, the dependent variable was agriculture bilateral trade flow between country *i* and *j* and is in log form. The country effect controlled the impact of country specific factors, namely, infrastructure, level of development, trade facilitation, multilateral resistance term, etc. The ordinary least square technique was used to estimate the equation 3 and it excluded zero trade observations. The estimated result found a greater R^2 under the country effect (0.69) than the time effect (0.52) model. It indicated that country specific factors would have more influence in determining agriculture bilateral trade flows between countries.

The coefficient of both reporter's GDP and partner countries' GDP were found to be expected sign and statistically significant at 1 per cent level. Estimated results showed that the magnitude of reporter countries' GDP coefficient was greater than partner country's GDP coefficient. The coefficient of reporter country's GDP was 0.73, implying that 1 per cent increase in reporter country's GDP would increase the agriculture bilateral trade flow by about 0.73 per cent, the other things remaining constant. Estimated coefficient of partner country's GDP was 0.31, indicating that 1 per cent increase in partner country's GDP would increase agriculture bilateral trade flow by about 0.31 per cent on an average.

The estimated coefficient of population for partner country was found to be negative and statistically significant at 1 per cent level. The reporter country's coefficient of population was statistically insignificant. The negative sign of population coefficient suggested absorption effect of population (Martinez & Lehmann 2003) and explained the greater domestic consumption demand. The other factor that changed the sign of population coefficient was the composition of population, which influenced the supply and demand of goods across the countries.

The estimated coefficient for distance carry expected sign and was statistically significant at 1 per cent level under the country effect model. The magnitude for distance coefficient increased in country fixed effect than time fixed effect model. The coefficient of distance was -0.65, implying that 1 per cent increase in distance between trading partners would reduce agricultural trade by about -0.65 per cent on an average. Other estimated coefficients such as common language and common border were statistically significant at 1 per cent and 10 per cent level respectively.

The coefficient of $AIFTA_{ij}$ was 0.864 [exp. (0.864)-1*100] = 137.26. The result indicates that if both the trading partners were members of AIFTA, the intraregional agricultural trade would tend to increase by 137.26 per cent more than ROW. The coefficient of $AIFTA_j$ was found to be statistically insignificant.

The other intra-dummy coefficient, namely, $SAFTA_{ij}$ was positive and statistically significant at 1 per cent. The magnitude of $SAFTA_{ij}$ coefficient was found to be higher in the time and country fixed effect model than the time fixed effect model, suggesting that the combined time and country fixed effect would have greater influence on agricultural trade. On other hand, the coefficient of $SAFTA_j$ was positive and statistically significant at 1 per cent level.

An interesting result was noticed in case of $NAFTA_{ij}$ coefficient. It was found to be negative and statistically insignificant under the time fixed effect model, while it was positive and statistically significant in the time and country fixed effect model. On the other hand, the coefficient of $NAFTA_j$

was positive and statistically insignificant in the time fixed effect model, but positive and statistically significant at 1 per cent level.

The regression coefficient for both $MERCOSURE_{ij}$ and EU_{ij} were statistically significant at 1 per cent level with negative sign. The extra-dummy coefficients, namely, $MERCOSURE_j$ and EU_j were statistically significant with negative sign.

Table 1.3: Estimation Results of Gravity Model with Time and Country Fixed Effect: OLS

Variables	OLS
Constant	4.750** (1.826)
log_GDP_R	0.738*** (0.094)
log_GDP_P	0.318*** (0.076)
log_POP_R	-1.937*** (0.323)
log_POP_P	-0.134 (0.276)
log_Distij	-0.615*** (0.060)
Comm_langij	0.777*** (0.104)
CBorder_ij	0 .300* (0.166)
AIFTAij	0.864** (0.383)
AIFTAj	0.118 (0.078)
SAFTAij	3.394*** (0.582)
SAFTAj	1.385** (0.502)
NAFTAij	3.341** (1.731)
NAFTAj	3.530*** (0.564)
MERCOSUREij	-2.454*** (0.453)
MERCOSUREj	-3.486*** (0.341)
EUij	-3.197*** (0.628)
EUj	-4.613*** (0.622)
Observation	22317
P> chi 2	0.0000
R^2	0.69

Note: Standard errors in Parentheses; Standard errors were calculated using White's heteroskedastic robust standard errors.
** Significant at 10 % level, ** Significant at 5 % level, *** Significant at 1 % level.*
Source: Author's Estimation

1.9.3 Gravity Model with Time Fixed Effect (PPML)

Zero trade flows are common problem in the estimation of the Gravity Model. Omitting zero value observation causes serious problems as it would delete important information on low level of trade (Eichengreen and Irwin, 1998). This can lead to biased results, particularly when zeros trade flows are nonrandomly distributed (Burger, Oort, and Linders 2009). Therefore, the present study borrowed PPML estimation technique suggested by Santos Silva and Tenreyro (2006) to deal with zero trade observations. The data contains about 9 per cent observations with zero values (no trade).

The result of the Gravity Model with time fixed effect using PPML (it includes zero observations) estimation technique has been presented in Table 4.4. In this model, the dependent variable is agriculture bilateral trade flow between country *i* and *j* and is in level form (X_{ij}). The coefficient of reporter and partner country's GDP are positive and statistically significant at 1 per cent level. The coefficient of GDP of the reporting country is 0.60, implying that 1 unit increases in GDP of the reporting country would tend to increase the agriculture bilateral trade flow by about 0.60 units, the other factors remaining constant. In case of the partner country, GDP coefficient was 0.36, suggesting that a 1 unit change in GDP of the partner country would increase agricultural bilateral trade flow by about 0.36 units on an average.

The coefficients of population for both reporter and partner country were found to be statistically significant at 1 per cent level, but the coefficient of population of the reporting country carried negative sign. An explanation for the latter has been provided in the previous section. The coefficient of distance was statistically significant at 1 per cent level with expected sign. The coefficient of distance was -0.16, suggesting that 1 unit change in distance between trading partners would tend to reduce the agriculture trade by about -0.16 units. In case of common language, the coefficient was statistically insignificant under the PPML estimation technique. The coefficient of common border was statistically significant at 1 per cent level. The coefficient of common border was 1.213 [exp. (1.213)-1*100] = 236.36. The result indicates that if both the trading partners have common border they are likely to trade 236.36 units more than distant countries.

The coefficient of $AIFTA_{ij}$ was positive and statistically significant at 1 per cent level. The positive sign of coefficient of $AIFTA_{ij}$ indicates that the members of AIFTA would experience TC effect in agriculture trade among them. The coefficient of $AIFTA_{ij}$ was 0.571 [exp. (0.571)-1*100] = 77.00, implying that if both the trading partners were members of AIFTA, the intra-regional agricultural trade would increase by 77.00 units more than ROW. The coefficient of $AIFTA_j$ was positive and

statistically significant at 1 per cent level. The positive of coefficient of $AIFTA_j$ indicates a TD effect for agriculture trade. The coefficient of $AIFTA_j$ was 0.169 [exp. (0.169)-1*100]=18.41. The result indicates that if both the trading partners were members of AIFTA, extra-regional agricultural trade would tend to increase by 18.41 units more than trade amongst themselves.

The coefficients of $SAFTA_{ij}$, and $NAFTA_{ij}$ were positive but statistically insignificant. However, the coefficient of $MERCOSURE_{ij}$ and EU_{ij} were positive and significant at 1 per cent level. The coefficient of $MERCOSURE_{ij}$ was 1.154 [exp. (1.154)-1*100] = 217.08, suggesting that if both the trading partners were members of MERCOSURE, the intra-regional agriculture trade would increase by about 217.08 units more than ROW. EU_{ij} coefficient was 1.053 [exp. (1.053)-1*100] = 186.62, which means that the members of EU would prefer more intra agriculture trade than trade with non-EU members. The result indicates TC effect on agricultural trade among the member countries.

The coefficient of $SAFTA_j$ was negative and statistically significant at 1 per cent level. The negative sign of the coefficient of $SAFTA_j$ indicates TD effect on agricultural trade. The coefficients of $NAFTA_j$ and EU_j were positive and significant at 1 per cent and 5 per cent level respectively. The coefficient of $MERCOSURE_j$ was found to be positive but statistically insignificant.

Table 1.4: Estimation Results of Gravity Model with Time Fixed Effect: PPML

Variables	***PPML***
Constant	-6.059*** (0.408)
log_GDP_R	0.608*** (0.002)
log_GDP_P	0.368*** (0.001)
log_POP_R	-0.111*** (0.013)
log_POP_P	0.0129*** (0.012)
log_Distij	-0.160*** (0.046)
Comm_langij	0.169 (0.098)
CBorder_ij	1.213*** (0.178)
AIFTAij	0.571*** (.006)
AIFTAj	0.169*** (0.005)
SAFTAij	0.321 (0.276)
SAFTAj	-0.419*** (.100)
NAFTAij	1.06 (0.603)
NAFTAj	0.770*** (0.134)
MERCOSUREij	1.154*** (0.279)
MERCOSUREj	0.136 (0.105)
EUij	1.053*** (0.139)
EUj	0.244** (0.082)
Observation	24500
P> chi 2	0.0000

Note: Standard errors in Parentheses; Standard errors were calculated using White's heteroskedastic robust standard errors.

** Significant at 10 % level, ** Significant at 5 % level, *** Significant at 1 % level.*

Source: Author's Estimation

1.9.4 Gravity Model with Time and Country Fixed Effect (PPML)

Table 4.5 presented the estimation results of the Gravity Model with time and country fixed effect using PPML (it includes zero observations) estimation technique. The dependent variable in this model was agricultural bilateral trade flow between countries *i* and *j*, and was in level form (X_{ij}). The country fixed effect model captured the impact of country specific factors, namely, infrastructure, level of development, trade facilitation, multilateral resistance term, etc.

The coefficients of reporter and partner country's GDP were positive and significant at 1 per cent level. The results indicated a positive relationship between country's level of income and agriculture trade. Similar results were observed for GDP coefficient under the time and country fixed effect model. For instance, the coefficient of GDP of the reporting country was 0.60, implying that 1 unit increase in GDP of the reporting country would tend to increase the agriculture bilateral trade flow by about 0.60 units on an average, the other factors remaining constant. The partner country's GDP coefficient was 0.37, suggesting that the 1 unit change in GDP of the partner country would tend to change agricultural bilateral trade flow by about 0.37 units on an average.

The coefficient of population of the reporting country was negative and significant at 1 per cent level. The negative sign of population coefficient indicated the absorption effect of population (Martinez & Lehmann 2001) and explained the greater domestic consumption demand. The partner country's coefficient of population was positive and statistically significant at 1 per cent level.

The coefficient of distance carries expected sign and found to be statistically significant at 1 per cent level. The coefficient of distance was -0.62, implying that 1 unit change in distance between trading partners would tend to reduce agricultural trade by about -0.62 units. The coefficient of common language was statistically insignificant under the time fixed model. However, it was statistically significant at 1 per cent level in time and country fixed effect model. The coefficient of common border was also statistically significant at 1 per cent level.

Moving onto TC effect, the coefficients of $AIFTA_{ij}$, and $SAFTA_{ij}$ were positive and statistically significant at 1 per cent level. The results indicate that TC effect on agricultural trade among the partners. For instance, the coefficient of $AIFTA_{ij}$ was 0.573 [exp. (0.573)-1*100] =77.36, suggesting that if both the trading partners were members of AIFTA, the intra-regional agricultural trade would increase by 77.36 units more than ROW.

The coefficient of $SAFTA_{ij}$ was 1.452 [exp. (1.452)-1*100] = 427.16, implying that if both the trading partners were members of SAFTA, the intra-regional agricultural trade would increase by 427.16 units more than ROW. The coefficient of $NAFTA_{ij}$ was positive and statistically significant at 1 per

cent level. The result supports the argument that FTA would have a positive impact on intra-regional agriculture trade during the study period.

The coefficient of $MERCOSURE_{ij}$ was statistically insignificant. The coefficient of EU_{ij} showed no TC effect on agricultural trade between partners. On the other hand, the coefficients of $MERCOSURE_j$ and EU_j indicated TD effect on agricultural trade.

Table 1.5: Estimation Results of Gravity Model with Time and Country Fixed Effect: PPML

Variables	***PPML***
Constant	-1.398** (0.481)
log_GDP_R	0.606*** (0.002)
log_GDP_P	0.370*** (0.002)
log_POP_R	-0.288*** (0.016)
log_POP_P	0.130*** (0.016)
log_Distij	-0.622*** (0.044)
Comm_langij	0.417*** (0.086)
CBorder_ij	0.581*** (0.139)
AIFTAij	0.573*** (0.006)
AIFTAj	0.173*** (0.005)
SAFTAij	1.452*** (0.303)
SAFTAj	-0.056 (0.223)
NAFTAij	2.333*** (0.504)
NAFTAj	1.094*** (0.219)
MERCOSUREij	-0.306 (0.303)
MERCOSUREj	-1.689*** (0.226)
EUij	-0.459** (0.243)
EUj	-1.830*** (0.224)
Observation	24500
P> chi 2	0.0000

Note: Standard errors in Parentheses; Standard errors were calculated using White's heteroskedastic robust standard errors.

** Significant at 10 % level, ** Significant at 5 % level, *** Significant at 1 % level.*
Source: Author's Estimation

1.10 SUMMARY

The Gravity Model was used to examine the impact of FTAs on members' agricultural trade. This study estimated the Gravity Model using OLS and PPML estimation techniques in order to deal with hetroskedasticity and zero trade observations. The sample size contained trade data for 50 countries for 10 years (2005 to 2015). Five major FTAs, namely, AIFTA, SAFTA, NAFTA, MERCUOSURE, and EU_15 were selected for the analysis. Apart from the basic Gravity Model, the study included some other variables such as intra and extra dummy variables to capture TC and TD effects respectively.

The coefficient of GDP both for reporter and partner country found to be statistically significant in all the models but the magnitude of GDP coefficient varied from one model to other. It implies that there is positive relationship between Country's income and agriculture bilateral trade flow. The coefficient of population sign both for reporter and partner country did not found consistent results across the models. For example, under the time fixed model (OLS) both reporter and reporter country found statistically significant. In case of, time and country fixed effect model, the coefficient of population for partner country found to be negative and statistically significant at 1 per cent level. Implying that the negative sign of population coefficient suggested absorption effect of population (Martinez & Lehmann 2001) and explained the greater domestic consumption demand.

The estimated coefficient for distance carry expected sign in all the models used for the analysis. The magnitude of distance coefficient varied form one model the other. It shows that there is inverse relationship between distance and agriculture bilateral trade flows between the countries. This study assumed that distance is a proxy for trade cost, which means that increase in trade cost it will reduce bilateral trade flows between countries. The coefficient of common border and common language are found to be statistically significant in all the models. Suggesting that if both trading partners shared a common language or common border they would tend to be trade more when compared with no common border or no common language.

The study estimated TC and TD effect in agricultural trade using the Gravity Model. A TC effect was observed in AFITA, MERCOSURE and EU_15 during the study period under the time fixed effect model. Under the time and country fixed effect model, AIFTA, SAPTA and NAFTA experienced TC effects between members. It showed that country specific characters affected bilateral trade flows between members. Further, under time fixed effect model, a strong TD effect was noticed in SAPTA. Under the time and country fixed effect model, only EU_15 and MERCOSURE found trade being diverted to non-members. In a nutshell, the results supported the idea that FTAs pave a positive path

towards freer multilateral trade. FTAs not only help in boosting trade between members, but also strengthen extra trade with non-members.

The impacts of FTAs on trade flows differ from region to region and from FTA to FTA due to the varied implementation periods. The study found that the PPML estimation technique was more promising than OLS estimation technique, but required further attention. Finally, measuring TC and TD effects were the most difficult tasks because of a lack of appropriate empirical methodology. In a nutshell, the results support the argument that the FTAs help in the creation of freer multilateral trade. FTAs not only help boosting agriculture trade between members, but also strengthen extra trade with non-members.

Appendix Table

Table A1.1: Sample of Countries Included for Analysis

SAPTA	AIFTA	NAFTA	MERCOSURE	EU_15	Rest of the World
Afghanistan	Cambodia	Canada	Argentina	Austria	Algeria
Bangladesh	Indonesia	Mexico	Bolivia	Belgium	Australia
India	Malaysia	USA	Brazil	Denmark	China
Maldives	Philippines		Paraguay	Finland	Ghana
Pakistan	Singapore		Uruguay	France	Hong Kong
Sri Lanka	Thailand		Venezuela	Germany	Israel
	Vietnam			Greece	Japan
				Hungary	Korea RP
				Ireland	Qatar
				Italy	Russian F
				Luxembourg	Saudi Arab
				Netherland	South Africa
				Portugal	Switzerland
				Spain	
				Sweden	
				U.K.	

Source: Author's selection

Table A1.2: Descriptive Statistics of Basic Gravity Variable

Variable	Observation	Mean	Std. Dev.	Min	Max
log_Xij	24500	3.51	3.11	-13.82	10.75
log_GDP_R	24500	12.68	1.78	7.02	16.67
log_GDP_P	24500	12.68	1.78	7.02	16.67
log_POP_R	24500	3.28	1.67	-1.19	7.22
log_POP_P	24500	3.28	1.67	-1.19	7.22
log_Distij	24500	8.70	0.88	5.15	9.88

Source: Author's calculation

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