

# Trade Determinants between India and ASEAN: A Gravity Model Approach

Md Sarafraz Equbal

PG Department of Economics, University of Kashmir, Hazratbal, Srinagar, 190006

Email: [sarfraz.eco@gmail.com](mailto:sarfraz.eco@gmail.com)

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**Abstract:** This study analyses the determinants of agricultural trade between India and ASEAN countries within the framework of the ASEAN-India Free Trade Agreement (AIFTA). Using a gravity model and the Poisson Pseudo-Maximum Likelihood (PPML) estimator, the study accounts for zero trade flows and heteroskedasticity to obtain robust results. The findings reveal that economic size (GDP) of both exporting and importing countries positively influences agricultural trade, while geographic distance negatively affects trade due to transportation costs and perishability. Population effects are mixed, reflecting domestic consumption pressures and possible self-sufficiency in importing countries. Contiguity significantly enhances trade flows, whereas cultural and historical factors show limited influence. Importantly, AIFTA does not exhibit a statistically significant impact on agricultural trade, indicating that tariff reductions alone are insufficient. The study concludes that economic and geographic factors dominate trade patterns, and emphasizes the need to address non-tariff barriers, improve trade facilitation, and strengthen infrastructure to enhance agricultural trade integration between India and ASEAN.

*Keywords:* ASEAN; India; FTA, Trade; Gravity model

*JEL Classification:* F14, F15, Q17, C23, F13

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## 1. Introduction

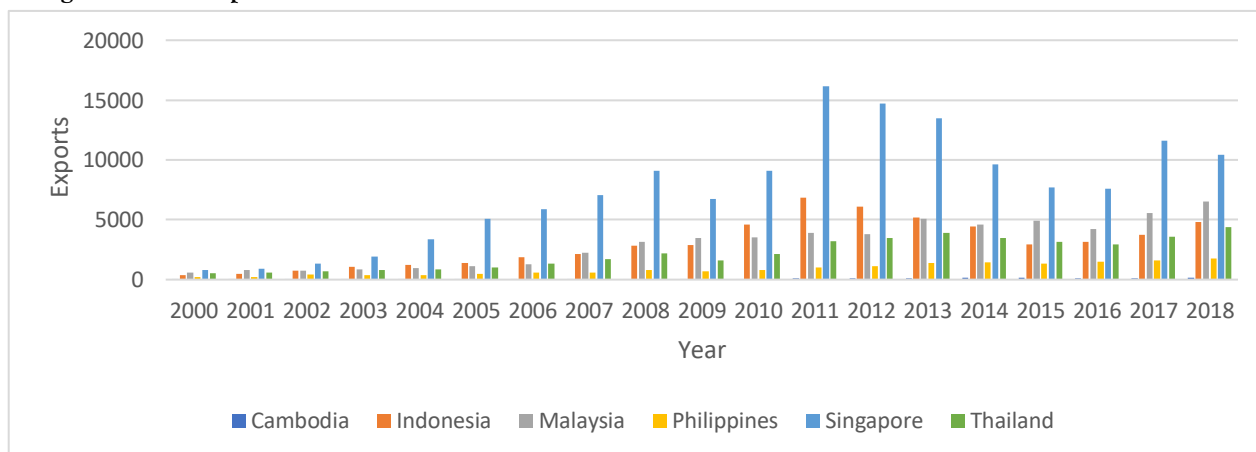
International trade serves as a crucial driver of economic growth and development, extending a nation's reach beyond its domestic borders (Eravwoke and Imide, 2013). This engagement with other countries enables access to a wider customer base, resulting in expanded production and economies of scale. This, in turn, fosters economic advancement. Moreover, international trade's encouragement of specialization allows countries to focus on areas where they hold a comparative advantage, leading to efficient resource allocation, heightened productivity, and global economic benefits (Ricardo, 1817). One prominent advantage lies in the enhanced consumer choices made possible through importing goods and services that might be absent or more affordable elsewhere (Broda and Weinstein, 2006). This diversity of offerings elevates living standards and consumer satisfaction. Furthermore, international trade's role in job creation cannot be understated (Helpman, et.al., 2004). Export-driven industries often experience employment growth as they cater to international markets, thereby reducing unemployment rates and elevating incomes. Beyond economic ramifications, international trade facilitates the exchange of knowledge, technology, and best practices between nations. (Bernard, & Jensen, 1999, Alvarez & Lopez 2005, Bloom, Draca, & Van Reenen, 2016)

Agriculture sector has been dominating sector as far contribution of GDP, employment and export earnings in most of the developing economies. In case of India agriculture sector contributes to GDP and Employment and is also one of the important sources of foreign exchange earnings. The share of India's agricultural exports and imports in the world agriculture trade in 2013-14 was 2.69 and 1.31 percent, respectively (Ministry of Agriculture and Farmers Welfare, 2015). India and ASEAN members are natural partners in trade, and the ties date back hundreds of years. India's partnership with the ASEAN members began with India becoming a sectoral dialogue partner at ASEAN Meet in 1992 as an initial step towards India's Look East policy. In 1996 India became a full dialogue partner of ASEAN. Free Trade Area was established between India-ASEAN in 2009 and FTA in goods became effective from 2010. Latest is the FTA in services and investment signed- by all ASEAN nations with India. The ASEAN is India's fourth-largest trading partner after the EU, the US, and China (ASEAN Statistics, 2013). India's share of total ASEAN trade accounted for 2.7 percent in 2013, which grew from just 0.7 percent in 1993. In the ASEAN market, the processed foodstuff, beverages, tobacco, and other value-added products exported by India have massive demand. Among various farm products imported from the ASEAN, animal and vegetable fats and oils dominate the scenario (Renjini et al., 2017)

Hence, trade of India with ASEAN in general and agriculture trade, in particular, appears to be pertinent. In this context, it is worthwhile to study the factor determining agriculture trade of India with ASEAN, the study will help identify the future trade opportunities with ASEAN via agriculture which may boost the economy in the long run.

Although many studies have analysed the determinants of trade at macro level, the sectoral level analysis particularly in agriculture is much limited. Most of the existing studies have focussed on the limited aspects of agricultural trade in the select trade blocs. Apart from various determinants, we use Trade agreement which is signed by these nations to enhance regional trade AIFTA as one of the independent variables to determine whether agricultural trade has increased or not.

**Fig:1: India's Exports to Selected ASEAN Countries**



The graphical representation of India's exports to ASEAN countries for the period 2000–2018 reveals a consistently rising trend, albeit with substantial heterogeneity across

Source: Author's own compilation

Singapore emerges as the dominant export destination, displaying markedly higher export values throughout the period, reflecting its role as a major regional trading and re-export hub with advanced logistical and port infrastructure. Malaysia and Indonesia form the next significant cluster,

maintaining relatively high export volumes and demonstrating strong, persistent demand for Indian products—particularly petroleum, chemical, and engineering goods. In contrast, exports to smaller ASEAN economies such as Cambodia, the Philippines, and Thailand remain comparatively modest but exhibit a gradual upward trajectory, indicating India’s expanding engagement in these emerging markets. Overall, the visual trend underscores both the depth and the diversification of India’s export relations within the ASEAN region

**Table: 1 CAGR (2000–2018) – India’s Export Growth to ASEAN Countries**

Country	CAGR (%)
Cambodia	18.90%
Indonesia	15.02%
Singapore	15.13%
Malaysia	14.52%
Philippines	13.20%
Thailand	12.68%

Source: Calculated by Author

Table 1 represents the annual compound growth rate of agricultural exports from India to selected ASEAN countries. It shows the growth rate has been high with Cambodia along with Indonesia and Singapore indicates major recipient of agriculture exports. Relatively Philippines and Thailand receive less exports from India. Over all it shows that there has been increasing trend in agricultural exports to these selected ASEAN countries represents ASEAN as one the major and important export destination of India

## 2. Literature review

This section summarizes the previous studies that used gravity model to estimate the potential trade. Nobel Laureate Jan Tinbergen (1962) was the first to publish an econometric study using the gravity equation for international trade flows. In his first study involving data on 18 countries in 1958, the volume trade between two countries was specified to be proportional to the product of an index of their economic size, and the factor of proportionality depended on the measures of trade resistance between them. The first important attempt to provide a theoretical basis for gravity models was the work of Anderson (1979) based on the Armington (1969) assumption. He assumed that products are differentiated by the country of origin and consumers have preferences defined over all the differentiated products. Bergstrand (1985, 1989), Helpman and Krugman (1985), Helpman (1987), Deardorff (1995) and Anderson and Van Wincoop (2003) showed that the gravity equation can be derived from a number of different international trade theories including the Ricardian model, Heckscher–Ohlin model and new trade theories of economies of scale, monopolistic competition and intra-industry trade. Srinivasan (1994) and Srinivasan and Canonero (1995) used a gravity model of international trade to investigate the implications of SAPTA. The result demonstrated that small countries would gain much from preferential trade liberalization. Rajapakse and Arunatilleke (1997) used gravity model of bilateral trade between Sri Lanka and other SAARC countries, the results of this study show that there is potential for improvements in bilateral trade with the removal of restrictive trade

Korinek and Melatos (2009) analysed the effects of three RTAs (i) ASEAN Free Trade Agreement (AFTA) (ii) Common Market for Eastern and South Africa (COMESA) and (iii) MERCOSUR on

agricultural trade using a gravity model. The results suggest that conventional gravity model variables have expected effect on the volume of trade. The results suggest AFTA, COMESA and MERCOSUR have increased trade in agricultural products between its member countries significantly and the agreements were net trade creating. Trade cost remains as important determinant of agriculture trade flows of those member states. Furthermore, historical trade pattern and traditional economic ties are also important determinants of trade flows. It also highlights the fact that RTA creates free trade among member countries, but it does not guarantee welfare improvements either for members and non-members. Clarete et al. (2002) also did similar econometric study for Asia using panel data for the period 1980 to 2000. The results indicated that conventional gravity variables, i.e., size of economies, distance, geographical area and sharing a common border, were statistically significant at 0.05 probability level. Distance between the two countries was the most important basic determinant of trade flows in Asia. The analysis proved that trade agreements of Economic Cooperation Organization (ECO), EFTA, MERCOSUR, SAPTA and South Pacific Regional Trade and Economic Cooperation Agreement (SPARTECA) generate strong positive intra bloc trade effects and it led member states to divert their trade towards its regional members. Asia-Pacific Economic Cooperation (APEC) creates statistically significant trade flows among its members as well as rest of the world. However, EU showed negative and statistically significant results on its intra-bloc trade for the years of 1980 and 1985 and insignificant results for both 1995 and 2000. Estimates of AFTA and NAFTA did not show significant effects on intra bloc trade but reduced trade with both members and rest of the world. Clarete et al. (2002) suggest that APEC, ECO and MERCOSUR appeared to be having the greatest impacts on intra bloc trade and AFTA and NAFTA have reduced trade with their members during the study period.

The related studies were conducted by Veeramani and Saini (2010); Amoro and Shen (2013), Kannan (2013); Boansi, Odilon Kounagbé Lokonon and Appah (2014); Kingu (2014). Few studies are sector-specific which include, Kimura and Lee (2006), Kumar (2010); Sahoo and Nauriyal (2013); Yean and Jia (2014); Tesfaye (2014); Alkhiteeb and Sultan (2015). Some studies considered trade as a whole while addressing the determinants of trade which included Sasatra and Prasopchoke (2007); Chakravarty and Chakrabarty (2014); Wani, Dhama, and Rehman (2016); Gururaj, Satish, and Kumar (2016). No studies were conducted, which took into account the influencing factors determining agriculture trade of India with ASEAN countries as a whole. Thus, the present study tried to fill this gap and open up avenues for the other researchers in the particular area.

Globally, free trade agreements (FTAs) have proliferated since the mid-1990s. These trade agreements work alongside the multilateral trade agreements framed by the World Trade Organisation (WTO). Most countries are inclined to give importance to economic regionalism over multilateralism with a consequent rise in volume of world trade through FTAs (World Trade Report, 2011; Bowels, 2000). The preference for regionalism is quite evident from a surge in number of FTAs signed from 124 during 1948/1994 to 400 during 1995/2015.1 FTAs increase economic strength by removing barriers to trade and boosting investment among the member countries (Wong & Chan, 2003). Some scholars, however, have argued that FTAs hamper multilateral trade negotiations (Levy, 1997; Mayer, 1984; Krishna, 1998; Grossman & Helpman, 1994; Bhagwati, 1991; Bhagwati, 1993), while others have found that FTAs are a positive path towards freer multilateral trade (Freund, 2000; Ethier, 1998; Hillman et al., 1995; Summers, 1991). India has emerged as a rapidly growing economy in South Asia changing the dynamics of economic

integration in the region (Wang, 2006). Although India is committed to multilateral trade policy, it has embarked on negotiating a number of free trade agreements during the recent decades. Currently, 42 FTAs have been signed with various countries to diversify and expand the export market destinations (Economic Survey of India, 2015-16). With its 'Look East' policy agenda initiated during the 1990s, India has been actively engaging the Southeast Asian countries for a closer economic and strategic relationship (Hong, 2006). India became a partner of Association of Southeast Asian Nations (ASEAN) and signed the ASEAN-India Free Trade Agreement (AIFTA) in August 2009. This agreement came into effect on 1 January 2010. India and ASEAN look upon AIFTA as a complement to the multilateral trading system by ensuring the compatibility of the FTAs with the rules laid down by the WTO. AIFTA intends to increase the bilateral trade between India and ASEAN member countries, and improve welfare of people in these two regions (Sikdar & Nag, 2011; Sasatra & Prasopchoke, 2007; Karmakar, 2005; Sen, 2004). India's free trade agreement with ASEAN involved negotiations on tariff reduction in merchandise goods including sensitive commodities like agricultural products. The major concern during the negotiations was that a possible surge in import of agricultural products from ASEAN countries will have serious implications for livelihoods of Indian farmers. Studies have shown that tariff reduction commitment schedule agreed between India and ASEAN might adversely affect the sectors such as tea, coffee, spices and rubber (Pal & Dasgupta, 2009). Further provision of rules of origin under AIFTA was considered harmful to the interests of tropical commodity producers in the Indian state of Kerala (Harilal, 2010; Veeramani & Saini, 2011). On the contrary, studies have also shown a significant trade potential between India and ASEAN through better economic cooperation (Sen, 2004; Yean & Jia Yi, 2014). However, these studies are not comprehensive in terms of commodity coverage and do not capture the country specific characteristics and time effects. This research examines the impact of free trade agreement on India's agricultural sector with a special reference to AIFTA. The issues of trade creation and trade diversion are analysed by using gravity model. The rest of the paper is organised as follows. The second section provides a brief review of literature. Sources of data, country coverage and FTAs covered are given in the third section. Econometric model and problems in estimation are discussed in the fourth section. The fifth section analyses the trend in trade between India and ASEAN. The results of trade creation and trade diversion effects are discussed in the sixth section. The final section provides concluding remarks. ed to increase in agricultural trade among the members. There was a significant export and import diversification for EU-15, but the creation of SADC increased agricultural exports to non-member countries. It is discernible that only a few studies had analysed the impact of FTAs on agriculture trade as agriculture was excluded from such agreements until 2000s. However, since the Doha Round of Development in 2001, agriculture became part of negotiations of many FTAs. Existing studies have mostly concentrated on analysing the effects of NAFTA and EU. Limited empirical evidence is available on the effects of ASEAN-India Free Trade Agreement (AIFTA) on agriculture. Considering this research gap in the literature, the present study has analysed the effects of AIFTA on agricultural trade among the member countries using the gravity Model

### 3. Data and Methodology

The analysis of the present study is conducted on a sample of 11 countries for a period of 2000-2019. Sample countries include India and 10 ASEAN countries. Data on bilateral agriculture exports is extracted from UNCOMTRADE database. The World Development Indicators database was used to acquire data on Gross Domestic Product (GDP) and population. The Centre d'Etudes Prospectives et information's Internationales (CEPII) provided data on common language, common

boundary, and distance. CEPII calculates the geographic distance between countries using the great circle method of the latitudes and longitudes of the major urban metropolises in terms of population. Data on FTA's was taken from WTO. The total number of observations equals 2635. The description of variables used in the study and their expected signs are given in Table 2

## 2. DESCRIPTION OF GRAVITY MODEL VARIABLES

Variable	Description	Expected Sign
<b>Dependent Variable</b>		
$\ln X_{ij}$	Log of bilateral agricultural exports	
<b>Independent variable</b>		
$\ln \text{Gdp}_i$	Log of gross domestic product of reporter country i	+
$\ln \text{Gdp}_j$	Log of gross domestic product of partner country ij	+
$\ln \text{gdp}_i$	Log of gdp per capita of reporter country i	+/-
$\ln \text{Pop}_j$	Log of gdp per capita of partner country j	+/-
$\ln \text{Dist}$	Log of Distance between country i and j	-
Common border	Dummy variable = 1 if country i and j have a common border; 0 otherwise	+
Common language	Dummy variable = 1 if country i and j have a common ethno language; 0 otherwise	+
Common colony	Dummy variable = 1 if country i and j share common colonial ties ;0 otherwise	+
$\text{FTA}_{ij}$	Dummy variable = 1 if both country i and j are the members of FTA	+/-

Source: Author's own compilation

### 3.1: GRAVITY MODEL

To account for a comprehensive analysis and to examine the determinants of agricultural exports within south Asian block. We have employed a widely celebrated gravity model technique derived from Newton's universal law of gravitation, which states which states that the gravitational pull

between two physical bodies is proportional to the product of their body mass divided by the squared distance between the gravity centres. The model has been successfully applied to different types of flows such as migration, foreign direct investment, and more specifically, to international trade flows (Zarzo, 2003). The first empirical study with gravity model of international trade was done by Tinbergen (1962) and Poyhonen (1963). The theoretical application of gravity model in trade describes that trade flows between two countries are proportional to the product of each country's 'economic mass', generally indicated by Gross Domestic Product (GDP), divided by the distance between the respective economic centres – usually using distance between the countries' capital cities as a proxy. Thus, it is postulated that the trade flow between the two countries is directly proportional to the two country's income and inversely proportional to the distance between them.

$$T_{ij} = Y_i * Y_j / D_{ij}$$

$$X_{ij,t} = \alpha Y_{i,t}^{\beta_1} Y_{j,t}^{\beta_2} D_{ij}^{\beta_3}, \beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \dots \dots \dots (1)$$

Where  $X_{ij}$  is bilateral trade flow from country I to country j.  $Y_i$  and  $Y_j$  are GDP of country I and country j and  $D$  is the distance between two countries. In addition to these basic variables, other variables like common language, common border, population etc. can also be included in standard gravity model (Frankel, 1997).

Traditionally gravity model was estimated by using cross sectional data to examine the trade flow between countries. However, cross-section data collected over multiple time periods (panel data approach) yields more meaningful information than cross-section data alone. The benefit of this approach is that, first, the panel can document the key relationships involving variables over time; and, second, the panel can track the individual effect of unobserved heterogeneity (Rahman, 2007). Matyas (1997) contends that the cross-section approach is hampered by misspecification and recommends that the gravity model be stated as a "three-way model" including exporter, importer, and time effects. Panel data approaches, according to Egger (2000), are the best for untangling time-invariant and country-specific effects. Therefore, we have used panel data methodology for our empirical gravity model of export and import flows. Empirical studies shown that exports, imports or even the total trade can be suitable as dependent variable for examine the determinants of trade flow (Kien, 2009).

### 3.2: Estimation technique

There are mainly three estimating methodologies utilized in the literature when working with panel data – pooling, fixed effects, and random effects approaches. However, none of the three techniques can be applied to a multiplicative model or a zero-trade situation. The equation 3 is estimable only when we don't face the problem of zero trade which contains a vital information regarding the trade flow. Not taking into account zero trade flows means a vital information regarding low levels of trade is missing. (Eichengreen and Arwin, 1997). Dropping such observations from the estimation will lead to unbiased estimates especially when zero trade flows are randomly distributed (Burger 2009)

So the log log regression model can be used only when dependent variable trade volume is greater than zero. Such specification/model will create a problem by dropping zero trade values from the estimation process. But leaving out zero trade values means losing important information which

these low trade values contains and therefore causing serious issue. This can lead to biased results, particularly when zeros trade flows are non-randomly distributed (Burger,2009). The standard gravity model includes time-invariant variables such as distance, common borders, common language, and an FTA dummy. A random effects model can be applied under the assumption that unobserved heterogeneity is not correlated with the explanatory variables. However, endogeneity issues can lead to biased and inconsistent estimates of the gravity model (Baier & Bergstrand, 2007; Urata, 2010). Countries often form FTAs with trading partners due to pre-existing trade relationships influenced by factors such as common language, cultural ties, and historical colonial links. As a result, the FTA variable is likely to be correlated with the error term. Incorporating time effects and country-specific effects can help mitigate endogeneity bias

To address this issue, we apply Santos-Silva and Tenreyro's so-called PPML estimator (2006). Not only it captures the useful information contained in zero trade flows but also PPML estimation technique is suitable method in presence of heteroscedasticity. With a solid theoretical foundation and substantial empirical evidence, the PPML approach has long been regarded as one of the most effective techniques for calculating gravity equations (2011).

**3.3: Analytical specifications**

The Augmented gravity model in case of panel data approach is expressed as:

$$X_{ijt} = \alpha gdp_{it}^{\beta_1} gdp_{ij}^{\beta_2} dis_{it}^{\beta_3} gdp_c_i^{\beta_4} \varepsilon_{ijt} \dots \dots \dots (2)$$

Taking log on both sides of the equation 3 and include other dummy variables in the equation 2 is expressed as

$$\ln X_{ijt} = \alpha + \beta_1 \ln gdp_{it} + \beta_2 \ln gdp_{ij} + \beta_3 \log pop_i + \beta_4 pop_j + \beta_5 \ln dis + + \beta_6 colony + \beta_7 \ln g_{ij} + \beta_8 contig + \beta_9 AIFTA + \varepsilon_{ijt} \dots \dots \dots (3)$$

The equation to be estimated using PPML estimation technique is described as

$$X_{ijt} = \alpha + \beta_1 \ln gdp_{it} + \beta_2 \ln gdp_{ij} + \beta_3 \log pop_i + \beta_4 pop_j + \beta_5 \ln dis + + \beta_6 colony + \beta_7 \ln g_{ij} + \beta_8 contig + \beta_9 AIFTA + \varepsilon_{ijt} \dots \dots \dots (4)$$

Here the gravity model is in log linear form, the interpretation of coefficients of dummy variables is by taking it in exponential and then minus 1 from it (Frankel 1997)

In order to capture time effects that is to that is to account for macroeconomic effects, like economic recessions or booms to the international flows and time trend in trade (Sun and Reed 2010; Yang and Martinez-Zarzoso 2014; Milton and Siddique 2014). The model is as follows

$$X_{ijt} = \alpha + \beta_1 \ln gdp_{it} + \beta_2 \ln gdp_{ij} + \beta_3 \log pop_i + \beta_4 pop_j + \beta_5 \ln dis + + \beta_6 colony + \beta_7 \ln g_{ij} + \beta_8 contig + \beta_9 AIFTA + \delta t + \varepsilon_{ijt} \dots \dots \dots (5)$$

The next model includes, along with time effects, the importer- and exporter-specific fixed effects to take into account the unobserved country-specific variables such as infrastructure and factor endowments. This allows for properly controlling for the MRTs as recognized by Anderson and van Wincoop (2003). The final estimable equation is given below,

$$X_{ijt} = \alpha + \beta_1 \ln gdp_{it} + \beta_2 \ln gdp_{ij} + \beta_3 \log pop_i + \beta_4 pop_j + \beta_5 \ln dis + + \beta_6 colony + \beta_7 \ln g_{ij} + \beta_8 contig + \beta_9 AIFTA + \delta t + \gamma_i + \varepsilon_{ijt} \dots \dots \dots (6)$$

## 5. Results and Discussions

Table 2: OLS and PPML estimation Results

	OLS	OLS(TE)	PPML(TE)	OLS(TE&CE)	PPML(TE&CE)
lngdp <sub>i</sub>	2.061*** (0.06)	2.323*** (0.06)	0.916*** (0.04)	2.582*** (0.21)	0.528*** (0.17)
lngdp <sub>j</sub>	1.223*** (0.05)	1.465*** (0.05)	0.694*** (0.03)	0.174 (0.21)	0.679*** (0.12)
lnpop <sub>i</sub>	-0.033 (0.05)	-0.203*** (0.05)	-0.129*** (0.02)	-13.923*** (1.55)	-1.418** (0.63)
lnpop <sub>j</sub>	-0.234*** (0.04)	-0.388*** (0.04)	-0.030 (0.02)	-3.884** (1.56)	-2.956*** (0.60)
Indist	-0.957*** (0.09)	-0.864*** (0.08)	-0.548*** (0.07)	-0.147 (0.15)	-0.695*** (0.05)
colony	-0.014 (0.16)	-0.128 (0.15)	-0.139** (0.07)	0.821*** (0.15)	-0.061 (0.07)
lang	-0.826*** (0.17)	-1.327*** (0.17)	-0.662*** (0.06)	-0.081 (0.16)	-0.815*** (0.08)
contig	1.965*** (0.20)	2.367*** (0.19)	0.810*** (0.08)	1.489*** (0.20)	0.726*** (0.07)
AIFTA <sub>ij</sub>	-1.179*** (0.14)	-2.371*** (0.37)	-0.159 (0.20)	1.329** (0.58)	0.058 (0.16)
Constant	-61.938*** (1.47)	-70.916*** (1.56)	-22.190*** (1.05)	267.438*** (44.59)	-0.715** (0.33)
Observations	2635	2635	2635	2635	2635
R <sup>2</sup>			0.544		0.762
Adjusted R <sup>2</sup>					

Source: Author's own calculation

The Poisson Pseudo-Maximum Likelihood (PPML) estimator is preferred over ordinary Least Squares (OLS) in analyzing agricultural trade flows within the ASEAN bloc, including India, due to its ability to handle zero trade values and heteroskedasticity, both common in agricultural trade data. OLS, which assumes homoskedasticity and ignores zero trade flows, can produce biased estimates. The PPML approach, particularly with Time Fixed Effects (TE) and Country-Specific Effects (CE), provides more reliable results by controlling for unobserved heterogeneity. The

significant shifts in coefficient values across different specifications highlight the importance of accounting for fixed effects in understanding agricultural trade dynamics.

The results confirm the fundamental determinants of agricultural trade within ASEAN and India. Both the GDP of the exporting country and the importing country positively influence trade. In the PPML models, the GDP of the exporter ( $\ln gdp_i$ ) has a coefficient of 0.916 in PPML(TE) and 0.528 in PPML(TE&CE), meaning that a 1% increase in the exporter's GDP increases agricultural exports by 0.92% and 0.53%, respectively. Similarly, the GDP of importing countries ( $\ln gdp_j$ ) has coefficients of 0.694 (PPML TE) and 0.679 (PPML TE&CE), confirming that higher economic growth in ASEAN countries boosts their demand for agricultural imports within the bloc. The role of distance ( $\ln dist$ ) is also crucial; its negative and significant coefficient (-0.548 in PPML(TE) and -0.695 in PPML(TE&CE)) confirms that greater geographic distance reduces agricultural exports due to higher transportation and storage costs, which are critical in perishable goods trade.

The impact of population on agricultural trade is mixed. The exporter's population ( $\ln gdp_i$ ) negatively affects agricultural exports (-0.129 in PPML(TE) and -1.418 in PPML(TE&CE)), suggesting that as a country's population grows, more agricultural output is absorbed domestically, reducing surplus for exports. On the importing side, the population of ASEAN countries ( $\ln gdp_j$ ) is insignificant in PPML(TE) but strongly negative in PPML(TE&CE) (-2.956). This suggests that larger populations in importing countries might indicate a shift toward domestic agricultural production or reduced reliance on intra-bloc agricultural imports, potentially due to self-sufficiency policies or regional trade agreements favoring intra-ASEAN trade.

Regarding trade facilitators, the contiguity ( $contig$ ) coefficient is positive and significant (0.810 in PPML(TE) and 0.726 in PPML(TE&CE)), confirming that agricultural trade within ASEAN and India is higher when countries share a border or are in close proximity. Interestingly, colonial ties ( $colony$ ) become insignificant in PPML(TE&CE), suggesting that historical linkages do not significantly influence contemporary agricultural trade. Additionally, common language or ethnic ties ( $lang$ ) show a negative effect (-0.662 in PPML(TE) and -0.815 in PPML(TE&CE)), which is counterintuitive. This may reflect ASEAN's preference for diversifying import sources beyond traditional partners despite cultural or historical ties.

A key focus is the ASEAN-India Free Trade Agreement (AIFTA<sub>ij</sub>) and its impact on intra-bloc agricultural trade. In PPML(TE), the coefficient is -0.159, and in PPML(TE&CE), it is 0.058, both statistically insignificant. This suggests that AIFTA has not significantly boosted agricultural trade within the ASEAN bloc and India when controlling for time and country-specific effects. In contrast, the OLS results indicate a negative impact (-1.179 in OLS and -2.371 in OLS(TE)), likely due to omitted variable bias. The insignificance in PPML implies that while AIFTA has reduced trade barriers, other factors such as non-tariff measures (NTMs), quality standards, or logistical constraints might be limiting its effectiveness in increasing agricultural trade. Many ASEAN countries have strict sanitary and phytosanitary (SPS) regulations, which can act as hidden barriers despite tariff reductions under AIFTA. Additionally, ASEAN's strong intra-regional trade in agriculture may reduce the reliance on imports from within the bloc, including India.

While the analysis does not find a strong positive impact of AIFTA on intra-ASEAN agricultural trade, this does not necessarily mean that the trade agreement has failed. Rather, it suggests that agricultural trade is influenced by more than just tariff reductions. Addressing non-tariff barriers, improving trade logistics, and ensuring compliance with ASEAN's quality standards could enhance the effectiveness of AIFTA in boosting agricultural trade within the region. Future research should explore whether specific agricultural commodities (such as rice, spices, or dairy) have benefited differentially from AIFTA and whether targeted policy interventions can improve agricultural trade integration within ASEAN and India.

## 6. CONCLUSION

The results highlight the key determinants of agricultural trade within the ASEAN bloc, including India, emphasizing the role of economic size, geographic factors, and institutional influences. Larger economies within the region, as indicated by the positive and significant coefficients for GDP, engage in higher levels of agricultural trade, reinforcing the gravity model's predictions. However, distance negatively affects trade, reflecting transportation costs and perishability concerns in agricultural exports. Population size has mixed effects, where larger populations in exporting countries reduce export intensity is significantly negative in PPML(TE&CE) at -1.418), possibly due to greater domestic consumption. Conversely, the population of importing countries negatively affects trade in PPML(TE&CE) (-2.956), suggesting structural trade barriers or local agricultural self-sufficiency.

The ASEAN-India Free Trade Agreement (AIFTA) does not show a significant impact on agricultural trade flows within the region in the PPML models. While the agreement aims to facilitate trade, non-tariff barriers, local market protection, and quality regulations may still be restricting agricultural exports. Additionally, the insignificant effect of colonial ties and common language/ethnic ties suggests that historical or cultural factors play a limited role in shaping intra-ASEAN agricultural trade patterns. However, contiguity (contig) has a strong positive effect (0.726 in PPML(TE&CE)), indicating that neighbouring countries engage in higher agricultural trade, likely due to lower transportation costs and established supply chains.

Overall, the findings suggest that economic and geographic factors dominate agricultural trade flows within ASEAN and India, while trade agreements alone do not significantly enhance exports. For AIFTA to have a more meaningful impact, reducing non-tariff barriers, improving trade facilitation measures, and enhancing infrastructure for perishable agricultural goods are crucial steps. Future research should explore commodity-specific trade impacts and assess how trade facilitation policies can enhance agricultural integration within the ASEAN-India region.

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