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Does gravity work in the context of India and ASEAN bilateral trade? An application of the FGLS method

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Abstract. *The proliferation of regional trade agreements after the article of GATT encouraged India to announce its Look East Policy in 1991 that aimed to strengthen India's trade relations with ASEAN nations, followed by the signing of the India-ASEAN FTA in 2009. Since then, the trade relations between India- ASEAN have increased manifold. The proposed study aims at exploring the determinants of bilateral trade flows between India and ten ASEAN nations under gravity model analysis framework for a period of 32 years ranging from 1988-2019. The FGLS estimation methodology has been employed for estimating bilateral trade. The results of the augmented gravity model exhibit that bilateral trade is positively affected by GDP, population, TR/GDP ratio, bilateral real exchange rate. In contrast, transaction costs, tariff rates, common border, and common official languages significantly negatively impact bilateral trade flows. Further trade potential has been calculated as a difference between predicted trade and actual trade. The results indicate a substantial untapped trade potential between India and ASEAN countries except for Brunei and Cambodia, where trade has already reached its maximum potential.*

Keywords: India, ASEAN, gravity model, FGLS, trade potential.

JEL Classification: F1, F14, O5.

1. Introduction

The role of international trade in economic development has been given considerable importance by classical and neo-classical economists like Adam Smith, David Ricardo, and Hecksher and Ohlin in their international trade theories. According to these theories, international trade happens when countries exchange goods and services across borders based on their factor endowments and competitiveness in the global economy. When countries participate in global trade, they benefit from increased income, economies of scale, fuller resource utilization, a raised standard of living (Frankel and Romer, 1996), and broader market access. Thus, international trade results in increased economic development and growth (Omoju and Adesanya, 2012).

To regulate and facilitate global trade, an international organization, WTO, was established in 1995 as a successor of GATT. Over the past 60 years, WTO and GATT have helped in creating a solid and prosperous international trading system, thereby contributing to unprecedented economic growth by reducing trade barriers(1). In the post-WTO establishment period, the global trade scenario witnessed a diversion from the multilateral trading agreements system to the regional trading agreements system (Chandran, 2018). There was an upsurge in the regional trade agreements because Article XXIV of GATT in 1994 provided provisions for their establishment after recognizing the importance of closer integration of the economies to enhance world trade. This upsurge could be attributed to the delay in the negotiations at multilateral level talks (Jayasinghe and Sarker, 2008). The significance of the proliferation of regional trade agreements can be ascertained from the fact that all WTO members have signed one RTA in force, and as of 15 June 2021, 349 RTAs were in force (2).

Since its establishment in 1967, ASEAN has become one of the biggest regional trade blocs in the world. By 2018, ASEAN's share in the global GDP had increased to 3.5% from 2.9% in 2010. ASEAN is fifth among the largest economies in the world after the U.S., the E.U., China, and Japan, with nominal GDP estimated at US$ 3.0 trillion (The ASEAN Secretariat, 2019).

Bilateral trade relations between India and ASEAN began to flourish after India announced its Look East Policy in 1991 to develop mutually beneficial economic regional agreements in the east-Asian region (Banik and Kim, 2020). India-ASEAN FTA in goods was signed in 2009. The then 'Look East Policy' has been upgraded into a dynamic and action-oriented "Act East Policy" in 2014. India-ASEAN FTA in services was signed in 2015. Currently, 30 dialogue mechanisms exist between India and ASEAN which involve various sectors. Trade relations between India and ASEAN have grown rapidly over the past three decades making ASEAN India's fourth-largest trading partner after the E.U., the U.S., and China (Sharma and Kathuria, 2020).

With a background of India-ASEAN relations, Table 1 and Table 2 have been used to discuss the performance of India and ASEAN for 2019 and the growth of bilateral trade from 1988-2019, respectively, subject to data availability.

Table 1. *Macroeconomic performance of India and ASEAN countries (Year 2019)*

Country name	GDP (Billion US$)	GDP Growth rate (%)	PGDP (US$)	Inflation Rate (CPI) (annual %)	Unemployment Rate (%)	FDI Net Inflow (Billion US$)	FDI Net Inflow (as% of GDP)	Trade (Billion US$)	Trade (as % of GDP)
India	2868.9	4.18	2099.599	3.72	5.27	50.6	1.76	1134.7	39.55
Brunei	13.5	3.87	31086.75	-0.39	6.92	0.4	2.77	14.6	108.51
Cambodia	27.1	7.05	1643.121	2.03	0.13	3.7	13.52	33.5	123.56
Indonesia	1119.2	5.02	4135.569	3.03	3.62	25.0	2.23	417.5	37.30
Lao PDR	18.2	4.65	2534.898	3.32	0.62	0.	4.16	7.8	42.97
Malaysia	364.7	4.30	11414.21	0.66	3.31	9.1	2.50	448.6	123.00
Myanmar	76.1	2.89	1407.813	8.83	0.5	2.3	3.01	44.8	58.93
Philippines	376.8	6.04	3485.084	2.48	2.24	7.7	2.04	258.5	68.61
Singapore	372.1	0.73	65233.28	0.57	3.1	105.5	28.35	1187.4	319.15
Thailand	543.5	2.35	7806.742	0.71	0.72	4.8	0.89	600.0	110.39
Vietnam	261.9	7.02	2715.276	2.80	2.04	16.1	6.15	551.0	210.40
ASEAN	3173.0	4.23	5624.299			175.3	5.52	3571.0	112.54

Source: WDI database of World Bank and author's calculation.

Table 1 shows that Indian GDP at current prices was US$ 2869 billion with a growth rate of 4.2%, and per capita GDP stood at around US$ 2100 in 2019.

In 2019, ASEAN accounted for 3.62% of global GDP, and its share in global exports was 7.5%. The size of the ASEAN economy was US$ 3173 billion in 2019, and a population of 660.62 million people resided in the region. The per capita GDP at the current prices of ASEAN stood at US$ 5624.30. Based on GDP at current prices, in 2019, Indonesia was the biggest economy in ASEAN with US$ 1119.2 billion GDP. In contrast, Brunei was the smallest economy with a GDP of US$ 13.5 billion. Singapore had the most enormous per capita income in the ASEAN region at US$ 65233.28, whereas Myanmar has the lowest per capita income at US$ 1407.8.

Although India has the highest GDP at current prices compared to all other ASEAN member countries, per capita GDP shows a different picture. As India has the second-largest population globally, no wonder per capita GDP is lower despite having the highest GDP than ASEAN countries. The TR/GDP ratio of India is only 39.55% higher than in Indonesia only. Even Brunei has a higher TR/GDP ratio of 108.5% than India, indicating that India still has to enhance its trade.

After the signing of AIFTA in goods, bilateral trade has increased between India and ASEAN countries. In Table 2, the Compound Annual Growth rate of bilateral Trade has been displayed. The highest CAGR has been calculated in the bilateral trade with Cambodia (25%) with a trade surplus, which exhibits that the Indian exports are more than the imports. The bilateral trade with Vietnam has the second-highest CAGR of 22.4% but with a trade deficit, thus resulting in more imports to India from Vietnam than exports. The compound annual growth rate (CAGR) of India-ASEAN total trade for 1991-2001 has been a robust 11.1% (Karmakar, 2005). There has been a positive CAGR of 13.22% of Indian-ASEAN bilateral trade with a massive increase in the trade deficit from US$ 701 million in 1988 to US$ 22790 million in 2019. India's exports to the ASEAN region have registered a CAGR of 14.06%, and imports have recorded a 12.80% CAGR. The trend of bilateral trade shows

that exports need to be increased, and for this, formulation and implementation of suitable foreign trade policy should be done. Foreign trade policy (2015-2020) of India aimed at promoting exports and making India a significant partner in global trade by 2020, but still India lagged behind in the exports.

Table 2. *India and ASEAN Bilateral Trade, CAGR (year 1988 and 2019)*

	1988				2019				
ASEAN partner countries	Indian Exports to ASEAN	Indian Imports from ASEAN	Total Bilateral Trade between India and ASEAN	Balance of Trade (Deficit/ Surplus)	Indian Exports to ASEAN	Indian Imports from ASEAN	Total Bilateral Trade between India and ASEAN	Balance of Trade (Deficit/ Surplus)	CAGR of bilateral trade (in %)
Brunei	2.02	0.27	2.29	1.74	56.81	581.37	638.18	-524.56	19.24
Cambodia	0.24	0.00	0.24	0.24	204.00	46.59	250.59	157.41	24.32
Indonesia	30.68	62.57	93.25	-31.89	4515.38	15563.89	20079.27	-11048.51	18.27
Lao PDR	0.07	0.00	0.07	0.07	29.29	2.62	31.91	26.66	21.15
Malaysia	90.23	543.49	633.72	-453.27	6268.54	10407.57	16676.11	-4139.03	10.75
Myanmar	1.54	53.58	55.12	-52.04	956.90	506.73	1463.63	450.17	10.79
Philippines	24.83	1.72	26.54	23.11	1635.53	556.91	2192.45	1078.62	14.79
Singapore	209.94	360.37	570.31	-150.42	10738.69	14893.89	25632.58	-4155.20	12.62
Thailand	131.40	178.99	310.39	-47.59	4331.65	7034.31	11365.96	-2702.66	11.90
Vietnam	16.91	7.93	24.84	8.97	5512.87	7446.09	12958.96	-1933.22	21.59
ASEAN	507.84	1208.93	1716.77	-701.08	34249.66	57039.98	91289.64	-22790.32	13.22

Note: All values are in Million US$. CAGR is obtained through Author's calculation and is in %.
Source: UN-COMTRADE database on WITS.

In this context, the present study tries to investigate the determinants of bilateral trade flows of India with ASEAN countries. The paper uses simple average tariff and transaction cost (proxy for bilateral distance) as the determinants of India and ASEAN countries bilateral trade flows that previous studies did not use. The FGLS methodology has been used for the same purpose Trade potential has been calculated to estimate the future direction of trade relations between these trading partners.

The rest of the paper proceeds as follows. Section 2 includes the review of literature, followed by a detailed discussion of methodology which involves model selection, description of data, its sources, and variables in Section 3. In section 4, results have been reported and discussed. Section 5 discusses trade potential, and lastly, section 6 concludes the study.

2. Literature review

This section presents the studies that have been done on India-ASEAN bilateral trade relations. After the Look East Policy announcement followed by the signing of the India-ASEAN FTA (AIFTA), the growing economic ties between India and ASEAN have encouraged researchers to explore Indian-ASEAN trade relations and the impact of AIFTA on different aspects of the Indian economy.

Studies by Pal and Dasgupta (2008, 2009) and Sen et al. (2004) critically assessed the impact of AIFTA in the presence of significant complementarities between India and ASEAN industries. They suggested that FTA should also be signed in services and

investment along with FTA in goods. Pal and Dasgupta (2009) studied proposed tariff lines reduction under FTA and concluded that the agriculture sector in India, especially the plantation sector, would face competition in tea, coffee, spices, and rubber industry due to increased imports from ASEAN as a result of reduced tariff lines. In contrast, the automobile sector would be benefitted under FTA. Regarding the balance of trade of India, Bhattacharyya and Mandal (2010) estimated the negative impact of FTA and the deterioration of the trade balance of India.

Ahmed (2010); Sikdar and Nag (2011); Veeramani and Saini (2011) analyzed welfare effects of AIFTA taking into account allocative efficiency and terms of trade effects. They found out that AIFTA would increase welfare for India and ASEAN, but ASEAN would benefit more. Ahmed (2010) analyzed that due to AIFTA, terms of trade of India would worsen, increased imports from ASEAN would hamper the employment and wages in the plantation sector, trade balance of India would be negative, and loss of revenue to the government. Veeramani and Saini (2011) estimated that loss in government revenue would be compensated by increased consumer surplus due to increased imports. Sikdar and Nag (2011) concluded that there would be a loss in welfare in the short-run, but in the long-run positive effect of FTA on welfare could be seen due to the complete elimination of tariffs. Mandal (2018) revealed that AIFTA would positively impact ASEAN whereas, negative welfare impact on India.

Apart from welfare impact, studies have been conducted on analyzing sectoral impacts of AIFTA. Karmakar (2005) suggested that trade agreements in services with ASEAN would be more beneficial to India as India is the major importer of services, whereas Gupta (2019) revealed that even after signing of AIFTA in services with ASEAN, Indian exports of services, especially in IT services, to ASEAN have not increased as compared to the US and the EU. Francis (2011) argued that tariff reduction under AIFTA would adversely affect the semi-processed and processed agricultural products while, Chandran and Sudarsan (2012) and Ratna and Kallummal (2013) showed that trade creation will happen in fisheries because India enjoys comparative advantage in the sector. Existence of complementarities in energy, consumer durables and food items was studied by Banik (2014) and to gain positively from AIFTA the author suggested that India should participate in production networking with east-Asian countries. Bhattacharyya and Mandal (2014) and Mukherjee (2016) presented opposite results on impact of AIFTA on intermediate and final goods. In their ex-ante study, Bhattacharyya and Mandal (2014) proposed that trade in intermediate goods will be affected more both favorably and unfavorably under FTA than the final goods and factors other than tariff should be considered in AIFTA. On the other hand Mukherjee (2016) found out that AIFTA showed no impact on trade of intermediate and final goods between India-ASEAN whereas, India trade more with Singapore and Malaysia with which India have separate CECA region. Sensitiveness of exports and imports of Indian textile industry due to the proposed tariff lines reduction under FTA was studied by Mandal (2018a) revealed that Indian exports are tariff sensitive whereas imports from ASEAN are not, given the fact that ASEAN countries already have tariff rates lower that India. Jena and Saini (2020) studied the impact of AIFTA on employment generation in industries and found that AIFTA had resulted in reduction in employment generation in Indian industries due to their low competitiveness. Signing of AIFTA had also encouraged

the researchers to study its trade creation or diversion impact on bilateral trade. Renjini et al. (2017) and Jagdambe and Kannan (2020) found out that there has been trade creation in agricultural sector due to AIFTA and similar result was found out in bilateral trade by Chandran (2018) but Khurana and Nauriyal (2017) showed trade diversion effects due to reduced exports under AIFTA.

Some studies such as Philip and Alappatt (2015) revealed that AIFTA has contributed in Indian growth and development and suggested more FTAs between India and ASEAN should be signed, Oberoi (2019) opined that AIFTA has resulted in shifting of Indian economic structure from low specialized economy to competitive and highly specialized economy and Sharma and Kathuria (2020) analyzed that trade between India and ASEAN was mutually beneficial and thus resulted in increased investment, effectiveness of capital market and enhanced economic efficiency

Based on above discussion it can be argued that the most of the previous studies investigated the likely impact of AIFTA especially on Indian economy, welfare and on various sectors whereas, the present study aims at analyzing the determinants of India-ASEAN bilateral trade and the presence of trade potential between them which most of the previous studies have not explored.

3. Methodology

3.1. Model selection

The first use of gravity model for analysis of international trade was made by the Nobel laureate Dutch economist Jan Tinbergen in his seminal work in 1962 (Tinbergen, 1962). The analogy of gravity model in global trade has been derived from "Universal Law of Gravitation" in physics given by Sir Isaac Newton. The gravity model in its basic form put forwards that the trade between two countries (Tij) is proportionally related to the product of GDP (YiYj) of the nations involved and negatively related to the economic distance (usually proxied by physical distance, Dij) between them.

$$T_{ij} = \alpha(Y_i Y_j / D_{ij}) \quad (1)$$

The above mention model is used in log-linear form to analyze the bilateral trade.

$$\ln T_{ij} = \alpha + \beta 1 \ln(Y_i Y_j) - \beta 2 \ln(D_{ij}) + u_{ij} \quad (2)$$

α, β1 and β2 are the estimated coefficients and uij is the stochastic error term capturing shocks other than GDP and distance that affects bilateral trade.

However, the gravity model proposed by Tinbergen was criticized for lacking theoretical foundation. After having introduced basic gravity model in international trade, a number of researches were carried out by making modifications in the basic model. For example, Linnemann (1966) analyzed trade flow composition through partial equilibrium models of export and import, Leamer (1974) applied gravity model to find out how income and population impact trade. It was in 1979 when Anderson attempted to provide the theoretical validation to the gravity model in trade by estimating it using demand function under

assumption of constant elasticity of substitution. In his model, country of origin was used as the basis to differentiate the goods. Then, Bergstrand (1985,1989) theoretically justified the application of gravity model based on monopolistic competition. Helpman and Krugman (1985)'s derivation was based on assumption of economies of scale and product differentiation. Deardorff (1998) proved the consistency of gravity model in the presence of difference in factor endowments as per the trade theory given by Hecksher and Ohlin. Anderson and Wincoop (2001) applied gravity model to understand the impact of cross border barriers on trade and in 2003 introduced the concept of relative trade costs, which are crucial to control for a well-specified gravity model. The impact of endogeneity of trade flows and free-trade agreements explained by Baier and Bergstrand (2002), Rahman (2003) and Irshad et al. (2018). Over the years, gravity model, since its introduction, have been evolved and used in various forms for analyzing trade flows.

For analyzing the determinants of bilateral trade, augmented gravity model incorporating product of GDPs and Population variables have been used in this paper on the basis of (Frankel and Wei, 1992; Kabir Hassan, 2000; Sharma and Chua, 2000; Rahman and Dutta, 2012). Trade/GDP ratio variable has been used according to the studies of M. M. Rahman (2003) and Irshad et al. (2018).

$$\ln(\text{Tradeijt}) = \beta_0 + \beta_1 \ln(\text{GDPit} * \text{GDPjt}) + \beta_2 \ln(\text{POPit} * \text{POPjt}) + \beta_3 \ln(\text{DPGDPijt}) + \beta_4 \left(\frac{\text{T.R.}}{\text{GDPit}}\right) + \beta_5 \left(\frac{\text{T.R.}}{\text{GDPjt}}\right) + \beta_6 \ln(1 + \text{Tariffijt simpleavg}) + \beta_7 \ln(\text{BiRERijt}) + \beta_8 \ln(\text{TCijt}) + \beta_9 \text{D1language} + \beta_{10} \text{D2commonborder} + u_{ijt} \quad (3)$$

Model in equation (3) was the original model to be used to study but because of multicollinearity problem variable ln (DPGDPijt) has been dropped. So, the estimated model is shown in equation (4).

$$\ln(\text{Tradeijt}) = \beta_0 + \beta_1 \ln(\text{GDPit} * \text{GDPjt}) + \beta_2 \ln(\text{POPit} * \text{POPjt}) + \beta_3 \left(\frac{\text{T.R.}}{\text{GDPit}}\right) + \beta_4 \left(\frac{\text{T.R.}}{\text{GDPjt}}\right) + \beta_5 \ln(1 + \text{Tariffijt simpleavg}) + \beta_6 \ln(\text{BiRERijt}) + \beta_7 \ln(\text{TCijt}) + \beta_8 \text{D1language} + \beta_9 \text{D2commonborder} + u_{ijt} \quad (4)$$

3.2. Description of data and variables

The study is aimed to analyze the determinants of the bilateral trade flows between India and 10 member countries of ASEAN over the span of 32 years period from 1988-2019 by using the gravity modelling analysis of trade. The study makes use of the secondary data as described in detail in Table 3 below.

Generally, in gravity model of trade, distance is used as a proxy for transaction (or transportation) cost, but in this paper transaction cost has been used as an independent variable because distance is time-invariant it doesn't take into account the dynamics of changing economies. The use of transaction cost has been done in line with Manglani (2020) and is calculated using formula TCijt= (1 - EXjit/IMijt), which was given by De and Ghosh (2008). TCijt is transaction cost between country i and j for time period t. EXjit is the exports of country j to i (calculated at f.o.b. prices) and IMijt is the imports of country i from j (calculated at c.i.f. prices) for the period t. Many formulations have been used to

measure transaction (transport) costs using c.i.f. and f.o.b. prices like c.i.f. /f.o.b. ratio (Behar and Venables, 2011). The most basic and direct measure of transaction cost in international trade is the difference between c.i.f. and f.o.b. prices, which is the cost of getting an item from an exporting country to importing country (De and Ghosh, 2008). The secondary data for TCijt is derived from Direction of Trade Statistics of the IMF.

Table 3. *Description of the variables used in the gravity model of trade*

Variable names	Description	Notes	Source
Dependent Variable			
ln (Tradeijt)	Total Bilateral Trade between India and ASEAN countries	Sum of Exports of India to ASEAN + Imports from ASEAN to India; value in Current US$(value in 000US$ converted into absolute value by multiplying with 1000)	*UN-Comtrade Database through WITS*
Independent Variables			
ln (GDPit*GDPjt)	Product of GDP of India and ASEAN countries	Value in Current US$	*World Development Indicators Database (WDI) of World Bank* *World Development Indicators Database (WDI) of World Bank*
ln (POPit*POPjt)	Product of Population of India and ASEAN countries	In million	
ln (DPGDPijt)	Absolute per capita GDP difference between India and ASEAN	Value in current US$	
(T.R./GDPit)	Ratio of Total Trade to GDP of India	(ratio)	
(T.R./GDPjt)	Ratio of Total Trade to GDP of ASEAN countries	(ratio)	
ln (1+Tariffijt simpleavg)	Effectively Applied Simple Average tariff by ASEAN countries on Indian exports	1 is added to the tariff series to remove zeroes and to take log of tariff (in %)	*WITS –UNCTAD TRAINS Database*
ln (BiRERijt)	Bilateral Real Exchange Rate between India and ASEAN countries	BiRERijt= (NERi/CPIi)/ (NERj/CPIj) NER(i) and (j) is nominal exchange rate of countries (i) and (j) in terms of US dollar (in%)	*International Financial Statistics of IMF.*
ln (TCijt)	Transaction Costs between India and ASEAN countries	Calculated using formula [TCijt= (1 - EXjit/IMijt)] Exjit=exports j to i at fob prices IMijt=imports to i from j at cif prices	*Direction of Trade Statistics Database of the International Monetary Fund*
D1language	Dummy of Official language between India and ASEAN, if its common then dummy variable takes value =1, otherwise zero (0)		*Dist_cepii Database of CEPII*
D2commonborder	Dummy of Common Border/ contiguity between India and ASEAN, if they share common border then dummy variable takes value=1, otherwise zero (0).		*Dist_cepii Database of CEPII*
ln	Natural log form of variables		

Note: Author's compilation.

3.3. Expected sign of coefficients

GDPit and GDPjt: GDP of a country refers to the economic size of a country. The greater the economic size, more will be the income of the countries involved in trade, thus more will be the bilateral trade. GDP coefficient is expected to have positive sign.

POPit and POPjt: Population of the countries involved in bilateral trade refers to market size of the countries, greater the market size or higher population, more will be the demand for the products of the partner countries which will lead to more trade. Population coefficient is expected to have positive sign.

T.R./GDPit and T.R./GDPjt: T.R./GDP ratio is used as a proxy to represent the openness of a country and it indicates the liberalization of trade barriers by a country. High TR/GDP ratio, high will be the trade, thus positive sign is expected.

Tariff: Effectively Applied Simple Average tariff imposed by ASEAN countries on Indian exports expected to have negative sign as tariff hampers the bilateral trade between two countries.

Bilateral Real Exchange rate: Bilateral nominal exchange rate is calculated by dividing Indian currency per U.S. dollar with the ASEAN members' currency per U.S. dollar. And this nominal currency is then multiplied by the ratio of CPI of partner country and CPI of India. An increase bilateral real exchange rate implies devaluation of domestic (Indian) currency. As a result, exports from domestic to partner countries would become cheaper and imports more expensive. Thus, devaluation of national currency would lead to anticipate increased bilateral trade flows from domestic to partner countries (Serlenga and Shin, 2007). In brief, it is expected that bilateral real exchange rate would have a positive effect on bilateral trade flows between India and ASEAN countries.

Transaction Cost: It refers to the cost involved in bilateral trade such as freight cost, transit cost etc. As costs tend to hinder the trade, the expected sign of its coefficient is negative.

Common official language: Countries having common official language tend to trade more so, its expected sign is positive.

Common Border: Countries sharing common borders are expected to trade more than countries without common borders. So, positive sign is expected for coefficient of common border variable.

3.4. Estimation method

The determinants of bilateral trade of India with 10 member countries of ASEAN for 32 years leads to the formation of a panel thus, methodology of Panel Data analysis has been employed for this purpose. The panel data analysis is considered to be suitable over cross section or time series data because it takes into account unobservable individual heterogeneity/effects, less multi-collinearity in panel data and dynamic effects can also be modelled formally (Baltagi, 2005).

For estimating equation 2, all conventional sets of methods have been used i.e., Pooled OLS, Fixed Effects and Random Effects. Model specification tests such as F-test (between Pooled OLS and FEM), BP-LM test(p-value = 0.000) (between REM and Pooled OLS), Hausman test (between FEM and REM) have been employed. The Hausman test results (p-value = 0.000) favor Fixed Effects Model. Fixed Effects model then checked for the heteroskedasticity (Wald-test for groupwise heteroskedasticity statistic = 3976.88; p-value = 0.000), autocorrelation (Woolridge test for auto-correlation statistic = 222.116, prob > f = 0.000) and cross-sectional dependence (BP-LM test(p) = 0.000) and it is found that the model is suffering from all three problems and application of FEM and REM will give inconsistent estimator (Sy et al., 2020). So, to deal with this problem Feasible Generalized Least Squares (FGLS) methodology including dummy variables for country-pairs to control for fixed effects is considered. FGLS estimators are consistent and efficient as this method takes into account heteroskedasticity across panels, auto-correlation within

panels and cross sectional correlation/dependence and can be use when T > N (Beck and Katz, 1995), which is applicable to this study. FGLS generates estimates that are dependent on the disturbance covariance matrix estimations as well as any estimated autocorrelation parameters (Greene, 2012). Because weights are assigned to observations on the basis of the square root of their variances, the FGLS is the most appropriate model when the exact form of heteroscedasticity in the data is not known. It is also resistant to any kind of heteroscedasticity (Akhter and Ghani, 2010; Martı´nez-Zarzoso, 2013).

4. Empirical findings and discussion

The descriptive statistics of the results as well as pairwise correlation matrix are reported in the Appendix in Table 6 and Table 7 respectively. Table 4 displays the estimated results of determinants of bilateral trade flows of India with ASEAN countries. Except for T.R./GDPit and bilateral real exchange rate, all of the coefficients are found to be significant. Furthermore, with the exception of dummy variables, the expected sign of coefficients is mostly consistent with the hypothesis.

Table 4. *Estimates of gravity model under different estimation methods*

Dependent Variable is ln (Tradeijt)				
	(1)	(2)	(3)	(4)
	POLS Robust	Fixed Effect Robust	Random Effects Robust	FGLS
ln (GDPit*GDPjt)	0.877***	0.151	0.688***	0.236**
	(8.10)	(0.30)	(3.45)	(1.97)
ln (POPit*POPjt)	0.662***	4.925*	0.96**	3.553***
	(6.25)	(2.12)	(2.25)	(5.02)
(TR/GDPit)	0.732	-2.59	1.264	0.082
	(1.33)	(-0.76)	(1.09)	(0.07)
(TR/GDPjt)	1.597***	4.31	2.59	1.889***
	(3.36)	(1.62)	(1.58)	(7.58)
ln (BiRERijt)	0.337***	0.529	0.288	0.211
	(3.69)	(1.55)	(1.35)	(1.52)
ln (1+Tariffijt simpleavg)	0.227	-0.159	0.076	-0.029*
	(1.39)	(-0.92)	(0.65)	(-1.87)
ln (TCijt)	-0.289**	-0.447**	-0.323***	-0.123***
	(-2.04)	(-2.50)	(-3.42)	(-2.72)
D1language	-1.091***		-1.918	-9.07***
	(-3.22)		(-1.06)	(-4.56)
D2commonborder	1.794**		2.222	-12.749***
	(2.50)		(1.60)	(-3.67)
_cons	-53.226***	-178.009**	-55.623***	-116.293***
	(-15.31)	(-2.66)	(-5.73)	(-5.71)
Observations	320	320	320	320
R-squared	0.706	0.602	0.686	
F-test	313.020	192.669		
Prob > F	0.000	0.000		
Chi-square			2344.971	574.88
Prob > chi2			0.000	0.000
*** p<.01, ** p<.05, * p<.1				
t-statistic in parentheses				

Note: Author's calculation. Country-pair fixed effects are included (not reported).
t statistics in parentheses.
* Denote statistical significance at 10%.
**Denote statistical significance at 5%.
***Denote statistical significance at 1%.

4.1. Discussion of results

As mentioned earlier, FGLS estimation is appropriate when there is presence of heteroskedasticity, auto-correlation and cross-sectional dependence in the model. So, discussion of results of FGLS estimation is done here.

The coefficient of product of GDPs of India and ASEAN countries is positive and affecting the bilateral trade with high significance at 5% level indicating India trade more with ASEAN countries. The bilateral trade of India is expected to increase by 0.24% if GDPs of both the countries increase by 1%. High GDPs implies greater market size, availability of greater varieties of products which results in increased demand for both partners' products, resulting in more bilateral trade. The positive coefficient of product of population of the partner countries is significantly affecting the bilateral trade at 1% level. The population implies market size of the countries. If market size increases of both the countries by 1%, bilateral trade will increase by 3.56%. The impact of increase in market size (i.e. population) is more than the increase in economic size (i.e. GDP).

T.R./GDPi and T.R./GDPj ratios are the proxies of openness of countries. It refers to what extent a country liberalizes its trade barriers. The coefficient of T.R./GDPi ratio of India has expected positive sign but insignificant coefficient of 1.08% [exp (0.082) = 1.08], whereas T.R./GDPj ratio of ASEAN countries has positive sign with magnitude of 6.55% and significantly affecting trade at 1% level [exp(1.88)=6.55]. This variable reflects that bilateral trade of India with ASEAN countries will increase by 6.55% when T.R./GDPj ratio increases by 1%. More liberalized trade policy of a country encourages the other countries to trade with it thus higher bilateral trade between countries. The TR/GDP of India is low as compared to ASEAN countries this results in the insignificance of coefficient of T.R./GDPit, but the positive sign signifies that if T.R./GDPi increases further this will enhance the trade with ASEAN. However, if India increases its trade openness for ASEAN countries, this would lead to increase in volume of imports from ASEAN to India, resulting in deterioration of Indian balance of trade Sarin (2018). The coefficient of real bilateral exchange rate is as per the hypothesis i.e. positive but insignificant.

The coefficient of tariff imposed by ASEAN countries to Indian products is negative and significantly affecting trade at 10% level. The magnitude of coefficient is .03% which is very low and 1% increase in tariff rates will result to decline in trade by 0.03%. The effect of trade openness of ASEAN member countries is very high as compared to the effect of tariff, thus more bilateral trade is expected between India and ASEAN member countries. The coefficient of transaction cost, used as a proxy for distance has a negative and significant effect on trade at 1% level. The bilateral trade tends to decrease by 0.12% if transaction costs increase by 1%, thus emphasize should be on decreasing the transaction costs which impede trade. The sign of common border is negative and opposite of our hypothesis, as similar to Feenstra et al.(2001) and Kabir and Salim (2010). This indicates, common border exerts a trade discouraging influence. Among all the ASEAN member countries India shares common border only with Myanmar. The trading partners having a common official language are expected to trade more with each other, but the coefficient of official language turned out to be negative in the present study and significant as well (Irshad et al., 2018) implying that India should trade more with the ASEAN countries that

do not have common official language which is English. The dummy variables, that are expected to be trade boosters, are having trade impeding effect on bilateral trade flows between India and ASEAN in the present study. Efforts should be made on converting these negative effects of dummy variables in favor of Indian trade flows to ASEAN countries.

5. Estimating trade potentials between India and ASEAN countries

After estimating the bilateral trade between India and ASEAN member countries using FGLS methodology, trade potential has been estimated using the formula P-A and P/A, where P is the predicted value of bilateral trade estimated using eq.(2) by the FGLS methodology and A is actual bilateral trade. P-A is the absolute difference between predicted and actual bilateral trade and P/A is the ratio between two. If absolute difference is a positive value, it shows expansion of trade in the future, whereas a negative value depicts over-trade between two partner countries. For P/A, value exceeding 1 shows, trade potential to be exceeded in future between two countries involved in trade and value less than 1, depicts over-trade. Table 5 shows the results of trade potential of India with ASEAN member countries for the year 2019.

Table 5. *Trade potential of India with ASEAN countries for year 2019*

Country	Predicted Trade (Million US$)	Actual Trade (Million US$)	P-A (Million US$)	P/A (Ratio)
Brunei	509.00	638.18	-130.00	0.80
Cambodia	27.80	250.59	-223.00	0.11
Indonesia	33300.00	20079.27	13200.00	1.66
Lao PDR	74.40	31.91	42.50	2.33
Malaysia	30700.00	16676.11	14000.00	1.84
Myanmar	8550.00	1463.63	7090.00	5.84
Philippines	7510.00	2192.45	5320.00	3.43
Singapore	55700.00	25632.58	30100.00	2.17
Thailand	22200.00	11365.96	10900.00	1.95
Vietnam	60800.00	12958.96	47800.00	4.69
ASEAN	219371.20	91289.64	128081.56	2.40

Source: Author's own calculation.

The results show that trade potential of India with Brunei and Cambodia has already exceeded the actual trade, whereas, for other remaining countries there is untapped trade potential that is to be exploited. India's main import from Brunei is crude oil. Crude oil is one of the most important sources of energy globally on which various industries rely heavily, India imports crude oil worth U.S. $ 500 million to U.S. $ 1billion approximately every year. This explains why actual trade is more than potential trade between India and Brunei. India mainly exports transport equipment, meat and meat products, gems and jewelry, rice and spices to Brunei. To Cambodia, India mainly exports pharmaceuticals, textiles, auto-mobiles and engineering goods whereas India imports mainly primary products like natural rubber, this diversification in export and import commodities, may be attributed to why actual bilateral trade between India and Cambodia exceeds potential trade. Actual trade being more than potential trade can also contribute to lower trade barriers between partner countries, to maintain and strengthen the trade relationship with these countries, and to increase Indian foreign exchange reserves. Untapped trade potential of India with Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand

and Vietnam serve as an opportunity to India to have greater market access in these countries and expand bilateral trade flows in the goods in which India have comparative advantages.

6. Conclusion

This paper examines the determinants of bilateral trade flows between India and ASEAN for the period of 32 years from 1988 to 2019. The study has been carried out using gravity model analysis of panel data. This study makes use of secondary data on GDPs, population, bilateral exchange rates, tariff rates, trade openness provide by TR/GDP ratio, transaction cost (proxy for distance), and dummy variable for common language and common border. After having tested data as per econometric principles, data was found to be suffering from heteroskedasticity, auto-correlation and cross-sectional dependence. So, to deal with these problems FGLS method has been employed which gives consistent estimates in the presence of these problems.

The choice of the variables, which are used in the analysis, has been made after reading proper literature. To measure the impact of economic size of the countries, GDP is used as its proxy, population indicates market size, TR/GDP ratio used for trade openness. Exchange rates, tariff rates and transaction costs are involved in the model as the barriers to bilateral trade. Dummy variables are also used. After estimating bilateral trade, trade potential has been estimated for understanding of over and under trade. The findings may be summarized as follows**.**

Product of GDPs, population, bilateral exchange rates, trade openness of the countries positively affect the bilateral trade of India with ASEAN. Product of population and trade openness of partner country have the high positive coefficients depicting that market size of the partner countries involved in the trade play important role. As the market size increases it results in increased consumption and thus increased demand which facilitates the trade. Trade openness of the partner country also enhances the trade because lesser the restrictions on trade and more liberalized trade policy, more will be the trade.

The impact of tariff rates imposed by ASEAN on Indian products and transaction cost (proxied for distance) have resulted in significant negative effect on trade. The impact of dummy variables of common official language and border turn out to be negative and significant.

The trade potential has been calculated for the year 2019 as the difference between estimated and actual trade. The results show that India has been overtrading with Brunei and Cambodia, whereas under-trading with the remaining ASEAN countries. The under-trade has been highest with Myanmar and Vietnam followed by Philippines Singapore, Thailand, Lao PDR, Malaysia and Indonesia. The highest ratio of under-trade with Myanmar can be attributed to the negative impact of common border which in turn can be related to underdeveloped border infrastructure between India and ASEAN.

Measures should be taken to develop border infrastructure as Myanmar acts as the gateway between India and rest of the ASEAN countries.

A great deal of opportunity lies for promoting Indian trade (exports) to ASEAN countries as they have large amount of untapped trade potential between them. Although foreign trade policy aimed at export promotion of India has been formulated, measure should be in direction of promoting exports in targeted goods and sectors in which India enjoys high competitiveness among ASEAN countries. Trade facilitation measures, development of infrastructure should be done to increase bilateral trade in the region.

Notes

(1) World Trade Organization/Home page/Global trade, http://www.wto.org/
(2) WTO/Regional Trade Agreements/the WTO committee (CRTA), https://www.wto.org/english/tratop_e/region_e/regcom_e.htm

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Appendix

Table 6. *Descriptive statistics for panel data*

Variables	N	Mean	Min	Max	Kurtosis	Skewness	Std. Dev.
Ln (Tradeijt)	320	20.19	-15.665	24.724	34.841	-4.139	3.938
Ln (GDPit*GDPjt)	320	51.886	46.628	56.428	2.375	-.15	2.213
Ln (POPit*POPjt)	320	37.639	32.952	40.452	3.064	-.861	1.835
Ln (DPGDPijt)	320	7.034	1.483	11.069	2.25	.201	2.048
(TR/GDPit)	320	.34	.135	.558	1.611	.087	.134
(TR/GDPjt)	320	1.158	-1.278	4.374	5.101	1.455	.94
Ln (1+Tariffijt simpleavg)	320	1.172	0	3.789	1.611	.189	1.108
Ln (BiRERijt)	320	1.563	-.204	4.786	1.74	.654	1.764
Ln (TCijt)	320	-.517	-5.189	.881	3.265	-.922	1.317

Source: Author's compilation.

Table 7. Pairwise correlation matrix of panel data model

Variables	Ln (Tradeijt)	Ln (GDPit*GDPjt)	Ln (POPit*POPjt)	Ln (DPGDPijt)	Ln (T.R./GDPit)	Ln (T.R./GDPjt)	Ln (BiRERijt)	Ln (1+Tariffijt simpleavg)	Ln (TCijt)	D1language	D2 common border
Ln (Tradeijt)	1.000										
Ln (GDPit*GDPjt)	0.774* (0.000)	1.000									
Ln (POPit*POPjt)	0.406* (0.000)	0.546* (0.000)	1.000								
Ln (DPGDPijt)	0.350* (0.000)	0.377* (0.000)	-0.457* (0.000)	1.000							
(TR/GDPit)	0.455* (0.000)	0.627* (0.000)	0.145* (0.000)	0.222* (0.000)	1.000						
(TR/GDPjt)	0.406* (0.000)	0.284* (0.000)	-0.279* (0.000)	0.609* (0.000)	0.143* (0.010)	1.000					
Ln (BiRERijt)	0.184* (0.001)	0.057 (0.307)	-0.627* (0.000)	0.855* (0.000)	0.002 (0.965)	0.594* (0.000)	1.000				
Ln (1+Tariffijt simpleavg)	0.165* (0.003)	0.206* (0.000)	0.360* (0.000)	-0.142* (0.011)	0.163* (0.003)	-0.169 (0.002)	-0.194* (0.000)	1.000			
Ln (TCijt)	-0.126* (0.024)	-0.034 (0.541)	0.211* (0.000)	-0.257* (0.000)	-0.121* (0.030)	0.048 (0.393)	-0.304* (0.000)	0.172* (0.002)	1.000		
D1language	0.201* (0.000)	0.233* (0.000)	-0.021 (0.715)	0.340* (0.000)	0.000 (1.000)	0.518* (0.000)	0.312* (0.000)	-0.067 (0.233)	0.149* (0.008)	1.000	
D2common border	0.042 (0.457)	-0.074 (0.188)	0.156* (0.005)	-0.230* (0.000)	0.000 (1.000)	-0.360* (0.000)	-0.078 (0.165)	-0.094 (0.093)	-0.303* (0.000)	-0.167* (0.003)	1.000
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$											

Source: Author's calculation.