



## Measuring Potential and Performance of Indo-ASEAN International Trade Using Gravity Model Approach

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### Abstract

International trade is a key component of the global growth strategy. It is a tool that can carry the changes needed in the countries' factor-endowments. Keeping factor-endowment in mind we find an enormous potential for India's exports to ASEAN economies to increase, taking into account the inherent advantages of different product categories. During the pre and post-ASEAN-India Free Trade Agreement (AIFTA), India's trade ties with ASEAN have changed. The current research uses the 2010 to 2019 panel data to apply the gravity model of foreign trade between India and ten ASEAN members. The Trade Flows, GDP, Distance, Population, Border Sharing, and Common Language panel data obtained from the official website of DGFT (director general of foreign trade), WTO, and CEPII database are used for this purpose. In the current study, we have used an extension of the original model (by Walter Isard in 1954) to establish the gravity model of international trade between India and ASEAN countries. To create a gravity model of international trade, the ordinary least square gravity model method was applied to the collected data. It was found that there is a trade opportunity between India and ASEAN countries from the findings of gravity trade models. The Indo-ASEAN trade relationship between goods and services will continue to be a mutually beneficial relationship that will enhance the effectiveness of capital markets, encourage investment, and create new opportunities for India and ASEAN to deepen trade.

**Keywords:** Gravity Model, Trade Flow, Ordinary Least Square Method, International Trade, ASEAN, GDP.

**JEL Classification:** F14, F17, F18, F39

**Paper Classification:** Research Paper

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### Introduction

Growing international trade activities consisting of countries having close economic links with each other are taking place in the economic growth of underdeveloped and developing countries. The two unavoidable components of rapid growth are foreign investment (foreign capital) and foreign trade (international trade) in today's world. International trade, accelerating competence between countries, enables various countries to engage in global trading activities as well. Different world economies, both developed and emerging, have dynamically moved towards the establishment of regional blocs to boost their trade and growth goals, and India has also taken some constructive steps in this direction by signing FTAs.



India and the ASEAN countries constitute an enormous, uniformly matched region representing an enormous market in which, due to the country's endowment factor, producers can achieve economies of scale of large-scale production and different investors can most productively take advantage of productive resources. Trade relations between India and ASEAN have grown rapidly over the past three decades and ASEAN is now India's fourth-largest trading partner after the EU, the US, and China. (India-Asean bilateral Trade may double by 2025 to \$ 300 billion: Study, 2019). India's merchandise exports to ASEAN economies amount to about \$38 billion, \$59 billion in imports, and \$97 billion in total trade in 2018-19. (Agrawal, 2019). In the past, India's engagement with much of Asia, including Southeast and East Asia, was built on an idealistic conception of Asian brotherhood, based on shared experiences of colonialism and cultural ties (Acharya, 2015).

The current study applies the gravity model of international trade between India and ten ASEAN members from 2010 to 2019. Many researchers have used the gravity model to show the association among gross domestic product (GDP), the population of the countries, the geographical distance between/among the countries, common language, boarder sharing and other important variables with can affect international trade among the nations (Blomqvist, 2004; Montanari, 2005; D. T. T. Binch, 2011; Trung V. V., 2015).

The article continues as follows: A brief overview of the theoretical framework and empirical literature in this field, followed by the study's objectives and justification, is the next section. The methodology and methodological approach and the data used, followed by data analysis and the calculation of empirical results, are explained in subsequent parts. The last section describes the conclusion and future direction for the research.

## Theoretical Framework

### The Traditional Gravity Model

In economics, the gravity model is the most stable and common model to describe the international trade relations and capital flows between two economies. The gravity model for trade is similar to the function of Newtonian physics that defines the gravity force. The traditional gravity model defines the trade flow between a pair of countries as being proportional to their "mass "economic (national revenue) and inversely proportional to the distance between them. In the extension of the gravity model approach different economic factors such as tariff and non-tariff barriers, transportation costs and non-economic factors such as distance, language, cultural similarities, a common border between the nations, technological development are used to create the international trade models for the economies (Van Bergeijk, 2010; L. De Benedictis, 2011; Shepherd, 2013). (Krugman P. R., 2005) also utilized the gravity model to find out trade flows between the countries.

(Tinbergen, 1962) and (Poyhonen, 1963) suggested the standard gravity model, describing the equation as follows:

$$F_{ij} = \frac{G^{M_i M_j}}{D_{ij}} \dots\dots\dots \text{(Equation 1)}$$

Where:

$F_{ij}$  is the gravitational attraction

$M_i, M_j$  are the mass of two objects

$D_{ij}$  is the distance

$G$  is the gravitational constant

In equation 1, gravitational force ( $F_{ij}$ ) shows the volume of international trade between any two economies which is proportionate to the product of their GDPs (represented as  $M_i$  and  $M_j$ ) and the distance dissuasion function where distance is generally interpreted to include all factors that might create trade confrontation. If we take the logarithm of equation 1, we get the following linear form of the equation:

$$\text{Log}(F_{ij}) = G + X_1 \log(M_i M_j) + X_2 (D_{ij}) + U_{ij} \dots\dots\dots \text{(Equation 1)}$$

In Equation 2,  $G$ ,  $X_1$ , and  $X_2$  are coefficients to be estimated. Any other shock and chance incidents that can affect bilateral trade between the two countries are captured by the error term ( $U_{ij}$ ).

## Review of Literature

This section presents a review of existing literature on the offered topic. The gravity model introduced by (Tinbergen, 1962) is the most successful empirical trade flow equation. The gravity model hypothesizes that the larger, the richer, the closer and together, the two countries are, the more they trade. (Bikker, 1987) created an extension of gravity model using GNP, Population, and distance as predictors for international trade between countries. (Kalirajan, 1999) compared the actual and potential trade between Australia and its trading partner. For calculating potential trade, he has used the gravity model of international trade. (Batra, 2006) created the gravity model of India's global trade to investigate India's global trade potential. (D. Ciuriak, 2006) used a trade specialization variable to capture the degree of complementarity of the comparative advantage of trading partners in a gravity model. (Kimura F., 2006) assessed the impact of various factors on bilateral trade services relative to that on bilateral goods. They have created a regression equation of bilateral trade in services for 10 OECD countries.

(K. Kepaptsoglou, 2010) analyzed the effects of Free Trade Agreements on international trade using the gravity model. They have also reviewed the empirical literature on the gravity model. (Jr. Deluna, 2013) used OLS methods, to examine the factors influencing the transfer of goods between the Philippines and its trade partners, while applying the gravity model to panel data for the period 2008 to 2012. (H. K. Tumwebaze, 2015) analyzed the factors impacting Uganda's exports using an augmented gravity model of trade.

(T. Krisztin, 2015) have created a gravity model of international trade using the Poisson gravity model along with pseudo maximum likelihood (ML). To increase the export value, (Wang X., 2016) evaluated Peru's export performance and attempted to identify the dominant economic factors that should be further identified. (Trung V. V., 2015) developed a gravity model using panel data for bilateral trade between Vietnam and its 45 partners to define the determinants of Vietnam's trade-in climate-smart goods from 2002 to 2013. (Sharma, 2017) also created a dynamic foreign trade model of international trade flows between India and ASEAN. (Atif, 2017) evaluated the key determinants of Pakistan's agricultural exports by applying a stochastic border gravity model to a sample of 63 countries over the period 1995-2014. (Kabir, 2017) presented a survey of the current gravity model by taking stock of established information in the context of trade flows on the major theoretical and empirical aspects of the gravity model.

The key theoretical advances in gravity literature were examined and interpreted by (Baier S. L., 2018) from their very early, a-theoretical applications to the current structural contributions.

(Cantore N., 2018) also presented problems and introduced techniques for estimating empirical equations of gravity. They developed a gravity model based on the OECD classification of environmental products, using trade data over a 15-year period from 1999 to 2014 across 71 countries. The foreign exchange rate has been incorporated into the gravity model of trade in their study. (M. Maciejewski, 2019) aimed to illustrate the variations in the strength of the use of development factors in the exports of the countries of the European Union. Using the gravity model of international trade, (Ghani, 2019) examined the relation between migration and international trade. (Shahriar, 2019) worked towards theoretical developments in the trade gravity model and to discover the dominant features of the gravity trade model development. They argued that the development of the gravity model is the result of several study efforts. The model has been given a firm theoretical basis by a wide body of literature. By integrating time-invariant variables such as per capita gross domestic product (PCGDP), distance, language, etc., (Lohani, 2020) attempted to investigate India's trade flow with BRICS nations using the increased gravity model of trade.

A broad gap can be seen from the definitive review of relevant literature for research on the offered subject in the Indian context. We have found very few studies using the gravity model to investigate the elements of international trade. The observed distance can be used to test the capacity for international trade and the efficiency of international trade between India and ASEAN countries. This study aims to make some definitive contributions using the gravity model to the Indo-ASEAN trade relationship.

### **Objectives of the Study**

1. To research the Indo-ASEAN trade Dynamic Trend over a period of time and prepare a Gravity Model Predictive Model of India's Foreign Trade.
2. To compare the estimated and real flow of trade between India and ASEAN.

### **The Rationale of the Study**

The bilateral trade relations between India and ASEAN are still in their early stages, and there is a great deal to be done to benefit from bilateral trade between the two countries. The two nations are willing to lift the pillars of the current commercial relationship between them. The researcher believes that Asia's increasing economic power, especially China, India, and ASEAN, will take full advantage of the comparative advantage of interchange and bilateral ties between them. Stronger trade ties and more closely cohesive capital markets for India and ASEAN will allow the sustainable growth momentum needed to meet the needs of their increasing and vast populations. Keeping all the key considerations in mind the current title was taken into account in the report. In the next section of the study, we have discussed the data and methodology used in current research.

### **Data and Methodology**

#### **The Data**

Panel data values of 10 years (annual data) starting from 2010 to 2019 are included in the secondary data to create the dynamic trade model of India's international trade with ASEAN. Data on variables have been gathered from different sources for the current analysis. The data includes the overall individual trade flow between India and ASEAN countries, the GDP of India and GDP of all ASEAN members, the population of India and all ASEAN countries, and the distance

(Constant variable) between India and ASEAN for the period 2010-2019. In addition to this, two dummy variables have also been used in the study. These variables are the contiguity and common language used in India and these countries. The data for dummy variables and weighted distance have been collected from the CEPII database. The data for GDP and Population has been collected from World Bank sources. The data of trade flow between India and ASEAN have been collected from the official DGFT website. Data for imports and exports were added to find out the trade flow data between India and ASEAN members.

### Econometric model used

An extension of the Gravity model of international trade has been utilized to explain the total trade between India and ASEAN. To find out the gravity model of international trade between India and ASEAN, we have used a different variation of the initial gravity model (Krugman P. R., 2005). In the current study, we have taken one dependent variable i.e. total trade, and four independent variables which are GDP of countries, Population, common language, border sharing, and distance between India and other countries. The log-linear form of gravity model for the current study can be written as under:

$$\log T_{ijt} = \beta_0 + \beta_1 \log(Y_{it}) + \beta_2 \log(Y_{jt}) + \beta_3 \log(N_{it}) + \beta_4 \log(N_{jt}) + \beta_5 \log D_{ij} + \beta_6 C_{it} + \beta_7 B_{jt} + e_{ijt}$$

$$\text{or } (y_{\log\_ols} \sim \text{dist\_log} + \text{inc\_o\_log} + \text{inc\_d\_log} + \text{comlang\_off} + \text{contig} + \text{pop\_o} + \text{pop\_d})$$

Where

i = India

j = ASEAN members

t = 2010, 2010, 2011, 2012..... 2019

$T_{ijt}$  = India's trade with ASEAN members in year t

$Y_{it}$  = India's GDP in year t

$Y_{jt}$  = GDP of member countries in year t

$N_{it}$  = India's Population in year t

$N_{jt}$  = Population of member countries in year t

$D_{ij}$  = Distance in kilometers between India and ASEAN countries

$C_{it}$  = Common language between India and ASEAN country in year t

$B_{jt}$  = Boarder sharing between India and ASEAN countries in year t

$e_{ijt}$  = Error term

The Gross Domestic Product of India and ASEAN countries have been used as a measure of economic sizes for the economies. These variables are expected to have a positive impact on international trade between India and ASEAN countries. The Population of India and ASEAN is used to estimate the market size of each country, which is a factor affecting international trade positively. The reasoning behind considering it as a favorable aspect is that the bigger the size of the market, the more it trades.

Distance represents transportation cost when participating in international trade. In the current

analysis, the weighted distance in kilometers between India and ASEAN member countries was used. The Weighted Distance data was collected from the CEPII database. It is predicted that this variable would have a negative effect on trade flows because transport costs are proportional to the distance between the two countries.

The two dummy variables *contig* and *comlang\_off* represent the border sharing by ASEAN members with India and common language spoken in India and ASEAN countries respectively. In order to improve strategic and trade links between economies, the shared language and cultural similarities between the two economies have a positive influence. The presence of both variables has a positive influence on the flow of international trade and their absence has been treated as having a negative impact. For both the dummy variables, 1 was used to demonstrate their existence, and 0 was used to demonstrate absence. The encoding for variables taken for the current study is presented in Table 1.

**Table 1: Variables and the code used**

Coding	Variable
iso_o	Alphanumeric code for India (Exporter)
iso_d	Alphanumeric code for ASEAN countries (Importer)
Flow	Total trade between India and ASEAN countries in USD million
Contig	1 for contig and 0 for no contig (sharing of the common border)
comlang_off	1 for common language otherwise 0
Distw	Weighted distance (pop-wt, Km)
Year	1991 to 2020
pop_o	Population for India in million
Pop_d	Population for ASEAN Members in million
gdp_o	GDP of India in USD million
gdp_d	GDP for ASEAN members in USD million

Source: Author

## Empirical Results

Table 2 presents the result of the gravity model using the ordinary least square method. The first column reports OLS estimates (coefficient) using the logarithm of total trade as the dependent variable. The value of adjusted R-squared is 0.9030, so it can be said that the current model explains 90% variance in trade flow from the variables taken. Further, we notice that distance has a significant negative impact (at a 5% level of significance) on trade between India and ASEAN (confirms the existing literature). Other variables excluding the population of destination countries have a significant impact on international trade at a 1% level of significance. These entire variables are seen to have a positive impact on the trade relationship. The population of destination countries (ASEAN members) individually is very less in comparison to the Indian population so this factor is not much significant for creating a trade model.

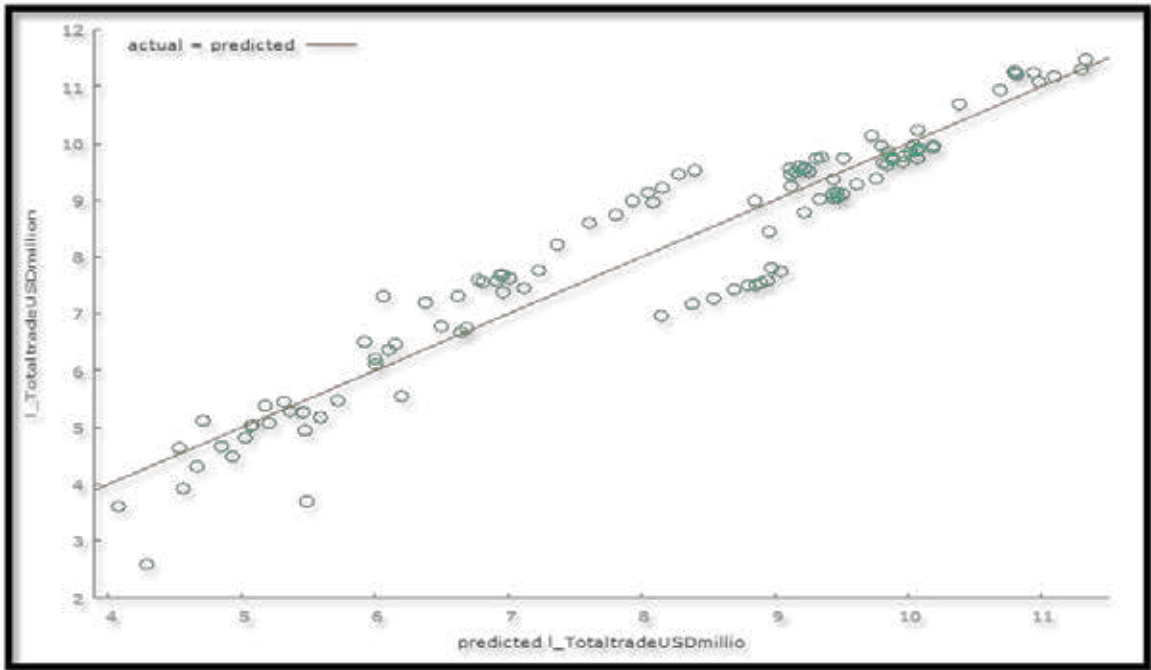
**Table 2: Results of OLS Regression**

	Estimate	Std. Error	t-value	Pr(>  t )
Intercept	16.67695	3.511312	3.143	5.40e-05 ***
dist_log	-1.20121	0.383603	-3.131	0.0107 **
inc_o_log	1.39726	0.188447	7.415	2.28e-05 ***
inc_d_log	1.903337	0.084613	23.201	< 2e-24***
comlang_off	1.223561	0.245111	-5.991	3.32e-09 ***
Contig	1.769422	0.298576	5.926	5.34e-08 ***
pop_o	0.003498	0.007224	0.672	0.659
pop_d	0.012550	0.001235	7.508	3.14e-13 ***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
 Residual standard error: 0.6095 on 92 degrees of freedom  
 Multiple R-squared: 0.8926, Adjusted R-squared: 0.903006  
 F-statistic: 127.6 on 7 and 92 DF, p-value: < 2.2e-16

Source: Author's calculation

**Figure 1: Actual Vs Predicted Trade Flow between India and ASEAN**



Source: Figure created on the output of Model

Table 3 presents the comparison between Actual and estimated trade between India and ASEAN members. For this comparison first, we have calculated the average value of actual and estimated trade flows between India and ASEAN, and then calculated the difference. To find out the deviation of actual from estimated we have deducted actual from estimated so the negative values show over performance and positive value shows underperformance of international trade

between India and individual ASEAN members. It can be seen that in terms of overall trade, Laos, Myanmar, and the Philippines have been underperforming. Brunei, Cambodia, Indonesia, Malaysia, Singapore, Thailand, and Vietnam have exceeded actual performance. Brunei is seen to have a growing relationship with India while Laos is far behind the estimated trade. In conclusion, it can be said that there is scope for trade between India and the members of ASEAN.

**Table3: Actual Vs Estimated Trade flow between India and ASEAN members**

Country	Actual Total trade (USD \$ million)	Estimated Total trade (USD \$ million)	Over/Under Performance (USD \$ million)	% Over/Under Performance
Brunei	682.91	541.98	-140.93	-26.001
Cambodia	261.32	215.77	-45.55	-21.108
Indonesia	21,213.47	20198.89	-1014.58	-5.023
Laos	50.21	108.75	58.54	53.829
Myanmar	1,719.05	1764.55	45.50	2.578
Malaysia	17,348.70	16998.85	-349.85	-2.058
Philippines	2,158.42	2348.68	190.26	8.101
Singapore	27,623.61	27396.32	-227.29	-0.829
Thailand	11,665.53	11915.75	250.22	2.099
Vietnam	13,724.43	13483.83	-240.60	-1.784

*Source: Author's Calculation*

## Conclusion and Future direction of Research

The current research focuses on contributing to the existing literature on the use of standard log-linear procedure (OLS) to form the gravity model and to estimate the minimum square parameters of interest. The model extension covers all Macroeconomic as well as other variables that can be helpful from the point of view of import and export between the trading countries. In shaping the pattern of global economic engagement, it works to stress the importance of geographical proximity, economic, and socio-economic dimensions. It varies entirely from conventional foreign trade theories (i.e. absolute advantage or comparative advantage). We have created a way to present an extended form of the gravity model of international trade using GDP, population, distance, common language, and sharing of boundaries in the current research. The research has also attempted to present significant determinants of foreign trade through the adopted variables. An augmented trade gravity model was estimated using the OLS equation of gravity model. The key findings of the study include that India, with almost all ASEAN members except Laos, Myanmar, and the Philippines, is achieving significant international trade success. The findings of the present study can be used by policymakers to make effectively prepare and execute various policies that will be useful for boosting trade between India and these nations.

The log-linear specification of the gravity model along with OLS estimation also has certain limitations. The basic problem with this approach is the presence of heteroscedasticity log-linearization. So to overcome this problem we can find the scope of the current study in the use of other econometric models such as the Poisson specification of the gravity model along with the Poisson pseudo maximum likelihood (PPML) and other models. The current study also provides ample scope for evaluating India's trade performance with its trading partners and fitting relationships and interdependence with other macroeconomic variables which are impactful in enhancing the international trade of the country.

## Threats to validity

The current research is relevant and limited to the international trade between India and ASEAN members for the current data, time period (1991-2019), and taken variables to determine the international trade between the two.

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