International Journal of Policy Sciences and Law
ISSN: 2582-9203

IJPSL

Volume 3, Issue 1

A Gravity Model Analysis of India's Bilateral Trade Flows

Manak Kataria[1]
Shivansh Raman[2]

[1] *B.A. Hons. Economics, Hindu College, University of Delhi*
[2] *B.A. Hons. Economics, Hindu College, University of Delhi*

Abstract

We aimed to study the determinants of India's trade with important partners and the potential for expanding trade. The Gravity model, as in physics, analyses trade between countries through the geographical "distance" between the countries and their economic "size". We apply an augmented gravity model in order to study balanced panel data consisting of bilateral trade flows with 45 countries from 1999 to 2018. Amongst panel-data models, we decided to use a Hausman-Taylor regression to incorporate time-invariant variables, given the non-viability of the assumptions of a Random Effects model. We find evidence that the partner country's economic size as well as India's population and GDP have a positive influence on bilateral trade; while distance has a negative effect. These results show that the gravity model can explain the pattern of India's trade. We also studied the impact of variables like overlapping membership in a Regional Trade Agreement (RTA) along with cultural similarities, for which we use common languages as a proxy. We find that while RTA membership has no significant impact on trade, sharing a common language has a statistically insignificant positive effect on trade flows; though the magnitude is small. By comparing the average figures for a potential trade with actual values, we can predict whether India has the potential to expand its trade with that country. We supplement this analysis by applying the method of speed of convergence, which provides more accuracy than the point-estimates method.

Keywords: *gravity model, international trade, India, trade potential, convergence*

Acknowledgements

We would like to express our deepest appreciation to Peter Egger for his comprehensive explanation of the gravity trade model in his research paper, "An Econometric View of the Estimation of Gravity Models and the Calculation of Trade Potentials".

1.0 Introduction

1.1 Trade and the Indian Economy

Trade forms an integral part of the Indian economy. India exports approximately 7500 commodities to about 190 countries whilst importing around 6000 commodities from 140 countries[1]. Foreign trade has been on a constant rise, rising from 86.5 billion dollars in 1999 to 781.5 billion in 2020[2].

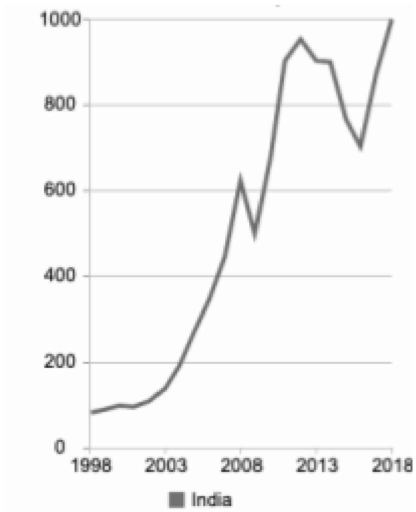

Figure 1: India's Imports, Source: WITS

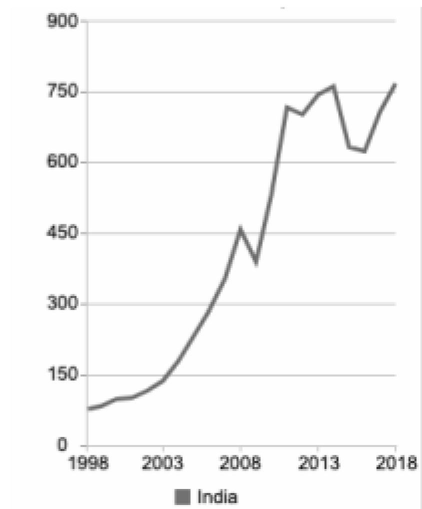

Figure 2: India's Exports, Source: WITS[4]

These large increases in trading quantities are the results of an economic reform passed in 1991 that aimed at liberalising the economy by reducing quantitative restrictions on imports, deregulating markets and reducing taxes. Through this paper, we aim at studying the factors affecting trade as it has been the driving force behind the economic development of the Indian economy. According to the World Bank collection of development indicators, trade consisted of 37.87 % of the GDP in 2020 and trade as a percentage of the gross domestic product was as high as 55 per cent in 2011-12[5]. Despite this emergence of trade in the Indian economy, India's share in global trade is still relatively low when compared to other developing economies such as Singapore, China and Mexico. The order of the top four exporters has remained unchanged since 2018, with China being the top exporter with a share of 34 per cent in 2020, followed by the Republic of Korea (share of 7 per cent), Mexico (share of 5 per cent) and Singapore (share of 5 per cent)[6]. Thus, it is appropriate to study the potential for the growth of trade in the Indian Economy. The remainder of the paper is structured as follows. In the next section, an introduction to the gravity model and its theoretical foundations are presented. We briefly review the existing literature on the application of the gravity model to international trade flows. In section three, we address our approach, methodology, main econometric issues and data sample for the estimation of the gravity model. Results are analysed in section four.

1.2 Trade Models

Several attempts have been made by numerous economists to explain the factors determining trade between countries. Adam Smith, in his book "An Inquiry into the Nature and Causes of the Wealth of Nations", explains trade as a result of countries having an absolute advantage in the production of certain goods[7]. He defines absolute advantage as the ability of a particular nation to produce a good at lower labour costs relative to another country and argues that regardless of the nature of the advantages enjoyed by a nation, whether they be natural or acquired, it is in the best interest of countries which are looking to profit from these advantages to trade with the former rather than engaging in production. Similar to Adam Smith, David Ricardo explains trade as a result of particular advantages which accrue to certain nations ('Essay on Profits')[8]. The Ricardian model defines comparative advantage as the ability of an individual or group to perform a particular economic activity at a lower opportunity cost relative to that of another activity. The model attempts at explaining why countries engage in trade even when one country's labour force is more efficient at producing every single well as compared to workers in another country by proving how both nations can increase their overall consumption by exporting the good for which it has a comparative advantage whilst importing the other well, given the differences in labour productivity in each economy.

However, the original Ricardian model assumes labour to be the only primary input to production and assumes differences in the relative ratios of labour for which the production of a good can be traded off. The incomplete nature of the original model led to newer extensions to the Ricardian trade theory, most notably by McKenzie[9] and Jones[10], who extended the model to multiple countries and goods as well as traded intermediate goods. Further innovations in trade theory consist of the Heckscher–Ohlin model and the Gravity model. The Heckscher–Ohlin theory[11] determines trade by differences in factor endowments by arguing that international trade consists of indirect factor arbitrage wherein countries export goods that they can produce in large quantities whilst importing goods that are relatively scarce, implying that countries with readily available capital and scarce labour will export capital intensive products, with labour intensive countries doing the opposite. The Gravity model[12], in its elementary form, analyses trade between countries on the basis of the geographical distance between the countries and the economic sizes of both countries. It is analogous to the Newtonian physics function that describes the force of gravity as it assesses the flow of trade between a pair of countries as being proportional to their economic "mass" and inversely proportional to the distance between them.

2.0 Literature Review

The Gravity Model is often used to explain the factors driving the volume of flows in international trade. It was first applied to analyse foreign trade in Timbergen (1963) which considered trade flows between two countries as the dependent variable, and sizes of GDP and distances between them as the independent variable.[13] He estimated that geographical distance had a negative effect on trade and the size of GDP a positive effect, with countries that are closer to each other trading more. The effect of distance can be seen as being related to the rising cost of transportation with increasing trade, as well as larger cultural differences, which can impede the transfer of information and establishment of trust.

Anderson (1979) provides a theoretical derivation of the gravity model equation for cross-sectional analysis; using assumptions about Cobb-Douglas expenditure behaviour, balanced trade, and that preference for a country's goods are homothetic and uniform across countries.[14] Bergstrand (1985) further strengthens the theoretical foundation by relaxing some of the common assumptions and incorporating prices.[15] Papers from Helpman (1987)[16] and Deardorff (1984) [17]reveal that the classical Heckscher-Ohlin model does not have the same conclusions about the effect of the product of the economic sizes of the country on their bilateral trade. However, Deardorff (1998) does attempt to derive the gravity model from the Heckscher-Ohlin model. [18] Our paper also looks at the effect of exchange rates on bilateral trade flows. Dell'Ariccia (1999) revealed the negative effect of exchange rate volatility on trade flows, after applying the gravity model to panel data from western Europe.[19] While one might suspect the relationship to be affected by simultaneous causality, the paper finds that the negative correlation holds, even after controlling for simultaneity bias.

Dinh Thi Thanh et al (2011) applied the gravity model to analyse bilateral trade activities between Vietnam and 60 countries from 2000 to 2010.[20] They found that foreign economic size has a greater impact on the flow of bilateral trade than Vietnam's GDP. They find that geographical distance has a negative effect while common culture, taken as the presence of any Vietnam's major religions as official or majority religion in the partner country, also has a positive effect on trade with the partner country. They utilise the measurement method of speed of convergence to identify the countries with which Vietnam has a high potential for trade growth.

Among Indian studies, Tharakan et al (2005) find that the effect of distance on India's software trade is insignificant, after applying the gravity model to Indian panel data for the period of 1997-2001.[21] Tripathi et al (2013) studied panel data consisting of India's trade with 21 countries over a period of 14 years and utilised a Tobit model, random-effects model and a GMM-system estimator to estimate a modified gravity equation.[22]They find that while the market size and common borders have a statistically significant positive relationship between trade, which is in line with the rest of the literature; they also show that distance has a positive effect on India's bilateral trade.

Batra (2004) undertook an analysis of cross-sectional data consisting of India's trade for the year 2000.[23] She used pooled OLS and used an augmented gravity model to find statistically significant positive effects of both GDP and regional trade groupings. She also incorporated a dummy variable for a common border between the two countries, in addition, and estimated that sharing a common border has a positive effect on trade, holding other factors constant. Using this model, she estimated India's trade potential with different countries, which revealed that India's trade potential has the highest magnitude with South-East Asian countries. Within specific country groupings/trade arrangements, she finds that India's trade potential is maximum with Pakistan in SAARC, with Oman, Qatar and Kuwait in the GCC, and with the Philippines and Cambodia in the ASEAN region. Other papers have also used variations of the gravity model to estimate Indian trade potential; Renjini et al (2017) explored the potential of India's agricultural trade with ASEAN countries using a gravity model equation.[24] Rojid (2006) explored the trade potential among the COMESA trading bloc.[25]

Bhattacharya(2004) does a comparative analysis and simulates the increase in India-Bangladesh bilateral trade under four different hypothetical scenarios of different tariff rate cuts.[26] The author estimates that in a free trade regime India's exports will be more than the increase in its imports from

ISSN: 2582-9203

Bangladesh. Bhattacharya et al (2006) undertook a gravity model analysis for 177 countries with which India had trade relations at least once between 1950 and 2000.[27] They found that the gravity model can explain about 43 to 50 per cent of the fluctuations in India's trade and that India's trade responds less than proportionally to size and more than proportionally to distance. They explored the effect of having a common coloniser, using the common language as a dummy variable, and found that it has a significant positive effect. They estimated that India's trade is more with developed nations rather than developing trading partners.

Egger (2002) provides a comprehensive analysis of the various regression models which can be used to analyse bilateral trade through the gravity model.[28] It also scrutinizes the various techniques which have been used to predict trade potential between countries. Jacobs et al. (2001)[29] analyse trade using the speed of convergence method. The abovementioned studies incorporate a number of explanatory variables of bilateral trade and have analysed a varied set of countries across varied periods. Yet, certain macroeconomic and human capital-based variables including economic growth, unemployment, inflation, and education seem to be studied by a majority of researchers.

3.0 Data and Methodology

3.1 The Model

The gravity model that we use in this paper consists of the gravity equation in which T_{ijt}, the size of the trade flow between any pair of countries, is stochastically determined by distance and economic size. We apply an alternate version of the gravity model given by Krugman and Obsfelt (2005). The model is "augmented" in that several variables that account for other factors that may affect trade have been included in addition to the natural logarithms of income and distance.

To account for other factors that may influence trade levels, dummy variables have also been added to the basic model. The augmented gravity equation is expressed as follows:

Augmented gravity model:

$$logT_{ijt} = \alpha0 + \alpha1logY_{it} + \alpha2logY_{jt} + \alpha3logN_{it} + \alpha4logN_{jt} + \alpha5logD =+ \alpha6EX_{ijt} + \alpha7Cij + \alpha8R_{ijt} + u_{ijt} \quad \textbf{(1)}$$

Where:

i = 1 (India)

j = 2, 3, 4,... (partner countries)

t = 1999, 2000, 2001,..., 2018

T_{ijt} : India's trade with country j in year t

Y_{it} : India's GDP per capita in year t

Y_{jt} : GDP of country j in year t

N_{it} : India's population in year t

N_{jt} : Population of country j in year t

D_{ij} : Distance in kilometres between India and country j

EX_{ijt} : Exchange rate between India and country j in year t

C_{ij} : Culture dummy variable for the common language between India and country j

R_{ijt} : Dummy variable for the common RTA membership between India and country j in year t

u_{ijt} : Error term·

The following model was specified for Pooled OLS method:

$$\log T_{ijt} = \alpha_0 + \alpha_1 \log Y_{it} + \alpha_2 \log Y_{jt} + \alpha_3 \log N_{it} + \alpha_4 \log N_{jt} + \alpha_5 \log D_{ij} + \alpha_6 EX_{ijt} + \alpha_7 C_{ij} + \alpha_8 \mathrm{R}_{ijt} + e_{ijt}$$

Further, the model for Random Effects was as follows:

$$\log T_{ijt} = \alpha_0 + \alpha_1 \log Y_{it} + \alpha_2 \log Y_{jt} + \alpha_3 \log N_{it} + \alpha_4 \log N_{jt} + \alpha_5 \log D_{ij} + \alpha_6 EX_{ijt} + \alpha_7 C_{ij} + \alpha_8 \mathrm{R}_{ijt} + \mathrm{u}_{ijt}$$

Where $u_{ijt} = v_{ijt} + \mu_{ijt}$

We have decided to use panel data, although traditionally the gravity model has also been estimated for cross-sectional analysis as studies like Matyas (1997) have pointed out that bilateral trade flows are strongly affected by the time component.

An explanation of the relevant variables is as follows:

Distance: We use 'distw' as our geographical variable. It measures the population-weighted distance between the most populated cities in each country, in **kilometres**.

Culture: Our model uses 'comlang_eth' as the cultural variable. The dummy equals 1 if countries share a common language spoken by at least 9% of the population. This variable was selected over the common official language as we wanted to look at the effect of cultural distance on trade which is better reflected by widely spoken languages as opposed to the official list.

Economic Size (per capita, **in current thousands** US$): The economic size of a country is measured through its population and its gross domestic product. GDP is measured in current thousands of US$ and population in thousands.

Regional Trade Agreements: The following trade facilitation variable shows a value of 1 if the countries participating in trade are engaged in a regional trade agreement of any type within the given year, and a value of 0 otherwise. The WTO data on regional trade agreements consist of 4 types of RTA's:

- Partial Scope Agreements which primarily involve the elimination of import tariffs in certain sectors of the economy.
- Free Trade Agreements entail the removal of import tariffs in most sectors, however, FTA members retain independent trade policies.
- Customs Unions require unionisation of the external trade policies of its members, including establishing a common external tariff.
- Economic Integration Agreements which involve the liberalisation of trade in services.

Population: The following variable aims at measuring the number of inhabitants in a particular geographical territory. The data used for analysis has been measured as the unit value of a **thousand per unit.**

Exchange Rate: Studies like Dell Arricia (1999) have shown that the inclusion of the exchange rate as a control variable has helped to explain the trade variation among participating countries. Therefore, the exchange rate will be included as an explanatory variable in the model and calculated by the formula:

EX_{ijt}= Annual average of the national currency unit of India per US dollar (in year t) /Annual average of the national currency unit of country j per US dollar

With this formula, the data refers to the annual average exchange rate by India's currency units per one unit of the partner country's currency.

3.2 A Priori Expectations

We aim at testing the following hypotheses during our estimations and analysis.

Hypothesis 1: There is a positive effect of economic size and market size on bilateral trade.

Hypothesis 2: There is a negative effect of geographical distance on bilateral trade.

Hypothesis 3: There is a positive effect of a common language on bilateral trade.

Hypothesis 4: There is a positive effect of common RTA membership on bilateral trade.

Based on the literature, we expect a positive effect of economic size as measured by GDP on bilateral trade flows. For distance; given the previous studies of India's trade: Tharakan et al. (2005), De (2013), Bhattacharyya and Banerjee (2006), and Batra (2004), have found a negative relationship between distance and India's bilateral trade; we expect a negative sign.

Common language is expected to reduce transaction costs as speaking the same language helps facilitate trade negotiations. Moreover, transaction costs accruing to cultural differences are reduced due to the existence of a shared history between countries. Variables such as common coloniser or common legal origins are likely to have similar effects on the model.

Countries often enter into regional trading agreements with the intention of facilitating bilateral trade. The dummy variable is equal to one when both countries in a given pair belong to the same regional group and 0 otherwise. The estimated coefficient will then tell us how much of the trade can be attributed to a special regional effect. On average it has been found that RTAs impact positively on trade with a study by Frankel and Rose (2002) indicating a tripling of trade between partners on account of membership of RTAs.[27]

3.3 Data Sources and Sample Selection

We studied balanced panel data consisting of India's trade with 45 trading partners[1] over a 20-year time period starting from 1999 and ending in 2018. The provision of trade flows between countries occurs through two sources: The French Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)'s BACI database and the International Monetary Fund's Direction of Trade Statistics Database. BACI provides a single harmonised trade flow for each importer-exporter-year, by reconciling Comtrade mirror flows. In the absence of such data, The

[1] The list of countries chosen for analysis: Angola, UAE, Argentina, Australia, Belgium, Bangladesh, Brazil, Canada, Switzerland, China, Egypt, Spain, France, Britain, Ghana, Indonesia, Iran, Iraq, Israel, Italy, Japan, Kenya, Republic of Korea, Kuwait, Sri Lanka, Mexico, Mozambique, Malaysia, Nigeria, The Netherlands, Nepal, Oman, Philippines, Poland, Qatar, Russia, Saudi Arabia, Singapore, Thailand, Turkey, Tanzania, Ukraine, United States of America, Vietnam, South Africa

IMF's Direction of Trade Statistics (DOTS), which contains trade data as reported by country authorities to the IMF, is used to collect trade flows between countries. The choice of countries was based on data availability in order to avoid the problems caused by excessive missing data. The choice of time frame was based on data availability as well as to avoid years of economic fluctuations and to ensure analysis of a relatively stable economic environment.

As for the sources for relevant data, we use the CEPII's GeoDist Database for the collection of data relating to the geographical distance between nations and for the culture variable which provides information about the existence of a common language among the nations. The World Development Indicators Database is the primary source of GDP data. In the absence of WDI data, we use Dr Katherine Barbieri's International trade database to collect data on the gross domestic product of countries and Angus Maddison's Statistics on World Population for collecting population data. The World Bank Database has been used for the collection of data relating to exchange rates and the World Trade Organisation Database has been used for the provision of data concerned with regional trade agreements.

3.4 Pre-Estimation Analysis

Certain analyses and diagnostics tests have been undertaken as preliminaries to the analysis of panel data

Table 1: *Descriptive Statistics*

	Trade	Distance	Common Language	Partner Population	Partner GDP	RTA	Exchange Rate
Mean	3328859.99	5981.54544	0.333333333	90409.21987	1054857352	0.21111111	26.22910008
Standard Deviation	5625502.66	3475.57257	0.471666631	197169.0535	2492319461	0.40832397	38.56589379
Minimum	5872.434	1143.184	0	572.155	4075049.47	0	0.001075981

Maximum	52057737.5	15676.285	1	1392729.98	2.058E+10	1	231.5327815
Count	900	900	900	900	900	900	900

Source: Authors' Calculations

Table 2: *Correlation Matrix*

	distw	**comlang_eth**	**pop_Ind**	**pop_partner**	**gdpcap_ind**	**gdpcap_partner**	**rta**	**exr**
distw	1	0.19600758	0	0.21024859	0	0.21287955	-0.3289291	0.3000298
comlang_eth		1	0	0.03079101	0	0.04791024	-0.0019252	0.12384465
pop_Ind			1	0.0780918	0.9924812	0.23662428	0.21294858	0.03959554
pop_partner				1	0.07758746	-0.3045762	0.19502432	-0.374128
gdpcap_ind					1	0.2353894	0.21294858	0.03711984
gdpcap_partner						1	-0.1774239	0.66965004
rta							1	-0.3101269
exr								1

Source: Authors' Calculations

3.2.1. Multicollinearity Test

The existence of multicollinearity was checked using Variance Inflation Factors (VIF) for the explanatory variables. Multicollinearity can be explained by the high correlation between two variables: India's GDP and India's population. However, this is a common statistical phenomenon with gravity model estimation. With a large enough sample size as in our study, the impact of multicollinearity on estimated results can be controlled.

Table 3: *Variance Inflation Factor Test*

	VIF
log(distw)	1.077712892
comlang_eth	1.025321232
log(pop_Ind)	18.38868544
log(pop_partner)	1.558674297
log(gdpcap_ind)	20.28322471
log(gdpcap_partner)	2.480779998
rta	1.203651376
exr	1.07993187

Source: Authors' Calculations

3.3 Empirical Analysis

Panel data can be analysed through three main models: pooled regression models, random effects models (REM) and fixed effects models (FEM). The Pooled regression consists of constant coefficients, referring to both intercepts and slopes. The use of this model is dependent on the existence of unobserved heterogeneity which is correlated with some observed regressor and on the presence of heteroscedasticity. In case there are unobservable factors which affect the dependent variable, then a fixed effects model or a random effects model is preferred to the pooled regression model. The presence of heteroscedasticity also inhibits the usage of the pooled regression model. We apply the Breusch-Pagan test on the Pooled regression model:

Table 4: *Breusch-Pagan test*

Model	Chi-square	P-value
Pooled OLS	4963.3***	< 2.2e-16

Source: Authors' Calculations

Note: *** is statistically significant at 1% level

Due to the presence of heteroscedasticity in our model, we reject the Pooled regression model for analysing panel data.

Individual-specific effects are individual characteristics which may affect the explanatory variables. A Fixed Effects model is used when there is a correlation between the individual effects and the explanatory variables. Moreover, this model helps in separating the impacts of individual effects from explanatory variables, thereby helping in evaluating the net effects of the explanatory variable on the dependent variable. The presence of time-invariant variables restricts the usage of the fixed effects model. In our case, the distance between the trading countries remains constant over time and thus it becomes difficult to analyse its effect on the trade flow between the countries.

Here, we have two possible alternatives.

We can apply a Random Effects model. Due to the presence of heteroscedasticity, we use a Feasible Generalised Least Squares (FGLS) regression, where we adjust the weights after accounting for heteroscedasticity.

Table 5: *FGLS model Results*

Independent Variable	Coefficient	z-statistic	p-value
D_{ij}	-0.8374	-186.7052	2.2e-16
C_{ij}	0.3683	96.6752	2.2e-16

N_{it}	-1.1670	-4.4503	8.574e-06
N_{jt}	0.5465	304.4064	2.2e-16
Y_{it}	1.1868	27.5371	2.2e-16
Y_{jt}	0.5475	139.0867	2.2e-16
R_{ijt}	0.1333	16.4837	2.2e-16
EX_{ijt}	-0.0006	5.0589	4.216e-07

Source: Authors' Calculations

However, from Egger (2002), the application of the random effects model is problematic due to possible inconsistency from the correlation between some of the explanatory variables and unobserved individual effects.

We test the appropriateness of the Random effects model, using the Hausman test, where the null hypothesis is that the preferred model is random effects.

Table 6: *Hausman Test Results*

Model	**Chi-square**	**P-value**
FGLS	173.03***	< 2.2e-16

Source: Authors' Calculations

Note: *** is statistically significant at 1% level

The extremely low p-value tells us that we cannot apply the Random Effects model. We, instead, apply the Hausman-Taylor model of panel-data regression. This approach makes use of several dimensions of panel data to overcome the correlation issue with the REM. Other measures of economic size in terms of current dollar value and purchasing power parity do not alter either the sign or significance of different explanatory variables.

Table 7: *Hausman-Taylor Model Results*

Independent Variable	Coefficient	z-statistic	p-value
log(distw)	-0.7978871	-3.2400	0.001195
comlang_eth	0.41927726	1.3962	0.162652
log(pop_Ind)	-1.4865109	-2.7345	0.006248
log(pop_partner)	0.66980026	9.2327	$<$ 2.2e-16
log(gdpcap_ind)	1.39862643	14.9469	$<$ 2.2e-16
log(gdpcap_partner)	0.35440313	11.0363	$<$ 2.2e-16
rta	0.04155429	0.7976	0.425077
exr	-0.0033834	-3.9306	8.473e-05

Source: Authors' Calculations

4.0 Trade Potential

Evaluating trade potential is vital in determining whether flows of bilateral trade between countries have been overused or underused. One way of measuring trade potential along with overuse/underuse of trade flows is to compare the actual values of trade given in the dataset along with potential trade values constructed through the model. We measure potential trade by applying the point-estimated coefficients to the data of independent variables in the gravity model. This method, however, has been criticised in numerous studies such as Egger,2002 which state that large systematic differences in observed and in-sample predicted trade flows indicate misspecification of the econometric model instead of unused/overused trade potentials. Acknowledging these criticisms, Jacobs et al. (2001) suggest a method which measures the speed of convergence (SC) of trade flow. Moreover, we define ΔT as the difference between potential trade value and actual trade value.

Speed of convergence = 100*(Average growth rate of potential ÷ Average growth rate of actual trade) - 100 **(2)**

ΔT= potential trade value - actual trade value **(3)**

4.1 Estimation of Trade Potential

Convergence between potential trade value and actual trade value occurs when ΔT and SC differ in sign. If ΔT and SC are like signs, we will have divergence. For the calculation of the average growth rate and potential growth rate, and the difference in actual and potential trade value, we use the results obtained in our FGLS model. The results of trade potential are shown in Table. We find that a total of 26 countries out of the 45 available in the sample set have convergence in trade with India, indicating India's unexploited potential for trade with numerous countries.

Table 8: *Trade Potential Results*

Country	ΔT	Speed of Convergence	Situation
Angola	-234750	-46.56216876	Diverge
UAE	15854679	-14.77249319	Converge
Argentina	-562810	-13.69728702	Diverge
Australia	-1333008	-0.130124461	Diverge
Belgium	2807853	5.644173312	Diverge
Bangladesh	-378540	-12.22392159	Diverge
Brazil	410943.5	-42.77615295	Converge
Canada	-1481789	24.60977788	Converge
Switzerland	-654746	6.928010094	Converge

China	-2171376	-20.82690611	Diverge
Egypt	-505490	-27.19674908	Diverge
Spain	75195.63	-1.221309075	Converge
France	1209.447	-1.450883673	Converge
Britain	996303.9	22.02646131	Diverge
Ghana	-12980.1	-13.17689651	Diverge
Indonesia	-19043.3	-5.169033303	Diverge
Iran	-291647	-35.60915574	Diverge
Iraq	-662663	-49.62714653	Diverge
Israel	-519106	4.053661712	Converge
Italy	463218.5	3.72915561	Diverge
Japan	-3123066	44.71260731	Converge
Kenya	741718.4	-26.9101225	Converge
Republic of Korea	-2215825	-17.44806829	Diverge
Kuwait	-5341728	1582.261996	Converge
Sri Lanka	1636224	-7.119540226	Converge
Mexico	85073.39	-42.79501619	Converge
Mozambique	295496.2	-43.7092078	Converge
Malaysia	1203276	-9.306096629	Converge

Nigeria	-308440	31.48147749	Converge
The Netherlands	2268279	-24.07767404	Converge
Nepal	1510136	-33.55452594	Converge
Oman	377033.8	-26.53245382	Converge
Philippines	-1348995	-13.16003725	Diverge
Poland	-871168	-19.27878018	Diverge
Qatar	-622642	-40.42123728	Diverge
Russia	-2288139	150.8961807	Converge
Saudi Arabia	1918705	-4.787816704	Converge
Singapore	4238358	-26.73282403	Converge
Thailand	-392057	3.290311834	Converge
Turkey	480581.7	-40.01149668	Converge
Tanzania	631387.5	-37.00277051	Converge
Ukraine	-492212	-32.43182525	Diverge
USA	14579021	1.447355394	Diverge
Vietnam	952625.8	-29.67729424	Converge
South Africa	877810.5	-31.04165124	Converge

Source: Authors' Calculations

Among countries with whom India shares the condition of divergence, there are 27 countries with which India has overtraded, implying an excess of actual trade over potential trade, leaving 4 countries with which trade flows have been underutilised. Among countries with whom India shares the condition of convergence, we measure the 'Time of Convergence (TC)' to analyse the speed with which actual trade coincides with a potential trade. Lower values of ΔT combined with higher values of SC lead to lower values of TC.

Table 9: *Time of Convergence results*

Country	**Time of Convergence**
France	833.593087
Mexico	1987.927528
Mozambique	6760.501423
Brazil	9606.837089
Turkey	12011.08917
Oman	14210.288
Tanzania	17063.25035
Kenya	27562.80297
South Africa	28278.47465
Vietnam	32099.48238
Nepal	45005.43528
Spain	61569.69771
The Netherlands	94206.74857
Malaysia	129299.7153

Singapore	158545.0758
Sri Lanka	229821.6358
Saudi Arabia	400747.3334
UAE	1073256.806

Source: Authors' Calculations

5.0 Analysis

We find that, after application of all relevant statistical tests and existing literature, that the Hausman- Taylor Model of regression (1981) provides the most appropriate and accurate estimator for measuring the effect of various economic variables on the Indian bilateral trade flows with 45 countries (only countries which have a consistent and significant value of trade over the given period were selected) from the year 1999 to 2018. We find that distance (as measured on a weighted scale) has a statistically significant negative effect on trade flows. This is in line with the predictions of the gravity model. The common language variable, which was used as a proxy for cultural differences and distances, however, doesn't have a statistically significant impact on trade. We chose to break up the economic size of the two countries into both GDP per capita and population. This was to disaggregate the effects of economic size into the effect of greater wealth (GDP per capita) and that of the larger market size (population). Interestingly, we find that the population of India has a negative effect on the trade flow values, while that of the partner country has the opposite direction. The GDP per capita of both India and the partner country has a positive effect. We included common membership in Regional Trade Agreements as a variable, but that was shown to be statistically insignificant. However, the inclusion of effective tariff rates between two countries, which would also have measured the same concept but in a more comprehensive sense, could have had a different result. Unfortunately, the data for effective tariff rates was not complete for the period that we were looking at and could, thus, not be included. A higher exchange rate had a statistically significant negative effect, but the coefficient was extremely small.

By the result of the measurement method of speed of convergence, we identify the countries which have a high potential for trade growth with India. In Europe, we have very high trade potential with France, Spain, and the Netherlands, with the overall greatest trade potential with France. Amongst our neighbours, we have high trading potential with Nepal and Sri Lanka. On the African continent, we have high trading potential with Mozambique, Kenya and South Africa.

Moreover, this method also contributes to the explanation of the overtrade situation between India and some countries such as Canada, Switzerland, Israel, Japan, Kuwait, and Russia. This might be explained by the enhanced flow of foreign direct investment (FDI) with countries like Canada, historically strong relationships with Russia, extensive commodity trade with Kuwait and so forth.

6.0 Conclusions and Limitations

The paper aims to identify determinants of India's bilateral trade flows using static panel data analysis. We find that variables denoting economic sizes such as the GDP of origin and partner country, and the population of the partner country have a positive impact on the flow of bilateral trade between them. This aligns with the conclusions given by the gravity model. However, we find that the population size of India has a negative impact on the trade flows between the countries. The mechanisms through which this negative impact occurs are beyond the scope of this paper and require a more inclusive dataset. Moreover, our results with respect to the relationship between geographical distance and bilateral trade between countries also align with the initial conclusions obtained with the gravity model as we find the distance to be negatively impacting trade flows. The cause for this is that distance acts as a proxy for transportation costs and increases the risk of transporting perishable goods. The exchange rate is estimated to have a statistically negative impact on bilateral trade, but with a very low magnitude. The existence of regional trade agreements and a common language shared by at least 9 per cent of the population are found to be insignificant in our analysis of bilateral trade.

References

1) *Economic review 2017: State Planning Board, Thiruvananthapuram, Kerala, India*. ECONOMIC REVIEW 2017 | State Planning Board, Thiruvananthapuram, Kerala, India. (n.d.). Retrieved November 16, 2022, from

https://spb.kerala.gov.in/economic-review/ER2017/web_e/ch341.php?id=31&ch=341

2) Trade Statistics - Conte, M. and P. Cotterlaz and T. Mayer (2022), "The CEPII Gravity database". CEPII Working Paper N°2022-05, July 2022 http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=8
3) *Imports by country product from World*. Imports By Country Product from World US$000 1988 - 2020 | WITS Data. (n.d.). Retrieved November 29, 2022, from https://wits.worldbank.org/CountryProfile/en/country/by-country/startyear/LTST/endyear/LTST/tradeFlow/Import/indicator/MPRT-TRD-VL/partner/WLD/product/Total
4) *Exports by country product to World*. Exports By Country Product to World US$000 1988 - 2020 | WITS Data. (n.d.). Retrieved November 29, 2022, from https://wits.worldbank.org/CountryProfile/en/Country/BY-COUNTRY/StartYear/1988/EndYear/2020/TradeFlow/Export/Indicator/XPRT-TRD-VL/Partner/WLD/Product/Total
5) *Trade (% of GDP) - India*. Data. (n.d.). Retrieved November 16, 2022, from https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS?locations=IN
6) Nandi, S. (2021, November 6). *India's share of exports declines among developing countries in 2020*. Business Standard News. Retrieved November 16, 2022, from https://www.business-standard.com/article/economy-policy/india-s-share-of-exports-declines-among-developing-countries-in-2020-121110600912_1.html
7) Smith, A. (1981). *An inquiry into the nature and causes of the wealth of nations*. Liberty Press.
8) Ricardo, D. (2007). *Ricardo's high price of bullion: Including an essay on profits*. Cosimo Classics.
9) McKenzie, L. W. (1953). Specialisation and efficiency in world production. *The Review of Economic Studies*, *21*(3), 165. https://doi.org/10.2307/2295770
10) Jones, R. W. (1961). Comparative advantage and the theory of tariffs: A multi-country, multi- commodity model. *The Review of Economic Studies*, *28*(3), 161. https://doi.org/10.2307/2295945
11) Heckscher-Ohlin model. (2009). *Encyclopedia of Business in Today's World*. https://doi.org/10.4135/9781412964289.n464
12) Isard, W. (1954). Location Theory and Trade Theory: Short-run analysis. *The Quarterly*

Journal of Economics, *68*(2), 305. https://doi.org/10.2307/1884452

13) Tinbergen, J. (1963e). Shaping the world economy. *The International Executive*, *5*(1), 27–30. https://doi.org/10.1002/tie.5060050113
14) James E. Anderson. (1979). A Theoretical Foundation for the Gravity Equation. *The American Economic Review*, *69*(1), 106–116.
15) Bergstrand, J. H. (1985). The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence. *The Review of Economics and Statistics*, *67*(3), 474. https://doi.org/10.2307/1925976
16) Helpman, E. (1987a). Imperfect competition and international trade: Evidence from fourteen industrial countries. *Journal of the Japanese and International Economies*, *1*(1), 62–81. https://doi.org/10.1016/0889-1583(87)90027-x
17) Deardorff, A. V. (1984). An exposition and exploration of Krueger's trade model. *The Canadian Journal of Economics*, *17*(4), 731. https://doi.org/10.2307/135069
18) Deardorff, Alan V. 1998. "Fragmentation in Simple Trade Models." *SSRN Electronic Journal*. https://fordschool.umich.edu/rsie/workingpapers/Papers401-425/r422.pdf
19) Giovanni Dell'Ariccia. (1999a). Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union. *Imf Staff Papers*, *46*(3), 315–334. https://www.imf.org/external/pubs/ft/wp/wp98107.pdf
20) *Applying gravity model to analyze trade activities of Vietnam - F.R.E.I.T*. (n.d.). Retrieved November 29, 2022 from https://freit.org/WorkingPapers/Papers/TradePatterns/FREIT639.pdf
21) Tharakan, P. & Van Beveren, Ilke & Van Ourti, Tom. (2005). Determinants of India's Software Exports and Goods Exports. The Review of Economics and Statistics. 87. 776-780.
22) Sabyasachi Tripathi, & Nuno Carlos Leitão. (2013). India's Trade and Gravity Model: A Static and Dynamic Panel Data. *Research Papers in Economics*.
23) Batra, Amita. 2006. "India's Global Trade Potential: The Gravity Model Approach." *Global Economic Review* 35 (3): 327–61. https://doi.org/10.1080/12265080600888090
24) Renjini, V., Kar, A., Jha, G., Kumar, P., Burman, R., & Praveen, K. (2017a). Agricultural trade potential between India and ASEAN: An application of gravity model. *Agricultural*

Economics Research Review, *30*(1), 105. https://doi.org/10.5958/0974-0279.2017.00009.x

25) Rojid, S. (2006a). COMESA trade potential: a gravity approach. *Applied Economics Letters*, *13*(14), 947–951. https://doi.org/10.1080/13504850500426061
26) Swapan K. Bhattacharya. (2004). Does Bangladesh Benefit from Preferential Trade with India? A Gravity Analysis. *Economic and Political Weekly*, *39*(48), 5152–5162. http://www.jstor.org/stable/4415839
27) Bhattacharyya, R. & Banerjee, T (2006). Does the gravity model explain India's direction of trade? A panel data approach. Research and Publication Department, IIMA. Retrieved from: http://www.iimahd.ernet.in/publications/data/2006-09-01tathagata.pdf
28) Egger, P. (2002) An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials. World Economy, 25, 297-312.
29) Frankel, J., & Rose, A. (2002b). An Estimate of the Effect of Common Currencies on Trade and Income. *The Quarterly Journal of Economics*, *117*(2), 437–466. https://doi.org/10.1162/003355302753650292