AUGMENTED GRAVITY MODEL: AN EMPIRICAL INVESTIGATION INTO INDIA'S TRADE FLOWS DURING TWO EXIM POLICY PERIODS

Mr. Amandeep
Assistant Professor, Government National College, Sirsa, Haryana-125055 [INDIA]
E-mail: amandeeps@gncsirsa.com, ORCID: https://orcid.org/0000-0001-5930-8630

Prof. B.K. Punia
Haryana School of Business, Guru Jambheshwar University of Science & Technology, Hisar-125001 [INDIA], E-mail: bkpunia@rediffmail.com, bkpunia@gmail.com
ORCID: https://orcid.org/0000-0003-4199-610X

Introduction

Indian exports slowed for a long time because the country relied heavily on agricultural products like tea, jute, and cotton. The inelastic demand for these products cannot be overstated, and India's exportable goods were not competitively priced. Following the devaluation of the rupee in 1966, the government entered into several treaties with socialist countries and began offering fiscal and monetary incentives to their citizens. In addition, several councils and agencies were established to boost exports. In the 1970s, exports proliferated for all these reasons. However, because most exportable commodities were primary goods, our import bill has always been greater than the export value. Due to rising domestic consumption, India exported only a small percentage of its surplus. It was concluded that tax incentives and similar programs to encourage exports were insufficient. Developed nations, such as the United States, raised tariff barriers to combat imports from less developed nations. It is worth noting that the unit value of exportable goods increased by a much larger margin than the quantum index of exports when most developed countries were experiencing economic recession.

Due to rapid industrialization and the government's efforts to supplement domestic production and maintain a minimum level of buffer stock by regularly importing food grains from 1958-59 to 1972-73 under the PL 480 scheme, the value of India's imports rose above the value of its exports since 1951. Increasing imports and supplies of price-sensitive commodities like cement, edible oils, etc., had helped keep inflation in India under control. In the name of boosting exports, imports have been liberalized, allowing entry of both necessary and luxury items. Since 1973, when OPEC was formed, oil prices have been ramped up regularly. India's import costs have increased because of this.

The new FTP (2009-14) includes several provisions designed to promote steady growth in international trade and reverse a last ten-month decline in exports. The measures include both financial and procedural leniencies. For 2010–11, exports were projected to reach $200 billion, representing a 15 percent increase for the forecast period. The FTP also plans for an annual growth rate of 25% in the medium term. Therefore, it was anticipated that improvements to export-related infrastructure, a decrease in transaction costs, and the provision of full refunds of all indirect taxes and levies would all contribute to meeting the targets.

In the past, the Foreign Trade Policy 2009-14 included five separate schemes for incentivizing merchandise exports with duty scrips of varying types and conditions (sector-specific or actual user only) such as the Focus Product Scheme, the Market Linked Focus Product Scheme, the Focus Market Scheme, the Agricultural Infrastructure Incentive Scrip, and the VKGUY (Vishesh

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Krishi and Gram Udyog Yojana). The Foreign Trade Policy 2015-2020 (FTP 2015-20) has consolidated all of these programs into a single program called the Merchandise Export from India Scheme (MEIS), and the scrips issued under the program will no longer be subject to any conditions. The critical components of MEIS include information on the various product groups supported by MEIS. Under the Foreign Trade Policy 2015-2020, the MEIS plan applies to the following nation clusters: Category A: Traditional Markets (30) - European Union (28), USA, and Canada. The 139 nations in Category B, Emerging & Focus Markets, including those in Africa (55), Latin America and Mexico (45), the Commonwealth of Independent States (12), Turkey and West Asian countries (13), the Association of Southeast Asian Nations (10), Japan, South Korea, China, and Taiwan. Category C: All Other Markets (70). The following section of literature review followed by estimation of gravity model for EXIM policy 2010-15 and 2015-20.

Literature Review

(Tinbergen, 1962), (Pöyhönen, 1963), (Anderson, 1979), (Caves, 1981), and (Toh, 1982) all used empirical models to conclude that geographical proximity is a crucial factor in establishing the validity of the Gravity model. Cultural proxies (boundary, common language), as conclusively demonstrated by (Rauch, 1999)and (Eichengreen & Irwin, 1998), should be factored into the gravity equation. Culture, language, and nationality/border status represent dummy variables in the empirical model. It is common to practice base transportation costs on the distance traveled. There is a negative association between distance and trade, as shown by prior research (Balassa, 1966; Balassa & Bauwens, 1987). It means that lower transportation costs explain a rise in bilateral trade. Because of their commonalities, the two countries work well together economically. (Frankel & Rose, 1998) research showed how crucial these qualitative factors are for evaluating free-trade pacts between regions (RTAs). Positive evidence has been found (Balassa, 1966) and (Balassa & Bauwens, 1987). (Anderson, 1979) was the one who initially brought up the problem of product differentiation. (Bergstrand, 1985) used the income per capita to specify the supply side of economies in this context. (Tharakan et al., 2005) used the Gravity model formulation to assess the factors that determine India's bilateral software. When examining the relationship between Indian software exports and overall goods trade flows using the Tobit model for the years 1997–2001, the authors conclude that distance plays no important role in the relationship between the two. Using data from 2000-2006 in a panel format, (De, 2013) developed a Gravity model to examine the interconnections between India's services trade flow and its likely impediments. According to the study's results, if India were to increase its efforts to facilitate the trade of services by just 1%, its services exports would increase by 2%. Finally, the report suggests stronger policies toward an enhanced services trade infrastructure, which will help India's service exports in various ways. A cross-sectional and panel data model (Bhattacharyya & Banerjee, 2006) concludes that India's trade responds less than proportionally to size and more to distance. This conclusion is based on an analysis of the 177 countries with which India engaged in trade at least once between 1950 and 2000. Moreover, they discover that India has a greater trade volume with high-income nations than low-income ones. (Batra, 2004) employed an OLS estimate approach within a Gravity model for the year 2000, considering the trade flows from the sample of 146 countries, and concluded that the economic size of a nation pair and geographical proximity favorably affect India's bilateral trade flows. The study (Bhattacharya, 2004) used the Gravity model to estimate the expansion of bilateral commerce between India and Bangladesh in

response to four potential reductions in tariff rates. Under a free trade arrangement, the author estimates that India's exports will increase more than the country's increased imports from Bangladesh. (Kabir & Salim, 2010) used the augmented Gravity model to estimate the factors that influence the bilateral trade of four founder members of BIMSTEC with their major worldwide partners and other BIMSTEC members. The distance elasticity of trade was negative, as predicted, and the results show that GDP, governance, and FTA membership of both importer and exporter countries positively affect trade flow. (Filippini & Molini, 2003) used a Gravity model to study the bilateral trade of East Asian developing countries. All factors' signs (GDP, distance, population) were consistent with the model's presumptions, as determined by the research. (Baier & Bergstrand, 2007) examined whether or not a free trade agreement boosts international trade among its members. The authors state that their paper was inspired by the fact that estimations based on the Gravity equation for 40 years failed to provide a definitive "yes" about the impact FTA has on trade flows. Since FTA had gained in popularity due to the consensus that it would boost trade, they found this peculiar. They contend that prior researchers erred because they did not use differenced panel data to solve a theoretically motivated Gravity equation, as they did in this study. In their study, Baier and Bergstrand included a panel of 96 trading partners from 1960 to 2000. Data included general bilateral trade flows, real GDP, bilateral distance, dummy values for full free trade agreements and customs unions, capital-labor ratios, and "political" factors as potential instruments. This study aimed to calculate the average treatment effect of FTA on merchandise flows. They concluded that the data provided compelling empirical evidence that an FTA will, on average, increase trade between two member nations by roughly 86% after 15 years. (de Azevedo, 2002) used a Gravity Model technique to investigate the real effects of Mercosur on trade. A Single regression was generated using the Tobit and the OLS models, employing data from 55 nations for each year from 1987 to 1998. The analysis utilized the total fuel-net bilateral imports, GDP (current and per capita), population, distance, real exchange rate, transition, and dummy variables for customs union membership. The results indicated that the intra-block effect of Mercosur was not significant. Trade between the countries had begun to expand before Mercosur. The author asserted that this trend would have continued even if Mercosur had not been formed. However, Mercosur positively impacted its member countries' aggregate imports and exports. As a result, countries started importing more from other blocs, even though there were no indicators of trade diversion. In contrast, "export diversion" occurred due to a general reduction in exports throughout the transition and incomplete customs union periods. To determine whether or not the CEFTA free trade agreement influenced trade among member nations, (Begović, 2011) used a Gravity model technique. The author used a panel dataset from 1999 to 2007 that included data from 20 exporting nations. The estimation of the dynamic specification model was carried out using the General Method of Moments. Export volumes, GDP (nominal), GDP (per capita) differences, the Consumer Price Index (CPI), the bilateral exchange rate (BER), the distance between the two countries, and "dummies" for factors such as CEFTA membership or other FTAs, common borders and language, cultural past, etc. were all collected for the investigation. The result was that the trade agreement did not improve trade in the region. Furthermore, the Linder effect was evaluated and shown to have the expected negative result. The impact of the World Trade Organization (WTO), the Generalized Agreement on Tariffs and Trade (GATT), and the General System of Preferences (GSP) was studied by (Rose & Spiegel, 2004).

(Kien, 2009) investigated the ASEAN Free Trade Area and the factors influencing its export flows. The research authors employed a Gravity model and panel data to reach their conclusions. According to the estimation, export flows did rise along with GDP, and the trade area greatly aided member nations in establishing new trade relations. World Trade Organization (WTO) researcher (Laird, 1997) examined the impact of the Mercosur union between 1986 and 1995. They concluded that there is strong evidence that trade between Mercosur states increased after 1991. Until 1995, exports had doubled, and imports had shown steady growth. However, the WTO claims that the trade agreements themselves did not bring about the majority of the positive effects on trade, especially given that trade with other countries had also expanded simultaneously. Except for the fact that before the formation of Mercosur, Argentina and Brazil had their free trade pact, where most trades had increased. Their research (Martínez-Zarzoso & Nowak-Lehmann, 2003) evaluated trade between the European Union and Mercosur and the two blocs' potential for trade.

Additionally, the Gravity equation was expanded to include many factors, including bilateral trade, income, exchange rates, and income differences, which significantly impacted the bilateral trade flows. The results concluded that Mercosur could trade more than each country's exports in 1996. A study was carried out (Rojid, 2006) to examine two issues. First up was the question of whether COMESA, which stands for Common Market for Eastern and Southern Africa, is a bottleneck or a building bloc. The second objective was to explore the regional trade potential for COMESA member states. The Gravity model was employed to learn more about the potential in the area and the integration plan. The export-determining coefficients were both as predicted and very significant. According to the findings of this article, COMESA is more of a trade facilitator within its borders than an international trade barrier. The article claims that COMESA is already overtrading with its member countries because of the region's low trade potential. Using panel data from 2013–2016 and the Gravity trade model, (S. Kiran et al., 2018) analyzed the factors that affect Pakistani and SAFTA exports. For this study, researchers used a multiple regression model with exports as the dependent variable and GDP, GDP per capita, distance, border, and inflation as independent variables to assess each factor's effect on international trade. The conclusions of these researchers were in direct opposition to those of (Wang & Badman, 2016), who had found a positive correlation between GDP and trade flows in an earlier study.

Nonetheless, research by (S. Kiran et al., 2018) shows an inverse association between Pakistan's GDP and its exports to SAFTA countries. This result provided strong evidence for the Linder hypothesis rather than the H-O hypothesis, suggesting that countries with distinct factors of endowment tend to engage in less trade. (Abbas, 2019) looked at the impact of 47 principal trading partners on Pakistan's international trade flow from 1980 to 2016. The study found that the SAFTA significantly adversely affected import and export flows. In contrast, the FTA with China, Malaysia, and Indonesia had a substantial positive effect on imports and an adverse effect on export flows. As the only exception, the scenario of an FTA with the United States strongly influences export flows and significantly negatively affects import flows.

Specifications of the empirical model

Estimate Augmented model

The purpose of this study is to use the Augmented Gravity model, which takes into account more factors than only the GDPs of trading countries and the distance between them, to estimate India's bilateral trade, exports, and imports with its trading partners (177 countries).

Basic Gravity model:

$$lnTT_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnGDP_{it} + \beta_3 lnDIST_{ij} + eij$$

Total trade (imports + exports) between India (i) and its trading partners (j) is represented as TTij, where i is India and j are its trading partners; GDP is each country's nominal gross domestic product; DISTij reflects trade costs between the two nations; distance is the geographical distance between trading countries, and eij is a random error term.

Furthermore, the following variables (which will be discussed in detail in the subsequent subsections) will also be employed in this study, in addition to GDPs and distance: Aggregated population of countries i and j in period t (POPijt), the total area in country j (AREAj) in km2, foreign direct investment in country i in period t (FDIit), nominal effective exchange rate in country i in time t (NEERit), shared religious beliefs across trading partners (RELijt), and dummy variables for a shared border (Border), former colony (COL), common official language (LANG), and shared continent (CONT). The linear form of the Augmented Gravity model is as follows:

$$lnTT_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnGDP_{it} + \beta_3 lnDIST_{ij} + \beta_4 lnPOP_{ijt} + \beta_5 lnNEER_{it} + \beta_6 lnAREA_j + \beta_7 lnREL_{ijt} + \beta_8 ln\text{FDI}_{it} + \beta_9 Border + \beta_{10} CONT + \beta_{11} COL + \beta_{12} LANG + e_{ijt}$$

Where ln means natural logarithm, It is important to note that this model is not the only one because it includes modifications with other dependent variables. In addition to TT (total trade), the following models have regressors for imports (M) and exports (X):

$$lnX_{ijt} = \gamma_0 + \gamma_1 lnGDP_{jt} + \gamma_2 lnGDP_{it} + \gamma_3 lnDIST_{ij} + \gamma_4 lnPOP_{ijt} + \gamma_5 lnNEER_{it} + \gamma_6 lnAREA_j + \gamma_7 lnREL_{ijt} + \gamma_8 ln\text{FDI}_{it} + \gamma_9 Border + \gamma_{10} CONT + \gamma_{11} COL + \gamma_{12} LANG + \pi_{ijt}$$

$$lnM_{ijt} = \delta_0 + \delta_1 lnGDP_{jt} + \delta_2 lnGDP_{it} + \delta_3 lnDIST_{ij} + \delta_4 lnPOP_{ijt} + \delta_5 lnNEER_{it} + \delta_6 lnAREA_j + \delta_7 lnREL_{ijt} + \delta_8 ln\text{FDI}_{it} + \delta_9 Border + \delta_{10} CONT + \delta_{11} COL + \delta_{12} LANG + \tau_{ijt}$$

The Augmented Gravity model incorporates a more significant number of parameters than the original model. The next step is to determine how each variable affects the foreign trade between India and its trading partners throughout the studied period (FY 2010–11 to FY 2014–15 and FY 2015–16 to FY 2019–20).

Description of variables

A theoretical model is presented in the above section in which exports (X), imports (M), and total trade are used as explanatory variables in an Augmented Gravity model (TT). The totality of all international trade between India and its partners can be estimated using this group of dependent variables. The first three parameters of the model are practically identical to those in the fundamental gravity model presented in the section above. India's GDPi, its partner's GDPj, and most notably, the distance (in terms of the physical separation of their respective economic hubs and capitals, or "distance") between them are the three most essential factors in determining the viability of a trade relationship. The variables utilized in this work are described in the sections that follow.

Exports (X), Imports (M), and Total Trade (TT): The value of all the goods that are exported from India to its partner in US dollars are used to calculate exports. The total value of all items imported into India in US dollars from a specific trading partner is considered the total value of imports. The arithmetic sum of exports and imports is known as total trade. Data on exports and

imports have been obtained Government of India Ministry of Commerce and Industry: Department of Commerce.

Income (GDP): Gross domestic product (GDP) is a standard economic indicator of a country's economic health since it measures the value of all final items produced within a certain period. It is estimated in terms of absolute value (current US dollars). This variable takes into account both the GDP of India and the GDP of its trading partners. This indicator relies on World Bank's World Development Indicators database.

Distance (DIST): This is the geographic separation, expressed in kilometers, between India's economic centers (capital cities) and its trading partners (km). CEPII is the data source used to calculate distances.

Nominal effective exchange rate (NEER): The value of a country's currency relative to a group of other currencies is quantified by the nominal effective exchange rate (NEER), which is an unadjusted weighted average exchange rate. The nominal exchange rate is the national currency needed to buy foreign currency. The NEER can represent relative worth and cannot provide evidence as to whether or not a currency is strong or strengthening. It only states whether a currency is strong or weak relative to other currencies or if it is deteriorating or strengthening. Like any other exchange rate, the NEER can determine which currencies offer the best value storage. This indicator's data is gathered from the CMIE repository.

Total geographical area (AREA): Areaij is the cumulative land area of country i (India) and country j (its trading partner) measured in km2. Land areas of importers and exporters are obtained from the FAOSTAT Statistical Database of the UN.

Total population (POP): POP is the total population of India and its trading partner. Population statistics are retrieved from the World Bank's World Development Indicators database.

Foreign direct investment inflows (FDI): Whether FDI and exports are net substitutes or net complements has not been empirically determined. Horizontal FDI models theoretically support a substitution relationship between FDI and exports, while vertical FDI models theoretically support the existence of complementarity (Liu & Graham, 1998). Empirical findings show that most nations experience complementarity between FDI inflows and trade, even though the conclusions are inconsistent because studies utilize different samples, FDI proxies, and degrees of analysis (Forte, 2004). It has been observed that there is no statistically significant link between FDI and foreign trade in countries where the two are substitutes for one another in economic policy (Blonigen, 2001). Turkey is a prime example of an economy without a causal connection between FDI and trade (B. Kiran, 2011). Foreign direct investment figures were obtained from the World Bank's World Development Indicators database.

Common Religion (REL): For each pair of countries, the religion dummy assigns a value of one if the majority of the population practices the same religion out of the seven major world faiths (Buddhism, Catholicism, Confucianism, Hinduism, the Jewish faith, Islam, and Protestantism). World Religion Database is the source for the Common Religion data.

Common border (CONT): Whether or not India's trading partners share a border with India is indicated by the dummy variable ("1" if border countries are neighbors, "0" otherwise). This dummy assumes that economic activity will be concentrated in regions nearby. The information used to construct the Common border dummy was obtained from the CEPII database.

Former colony (COL): This refers to the countries governed by a single country over the last century. COL is set to 1 if the two countries once belonged to the same colonial power and 0

otherwise. The historical link dummy information comes from the CEPII database.

Common official language (LANG): The extent to which a given pair of countries share a "language dummy" variable indicates a common language. The dummy is set to a value of 1 if India's trading partner shares the same official language as India and a value of 0 otherwise. The information on the Common official languages used by the dummy comes from the CEPII database.

Presentation of results

This section aims to show, examine, and compare the estimated findings of the gravity models of bilateral trade flows between two periods (2010-11 to 2014-15 and 2015-16 to 2019-20). Bilateral foreign trade between India and its trading partners will be modeled using gravity equations, and the estimated results of these variables will be discussed in the following section. The following tables estimate bilateral exports, bilateral imports, and total trade. Additionally, the following estimates will be calculated using the augmented gravity model and the Robust OLS and PPML estimation methods. Our panel data comprises 875 observations from 2010-11 to 2014-15 and equally from 2015-16 to 2019-20. Descriptive statistics for the variables included in the gravity models from 2010-11 to 2014-15 are presented in Table 1. The correlation matrix for the same period is shown in Table 2.

Table 1: Descriptive statistics for the period 2010-11 to 2014-15

Variable	Observations	Mean	Std. Dev.	Min	Max
Total Trade	875	4200.061	10041.96	0.35	75455.01
lnTT	875	2.654541	1.103403	-0.45593	4.877688
Imports	875	2549.933	6646.558	0	61707.95
lnM	854	2.115837	1.401883	-2	4.790341
Exports	875	1650.128	4420.195	0.35	42448.66
lnX	875	2.333795	1.018104	-0.45593	4.627864
lnGDPj	875	10.63292	0.96958	8.364531	13.26098
lnGDPi	875	12.28477	0.026177	12.2608	12.32296
lnDIST	875	3.796765	0.282051	2.834656	4.228825
lnPOP	875	20.99325	0.065317	20.94668	21.72279
lnFDI	875	4.631899	0.076886	4.535269	4.744754
lnNEER	875	1.860344	0.037636	1.829304	1.926342
lnAREA	875	5.024113	1.048918	2.429752	7.232371
lnREL	855	-4.0682	1.196096	-8.63936	-2.15505

Table 2: Correlation matrix for the period 2010-11 to 2014-15

	lnTT	lnM	lnX	lnDIST	lnPOP	lnAREA	lnFDI	lnNEER	LANG	COL	Border	lnREL	CONT
lnTT	1												
lnM	0.9	1											

	31												
lnX	0.939	0.801	1										
lnDIST	-0.295	-0.269	-0.321	1									
lnPOP	0.380	0.337	0.376	-0.1111	1								
lnAREA	0.470	0.499	0.442	-0.06	0.362	1							
lnFDI	-0.013	-0.003	-0.023	-0.0001	0.119	-0.007	1						
lnNEER	-0.019	-0.003	-0.024	0.003	-0.224	-0.005	-0.0855	1					
LANG	-0.172	-0.248	-0.109	0.263	-0.030	-0.241	-0.0001	0.001	1				
COL	-0.090	-0.173	-0.043	-0.044	-0.079	-0.439	-0.00002	0.001	0.558	1			
Border	0.102	0.047	0.152	-0.460	0.074	-0.042	-0.00008	-0.001	-0.067	0.203	1		
lnREL	0.035	0.018	0.034	-0.255	-0.077	0.062	-0.0001	-0.001	-0.146	0.097	0.0211	1	
CONT	0.162	0.126	0.187	-0.433	0.439	0.106	-0.0001	-0.001	-0.052	0.095	0.7622	-0.059	1

Robust OLS estimations.

Given the historical context of the dataset used here, it is imperative to apply an estimating strategy that considers the heterogeneity in gravity models that arises from subject-specific and time-specific effects in the panel data. Table 3 below displays some preliminary findings based on these estimations.

Table 3 summarises the research findings. However, while the study focuses on the PPML estimator's superiority to the pooled OLS estimators, it is worth noting that the findings from pooled OLS estimators are presented as a baseline (just for visual comparison). Due to the lack of zeros in the pooled OLS approaches, the PPML is chosen. Sample selection bias can affect the degree of freedom if zero observations are dropped. The PPML estimator for the gravity equation proposed by Santos Silva and Tenreyro (2006) provides a simple solution to this problem. The

PPML estimator considers zero-valued trades in its calculations. PPML does not reject dependent variable values with zero. The number of observations based on the PPML estimator stood greater in the current investigation, as shown in Table 3, demonstrating that this is indeed the case.

In addition, the PPML estimator appeals to applied policy researchers because it is consistent even in the presence of fixed effects, mainly when dummy variables are included in the model specification. It makes the PPML estimator a desirable tool for applied policy researchers. The interpretation of the coefficients based on PPML is likewise simple, and it follows the same reasoning as the interpretation of the coefficients based on Pooled OLS. Because the PPML regression's dependent variable is defined in levels rather than logarithms, the coefficients of independent variables provided in logarithms may still be read as simple elasticities; this characteristic is critical. In addition, the coefficients of independent variables incorporated in levels are understood as semi-elasticities, the same as pooled OLS.

Table 3: Table Robust OLS Estimates of the Augmented Gravity Models between India and 175 Countries, Total Trade, Exports and Imports, 2010-15 (Clusters in Distance between the countries)

	Robust OLS			PPML		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	lnTT	lnM	lnX	Total Trade	Imports	Exports
lnGDPj	0.939***	1.187***	0.822***	1.879***	2.070***	1.838***
	(0.0572)	(0.0793)	(0.0581)	(0.147)	(0.200)	(0.188)
lnGDPi	1.695***	4.233***	0.377	0.385	1.580	0.0224
	(0.580)	(1.330)	(0.412)	(0.928)	(1.384)	(1.271)
lnDIST	-0.459**	-0.511**	-0.566***	-1.588***	-1.251**	-1.849***
	(0.180)	(0.247)	(0.181)	(0.477)	(0.599)	(0.572)
lnPOP	-0.299	-1.627	0.270	1.899	-2.658	3.017***
	(0.641)	(0.852)	(0.596)	(1.609)	(3.322)	(0.890)
lnAREA	0.105**	0.155**	0.101	-0.184	-0.0737	-0.214
	(0.0493)	(0.0623)	(0.0554)	(0.125)	(0.181)	(0.118)
lnFDI	-0.418***	-0.783**	-0.293**	-0.881***	-0.819***	-0.800**
	(0.139)	(0.325)	(0.119)	(0.258)	(0.284)	(0.316)
lnNEER	0.391	1.462**	-0.111	2.130***	1.894**	1.238**
	(0.286)	(0.674)	(0.277)	(0.586)	(0.937)	(0.540)
LANG	0.0408	-0.169	0.194	-0.0183	-0.177	0.354
	(0.0986)	(0.150)	(0.100)	(0.191)	(0.268)	(0.238)
COL	0.337***	0.385**	0.279***	0.924***	0.902***	1.003**
	(0.101)	(0.156)	(0.107)	(0.304)	(0.330)	(0.465)
Border	0.273	-0.319	0.666***	-0.962	-4.972**	0.624
	(0.183)	(0.245)	(0.183)	(0.983)	(2.059)	(0.510)
lnREL	0.0965***	0.0902	0.0822**	0.193***	0.277***	0.121
	(0.0339)	(0.0459)	(0.0347)	(0.0678)	(0.100)	(0.0738)
CONT	-0.0325	0.485	-0.372	-0.991	2.242	-2.347***
	(0.381)	(0.469)	(0.376)	(0.984)	(2.097)	(0.594)
Constant	-19.16	-26.02	-13.30	-50.01	27.00	-67.51***

	(13.67)	(21.76)	(11.66)	(30.96)	(59.69)	(19.46)
Obs.	855	835	855	855	855	855
R^2	0.776	0.718	0.736	0.784	0.733	0.729

Robust standard errors for OLS estimation and standard errors for PPML estimation are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The model's estimated coefficients have expected signs, as stated in theory, shown in Table 3. The coefficients before the GDP of India variable show positive signs but statistically insignificant impacts on bilateral trade, imports, and exports, respectively. It indicates a lack of specialization in the production and diversification of products. In contrast to the above, the impact of the economic size of a trading partner country on Indian bilateral trade, imports, and exports is much higher and statistically significant at a 1% level. The impact on India's bilateral trade is high because foreign demand growth has intensified in recent years. However, the intensity of the coefficient of GDP of partner countries on imports is more than exports, which describes the rising trade deficit during 2010-15. It indicates that the large volume of trade with developed and wealthy economies, which typically spends more on trade, would significantly increase the total trade of India, which would, in turn, stimulate the growth of its economy. Distance has a highly negative statistically significant impact on India's bilateral trade, imports, and exports with its trading partners at a 1% level. The coefficient before the aggregate population variable is significant at a 1% level for exports, whereas it has no significant impact on bilateral trade and imports. The variable geographical area in km2 of the partner country has no significance in determining either bilateral trade, imports, or exports of India. The coefficient before the FDI in India over the analysis period has a negative sign. It is significant for bilateral trade and imports at a 1% level and exports at a 5% level. It indicates that FDI has contributed to domestic production with country-based resources. The negative sign before the coefficient of FDI on imports indicates the local availability of domestic demands. The negative impact on exports of FDI could indicate concentrated wealth and market power in the hands of a few. It could further indicate the elimination of competition in the market and hence lesser exports due to FDI in India. The coefficient before NEER for all dependent variables is positive and statistically significant at the 1% level for bilateral trade and the 5% level for imports and exports. It concludes that India has not lost its competitiveness in foreign markets due to the nominal appreciation of its currency. It could be due to low inflation in India than its trading partners. The variable common official language is insignificant and does not affect the bilateral trade, imports, and exports between India and its trading partner countries. The common colony variable has a positive sign and a significant effect on all the dependent variables. The variable border is not significant for bilateral trade and exports but for imports. The sign of the coefficient before the border for imports is negative, which could be explained by India's unfriendly political relationship with its bordering countries during the analysis period. The coefficient before the common religion is positive and significant for bilateral trade and imports at a 1% level but for exports. The continent variable has a negative and considerable impact on India's exports but has no impact on bilateral trade and imports. It proves that India exports more to nations on other continents than its own.

Finding GDP coefficients near unity in the goods trade literature is common, and some theories predict they should be precisely unity. This hypothesis can be tested. The results are in Table 4.

Because the p-value of the F-statistics is more than 0.05, we cannot reject the null hypothesis of equality for total trade at the 5% significance level. However, the scenario differs when dealing with exports and imports on a bilateral basis. We reject the null hypothesis for imports and exports at the 1% level.

Table 4: Tests of the hypotheses that both GDP coefficients are equal to unity (2nd row) and that all historical and cultural coefficients are equal to zero (3rd row) for the period 2010-11 to 2014-15

lnTT	lnM	lnX
(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 170) = 1.27 Prob > F = 0.2844	(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 168) = 5.85 Prob > F = 0.0035	(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 170) = 5.19 Prob > F = 0.0065
(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 170) = 5.24 Prob > F = 0.0005	(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 168) = 1.94 Prob > F = 0.1059	(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 170) = 9.11 Prob > F = 0.0000

The same method can be used to examine the combined hypothesis that trade is unaffected by historical, cultural, and geographic ties or that the coefficients on all such variables are equal to zero. The results are shown in the third row of Table 4. The null hypothesis for imports alone was not successfully rejected in this instance. The F-test p-values are too high to reject the null hypothesis, even at the 5% significance level. This evidence suggests that historical, cultural, and geographical ties do not significantly determine bilateral imports.

On the other hand, one might conclude that geographical, historical, and cultural connections are crucial factors in determining exports and total trade. The null hypothesis for total trade and exports is rejected at a 1% significance level since the F-test p-value is less than 0.01. Table 5 presents descriptive statistics of the variables used in the gravity models for the EXIM policy 2015. The correlation matrix for 2015-16 to 2019-20 is shown in Table 6.

Table 5: Descriptive statistics for the period 2015-16 to 2019-20

Variable	Observations	Mean	Std. Dev.	Min	Max
Total Trade	875	4235.216	10712.43	0.27	89714.23
lnTT	875	2.704052	1.063371	-0.56864	4.952861
Imports	875	2529.213	6942.466	0	76380.7
lnM	852	2.200876	1.337035	-2	4.882984
Exports	875	1706.003	4793.884	0.27	53088.77
lnX	875	2.37012	1.003933	-0.56864	4.725003
lnGDPj	875	10.66021	0.946324	8.538443	13.33109
lnGDPi	875	12.41973	0.032022	12.36074	12.45796
lnDIST	875	3.795079	0.282585	2.834656	4.228825
lnPOP	875	21.04809	0.063937	21.00435	21.75976
lnFDI	875	4.828494	0.054188	4.779741	4.913671
lnNEER	875	1.80908	0.017322	1.784617	1.83187
lnAREA	875	5.024113	1.048918	2.429752	7.232371
lnREL	855	-4.0682	1.196096	-8.63936	-2.15505

Table 6: Correlation matrix for the period 2015-16 to 2019-20

	lnTT	lnM	lnX	lnDIST	lnPOP	lnAREA	lnFDI	lnNEER	LANG	COL	Border	lnREL	CONT
lnTT	1												
lnM	0.932	1											
lnX	0.925	0.782	1										
lnDIST	-0.286	-0.227	-0.325	1									
lnPOP	0.398	0.340	0.392	-0.116	1								
lnAREA	0.467	0.470	0.433	-0.077	0.375	1							
lnFDI	-0.005	-0.032	0.024	-0.002	0.206	0.006	1						
lnNE	0.0	0.0	-	0.00	-	-	-	1					

ER	01	28	0.03	1	0.202	0.001	0.809						
LANG	-0.167	-0.222	-0.117	0.251	-0.020	-0.250	0.001	0.001	1				
COL	-0.081	-0.166	-0.039	-0.051	-0.069	-0.426	0.001	0.001	0.553	1			
Border	0.097	0.043	0.140	-0.355	0.045	-0.031	-0.064	0.085	-0.065	0.136	1		
lnREL	0.012	-0.002	0.021	-0.24	-0.072	0.076	0.001	-0.003	-0.126	0.110	0.022	1	
CONT	0.178	0.111	0.210	-0.437	0.444	0.108	0.004	-0.005	-0.051	0.101	0.642	-0.063	1

Table 7: Table Robust OLS Estimates of the Augmented Gravity Models between India and 177 Countries, Total Trade, Exports and Imports, 2015-20 (Clusters in Distance between the countries)

	Robust OLS			PPML		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	lnTT	lnM	lnX	Total Trade	Imports	Exports
lnGDPj	0.915***	1.124***	0.849***	1.906***	1.879***	1.966***
	(0.0602)	(0.0889)	(0.0586)	(0.133)	(0.154)	(0.187)
lnGDPi	0.676***	1.321***	0.582***	1.605***	2.083***	0.993**
	(0.194)	(0.421)	(0.169)	(0.345)	(0.515)	(0.389)
lnDIST	-0.328*	-0.244	-0.470**	-1.599***	-1.706***	-1.392***
	(0.177)	(0.253)	(0.190)	(0.408)	(0.493)	(0.493)
lnPOP	-0.522	-0.872	-0.519	2.265*	3.195**	0.674
	(0.682)	(0.919)	(0.658)	(1.251)	(1.397)	(1.458)
lnAREA	0.122**	0.130*	0.0998*	-0.194**	-0.231*	-0.141
	(0.0532)	(0.0768)	(0.0530)	(0.0972)	(0.130)	(0.106)
lnFDI	-0.507***	-0.874**	-0.201	-1.725***	-2.167***	-1.064***
	(0.187)	(0.426)	(0.169)	(0.314)	(0.433)	(0.289)
lnNEER	-1.086**	0.521	-2.211***	-0.948	-0.254	-2.255**
	(0.549)	(1.138)	(0.524)	(0.906)	(1.462)	(1.108)
LANG	-0.0164	-0.140	0.117	-0.0942	-0.353*	0.215
	(0.0992)	(0.152)	(0.100)	(0.197)	(0.212)	(0.264)
COL	0.348***	0.277*	0.307***	0.833***	0.769**	0.949**
	(0.0987)	(0.162)	(0.0991)	(0.279)	(0.304)	(0.403)
Border	0.409	0.301	0.591**	-0.0581	-1.392***	0.646

	(0.301)	(0.482)	(0.276)	(0.329)	(0.469)	(0.481)
lnREL	0.0947**	0.0983	0.0909**	0.152**	0.177**	0.116
	(0.0394)	(0.0599)	(0.0366)	(0.0676)	(0.0790)	(0.0918)
CONT	0.0897	0.00444	0.0855	-1.397*	-1.670**	-1.102
	(0.471)	(0.593)	(0.476)	(0.768)	(0.837)	(0.938)
Constant	0.874	-3.977	3.522	-63.47***	-87.58***	-26.10
	(13.20)	(17.86)	(12.80)	(24.05)	(26.71)	(28.59)
Obs.	827	804	827	827	827	827
R^2	0.765	0.658	0.737	0.871	0.832	0.810

Robust standard errors for OLS estimation and standard errors for PPML estimation are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The coefficients before the GDP of India variable show positive sign and has a statistically significant impact on bilateral trade, imports, and exports, respectively. It indicates a specialization in the production and diversification of products. The coefficients before the GDP of the partner country on bilateral trade and exports are much higher and significant at the 1% level. However, the impact of the GDP of the partner country on imports is significant at a 1% level but has less intensity than the GDP of India. The impact on India's bilateral trade is high because foreign demand growth has intensified in recent years. However, the intensity of the coefficient of GDP of partner countries on exports is more than imports, which describes the falling trade deficit during 2015-20. It indicates that the large volume of trade with developed and wealthy economies, which typically spends more on trade, would significantly increase the total trade of India, which would, in turn, stimulate the growth of its economy. Distance has a highly negative statistically significant impact on India's bilateral trade, imports, and exports with its trading partners at a 1% level. The coefficient before the aggregate population variable is significant at a 1% level for imports, whereas it has no significant impact on bilateral trade and exports.

The variable geographical area in km2 of the partner country has significance in the determination of bilateral trade at a 5% level but imports and exports of India. It indicates India's rising bilateral trade with smaller countries in recent years. The coefficient before the FDI in India over the analysis period has a negative sign and is significant for bilateral trade, imports, and exports at a 1% level. It indicates that FDI has contributed to domestic production with country-based resources. The negative sign before the coefficient of FDI on imports indicates the local availability of domestic demands. The negative impact on FDI exports could indicate concentrated wealth and market power in the hands of a few. It could further indicate the elimination of competition in the market and hence lesser exports due to FDI in India.

The coefficient before NEER for all dependent variables is positive and statistically significant at the 1% level for bilateral trade and the 5% level for imports and exports. It concludes that India has not lost its competitiveness in foreign markets due to the nominal appreciation of its currency. It could be due to low inflation in India than its trading partners. The variable common official language is insignificant and does not affect the bilateral trade, imports, and exports between India and its trading partner countries. The common colony variable has a positive sign and a significant effect on all the dependent variables. The variable border is not significant for bilateral trade and exports but for imports. The sign of the coefficient before the border for imports is

negative, which could be explained by India's unfriendly political relationship with its bordering countries during the analysis period. The coefficient before the common religion is positive and significant for bilateral trade and imports at a 1% level but for exports. India's exports are negatively and significantly impacted by the continent variable, whereas bilateral trade and imports are unaffected. It demonstrates that India exports more to countries on other continents than those on the same continent.

The GDP coefficients can now be tested to see if they are near unity. The findings are tabulated in Table 8. The result indicates that the null hypothesis of equality is not rejected by the data for imports exclusively (the p-value of the F-statistics is more than 0.05, indicating that one cannot reject the hypothesis at the 5% level). However, the conviction for total trade and exports is not the same. The null hypothesis is rejected at the 1% level for total trade and exports.

Table 8: Tests of the hypotheses that both GDP coefficients are equal to unity (2nd row) and that all historical and cultural coefficients are equal to zero (3rd row) for the period 2015-16 to 2019-20

lnTT	lnM	lnX
(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 169) = 2.64 Prob > F = 0.0741	(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 168) = 1.25 Prob > F = 0.2886	(ln_GDPj = ln_GDPi = 1) (1) ln_GDPj - ln_GDPi = 0 (2) ln_GDPj = 1 F(2, 169) = 7.25 Prob > F = 0.001
(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 173) = 5.34 Prob > F = 0.0004	(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 168) = 1.13 Prob > F = 0.3453	(comlang_off = comcol = contig = border = 0) (1) comlang_off - comcol = 0 (2) comlang_off - contig = 0 (3) comlang_off - border = 0 (4) comlang_off = 0 F(4, 169) = 6.36 Prob > F = 0.0001

The same method can be used to examine the combined hypothesis that trade is unaffected by historical, cultural, and geographic ties or that the coefficients on all such variables are equal to zero. The corresponding results are shown in Table 8's third row. The null hypothesis for imports alone was not successfully rejected in this instance. Because the F-p-values tests are higher than 0.05, this evidence suggests that historical, cultural, and geographical ties do not play a significant role in determining imports in the second study period. Contrarily, one can conclude that shared cultural, geographical, and historical ties are crucial in explaining total trade and exports. The null hypothesis is rejected for total trade and exports because the p-value for the F-test is less than

0.05. It means that the null hypothesis is rejected at the 5% level of significance.

Findings and conclusions

Results include an examination of the influences on India's exports and imports from 2010 to 2015 and from 2015 to 2020, as well as an explanation of the expansion of trade between India and its trading partners during two periods of study. From 2010 to 2020, the study relied on 175 trading partners that accounted for 86.70 percent of bilateral trade, 83.1 percent of total imports, and 92.3 percent of total exports. One of the main features of our data set is a vast panel data set, which includes 1750 observations.

(Silva & Tenreyro, 2006) suggests using the PPML estimator, a gravity-based trade analysis method, to conduct independent regressions on bilateral trade, imports, and exports. The results have real-world implications and are statistically significant as well.

We find a statistically significant and positive relationship between the GDP of India's trading partners and India's trade indicators across both periods (bilateral trade, imports, and exports). Compared to the later period, the connection between India's GDP and trade statistics is weak and inconsequential. This finding contradicts the hypothesis that India's economic size would predict its trade metrics in the first part of the analysis. The subsequent analysis period, however, reveals a strong and positive relationship between India's economic size and its bilateral trade, imports, and exports. The analysis concludes a significant negative correlation between distance and trade indicators across the two periods.

In contrast to the first section of the analysis, the negative relationship between distance and imports becomes more significant in the second. However, when compared between the two periods, it has decreased for exports. In the second period, the negative coefficient of the distance variable for imports is more significant, which coincides with the time when India's trading partners complained to the WTO about trade concerns. India has introduced several new import-licensing requirements in recent years. Meanwhile, it has automated processes, reduced redundant procedures, and streamlined administrative regulations, which have aided exports by decreasing the number of delays seen and the overall cost of doing business. For example, between 2015 and 2019, the World Bank's Global Development Indicator for Time to Exports and Border Compliance shows that India reduced their export time from 109 hours to 52 hours. On bilateral trade and imports, the aggregate population variable has little impact. Early in the econometric analysis, it is positively related to exports.

However, the relative importance of these factors has flipped in the second period, with aggregated population variables being significant for bilateral trade and imports but not exports. By examining how the mix of India's exports has changed over time, it is possible to confirm this connection. Indian exports have been more skewed toward capital-intensive goods to the detriment of those that rely on human labour. For example, India's human hair and related product exports peaked in 2013–14 and have been falling ever since (source: tradeMap). The geographical area in the km2 variable does not have statistically significant coefficients for any of the analysed trade indicators except for bilateral trade and imports in the second period. The coefficients are inversely related to bilateral trade and imports. Some of India's most often-imported goods are oil, precious stones, electronics, heavy machinery, and organic chemicals, and imports of these goods from less developed countries have increased over the past few years. India's trade parameters and foreign direct investment (FDI) have a strong inverse relationship. There is always a risk that inward FDI will hurt exports if the level of technology transmitted is

insufficient, if the investment stalls the growth of domestic companies with export potential, or if it is only directed at the home market. Global perspectives show that FDI and trade trends are not necessarily related. The United Nations Conference on Trade and Development (UNCTAD) forecasts an increase in FDI flows for the year, despite the World Trade Organization's prediction of slowing trade growth for 2019. According to figures from the World Trade Organization, after rising by 10.2% in 2018, the global trade of goods decreased by 3% in 2019. UNCTAD predicts that global FDI flows will rise by 3% in 2019 after a sharp decline in both 2017 and 2018. Even though this growth was encouraging, it left overall global FDI inflows below the norm for the ten years prior and showed an utterly distinct trend from global trade.

The first section of the research demonstrates a robust positive relationship between NEER and trade metrics. In the second section, the link between the NEER coefficient and exports is a statistically significant negative. Since the NEER export coefficient is negative, an increase in the NEER reduces India's export revenue. At any point in time, using a common official language has no direct impact on India's trade indicators. India's trade with countries with a history of British colonial control is higher than with other countries, regardless of the period under consideration. The border variable's coefficient indicates that borders have a consistently negative impact on Indian imports. Due to recent political and regional unrest between India and its neighbouring countries, the negative relationship's severity has increased over the second period. There is positive significance across both periods for the common religion variable regarding Indian imports but not exports. India imported less in the first part of the analysis and exported less in the second portion to countries on the same continent. It reflects a recent shift in Indian export policy, prioritizing markets in the Far East and Far West.

Although this study has some interesting results, it also has certain drawbacks that could be addressed in future research. To begin, this study examines the variables affecting India's trade metrics over two distinct five-year periods. Given the broad variation in the quality and utility of traded products, it is logical to assume that there will be differences in the relative weights given to the various factors. Research in the future should concentrate on figuring out what kinds of goods is most affected by these variables. Second, more studies might examine the effects of trade protection measures (tariff and non-tariff) over time.

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