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Impact of India's FTAs and FTA Partners on India's Trade: A Gravity Model Approach

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Abstract

This paper explores the impact of Free Trade Agreements (FTAs) on India's trade flows, focusing on exports and imports through a gravity model. FTAs are formal agreements establishing trade obligations between nations. As of September 2024, the World Trade Organization (WTO) recognized 373 FTAs in force globally. Advancements in transportation and digital technologies have spurred FTA growth, lowering trade barriers and expanding markets. The ASEAN-India Free Trade Agreement (AIFTA) increased bilateral trade to US$110.4 billion in 2021-22, benefiting Indian exporters with preferential tariff access, enhanced export potential, and reduced trade deficits. However, AIFTA's impact has been uneven, with gains limited to specific sectors. The study also examines India's bilateral FTAs and SAFTA (South Asian FTA) between 2014 and 2024, finding SAFTA to be ineffective in boosting trade. Using OLS and fixed-effects models, the paper highlights GDP and geographic distance as key trade determinants and underscores the need for strategically designed FTAs.

Key Words: *India, FTA, SAFTA, ASEAN-India FTA, Gravity equation, Fixed effects model, Imports and exports, Bilateral Trade*

Introduction

FTAs are considered as potential determinants of trade efficiency to their member countries as they are said to have a positive effect on trade volumes (Wonnacott, R. J. (1996); Carrere, C. (2006); Cipollina, M., & Salvatici, L. (2010)). Since the Doha round in 2008, FTAs turned out to be extremely popular and changed the relative competitiveness and trade diversion of the country. The Modi government realized that this had to change and that re-engagement with smaller agreements with Mauritius, Australia, Oman, and EFTA was not enough; they showed a hidden intent to go back to the basics of India's FTA strategy, which was defensive in nature and shaped by colonial trade experiences and balance of payment concerns. The aim was to limit imports rather than expand exports, attract investment, or get hooked into GVCs.

India also has shown reluctance to accept binding rules in FTAs. These appear to India as restrictive of policy space and increasingly disadvantageous for the domestic sectors in manufacturing and agriculture, especially on new issues like digital trade. Since 2014, India has been actively engaging in FTA discussions with several countries and regional blocs and exercising strategic economic diplomacy up to 2024. Under Prime Minister Narendra Modi, India has transformed to a more pragmatic trade policy seeking for both balance growth and protectionism.

Reducing the tariffs on the import of intermediates enhances the competitiveness of our finished goods. Doing this under FTAs enables liberalization and access to markets for our exporters with a trade-off. The consumer also gets more choices. Thus the Modi government which opposed FTAs in its election campaign restarted our FTA journey with small steps through FTAs with Mauritius, Australia, Oman and EFTA.

Our past FTA engagement has been far too defensive, possibly because of our colonial legacy of unjust trade terms and balance of payments problems up to the early nineties. The mainspring has not been an urge to export more, invite investments, or integrate with GVCs. It has instead been to restrict imports. The FTAs undertaken have also been with a view to protect domestic agriculture, manufacturing and expansion of digital trade. The government's recent shift to negotiating FTAs with the EU and UK, however, is a step in the right direction. This shall increase engagements on FTAs at multilateral platforms, more specifically at the Continental Free Trade Area of Africa, and India must eventually move towards more liberal rules of origin to strengthen trade relations. Comprehensive FTAs, which include bilateral aspects of trade and investment, are inescapable because low foreign direct investment is a major hurdle for growth. Indians are cautious over labour and environmental standards but are ready to sign into FTAs with most countries except China and the US, which have made a few high demands on regulatory standards. Negotiations with the European Union (EU) formed the core of the initial phase. During the negotiations for the Broad-based Trade and Investment Agreement between India and the EU, India held discussions on market access, tariffs, intellectual property rights, among other matters. Reestablished through Brexit, relations with the UK were on an escalator and both countries appreciated mutual benefits from a comprehensive trade deal. India focused even more on the relationships within Asia. In the India-ASEAN Free Trade Agreement, agreed earlier, another round of consultations to address concerns on non-tariff barriers and trade imbalances were held. India launched negotiations with Australia in the Indo-Pacific region and is part of the Indo-Pacific Economic Framework (IPEF).

There has however been a withdrawal recently by India from the Regional Comprehensive Economic Partnership (RCEP) in 2019, citing trade deficits, especially with China. This has thus been a period of a balance between protection of domestic industries and new market access, especially for services and pharmaceuticals. The changing nature of global trade gives this generation of FTAs great importance to Indian economic ambitions.

In order to facilitate preferential trade, new free trade agreements should adopt more lenient origin criteria rather than imposing strict value add requirements and changing product classification. Low foreign direct investment has impeded our growth story, therefore broad free trade agreements that include both commerce and investment are crucial. Furthermore, rather than fiercely opposing new issues like labour standards and environmental constraints, we should embrace a deliberate, best-effort, non-binding policy in exchange for quantifiable gains in industries like services. With the exception of China, the world's factory, and the US, which requires labour standards that satisfy all requirements, India, the largest country with the quickest pace of growth, is prepared for free trade agreements.

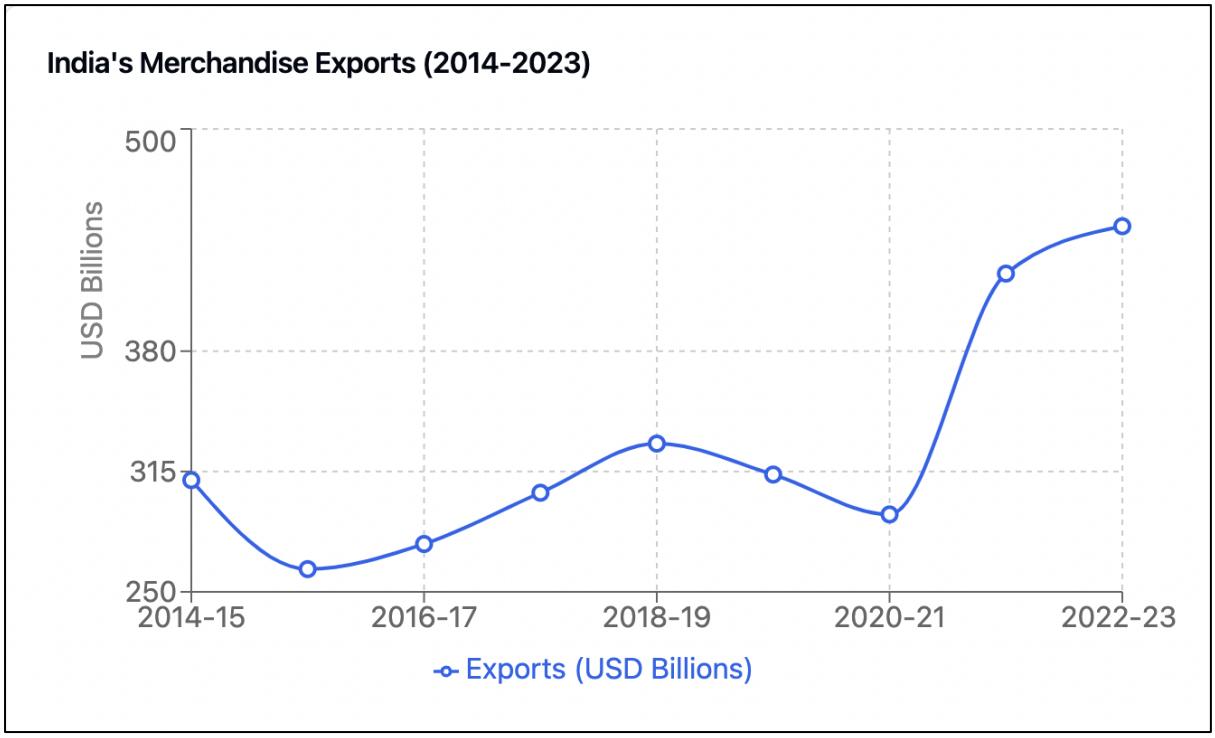
In this paper, we use the gravity model to determine the effect of selected FTAs and country specific effects of FTA partners on India’s exports and imports for the period of 2000–2023. The FTAs that are being considered here include India’s bilateral FTAs with its trading partners, India’s FTA with the Association of South East Asian Nations (ASEAN) region and the South Asian FTA (SAFTA). The bilateral FTAs in the analysis include India’s FTAs with Australia, Bhutan, Japan, Malaysia, Mauritius, Nepal, Republic of Korea, Singapore, Sri Lanka and United Arab Emirates, as shown in Table 1.

The traditional gravity model is deterministic, meaning it predicts a specific outcome based on certain economic variables (e.g., GDP, distance). It assumes that trade flows between two countries are a direct, fixed function of these variables. The equation is typically:

$$T_{ij} = \frac{GDP_i \times GDP_j}{Distance_{ij}}$$

It assumes that all relevant factors affecting trade are captured by the variables in the model. It does not explicitly account for unobserved or unmeasured factors, leading to potential biases if important factors are left out. In its simplest form, the traditional model can be estimated using ordinary least squares (OLS) regression. It assumes that trade flows follow a stable and predictable pattern based on observable variables

Here are three key graphs illustrating India's trade and economic performance from 2014 to 2024:



Source: Ministry of Commerce and Industry, Government of India.

Figure 1. India's trade in the last decade (2014-2023)

The graphs reveal that:

1. India's merchandise exports show three distinct phases over this period. Initially, there was a sharp decline from $310.34 billion in 2014-15 to $262.29 billion in 2015-16, driven by the global economic slowdown and falling commodity prices.
2. The second phase (2016-19) marked a steady recovery, with exports climbing to $330.08 billion, demonstrating the sector's resilience. However, this progress was interrupted by COVID-19, causing exports to drop to $291.81 billion in 2020-21 due to global supply chain disruptions and lockdowns.
3. The most striking phase was post-COVID, when exports surged dramatically to $421.89 billion in 2021-22 and reached a historic high of $447.46 billion in 2022-23. This 44% growth over the entire period reflects successful export promotion policies, pent-up demand, and India's growing role in global supply chains. The data reveals India's export sector's ability to recover from setbacks and adapt to changing global conditions, though it also highlights its vulnerability to external shocks like global economic downturns and pandemics.

These numbers actually highlight the economic gains India made through this period of increased trade integration. This research paper aims to understand the country specific effects of India's FTA partners and its FTAs on its trade by using the gravity model of trade. The traditional gravity model suffers from the inherent problem of heteroscedasticity of residuals, since a panel data of pairwise country combinations is taken over a

large time period. This research paper aims use a fixed effects model of gravity, by incorporating dummy variables for FTAs to overcome the limitations of pooled OLS regression.

Table 1 highlights the FTAs chosen for analysis, and their relative share in India's trade in 2023.

Table 1. Selected FTAs for analysis

Agreement Name	Year of entry into force	Current signatories	Export share in India's total exports in 2023	Import share in India's total imports in 2023
Bilateral FTA's	2022	Australia, India	3.74%	0.96%
	2016	Bhutan, India	0.20%	0.52%
	2011	Japan, India	3.68%	0.85%
	2011	Malaysia, India	2.31%	0.99%
	2021	Mauritius, India	0.01%	0.06%
	2010	Nepal, India	0.20%	1.10%
	2009	Republic of Korea, India	1.56%	2.69%
	2006	Singapore, India	3.34%	1.06%
	2000	Sri Lanka, India	0.20%	0.48%
	2022	United Arab Emirates, India	9.79%	4.57%
ASEAN FTA	2010	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, India	9.76%	12.27%
SAFTA	2006	Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka, India	3.15%	0.71%

Source: Ministry of Commerce and Industry, Government of India.

Literature review

Sharma, P. (2017) in her paper examines the changes occurring in trade between India and the ASEAN region due to the AIFTA with data points that span from 2003 to 2017 and compares the trade during pre- and post-FTA periods. Finds significant increases both in exports as well as in imports with most ASEAN nations during post-FTA periods, except Brunei. However, annual growth rates of trade do not vary significantly between the periods. The paper's strength is that it presents a completely statistical analysis that has robust insights into trade dynamics. It is also aptly recognized that though FTA has boosted the volumes of trade, long-term benefits for India are more latent. That is, the study can further qualify the impacts on industries and the economy. The paper goes a long way in adding value to the knowledge that issues from how effectively FTAs have promoted trade linkages between developing nations and the regional blocs.

Other literatures on the subject matter reveal some aspects of India-ASEAN dynamics regarding trade increases bilaterally after the enforcement of the AIFTA. From the use of gravity model, Gulnaz, S., & Manglani, H. (2023) indicates that trade flow between India and ASEAN is very high on the export and import flows, and India can have competitive advantage in manufacturing over time. Index of export intensity shows stronger integration with ASEAN while that of imports remains on a higher level but declined in the latter years. The primary determinants of trade flows comprising GDP, trade openness, and trade costs are highly crucial in most cases. In the case of India and trade with ASEAN, both GDP and openness contribute positively to exports, but trade costs adversely impact exports and imports simultaneously. Though the revealed comparative advantage index depicts a shift from agriculture to manufacturing in the profile of exports from India, the study in general

places emphasis on the necessity of liberalization and strategic partnerships in India-ASEAN trade relations improvement.

The recent literature on India's BITs reveals that the state has drastically shifted from the previous practice of its treaties mainly in light of mounting arbitration cases against it. India's BITs conventionally borrow lessons from capital-exporting states whose interests still lie in the protection of foreign investments. But current events have forced India to construct a much more rational approach that strikes a balance between state regulation authority and investment protection. This is quite similarly reflected in the draft Model BIT of 2015 by Ranjan, P. (2015), which includes clauses designed to preserve safeguards for investors while continuing regulatory authority.

Major non-economic benefits the bilateral Free Trade Agreements Sri Lanka has with India and Pakistan illustrate; these particularly pertain to regional peace enhancement and national security consolidation. Actually, Bandara, J. S., & Yu, W. (2012) pointed out that the free trade agreements have led Sri Lanka into a position whereby it can make military cooperation possible with Pakistan, thereby countering Indian potential dangers against it during its civil war with the LTTE. Though apparently the political and strategic gains were at the bottom, economic incentive was seemingly the primary driving force behind these accords, yet political and strategic gains derived from these agreements, including deepened diplomatic ties and military support, formed at the roots of forming Sri Lanka's wartime strategy and the post-war regional stability.

The study by Francois, J. F., McQueen, M., & Wignaraja, G. (2005) deals with the literature on Free Trade Agreements between developing nations and the European Union. This analysis pays special attention to the economic and related consequences of such accords in terms of the establishment of new trade, welfare effects, and tariff liberalization. Francois et al. 2005 provide a comprehensive review of the EU's accords with South Africa, Mexico, Chile, and Egypt. Though they make preferential access to the EU market, product exclusions limit the benefits of such agreements, particularly in the agricultural area. Authors used computable general equilibrium models to estimate the impact of the accords. Welfare gains are variable and small across countries while liberalization promotes increment in commerce.

Analysis Using a Gravity Model by Singh, P. K., & Pandey, M. (2020) investigates the impacts of the ASEAN-India Free Trade Agreement (AIFTA) on the exports of goods of India. This study employs a gravity model to study trade flows from and to India as well as the ASEAN countries. From the result, AIFTA had generally increased trade but had not significantly increased Indian exports. Several factors determine India's export success. Infrastructural gaps, non-tariff barriers & varying economic growth rates of the ASEAN countries are some examples. These findings well resonate with other studies on FTAs in developing countries as it illustrates that beyond mere tariff reduction, there are much stronger influences on export performance.

Banik, N., & Kim, M. (2022) gauge the influence of the CEPA between India & the Republic of Korea on bilateral trade, investment, and economic ties. This piece of research integrates different approaches-methodologies-methods, which include discussing policy papers and interviewing key stakeholders while cross-checking numbers on trade and investments. They reveal that trade & investment have developed quite noticeably in areas like machinery, electronics, and cars. But even of those, challenges persist as visible in delays in infrastructure or non-tariff barriers. Readjustment of CEPA & these obstacles is important for further improvement in ties & promotion of regional economic cooperation.

Jain, M. (2020) in his analysis looks at how, with the advent of the ASEAN-India Free Trade Agreement (AIFTA), India's export competitiveness is being impacted using the revealed comparative advantage index. It tracks various groups of commodities both before and after the pact for shifts. The studies reveal that AIFTA is opening opportunities for competitiveness for India in engineering goods, chemicals, and even textiles, but problems like infrastructure issues and NTBs still exist. Such output goes onto agreeing with the earlier observations about FTAs between developing countries, where initial realization went beyond mere tariff reduction to enhance actual export performance.

Kumar, S., & Prabhakar, P. (2017) in the paper analyze the role of FTAs in the trade potential and the trade efficiency of India with the help of the stochastic frontier gravity model. The paper takes the focus to six different FTAs of India with bilateral and ASEAN countries and uses a stochastic frontier model that incorporates multilateral resistances as opposed to the traditional gravity model in determining factors responsible for trade efficiency of India, using commodity level data from 2000 to 2014. Findings of the study showed that India's Bilateral FTAs and its FTA with ASEAN was significant enough in enhancing its trade

efficiency, whereas the South Asian FTA was insignificant in doing so. It enhances efforts through FTAs to boost India's trading power.

Das, R. U., Rishi, M., & Dubey, J. D. (2016) in their paper find whether India's Intra-Industry Trade (IIT) flows lead to higher trade flows among ASEAN+6 nations through an FTA, using the augmented gravity model. Using the Panel Tobit methodology, the study analyses the relationship between RCA and IIT and includes newer theories rather than the traditional theories based on comparative advantage and the Krugman model to explain the relationship. The study concludes that the theoretically as well as empirically combining an FTA in goods among ASEAN+6 countries can both catapult and sustain IIT flows in the region. An FTA can also overcome the ceiling constraint on IIT flows even if measured by the RCA index.

Sahu, P. K. (2014) traces how the free trade agreements of Malaysia influenced trade and investment and special attention was given towards MICECA. This research analyses whether increased trade of Malaysia with its FTA partners has increased FDI inflow into Malaysia from its FTA partners for the period 2004-2011, using the test of Granger causality. The study points out the causality between the trade of Malaysia with its FTA partners and FDI inflows from them into Malaysia. It concludes that the Malaysia-India FTA increased market access and investment flows, but further cuts in tariffs are needed along with non-tariff barriers in order to realize the full potential of the agreement.

Roy, A., & Mathur, S. K. (2016) examines the likely impact of Brexit on FTA between India and the European Union. It emphasizes the historical trading linkages between India and the EU and mentions that Brexit reduces the benefits that India might have derived from the Free Trade Area, especially due to the UK's critical role in trade. The study also shows that simple tariff cuts may not be enough to have the same sorts of profound impacts on trade and welfare as non-tariff barriers, such as regulatory divergences. In the end, Brexit muddies the economic waters, making the India-EU Free Trade Area less appealing to both sides.

The India-ASEAN Free commerce Agreement (AIFTA) literature study discloses several research works that assess the possible impacts of the agreement on trade and welfare. According to Pal, P., & Dasgupta, M. (2008), greater competitive pressures may build up in textiles and auto parts; however, their primary source of worry was the negative fallout on plantation industries of India- tea, coffee, and spices - for which concerns were echoed by Harilal, K. N. (2014), who specifically stated that most concern arose regarding the economy of Kerala.

For India, partial equilibrium models of Veeramani, C., & Saini, G. K. (2010) revealed large revenue losses in tariff although there is a net welfare gain as portrayed through increased consumer surplus. The study reveals that despite enhanced trade by AIFTA, all sectoral effects from the agreement should be properly regulated in order not to have a negative impact on sensitive industries.

Joshi, M. (2022) reviews various factors that have resulted in gradual decline in Indian export competitiveness since several Indian products are promoted through free trade agreements. Weak regional trade agreement, foreign countries' competition, the rivalry in related businesses, little value addition, and several restrictions imposed on internal trade of a country (Moreover, the average import tariff in the country was 10.21 percent in 2019 (WITS, 2022b); India has the highest tariffs among the partners of its Free Trade Agreement with the rest of the East Asian and South East Asian associates). Finally, questions regarding cost and quality exports of Indian textile and petroleum to Japan has been a prime example of how high import taxes can push up the price of goods that can be exported. Fuel exports from India decreased up to 65% in the years following Indo-Jap Free Trade Agreement.

Trotignon, J. (2010) explores the relationship between regional integration and the promotion of multilateral trade using a gravity model. The author examines whether trading blocs, particularly those formed since the 1980s, have facilitated or hindered multilateral trade flows. By estimating three regional dummy variables representing intra-bloc trade, extra-bloc exports, and extra-bloc imports, the study provides insights into trade creation and diversion effects within these blocs. The analysis suggests that most regional groups, including the European Monetary Union (EMU) and ASEAN Free Trade Area (AFTA), have contributed positively to global trade by enhancing intra-bloc and multilateral trade flows. However, the North American Free Trade Agreement (NAFTA) shows some evidence of export trade diversion. The study concludes that these trading blocs generally act as building blocks for global trade liberalization, reinforcing member nations' integration into the global economy. The gravity model demonstrates that regional agreements not only bolster intra-bloc trade but

also have the potential to promote global trade by reducing trade barriers and facilitating economic cooperation among countries .

Research Problem

Through thorough examination of past literature and understanding of the Gravity model, the research problem was formulated as:

"Does the nature of India's FTA partners and its FTAs have an impact on increasing India's trade in the 21st century?"

Research Objectives

India is rising power in the global economy and is quickly becoming an important trade partner in the world. In this context, this research paper aims to:

1. To understand the effect of country specific factors of India's FTA partners on its trade.
2. To analyse the effectiveness of India's FTAs in improving its imports and exports with FTA partners.

Research Methodology/Empirical Strategy

The traditional Gravity equation in international trade, as propounded by Tinbergen, J., & Bos, H. (1962), assumes trade flows as a function of economies of trading countries and the distance separating them. The following formula was devised:

$$T_{ij} = A \frac{Y_i^{\beta 1} Y_j^{\beta 2}}{D_{ij}^{\beta 3}}$$

The log of the above formula is taken in order conduct log-log regression as follows:

$$\ln (T_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) - \beta_3 \ln(D_{ij}) + \varepsilon_{ij}$$

where T_{ij} is the dependent variable, which is the trade flow between country i and country j, Y is the GDP of the two countries, and D is the distance separating the two. α is the intercept of the regression equation, and β is the coefficient of the independent variables. ε_{ij} is the error term of the regression equation.

This equation is derived from the traditional equation of gravity in physics, and although has no fundamental foundation in economics, is still considered a stable and robust empirical relation. The next section discusses the addition and selection of variables to the traditional gravity equation.

Selection of variables

The traditional gravity equation is modified in this paper in order to understand the country-specific effects of India's FTA partners on its trade flow with them. Although the gravity model only considers trade as an output of incomes of countries and their distance, this paper seeks to understand the effect of a host of variables by incorporating them into the equation.

Incomes of countries

A conventional gravity variable, real GDP in current US$ of all FTA partners of India in the given time period has been taken as proxy for income. It is assumed to have a positive effect on trade between two countries, thus has a positive coefficient in the gravity equation.

Distance between countries

The distance between the two trading partners is taken as proxy for transport costs. For ease of computational purposes, and as several studies follow, the geodesic distance between the political capitals of the countries is assumed as the distance between the two. It is calculated by using latitude and longitude coordinates of the capitals by using the following formula in Excel:

*acos(sin(lat1)*sin(lat2)+cos(lat1)*cos(lat2)*cos(lon2-lon1))*6371*

Although this approach has several limitations, as it can lead to underestimation or overestimation of distance, with actual trading routes being different to simple distances between two capitals.

Contiguity

Contiguity is a variable used in several gravity models, which seeks to understand the effect of countries sharing a land border.

$Contiguity_{ij}$ = 1, if the trading countries i and j share a land border

= 0, otherwise
The values for this variable have been put in manually, with India's bordering countries having a value of 1.

Common language

As the name suggests, this variable outlines the effect of trading partners having a common language, on the trade flow. It is a widely used variable in gravity studies.
Common language$_{ij}$ = 1, if the trading countries i and j share a common language,
=0, otherwise
The values for this variable have been entered manually, after verification of all common languages spoken in the respective countries.

REMOT

As discussed earlier, the usage of geodesic distance of capitals as a proxy for trade costs has several limitations. However, the distance variable cannot be dropped as it would lead to omitted variable bias in the model. Thus, the variable is improved by incorporating the relative importance of the distance into the variable. As followed in the model used by Trotignon, J. (2010), the computed variable is:

$$REMOT_{ij} = \frac{\ln (D_{ij} \text{ x } GDP_j)}{GDP_{World}}$$

Which is the relative distance, measured as the logarithm of geodesic distance between countries i and j multiplied by GDP of trading partner j and divided by total world GDP. This follows the theory that a country would trade more often with richer country than with a poorer country, albeit both being at equal distances from it. This variable also helps in removing time invariance of the distance variable, as discussed later.

GDP Difference

In order to test the effect of factor endowment on trade flow, the per capita GDP difference between India and its trading partner is considered. As followed in the model used Trotignon, J. (2010), the computed variable is:

$$\text{GDP difference}_{ij} = \ln \left| \frac{GDP_i}{POPi} - \frac{GDP_j}{POP_j} \right|$$

Which is the logarithm of the absolute difference between per capita GDPs of the two countries.

FTA Dummies

In order to understand the specific effects of India's FTAs since 2000, three dummy variables have been added for each type of FTA – Bilateral, ASEAN and SAFTA. The dummy variable assumes the following value as per the stochastic model of Kumar, S., & , P. (2017):

Dummy$_{ij}$ (Bilateral, ASEAN, SAFTA) = 1, if the country is a member of trade agreement with India at t≥ year of enforcement of agreement;
= 0, otherwise

By incorporating all the above variables into the gravity equation, the final model equation is as follows:

$$\ln (T_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(D_{ij}) + \beta_4 \ln (\text{Contiguity}_{ij}) + \beta_5 \ln(\text{Common language}_{ij}) + \beta_6 \ln(REMOT_{ij}) + \beta_7 \ln(\text{GDP Difference}_{ij}) + \beta_8 \ln(ASEAN_{ij}) + \beta_9 \ln(\text{Bilateral}_{ij}) + \beta_{10} \ln(SAFTA_{ij}) + \varepsilon_{ij}$$

The dependent variable T, imports and exports, is regressed separately against the independent variables.

Data Collection

The time period for the study is 2000 to 2023, with commodity data of India and all its FTA partners collected for the same. India's existing free trade agreements was obtained through Department of Commerce, Ministry of Commerce and Industry.

The data for imports and exports with all countries is collected from IMF's Direction of Trade Statistics, and some missing values were obtained from World Integrated Trade Solution, World Bank. Real GDP in current US$ for all countries, World GDP in current US$, and total population for each country over the time period was retrieved through World Development Indicators, World Bank. All data was converted into millions USD.
Political capitals of countries, and their longitudes and latitudes were obtained from the CEPII distances database. The geodesic distance was computed as described earlier. The distance thus obtained was in kilometres.

The computation for each variable as discussed before, was done in Excel. The database was further exported to Jamovi and Gretl, where the required statistical tests were conducted.

The following table illustrates the descriptive statistics of variables considered, extracted from Jamovi:

Table 2. Descriptive Statistics of variables from Jamovi

	ln(exports)	ln(imports)	ln(GDP India)	ln(GDP Partner)	ln(Distance)
N	526	528	528	528	528
Missing	2	0	0	0	0
Mean	6.0922	6.7963	14.219	11.218	7.9821
Median	6.3749	7.2044	14.417	11.456	8.0757
Standard deviation	2.9528	2.0139	0.63701	2.1686	0.68794
Minimum	-4.0652	-0.27148	13.057	6.1328	6.5261
Maximum	10.835	10.324	15.082	15.652	9.1009

Source: Author's Contribution

	Contiguity	Comm lang	REMOT	GDP difference	Bilateral dummy	ASEAN dummy	SAFTA dummy
N	528	528	528	528	528	528	528
Missing	0	0	0	0	0	0	0
Mean	0.27273	0.54735	1.2160	7.1109	0.21212	0.26515	0.23864
Median	0.0000	1.0000	0.90267	7.0000	0.0000	0.0000	0.0000
Standard deviation	0.44578	0.49823	2.4557	1.5578	0.40920	0.44183	0.42665
Minimum	0	0	-4.0855	2.3561	0	0	0
Maximum	1	1	6.5795	11.363	1	1	1

Table 3. Descriptive Statistics of variables from Jamovi

Source: Author's Contribution

The column of ln(exports) showcases two missing values, due to the unavailability of data on exports between Lao PDR and India in 2000 and 2001, and thus have been considered 0, due to minimal trade between the two in further years. The logarithm of 0 is undefined, hence the missing values.

Analysis and findings

Pooled OLS

The database so formed was exported to Jamovi in order to conduct pooled OLS regression. In this step, only the traditional bilateral variables of the gravity equation were included – namely GDP of countries, distance, contiguity and common language. Exports and imports were regressed separately with the respective variables. Exports refer to exports of respective partner countries to India, and vice-versa for imports. The equation regressed in the first step is:

$$\ln(T_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(D_{ij}) + \beta_4 \ln(\text{Contiguity}_{ij}) + \beta_5 \ln(\text{Common language}_{ij})$$

with T_{ij} being exports and imports respectively.

Table 4 reveals that the analysis is significant, with the p-value of the regression model being less than 0.05. All the variables are significant in determining exports to India from partner countries, except common language. The analysis shows that common language is not a big facilitator of trade. Surprisingly, the coefficient of ln(Distance) is positive, indicating more trade over larger distances. The result can be down to the FTAs signed by India. All variables with positive coefficients show trade promotion.

Table 4. Linear Regression - ln(exports) – Model Fit measures

				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
1	0.75063	0.56344	0.55924	134.23	5	520	< .00001
Note. Models estimated using sample size of N=526							

Source: Author's Contribution

Table 5. Model Coefficients - ln(exports)

Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	-20.11976	2.834617	-7.0979	< .00001
ln(GDP India)	0.44235	0.140231	3.1544	0.00170
ln(GDP Partner)	0.97863	0.045800	21.3675	< .00001
ln(Distance)	1.02621	0.250473	4.0971	0.00005
Contiguity	1.91559	0.414547	4.6209	< .00001
Common language	0.38572	0.216958	1.7779	0.07601

Source: Author's Contribution

The process is repeated in Jamovi, with imports as dependent variable in this scenario. The model is significant, and all the variables significantly explain change in imports as well. Coefficient of distance follows traditional theory, however the negative coefficient of contiguity can be down to the limitations of using geodesic distance, or as a result of higher trade with partners further away. India exports more to countries further away than it imports.

Table 6. Linear Regression – ln (imports) - Model Fit measures

				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
1	0.81727	0.66794	0.66476	210.00	5	522	< .00001
Note. Models estimated using sample size of N=528							

Source: Author's Contribution

Table 7. Model Coefficients - ln(imports)

Predictor	**Estimate**	**SE**	**t**	**p**
Intercept	-5.26269	1.677989	-3.1363	0.00181
ln(GDP India)	0.52739	0.083148	6.3428	< .00001
ln(GDP Partner)	0.74500	0.027110	27.4806	< .00001
ln(Distance)	-0.56189	0.148942	-3.7726	0.00018
Contiguity	-0.85238	0.246464	-3.4585	0.00059
Common language	1.68096	0.128750	13.0560	< .00001

Source: Author's Contribution

However, using pooled OLS for panel data has several shortcomings. It can lead to biased results, as country-specific results may be ignored in the model. Since it converts panel data into cross-sectional, it is not useful for the gravity equation we have formed in this paper. Thus, a fixed effects model is used for panel data.

Fixed Effects Model of Gravity

Hausman Test is conducted in Gretl in order to check the feasibility of a fixed effects model. If the analysis is significant, fixed effects model is used, and random effects model otherwise. Time invariant variables of ln(Distance), Contiguity and Common language are removed since such variables cannot be incorporated into a fixed effects model, which do not change over time. Thus, the Distance variable was modified by calculating relative distance variable REMOT, to be added to the model. The equation regressed in the fixed effects model is:

$\ln(T_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(REMOT_{ij}) + \beta_4 \ln(GDP\ Difference_{ij}) + \beta_5 \ln(ASEAN_{ij}) + \beta_6 \ln(Bilateral_{ij}) + \beta_7 \ln(SAFTA_{ij}) + \varepsilon_{ij}$

The results from Gretl with dependent variable ln(exports) are as follows:

Hausman test - Exports
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(7) = 15.1322
with p-value = 0.0343414

Since the p-value of the test is less than 0.05, it shows that the model is significant and a fixed effects model can be used. The model is carried out in Gretl with ln(exports) as dependent variable and all other variables as independent, except the time invariant variables. The results are shown in Table 8. Findings show that GDP on India has a negative effect on its imports from these countries, while the GDP of the partner affects it positively and significantly. The bigger the GDP of partners, the more it exports to India. Relative distance acts as a strong stumbling block for trade, while per capita GDP difference, i.e.., factor endowment is not a significant factor. Out of the three FTAs chosen, only the ASEAN FTA has had a significant impact on India importing from its partner countries. Analysis shows that bilateral FTAs and the SAFTA FTA has not been able to propel partner countries' exports to India.

Table 8. Fixed effects model output from Gretl

Dependent variable: ln(exports)				
	coefficient	std. error	t-ratio	p-value
Const	-19.2996	3.2487	-5.9407	0.0000
ln(GDPIndia)	-1.3640	0.6480	-2.1049	0.0358
ln(GDPPartner)	4.4260	1.1558	3.8294	0.0001
REMOT	-3.6135	1.1586	-3.1189	0.0019
GDPdifference	-0.0706	0.1115	-0.6333	0.5268
Bilateraldummy	-0.2328	0.2106	-1.1054	0.2695
ASEANdummy	0.6965	0.2148	3.2418	0.0013
SAFTAdummy	-0.5007	0.2585	-1.9370	0.0533
Mean dependent var	6.0922	S.D. dependent var	2.9528	
Sum squared resid	617.1239	S.E. of regression	1.1143	
LSDV R-squared	0.8652	Within R-squared	0.4147	
LSDV F(28, 497)	113.9065	P-value(F)	0.0000	
Log-likelihood	-788.3808	Akaike criterion	1634.7616	
Schwarz criterion	1758.4553	Hannan-Quinn	1683.1931	
rho	0.7580	Durbin-Watson	0.4328	

Source: Author's Contribution

The same test and model is carried out with ln(imports) as dependent variable. The Hausman test shows that model is significant and a fixed effects model can be carried out.

Hausman test - Imports
Null hypothesis: GLS estimates are consistent
Asymptotic test statistic: Chi-square(6) = 14.5305

with p-value = 0.0242401

GDP of India is not a significant factor in its exports, as per the model, as is factor endowment. GDP of partner and relative distance are important variables in explaining India's exports to its partners, which is a logical conclusion. More the income of partner country, more the exports from India, i.e., the partner country has more capacity to import. In terms of impact by FTAs, only bilateral FTAs have helped in improving India's exports. ASEAN and SAFTA, with p-value above 0.05, have lagged in boosting India's exports.

Table 9. Fixed effects model output from Gretl

Dependent variable: ln(imports)				
	coefficient	std. error	t-ratio	p-value
const	-12.6242	1.1276	-11.1955	0.0000
ln(GDPIndia)	-0.1938	0.2257	-0.8586	0.3910
ln(GDPPartner)	2.1947	0.4021	5.4578	0.0000
REMOT	-1.6547	0.4036	-4.1000	0.0000
GDPdifference	-0.0664	0.0389	-1.7101	0.0879
Bilateraldummy	0.1451	0.0734	1.9761	0.0487
ASEANdummy	0.1444	0.0749	1.9269	0.0546
SAFTAdummy	-0.1265	0.0899	-1.4074	0.1599
Mean dependent var	6.7963	S.D. dependent var	2.0139	
Sum squared resid	75.3805	S.E. of regression	0.3887	
LSDV R-squared	0.9647	Within R-squared	0.8025	
LSDV F(28, 499)	487.5191	P-value(F)	0.0000	
Log-likelihood	-235.3110	Akaike criterion	528.6220	
Schwarz criterion	652.4258	Hannan-Quinn	577.0886	
rho	0.7244	Durbin-Watson	0.5536	

Source: Author's Contribution

Limitations

As discussed before, the gravity model of trade suffers from the problem of heteroscedasticity in large sets of panel data. The use of Pooled OLS for panel data is also ridden with several shortcomings, since it converts the same to cross sectional data and the resulting analysis maybe inconsistent.

Time invariant variables have to be dropped in a fixed effects model, thus conventional variables of gravity had to be dropped, and some were modified in order to be included in the model. The model suffers from the problem of autocorrelation, since the Durbin-Watson value for any fixed effects model does not lie in the range of 1.5 to 2.5. The same can lead to biased predictor estimates.

However, despite these limitations, the model can still provide a useful understanding in determinants of trade of India, as discussed.

Recommendations

A stochastic frontier gravity model can be adopted to overcome the limitations of our model. By separating the conventional error term, it helps in overcoming the problem of heteroscedasticity. However, the same was out of the purview of this paper. Also, this paper focussed on commodity exports and imports of India. Some studies have used the gravity model on services exports and imports as well. The same can be covered in future studies on India.

Conclusion

This research paper aimed to understand the prominent factors of Indian trade in its FTAs and FTA countries, using a gravity-based model approach over the time period of 2000 to 2023. Several variables were

incorporated into the established gravity equation to understand their effect, and pooled OLS and fixed effects model using Hausman test were used to draw out the findings.

Findings reveal that in the traditional gravity model estimated using pooled OLS, common language is a significant variable in determining imports but not exports of partners. The rest of the variables strengthened the assumed theories of distance as proxy for trade costs. In the fixed effects model, GDP of India is only shown to determine its imports, but the partner GDP positively and significantly affect both. Relative distance is a very important factor in improving trade with closer and richer countries, however factor endowment has little role to play. Out of the FTAs, ASEAN has increased India's imports, while Bilateral FTAs have boosted its exports. Analysis shows that the SAFTA FTA has been weakest FTA out of the three in improving India's trade.

Thus, the study concludes that in the present world of integration and globalisation, nature of economies of partnering countries do have an effect on trade of home country. In case of India, FTAs, distances, GDPs and other such factors, all have a role to play in its trade balance with respective countries. India must strategically enter FTAs based on such positive coefficient variables, to improve its trade.

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