Institutions and Free Trade Agreements as Determinants of Trade Potential of India: a Stochastic Frontier Gravity Model Analysis

Naseer Ul Hassan[1] | *University of Kashmir, Srinagar, India*
Md. Sarafraz Equbal[2] | *University of Kashmir, Srinagar, India*
Quaseen Jahan[3] | *University of Kashmir, Srinagar,, India*

Received 3.2.2025 (revision received 1.5.2025), **Accepted** (reviewed) 28.5.2025, **Published** 12.12.2025

Abstract

This study examines how institutions and free trade agreements affect India's actual export and import potential using a panel data set of 40 nations for the years 2000–2022. A simultaneous single-step stochastic frontier model was generated in order to determine the trade efficiency (actualized trade potential). A system generalized method of moments estimator was then used to calculate the influence of institutions and free trade agreements. The results indicate that average export efficiency and import efficiency were found to be approximately 76% and 57%, respectively. Bilateral Free Trade Agreements are positively correlated with the trade efficiency while Multilateral Free Trade Agreements produce negative or insignificant results. The institutional-distance variables yield distinct outcomes for import efficiency and export efficiency.

Keywords	***DOI***	***JEL code***
Trade potential, institutional distance, FTA, Gravity Model, Stochastic Frontier Model, GMM	*https://doi.org/10.54694/stat.2025.5*	*F02, F14, F15*

INTRODUCTION

Trade potential is not the average trade, as was previously defined in the traditional gravity model research, but rather the maximum volume of trade that could be completed in the absence of trade barriers (Armstrong, 2007). Nevertheless, in reality, trade potential is rarely fully realized; trade efficiency

[1] Department of Economics, University of Kashmir, Srinagar, 190006, Jammu and Kashmir, India.
[2] Department of Economics, University of Kashmir, Srinagar, 190006, Jammu and Kashmir, India. Corresponding author: e-mail: sarfraz.eco@gmail.com.
[3] Department of Economics, University of Kashmir, Srinagar, 190006, Jammu and Kashmir, India.

is the measure of how much trade potential is realized. Tariffs and quotas are examples of protectionist trade policies and are termed as formal impediments to trade in the literature, these formal impediments have an impact on trade efficiency. These trade barriers, however, do not adequately account for the fact that trade is far lower than it should be. McCallum (1995) finds that social structures such as political systems, property rights, contract enforcement etc, prevailing in a country play a significant role in trade flows between nations. These social structures are termed as Institutions in economic literature. These institutions act as informal resistances to trade.

Free Trade Agreements (FTAs) are defined as reciprocal trading arrangements between two or more parties, irrespective of their geographical proximity (WTO). These agreements facilitate an increase in trade among partner countries by alleviating policy-imposed trade restrictions. Furthermore, FTAs are regarded as factors that reduce the barriers to trade (Frankel et al., 1997).

The impact of informal resistances is captured by making use of institutional-distance on trade efficiency. Institutions are the humanely created restraints that govern human relationships and are categorised into formal and informal institutions. Formal Institutions establish the rules that govern the economic activity and thereby lowering the uncertainty, risk and transaction costs. While informal institutions also aid in coordinating economic activity and become especially significant when there are no strong formal market institutions. Accordingly, scholars have considered two types of Institutions-distance: formal and informal (Kostova et al., 2019*)*. This study makes use of World Governance Indicators given by World Bank for Formal Institutional-Distance (referred as ID here onwards) and Cultural indexes given by Hofstede for the Informal Institutional-Distance (referred as CD here onwards).

Trade is a major part of Indian economy. India both exports and imports a significant amount of goods. Since gaining its independence, the value of India's exports as well as its imports has increased. When it comes to signing free trade agreements with its trading partners, India is a cautious and tardy starter. India opted for a strict protectionist import substitution policy up until the early 1990s, which discouraged foreign trade and prevented India from joining any FTAs. India first joined an FTA in 1995 when it joined SAPTA after liberalising its economy and opening it up to international trade in 1991. This was followed in 1998 by India's first bilateral FTA with Sri Lanka. The majority of the FTAs with India date from the 2000s. The rationale for India to enter a free trade agreement are to diversify and increase export markets, to obtain relatively cheaper access to raw materials, intermediate goods, and capital goods, to open up new avenues services industry in India, to bring in foreign investment, to boost manufacturing, generate employment, and bolster competitiveness, and to implement its geopolitical strategy, such as the "Act East" policy. India has pursued a mix of bilateral and regional agreements, focusing on strategic partnerships and economic cooperation with various countries and regions. Over the years, India has entered with a focus on strategic alliances and economic cooperation, India has pursued a variety of bilateral and regional agreements. India has signed numerous trade agreements over the years. India is a member of 18 Regional Trade Agreements (RTAs) in effect as of 2022 with various nations and regions, such as Mauritius, the United Arab Emirates, Australia, South Korea, Japan and ASEAN nations. Additionally, tentative announcements have been made for four more RTAs. Since the commencement of Regional Trade Agreements (RTAs), India's trade has experienced a positive trajectory, diversifying into multiple forms of trade agreements.

To the best of our knowledge, this paper is the first to offer a detailed analysis of the impact of institutional distance on India's trade potential. Secondly, methodologically, this paper contributes as we use a single-step estimation technique of the frontier model to derive trade efficiency by using the less restrictive assumption of a truncated normal distribution for inefficiency. We also include dynamism in the efficiency model by making use of system GMM estimation, which is an improvement over other studies where a two-step approach with a half-normal distribution is used to derive inefficiency and then dynamism is included in the model, or a static stochastic frontier model is estimated.

1 REVIEW OF LITERATURE

When analysing India's trading potential, it is important to consider how institutions and Free Trading Agreements (FTAs) influence trade flows. A thorough grasp of how trade agreements and institutional quality affect trade efficiency and trends can be obtained from a well-organized literature review. Studies that have already been done on the gravity model of trade emphasize how crucial institutional strength is to lowering transaction costs and improving trade facilitation. In the meanwhile, studies on free trade agreements highlight how they promote economic integration and increase market access. This study expands on previous empirical findings by utilizing a Stochastic Frontier Gravity Model to evaluate India's trade potential while taking institutional and policy-related restrictions into consideration.

1.1 Free Trade Agreements and trade potential

Ravishankar and Stack (2014) enhance the traditional Gravity Model by incorporating a Stochastic Frontier approach, introducing a one-sided error term within the composite disturbance term to evaluate the trade potential between Eastern and Western European countries from 1994 to 2007. Their findings indicate that increased trade integration between these regions leads to a greater realization of frontier trade, with Eastern member states achieving, on average, two-thirds of the frontier estimates during the study period. Kumar and Prabhakar (2017) apply Stochastic Frontier specification of the Gravity Model to commodity-level trade, examining the influence of specific FTAs on India's export and import efficiency from 2000 to 2014. They conclude that India realized 60% of its export potential and 50% of its import potential on average during this timeframe. Kaushal (2022) utilizes the Stochastic Frontier Gravity Model to assess the impact of RTAs on India's export efficiency from 2008 to 2018, finding that while India has not fully realized its export potential, RTAs have significantly contributed to enhancing it. Doan and Xing (2017) employ the Stochastic Frontier Gravity Model to evaluate Vietnam's export efficiency to major trading partners from 1995 to 2013, also exploring the effects of FTAs and Rules of Origin. They determine that Vietnam's exports fall short of potential, with FTAs positively influencing export efficiency, whereas Rules of Origin have a negative impact. Abdullahi et al. (2022) assess the efficiency of China's agricultural exports to 114 countries from 2000 to 2019 using the Stochastic Frontier Gravity Model, revealing that China has, on average, 51% untapped export potential in its agricultural sector.

1.2 Institutional-distance and trade

Linders et al. (2004) describe cultural distance and as the differences in shared norms and values between two regions. Their study reveals that cultural distance positively influences trade, whereas institutional distance has a negative impact. Mohamued et al. (2022) examine the effect of institutional distance on China's outward foreign direct investment (FDI) towards African nations, concluding that institutional distance directly correlates with increased FDI flow and therefore inversely with the trade. Xu and Shenkar (2004) suggest that institutional and cultural distances have complementary effects. Kim and Park (2019) define institutional distance as the disparity in institutional quality between regions, noting that such disparities are positively associated with trade costs, particularly in contract-intensive industries, although the overall impact on trade costs is mixed. Vu Hong Van et al. (2022) employ a System GMM estimator, finding that institutional distance negatively affects bilateral trade between countries with high institutional quality, while it positively impacts trade where one or both countries have low institutional quality. T Long et al. (2023) utilize the Gravity Model with System GMM for China's exports, concluding that both cultural and institutional distances negatively affect China's trade. Doanh et al. (2022) use stochastic model to derive the efficiency for half-normal distribution of the inefficiency and the effect of institutional and cultural distances on trade efficiency is estimated separately by system GMM. They

conclude that both institutional and cultural distances impact trade efficiency negatively. Kostova et al. (2019) highlight that the effects of institutional distance vary depending on the home and host countries, and it does not uniformly or negatively influence all cross-border phenomena.

2 RESEARCH METHODOLOGY

This study utilizes a stochastic frontier adaptation of the Gravity model to evaluate India's trade potential and factors influencing it. The Gravity Regression is employed to forecast bilateral trade between partner regions, having emerged in the 1960s as an empirical tool without theoretical foundation. Anderson (1979) is acknowledged for introducing the theoretical basis of the Gravity Model, which was further developed by Anderson and Van Wincoop (2003) to incorporate Multilateral Resistance terms. Baldwin and Taglioni (2006) assert that the derivation by Anderson and Van Wincoop (2003) is applicable solely to cross-sectional data, and they propose a similar Gravity Equation for panel data.

The estimation of trade potential is conducted using the Stochastic Frontier specification of the Gravity Regression, as proposed by Kalirajan (1999, 2007). This approach is derived from the Stochastic Frontier Model, initially applied to assess production efficiency. The frontier model was introduced by Aigner et al. (1977), and Meeusen and Van Den Broeck (1977), with Aigner et al. (1977) presenting a linear model for estimating the production function using cross-sectional data. This model includes a production function regression with a composite error term, consisting of a random disturbance term distributed as N (0, σ^2) and an independent one-sided error term. Battese and Coelli (1988) applied the Stochastic Frontier Model to a production function defined for panel data, using three-year data from Australian Dairy Farms to estimate a model of time-invariant inefficiency. Cornwell et al. (1990) developed a time-varying inefficiency Stochastic Frontier model using 12-year panel data from the US Airlines, thereby eliminating the time-invariance constraint. The log-linearised form of gravity model is as following:

$$lnx_{ij} = \beta_0 + \beta_1 lnGDP_i + \beta_2 lnGDP_j + \beta_3 Dist_{ij} + v_{ij}, \tag{1}$$

where x_{ij} stands for bilateral trade (exports/imports) GDP_i and GDP_j are the respective GDPs of the trading partners, $Dist_{ij}$ is the geographical distance between the countries, *ln* is the natural logarithm, β_0, β_1, β_2 and β_3 are the parameters to be estimated the sign of β_3 is negative.

The Stochastic Frontier specification of the Gravity Model in Formula (1) proposed by Kalirajan (1999, 2007) with composite error term composed of two distinguishable random disturbance terms for estimating the Frontier (potential) trade and there from trade efficiency is as following:

$$lnx_{ij} = \beta_0 + \beta_1 lnGDP_i + \beta_2 lnGDP_j + \beta_3 Dist_{ij} + \varepsilon_{ij}, \tag{2}$$

$$\varepsilon_{ij} = \left(v_{ij} - u_{ij}\right), \tag{3}$$

where ε_{ij} is the composite error term composed of v_{ij} the conventional random disturbance term distributed independently and identically distributed as N (0, σ_v^2) and u_{ij} which is random variable derived from truncation of normal distribution, truncated above zero as $N^+(\mu_{ij}, \sigma_{ij}^2)$. v_{ij} and u_{ij} are independently distributed of each other. The rationale behind this specification of error terms is that Trade Potential is subject to two distinguishable random disturbances one v_{ij} incorporates the measurement error which allows the Trade Potential to vary and the other u_{ij} the Inefficiency factor reflects the fact that the value of Trade must be equal to or less than the Trade Potential as mentioned by Aigner (1977).

This study employs Battese and Coelli (1995) version of panel data model. The model differs from the earlier empirical studies in that it is a single stage simultaneous estimation procedure while earlier studies adopted a two-stage estimation procedure. In the two-stage estimation, the first stage involved estimation of the Frontier Function and prediction of Inefficiency and the second stage involved estimation of the regression for predicted Inefficiency. The panel data model specification is as following:

$$lnx_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 Dist_{ijt} + v_{ijt} - u_{ijt}, \tag{4}$$

where the symbols and subscripts mean the same as in Formula (3), subscript t represents the time variable indicating that model (4) is a panel data Stochastic Frontier Gravity Model. u_{ijt} the Inefficiency part is assumed to be a function of unquantifiable variables such as Socio-Political and Institutional factors and FTAs such that:

$$u_{ijt} = \delta z_{ijt} + w_{ijt}, \tag{5}$$

where z_{ijt} are the explanatory variables for Inefficiency component and δ is the vector of parameters to be estimated. w_{ijt} is the random disturbance term truncated from normal distribution N (0, σ^2) and the point of truncation is $-\delta_{zijt}$. Trade efficiency defined by Battese and Coelli (1995) is:

$$TE_{ijt} = \exp\left(-u_{ijt}\right). \tag{6}$$

The single stage simultaneous estimation of Stochastic Frontier Gravity Model is carried by method of Maximum Likelihood. The Likelihood function for the Stochastic Frontier Models, with composite error terms is given in Kumbhakar and Lovell (2000). After deriving the trade efficiency from single stage estimation of stochastic frontier model we include the dynamism in the efficiency model by using Blundell and Bond (1998) system GMM approach to small-sample correction. The dynamic model we estimate is following:

$$TE_{ijt} = \alpha_1 TE_{ijt-1} + \alpha_2 Z_{ijt} + \epsilon_{ijt}, \tag{7}$$

where TE_{ijt} is the trade efficiency in period t, TE_{ijt-1} is the trade efficiency in the previous period, Z_{ijt} are the determinants of trade efficiency, ϵ_{ijt} is the random disturbance term, α's are the parameters to be estimated.

3 ANALYSIS AND DISCUSSION

The Stochastic Frontier Gravity model estimated is:

$$lnx_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnDist_{ijt} + \beta_4 comlang + \beta_5 contig + \beta_6 comcol + v_{ijt} - u_{ijt}, \tag{8}$$

where u_{ijt} the Trade Inefficiency component is assumed to be a function defined by:

$$u_{ijt} = \delta_1 FTA_{ijt} + \delta_2 AIFTA_{ijt} + \delta_3 SAFTA_{ijt} + \delta_4 CD_{ij} + \delta_5 ID_{ijt} + w_{ijt}. \tag{9}$$

The dynamic model of trade efficiency estimated is:

$$TE_{ijt} = \alpha_1 TE_{ijt-1} + \alpha_2 FTA_{ijt} + \alpha_3 AIFTA_{ijt} + \alpha_4 SAFTA_{ijt} + \alpha_5 CD_{ij} + \alpha_6 ID_{ijt} + w_{ijt}, \tag{10}$$

where:

- in Formula (8) x_{ijt} represents bilateral trade flows (Imports or Exports) between India and each of its partner country in time t. GDP_{it} and GDP_{jt} represent GDPs of India and each of its partner countries in time t respectively $Dist_{it}$ is the geographical distance between capital cities of India and each of its partner countries. *comlang* is the dummy for common official language of India and its trading partner which takes the value = 1 if two countries share the same official language and = 0 otherwise *contig* is the dummy for contiguity that takes the value = 1 if India and its Partner country share border and = 0 otherwise. *comcol* is the dummy which takes the value =1 if India and its partner country had the same coloniser in the past and = 0 otherwise.
- in Formulas (9) and (10) CD_{ij} is the cultural distance between India and each of its partner countries. ID_{ijt} is the institutional distance between India and each of its partner countries in time *t*. FTA_{ijt} is the dummy for bilateral Free Trade Agreements which takes the value = 1 if India and its trading partner have a free trade agreement in operation in time period *t* and = 0 otherwise $AIFTA_{ijt}$ is the dummy variable for India-ASEAN Free Trade Agreement which takes the value = 1 if India and its partner country are members of AIFTA in time period *t* and = 0 otherwise $SAFTA_{ijt}$ is the dummy variable for South Asian Free Trade Agreement whose value = 1 if both India and its Partner country are members of SAFTA in time period *t* and its value = 0 otherwise.

In Fromula (10) TE_{ijt} is the trade efficiency and TE_{ijt-1} is the trade efficiency of the previous year. β's,α's,δ's, v_{ijt}, u_{ijt} and w_{ijt} in Formulas (8), (9) and (10) are same as explained earlier.

Data for bilateral trade flows (Imports and Exports) are taken in 1 000 current US$ from UN Comtrade. UN Comtrade has a "reporter-partner" structure, wherein each country reports trade in 1 000 current US$ with its partner countries in terms of both exports and imports. We take the data with India as reporter country. Data for GDPs, of India as well as of each of its trading partners is taken from the World Bank's Development Indicators (WDI).

Data for geographical distances, colonisation and shared official language and contiguity is taken from CEPII's GeoDist dataset.

For data related to each bilateral FTA, SAFTA and AIFTA the name, the date of entry into force, the original signatories, and specific entry or exit dates for additional signatories is taken from WTO Data set.

The ID_{ijt} variable for the Institutional Distance is derived from indicators of institutions from World Bank database which provides the data for six indicators of governance for each country since 1996 and each indicator takes the value lying between –2.5 and 2.5. The institutional distance is computed as following:

$$ID_{ijt} = \frac{1}{6}\sum_{k=1}^{6}\frac{\left(I_{ikt} - I_{jkt}\right)^2}{V_{kt}}, \tag{11}$$

where I_{ikt} and I_{jkt} represent score of K^{th} institutional indicators for country *i* (India) and country *j* respectively in time *t* and V_{kt} is the variance of K^{th} institutional indicators across countries in time *t*.

CD_{ij} is the cultural distance variable, it is derived from Hofstede cultural indexes. Geert Hofstede provides data on six cultural indexes for a multitude of countries, the score for each index ranges from 0 to 100. It is computed as following:

$$CD_{ij} = \frac{1}{6}\sum_{k=1}^{6}\frac{\left(C_{ik} - C_{jk}\right)^2}{V_k}, \tag{12}$$

where C_{ik} and C_{jk} represent K^{th} cultural index for country *i* (India) and country *j* respectively and V_k is the variance of K^{th} cultural index across countries.

3.1 Estimation of stochastic frontier gravity model for exports and imports

Before presenting the results, it is pertinent to mention whether the model specification in the form of Stochastic Frontier Gravity model is required for the analysis of the data set used in this study, for which Log Likelihood Ratio Test is conducted. The Log Likelihood Ratio Test for Export inefficiency tests Null Hypothesis (H_0) of presence of no inefficiency against the Alternative Hypothesis (H_1) of presence of trade inefficiency. Since, in the present model there are 5 parameters for inefficiency model to be estimated, therefore the degrees of freedom for the test will be 5. The null hypothesis (H_0) of no inefficiency for the export model is rejected as the test statistic of the export model is 1450.8448, which is greater than the critical value of the test statistic given in Table 1, Kodde and Palm (1986) at the 1% level of significance and 5 degrees of freedom. Similarly, The LRR test for imports rejects the null hypothesis (H_0) of no import inefficiency with the test statistic of the model 1 795.6406 which is greater than the critical value given in Table 1, Kodde and Palm (1986) at 5 degrees of freedom and 1% level of significance.

Table 1 Estimation of stochastic frontier gravity model

	(1) lnexports	(2) lnimports
Frontier *lnGDP_i*	0.717*** (14.65)	0.933*** (13.67)
lnGDP_j	0.573*** (25.95)	0.566*** (16.11)
lndist	−0.949*** (−14.33)	−0.436*** (−4.48)
contig	−0.154 (−1.20)	0.349* (2.08)
comlang_off	0.291*** (4.28)	−0.236* (−2.39)
comcol	0.824*** (10.12)	0.817*** (6.19)
_cons	−5.583*** (−4.04)	−15.22*** (−7.76)
Mu *Bilateral_FTA*	−10.44*** (−3.83)	−3.549*** (−3.54)
AIFTA	−2.491* (−1.98)	−1.035 (−1.12)
SAFTA	4.734*** (5.24)	5.356*** (4.71)
CD	1.436* (2.46)	0.886 (1.76)
ID	−4.854*** (−4.13)	−2.599* (−2.47)
Usigma *_cons*	0.606* (2.28)	0.966*** (3.85)
Vsigma *_cons*	−1.373*** (−17.21)	−1.083*** (−5.92)
N	529	529

Note: *z* statistics in parentheses $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Authors calculation using Stata 17

In Table 1 the coefficients on ln (GDP's) are positive and significant for both exports (model 1) and imports (model 2), implying that a proportional increase in GDPs of India and its trading partners has led to an increase in Indian exports and imports over the time period 2000–2022. The coefficient of ln (distance) is negative and significant for both the models, indicating that distance has an inverse effect on exports and imports. These findings are consistent with the gravity literature. Among the other traditional gravity variables Contiguity is insignificant for India's exports, therefore does not impact India's exports significantly. However, contiguity has a positive and significant impact on India's imports which indicates that India imports more from the trading partners which are geographically located around India. Common_Lang_Off is positive and significant for India's exports and negative but significant for India's imports, which indicates that India exports less to the countries sharing the same official language with India while at the same time imports more from such countries these results are validated by Kumar and Prabhakar (2017). The comcol variable is positive and significant for both imports and exports indicating that India's trade (both exports and imports) is more with such countries that have shared the common coloniser with India in the past.

The inefficiency Formula (9) which is taken to be a function of FTA variables, Bilateral_FTA, AIFTA, SAFTA and the Institutional variables, ID and CD shows all the variables are significant determinants of export efficiency/inefficiency but only Bilateral_FTA, SAFTA and ID are significant determinants of import efficiency/inefficiency. The above model is used to derive export and import efficiency t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. of India. To find the impact of each determinant of efficiency a dynamic model specified in equation (10) is estimated separately. The marginal effects of the static model are given in the Appendix 3 in Tables A3.1 and A3.2.

3.2 Efficiency estimates

The estimated parameters of Stochastic Frontier Gravity Model are used to compute Mean export efficiency and mean import efficiency of India. Export/Import efficiency can be defined as realised export/import potential. The following tables provides the Mean efficiency of India's exports.

Table 2 Average export efficiency

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Export efficiency	529	.756	.195	.007	.951

Source: Authors calculation using Stata 17

Table 3 Average import efficiency

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Import efficiency	529	.569	.241	.000	.874

Source: Authors calculation using Stata 17

It can be seen from the Tables 2 and 3 that the mean value of export efficiency and import efficiency is approximately 0.76 and 0.57 respectively, implying that on average, India has realised approximately 76% of its export potential and 57% of import potential over the period 2000–2022.

3.3 The system GMM estimation of dynamic efficiency models

Before presenting the system GMM estimation of Formula (10) we conducted fisher's unit root test for ID-variable (it being the only non-dummy time variant variable). The test rejects the null

that all panels contain unit root at 1percent level of significance. For our post estimation check-ups about the validity of instruments we implement Hansen (1982) test and for post estimation check-up of no second order serial correlation (AR2) we implement Arellano-Bond test. The Hansen test does not reject the null hypothesis for either export efficiency model or import efficiency model. The Arellano-Bond test indicates the presence of first order autocorrelation (AR1) for both the models but rejects the presence of second order serial correlation (AR2) in any of the two models.

Table 4 System GMM estimation of export and import efficiency models

	Expeff		**Impeff**
L.expeff	0.801*** (30.07)	*L.impeff*	0.864*** (21.57)
Bilateral_FTA	0.060** (3.61)	*Bilateral_FTA*	0.130** (2.92)
AIFTA	–0.002 (–0.13)	*AIFTA*	–0.030 (–1.43)
SAFTA	–0.048** (–3.43)	*SAFTA*	–0.238*** (–5.49)
CD	0.100*** (10.21)	*CD*	0.020 (1.77)
ID	–0.002 (–0.36)	*ID*	0.021*** (4.50)
N	480	*N*	480

Note: *t* statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Authors calculation using Stata 17

Table 4 indicates that the variable (denoted by L.expeff and L.impeff in Table 4) is significant and exhibits a positive coefficient for both export and import efficiency. This suggests that trade efficiency from the previous year positively influences the current year's trade efficiency. These findings align with the research conducted by Antimiani and Costantini (2013) and Nguyen et al. (2023). A plausible explanation for this trend is that as two countries initiate trade, they gradually reduce formal trade barriers, leading to an incremental increase in trade efficiency over time.

Among the three types of Free Trade Agreements (FTAs) involving India, bilateral FTAs demonstrate a significant and positive correlation with India's import and export efficiency, indicating that these agreements enhance India's trade efficiency. Conversely, the ASEAN-India FTA appears to be insignificant concerning both export and import efficiency, corroborating the conclusions of Bhattacharyya and Mandal (2014) who assert that AIFTA lacks significance for most industries. Additionally, Ratna and Kallummal (2013) highlight that India incurs a welfare loss due to allocative inefficiency and adverse terms of trade effects under its FTA with ASEAN countries.

In contrast, the South Asian Free Trade Area (SAFTA) shows a negative and significant impact on both India's export and import efficiency, suggesting that SAFTA acts as a detriment to India's trade efficiency. This adverse effect may be attributed to conflicts of interest among SAFTA members, as noted by Joseph (2014), along with a higher prevalence of informal trade compared to formal trade within this group, as discussed by Akram et al. (2014).

The two institutional variables, Cultural Distance (CD) and Institutional Distance (ID), present mixed results in the existing literature. The CD variable is positively correlated and significant for India's export efficiency, yet it is insignificant for import efficiency in this study. This indicates that cultural dissimilarities

between India and its trading partners positively influence export efficiency, while having no significant effect on import efficiency. Conversely, the ID variable, which pertains to governance dissimilarity, shows a positive and significant effect on India's import efficiency, but remains insignificant for export efficiency.

CONCLUSION

This study examines the role of FTAs and institutions in determining India's export potential and India's import potential. The paper includes the data from India and 45 countries from 2000–2022.The estimation shows that India realises 76% of its export potential and 57% of its import potential. The results for FTAs are such that bilateral FTAs of India are trade efficiency enhancing and therefore it is suggested to liberalize the trade through bilateral FTAs. The SAFTA has adverse effects on both export efficiency as well as import efficiency of India, this is due to the prevalence of informal trade and conflict of interest among SAFTA members, hence such bottlenecks must be removed to increase the efficiency of trade. The India-ASEAN FTA is found to be insignificant for either of India's export efficiency as well as India's import efficiency, this is due the factors other than tariffs as pointed out by Bhattacharya and Mundal (2014). It is suggested that such factors be identified and their effect on trade be reduced to increase the trade efficiency of India and its ASEAN members.

Among the institutional variables CD representing the cultural-distance between India and each of its trading partners, has a positive effect on export efficiency and insignificant effect on import efficiency. While ID representing the distance in the governance structures of India and each of its trading partners, has a positive effect on import efficiency and an insignificant effect on India's export efficiency. The effects of these two Institutional distances on trade in general and trade efficiency in particular is not uniform or of the same direction for all the countries in all the cases as is mentioned in the section of literature review on Institutional-distance and Trade (Section 1.2). The possible reason for such an inconclusive phenomenon is that while the magnitude of both CD and ID is directly related to the costs of transaction between any two trading partners, the two variables also impact the flow of foreign investments between the trading countries. When the two countries are less distant institutionally there is an increase in the flow of foreign investments between them, which impacts the flow of trade between two such countries in a negative way and vice-versa. Since it is a gradual and long-term process to change the institutions and policymakers have a limited effect on institutions in the short term. Therefore, it is suggested that India must look for more exports to culturally distant countries and increase its imports from such countries that have differing governance structures to that of India.

The limitations of this study are that the number of India's trading partners does not include all the countries. Secondly, we do not include sector-specific effects of FTAs and institutions in the study. Due to the uniqueness of each industry FTAs and institutions do not have same effects across all the sectors of the economy. These two gaps form the potential topics for the future research.

References

ABDULLAHI, N. M. et al. (2022). Examining the determinants and efficiency of China's agricultural exports using a stochastic frontier gravity model [online]. *Plos One*, 17(9): 321. <https://doi.org/10.1371/journal.pone.0274187>.

AIGNER, D. et al. (1977). Formulation and estimation of stochastic frontier production function models [online]. *Journal of Econometrics*, 6(1): 21–37. <https://doi.org/10.1016/0304-4076(77)90052-5>.

AKRAM, H. W. et al. (2014). India's trade relationship with SAFTA countries: a review [online]. *Journal of Indian Research*, 2(1): 46–58. <https://doi.org/10.1177/0262728020944145>.

ANDERSON, J. E. (1979). A theoretical foundation for the gravity equation [online]. *The American Economic Review*, 69(1): 106–116. <https://doi.org/10.1177/000841747904600316>.

ANDERSON, J. E., VAN W. E. (2003). Gravity with gravitas: a solution to the border puzzle [online]. *American Economic Review*, 93(1): 170–192. <https://doi.org/10.1257/000282803321455214>.

ARMSTRONG, S. P. (2007). Measuring trade and trade potential: a survey [online]. *Crawford School Asia Pacific Economic Paper*, 368. <https://dx.doi.org/10.2139/ssrn.1760426>.
BALDWIN, R., TAGLIONI, D. (2006). Gravity for dummies and dummies for gravity equations [online]. *NBER Working Paper*, 12516. <https://doi.org/10.3386/w12516>.
BATTESE, G. E., COELLI, T. J. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data [online]. *Journal of Econometrics*, 38(3): 387–399. <https://doi.org/10.1016/0304-4076(88)90053-X>.
BATTESE, G. E., COELLI, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data [online]. *Empirical Economics*, 20: 325–332. <https://doi.org/10.1007/BF01205442>.
BELOTTI, F. et al. (2013). Stochastic frontier analysis using Stata [online]. *The Stata Journal*, 13(4): 719–758. <https://doi.org/10.1177/1536867X1301300404>.
BHATTACHARYYA, R., MANDAL, A. (2014). Estimating the impact of the India – ASEAN free trade agreement on Indian industries [online]. *South Asia Economic Journal*, 15(1): 93–114. <https://doi.org/10.1177/1391561414527050>.
CORNWELL, C. et al. (1990). Production frontiers with cross-sectional and time-series variation in efficiency levels [online]. *Journal of Econometrics*, 46(1–2): 185–200. <https://doi.org/10.1016/0304-4076(90)90054>.
DOAN, T. N. AND XING, Y., (2018). Trade efficiency, free trade agreements and rules of origin [online]. *Journal of Asian Economics*, 55(C): 33–41. <https://doi.org/10.1016/j.asieco.2017.12.007>.
DOANH, N. K. et al. (2022). Impact of institutional and cultural distances on ASEAN's trade efficiency [online]. *Journal of Economic Studies*, 49(1): 77–94. <https://doi.org/10.1108/JES-07-2020-0343>.
HOFSTEDE, G. (1984). *Culture's consequences: International differences in work-related values* [online]. Sage, Vol. 5, p. 327. ISBN: 0803913060. <https://www.google.co.in/books/edition/Culture_s_Consequences/Cayp_Um4O9gC?hl=en&gbpv=0>.
JOSEPH, D. T. (2014). Leaning from SAFTA experience: a way forward for the future of free trade agreements of India [online]. *Asian Economic Review*, 56(2). <https://ssrn.com/abstract=2475437>.
KALIRAJAN, K. (1999). Stochastic varying coefficients gravity model: an application in trade analysis [online]. *Journal of Applied Statistics*, 26(2): 185–193. <https://doi.org/10.1080/02664769922520>.
KALIRAJAN, K. (2007). Regional cooperation and bilateral trade flows: an empirical measurement of resistance [online]. *The International Trade Journal*, 21(2): 85–107. <https://doi.org/10.1080/08853900701266555>.
KAUSHAL, L. A. (2022). Impact of regional trade agreements on export efficiency – a case study of India [online]. *Cogent Economics & Finance*, 10(1): 2008090. <https://doi.org/10.1080/23322039.2021.2008090>.
KIM, S., PARK, S. C. (2019). Institutional quality, trade costs and comparative advantage [online]. *KIEP Working Paper*, 19–06. <http://dx.doi.org/10.2139/ssrn.3700740>.
KODDE, D. A., PALM, F. C. (1986). Wald criteria for jointly testing equality and inequality restrictions [online]. *Econometrica: Journal of the Econometric Society*, 54(5): 1243–1248. <https://doi.org/10.2307/1912331>.
KUMAR, S., PRABHAKAR, P. (2017). India's trade potential and free trade agreements: a stochastic frontier gravity approach [online]. *Global Economy Journal*, 17(1): 20160074. <https://doi.org/10.1515/gej-2016-0074>.
KUMBHAKAR, S. C., HORNCASTLE, A. P. (2015). *A practitioner's guide to stochastic frontier analysis using Stata* [online]. Cambridge University Press. <https://doi.org/10.1017/CBO9781139342070>.
LINDERS, G. J. et al. (2005). Cultural and institutional determinants of bilateral trade flows [online]. *Tinbergen Institute Discussion Paper*, No. 05–074/3. <https://dx.doi.org/10.2139/ssrn.775504>.
LONG, N. T. et al. (2023). The role of cultural and institutional distances in international trade [online]. *Emerging Science Journal*, 7(2): 507–519. <https://doi.org/10.28991/ESJ-2023-07-02-015>.
MCCALLUM, J. (1995). National borders matter: Canada-US regional trade patterns [online]. *The American Economic Review,* 85(3): 615–623. <https://econpapers.repec.org/article/aeaaecrev/v_3a85_3ay_3a1995_3ai_3a3_3ap_3a615-23.htm>.
MOHAMUED, E. A. et al. (2024). Institutional distance and Chinese investment efficiency in Africa: a stochastic frontier analysis [online]. *International Journal of Emerging Markets*, 19(3): 729–751. <https://doi.org/10.1108/IJOEM-12-2020-1480>.
RATNA, R. S., KALLUMMAL, M. (2013). ASEAN–India Free Trade Agreement (FTA) and its impact on India: a case study of fisheries and selected agricultural products [online]. *Foreign Trade Review*, 48(4): 481–497. <https://doi.org/10.1177/00157325135047>.
RAVISHANKAR, G., STACK, M. M. (2014). The Gravity Model and Trade Efficiency: a Stochastic Frontier Analysis of Eastern European Countries' Potential Trade [online]. *The World Economy*, 37(5): 690–704. <https://doi.org/10.1111/twec.12144>.
STATACORP. (2021). *Stata: Release 17, Statistical Software.* College Station, TX: StataCorp LLC.
WANG, H. J. (2002). Heteroscedasticity and Non-Monotonic Efficiency Effects of a Stochastic Frontier Model [online]. *Journal of Productivity Analysis,* 18: 241–253. <https://doi.org/10.1023/A:1020638827640>.
XU, D., SHENKAR, O. (2002). Note: Institutional distance and the multinational enterprise [online]. *Academy of Management Review*, 27(4): 608–618. <https://doi.org/10.5465/amr.2002.7566108>.

APPENDIX 1

Table A1 List of India's trade partners included in the study

Afghanistan	Italy	Saudi Arabia
Australia	Japan	Singapore
Bangladesh	Lao PDR	South Africa
Belgium	Malaysia	Sri Lanka
Bhutan	Maldives	Tanzania Thailand
Brazil	Mauritius	UAE
Brunei Darussalam	Myanmar	UK
Cambodia	Nepal	USA
Chile	Netherlands	Vietnam
China	Oman	
Hong Kong SAR	Pakistan	
France	Philippines	
Germany	South Korea	
Indonesia	Russia Federation	

Source: WTO

APPENDIX 2

Table A2 Institutional indicators considered in the study

Governance institutions	Cultural institutions
1. Control of corruption	1. Individualism and collectivism
2. Rule of law	2. Power distance
3. Regulatory quality	3. Masculinity and femininity
4. Government effectiveness	4. Uncertainty avoidance
5. Political stability and absence of violence	5. Long-term orientation
6. Voice and accountability	6. Indulgence

Source: Worldwide governance indicators by World Bank and the 6-D model of national culture of Geert Hofstede

APPENDIX 3

According to Kumbhakar, Subal, and Horncastle (2015) maximum likelihood estimates of the inefficiency equation may not be very relevant for empirical purposes. The marginal effect of each determinant of inefficiency determines the magnitude of that determinant. Furthermore, Wang (2002) suggests that determinants of inefficiency do not have to be positive or negative for every observation. Therefore, marginal effects for the static model are also calculated.

Marginal effects of the static models

When the change in the level of inefficiency/efficiency is estimated due to the change in level of determinants of inefficiency/efficiency, we get Marginal effects of inefficiency/efficiency The marginal effects of each

inefficiency/efficiency determinant show how much, on average, a change in the level of each inefficiency/efficiency determinant leads to a change in the expected value of inefficiency/efficiency. The following tables give the marginal inefficiency for exports and imports respectively.

Table A3.1 Marginal effects on export inefficiency

Variables	Obs.	Mean	Std. dev	Min.	Max.
Bilateral ~ M	529	–1.018	1.849	–10.360	–.017
AIFTA_M	529	–.243	.441	–2.472	–.004
SAFTA_M	529	.461	.838	.008	4.696
CD_M	529	.140	.254	.002	.425
ID_M	529	–.316	.837	–4.804	.034

Source: Authors calculation using Stata 17

Table A3.2 Marginal effects on import inefficiency

Variables	Obs.	Mean	Std. dev	Min.	Max.
Bilateral ~ M	529	–.715	.795	–3.526	–.038
SAFTA_M	529	1.080	1.199	.057	5.321
ID_M	529	.085	.607	–2.563	.205

Source: Authors calculation using Stata 17

The positive values for determinant of marginal inefficiency indicate an on average increase in marginal inefficiency due to that determinant of inefficiency and the negative values indicate an on average decrease in the inefficiency due to that determinant. Table A3.1 gives the marginal effects on export inefficiency it can be seen from the table that *Bilateral_FTAs*, *AIFTA* and *ID* are negative therefore inefficiency decreasing factors while *SAFTA* and *CD* are positive and therefore inefficiency enhancing factors. The marginal contribution of *Bilateral_FTAs* is highest amounting to 102% approximately followed by *ID* which amounts to 32% approximately and *AIFTA* which is 24% approximately among the inefficiency decreasing factors. Among the inefficiency enhancing factors marginal contribution of *SAFTA* is 46% approximately and that of *CD* is 14% approximately.

Table A3.2 gives the marginal effects on import inefficiency, in the table it can be seen *Bilateral_FTAs* and *ID* are negative therefore inefficiency decreasing factors, these two on average contribute 71% and 8%, respectively, in decreasing import inefficiency. While, marginal effect of *SAFTA*, is import inefficiency enhancing by approximately 107%. The *AIFTA* and *CD* are insignificant for import inefficiency/efficiency.