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TRADE AGREEMENTS, INSTITUTIONAL QUALITY, AND AGRICULTURAL EXPORT EFFICIENCY IN INDIA: EVIDENCE FROM A STOCHASTIC FRONTIER GRAVITY MODEL

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Abstract: The study aims to analyse the extent to which FTA, s and institutional factors proxied by regulator quality index and political stability index and absence of Violence/Terrorism affects India's agriculture export potential. Based on new trade theory framework, we incorporated Stochastic frontier approach into the standard gravity model in line with gravity model of Kalirajan (1999) and Ravishankar and Stack (2014), over the period 2002 to 2019, for a sample of 49 major trading partners besides SAARC nations. Regarding standard gravity estimates all of them carry expected sign and are in line with theoretical considerations except border which is having a negative sign. The empirical results of SFA reveal that India realizes 35 percent of its export potential with SAARC countries and 54 percent with the rest of the world. Moreover, joining of SAFTA has improved India's export efficiency with SAARC nations, thus narrowing the gap between the actual and potential level of trade. However, in comparison to IAFTA, SAFTA is proving weak agreement as its export realizing potential is less than IAFTA. Regarding importing partner's regulatory/institutional quality, results reveal their significant and positive impact on India's export efficiency. Similarly, political stability index and absence of Violence/Terrorism which is measured as the likelihood of political instability increases the inefficiency. Its positive and statistically significant coefficient suggests that political instability has negative impact on efficiency.

Key words: Trade, Gravity model, Stochastic Frontier Model, SAARC

1.Introduction

The significance of international trade as a driver of economic progress has garnered wide recognition among economists, both classical and neoclassical, attributing it as a key engine for economic growth (Frankel and Rommer, 1999; Narayan et al., 2007; Rahman et al., 2017; Yousefi et al., 2020). Not only does trade significantly contribute to a country's GDP, but it also serves as a pivotal source of foreign exchange (Chenery and Strout, 1966; KAndriyan et al., 2020). The post-World War II era witnessed globalization and mutual market integration leading to a substantial increase in international trade (Shangquan, 2000; De Grauwe & Zhang, 2011)., exemplified by the surge in the total value of world merchandise commerce from USD 2.077 trillion in 1980 to approximately USD 18.89 trillion in 2019. Furthermore, the concept of export-led growth theory emphasizes economic integration, particularly for developing nations, to reach their maximum export potential for both short and long-term growth (Barro, 1991; Abbas, 2012). However, impediments such as differences in economic development, trade links, institutional qualities, and border regulations can lead to inefficiencies in realizing a country's trade potential (Dollar & Kraay, 2003; Alcala & Ciccone, 2004). Understanding a country's trade potential across various products and sectors concerning different trading partners is crucial for shaping trade policies and enhancing efficiency.

Despite India's strong dependence on domestic demand, its international trade played a significant role, as its trade to gdp ratio was 45.67%. The

pursuit of 13 FTAs and six Limited Scope Preferential Trade Agreements reflects India's dedication to global economic integration thereby enhancing its trade potential (Department of Commerce, 2020). Therefore, evaluating the impact and effectiveness of these FTAs in maximizing India's trade potential becomes imperative. FTAs are considered potential determinants of trade efficiency for member nations due to their expected positive impact on trade flows (Wonacott, 1996; Cipollini & Salvatici, 2010). These agreements aim to align a country's trade closer to its potential level, thereby enhancing the economic welfare of the involved nation (Baldwin & Venables, 1995; Kumar, 1994; Dunning, 1998; Todaro & Smith, 2006). However, complications arising from phenomena like the Spaghetti Bowl effect[1] and Rules of Origin[2] may obscure the impact of RTAs/FTAs on trade efficiency.

The study expands beyond FTAs to include institutional quality variables such as the importer quality regulator index and political stability index, recognized for their crucial role in trade efficiency. Enhanced institutional quality not only reduces information costs but also ensures better contract fulfilment, enabling nations to benefit more from trade (North, 1991). Conversely, weaker institutions may lead to reduced product quality and domestic welfare, prompting higher exports to nations with stronger institutional frameworks (Creane and Jeitschko, 2016; Anderson and van Wincoop 2001). This underscores the importance for countries to improve their institutions to thrive in international trade.

Regulatory quality (RQ) assesses the impact of government regulations on market exchange and commercial activity, reflecting the influence of institutional quality on trade efficiency (Guasch and Hahn, 1999; Kumar & Prabakhr, 2017). Political Stability and Absence of Violence/Terrorism is another intuitional quality variable used in the present study as a determinant of inefficiency of trade levels. In the present study, these variable holds added significance since SAARC region has been mired in political conflicts especially between the two most important countries of the bloc – India and Pakistan. Political Stability and Absence of Violence/Terrorism measures the perception of likelihood of political instability and politically motivated violence including terrorism.

Given limited literature on agricultural trade potential of India within the SAARC region concerning various FTAs and institutions, the study endeavors to estimate India's agricultural export potential and assess the impact of FTAs and institutional factors on trade efficiency. By analyzing various determinants of India's agriculture export flow and employing a stochastic frontier version of the Gravity model, the study contributes to

[1] Spaghetti Bowl" impact refers to the intricacy and transaction costs associated with the implementation of domestic rules of origin in implementing free trade agreements between countries

[2] A product's nation of origin can be determined by following a set of rules called rules of origin. It is important from the point of view of imposing import tariffs, as the duties and limits in some situations rely on the origin of the imports

understanding the influence of FTAs and institutional quality on the inefficiency levels of India's agricultural exports

The paper is organized as follows. Next section critically highlights the review of literature, followed by data and methodology, then gravity estimates and efficiency(in) scores are given due consideration in section 4. Lastly conclusion and policy implication are highlighted in section 5

2. Literature Review

The Stochastic Frontier specification of Gravity model was introduced in 1999 by Kalirajan.The basic gravity model was integrated with Stochastic Frontier Production Function to address the inherent bias present in the former in estimating potential trade flows. From then various studies have come up that have employed stochastic frontier-based gravity model of trade. The SFA version of the gravity model is commonly used by researchers looking for evidence of a trade-enhancing effect of economic integration Koh,2013; Shankar&Stack,2014; Armstrong&Pangestu,2018; Boffa et al., 2019).

For any country willing to prosper economically and gain the most from international trade, it is essential to put effort into building strong institutions. When institutions are weak, trade volume and intensity fall as a result. (Anderson and Marcouiller 2002). Institutional quality matters for international trade flows are consistent with the general literature on the role of institutions (Heo et.al,2020). In 1990, several FTAs have risen dramatically. The trade promotions through the FTAs occur after many countries entered into such agreements. Many studies regarding the degree of openness and the correlation between an individual country's growth have been examined. The impacts of FTAs can be investigated by considering whether both countries will be better off or worse off when they remove their trade barriers. The evidence of a positive effect of free trade on economic growth had been supported by Dollar (1992), Sachs et al. (1995), Edwards (1998), Frankel and Romer (1999), Dollar and Kraay (2004), Romyen, et al. (2019) by using varies of openness measurements. Moreover, the insignificant or negative impact of free trade on economic growth had been reported by Harrison (1996), Rodriguez and Rodrik (2000), Rodrik et al. (2004), Wacziarg and Welch, (2008).

A recent study by Nasir & Kalirajan (2013) analyses the export performance of emerging Asian and developed nations in selected services such as business and professional, information and computer, and telecommunications using stochastic frontier-based gravity model. To catch up with the growth potential in developed nations, the study suggests that the emerging nations must eliminate 'behind-the-border' barriers and adopt modern technology. In doing so, the study advocates good business environment and regulatory policy reforms in eliminating such behind border barriers in realizing the possible potential exports in these economies. The study conducted by Atif et. al (2016) using SFA approach, the results of technical efficiency estimates suggest that a huge unrealized potential of Pakistan's trade flows with neighboring countries, European union and middle eastern countries. Barma (2016) employs SFA to analyze the impact of trade barriers on the exports of

India. The study finds that both beyond-the-border and behind-the-border (presence of inefficiency) has an impact on export flows in India. The results, however, endorses the significance of regional groups like SAARC and ASEAN in promoting and increasing trade in that the.

Kumar and Prabhakar (2017) found that India's bilateral agreements and the ASEAN Free Trade Area (FTA) improved bilateral trade efficiency between India and the partner countries throughout the period 2000–2014. The results also highlight importance of trading partners' regulatory quality for enhancing the India's trade efficiency and note that the impacts of regulatory quality are non-monotonic. RTAs typically assist bilateral trade between member economies that are still in the early stages of development (Freckle ton & Whitely, 2020). Bilateral trade among the members of the Economic Community of West African States (ECOWAS) and service trade in the Nordic region have benefited greatly from the RTAs (Nordas, 2018). To a similar extent, trade is a key factor in spurring economic expansion. However, there is still a lack of research showing how local institutional quality affects trade patterns. It has been argued that effective institutions make international trade between two countries easier. A high level of institutional quality is indicative of politically pluralistic and inclusive institutions that prevent economic actors from using their position in the market to unfairly monopolize trade (through means such as tariffs and quotas), thereby restricting flows because of rent-seeking activities. In fact, De Groot, Linders, Rietveld, and Subramanian (2004) found that trade flows are driven by institutional quality and narrower gaps in governance, but weak or inadequate institutions may limit trade at levels not dissimilar to those associated with the implementation of tariffs (Anderson & Marcouiller, 2002; Francois & Manchin, 2013)

Capasso (2004) stressed that better institutions allow trade and the financial markets to network their resources towards activities that are productive to curtail waste and mismanagement. Thus, institutional quality might be an important foundation for financial sector development and promote trade. Hou et al. (2020) used panel data techniques to examine the effects of institutional quality on trade flows among countries that are part of the regional North American Free Trade Agreement (NAFTA) bloc during the years of 2006 and 2017, sampling 105 nations. The results of the studies showed that trade flow among the trading partners of the countries is strongly and positively influenced by an institution's quality.The effects of governance quality and the pro-trade effect of immigration were examined by Millogo (2015). The study found that institutional setting and governance are key factors affecting commerce. Using the gravity model, the study looked at 10 MENA (Middle East and North Africa) nations between 2001 and 2010. The estimated findings showed that the impact of migration on governance is emphasized as a crucial component in regulating the origin nation to give the migrant French export a better opportunity to consume a variety of goods, hence encouraging exchanges between France and MENA countries. Arezki and Vander Ploeg (2010) analyzed the relationship between trade policies, institutions, and natural resources. Their analysis covers the years 1965 to

1990 and showed that the resource curse is just less severe in countries with less restrictive trade policies and high institutional quality. Furthermore, they demonstrated empirically that resource expletive evidence is insufficient to compensate for the endogenous nature of selected regressors.

Bjornskov (2011) examined the countering of corruption by institutional quality and societal trust. The study's data were derived from an index of corruption comprised of several variables and scales. The study indicated that well-organized institutions are more successful. De Groot et al. (2004) verify that the institution's level of excellence and lesser breakdowns in governance aspects determine bilateral trade flow, whereas bad or weak institutional quality may slow trade flow to an amount that is relatively dissimilar to those associated to the imposition of tariffs (Francois and Manchin, 2013). It has also been observed that the relative size of institutions plays a role in international trade. For instance, in the European context, low levels of trust have been linked to a decline in bilateral trade (Guiso et al. 2009). Rule of law, excellent administration, and the endowment of an informal organization can all contribute to increased trade (Yu et al. 2015). Certainly, as this review of empirical research has shown, good institutional framework is a route that many local environments use to achieve long-run economic growth and development in many parts of the world (Acemoglu et al., 2005; Rodrguez-Pose and Storper, 2006).Yusuf et.al (2020) analyze how the institutional quality of Malaysia and 25 chosen African Organization of Islamic Cooperation (OIC) member countries affects the volume of their bilateral commercial transactions. From the World Governance Indicators and other trade predictors covering the years 1985-2016, four institutional traits were chosen. Results from a study using a gravity model of trade and the Poisson pseudo-maximum likelihood estimation method (PPML) technique show that the efficiency, quality, and political stability of African governments have a negative impact on trade between OIC member states. However, these indicators of institutional quality were contributing to the success of Malaysia's economy. Therefore, improved trade, economic growth, and development in Africa's OIC member countries can be achieved through reforms to improve the quality of their institutions.

3. Data and Methodology

3.1 Gravity Model

The workhorse of trade modeling, the Gravity Model was first of all empirically estimated by Tinbergen (1962), drawing analogy from the Newton's theory of gravitational force in order to explain the trade flow between countries. The basic axiom of Gravity Model states that the extent of trade between two (or more) countries increases with the increase in their national income. However, the distance between nations tends to reduce the prospective flow of trade. Over time there have been several improvisations in the modeling, estimation and understanding of the Gravity Model. Following the work of Tinbergen, Anderson in 1979 succeeded in strengthening the theoretical considerations of the model. The understanding of the supply side economics in the trade theory was forwarded by Bergstrand in 1985. It further enhanced the Gravity Model by adding prices as an important variable in the model equation. The integration of the old and new trade theories in

the Gravity model was incorporated by Deardorff in 2007 and followed by Eaton & Kortum in 2002. The celebrated two stage maximization version of the model was later forwarded by Anderson & Van Wincoop in 2003.

$$X_{ij,t} = A\frac{GDP_{it}GDP_{jt}}{D_{ij}} \quad (1)$$

Where, the dependent variable, X_{ijt} represents trade flow (exports) between exporting country *i* and importing country *j* at time *t*. GDP_i represents GDP of exporting country *i*, while GDP_j represents GDP of importing country *j*. D_{ij} represents geographic distance between the exporting and importing country. For estimation, we transform the above gravity equation into log-linear form as follows:

$$lnX_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} - \beta_3 lnD_{ij} + \varepsilon_{ijt} \quad (2)$$

Where β_o is a constant.β_1 shows the elasticity of exporting country's GDP, β_2 shows the elasticity of importing country's GDP,β_3 shows the elasticity of distance andε_{ijt} is the regression error term.

3.2 Stochastic Frontier Analysis (SFA)

The Stochastic Frontier Analysis (SFA) was first of all developed in 1977 in two independent studies. Aigner et al. (1977) and Meeusen & Broeck (1977) developed the model to estimate the efficiency of the economic processes. Since then, the literature on SFA has been growing immensely. The SFA model has been extended to several sub-fields of economics. The generic form of the model can be situated on the notion of a distance function. More the distance between the economic unit under analysis and the associated frontier, greater is the level of inefficiency. Empirically, inefficiency is taken as a part of the error term. However, the error term in the stochastic frontier model consists of the random error and the inefficiency component. The general form of the stochastic frontier is expressed as

$$y_{it} = f(\beta x_{it}) . \exp(\varepsilon_{it}) \quad (3)$$

$$\varepsilon_{it} = v_{it} - u_{it} \quad (4)$$

Where, y_{it} is the level of observed output of the i_{th} country in period t. $f(\beta x_{it})$is the frontier level of output and x_{it} is the input vector and βisthe corresponding vector of coefficients? The composed error term (ε_{it}) consists of v_{it} which is the white noise error term and u_{it} which is the technical inefficiency component. The inefficiency component follows a half normal distribution,$u_{it} \sim N^{+}(0, \sigma_u^2)$. If v_{it} =0, then the output is produced at 100% efficiency level, on the other hand if v_{it}>0 then it suggests the presence of inefficiency in the production process, u_{it} is the noise term which follows the normal distribution with 0 mean and constant variance, $v_{it} \sim N(0, \sigma_v^2)$. v_{it} *and* u_{it} are distributed independently of each other and with independent variables, $Cov(v_{it}u_{it}) = Cov(v_{it}x_{it}) = Cov(u_{it}x_{it}) = 0$. The technical efficiency (TE) is measured by the ratio of observed output and frontier output, such as

$$\text{TE} = \frac{f(\beta x_{it}) \exp(-u_{it}) \exp(v_{it})}{f(\beta x_{it}) \,.\, \exp(v_{it})} \tag{5}$$

.

$$\text{TE} \;\; = \exp(-u_{it}) \tag{6}$$

If u_{it}= 0 then TE is equal to 1 and production is said to be technically efficient. On the other hand, if u_{it} is equal to 1 then TE =0 and the production is said to be technically inefficient.

3.3 Time Invariant and Time Variant Inefficiency Models of SFA

The past literature on inefficiency analysis has frequently estimated inefficiency effects using time invariant and time varying efficiency models. Time invariant models assumed inefficiency effects to be time-invariant i.e., $u_{it} = u_i$ Such an assumption is highly unrealistic in a competitive environment where we expect technical inefficiency to change over time. Thus, given the dynamic behavior of inefficancy, various time varying models have been developed from time to time, like "time -decay model" of Battese and Coelli (1992) (bc92), "neutral technical inefficiency model" of Battese and Coelli (1995) (bc95), (bc95m) and "true random effects model" of Greene (2005) (tre) among others. Most of the time varying models, modeled the time varying behavior of inefficacy as follows:

$$u_{it} = u_i \beta(t) \tag{7}$$

Implying differential initial inefficiencies and with similar pattern of it over time. Following equation (8) the time varying behavior of inefficiency proposed by Battese and Coelli (1992), is specified as follows:

$$u_{it} = (u_i)(\exp[-\varphi(t - T)]) \tag{8}$$

where φ captures the rate of change in efficiency over time. If φ >0, u_{it}, is always increasing over time (i.e., as (t-T) increases), whereas φ <0 implies that u_{it} is always decreasing with time. Hence, one of the main problems of this model is that technical inefficiency is forced to be a monotonic function of time. It is undesirable, as it might be expected that capacity utilization would fluctuate from year to year, and that changes in technology would be discrete events rather than continuous. Battese and Coelli (1995) suggested a one-step procedure for estimating inefficiency term u_{it} now accounting for time as follows

$$u_{it} = \omega_{it} + \theta z_{it} \tag{9}$$

where z_{it} is the vector of covariates including unit and time specific characteristics influencing the behavior of inefficiency, θ is the associated matrix of coefficients and ω_{it} is an *i.i.d.* random error term.

3.4 Stochastic Frontier Gravity Model:

One of the recent advancements in the empirical analysis and understanding of international trade is the incorporation of the SFM into the generic Gravity Model (Kalirajan, 2000). The unobservable trade costs and resistances are measured in terms of the distance between the actual and potential trade . The trade potential of the country under study is assumed to be at the

frontier and the distance between the actual and potential trade is taken as inefficiency (in cost terms) (Ravishankar & Stack, 2014). The two trading partners try to lessen and minimize the transportation, transactional and other related costs while undertaking the international trade. The main source of inefficiency in the international trade is the high cost of trade and therefore the main justification behind the use of the SFM is the fact that trade gravity equation is taken to be the consequence of cost-minimization (Kalirajan, 1999).

The problem which the conventional gravity model suffers from is the inconsistent estimates because omission of information on trade costs and the solution to such problem was provide by Anderson and Wan coop by suggesting incorporation of MTR, s in the model. These MRT's are responsible for divergence between actual and potential level of trade and representing trade inefficiency. In the similar way, the model of Deardorff (2007) analyzes the behind-the-border factors as the fundamental reasons behind the inefficiency in the international trade of the exporting nation. To capture the impact of MRT, s literature has suggested different methods. First one as suggested by Bergestand (2001) to use country specific price indices. The potential weakness of this technique is the inaccuracy of the price indices in reflecting MRT's and the lack of data for all countries and years included in the study sample. Second, Anderson and Van Win coop (2003) suggested a non-linear estimation technique for estimating the MR that involved deriving the trade cost function in terms of observables and aggregating it across trading partners. However, due to the large amount of data required and the computational complexity, this method is not widely employed in the literature. As Fenestra (2002) suggests, the gravity model estimation should include exporter and importer dummies which indicate country-specific factors of bilateral trade. Even though this strategy has the advantage of being computationally simple and avoiding misspecification issues, it lacks a theoretical grounding in economic theory (Hummels and Levinsohn 1995). Structural gravity models have difficulty adding MR concepts, thus necessitating the use of an alternative technique. Using the ordinary least square method to estimate the structural gravity equation suffers from the endogeneity of FTAs between the trade block and results in a loss of estimation efficiency.

The Exclusion of MRTS leads to variable omission bias, thereby, causing heteroscedasticity in error term. Furthermore, the standard gravity model has the issue of inaccurately calculating trade potential and trade efficiency, which is the emphasis of this research. It's worth noting that the OLS estimation of gravity model for predicting trade potential uses the data set's centered values as the anticipated potential against which actual trade volumes are measured. Potential trade, on the other hand, refers to unhindered trade between countries. Thus, potential trade should be defined as the maximum amount of trade that can exist between any two countries, given the traditional factors of trade, such as the size of the trading countries' economies and the distance between them. This means that estimating prospective trade requires a

process that represents the data's upper limits rather than the data's centered values (Kalirajan, et al., 2007).

So, to overcome the problem of heteroscedasticity in error term and to evaluate the trade potential as the gap between the actual trade performance of a trading partner from that of potentially best termed by literature as trade efficiency, SFA is well justified to estimate the gravity equation. There is one side error term apart from conventional two-sided error term in the SFA gravity equation which captures the impact of unobservable trade costs or MRT, s causing trade inefficiency. Applying SFA approach we can also analyze the factors that affect the calculated trade efficiency scores. Therefore, in this context the resultant SFA gravity equation which is to be estimated in the present study is as

$$lnX_{ijt} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnPOP_{jt} + \beta_4 lnD_{ij} + \beta_5 BOR_{ij} + \beta_6 LANG_{ij} + \beta_7 SAFTA_{ijt} + v_{ijt} - u_{ijt} \quad (10)$$

The above equation contains a set of time variant determinants of trade such as GDP, population and free trade agreements as well as a set of time invariant determinants of trade such as distance, language and border. Another stochastic specification of the model is the bifurcated error termv_{ijt} is the double-sided white noise error term,u_{ijt} is the term that captures the technical inefficiency existent in the international trade process.

Furthermore, the resultant inefficiency effect model which captures the effect of various determinates on trade inefficiency is as follows:

$$u_{ijt} = \alpha_0 + \alpha_1 SAFTA_{ijt} + \alpha_2 AFTA_{ijt} + \alpha_3 IRQ_{jt} + \alpha_4 PSI_{jt} + \varepsilon_{ijt} \quad (11)$$

Where *SAFTA* denotes South Asian free trade agreement and *IAFTA* denotes India-ASEAN free trade agreement, *IRQ* denotes regulator quality index of importing country and *PSI* denotes political stability index of importing country.

3.5 Data Sources

The data used for this study has been extracted from the UNCOMTRADE database from the year 2002 to 2019 for SAARC countries and other 49 major trading partners of India. The classification used is SITC code (0+1+2–27–28+4), Rev. No. 3 of agricultural sector. These countries account about more than 50 percent of total export destinations of India. As far as SAARC countries are concerned, they constitute about 12 percent of total exports of India (MoC&I, govt of India ,2020). Data on GDP and population has been taken from the WDI, world bank database. The data on gravity variables like Language, border and distance has been extracted from CEPPI data base while the data on SAFTA is obtained from WTO. Data on regulatory quality index and Political stability index Political Stability and Absence of Violence/Terrorism data has been taken from World governance indicator (WGI). The summary statistics of data is given in appendix.

4. Results and Discussion

This section reports the results of various specification tests, stochastic frontier trade gravity model (Eq. 10) and trade inefficiency model (Eq.11). To achieve the purpose, OLS, Battese and Collie (1992), Battese and Collie (1995) and Battese and Collie (1995) (bc95m) one-step procedure is employed. The advantage of one step procedure over two-step is that in two-step procedure the stochastic gravity Eq. 10 is estimated first to obtain inefficiency estimates. In the second step, the inefficiency estimates so obtained are then regressed on inefficiency determinates (equation10) via OLS and tobit like techniques. Wang and Schmidt (2002) demonstrate that in two stage approach omitted resistance variables in first step affects the estimates of inefficiency and thus makes estimates biased while in case of single step approach there is no need, however, to know in advance the effect of such resistance variables in the SFA. Even the magnitude and direction of the impact of every included variable can be validated, and the resultant efficiency estimates can be robustly estimated. So, alternative approach to dealing with the issue of functional form in relation to trade costs is to estimate Equations (10)– (11) simultaneously.

4.1 Presence of Inefficiency Effects

First step in line with common practice of the frontier literature is to test statistical significance of presence/absence of inefficiency effects in the dataset using generalized likelihood -ratio (LR) test that guides the applicability of stochastic frontier model. For this purpose, we estimate the equation (10) using LR test to compare the OLS and Battese and Collie (1992) results. The LR test rejects the null hypothesis, and hence justifies the use of SFA approach to the present data set or justifies the inclusion of one-sided error term in addition to conventional idiosyncratic error term. Furthermore, the value of lambda (λ) which represents the proportion of standard of standard error of inefficiency term to conventional error term is statistically significant and greater than zero thereby implying the presence of inefficiency in the model.

Now to make the choice between alternative variants of SFA like bc92, bc95 and bc95m, we again resort to the LR test for model comparison. Note that bc92 model provides monotonic inefficiency scores of the individual units. To overcome this limitation, we also estimated bc95 model which captures the temporal variation of the nonmonotonic behavior of inefficiency effects across the individual units. Bc95 model also allows us to incorporate the determinants of inefficiency. Based on LR test value which is reported in the table below shows that bc95m is preferred model over bc92 and bc95. Hence, we focus and discuss the results of bc95m.

Table 1: Results of Stochastic Gravity Model

	(OLS)	(bc92)	(bc95)	(bc95m)
	lntv2	lntv2	lntv2	lntv2
lngdp_i	0.794***	0.427***	0.780***	0.765***

	(7.19)	(4.61)	(9.90)	(9.73)
lngdp_j	0.665***	0.449***	0.494***	0.449***
	(24.00)	(10.81)	(24.95)	(23.87)
LN_popj	0.335***	0.351***	0.317***	0.315***
	(13.21)	(6.80)	(19.66)	(18.94)
Contig	-1.535***	-1.375***	-1.429***	-1.375***
	(-5.93)	(-3.54)	(-8.78)	(-8.88)
Comlang	0.643***	-0.0844	0.366***	0.0561
	(4.93)	(-0.46)	(4.01)	(0.62)
Lndiscap	-1.709***	-1.555***	-1.779***	-1.525***
	(-15.89)	(-9.68)	(-21.95)	(-15.47)
$SAFTA_{ij}$	1.077***	-0.00221	0.248*	
	(4.10)	(-0.01)	(1.46)	
_cons	-12.47***	3.656	-5.345*	-5.543*
	(-4.10)	(1.35)	(-2.49)	(-2.52)
Sigma U		2.86***	16.01***	2.501***
Sigma V		0.821***	0.708***	0.604***
Lambda (λ)		3.48***	2.58***	4.13***
Gamma(Υ)		0.92	0.99	0.94
LR test of inefficiency		1039.03	342.05	360.21
LR test of Model comparison			696.98***	18.16***
Inefficiency Model				
Saftaij				-8.163***
				(-4.17)
Aftaij				-1.370*
				(-2.03)
RQIIMP				-2.389***
				(-7.19)
PS				0.714*
				(2.38)
Cons		-5.170	-192.8	
N	910	910	910	910

Standard errors in parentheses

*p< 0.05, **p< 0.01, ***p< 0.001

Source: Author's comuputation

4.2. Gravity Model Estimates

The results from bc95m, a one-step procedure model shows that all the basic gravity model variable carry expected sign and are in line with theoretical considerations except border which is having a negative sign. The estimated coefficient of Exporter GDP(India) (proxy for economic size) is positive and statistically significant at 1 level which indicates that with the increase in 1% GDP of India, the agricultural export flow will increase by 0.76%. In the similar way, the importing country GDP has also positive impact on agricultural exports of India. Its estimated coefficient shows that 1 % increase in importing country GDP will increase the agriculture export by 0.44%. Distance (proxy for transportation cost) with an estimated coefficient of (-1.52) and statistically significant at 1 % level indicates that 1 percent increase

in distance (transportation costs) agriculture export of India will decrease by 1.52%. The coefficient of population also a proxy for economic size of importing country is positive and statically significant demonstrates that increase in population of importing country will enhance the demand for Indian agricultural exports. The estimated coefficient (0.31) suggests that 1 % increase in population will increase the agricultural exports by 0.3 %.

Along with these independent variables we have added two dummy variables to capture the impact of common border and common language on the agriculture exports of India. The estimated coefficient of border in this study is however against the theoretical underpinnings of gravity model. The gravity model informs us that countries near to each other will have more intense trade relations than countries which are far away from each other. The possible reason for negative and statistically significant coefficient of border may be the hostile political and border conflict of India with its neighboring countries (Tina Barma (2017); S Kumar and P Prabhakar (2017). Another dummy variable common language has a positive impact on agricultural exports of India. Common language reduces the costs like information costs thereby increase the trade flow between countries Its positive and statically significant coefficient suggest that India's agriculture export flow is more towards those countries which share language and culture with India. Despite having positive impact of common language and culture, India's trade flow with Pakistan has been low due to the hostile political relations with Pakistan.

4.3. Inefficiency Estimates

The results of selected inefficiency covariates are also presented in above table. In this model our purpose is to evaluate the impact of various institutional factors and FTA's on inefficiency of agriculture exports of India. It is pertinent to mention here we are modelling inefficiency so the coefficients in this model captures inefficiency effects and therefore the negative sign of these coefficients suggest lower inefficiency and higher efficiency henceforth. The negative and statically significant coefficient of SAFTA indicates that it has reduced the export inefficiency of Indian agricultural exports. In other words, agriculture export efficiency has improved. Similarly, another free trade agreement AFTA too has reduced the inefficiency prevailing in agricultural export trade of India. These results show that India's joining of SAFTA and AFTA has proved beneficial in enhancing the efficiency. The study also reports that regulator quality index of importing partner of India reduces the inefficiency of India's Agri exports and hence increases the export flow of India. Similarly, political stability index and absence of Violence/Terrorism which is measured as the likelihood of political instability increases the inefficiency. Its positive and statistically significant coefficient suggests that political instability has negative impact on efficiency.

Table 2 reports India's average export efficiency of agricultural exports with SAARC and other major trading partners. It can be observed from the table that none of the country is demonstrating 100% export efficiency. This suggests that given the variables of our gravity model, India is not maximizing

its agricultural exports to its sample trading partners and there is much room to expand its exports to these destinations. Overall average efficiency which is .37indicates that there is about 63 % unexploited export potential. The highest efficiency with a value of .89, is recorded with USA followed by UAE and China.

Table 2: Export Efficiency Estimates

SAARC			Rest of World				
	bc92	**bc95**		**bc92**	**bc95**	**bc92**	**bc95**
Bangladesh	0.84	0.69	Angola	0.57	0.48	Ireland	0.15	0.18
Bhutan	0.58	0.57	Austria	0.03	0.03	Israel	0.14	0.2
Maldives	0.75	0.66	Bahrain	0.35	0.43	Italy	0.25	0.34
Nepal	0.40	0.56	Belgium	0.87	0.7	Jordan	0.8	0.63
Pakistan	0.1	0.21	Benin	0.8	0.6	Kuwait	0.74	0.61
Sri Lanka	0.54	0.6	Bolivia	0.02	0.04	Mexico	0.17	0.23
			Burkina Faso	0.08	0.13	Netherlands	0.8	0.68
			Canada	0.57	0.56	Paraguay	0.1	0.19
			China	0.36	0.44	Portugal	0.3	0.37
			China, Hong Kong	0.3	0.37	Qatar	0.25	0.31
ASEAN			Dem. Rep. of the Congo	0	0.02	Rep. of Korea	0.23	0.31
						Russian		
Cambodia	0.04	0.07	Egypt	0.31	0.35	Federation	0.15	0.19
Indonesia	0.35	0.42	Ethiopia	0.04	0.07	Saudi Arabia	0.64	0.58
Lao People's Dem. Rep.	0	0.03	France	0.23	0.32	Spain	0.36	0.45
Malaysia	0.81	0.66	Germany	0.21	0.3	Switzerland	0.09	0.12
Philippines	0.34	0.37	Greece	0.21	0.26	USA	0.89	0.71
						United Arab		
Singapore	0.67	0.58	Hungary	0.03	0.03	Emirates	0.87	0.69
						United		
Thailand	0.2	0.3	Iran	0.16	0.27	Kingdom	0.35	0.53
Viet Nam	0.75	0.62	Iraq	0.14	0.2	Uruguay	0.1	0.13
Overall mean efficiency				0.37				
SAFTA mean efficiency				0.35				
AFTA mean efficiency				0.45				

Source: Author's computation

Among SAARC countries mean export efficiency is recorded highest with Bangladesh which is 0.69. This is supported by the fact that currently Bangladesh is one of the largest agricultural trading partners of India. While as lowest export efficiency score is recorded with Pakistan which is .21 indicating that there is 79 percent trade potential which is still unutilized.

Similar findings have also been reported from studies like Atif et.al, (2019). The lowest export efficiency score with Pakistan can be attributed to the political hostility between the two nations. The export efficiency with respect other SAARC countries like Nepal, Bhutan, Sri Lanka and Maldives was found to b 0.40,0.58 .0.75 and 0.54 respectively. These scores indicate that there lies an untapped export potential of India with respect to SAARC countries Over all technical efficiency of India with respect SAARC block is .35 while as with ASEAN

Table 3: Export Efficiency with Individual SAARC Countries and SAARC as a Bloc

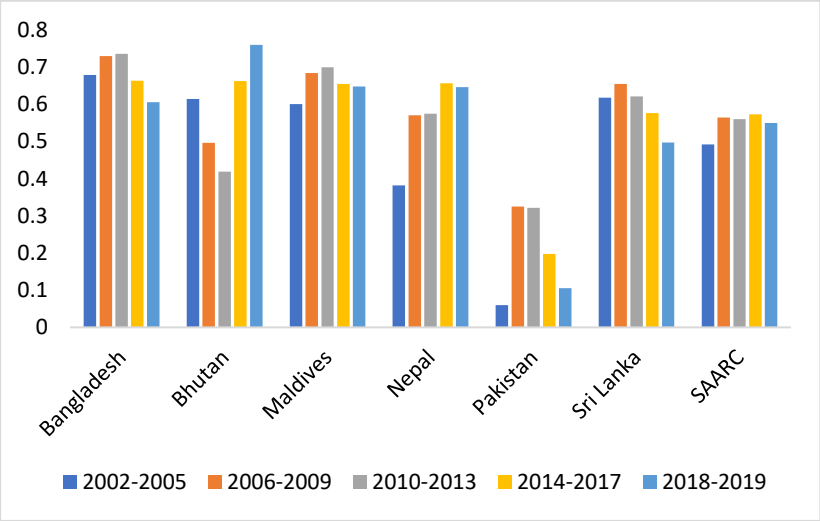
Year	Bangladesh	Bhutan	Maldives	Nepal	Pakistan	Sri Lanka	SAARC
2002-2005	0.679	0.614	0.601	0.382	0.060	0.618	0.492
2006-2009	0.730	0.496	0.685	0.570	0.325	0.655	0.564
2010-2013	0.736	0.419	0.700	0.575	0.322	0.621	0.560
2014-2017	0.663	0.663	0.655	0.657	0.198	0.577	0.573
2018-2019	0.606	0.760	0.648	0.646	0.106	0.497	0.550

Source: Author's Computation

countries it is 0.45 showing that ASEAN block is more efficient over SAARC block. This is line with the findings of Jain (2019) which reports that as compared to ASEAN–India FTA, SAFTA is a weak agreement that has a limited regional complementarity restricting intra-regional trade expansion even under the free trade mechanism. Further, Kumar and Prabhakar (2017) also report that higher exports efficiency levels in AFTA than SAFTA in overall trade.

For understanding of the impact of SAFTA on efficiency levels, we have divided the whole study period in two sub periods, that is, pre-SAFTA and

Figure 1: Export efficiency with individual SAARC countries and SAARC as a Bloc



Source: Based on table 4.3

post-SAFTA. Further, post-SAFTA period (as shown in Table 3 and Figure 1) has been divided in to five periods for a comparison purpose. The results show that in the first period, that is, from 2002-2005, the average technical efficiency was 0.49. After the enforcement of SAFTA in 2006, the export efficiency has improved and reached 0.56 from 2006 to 2009. After that no significant change has occurred over the period of 2010-2013. However, the efficiency levels have increased by .01 to 0.57 in the period 2014-17 but dipped back by 0.02 points to .55 percent. Such decline could be attributed to recent pandemic situation across the globe.

The results in the table although indicate that the efficiency levels of India's Agriculture trade have remained low vis-à-vis SAARC countries over the period under study (2002-2019). At the same time, the post-SAFTA joining have contributed to increased efficiency levels, though by a slight percentage point. This indicate that joining of SAFTA has reduced the export inefficiency. Thus, joining of FTAs like SAFTA has been advantageous for the India and other trading member countries in exploiting the unutilized potential.

5. Conclusion and Policy Implications

The purpose of the study has been to estimate the agriculture export potential efficiency of India with respect to the SAARC and other major export destinations of India to make a comparative analysis using SFA for the period 2002 to 2019. The SFA is integrated with the traditional gravity model to overcome the limitations of structural gravity models, including their inability to incorporate the country-specific effects or MRT's and estimate the export potential and technical efficiency. SFA describes the frontier level of trade exports as maximum possible unconstrained level of exports that can be realized after controlling for other important factors like GDP, distance and so on. Apart from this, SFA, through a one-sided error term, estimates inefficiency, which captures country-specific trade costs or MRT's.Regarding standard gravity estimates all of them carry expected sign and are in line with theoretical considerations except border which is having a negative sign.

Further the study aims to explain trade inefficiency by looking at characteristics specific to each nation, such as Free Trade Agreements (FTAs) with India's trading partners, and focus is given to SAFTA and institutional factors as the determinant of subsequent inefficiency.

The results of SFA reveal that India realizes 35 percent of its export potential with SAARC countries and 54 percent with the rest of the world. Such efficiency levels indicate further unrealized potential can be reaped among the trading partners, results also suggest the joining of SAFTA has improved India's export efficiency with SAARC nations, thus narrowing the gap between the actual and potential level of trade. However, in comparison to AFTA, SAFTA is proving weak agreement as its export realizing potential is less than AFTA. The results also revealed that the importing partner's regulatory/institutional quality significantly enhances India's export efficiency; however, the conditional trade liberalization in India and partner nations impedes India from reaching its potential export frontier and actively participating in the global value chain (GVC). Another important inference from the study is that political stability is a must condition to turn any free trade agreement into a successful one and to enhance the efficiency and potential of trade among SAFTA members. As south Asia, has been one of the politically instable regions since many decades. Therefore, it is necessary for countries like Pakistan and India to take a lead to turn SAFTA agreement a successful one keeping in view its potential and prospects.

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