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An Empirical Analysis of Factors Affecting Indian Agriculture Exports with SAARC Economies: A Gravity Model Approach

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Abstract

The purpose of this study is to empirically analyze the factors that affects India's agricultural exports and identify the potential in agricultural exports with South Asian Association for Regional Cooperation (SAARC) economies. Presents analysis utilizing various specifications of an augmented gravity model of trade, incorporating both time-invariant and time-varying factors collected from secondary sources for the period of 32 years from 1990 to 2021. The coefficient obtained from the gravity model of trade is subsequently employed to calculate the speed of convergence in order to ascertain the export potential of India with SAARC economies. The findings demonstrate that the majority of the variables display the anticipated sign and are statistically significant, thereby confirming the principle of the gravity model of trade. Moreover, the rate of convergence reflects that India has demonstrated convergence in agricultural exports with five SAARC members, specifically Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka, while experiencing divergence with Maldives. Thus, the study suggests that India possesses substantial untapped potential for agricultural exports with SAARC economies, which must be harnessed by expanding its agricultural exports portfolio.

***Key words*:** Agricultural exports, Exports potential, Gravity model of trade, Speed of convergence, SAARC

India is an agricultural country, and the agricultural sector plays a crucial role in the economy. With the increasing population and the need for food security the Indian agricultural sector has become more crucial than ever before. Agriculture is not only a source of livelihood for a significant portion of the population, but it also contributes significantly to the country's GDP. India is the world's 7th largest country in terms of land area and the country's diverse climate condition make it one of the largest producers of a wide range of agriculture products. India has a robust agricultural sector, and it is one of the largest producers of rice, wheat, sugarcane, cotton, and spices in the world. The agricultural sector plays a significant role in India's economy, as it accounts for around 18 percent of the country's GDP. India is also the world's largest exporter of rice, and it is among the top exporter of several agricultural products such as Buffalo meet, spices, tea, and cotton. Rice is India's most exported agricultural products, accounting for more than 19 percent of the overall agricultural export in 2021 22. Sugar, spices, Buffalo meat are among the top exported products for 9 percent, 8 percent, and 7 percent of agricultural export in 2020-2021 respectively. India is one of the world's top agricultural commodity exporters. The country reached total farm export of US$ 49.6 billion in 2021-22, a 20 percent increase from US$ 41.3 billion in 2020-21. According to India import export data, export of agricultural and allied products amounts of US$ 37.3 billion in 2020-21 representing a 17 percent increase over the previous year.

The South Asian Association for Regional Cooperation (SAARC) comprises eight countries in South Asia: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The South Asian Free Trade Area (SAFTA) agreement, which came into effect on January 1, 2006, aimed to foster economic integration within the region [1]. However, regional trade in South Asia remains remarkably low, standing at only four percent, in stark contrast to other regional blocs such as the European Union (67 percent), the North American Free Trade Agreement (62 percent), and others. The primary impediment to increased trade within South Asia lies in the persistent bilateral differences among member countries. Despite the potential of SAARC as a multinational forum, its effectiveness depends on the establishment of strong bilateral relationships among its members. It is crucial for SAARC member nations to cultivate mutual trust and a shared willingness to address and resolve bilateral disputes and concerns. Without such efforts, the region cannot fully harness the benefits of regional cooperation necessary for the welfare of its people. The agricultural export sector holds significant importance for policymakers, serving as a vital source of foreign exchange earnings and driving both crop diversification and improvements in farm income [2]. Research by Shivaraya [3] highlights the United Arab Emirates (UAE) and Malaysia as consistent and reliable markets for Indian onions. Similarly, Sri Lanka and Nepal emerge as key markets for Indian potatoes, while Bangladesh and Nepal stand out as stable importers of

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Indian fresh tomatoes. Furthermore, India demonstrates a comparative advantage in exporting commodities such as cotton, cereals, fish, and tea, [4]. Conversely, Pakistan's comparative advantage lies in the export of cotton and cereals. With this perspective in mind, the current study seeks to explore the determinants that affect agricultural exports and evaluate the export potential of India with its South Asian counterparts.

MATERIALS AND METHODS

In this study the trade statistics required for the study are extracted from various secondary sources. These sources include the Department of Trade Statistics under the Ministry of Commerce and Industry of the Government of India, World Development Indicators maintained by World Bank, Asia Economic Integration Centre maintained by the Asian Development Bank, World Integrated Trade Solution provided by the UN COMTRADE database, International Monetary Fund, as well as data from Statistical Yearbook of the Asia and Pacific, World Development Report, Direction of Trade Statistics, and UNCTADSTAT database, Centre d'Etudes Prospectives et d'Information Internationals (CEPII) , among others. The study examines a time period of 32 years, from 1990 to 2021, and employs various statistical and econometric tools to analyze the data.

Panel gravity model of trade

The origin of the gravity model can be traced back to one of the most significant works of Isaac Newton - the 'Philosophiae Naturalis Principia Mathematica' [5]. Newton, often revered as the 'patron saint of physics,' introduced the law of gravitational force in this work. This law states that the attractive force between two particles or bodies is directly proportional to their masses and inversely proportional to the square of the distance between them, measured from the center of each body involved in the interaction [6].

$$F = G\frac{m_1 \times m_2}{r^2} \text{ ---------- (1)}$$

Here, F stands for the forces between two objects, G stands for gravitational constant term and $m_1$and m_2 are the masses of the two objects and r^2 is the square of the distance between the bodies.

The gravity model of international trade was introduced and explained by Tinbergen [7] in his piece of work titled 'Shaping the World Economy.' In this model, 'Force' is substituted with 'Trade,' and instead of using 'mass' for objects or particles, it employs the 'GDP' (Gross Domestic Product) of the respective countries. Thus, the basic gravity model of trade suggests that the trade flow between two countries is determined by the size of their respective economies, as measured by GDP, and the distance between them, which serves as a proxy for trade costs. The following equation represents the basic gravity model of trade:

$$Trade_{ijt} = g\frac{M_{it} \times M_{jt}}{D_{ij}} \text{ ---------- (2)}$$

Here, $Trade_{ijt}$ represent trade between country i and country j at time t, M_i and M_j are the size of the economy for country i and j respectively, D_{ij} is the distance between country i and j and G is the gravitational term. The basic gravity equation can be expressed in a linear form as follows:

$$lntrade_{ijt} = lng + lnM_{it} + lnM_{jt} + lnD_{ij} + \sigma_{ij} \text{ -------- (3)}$$

Over the time, the basic gravity model has been augmented to include additional variables, such as GDP per capita, GDP per capita differences, Exchange rate, free trade agreements, etc. These additional variables help to explain the factors that influence trade flows beyond just economic size and distance. These explanatory variables can be further categorized into two types: autogenous variables, such as GDP, per capita GDP, and per capita GDP difference, exchange rate etc. which directly impact trade flows, and virtual variables like language, culture, free trade agreements (FTA), and regional trade agreements (RTA), which also play a significant role in influencing trade. Consequently, the augmented gravity equation has seen notable progress and application in various studies related to trade, treaties, and international agreements. The study employed the following augmented form of gravity model:

$$lnEX_{ijt} = \alpha + \beta_1 ln(GDP_{it}GDP_{jt}) + \beta_2 ln(PCGDP_{it}PCGDP_{jt}) + \beta_3 ln(PCGDPD_{ijt}) + \beta_4 ln(Distance_{ijt}) + \beta_5 ln(ER_{it}) + \beta_6 ln(ER_{jt}) + \beta_7 ln(TO_{it}) + \beta_8 ln(TO_{jt})\, \beta_9(Border_{ij}) + \beta_{10}(FTA) + \beta_{11}(Lang) + \mu_{ijt} \text{ ---------- (4)}$$

The (Table 1) explains details about the variables like full form of the variables, their expected sign, and data sources.

Table 1 Variables and their expected sign and data sources

Variables	Expected Sign	Data Sources
GDP_{ijt} =Gross Domestic Product (GDP) of country i and j, at time t	+ve	WDI
$PCGDP_{ijt}$ =GDP Per Capita of country i and j, at time t	+ve	WDI
$Distance_{ijt}$ =Distance between country i and j, at time t	-ve	CEPII
$PCGDPD_{ijt}$ =Per Capita GDP Differential of country i and j, at time	+ve or -ve	WDI
TO_{ijt} =Trade Openness measure as a trade-GDP ratio, at time t	+ve	WDI
ER_{ijt} =Exchange Rate based on US Dollar, at time t	+ve or -ve	IMF
$Border_{ij}$ =Common Border between country i and j, at time t	+ve	CEPII
$Language_{ij}$ =Common Language between country i and j, at time t	+ve	CEPII
FTA_{ij} =Free Trade Agreement between (Active) country i and j, at time t	+ve	ADB
EX_{ijt} = Agricultural exports between i and j, at time t	-	WITS

Analytical techniques

In international trade there are multiple factors that affect trade between countries, which leads to the existence of unobserved variations when estimating determinant variables [8]. In order to tackle this issue, panel data is utilized for regression analysis because panel data proves to be effective in examining factors that may not be readily observable [9]. In the existing literature, when working with panel data, three estimation techniques are commonly employed: pooled (OLS), fixed effects, and random effects approaches. Among these the two most widely used models for estimating panel data are the random effects model (REM) and the fixed effects model (FEM) [10]. However, Ordinary Least Squares (OLS) models are efficient but exhibit bias as they overlook individual

variations within the model. In Fixed Effects (FE) models, variables that remain constant over time (such as distance, borders, FTA, and common language) typically cannot be estimated using accompanying coefficients. The purpose of this study is to determine the variables that remain constant over time as well as those that change over time in affecting India's agricultural exports with SAARC economies. Consequently, we prefer the Random Effect Model over the Fixed Effect Model, which is also supported by the Hausman test. However, in the domain of panel data analysis, pool (OLS), fixed effects, and random effects approaches face challenges when dealing with the presence of both zero trade flows and logarithm transformation of the gravity equation. To address the above-mentioned issues, Santos Silva and Tenreyro [11] suggest a solution by advocating for the use of non-linear estimators, specifically the Poisson Pseudo Maximum Likelihood (PPML) estimation technique. According to their logic, the PPML method not only ensures consistency in the presence of heteroscedasticity but also adeptly handles scenarios involving zero trade flows and argue that the PPML estimator is a suitable approach for estimating gravity equations. Accordingly, in our study we used both random effect model as well as PPML estimation technique in order to address the above-mentioned issues and validate our estimated results. Furthermore, in the estimation process, when we suspect multicollinearity in equations (4), to mitigate this concern, we divide the equations into two separate versions, in which highly correlated variables appear separately. The two different version of equations (4) are outlined as follows:

$$lnEX_{ijt} = \alpha + \beta_1 ln(GDP_{it}GDP_{jt}) + \beta_2 ln(Distance_{ijt}) + \beta_3 ln(ER_{it}) + \beta_4 ln(ER_{jt}) + \beta_5 ln(TO_{it}) + \beta_6 ln(TO_{jt}) + \beta_7(Border_{ij}) + \beta_8(FTA) + \beta_9(Lang) + \mu_{ijt} \text{ ---------- 4(a)}$$

$$lnEX_{ijt} = \alpha + \beta_1 ln(PCGDP_{it}PCGDP_{jt}) + \beta_2 ln(PCGDPD_{ijt}) + \beta_3 ln(Distance_{ijt}) + \beta_4 ln(ER_{it}) + \beta_5 ln(ER_{jt}) + \beta_6 ln(TO_{it}) + \beta_7 ln(TO_{jt}) + \beta_8(Border_{ij}) + \beta_9(FTA) + \beta_{10}(Lang) + \mu_{ijt} \text{ ---------- 4(b)}$$

Exports potential

Several studies use point-estimated coefficients for explanatory variables to calculate the predicted exports potential using the gravity model. In this study, exports potentials have been determined using the concept of speed of convergence. The concept of speed of convergence introduced by Jakob *et al*. [12] as an alternative to the traditional method for calculating potential exports. The speed of convergence is characterized as the average growth rate of potential exports divided by the average growth rate of actual exports observed over the years.

$$Speed\ of\ Convergence\ (SC) = \left(\frac{Average\ growth\ rate\ of\ potential\ exports}{Average\ growth\ rate\ of\ actual\ exports}\right) \times 100 - 100$$

RESULTS AND DISCUSSION

Estimated results for gravity model of agricultural exports

In this section the empirical result of the gravity model of India's agricultural exports estimated through Random Effect model and PPML estimation approach presented in (Table 2) as follows:

The results of the empirical analysis of the gravity model of agricultural exports, conducted using the RE and PPML estimation approach presented in (Table 2) revealed that the combined GDP of India and other SAARC nation is positive and statistically significant. Specifically, the result shows that India's agricultural exports with SAARC countries increases from 0.58 to 0.74 percent as the size of the economy (India-SAARC) increases by 1 percent. This is in line with the results obtained by Orindi [13]. In his inquiry, Orindi analyzed the factors that influence the exportation of goods from Kenya, utilizing a sample consisting of 25 trading partners spanning from 1964 to 2008. According to the findings of the study, the combined GDP of the trading nation exerted a positive impact on Kenya's exports with its trading partners.

Table 2 Empirical results for gravity model of agricultural exports ($lnEX_{ijt}$)

Estimation technique	Random effect model		PPML- model	
Independent variables	Coefficient Eq.4 (a)	Coefficient Eq. 4 (b)	Coefficient Eq.4 (a)	Coefficient Eq. 4 (b)
$ln(GDP_{it}GDP_{jt})$	0.580*** (0.00)	-	0.754*** (0.00)	-
$ln(PCGDP_{it}PCGDP_{jt})$	-	0.556*** (0.00)	-	0.774*** (0.00)
ln $(PCGDPD)_{ijt}$	-	2.793*** (0.00)	-	2.673*** (0.00)
$lnDistance$	-2.441*** (0.00)	-1.920** (0.02)	-0.945 (0.41)	-2.110* (0.06)
$lnER_{it}$	0.677 (0.13)	3.080*** (0.00)	1.102 (0.10)	3.733*** (0.00)
$lnER_{jt}$	-0.502 (0.16)	-2.152*** (0.00)	-1.998*** (0.00)	-3.440*** (0.00)
$lnTO_{it}$	0.883*** (0.00)	1.039*** (0.00)	1.089*** (0.00)	0.733*** (0.00)
$lnTO_{jt}$	0.048 (0.72)	-0.043 (0.72)	0.158 (0.59)	-0.366 (0.16)
Border	-0.841*** (0.00)	-1.998*** (0.00)	1.365*** (0.00)	-0.301 (0.48)
FTA	0.550 (0.11)	1.061*** (0.00)	2.585*** (0.00)	3.101*** (0.00)
Language	0.698* (0.06)	3.296*** (0.00)	1.810*** (0.00)	4.695*** (0.00)
Constant	-4.534 (0.57)	10.830* (0.07)	-23.601*** (0.01)	11.251 (0.13)
R-squared (Overall) / Pseudo R-squared	0.86	0.88	0.76	0.75
Observation	192	192	192	192

Coefficient with *, **, and *** denotes statistically significant at 10%, 5% and 1% level of significance respectively

The analysis of international trade based on the Gravity model emphasizes the importance of a country's GDP per capita in capturing various factors related to its economic development [14]. Countries with higher GDP per capita are expected to engage in more extensive trade compared to those with lower GDP per capita. The former tends to be more innovative and has better infrastructure to facilitate international trade. Moreover, GDP per capita serves as an indicator of the exporting country's productive capacity and the purchasing power of the importing country. It is expected that the

coefficients associated with GDP per capita variables would be positive, as a higher GDP per capita indicates an increased potential for supply from the exporting country and increased demand in the importing country. Hence, in our model estimation, the coefficient associated with the product of GDP per capita is statistically significant and demonstrates a positive impact, thereby confirming the above statement. Specifically, a 1 percent increase in the product of GDP per capita leads to an increase in agricultural exports by 0.55 to 0.77 percent (Minimum from random effect model and maximum from PPML model).

Scholar commonly used GDP per capita differences to capture the factor endowment between the countries and examine two prevailing hypotheses: H-O hypothesis and Linder hypothesis. In our study we also used GDP per capita differences to capture the impact of factors endowment on Indian agricultural exports with SAARC economies. Accordingly, our estimated result shows that impact of GDP per capita difference is positive and statistically significant at 1 percent level of significance. That means India's agricultural exports with SAARC countries increases from 2.67 to 2.79 percent as the GDP per capita difference increases by 1 percent. The presence of a positive relationship between India's agricultural exports and GDP per capita difference implies a beneficial link between the extent of technological advancement and the bilateral trade dynamics involving India and its trade partners. Essentially, when there are differences in technological capabilities between countries, it tends to stimulate greater bilateral trade between the countries. Therefore, our estimated result provides evidence for the validity of the Heckscher–Ohlin hypothesis. The findings of this study align with those of Carrillo and Li [15] on trade blocs in Latin America. They found that the influence of GDP per capita differences was adverse for homogeneous product categories but became positive and statistically significant for differentiated product categories. The distance, serving as a proxy for transportations costs, manifests a negative impact on India's agricultural exports with SAARC member countries. As the distance between India and its SAARC counterparts expands, there is a corresponding reduction in Indian agricultural export activity with these nations. More precisely, the 1 percent increase in distance leads to a decrease in agricultural exports ranging from 0.94 to 2.44 percent with the maximum calculated by RE and the minimum by the PPML model. This is in line with the result obtained by Irshad *et al*. [16]. They observed that a 1 percent increase in distance between Pakistan and FTA member countries, Pakistan's exports decrease by 0.21 to 1.20 percent. In our gravity model analysis, we observed significant and positive impact of the exporter country's (India) exchange rate on India's agricultural exports. A one percent rise in the exporter country's exchange rate, (currency depreciation) is associated with an increase in India's agricultural exports ranging from 0.67 percent to 3.73 percent. Conversely, the exchange rate of the importing country (SAARC other than India) exhibits a significant and negative impact on India's exports. A one percent increase in the currency of SAARC nations (excluding India) results in a reduction in India's agricultural exports, ranging between 0.50 percent and 3.44 percent [17-18]. Karamuriro and Karukuza observed a positive and statistically significant relationship between Uganda's devaluation of currency and its trade volume, while the coefficient of a partner country's exchange rate is negative and statistically significant. Kaur and Nanda [19] found that the coefficient of other SAARC country's exchange rate is negative and statistically significant with India' trade volume. A nation's level of trade involvement tends to increase with its degree of trade openness. Indicators such as the proportion of customs-to-total tax revenues or the trade-GDP ratio can serve as effective proxies for measuring this openness. However, there is a prevalent preference for the trade-GDP ratio as a proxy for trade openness. Therefore, we adopt this particular variable as a proxy for openness because data pertaining to it is readily available for the relevant countries under consideration. In our analysis, the outcomes indicate that the trade openness of India has a significant positive impact, while trade openness of SAARC has both positive and negative impact on India's agricultural exports with SAARC nations but insignificant.

In case of dummy variables like the coefficient of common border shows negative effect on India's agricultural exports with SAARC nation indicating lower trade with bordering countries which contradicts the principles of the gravity model of international trade. This is because the gravity model provides valuable insights into trade patterns, it does not account for the complexities introduced by factors like trade barriers, economic dissimilarities, and political considerations. These factors can indeed outweigh the benefits of a common border and result in lower trade between neighboring countries, as indicated by the negative coefficient observed in our regression analysis. The coefficient associated with Free Trade Agreements (FTAs) is positive and statistically significant. This observation is in accordance with the principles of the Gravity model of trade and corresponds to earlier research conducted by Tamás and Manfred [20]. According to their findings other things, being equal Free Trade Agreement has a significant positive impact on trade flows between the countries. Tenzer *et al*. [21] suggests that the lack of a shared language and the resulting existence of linguistic barriers can pose a large challenge to international trade. In our analysis of the gravity model, we examine the relationship between India's agricultural exports and its common language with SAARC counterparts using both random effects and PPML estimation techniques. Our findings indicate a significant and positive association between them. This not only supports Melitz's claim regarding the hindrance of linguistic barriers in foreign trade but is also consistent with the anticipated theoretical outcomes. In essence, the presence of a common language appears to promote international trade, as indicated by both empirical findings and theoretical expectations.

Estimation of India's agricultural exports potential with SAARC economies

Analyzing the trade potential including exports and imports is an essential component of gravity model of international trade, in which the evaluation of predicted exports is compare with actual exports to ascertain whether the bilateral trade flows between two nations have been either overutilized or underutilized. Several studies use point-estimated coefficients for explanatory variables to calculate the predicted exports potential using the gravity model. In this study, agricultural exports potentials have been determined by using speed of convergence. The concept of speed of convergence introduced by Jakob *et al*. [22] as an alternative to the traditional method for calculating potential exports. Convergence occurs when the growth rate of potential exports is lower than that of actual exports, resulting in a negative computed speed of convergence. Conversely, in the opposite scenario, where the growth rate of potential exports surpasses that of actual exports, there is divergence. This approach enhances its effectiveness compared to the point estimation technique by taking advantage of the dynamic structure of the data consistently during the estimation process. It also facilitates a more rapid convergence

and ensures a more reliable analysis when compared to the examination of point estimates. This convergence measure has demonstrated robustness across various methodologies, including random effects and PPML [12]. The results are presented in (Table 3).

Table 3 Speed of convergence (%)

Country	Trade potential (Eq. 4-a)	Trade potential (Eq. 4-b)
Bangladesh	-24.4219	-8.32957
Bhutan	-155.033	-93.5144
Maldives	183.3871	19.96114
Nepal	-50.87	-19.5499
Pakistan	-202.598	-126.7074
Sri Lanka	-82.3514	-22.8208

The findings derived from (Table 3) concerning India's potential for exports with other SAARC members, as assessed with the help of speed of convergence, reveal a compelling situation that India demonstrated convergence in agricultural exports with five SAARC members nation: Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka, but experienced divergence with Maldives [24]. The speed of convergence analysis suggests that countries exhibiting divergence with India may be experiencing overexploitation of India's agricultural exports potential, indicating saturated exports relationships [25]. Conversely, countries displaying convergence with India indicate untapped agricultural exports potential, thereby presenting opportunities for further development and enhancement of bilateral trade ties. In the context of agricultural exports from India to member nations of SAARC, there has been a remarkable trend of substantial exports to Bangladesh. Over the years, India has exported a diverse range of agricultural commodities to Bangladesh, including cotton, wheat, rice (excluding basmati), sugar, spices, marine products, and buffalo meat. Specifically, during the pandemic, the export value of commodities such as wheat and rice witnessed remarkable growth rates, with increases of 727 percent and 132 percent, respectively, in the fiscal year 2020-21 compared to the previous year [26]. Similarly, India's agricultural exports to Bhutan have seen positive growth, with exports valued at US $ 177.64 million during the fiscal year 2021-22, reflecting 18 percent increase compared to the previous year. Key exports to Bhutan include vegetable oils, rice, dairy products, and cereal preparations. Moreover, India has taken advantage of the opportunity to introduce new products to the Bhutanese market, including dehydrated peaches, pears, papayas, and tamarinds, which have significant global demand. Moving forward, India has the potential to enhance its exports to Nepal, with a total export value of approximately US $ 1457.23 million recorded in the fiscal year 2021-22, marking a 9 percent increase compared to the previous year [27-28]. Major exports to Nepal include rice (excluding basmati), various cereals, fresh vegetables, spices, and oil meals. Additionally, there is room for growth in exports of items such as partially milled or fully milled rice, maize, oilcake, and wheat, to tap into Nepal's import demand. In the case of agricultural exports to Pakistan, major crops exported from India to Pakistan include wheat, rice, sugarcane, and cotton, alongside dairy products such as milk, ghee, and yogurt. India's substantial contribution to Sri Lanka's agricultural imports includes exporting a wide range of commodities such as tea, rubber, coconut, spices, textiles, poultry, vegetables, and fruits. This enduring trade relationship further highlights India's pivotal role as a key agricultural exporter in the region [29-30].

CONCLUSION

The study utilizes the augmented gravity model approach to analyze the main determinants of agricultural exports from India to SAARC member nation. The findings indicate that determinants variables, including GDP, per capita GDP, per capita GDP differential, trade openness, and India's exchange rate, have a positive and statistically significant impact on India's agricultural exports to SAARC countries. Conversely, the exchange rate of SAARC nations and the distance between India and SAARC member nations negatively affect India's agricultural exports. The findings of the study signifies that a higher GDP and per capita GDP in both India and the importing SAARC countries indicate stronger purchasing power and economic activity. This likely leads to increased demand for agricultural products, thereby positively impacting India's agricultural exports to these nations. In addition to this, the difference in per capita GDP between India and its trading partners can indicate potential market opportunities. A favorable per capita GDP differential suggests that India may have comparative advantages in supplying certain agricultural products that cater to the preferences and purchasing power of the importing countries. As far as relationship between trade openness and flow of agricultural exports is concerned, higher levels of trade openness indicate a more liberalized trade environment, which facilitates smoother trade flows and increased market access for agricultural products. As trade barriers are reduced, India is better positioned to capitalize on export opportunities within the SAARC region. Further, a favorable exchange rate for India implies that its agricultural products are relatively more affordable for importing countries, potentially boosting demand, and leading to increased exports. Conversely, an unfavorable exchange rate for SAARC nations may deter imports from India by making Indian goods relatively more expensive. While the negative impact of distance between India and SAARC member nations on agricultural exports suggests that geographical proximity plays a role in trade dynamics. Longer distances typically entail higher transportation costs and logistical challenges, which can hinder the competitiveness of Indian agricultural exports compared to local or nearby suppliers. Moreover, dummy variables such as free trade agreements and common language positively influence India's exports, while the presence of a common border has a negative impact. The impact of dummy variable like free trade agreement suggests that when India and its trading partners have signed free trade agreements, it typically leads to the elimination or reduction of tariffs and trade barriers between them. This makes it easier and more cost-effective for Indian exporters to access markets in SAARC countries, leading to an increase in exports. Additionally, FTAs often include provisions for regulatory harmonization and mutual recognition of standards, further facilitating trade. As a result, the presence of FTAs positively influences India's agricultural exports by creating a more favorable trade environment. Similarly, a common language between India and its trading partners can enhance communication and reduce transaction costs in trade-related activities. Shared language facilitates smoother negotiations, and marketing efforts, thereby improving the efficiency of trade transactions. This can lead to increased trust and cooperation between trading partners, ultimately boosting exports. Additionally, a common language may also foster cultural connections and consumer preferences, further enhancing the demand for Indian goods and services. Surprisingly, the presence of a common border between India and SAARC member nations has a negative

impact on India's exports. This could be attributed to various factors such as geopolitical tensions, trade barriers, and regulatory complexities associated with border trade. Common borders may also be associated with informal trade practices, smuggling, and security concerns, which can hinder the formalization of trade and growth of Indian agricultural exports with SAARC nation. Furthermore, utilizing coefficients derived from the gravity model to assess agricultural export potential between India and other SAARC nations reveals convergence in agricultural exports with five SAARC member nations: Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka. However, there is divergence with Maldives. This highlights the immense potential for India to enhance its agricultural exports to other SAARC economies, underscoring the need to diversify its export portfolio to fully capitalize on these untapped prospects.

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