Original Research Article

Trade Agreements and Export Performance of Bangladesh: A Gravity Model Analysis.

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ABSTRACT

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| This article evaluates the effects of agreements like BIMSTEC, SAFTA, APTA, EU PTA, OIC, and D-8 PTA on the export performance of Bangladesh. It also examines 24 years of bilateral trade relations between Bangladesh and its 52 key trading partners, ranging from 2000 to 2024, evaluating the effects of trade agreements on economic growth. The study puts together an extensive panel dataset comprising 3,568 observations to capture the multilateral resistance factors by considering two-way trade flows among all countries involved in the cited trade agreements. The study also use the Poisson Pseudo-Maximum Likelihood (PPML) fixed effects estimator method recommended by Silva and Tenreyro (2006), as it is considered the optimal approach for gravity-based analyses. Our findings reveal mixed outcomes concerning the alignment of Bangladesh`s trade patterns with the predictions made by the gravity model. The regression analysis, using the PPML fixed effects estimator, shows that the GDP of the importing country positively influences exports, but trade agreement’s impact on Bangladesh`s GDP is comparatively less significant. The research also finds a positive relationship between distance and exports, emphasizing the role of preferential trade policies and existing networks. Although sharing a common language and being geographically close demonstrate mixed outcomes, trade agreements markedly enhance exports, especially with island nations like Australia, Sri Lanka, China, Hong Kong, Japan, etc. From the study, it was found that Bangladesh sells more to the richer countries which is consistent across both OLS and PPML models, as the correlation between GDP and exports is significantly positive. Having a common language hinders trade, perhaps linguistically similar countries have formal restrictions on trade with Bangladesh, hence the biggest export market of Bangladesh does not have a language similar to that of Bangladesh. Similarly, geographical closeness does not guarantee increased trade because of regional barriers and informal trading behaviors. The study highlights the significance of trade agreements in improving market access and offers strategic policy recommendations as Bangladesh prepares for its LDC graduation. Finally, the results support the fact that FTAs, PTAs, or other agreements have a considerable effect on improving trade depending on Bangladesh’s capability, and hence these agreements are crucial elements of economic expansion. |

*Keywords: Trade Agreements, Gravity Model, GDP, Economic Growth, Panel Data, PPML,* *Econometric Model, OLS.*

1. INTRODUCTION

As a participant in several trade agreements, including Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) South Asian Free Trade Area (SAFTA), Asia-Pacific Trade Agreement (APTA), European Union (EU) Preferential Trade Agreement (PTA) (General), Organization of Islamic Cooperation (OIC), Developing-8 (D8), SAARC Preferential Trading Arrangement (SAPTA), and South Asian Free Trade Area (SAFTA), Bangladesh has preferential access to international markets. The research examines how trade agreements with economic blocks and bilateral trade partners can influence trade flows in Bangladesh. It shed lights on the global rise in regionalism, reflecting the incremental number of trade agreements and ongoing debate on whether these agreements enhance or hinder the economic welfare of a country. The objective of the study is to evaluate the effectiveness and role of existing trade agreements on Bangladesh`s exports and highlighting the advantages of trade agreements, whether it is FTA, PTA or Regional Trade Agreement (RTA). The structure of this study includes an overview of the trade agreements of Bangladesh, a literature review on gravity models, model specifications and results, and findings and conclusions. In most cases, trade agreements among developed nations have shown benefits like enhanced market access and reduced trade barriers but overall impact on trade growth remains limited for Developing Countries (Ullah and Inaba, 2011). The study also explored the need for additional analysis to determine whether these agreements support or obstruct deeper economic integration. Bangladesh`s export heavily concentrated on a few developed markets, it is imperative to understand how these agreements affect trade (Baier and Bergstrand,2007). Contrary to the conventional gravity model assumption that geographical proximity leads to higher trade volumes, Bangladesh`s main export destinations are often distant economies, primarily in Europe, USA, Canada and etc. On the other hand, its main sources of imports are predominantly Asian countries, except the United States. This unique trade pattern, which contradicts the traditional model, presents an interesting opportunity to explore alternative factors influencing trade patterns beyond transportation costs. A significant hurdle in previous gravity model analyses regarding Bangladesh is the occurrence of econometric challenges such as endogeneity, multilateral resistance, and instances of zero trade flows (Anderson & Van Wincoop, 2003). Although some studies, like those by Rahman and Dutta (2012), explored country-specific and time-fixed effects, they did not adequately tackle issues of heteroskedasticity or zero trade flows. The study also finds that log-linearized Ordinary Least Squares (OLS) estimation frequently yields skewed outcomes because of omitted zero trade instances and altered variances (Silva & Tenreyro, 2006). This study addresses these challenges by utilizing the Poisson pseudo-maximum-likelihood (PPML) estimator (Silva & Tenreyro, 2011), which ensures reliable and consistent assessments of Bangladesh`s trade transactions. The empirical framework incorporates country-pair and time-fixed effects to account for multilateral resistance elements (Anderson & Van Wincoop, 2003; Westerlund & Wilhelmsson, 2011). By employing a sophisticated estimation method within the gravity model, this research adds fresh perspectives on Bangladesh`s trade dynamics, assisting policymakers in tackling trade discrepancies and promoting export diversification.

**1.1 Overview of Trade Agreements of Bangladesh**

Bangladesh has actively participated in a number of regional trade agreements to expand its export potential and economic integration. In the mid-1980s, the seven nations of South Asia founded the South Asian Association for Regional Cooperation (SAARC) to encourage collaboration within the region. Initially, SAARC aimed at promoting regional peace rather than to facilitate commerce. To boost trade and regional ties, the member states ratified the South Asian Preferential Trading Arrangement (SAPTA) in 1993, which came into effect on December 7, 1995. In 2004, SAPTA transitioned into the South Asian Free Trade Area (SAFTA), a broader free trade arrangement. The reduction of tariffs under SAFTA began on January 1, 2006, with Pakistan, India, and Sri-Lanka the non-least developed country (LDC) members expected to lower tariffs on non-sensitive list items by 0-5% by the end of 2008. LDCs were provided with a target date of 2015 for making similar tariff reductions. The 'sensitive list' approach of the agreement, which includes items that are not subject to tariff reductions, continues to be quite restrictive and significantly impacts the trade dynamics (Regional Trade Agreements for Web, Ministry of Commerce, 2025).

Bangladesh became a member of the Asia Pacific Trade Agreement (APTA) in 1975, which offers tariff concessions among its member countries, including China and South Korea. The APTA, initially referred to as the Bangkok Agreement (BA), stands as Asia's oldest preferential trading arrangement, linking East, Southeast, and South Asia. Established in 1976 under the auspices of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), APTA seeks to boost intra-regional trade through concession agreements. Through three negotiation rounds, Bangladesh secures special tariff concessions for 587 products in the third round, in contrast to only 3 and 63 products in earlier rounds. Since 2006, China and South Korea have provided 100% tariff concessions on selected products of Bangladesh, underscoring the growing openness of the agreement. In 2009, APTA member countries endorsed a Framework Agreement on the Promotion, Protection, and Liberalization of Investment, intended to facilitate investment flows among participating nations and beyond (Haque, 2022; Ullah and Inaba, 2011).

In addition to its commitments in South Asia, Bangladesh is engaged in trade efforts such as the Trade Preferential System Among the OIC Members (TPS-OIC), which it signed in 1990, along with the Preferential Trade Agreement among D-8 Countries, established in 2001, both of which enhance economic collaboration and market access. Furthermore, partnerships with international organizations like the United Nations Conference on Trade and Development (UNCTAD) and the European Commission (EC) assist Bangladesh`s in building trade capacity and diversifying its markets. Collectively, these agreements enhance Bangladesh`s export competitiveness and economic development by broadening trade opportunities and ensuring advantageous market access. The D8, a cooperative initiative among Muslim developing nations, was founded in 1997 to enhance collaboration in trade, industry, agriculture, energy, health, and various other sectors. This global effort aims at elevating the economic status of developing countries and create fresh trading opportunities. During its 7th summit in 2010, D8 participants decided to transform the organization into a preferential trade agreement by 2011 (Ullah and Inaba, 2011).

Table 1. A summary of the trade agreements Bangladesh has participated in includes various regional and bilateral agreements

| Member Countries | BIMSTEC FTA | SAFTA | APTA | EU PTA (General) | OIC | D8 | SAPTA |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Afghanistan |  | ✓ |  |  | ✓ |  | ✓ |
| Bangladesh | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |
| Bhutan | ✓ | ✓ |  |  |  |  | ✓ |
| China |  |  | ✓ |  | ✓ |  |  |
| Egypt |  |  |  |  | ✓ | ✓ |  |
| India | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |
| Indonesia |  |  |  |  | ✓ | ✓ |  |
| Iran |  |  |  |  | ✓ | ✓ |  |
| Lao People's Democratic Rep. |  |  | ✓ |  |  |  |  |
| Malaysia |  |  |  |  | ✓ | ✓ |  |
| Maldives |  | ✓ |  |  | ✓ |  | ✓ |
| Myanmar | ✓ |  |  |  | ✓ |  |  |
| Nepal | ✓ | ✓ |  |  | ✓ |  | ✓ |
| Nigeria |  |  |  |  | ✓ | ✓ |  |
| Pakistan |  | ✓ |  |  | ✓ | ✓ | ✓ |
| Sri Lanka | ✓ | ✓ | ✓ |  | ✓ |  | ✓ |
| Republic of Korea |  |  | ✓ |  |  |  |  |
| Thailand | ✓ |  |  |  |  |  |  |
| Turkey |  |  |  |  | ✓ | ✓ |  |
| Albania |  |  |  |  | ✓ |  |  |
| Algeria |  |  |  |  | ✓ |  |  |
| Azerbaijan |  |  |  |  | ✓ | ✓ |  |
| Bahrain |  |  |  |  | ✓ |  |  |
| Benin |  |  |  |  | ✓ |  |  |
| Brunei |  |  |  |  | ✓ |  |  |
| Burkina Faso |  |  |  |  | ✓ |  |  |
| Cameroon |  |  |  |  | ✓ |  |  |
| Chad |  |  |  |  | ✓ |  |  |
| Comoros |  |  |  |  | ✓ |  |  |
| Djibouti |  |  |  |  | ✓ |  |  |
| Gabon |  |  |  |  | ✓ |  |  |
| Gambia |  |  |  |  | ✓ |  |  |
| Guinea |  |  |  |  | ✓ |  |  |
| Guinea-Bissau |  |  |  |  | ✓ |  |  |
| Guyana |  |  |  |  | ✓ |  |  |
| Iraq |  |  |  |  | ✓ |  |  |
| Ivory Coast |  |  |  |  | ✓ |  |  |
| Jordan |  |  |  |  | ✓ |  |  |
| Kazakhstan |  |  |  |  | ✓ |  |  |
| Kuwait |  |  |  |  | ✓ |  |  |
| Kyrgyzstan |  |  |  |  | ✓ |  |  |
| Lebanon |  |  |  |  | ✓ |  |  |
| Libya |  |  |  |  | ✓ |  |  |
| Mali |  |  |  |  | ✓ |  |  |
| Mauritania |  |  |  |  | ✓ |  |  |
| Morocco |  |  |  |  | ✓ |  |  |
| Mozambique |  |  |  |  | ✓ |  |  |
| Niger |  |  |  |  | ✓ |  |  |
| Oman |  |  |  |  | ✓ |  |  |
| Palestine |  |  |  |  | ✓ |  |  |
| Qatar |  |  |  |  | ✓ |  |  |
| Saudi Arabia |  |  |  |  | ✓ |  |  |
| Senegal |  |  |  |  | ✓ |  |  |
| Sierra Leone |  |  |  |  | ✓ |  |  |
| Somalia |  |  |  |  | ✓ |  |  |
| Sudan |  |  |  |  | ✓ |  |  |
| Suriname |  |  |  |  | ✓ |  |  |
| Tajikistan |  |  |  |  | ✓ |  |  |
| Togo |  |  |  |  | ✓ |  |  |
| Tunisia |  |  |  |  | ✓ |  |  |
| Turkmenistan |  |  |  |  | ✓ |  |  |
| Uganda |  |  |  |  | ✓ |  |  |
| United Arab Emirates |  |  |  |  | ✓ |  |  |
| Uzbekistan |  |  |  |  | ✓ |  |  |
| Yemen |  |  |  |  | ✓ |  |  |
| Albania |  |  |  |  | ✓ |  |  |
| Azerbaijan |  |  |  |  | ✓ | ✓ |  |

**Source:** BIMSTEC, FTA, SAFTA, APTA, EU PTA (General), OIC, D8, SAPTA etc. websites

**1.2 Literature review**

Numerous empirical studies have demonstrated that international groups of developed nations contribute positively to welfare. Baldwin (1997) observed that most research on agreements between European and North American nations indicated beneficial impacts on the living standards of the involved countries. Baier and Bergstrand (2007) discovered that bilateral trade between two FTA signed members increases twofold after a decade. Kandogan (2008) examined the trade impacts of regional blocs and found that economic cooperation and preferential trade agreements enhance trade among partner countries. However, there is a lack of pragmatic research regarding the trade effects of international blocs involving developing nations and LDCs, especially about the RTAs in South and Southeast Asia.

Since its independence in 1971, Bangladesh has experienced significant trade liberalization, transitioning from a protectionist approach to a more open economic stance (Ahmed, 2000). The annual GDP growth rate has risen from 5.3% in 2000 to 5.8% in 2023 (World Bank, 2023), with exports shifting from agricultural products to labor-intensive manufacturing products, especially in the ready-made garments (RMG) sector, which now represents over 84% of total export revenue (EPB, 2023-2024). While trade has played a role in generating employment, reducing poverty, and empowering women (Barua & Ansary, 2017), Bangladesh still grapples with a considerable trade deficit due to its heavy dependence on imports.

The effect of trade agreements can be investigated by examining whether both countries will be healthier or inferior after removing all trade barriers and implementing a free trade system than they would be without the free trade system. Previous empirical studies have typically looked at the relationship between a country's growth and its level of openness with trade agreements. In addition to the lack of research on how trade agreements affect the growth performance of two nations, empirical studies have not yet come to a consensus on how free trade or openness affects the economic growth of a single nation (Hur & Park, 2012).

In the recent years global trade has grown significantly in global production as a result of trade liberalization with trade agreements. At an average compound annual growth rate of little more than 7%, global commerce has increased 16 times while global production or GDP has increased fivefold due to trade agreements. In several nations, particularly in South-East Asia, export growth has surpassed 10% annually. Countries with more open trade policies have had the strongest GDP growth, and exports have tended to expand the fastest in these nations. It is assumed that the FTA, PTA and RTA made more open trade policies (Thirlwall, 2000). The majority of research on North American and European accords revealed improvements in living conditions in the participating nations. After ten years, bilateral commerce between two FTA members doubles, according to research by Baier and Bergstrand (2007). According to Kandogan's (2008) research on the impact of regional blocs on commerce, preferential trade agreements and agreements for economic cooperation both promote trade between partners (Ullah & Inaba,2011). Early in the 1990s, there was a significant surge in the number of free trade agreements, both bilateral and organizational. By boosting trade volume, the free trade agreement will boost the economy. However, non-member nations will suffer as a result of this accord. Regional trade agreements will help non-WTO nations flourish, but they won't have much of an impact on WTO nations.

**1.2.1 The gravity model and international trade**

The gravity model of international trade, initially introduced by Tinbergen in 1962, is not just a theoretical concept. Later researchers created various theoretical frameworks to clarify the gravity model. Anderson (1979) was the first to relate the model to product differentiation, distinguishing goods by their country of origin and demonstrating that larger economies tend to trade more. His research laid the theoretical groundwork for the gravity equation. Bergstrand (1985, 1989, 1990) built on Anderson's findings, integrating price indices and monopolistic competition, and discovered that imported goods often serve as closer substitutes for one another than domestic products. Deardorff (1998) further polished the gravity equation, demonstrating that the model remains valid even under arbitrary preferences, although specific trade flows may differ. McCallum (1995) introduced the "remoteness index" to represent multilateral prices, which aided in clarifying the "border puzzle." This represented a pivotal moment in gravity research, as scholars began to recognize trade barriers beyond mere distance, including elements like home bias and unaccounted trade (Trefler, 1995). Leamer and Levinsohn (1995) acknowledged the significance of distance and solidified the credibility of the gravity equation. Linnemann (1966) broadened the gravity model by adding more explanatory variables and establishing a theoretical framework rooted in the Walrasian equilibrium system. Leamer and Stern (1970) modified the gravity equation by applying a probability model for transactions, claiming that bilateral trade is unpredictable without considering transportation costs.

At first, the gravity model faced doubt, regarded more as a physical analogy than a solid economic theory (Head & Mayer, 2014). During that period, the Ricardian and Heckscher-Ohlin (H-O) models dominated trade theories by explaining trade through comparative advantage and differences in production factors. Nevertheless, these models could not fully elucidate the gravity equation, leaving it on the periphery of trade economics until Trefler (1995) successfully rationalized its existence (Head & Mayer, 2014).

The gravity model allows bilateral trade flows as a logarithmic-linear relationship influenced by the countries' incomes and the distance between them, offering a practical and applicable approach to understanding and predicting trade behaviours. This model demonstrates that trade is positively influenced by income levels and negatively affected by distance. This model was revolutionary in that it included trade costs, such as distance, which are significant hindrances in global trade (Bergstrand & Egger, 2010). This idea attracted the attention of trade economists, prompting further investigation. Over the years, this framework has been extensively used in empirical studies of global trade and RTAs, providing significant insights into the complexities of international commerce.

The gravity model has been frequently used by researchers to study international commerce and related issues including customs unions, Economic Integration Agreements (EIA), and immigrant ties that may affect multilateral trade (Joki & Haque, 2022). In addition to Tinbergen's foundational work, scholars like Anderson (1979), Bergstrand (1985, 1989, 1990), Helpman (1987), Deardorff (1998), Evenett and Keller (2002), and Feenstra et al. (2001) have significantly enriched the theoretical underpinnings of the model. The evolution of the gravity model has been a collective effort, with contributions from scholars across various fields shaping its development. Helpman (1987) argued that the model's empirical success underscored the relevance of the imperfect competition paradigm, while Deardorff (1998) demonstrated its compatibility with well-established theories such as Ricardian and Heckscher-Ohlin. Helpman and Krugman (1985) alongside Feenstra et al. (2001) showed how both classical and modern trade theories, which include product differentiation and comparative advantage, can substantiate the gravity model. Feenstra et al. (2001) explored the gravity model further by categorizing exports into differentiated, homogeneous, and intermediate goods. Their research revealed that differentiated products correspond to the exploitative competition framework, while homogeneous commodities fit the reciprocal dumping theory, which posits that nations might resort to dumping (selling products at prices lower than in their domestic markets) as a response to the trade policies of other countries.

The gravity model remains an active and dynamic research field, with a wealth of empirical studies examining its diverse applications. These investigations have utilized the gravity model to evaluate the effects of RTAs, including factors like trade creation and diversion. Numerous studies have focused on the regional integration of developed and industrialized nations, such as those conducted by Baldwin (1993, 1994), Oguledo and MacPhee (1994), and Bayoumi and Eichengreen (1995), who analyzed RTAs such as the EC, EU, NAFTA, and EFTA. Additional researchers, including Wang and Winters (1991), Hamilton and Winters (1992), and Baier and Bergstrand (2007), have leveraged the model to study RTAs in both developed and emerging markets which underscored the dynamism and continuous evolution of the gravity model.

2 Methodology, Econometric Model and Data

**2.1 Econometric model**

The Newtonian laws of motion, fundamental to classical physics, have been adapted into a trade theory by economists (Newton, 1687). The equation is presented as follows:

(1)

In this equation, F represents the gravitational force acting between two objects, G denotes the gravitational constant, m1 and m2 indicate the masses of the first and second objects, respectively, and r signifies the separation distance between the two objects. Economists have substituted F with the trade flow between pairs of countries, m1 and m2 with the GDP of the domestic country and the GDP of the foreign countries, respectively, and r with the geographical distance separating those two countries. In his book, Linnemann (1966) applied the gravity equation within a comprehensive economic context, where he referenced the gravity model of trade as:

(2)

Applying the logarithmic transformation to equation (2), it is transformed into:

In this case, there is a positive correlation between the trade and Gross Domestic Product (GDP) of both nations. However, a negative correlation is noted between distance and trade. This study uses the conventional gravity trade model to analyze trade flows between Bangladesh and its trading partners. To address the estimation biases resulting from the lack of multilateral trade resistance terms, we incorporate various dummy variables, drawing on the reasoning presented by Feenstra (2016). This model was also used by Baier and Bergstrand (2007). The trade flow within the gravity model, incorporating its own lag effects for one period along with population influences, can be expressed as follows:

Here,

If we apply the natural log of the variables, then the trade flow appears as:

Now if we take this form econometric form the model as follows:

The empirical analysis uses an extended version of the model, represented by equation (7). This enhancement accounts for various influences such as trade and regional agreements, border effects, and the impacts of multilateral trade resistance.

(7)

**2.2 Methodology and Data**

The data encompasses the top 52 trading partner nations of Bangladesh and a panel dataset spanning 24 years, from 2000 to 2024, to investigate the latest trade trends of Bangladesh. This study structured the dataset to ensure that the regression effectively reflects the country-specific fixed effects for trade. This meticulous approach is in accordance with the methodology outlined by Anderson and Van Wincoop (2003), ensuring the highest quality of research. The study uses 11 variables including dummy variables where export flow is the dependent variable and other independent variables associated with trade flow, we mainly focus on gravity model variables such as population, Gross Domestic Product (GDP), distance, landlock, island, common language, contiguity and border. The model also uses the dummy variable part\_agreement to see the effect of the trade agreements as a whole for Bangladesh. The details descriptions of the variables are given in Table 2. We have made use of the Direction of Trade Statistics (DOTS) database provided by the International Monetary Fund (IMF), as well as data from the World Bank’s World Development Indicators Database and the French research institution Centre d'Études Prospectives et d'Informations Internationales (CEPII). For ease of analysis, we have converted GDP figures into millions of USD in Constant terms. Given the challenges associated with estimating gravity models, it is essential to consider the reciprocal nature of trade while factoring in country-pair fixed effects to prevent omitted variable bias (Anderson & Van, 2003). To tackle this problem effectively, we created an extensive panel dataset, a crucial component of our study, featuring 3,568 observations of bilateral trade flows, focusing on Bangladesh and the rest of the world across 24 years.

3. results and discussion

Table 2 summarizes the main statistics related to the key variables involved in the analysis. The dependent variable, export volume, represents Bangladesh`s exports, which are measured in millions of USD. This data encompasses Bangladesh and its seven partner countries included in this study, while data for the remaining 128 countries is provided in an aggregated format. Consequently, the dataset consists of 3,568 observations. We arranged the panel data to represent each country as an origin and a partner to capture country-specific fixed effects effectively. We observed that the summaries of both origin and partner countries are quite alike. The average export volume is 199.72 million USD, accompanied by a considerable standard deviation of 756.99, indicating significant variation across different country pairs. The minimum value of zero indicates cases of no trade occurring, while the maximum export volume reaches as high as 11,834.78 million USD.

Table 2. Summary statistics of panel data from year 2000 to 2024

| **Variable** | **Variable Descriptions** | **Mean** | **Standard Deviation** | **Min.** | **Max.** |
| --- | --- | --- | --- | --- | --- |
| **Dependent Variable** | | | | | |
| export | Export volume (In Million USD) of Bangladesh | 199.72 | 756.99 | 0 | 11834.78 |
| **Independent Variables** | | | | | |
| gdp\_o | GDP of origin country (In Million USD Constant terms), or in this case, Bangladesh | 520723.50 | 262233.39 | 46.01 | 1001067.00 |
| gdp\_d | GDP of partner countries (In Million USD Constant terms) | 646341.10 | 2093300.80 | 0 | 27720700.00 |
| pop\_o | Population of origin country (In Million), or in this case, Bangladesh | 154.51 | 11.59 | 131.58 | 173.56 |
| pop\_d | Population of partner countries (In Million) | 43.08 | 152.87 | .01 | 1425.89 |
| dist | Distance between two counties | 8208.28 | 4314.59 | 134.24 | 18047.04 |
| **Dummy Variables** | | | | | |
| common\_language | A dummy variable that captures common language used between the two paired countries. If the residents of the country pair speak at least one  common language, the dummy cell yields 1, otherwise, 0 | .52 | .50 |  |  |
| landlocked\_d | land =1 if both countries are landlocked and zero otherwise | .19 | .39 |  |  |
| Island\_d | Island =1 if both countries are islands or zero otherwise | .18 | .38 |  |  |
| contiguity | If the country pair shares a common border, then it yields 1, otherwise 0 | .01 | .10 |  |  |
| part\_agreement | A dummy variable that captures if Bangladesh part of any regional or PTA or other trade agreements, the dummy cell yields 1 if part of any trade agreements, otherwise, 0 | .47 | .49 |  |  |
| **No. Observations** | **3,568** | | | | |

***Note(s): d=destination country, o= origin country.***

***Source: Authors Own calculation***

Table 3 displays the outcomes of the gravity model estimation based on Equation 1. In addition to the PPML fixed-effects estimator, the study utilizes OLS and OLS fixed-effects methodologies. This comparative framework evaluates how the estimated coefficients impact multilateral resistance terms and data heteroskedasticity. Although both fixed-effects estimators in OLS and PPML are anticipated to produce consistent results, some inconsistencies might emerge due to heteroskedasticity. Recognizing that establishing direct causal links for an individual country poses challenges within a cross-country regression context is crucial. Instead, the estimated coefficients signify generalized effects relevant across all countries considered in the analysis.

Table 3. Gravity model estimation of exports of Bangladesh

| **Model** | **1** | **2** | **3** | **4** | **5** | **7** | **6** | **8** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Estimator** | **OLS** | **OLS** | **OLS** | **OLS** | **PPML** | **PPML** | **PPML** | **PPML** |
| Dependent Variable | lnexp = Co-effi (Sd err) | lnexp  Co-effi (Sd err) | lnexp  Co-effi (Sd err) | lnexp  Co-effi (Sd err) | x\_value\_mill  Co-effi (Sd err) | x\_value\_mill  Co-effi (Sd err) | x\_value\_mill  Co-effi (Sd err) | x\_value\_mill |
| lngdp\_o | -0.015  (0.024) | -0.0273  (0.017) | -0.015  (0.024) | -0.0274  (0.017) | 0.006  (0.055) | - | 0.001  (0.057) | - |
| lngdp\_d | 1.3758 \*\*\*  (0.024) | 0.476 \*\*\*  (0.039) | 1.361 \*\*\*  (0.024) | 0.476 \*\*\*  (0.0392) | 0.879 \*\*\*  (0.074) | 0.996 \*\*\*  (0.044) | 0.872\*\*\*  (0.075) | 0.999 \*\*\*  (0.042) |
| lndist | `-0.514\*\*\*  (0.059) | 0.033  (0.112) | -0.432 \*\*\*  (0.063) | 0.032  (0.111) | 0.447 \*\*\*  (0.063) | 0.515 \*\*\*  (0.075) | 0.718\*\*\*  (0.104) | 0.849 \*\*\*  (0.103) |
| lnpop\_o | 0.243\*\*\*  (0.018) | 0.149 \*\*\*  (0.014) | 0.242 \*\*\*  (0.018) | 0.149 \*\*\*  (0.014) | 0.086 \*  (0.0389) | - | 0.084\*  (0.040) | - |
| lnpop\_d | -0.225\*\*\*  (0.027) | 0.094 \*\*\*  (0.033) | -0.213 \*\*\*  (0.028) | 0.094 \*\*  (0.033) | -0.058  (0.060) | -0.118 \*  (0.050) | -0.001  (0.055) | -0.042  (0.047) |
| common\_language | -0.298\*\*\*  (0.076) | 0.289 \*  (0.136) | -0.224 \*  (0.078) | 0.289 \*  (0.136) | -0.263 \*  (0.112) | -0.365 \*\*\*  (0.098) | -0.134  (0.114) | -0.219 \*  (0.092) |
| landlocked\_d | -0.228\*  (0.092) | 0.330 \*  (0.155) | -0.194 \*\*  (0.093) | 0.330 \*  (0.155) | 0.143  (0.287) | -0.178  (0.241) | 0.192  (0.318) | -0.106  (0.267) |
| island\_d | 0.321\*\*  (0.111) | 0.258  (0.191) | 0.380 \*\*\*  (0.112) | 0.258  (0.191) | 0.288 \*  (0.129) | 0.197  (0.134) | 0.612\*\*\*  (0.146) | 0.607 \*\*\*  (0.148) |
| contiguity | -0.633\*  (0.356) | -0.819  (0.794) | -0.636 \*  (0.356) | -0.821  (0.794) | 0.041  (0.213) | 0.216  (0.226) | 0.038  (0.219) | 0.196  (0.244) |
| part\_agreement |  |  | 0.289 \*\*\*  (0.079) | 0.152  (0.790) |  | -11.529  (0.801) | 0.625\*\*\*  (0.157) | 0.764 \*\*\*  (0.122) |
| Constant | -10.240\*\*\*  (0.733) | -5.128 \*\*\*  (1.135) | -11.034 \*\*\*  (0.763) | -5.192 \*\*\*  (1.183) | -10.521 \*\*\*  (1.414) | -13.419 \*\*\*  (1.917) | -13.419 \*\*\*  (1.917) | -15.378 \*\*\*  (1.183) |
| R-squared | 0.637 | 0.559 | 0.640 | 0.569 | 0.405 |  | 0.371 |  |
| Pseudo-R-squared | - | - | - | - | - | 0.771 | - | 0.789 |
| Fixed Effect | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 3476 | 3476 | 3476 | 3476 | 3476 | 3476 | 3476 | 3476 |

Note(s): d=destination country, o= origin country.

Standard Errors in parentheses

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1

***Source:*** ***Authors Own calculation***

The destination country GDP (lngdp\_d) is very significant in all the models, which establish a positive significant relationship between Bangladesh exports and the size of the economy of its trading partners. The coefficients vary between 0.476 (OLS FE) and 0.999 (PPML FE), indicating that an improvement in GDP of a partner by 1 percentage point can result in the increase in exports by 47.6 per cent to 99.9 per cent. And this is also consistent with the Gravity Model of Trade which says that bigger economies require more imports. This finding is supported by the previous research (e.g., Anamul Haque, Rahman, Mnasri and Nechi). The responsiveness of PPML results is high, although the lower OLS coefficients indicate that unobserved effects are explained by fixed effects. On the whole, the destination countries that are richer import more Bangladeshi goods particularly in large industries such as RMG and textiles.

The coefficients of lndist (log of distance) are not consistent among models, with the estimated coefficient taking opposite directions. The estimation of OLS shows that the relation is negative (-0.514 to -0.432), thus, indicating that the export of Bangladesh decreases with distance, as expected based on the Gravity Model (longer distance implies the increase in trade costs). Conversely, PPML models reveal positive coefficients (0.447 to 0.849), which implies more exports to remote markets, which is surprising. This could be an indication of the high dependence of Bangladesh on high-income distant markets such as USA and EU where preferential trade agreements and well-organized buyer networks subsidize the distance costs. In the meantime, OLS findings highlight the significance of the distance factor, as such countries as India and ASEAN partners enjoy reduced transport cost and trade facilitation (Anamul Haque, 2022; Rahman, 2010; Mnasri and Nechi, 2021; Frede and Yetkiner, 2017; Bhattacharya & Das, 2014).

The findings indicate that lnpop\_o (log of population of Bangladesh) positively and significantly impacts exports in all specifications, which brings up the fact that population growth promotes export growth. Whereas in OLS specifications, a one-percent rise in the population of Bangladesh leads to an approximately 24-percent rise in exports, in PPML specifications, the effect is not as large, yet positive (approximately 8.6 percent) (Anamul Haque, 2022). This probably captures the contribution of increasing labor force to enhancing the production capacity. Nevertheless, OLS fixed effects models reveal a positive and significant effect (approximately 9.4 per cent) on analysing the population of destination countries, indicating that exports grow with higher consumer bases abroad. Conversely, the estimates of PPML indicate that the effect is insignificant or slightly negative (-0.118 to -0.001) and in a nonlinear regime, the population of destination country might not be a strong factor in export growth.

The coefficient for common language is predominantly negative and significant, ranging from -0.298 to -0.365, in most models. This significant negativity underscores the substantial impact of common language on trade. In the OLS models, it consistently shows a negative value. In the PPML model settings, the coefficient often remains negative or insignificant; however, in Columns 6 and 8, the coefficients for common language are both negative and significant (-0.365 and -0.219 at the 1% and 5% levels respectively), indicating that trade would decrease by 36.5% and 21.9% when both countries share a common language which is opposite of the study done by Goswami et.al 2022 and Frede and Yetkiner, 2017.

In the OLS models, the coefficient for landlocked countries is negative, varying between -0.228 and -0.194, which suggests that Bangladesh exports less to these nations. However, when looking at fixed-effects models, the coefficient becomes positive at 0.330, indicating that landlocked countries might still engage in considerable trade with Bangladesh. This positive coefficient underscores the importance of considering country-specific elements such as infrastructure quality, trade policies, and regional agreements in trade analysis. In the PPML models, the effect is either weak or insignificant, ranging from -0.178 to 0.192, which implies that the influence of being landlocked on trade is not consistently strong across various model specifications (Goswami et.al 2022).

The coefficient for island countries is both positive (0.321 to 0.612) and statistically significant, indicating that Bangladesh has higher export levels to island nations. The effect is most pronounced in the PPML models (0.612, 0.607), suggesting that when zero trade flows and heteroskedasticity are considered, the beneficial impact of being an island nation on trade becomes more evident, which concludes that having FTA or PTA greatly impact the both island countries and Bangladesh this may be attributed to island nations relying heavily on imports for essential goods, leading to increased dependence on external trade partners like Bangladesh.

The contiguity (shared land borders) coefficient is negative and significant in OLS specifications (-0.633 to -0.821) implying that Bangladesh engages in less trade with its neighboring countries such as India and Myanmar. Such a counterintuitive finding could be related to political tensions, non-tariff barriers, complicated trade regulations, and high amount of informal trade that is not reflected in official data. Also, redundant production facilities can make trade less because of competition than complementarity. Conversely, the PPML models have positive, albeit, statistically insignificant coefficients (0.038 to 0.196) indicating that shared borders, in itself, do not appear to be important in promoting formal trade, after controlling zero-trade flows and structural differences. Then it means that the logistic and regulatory frictions can neutralize the geographic benefits of contiguity. Additionally, informal trading pathways, which play a significant role in South Asia, may not be adequately captured in the trade data utilized for estimation (Goswami et.al 2022).

The coefficient for part\_agreement in OLS setting is 0.289, with a standard error of 0.079, signifying a positive and statistically significant effect (at the 1% level) on Bangladesh`s exports. This implies that possessing any trade agreements with economic partners boosts exports about 28.9%. In the PPML framework, Model 7 shows a coefficient of 0.625 (significant at the 1% level) along with a standard error of 0.157, while Model 8 indicates an even greater effect, exhibiting a coefficient of 0.764 and a standard error of 0.122 (also significant at 1%). This suggests that having part of any economic partnership is expected to increase trade by approximately 63% and 76%.

The empirical exercise based on the preferred estimator of PPML fixed effects as Silva and Tenreyro (2006) suggest illuminates the next practising determinants of export performance of Bangladesh, namely, destination country GDP, distance, population and trade agreements. The finding that Bangladesh sells more to the richer countries is consistent across both OLS and PPML models as the correlation between GDP and exports are significantly positive. The PPML model which is robust to heteroskedasticity as well as zero trade flows strengthens the position that growth in exports is demand dominated. Whereas in OLS specifications distance has a negative effect on exports (-43.2 to -51.4 percent), in the PPML estimates we surprisingly find a positive effect, which reflects that Bangladesh has to offer its goods to distant, high-income markets such as the USA and the EU, but trade preferences and well-established buyer networks make this possible. Surprisingly, a common language has a negative impact on trade perhaps due to the fact that the biggest export market of Bangladesh does not share language with it whereas linguistically similar countries have formal restrictions on trade (with Bangladesh). On the same note, contiguity displays major negative impact indicating that geographical closeness does not guarantee increased trade because of regional barriers and informal trading behaviours. Comprehensively, the results support the fact that FTAs, PTAs, or other agreements of kind have a considerable effect on improving trade, which is a crucial element of economic expansion.

3.1 Robustness of the model

The paper also examines the reliability of the results obtained through VIF test for multicollinearity. The mean VIF value bellow 5 consider that the regression model does not have any kind of serious multicollinearity among the explanatory variables. The table 4 indicates that the mean VIF for the explanatory variables is 1.82 which implies the model validity with no multicollinearity. The study uses the PPML estimator to address autocorrelation and heteroskedasticity in the analysis with standard errors clustered at the Bangladesh’s export and other importers country. The PPML model allows for serial correlation within the data pairs overtime and ensure the robust inference for the unobserved group dependencies (Goswami et.al 2024). The study, also use multilateral resistance terms, which refer to influencing trade relationships with other countries, and we use them to enhance the robustness of the gravity model. This approach is supported by many scholars, such as Anderson and Van Wincoop (2003), Baldwin and Taglioni (2006), Anderson and Yotov (2016), and Feenstra (2016), who use it profoundly in their studies. The comprehensive analysis in our study reflects the insights of these researchers. The study done by Anderson and Van (2003) shows that bilateral trade agreements, alongside conventional and country-specific trade variables, are very influential attributes for the accessibility of trading partners. Failing to address such accessibility concerns results in biased outcomes, regardless of the analytical specification chosen. Various methods can control for multilateral trade resistance; however, we mainly utilize the approach employed by Dall'Erba et al. (2021), Ciuriak et al. (2020), and Feenstra (2016). The technique highlighted in these studies is referred to as the pairwise time-fixed effects (time-FE).

Table 4: VIF test for Multicollinearity

| **Variable** | **VIF** | **1/ VIF** |
| --- | --- | --- |
| lnpop\_o | 2.83 | 0.353 |
| lngdp\_o | 2.79 | 0.357 |
| lnpop\_d | 2.51 | 0.398 |
| lngdp\_d | 2.24 | 0.447 |
| island\_d | 1.57 | 0.635 |
| lndist | 1.36 | 0.735 |
| part\_agreement | 1.32 | 0.757 |
| common\_language | 1.3 | 0.771 |
| landlocked\_d | 1.17 | 0.852 |
| contiguity | 1.13 | 0.885 |
| Mean VIF | 1.82 | |

Feenstra (2016) contends that time-FE captures multilateral resistance and addresses the unobserved heterogeneous effects specific to countries due to diverse national policies, institutions, and cultural dynamics, which cannot be sufficiently identified by the remoteness index put forth by Anderson and Van (2003) and Goswami et al. (2022). The study finds that Bangladesh primarily exports with an intensive margin, but she lacks export diversifications. In general, distance is generally considered a hindrance to trade, though Bangladesh's exports are predominantly concentrated with major export destinations, i.e., the USA, Germany, the United Kingdom, Spain, France and Poland, as per the data. These findings align with a study done by Anamul Haque, 2022. Additionally, the findings exhibit that Bangladesh's exports show a positive relationship with trade agreements, as Bangladesh enjoys the Generalised Scheme of Preferences (GSP) with the EU and other associated agreements with other countries and economic blocks, i.e., BIMSTEC, SAFTA, APTA, EU PTA, OIC, and D-8.

4. Conclusion

Bangladesh is projected to attain Developing Country status by 2026 and hence it is crucial for policymakers to evaluate and engage in both bilateral and multilateral agreements, such as FTAs, PTAs, and RTAs, or to join an economic group to enhance sustainable export competitiveness. The findings of the study indicate that Bangladesh exerts a significant influence on island nations, ranging from a 32.1% to a 61.2% increase in exports, as they have greater import dependency, presenting significant export potentiality for Bangladesh. The study findings suggest that Bangladesh`s exports are influenced by the size of the economy, regional or international trade agreements, or the development of market connections rather than geographical proximity. These findings also highlight the importance of implementing strategic trade policies aimed at high-income markets, improving trade facilitation, and diversifying both export products and markets to ensure sustained long-term growth. Additionally, analysis at the sector level could abet policymakers in suggesting specific trade policies that promote sustainable economic growth while reducing distortions in the export and import markets. Grasping sector-specific trade potential would also be a great role for Bangladesh in preparing for LDC graduation and navigating new tariff structures and market access conditions for Bangladesh. This would help policymakers more rigorously evaluate how other countries engage in other trading associations or blocks, especially where trade blocks comprise developed and developing countries. By studying these different factors and how they work together, future research could better understand the lasting impact of Bangladesh’s participation in both bilateral and multilateral agreements and global value chains.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

3.

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