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THE INTERNATIONAL TRADE OF BANGLADESH: AN EMPIRICAL ANALYSIS WITH GRAVITY MODEL

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ABSTRACT

We investigate the foreign trade pattern of Bangladesh using the gravity model of international trade. This work studies 24 years of Bangladesh's bilateral trade with its 52 major trade partners, from 1995 to 2018. We construct a large panel dataset of 3,168 observations to capture the multilateral resistance terms by accounting for two-way trade flows from each country with the others. We use the PPML fixed effects estimator suggested by Silva and Tenreyro (2006) as the most preferred method for gravity-based analysis. We find mixed results regarding the consistency of Bangladesh's trade pattern with the gravity model predictions. The results suggest that Bangladesh's export is positively determined by its income and partner countries' level of development, but it is relatively less influenced by partner countries income. However, Bangladesh's level of development is observed to be negatively correlated with both export and import. The distance between the trading countries matters less to Bangladesh, and Bangladesh comparatively tends to trade more with distant countries. The results also suggest that tariffs imposed by partner countries do not affect Bangladesh's export negatively as Bangladesh receives GSP benefits from its major export market. All the results of the fixed effects regression models are robust, and this paper has significant implications in terms of formulating trade policy for Bangladesh.

Contribution/ Originality: This study documents the first gravity-based trade analysis of Bangladesh that has used the PPML fixed effects estimator and considered for the two-way flow of trade to account for multilateral resistance apart from the previous gravity-based research. The findings have important policy implications for Bangladesh.

1. INTRODUCTION

International trade is beneficial, and is a proven economic activity that may enhance the total welfare of a nation (Krugman, Melitz, & Obstfeld, 2018). Trade boosts overall productivity (Malmberg, Malmberg, & Lundequist, 2000) and brings income stability (Caselli, Koren, Lisicky, & Tenreyro, 2020). Countries are now more economically interdependent than ever before (Farrell & Newman, 2017). The gravity model (Tinbergen, 1962) is one of the most powerful tools to describe trade patterns and trade flows among countries. Researchers have since extended the model by incorporating different variables to estimate the effect of various factors that determine trade flows. Here, this paper investigates the various factors that determine the bilateral trade patterns between Bangladesh and its major trade partners using this gravity model. Therefore, understanding the impact of those factors will have significant policy implications that may help Bangladesh achieve sustainable economic growth by

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improving the quality and diversification of its exports. The scope of this study is Bangladesh, which is one of the fastest-growing developing countries with an average economic growth of over 6% since the last decade (Sinha, 2017). Since independence in 1971, Bangladesh has gradually shifted from a position of a relatively protectionist stance, towards a more liberal economy (Ahmed, 2000). Trade liberalization gained momentum in the early 2000s, with Bangladesh significantly reducing import tariffs. The trade percentage of GDP increased to 36.76 %in 2019, from around 18.89 %in 1991 (World Bank World Development Indicators, 2019). However, Bangladesh continues to suffer from a large trade deficit, given the volume of exports remains significantly lower than imports. It further changed, and over the past few decades, the country's exports shifted from agriculture to the labor-intensive manufacturing sector, mostly the ready-made garments (RMG) industry (Haider, 2007). The RMG industry now constitutes more than 80 %of the total export earnings of Bangladesh (Islam, Rakib, & Adnan, 2016). In addition to increasing the trade balance of the country, trade substantially contributes to employment generation, poverty alleviation, and the empowerment of women (Barua & Ansary, 2017). As a result, foreign trade has become a critical determinant of the overall development of the economy. Located in South Asia, Bangladesh shares its border mostly with India and a relatively smaller border with Myanmar. Among South Asian nations, only India is a significant trade partner with Bangladesh. Bangladesh infrequently trades with other SAARC countries. Surprisingly, almost all the major trade partners of Bangladesh are distant countries instead of closer economies. Table 1 illustrates the top ten export and import partners of Bangladesh from 1995 to 2018, with cumulative values and respective shares. It shows that nearly 75 %of Bangladesh's exports are from the top ten export destination countries, while the top ten import partners represent around 65 %of total imports. Seven of the ten top export partners are European countries, while China is the only Asian country with a relatively small amount of share of nearly 2%. Conversely, European countries are not represented in the top ten import partner countries. Except for the United States, all the major import partners are from Asia. However, other than India, the rest of the Asian countries are distant trade partners.

Table 1. Top 10 export destinations and import sources – Bangladesh (1995-2018).

Country	Export	Percentage (%)	Country	Import	Percentage (%)
United States	62,229	21.08	China	96,464	19.55
Germany	45,468	15.41	India	76,326	15.47
United Kingdom	30,153	10.22	Singapore	31,362	6.36
France	19,439	6.59	Japan	23,544	4.77
Spain	13,901	4.71	Korea, Rep. of	17,896	3.63
Italy	13,782	4.67	Malaysia	17,262	3.50
Canada	9,902	3.35	Kuwait	15,410	3.12
Netherlands	10,917	3.70	Hong Kong	14,917	3.02
Belgium	8,517	2.89	Indonesia	14,703	2.98
China	5,803	1.97	United States	13,287	2.69
Others	75,028	25.42	Others	172,154	34.90
Total	295,139	100.00	Total	493,325	100.00

Note: Values are in million USD.

The motivation of this study originates from the distribution of Bangladesh's trade partners, which apparently contradicts with the general prediction of the gravity model of international trade. Apart from China and the United States, the major export destination countries and import partners differ. Empirical evidence of international trade suggests that geographical distance is vital for bilateral trade as shorter distances imply lower transportation costs, which facilitate higher trade (Obstfeld & Rogoff, 2000). Gravity equations use the 'distance' variable as a proxy for transportation costs, and most studies have observed that higher distances are associated with significant trade barriers. Contrary to these general expectations, the list of major trade partners of Bangladesh illustrated in Table 1 suggests a different outcome. It indicates that the distance variable is positively correlated, especially in the case of Bangladesh's export partners. Research has noted that with distance, transportation costs may be more

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tangible but other trade barriers such as cultural difference, which may be hard to observe, is also a factor (Berthelon & Freund, 2008; Lawless, 2010). Bangladesh, therefore, presents an interesting case to observe the effect of distance on trade. The seemingly contradictory relationship between distance and trade presents an opportunity to explore other factors that might explain Bangladesh's trade pattern.

Although the gravity equation has been widely used to analyze bilateral trade, most prior studies suffer from econometric flaws (Anderson & Van Wincoop, 2003); such as endogeneity, multilateral resistances, and zero trade flows can result in misleading inferences in the estimation of gravity equations. We did not find any gravity analysis on Bangladesh that has successfully addressed these issues. Studies such as Rahman and Dutta (2012) addressed the multilateral resistances term by accounting for country-specific fixed effects as advised by Anderson and Van Wincoop (2003) and the time fixed effects. However, there were no measures to deal with zero trade flows, and heteroskedasticity. Since most of the trade data between any two countries in some period involves zero values, the log-linearized estimation using the ordinary least squares (OLS) method simply drops the entire row and generates a biased estimation. Even in the absence of zero trade flow, the log-linearized estimation can generate a misleading estimation due to the presence of heteroskedasticity (Silva & Tenreyro, 2006). As no previous study has investigated Bangladesh's trade with the gravity model and applied techniques to deal with these issues, those studies are likely to make misleading inferences. Information related to Bangladesh's major trading partners and the absence of quality research in the area motivated the analysis of trade patterns utilizing the gravity model. Therefore, the primary objective is to investigate whether the gravity model can explain the international trade patterns of Bangladesh. The results will produce significant policy suggestions for Bangladesh to address current concerns of an increasing trade deficit. The data includes the top 52 trading partners of Bangladesh and accounts for 98.10% of total exports and 94.70 % of total imports from 1995 to 2018. A panel data framework was applied and will account for country-pair fixed effects and time fixed effects to capture multilateral resistances in the regression model as suggested by Anderson and Van Wincoop (2003) and Westerlund and Wilhelmsson (2011). However, unlike previous studies, we will apply the Poisson pseudo-maximum-likelihood (PPML) fixed effects method suggested by Silva and Tenreyro (2006); Silva. and Tenreyro (2011) for estimating the gravity equation instead of OLS. We did not find any gravity research conducted on Bangladesh using this advance estimation technique. Silva and Tenreyro (2006); Silva. and Tenreyro (2011) demonstrated that PPML generates the most consistent estimations of the gravity equation even in the presence of zero trade flow and heteroskedasticity. Thus, this work contributes to the theoretically grounded literature to analyze Bangladesh's trade by applying the gravity model.

This paper includes five chapters. Chapter 2 also includes a comprehensive review of the relevant works. Chapter 3 outlines the sample and model specification. Chapter 4 reports on the results and provides explanations of the findings. The final chapter provides the potential policy implications.

2.THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Tinbergen (1962) articulates that the gross national income (GNI) and distance between trading countries are the primary determinants of trade flows. It means that the export a country can produce and the import a country can consume rests upon their economic size and relevant transportation costs. Tinbergen recommended estimating economic size by GNI and transport cost by geographical distance since it differs primarily by the locations of the trading countries. The model has an enormous explanatory capacity and was the first to incorporate trade costs in the form of distance, which is a significant barrier in international trade (Bergstrand & Egger, 2010). Trade economists and researchers found the concept appealing and began to explore it further. Linnemann (1966) expanded the model with more explanatory variables and provided a theoretical rationale based on the general system of Walrasian equilibrium. Leamer and Stern (1970) adapted the gravity equation using a probability model of transactions, arguing that bilateral trade is uncertain in the absence of transportation costs. Gravity theory was for the most part not accepted by economists till 1995, as it was regarded more like a physics analogy than

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theoretically founded from economic models (Head & Mayer, 2014). A general criticism that appeared was merely based on the intuition rather than conventional economic theory. During this time, the Ricardian and Heckscher-Ohlin (H-O) models were the most accepted theories of international trade, and they listed the reasons for international trade in terms of comparative advantage and variations in the availability of factors of production between trading countries. None of these standard models was theoretically capable of explaining the gravity equation (Bacchetta et al., 2012) and it remained outside the mainstream of trade economics until (Trefler, 1995) first successfully explained the presence of gravity (Head & Mayer, 2014). Later researchers developed numerous ways to explain the gravity model in conjunction with economic theories, and it has become an essential component of trade economics (Head & Mayer, 2014). Although, researchers have attempted to derive the gravity equation from models that considered product differentiation, Anderson (1979) was the first to achieve this successfully (Deardorff, 1998). His work laid the theoretical foundation for the gravity equation. Anderson (1979) differentiated the products by country of origin and indicated that consumers in a country would have preferences over all the differentiated products. He used both Cobb-Douglas preferences and constant-elasticity-of-substitution (CES) preferences in deriving the equation. He argued that the consumers in one country would buy some of each product from each country regardless of price differences. Thus, the larger economies would import and export more, compared to their smaller partners. However, Anderson (1979) work had major limitations as he assumed unity of prices, the identical structure of traded goods preferences, and also similar tariff and transportation costs across the trading countries. Bergstrand (1985) later explored the idea by deriving a reduced form of bilateral trade equation which includes price indices. He used GDP deflator to calculate these price indices and estimated his framework to examine the product differentiation assumptions. His empirical findings endorsed the hypothesis that products were not a perfect substitute, and imported products were better substitutes of each other compared to domestic products. Bergstrand (1989); Bergstrand (1990) drifted further from the H-O model by assuming monopolistic competition, and thus included product differentiation across the firms instead of countries. His work subsequently contributed to the finding of the initial Armington assumption, based on the attempts to derive the gravity equation with later approaches that proposed an equation from the simple monopolistic competition (Deardorff, 1998). Deardorff (1998) found that, regardless of the arbitrary preferences, the gravity equation would still hold on to average, although individual trade flows would exceed or fall short, depending on the weighted correlation between the partner countries deviations from the world average supply and demand. Although many studies and seminal works proved the validity of gravity with strong theoretical backgrounds, most of them failed to address the heterogeneous nature of prices. They either used price indices or applied various factors to deal with the multilateral pricing issues. However, the cost of trade would vary from country to country depending on the varying distances. McCallum (1995) first included a measure termed the 'remoteness index' to capture multilateral prices and described the findings as a 'border puzzle'. After 1995, several studies based on the gravity equation provided substantial theoretical grounds that made it a major tool to analyze international trade. While the introduction of the idea of missing trade by Trefler (1995) created a new era of gravity research, and researchers realized that all other trade models were unable to explain a large amount of trade (Head & Mayer, 2014). Although Trefler used home bias to describe missing trade instead of distance, his work pointed to the necessity of recognizing trade barriers. Nevertheless, the trade economists admitted the influence of distance in international trade after the influential work of Leamer and Levinsohn (1995) who recognized the credibility and robustness of the gravity equation (Head & Mayer, 2014).

The literature presented here represents some of the landmark works that have provided the theoretical foundations for the gravity equation. The validity and effectiveness of the gravity equation has since been confirmed within the literature. Many trade theories such as the Ricardian model, the Heckscher- Ohlin (H-O) model and the new trade theory have been demonstrated to support the gravity equation. Owing to its high applicability to trade policymaking, scholars have attempted to enhance the accuracy of its estimates.

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2.1. Research Objectives

Researchers have widely applied the gravity model to investigate international trade and associated factors such as economic integration agreements (EIA), currency unions, and immigrant linkages that might influence multilateral trade. However, most of these studies focused on analyzing trade flows between European countries. Gravity research in the context of Asian countries is relatively scarce. Only a few studies have attempted to analyze the bilateral trade of Bangladesh. Bangladesh's research that has applied the gravity model possesses common methodological limitations that have been discussed in this chapter, and none has applied the most recent techniques and methods.

Rahman (2003) is one of the most commonly cited works in relation to Bangladesh's trade analysis applying the gravity model. Rahman and Dutta (2012) published a similar work with modifications to Rahman's original work. Panel data from 35 major trading partner countries over a period of 37 years (1972 to 2008) was used to investigate the determinants of Bangladesh's trade using the gravity model. Their findings suggested that Bangladesh's total trade had positive relationships with partner countries' economy size, per capita GDP differential, and openness. Contrary to the gravity model prediction, they observed that Bangladesh's export was negatively determined by the partner countries' income. They further observed that partner countries' income and degree of openness increase Bangladesh's imports, and distance had a negative effect on Bangladesh's overall trade. Although most of the findings were consistent with gravity predictions, their estimation method had econometric limitations. Firstly, they only considered one-way trade flow from Bangladesh and did not correctly capture multilateral resistance terms. Secondly, they used the variable openness, which was computed as the trade to GDP ratio of the respective country. Since trade is also the dependent variable of the regression, such estimation clearly suffers severe endogeneity problem. Finally, they did not take any measures to deal with the issue of zero trade flows, which can lead to misleading estimations. Rahman and Ara (2010) used the gravity model to measure Bangladesh's trade potential with a dynamic approach. Their findings suggested that a large part of Bangladesh's trade remained unrealized, and it tends to trade more with larger economies, while a significant proportion of imports was from developing countries. They analyzed the panel data of 80 trading partners of Bangladesh from 1995 to 2007. However, the study also suffers from common flaws related to gravity research. Many countries that were included in their dataset would be expected to have zero trade flows. However, they applied the OLS fixed effects method and did not acknowledge the issue of zero trade flow; thus, results are likely to be biased and misleading.

Roy and Rayhan (2012) investigated Bangladesh import flows with the gravity model approach. They used panel data for the period from 1991 to 2007 and applied the OLS fixed effects estimator method. Their findings suggested that Bangladesh's import flows were mostly in line with the prediction of the gravity model. They observed that Bangladesh's imports were largely influenced by national and foreign countries GDP and exchange rates, and the distance variable was insignificant. However, only 17 countries were included in the study, and it did not consider influential factors; such as the level of development and tariffs within the regression. Some other studies , e.g. (Alam, Uddin, & Taufique, 2009; Iqbal & Islam, 2014; Oh & Rahman, 2013; Roy & Rayhan, 2011) have also attempted to analyze Bangladesh's international trade with the gravity model; although none of these was able to overcome the common limitations previously discussed.

This work has applied a different approach to avoid common omitted variable bias that occurs in most bilateral trade analysis. Most of the previous studies, e.g. (Rahman & Dutta, 2012; Roy & Rayhan, 2011) analyzing Bangladesh's trade, ran the regressions only for the trade of Bangladesh as dependent variable instead of accounting for the total trade by all the countries in the study. This approach does not account for the two-way flow of trade, and the effects of multilateral resistance remain unrealized. However, this work accounted for all the trade from each partner country to others, in the regression. First, it estimated the variables that are generally applied to all the countries of the study, and later the regression included a dummy variable representing Bangladesh and its interaction terms with other independent variables to estimate the impacts that are associated with Bangladesh. To

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the best of our knowledge, no study analyzing Bangladesh's bilateral trade has used the PPML fixed effects estimator to account for multilateral resistance terms and zero trade flows simultaneously. The dataset used in this work has no zero trade flow as the remaining 42 countries were aggregated into 'ROW countries' and included the top ten countries to account for country-pair fixed-effects. However, even in the absence of zero trade flows, the OLS fixed effect estimator can generate biased and misleading results in relation to heteroskedasticity (Silva & Tenreyro, 2006). To address this issue, we have applied the PPML methodology instead of OLS to analyze Bangladesh's trade. This work, therefore, fills a gap within the literature that analyzes Bangladesh's trade, providing more accurate estimations with less likelihood of bias.

3. SAMPLE AND METHODS

Data includes the top 52 trading partner countries of Bangladesh and a panel data set covering 24 years from 1995 to 2018 to analyze Bangladesh's most recent trade patterns, with a trade liberalization policy being adopted in the nineties. Among these countries, top ten countries accounted for 69.24% of Bangladesh's total exports, and 56.83% of Bangladesh's total imports during the study period. Aggregating the remaining 42 countries as the 'rest of the world' (ROW) allowed this work to organize the dataset in such a way so that the regression captures the country-specific fixed effects effectively following (Anderson & Van Wincoop, 2003).

We have utilized the Direction of trade statistics (DOTS) database of the International Monetary Fund (IMF), World Bank's World Development Indicators Database, and from CEPII, a French research institution. We have converted the GDP to millions and per capita GDP into thousands for convenience. We have constructed four variables from this data. Two of these denote origin countries' gross domestic product (*GDP_OR*) and per capita GDP (*GDP_PC_OR*) while the other two variables signify partner countries' gross domestic product (*GDP_PA*) and per capita GDP (*GDP_PC_PA*). All four common gravity variables appear in separately run regressions for both exports and imports. We have obtained applied weighted mean tariffs for all products in the average of effectively applied rates, weighted by the product import share corresponding to each partner country. We have constructed two variables; *TARIFF_OA* which represents import tariffs imposed by an origin country on the imported goods and *TARIFF_PA*, which represents tariff imposed by partner country on the exports of the origin country. Hence, the variable *TARIFF_PA* is a trade barrier to the origin countries' exports, and *TARIFF_OR* is a barrier to the imports of the origin country. We constructed one variable *DISTANCE* to measure the distance between trading countries in kilometers. Appendix B includes all the details about the data including their measurement and sources. Given the issues with gravity estimation, it is important to consider the two-way flow of trade while accounting for country-pair fixed effects to avoid omitted variable bias (Anderson & Van Wincoop, 2003). To appropriately address this issue, we constructed a large panel dataset of 3,168 observations of bilateral trade flows where we set Bangladesh, top ten trade partners, and the ROW countries in the panel for the 24-year study period.

3.1. Summary Statistics

Table 2 reports summary statistics. It reflects the data of Bangladesh and its 52 partner countries included in this study, although the data for the last 42 countries is present in an aggregate form. Thus, the total number of observations is 3,168. We organized the panel setting for each country as the origin and a partner to capture the country-specific fixed effects and found that the summary of the variables for origin and partner countries is quite similar. Apparently, there are some notable differences in the dependent variables *EXPORT* and *IMPORT* in the table. The standard deviation of the variables was high and occurred due to the incorporation of the ROW countries.

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Table 2. Summary statistics (1995-2018).

Variable	Mean	Standard Deviation	Min.	Max.	No. of Observations
Dependent Variables					
EXPORT (Mn)	60505.21	143412.1	13.32114	1235280	3,168
IMPORT (Mn)	62026.06	144632.5	14.253	1235280	3,168
Independent Variables					
GDP_OR (Mn)	4282140	5302316	37939.75	23400000	3,168
GDP_PA (Mn)	4197980	5342049	37939.75	23400000	3,168
GDP_PC_OR ('000)	24.89549	17.61114	0.3294241	66.18878	3,168
GDP_PC_PA ('000)	24.22482	17.63481	0.3294241	66.18878	3,168
DISTANCE (Km)	57214.56	115867.8	342.9475	423745.8	3,168
TARIFF_OR (%)	4.452563	5.240519	0	28.51	3,168
TARIFF_PA (%)	4.451326	5.242024	0	28.51	3,168
CPI_OR	93.58376	20.92509	37.74521	170.1642	3,168
CPI_PA	93.58376	20.92509	37.74521	170.1642	3,168
BGD	0.0833333	0.276429	0	1	3,168

Figure 1 illustrates the growing trend of exports and imports for Bangladesh in the same period. It indicates that the trade deficit increased faster around 2002 as imports started growing much quicker than the exports. Table 3 illustrates the Pearson correlation matrix for the main variables used in this thesis. The dependent variables *EXPORT* and *IMPORT* were correlated with almost all the independent variables at 5 %significance level. As expected, *EXPORT* was negatively correlated with *TARIF_PA* and *IMPORT* was negatively correlated with *TARIFF_OR* at 5 %level of significance. Most of the values were also statistically significant, which was not surprising if we consider the nature of those variables. However, these correlations are modest, indicating little concern for multicollinearity problems.

3.2. Model Specifications

We have utilized an econometric model, which was consistent with the model used by Baier and Bergstrand (2007). However, to analyze both export and import patterns of Bangladesh, we utilized two separate models for exports and imports.

$$\ln(\text{EXPORT})_{ijt} = \beta_0 + \beta_1 \ln(\text{GDP\_OR})_{it} + \beta_2 \ln(\text{GDP\_PA})_{jt} + \beta_3 \ln(\text{GDP\_PC\_OR})_{it} + \beta_4 \ln(\text{GDP\_PC\_PA})_{jt} + \beta_5 \ln(\text{DISTANCE})_{ij} + \beta_6 \ln(\text{TARIFF\_PA})_{jt} + \beta_7 \ln(\text{CPI\_PA})_{jt} + \varepsilon_{ijt} \quad (1)$$

and

$$\ln(\text{IMPORT})_{ijt} = \beta_0 + \beta_1 \ln(\text{GDP\_OR})_{it} + \beta_2 \ln(\text{GDP\_PA})_{jt} + \beta_3 \ln(\text{GDP\_PC\_OR})_{it} + \beta_4 \ln(\text{GDP\_PC\_PA})_{jt} + \beta_5 \ln(\text{DISTANCE})_{ij} + \beta_6 \ln(\text{TARIFF\_OR})_{it} + \beta_7 \ln(\text{CPI\_OR})_{it} + \varepsilon_{ijt} \quad (2)$$

We have two equations, where Equation 1 is $ln(EXPORT)_{ijt}$ is the log of exports value of country i to country j in year t, and Equation 2 is $ln(IMPORT)_{ijt}$ is the log of imports values of country i from country j in year t. In both equations, all of the right hand side variables are the same. $ln(GDP\_OR)_{it}$ and $ln(GDP\_PC\_OR)_{it}$ respectively stand for the log of gross domestic product and log of per capita gross domestic product of origin country i in year t. $ln(GDP\_PA)_{jt}$ and $ln(GDP\_PC\_PA)_{jt}$ represent the log of gross domestic product and log of per capita gross domestic product respectively for partner country j in year t. $ln(DISTANCE)_{ij}$ denotes the log of distance from origin country i to the partner country j. $(TARIFF\_PA)_{it}$ is the log of tariff imposed by partner country j on the exported goods of country i (imported goods for j) in year t while $(TARIFF\_OR)_{it}$ is the log of tariff imposed by origin country i on imported goods in year t. $ln(CPI\_OR)_{it}$ represents consumer price index of origin country i and $ln(CPI\_PA)_{jt}$ represents the consumer price index for partner country j in year t. ε_{ijt} is the error term associated with the estimation.

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Table 3. Sample correlation matrix.

	(1) EXPORT	(2) IMPORT	(3) GDP_OR	(4) GDP_PA	(5) GDP_PC_OR	(6) GDP_PC_PA	(7) DISTANCE	(8) TARIFF_OR	(9) TARIFF_PA	(10) CPI_OR	(11) CPI_PA	(12) BGD
(1) EXPORT	1.0000											
(2) IMPORT	0.9506**	1.0000										
(3) GDP_OR	0.4751**	0.4983**	1.0000									
(4) GDP_PA	0.4948**	0.4776**	-0.0057	1.0000								
(5) GDP_PC_OR	-0.0157	0.0386**	0.1253*	0.0781*	1.0000							
(6) GDP_PC_PA	0.0205	-0.0258	0.0919*	0.0508*	-0.0120	1.0000						
(7) DISTANCE	0.6007**	0.5912**	0.4080*	0.4120*	-0.1895*	-0.1729*	1.0000					
(8) TARIFF_OR	-0.1245**	0.1372**	-0.2331*	-0.0819*	-0.6539*	-0.0266	-0.0408*	1.0000				
(9) TARIFF_PA	-0.1311**	-0.1175**F5	-0.0838*	-0.2245*	-0.0432*	-0.6318*	-0.0407*	0.0270	1.0000			
(10) CPI_OR	0.1371**	0.1341**	0.2292*	0.2130*	0.2722*	0.2225*	-0.0184	-0.4558*	-0.2186*	1.0000		
(11) CPI_PA	0.1334**	0.1373**	0.2171*	0.2275*	0.2293*	0.2681*	-0.0184	-0.2183*	-0.4567*	0.6183*	1.0000	
(12) BGD	-0.1249**	-0.1256**	-0.2374**	0.0205	-0.4138*	0.0490*	0.0522*	0.5282*	-0.0401*	-0.0576*	0.0052	1.0000

Note: * p<0.05 and ** p<0.01.

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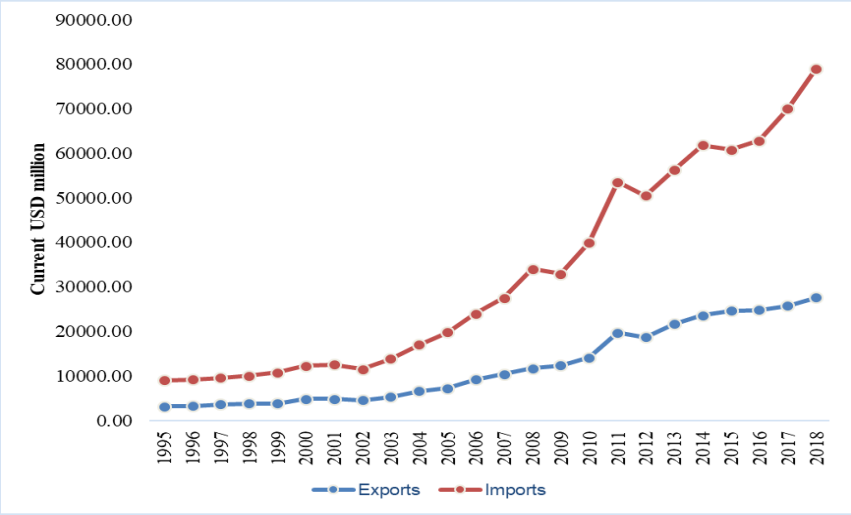

Figure 1. Bangladesh's total exports and imports during the study period (1995-2018).

The equations incorporate the country-pair fixed effects and country-pair time fixed effects through further modification as consistent with Baldwin and Taglioni (2006). We have also run the fixed effects regression both with OLS and PPML methods.

4. RESULTS AND DISCUSSION

Table 4 presents the results of the gravity Equation 1. Along with PPML fixed effect estimator, we have also utilized the OLS and the OLS fixed effects methodologies. This helps to observe how multilateral resistance terms and the presence of heteroskedasticity in the data affect the estimated coefficients. The fixed effects estimators for both OLS and PPML methodology are expected to provide reasonably consistent results for the data set, although some variation may occur due to heteroskedasticity. It is important to note that identifying direct causal relationships for a particular country is difficult from a cross-country regression. The estimations from the general equations were applicable for all the countries included in the study. Nevertheless, the models, including the dummy variables (*BGD*) for Bangladesh as origin country and the interaction terms of that dummy with other explanatory variables, will help to explain the Bangladesh perspective. Table 4 illustrates regression specifications for all of the export models. The first model reports the results of a simple OLS regression. The regression specifications for equation second and third model account for multilateral resistance terms through the OLS fixed effects and the PPML fixed effects estimators respectively. To investigate the trade patterns of Bangladesh, we have modified these three models to observe how the covariates for general specifications interact with the dummy variable representing Bangladesh. The coefficient representing the economic size of the origin country (*ln_GDP_OR*) reported the expected positive sign and statistical significance only for column 1 and column 4. However, the results of these two columns are not valid for gravity estimation since none of this accounted for multilateral resistance terms. Column 3 and column 6 represent the fixed effects of PPML estimator, which is the preferred methodology. Nevertheless, the coefficients for the gross domestic product of origin country are not statistically significant for all models accounting for multilateral resistance. This is an interesting finding that seems to be inconsistent with the general predictions of the gravity model. However, the interaction term for the coefficient of origin countries GDP and the dummy variable for Bangladesh (*BGD x ln_GDP_OR*) are large, positive and statistically significant in both OLS fixed effects and PPML fixed effects estimators. This implies that Bangladesh's GDP determined the exports more positively compared to other countries included in this analysis. Further, the coefficient representing the economic size of the partner countries (*ln_GDP_PA*) is positive and statistically significant for all six columns presented in

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Table 4. Moreover, it is consistent between all the models that account for multilateral resistance through fixed effects estimators.

Table 4. Estimation of exports.

Model	1	2	3	4	5	6
Estimator:	**OLS**	**OLS**	**PPML**	**OLS**	**OLS**	**PPML**
Dependent variable:	**ln_EXPORT**	**ln_EXPORT**	**EXPORT**	**ln_EXPORT**	**ln_EXPORT**	**EXPORT**
ln_GDP_OR	0.765***	-0.0774	0.127	0.624***	-0.597*	0.120
	(0.0190)	(0.262)	(0.180)	(0.0206)	(0.024)	(0.181)
ln_GDP_PA	0.854***	0.447***	0.436***	0.868***	0.404***	0.437***
	(0.0207)	(0.0534)	(0.0339)	(0.0207)	(0.0431)	(0.0339)
ln_GDP_PC_OR	0.135***	0.926***	0.576**	0.0222	1.405***	0.582**
	(0.0163)	(0.279)	(0.197)	(0.0163)	(0.258)	(0.198)
ln_GDP_PC_PA	0.0575**	0.0620***	0.0609***	0.0229	0.0417**	0.0602***
	(0.0205)	(0.0146)	(0.0132)	(0.0213)	(0.0151)	(0.0132)
ln_DISTANCE	0.123***	-0.771***	-0.659***	0.126***	-0.894***	-0.661***
	(0.0137)	(0.0229)	(0.0169)	(0.0139)	(0.0239)	(0.0170)
ln_TARIFF_PA	-0.201***	-0.0250	-0.0591***	-0.230***	-0.0720**	-0.0593***
	(0.0247)	(0.0198)	(0.0152)	(0.0267)	(0.0233)	(0.0153)
ln_CPI_PA	-1.188***	0.102	0.0257	-0.900***	0.253**	0.0268
	(0.131)	(0.111)	(0.0776)	(0.134)	(0.0938)	(0.0778)
BGD x ln_GDP_OR				3.682**	7.485***	6.871***
				(1.209)	(1.699)	(1.488)
BGD x ln_GDP_PA				-0.402***	-0.305	-0.500***
				(0.0680)	(0.172)	(0.0670)
BGD x ln_GDP_PC_OR				-3.443*	-7.724***	-7.423***
				(1.430)	(1.974)	(1.661)
BGD x ln_GDP_PC_PA				0.324***	1.008***	1.186***
				(0.0590)	(0.123)	(0.0878)
BGD x ln_DISTANCE				0.217***	0.169*	0.227***
				(0.0416)	(0.0782)	(0.0440)
BGD x ln_TARIFF_PA				0.349***	0.600**	0.794***
				(0.0579)	(0.207)	(0.100)
BGD x ln_CPI_PA				-0.485	-2.092**	-0.524
				(0.527)	(0.659)	(0.560)
BGD				-40.16**	-81.58***	-79.71***
				(14.20)	(19.99)	(17.16)
Observations	3036	3036	3036	3036	3036	3036
Country-Pair FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes

Note: Robust standard errors in parentheses.
* p<0.05, ** p<0.01, *** , P<0.001.

Column 1 and column 4 provide much larger coefficients which are misleading which demonstrates the biased estimations if the fixed effects are not applied in the estimator. However, the interaction term between the dummy variable for Bangladesh (*BGD*) and its partner countries GDP (*BGD x ln_GDP_PA*) is negative and statistically significant at 1 %level for the PPML fixed effects estimator (column 6). The estimated elasticities for *ln_GDP_PA* and *BGD x ln_GDP_PA* are 0.437 (s.e. = 0.0339) and -0.500 (s.e. = 0.0670) respectively. The larger estimate suggests a larger role of the coefficients in determining the exports pattern. So, the overall effect of the partner countries' GDP on Bangladesh's exports is small but negative. This finding contradicts with the general prediction of the gravity model but consistent with Rahman and Dutta (2012) who report that Bangladesh's exports were negatively determined by partner countries' total income. Thus, there is evidence that Bangladesh's exports are positively determined by its own GDP, and negatively determined by partner countries GDP. The finding is mixed in nature. The explanatory variable representing the level of development of origin country *ln_GDP_PC_OR* was positive and significant in both the OLS fixed effects and the PPML fixed effects estimators. This finding was

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consistent with the general prediction of the gravity model as the more developed countries were capable of producing technologically advanced, sophisticated and high-value products that contribute to increasing export volume (Lall, 2000). However, the interaction term (*BGD x ln_GDP_PC_OR*) between this variable with Bangladesh dummy (*BGD*) was negative and statistically significant for both the OLS fixed effects and PPML fixed effects regression. The PPML estimated elasticities for *ln_GDP_PC_OR* and *BGD x ln_GDP_PC_OR* were 0.582 (s.e. = 0198) and -7.423 (s.e. = 1.661) respectively. Hence, the total effect of these variables on the exports of Bangladesh was strong and negative. This finding implies that the level of development negatively determines Bangladesh's exports. One possible cause may be the enlargement of domestic market demand which is substituting the country's exports. The per capita gross domestic product of the partner country (*ln_GDP_PC_PA*) is positive and statistically significant for both the PPML estimators. The OLS fixed effects specifications were also positive and significant and confirmed the robustness of the estimation. The coefficients representing partner countries' per capita GDP remained almost unchanged after the introduction of the dummy variable *BGD* and the interaction term (*BGD x ln_GDP_PC_PA*) in the regression. This finding suggests that in general, exports are positively determined by the partner countries' level of development. However, the estimated coefficient of the interaction term was much larger (1.186) than the coefficient of the original variable (0.0602) in the PPML fixed effects estimator. The OLS fixed effects estimator also reported a similar difference between the same coefficients. This difference between the coefficients suggests that Bangladesh's exports have a stronger and positive relationship with the partner countries' level of development compared to the other countries included in the study.

The geographic distance is an important standard gravity variable which helps to measure the effect of trade costs. Except the basic regression models, both the OLS fixed effects and PPML fixed effects estimators report negative and significant coefficients for the distance variable which was consistent with the general prediction of the gravity model. The interaction term between dummy variable *BGD* and distance variable (*BGD x ln_DISTANCE*) returned a positive and significant coefficient in PPML estimator. This coefficient was also positive and significant for OLS fixed effects estimator at 10% level but insignificant at 5% level. The PPML estimated elasticities for *ln_DISTANCE* and *BGD x ln_DISTANCE* was respectively -0.661 (s.e. = 0.0170) and 0.227 (s.e. = 0.0440). Hence the overall effect of distance on Bangladesh was still negative due to the stronger effect of the large negative coefficient. This finding suggests that distance matters less to Bangladesh's exports compared to its partner countries. This is consistent with Rahman (2010) and suggests distance created fewer trade barriers for Bangladesh compared to other countries. That is why Bangladesh tends to export more to distant countries.

Partner countries' tariffs imposed on imported goods, work as a trade barrier to the exports of the origin countries. The preferred methodology of this thesis, the fixed effects PPML estimators report negative coefficients for *ln_TARIFF_PA* that were statistically significant. This result was consistent with the prediction of the general gravity model. However, again the coefficient of the interaction term (*BGD x ln_TARIFF_PA*) between the dummy variable *BGD* and tariff applied by partner countries was positive and statistically significant with the PPML fixed effect estimator. The estimated elasticities for *ln_TARIFF_PA* and *BGD x ln_TARIFF_PA* were -0.0593 (s.e. = 0.0153) and 0.794 (s.e. = 0.100) respectively. The much larger positive coefficient of the interaction term suggests that the overall effect of the partner countries' tariffs on Bangladesh's trade was positive. The OLS fixed effects estimator also has significant and large positive coefficients for this interaction term. This finding contradicts with Rahman and Ara (2010) who identified a negative relationship between tariffs and Bangladesh's exports. This was an exceptional finding that requires further investigation.

Table 5 presents the import models with similar specification explained in Table 4. The GDP of the origin country (*ln_GDP_OR*) is statistically insignificant for all the estimators accounting for the multilateral resistance terms. There were similarities to the outcome from the export regression, which was not aligned with the general prediction of the gravity model. The interaction term (*BGD x ln_GDP_OR*) for the coefficient of origin countries GDP and the dummy variable for Bangladesh was also statistically insignificant. This finding contradicts Roy and

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Rayhan (2012) who obtained a positive significant coefficient for importers GDP in an analysis of import flows to Bangladesh with a gravity approach. However, our study differs with them in terms of sample and approaches.

Table 5. Estimation of imports.

Model	1	2	3	4	5	6
Estimator:	**OLS**	**OLS**	**PPML**	**OLS**	**OLS**	**PPML**
Dependent variable:	**ln_IMPORT**	**ln_IMPORT**	**IMPORT**	**ln_IMPORT**	**ln_IMPORT**	**IMPORT**
ln_GDP_OR	0.842***	-0.266	-0.449*	0.775***	-0.309	-0.445*
	(0.0234)	(0.266)	(0.213)	(0.0253)	(0.261)	(0.213)
ln_GDP_PA	0.827***	0.496***	0.437***	0.836***	0.494***	0.437***
	(0.0178)	(0.0331)	(0.0352)	(0.0170)	(0.0324)	(0.0352)
ln_GDP_PC_OR	0.0803**	1.016***	1.112***	0.0932***	1.053***	1.109***
	(0.0252)	(0.280)	(0.217)	(0.0235)	(0.275)	(0.218)
ln_GDP_PC_PA	0.0649***	0.0656***	0.0932***	0.105***	0.0917***	0.0937***
	(0.0147)	(0.0165)	(0.0167)	(0.0140)	(0.0164)	(0.0167)
ln_DISTANCE	0.0942***	-0.750***	-0.594***	0.123***	-0.693***	-0.592***
	(0.0139)	(0.0218)	(0.0165)	(0.0140)	(0.0204)	(0.0165)
ln_TARIFF_OR	-0.211***	-0.0275	-0.0471**	-0.173***	-0.0249	-0.0471**
	(0.0271)	(0.0155)	(0.0153)	(0.0269)	(0.0152)	(0.0153)
ln_CPI_OR	-1.173***	0.139	0.192*	-1.217***	0.138	0.188*
	(0.120)	(0.117)	(0.0933)	(0.122)	(0.119)	(0.0942)
BGD x ln_GDP_OR				-1.385	-0.369	-1.178
				(6.921)	(3.886)	(2.960)
BGD x ln_GDP_PA				-0.697***	-0.375***	-0.393***
				(0.114)	(0.0520)	(0.0366)
BGD x ln_GDP_PC_OR				-0.876	-1.256	-1.569
				(5.613)	(3.275)	(2.679)
BGD x ln_GDP_PC_PA				-0.827***	-0.385***	-0.470***
				(0.0404)	(0.0308)	(0.0289)
BGD x ln_DISTANCE				0.108	-0.0208	0.0727**
				(0.0660)	(0.0341)	(0.0237)
BGD x ln_TARIFF_OR				-0.0279	-0.125	-0.235
				(0.317)	(0.165)	(0.127)
BGD x ln_CPI_OR				4.559	2.372	4.345***
				(3.328)	(1.715)	(1.103)
BGD				6.511	-1.833	-1.735
				(68.42)	(39.17)	(31.18)
Observations	3038	3038	3038	3038	3038	3038
Country-Pair FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes

Note: Robust standard errors in parentheses.
* p<0.05, ** p<0.01, *** p<0.001.

The coefficients of the partner countries GDP (*ln_GDP_PA*) were positive and statistically significant for all the estimators. This suggests that the partner countries' total income positively determines the import volume for all 53 countries included in the study. However, the interaction term between the dummy variable for Bangladesh (*BGD*) and partner countries GDP (*BGD x ln_GDP_PA*) is negative and statistically significant in both the OLS fixed effects and the PPML fixed effects estimators. The PPML estimated elasticities (column 6) for *ln_GDP_PA* and *BGD x ln_GDP_PA* were 0.437 (s.e. = 0.0352) and -0.393 (s.e. = 0.0366) respectively, although, the overall effect was still positive due to larger positive coefficient. This result implies that partner countries' total income had a positive but weaker relationship with Bangladesh's imports volume. This suggests mixed results regarding the relationship between Bangladesh's import flows and trading countries income. However, the overall impact of origin and partner countries is positive. The coefficients for the per capita GDP of the origin country (*ln_GDP_PC_OR*) were positive and statistically significant in both the OLS fixed effects and the PPML fixed effects estimators. That means the level of development of the importing countries positively determined the respective import volume. This is consistent with general economic theory as a higher level of income is associated with greater consumption which eventually increases imports. Nevertheless, the coefficient of the interaction term of origin countries per capita GDP and Bangladesh dummy was not significant. Thus, the evidence suggests that

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the relationship between Bangladesh's GDP and imports flow were positive, but not significantly different from other countries. The coefficients for the per capita GDP of the partner country (*ln_GDP_PC_PA*) also demonstrate significant and positive relationships with imports flow for all the regressions. However, both the OLS fixed effects and the PPML fixed effects estimators reported a negative coefficient for the interaction term (*BGD x ln_GDP_PC_PA*). The PPML estimated elasticities for the *ln_GDP_PC_PA* and *BGD x ln_GDP_PC_PA* were 0.0937 (s.e. = 0.016) and -0.470 (s.e.= 0.0289). The much larger negative coefficient implies that the partner countries level of development negatively determined Bangladesh's import flows and suggests that gravity model does not fully hold to describe Bangladesh's imports pattern. The distance coefficients for all the import regressions were negative and statistically significant. However, the measured elasticity of the interaction term (*BGD x ln_DISTANCE*) between the Bangladesh dummy and distance variable was small but positive and significant with the PPML fixed effects estimator. The estimated elasticities for *ln_DISTANCE* and *BGD x ln_DISTANCE* were -0.592 (s.e. = 0.0165) and 0.0727 (s.e. = 0.0237) respectively. The overall effect of distance on Bangladesh's imports was negative, but this finding implies that distance creates a less barrier to Bangladesh's imports compared to other countries included in this study. This is evident that many of the top import partners of Bangladesh are relatively distant countries. The coefficient for the importing countries tariff (*ln_TARIFF_OR*) is negative and statistically significant for PPML fixed effects estimators. The import tariff imposed by origin country increases the trade costs. So, this result is consistent with the general prediction of the gravity model. However, the interaction term (*BGD x ln_TARIFF_OR*) is not statistically significant. This finding suggests that the relationship between Bangladesh's imports tariffs and imports volume is negative and it is not significantly different from the same relationship of other countries.

4.1. Additional Analysis

We have performed a descriptive analysis to investigate the reasons behind the unusual patterns of Bangladesh's export and import flows. We find strong empirical evidence that Bangladesh's level of development negatively determines Bangladesh's exports volume as evidenced through its top export's basket. Since the labor-intensive ready-made garments (RMG) industry wages generally increase with an increase in the per capita GDP of a country (Angeles, 2008) which significantly increases the production costs of those critical export goods (Anner, 2020). Further, RMG exporters face constant pressure from global buyers in the highly competitive market to reduce the cost of the production (Barua, Kar, & Mahbub, 2018) which is also consistent with this antagonistic relationship with its per capita GDP. With gravity model explanation, Bangladesh appears to be exporting too much in the intensive margin and not enough in the extensive margin. The second empirical finding of this thesis that demands further explanation is the limited effect of distance on Bangladesh's trade compared to other countries. The top six countries alone account for 61.68% of Bangladesh's total exports during the study period. The products traded with Bangladesh were almost similar in all six countries. This finding is in line with the Heckscher-Ohlin (H-O) model, which argues that countries with different factor endowments would trade more. However, the difference in the factor endowments outweighs the effect of the distance barrier, and Bangladesh tends to trade more with those countries. However, this trade pattern does not support (Linder, 1961) hypothesis, which predicted that countries with similar per capita income would trade more between each other. The last empirical finding of this study that requires further explanation is the positive relationship between Bangladesh's exports and partner countries import tariffs. Apart from the US, Canada, and China, all the top ten exports destinations of Bangladesh were EU countries. Bangladesh receives a generalized scheme of preference (GSP) facility from the EU as a least developed country. Under GSP, almost all exported goods from Bangladesh are exempted from any duty in the EU member countries. None of the major competitors of Bangladesh in the RMG industry, such as China and India, receive this advantage in the EU market. Thus, if the import tariffs of EU member countries increase, it does not affect the trade costs of the goods that are imported from Bangladesh. Moreover, the importing firms of the EU

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countries would prefer to import more from Bangladesh instead of other countries to take advantage of the tariff exemption. This might provide a competitive advantage to Bangladeshi exporters to the EU market. Bangladesh also received a similar facility from the US during most of the period of this study. This may be a reason for the positive relationship between partner countries tariffs and Bangladesh's exports.

5. FINDINGS AND CONCLUSION

This work investigates whether the gravity model explains the international trade patterns of Bangladesh. We have used 52 major trade partners which account for 98.10% of the total exports and 97.70% of the total imports of Bangladesh during the study period (1995-2018) and our data includes a large panel data set of 3168 observations. We have run separate regressions for exports and imports and utilized the most appropriate method of gravity-based trade analysis, the PPML fixed effects estimator, as suggested by Silva and Tenreyro (2006). We have revealed some of the unique characteristics of Bangladesh's trade that were not in line with the general predictions of the gravity model. The results are robust and significant both economically and statistically. We find that Bangladesh's GDP is positively related to the export volume of Bangladesh but does not have a significant relationship with import flows. Contrary to the gravity prediction, we find evidence that partner countries' GDP has a weak but negative relationship with Bangladesh's exports, whereas its impact on Bangladesh's imports is positive but smaller in comparison with other countries. Bangladesh's level of development is negatively related to its export flows, where the relationship with imports is positive and like other countries included in this study. However, the partner countries level of development has a comparatively strong and positive relationship with Bangladesh's exports, but the same variable is negatively related to Bangladesh's import flows. One notable finding is the minimal effect of distance on both exports and imports. Bangladesh tends to trade more with the distant countries compared to its other trade partners, and trade costs associated with geographical distance appear to matter less. However, the distance still negatively affects Bangladesh's trade, and this specific finding is not inconsistent with the gravity model, but more consistent with H-O theory. The positive relationship between Bangladesh's exports with importing countries tariffs rate is established. The GSP facility offered to Bangladesh by the EU allows Bangladeshi exporters to avoid higher tariffs and provides a competitive advantage over its major competitors. Thus, the effective tariff does not create any trade barrier to Bangladesh in its major market. This paper makes several contributions. To the best of our knowledge, this is the first gravity-based trade analysis of Bangladesh that has used the PPML fixed effects estimator and considered for the two-way flow of trade to account for multilateral resistance terms. Moreover, this study addressed the common econometric issues that can lead to biased and misleading estimations within the gravity equation. Previous gravity-based research on Bangladesh trade had a tendency to be associated with econometric and theoretical limitations. The findings of this study also provide important policy implications for Bangladesh's international trade. However, this study may be subject to sample selection bias since it includes only 52 of the top trade partner countries. Secondly, with data aggregation, we have also lost a significant amount of information from the data. Using the current price without addressing the exchange rate can also create to misleading inferences. Further, we cannot completely rule out the issue of endogeneity due to the nature of the data used in this study even after utilizing country-pair fixed effects and time fixed effects to capture multilateral resistance terms. There may be a presence of reverse causality among the variable. We present further research scope addressing this limitation. However, analyzing the trade patterns with different regions would provide more useful information for trade policy formulation.

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APPENDIX

Appendix A. List of partner countries.

Top 10 Trade Partners				
China	Japan	France	Germany	India
Spain	Singapore	United Kingdom	United States	Italy
Rest of the World (ROW) (42 Countries)				
Greece	Hong Kong	Indonesia	Ireland	Kore, Rep.
Chile	Czech Republic	Denmark	Egypt	Finland
Australia	Austria	Belgium	Brazil	Canada
Kuwait	Malaysia	Mexico	Myanmar	Nepal
Netherlands	New Zealand	Norway	Oman	Pakistan
Peru	Philippines	Poland	Portugal	Qatar
Russia	Saudi Arabia	Slovak Rep.	South Africa	Sri Lanka
Sweden	Switzerland	Thailand	Turkey	Ukraine
UAE	Vietnam			

Note: This study includes total 52 countries where the 42 countries are aggregated as ROW. Trade data of China includes Taiwan, but Hongkong is reported separately.

Appendix B. Description of the key variables.

Variable Name	Symbol	Definition	Data Source
Export	*EXPORT*	Total export (FOB) volume from origin country to partner country in current US million dollar in one particular year	IMF, Direction of Trade Statistics
Import	*IMPORT*	Total import (CIF) volume from partner country to origin country in current US million dollar in one particular year	IMF, Direction of Trade Statistics
GDP of origin country	*GDP_OR*	Gross domestic product of origin country in current US million dollar	World Bank, World Development Indicators
GDP of partner country	*GDP_PA*	Gross domestic product of partner country in current US million dollar	World Bank, World Development Indicators
Per capita GDP of origin country	*GDP_PC_OR*	Gross domestic product per capita (GDP divided by population) of origin country in current US thousand dollar	World Bank, World Development Indicators
Per capita GDP of partner country	*GDP_PC_PA*	Gross domestic product per capita (GDP divided by population) of partner country in current US thousand dollar	World Bank, World Development Indicators
Distance	*DISTANCE*	Capital to capital distance between the trading countries in kilometers.	CEPII
Tariff of origin country	*TARIFF_OR*	Applied weighted mean tariff of all product imposed by origin country on imported goods	World Bank, World Development Indicators
Tariff of origin country	*TARIFF_PA*	Applied weighted mean tariff of all products imposed by partner country on exported goods	World Bank, World Development Indicators
Consumer price index of origin country	*CPI_OR*	Consumer price index of origin country based on 2010 US dollar	World Bank, World Development Indicators
Consumer price index of partner country	*CPI_PA*	Consumer price index of partner country based on 2010 US dollar	World Bank, World Development Indicators
Bangladesh	*BGD*	Dummy variable if the origin country is Bangladesh	Generated

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Appendix C. Most distant top trade partners of Bangladesh with major trading products.

	United States	Spain	United Kingdom	France	Italy	Germany
Distance from Bangladesh (in kilometre)	12947	8661	8012	7917	7312	7077
Top exported items to Bangladesh	1. Raw materials 2. vegetable 3. Miscellaneous 4. Capital goods 5. Machine and Electronics	1. Intermediate goods 2. Capital goods 3. Machine and Electronics 4. Chemicals 5. Textile and Clothing	1. Capital goods 2. Machine and Electronics 3. Intermediate goods 4. Raw materials 5. Metals	1. Capital goods 2. Machine and Electronic 3. Intermedia goods 4. Raw materials 5. Chemicals	1. Capital goods 2. Machine and Electronic 3. Intermedia goods 4. Chemicals 5. Transportation	1. Capital goods 2. Machine and Electronic 3. Intermedia goods 4. Chemicals 5. Miscellaneous
Top imported items from Bangladesh	1. Textile and Clothing 2. Footwear 3. Raw materials 4. Intermediate goods 5. Animal	1. Textile and Clothing 2. Footwear 3. Intermediate goods 4. Hides and skins 5. Raw materials	1. Textiles and Clothing 2. Raw materials 3. Animal 4. Transportation 5. Footwear	1. Textiles and Clothing 2. Footwear 3. Raw materials 4. Animal 5. Hides and skins	1. Textile and Clothing 2. Intermediate goods 3. Hides and skins 4. Footwear 5. Raw materials	1. Textiles and Clothing 2. Footwear 3. Raw materials 4. Animal 5. Hides and skins

Source: Author's construction from World Bank World Integrated Trade Solution (WITS) https://wits.worldbank.org/.

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