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The impact of transport infrastructure on Readymade garment export in Bangladesh: A gravity model estimation

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Abtract

Transport infrastructure is considered the most important component for international trade by accessing the world market. This study aims to explore identifying the role of transport infrastructure performance in Readymade garment (RMG) bilateral export between Bangladesh and its trading partners. This study employed a gravity model under two different econometric specifications: Pooled OLS (POLS) and Poisson pseudo-maximum likelihood (PPML) estimator with time and country-specific effects. The current study considered different transportation moods such as rail, road, air, and sea. Results showed the standard gravity variables are highly significant with the expected signs. The novelty of this study is to provide an empirical analysis of the impact of different transportation moods on commodity trade, more precisely in the RMG industry. Finally, the result shows that logistics except for road the other three transportation moods such as rail, air, and sea are found a positive and significant correlation with RMG trade.

Keywords:

Transport infrastructure, Readymade garment export, Gravity model, Bangladesh.

Introduction

Infrastructure plays an important role in economic development and international trade. The international economy has become more globalized as a result of advancements in transportation and rapid improvement. The improvements of transport infrastructure help a country to domestically and globally connect its trade partners by reducing the travel time and cost which facilitate the producer country to access distant markets and promote trade (Bottasso et al., 2018; Donaubauer et al., 2018; Francois et al., 2013; Ismail & Mahyideen, 2015; Nordås & Piermartini, 2004). It allows countries to lower transportation and trade expenses, boost international trade activities, and improve their competitiveness. However, a lack of infrastructure is a significant impediment to global trade integration (Gani, 2017).

According to United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), transportation infrastructure includes transportation networks, roads, rails, ports and warehouses, storage facilities, and trade services. The competitive character of developing countries can make an inefficient logistics industry and inadequate transportation infrastructure very difficult to overcome (Asian Development Bank (ADB), 2019). The most significant barrier to international markets is insufficient domestic infrastructure in poorer countries (Coşar & Demir, 2016). Various forms of infrastructure are required in trade, including transportation networks, cars, ports and warehouses, and storage (UNESCAP, 2019).

The countries from the South Asian region are growing very fast. Furthermore, South Asia must sustainably maintain its growth momentum. Economic and social infrastructure development is one of the most important determinants of economic growth, particularly in emerging countries. South Asian countries benefit from infrastructure development in terms of economic growth and per capita income. Nonetheless, South Asian countries should put a higher focus on infrastructure development (Sahoo & Dash, 2012). According to the Asian Development Bank (ADB), ASEAN countries would require a total infrastructure investment of USD 3.1 trillion from 2016 to 2030 (Asian Development Bank (ADB), 2019). As the overall volume of trade trade in ASEAN countries is likely to grow, infrastructure requirements will become increasingly necessary to support the overall economic growth. Bangladesh, a nation northeast of the Asian subcontinent country has made great development in various social and economic areas over the previous few decades. Bangladesh is a developing economy in Asia. The garment industry in Bangladesh is one of the most important sectors, with a large market all over the world. Bangladesh is the world's second-largest garment producer and exporter, after China. Bangladesh's RMG is regarded as the country's economic backbone. Bangladesh is the world's second-largest manufacturer and exporter of RMG after China (WTO, 2019).

In terms of infrastructure development, Bangladesh ranks 111th out of 137 countries worldwide (Schwab, 2018). This indicates that infrastructure is a major obstacle to the economic development of Bangladesh and the country has a lot of room to grow its infrastructure. Furthermore, Bangladesh, Cambodia, and Myanmar, three Asian nations, have the widest gap between their existing trends and infrastructure investment requirements (Global Infrastructure Hub, 2017; Muhammad, 2011). Bangladesh has the highest density of roads in the world. Although just 30% of the roads are paved, over 60% of the rural population lacks access to roadways at all times of the year (Asian Development Bank (ADB), 2019). Connectivity comparison indicates that Bangladesh is well behind China (the biggest RMG exporter). In each sub-indicator – roads, ports, railroads, and air-connectivity infrastructure – the "Transport Infrastructure" sub-individual for the Global Competitiveness Index (Table 1) in Bangladesh. Massive public investment and successful implementation have been a major factor for the development of infrastructure in China which Bangladesh is lagging behind (Qin et al., 2016).

Table 1: Ranking in infrastructure parameters of Global Competitiveness Index

Infrastructure Indicators	**Bangladesh**
Road connectivity index 0-100 best)	121
Quality of roads 1-7 (best)	111
Railroad density km of roads/square km	40
The efficiency of air transport services 1-7 (best)	109
Airport connectivity (score)	63
Linear Shipping Connectivity Index 0-157.1 (best)	81
Efficiency of seaport services 1-7 (best)	93

(Source: World Bank, Global Competitiveness Report, 2018)

Sustainability is critical for access to supportive infrastructure, with Bangladesh's RMG industry facing a major deficit. According to Global Infrastructure Hub (2017) Infrastructure is the biggest problem in the Bangladesh RMG business. The costs are measured by charges levied in US dollars on a 20-foot container. Included are the charges involved with exporting or importing the products. These include paperwork costs, customs and technical inspections administrative fees, customs broker fees, terminal handling fees, and inland transit. The most frequent means of transport for the export of RMG products is shipping logistics. The comparison cost per container amongst top exporters of apparel is indicated in Figure 1. While China has become the leading exporter of RMG products, the cost per container is below Bangladesh's. Vietnam, another close competitor o Bangladesh in terms of exporting RMG products which likewise has cheaper transportation costs than Bangladesh. In Bangladesh, the transport system is not also a property damaging the good, narrow and damaged road. Bangladesh is also harmed by the highest cost per export of containers. Even the nice, narrow, and broken road in Bangladesh does not cause a damaged property. Furthermore, the carrying of ready-made things via the port occasionally becomes a lengthy operation.

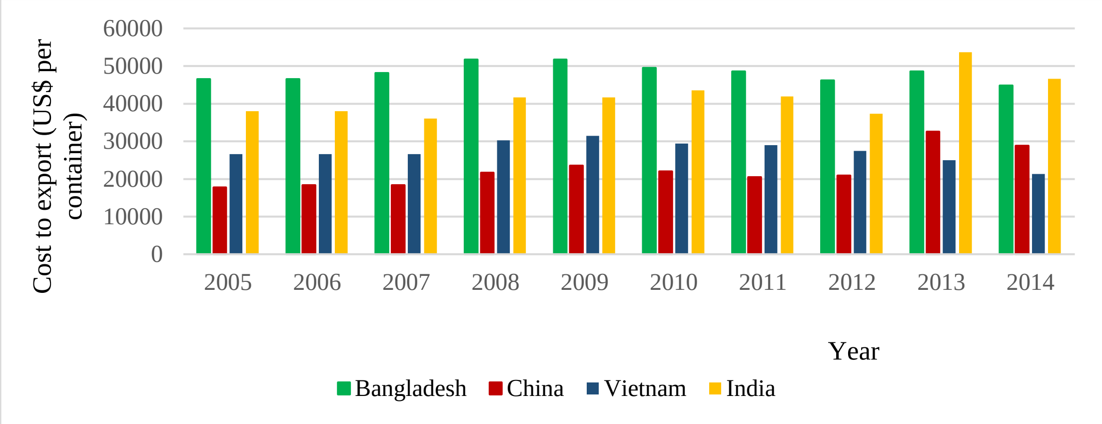

Figure 1: Per Container Cost to export in top exporters of RMG
(Source: World Development Indicator Database, 2018)

The RMG industry is heavily dependent on the Dhaka-Chittagong highway as Chittagong's main port. The two towns of Dhaka and Chittagong include much of the RMG industry. This makes it extremely vital to export RMG products over the Dhaka-Chittagong route. A two-lane road with considerable traffic and a four-lane highway is now under construction. During 280 km from Dhaka to Chittagong Seaport, an ineffective cargo is reached for one day. Due to substandard road installations, cargo vehicles must remain in traffic jams between Chittagong and Dhaka for hours. The port of Chittagong is affected by labour problems, inadequate port administration, and lack of equipment, which handles almost 85 percent of the trade in the country. Overall, Bangladesh's inconvenient and outdated transportation and infrastructure are important barriers to attracting foreign investment. Investors are constantly on the lookout for outstanding infrastructure. Likewise, Bangladesh's transportation system is inadequate with small and broken roads contributing to property damage. Bangladesh also has a major traffic jam, which it has been unable to resolve for a long time due to a lack of proper urban planning.

Therefore, it is important to understand the developments in transportation and their role in the country's trade performance. The country must evaluate its transportation performance to target more trade and achieve a competitive advantage by increasing the international trade potential. Hence, this paper is one of the first attempted to examine the relationship between improvements in transport infrastructure and the export performance of RMG. More explicitly, we focus on the four different transportation moods on trade. The contribution of this study is to estimate the empirical relationship between different transport infrastructures and bilateral RMG export in Bangladesh. This research also explicitly followed the vastly used framework in international trade which is the augmented gravity model (Anderson & Van Wincoop, 2003). We also took into account countries' multilateral resistance issues using fixed effects (Feenstra, 2002; Y. Zhang et al., 2016). Along with using panel data estimation, the current study also considered the Poisson pseudo-maximum likelihood (PPML) estimator introduced by Silva and Tenreyro (2006) aiming to get a more robust coefficient.

This paper is organized as follows. The second part presents a literature review of the literature. The third section shows the empirical model and data. The fourth section details the results obtained and, finally, the last section presents the conclusions of this research.

Literature review

This study analyses the influence and impact on trade expenses of physical infrastructure. Previous studies have shown the importance of the quality of the physical infrastructure to enhance export while reducing trade costs supported by empirical evidence. A reduction in transportation costs has a statistically significant and positive impact on international trade. Most literature recognizes that transport is one of the most important types of infrastructure that support economic activity and trade (Martinez-Zarzoso et al., 2008; Pradhan et al., 2018). Transport infrastructure has various features, including road networks, ports, and airports. Some countries may have great road infrastructure but relatively inadequate road infrastructure. Infrastructures facilitation may differ in sectors since, depending on the nature of the industry, different sectors need various forms of infrastructure.

Infrastructure is a critical determinant of trade. The number of freight users not only drives infrastructure building and maintenance but also allows transportation officials to provide significant benefits. Many studies link transportation to economic infrastructure and trade volume growth, highlighting the importance of logistical services (Gillen & Waters II, 1996; Lakshmanan, 2011). In this regard, there are some studies those explicitly done on transport infrastructure indicators such as train, road length, and air traffic departures number (Alamá-Sabater et al., 2013; Bensassi et al., 2015; Clark et al., 2004; Hoffmann et al., 2016; Limao & Venables, 2001; Márquez-Ramos, 2016; Micco & Serebrisky, 2004). Likewise, Cullinane et al. (2006) propose that containers attract more users in high-level ports, hence ensuring a link between container performance and port efficiency.

Therefore, they suggest that solely container performance as the output variable is included in port performance analyses. Most published articles on port performance evaluations have followed this strategy. Portugal-Perez and Wilson (2012) examined the impact on export performance of 101 developing countries of four major parameters pertaining to trade facilitation - physical facilities and transport quality. The physical infrastructure has the biggest impact on exports in almost all requirements and samples between all metrics. Hernandez and Taningco (2010) employed a method for the gravity model and discovered an important impact on the quality of port facilities in East Asia's bilateral trade flows. However, the influence may vary from sector or product category. Additional research using the Gravity Model highlighted the critical importance of infrastructure in trade, in addition to the studies described to date. For example, Hoekman and Nicita (2011) found that low road and port performance, poor customs performance, and weaker regulated trade.

With a large sample of 150 developing and emerging economies, Donaubauer et al. (2018) has assessed the influence of infrastructure on bilateral trade. The results of this analysis indicate that increasing infrastructure and quality resources decrease trade costs and increase trade flows. This infrastructural enhancement also promotes a reduction in multilateral trade costs.

In Cambodia, Bangladesh, and India, Siddiqui and Vita (2021) focused on a comparative analysis of the impact logistical performance on the export of RMG sector. The panel analyses the influence of logistical performance in the industry for the period 2001–2016 on trade in the three nations of Cambodia, Bangladesh, and India. Their results show that transit in the RMG business has a positive effect on trade. The current research also presents country-specific evidence to enhance trade by adopting policies to facilitate trade. In the instance of Mexico, trade facilitation has increased industrial exports by 22.4%. The logistics Performance Index (LPI) also was employed as an explanatory trade variable by several research. Logistics performance has a considerable trade impact in most medium-income countries where infrastructure development is the focus (Korinek & Sourdin, 2011; Munim & Schramm, 2018). The findings reveal that the infrastructure has a significant and positive association between the level of infrastructure and the volume of trade. As a result, disparities in transport costs among countries will decrease their capacity for global markets to trade.

Li et al. (2019) evaluated the transportation and trade constraints of Chinese agricultural traders. In 2004, the estimate is based on a survey by Chinese agriculture traders. The results reveal that Chinese trade barriers represent about 20% of market value, whereas transit costs are about 40% of trade barriers. As a result of improved fuel consumption productivity and a decreased demand for labor, the author noted transport costs rise by around 0.7 percent relative to transport distance.

The existing literature also focuses on the adoption of country-specific trade facilitation measures to increase trade performances. This paper contributes to the international trade literature that identities transportation costs in the context of Bangladesh's RMG industry export. Bangladesh appears to have much less importance than other measures like infrastructure because of both tariff and non-tariff barriers. Poor physical infrastructure is reflected in high transport costs that will hinder trade and hamper trade liberalization gains. The infrastructure of transport influences the competitive advantage of the country since the costs of different means of transport affect trade volumes and trade composition. This allows the government to build an integrated and sectoral more complete trade policy. This study looks at all means of transport, like land, air, and maritime infrastructure, because international trade is based on transportation and distribution.

Methodology

A substantial number of research have been carried out employing the empirical framework of a gravity equation which has been focused on the effect of various logistics parameters on international trade. In the literature on international trade and Gravity, Models have been widely used because it is one of the most empirically successful equations in economics (Anderson & Van Wincoop, 2003). However, at that time other prominent models of international trade were available one is the Richardian model which includes that technological differences can affect the trade patterns across countries, another model is named Heckscher-Ohlin (HO) model which includes different factor endowments among countries based on trade. Also, it was anticipated that HO models and Richardian models were not capable to provide a foundation for the gravity model for example in the HO model, the country size has very less effect on the trade flows. The gravity model takes the natural logarithm of the value of trade between two countries to the log of their respective GDPs. Thus, this specification allows an easy interpretation of the estimated parameters. For instance, the logarithms of GDP in a gravity equation express the elasticity of trade to GDP which indicates that the percentage of variation in trade flows depends on the one percent increase in GDP (Nijkamp & Reggiani, 1992).

Due to the extraordinary stability of the gravity equation and its capacity to clarify bilateral trade flows, it became popular among researchers. Anderson (1979) gave an empirical premise to gravity models for the first time. He did as such with regards to a model where goods were separated by the nation of origin and where purchasers have inclinations characterized over all the separated items. This structure would conclude that, whatever the value, a nation will consume probably a portion of every good from each nation. Therefore, the classical gravity model includes the trade flows (X), the domestic GDP of countries i and j, and the distance (t) represents the costs incurred while trading. The intuitive gravity model to trade is:

$$X_{ij} = C\,\frac{Y_i\,Y_j}{t_{ij}^2} \qquad (1)$$

Thus, the trade between the two countries depends on their economic masses and is negatively related to trade costs between them. This means larger countries trade more than smaller nations and the trade volume tends to be large. In the estimation procedure of the gravity model, it needs to take the natural logarithms of all variables to estimate the regression model. However, trade volume can be negatively affected due to the geographical distance which results that the larger the distance between the two countries the lesser the trade volume. The gravity model has received much attention when Anderson and Van Wincoop (2003) have given the empirical equation for the basic gravity model: The empirical equation for the basic gravity model:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \ln \beta_3 T_{ij} + €_{ij} \qquad (2)$$

In this equation, X_{ij} represents the trade (export) amount between country (i) and country (j); Y_i is the GDP of country i and Y_j is the GDP of country j, and T_{ij} is the trade cost. € is the error term. There is an advantage of using the gravity model because it gives an explicit form for various types of trade costs. In addition, this model can analyze the bilateral effect of transportation time and the spillover effect on other countries.

In order to capture the effects of various transportation costs or connectivity, this model includes the transportation value and cost between the countries. several empirical types of research focused on how the transportation system really can affect the countries' trade such as railway transportation promotion plays an important role in terms of growing the economic growth and trade (Coşar & Demir, 2016; Xu et al., 2017). In this study, transport infrastructure is divided into four sub-indicators; rail, land, sea, and air. The connectivity transport infrastructures are divided into sea rate (US$), Air cost (US$), Rail (km/total land km^2), and road (km/total land km^2). In order to examine the effects of different transportation modes on the exports of textile products the total roads (Coşar & Demir, 2016) and the rail length of total land (Sun et al., 2019; B. Zhang et al., 2017) and the expense of transaction cost by seaports (Clark et al., 2004; Schøyen et al., 2018) and the air cost of exports (Brugnoli et al., 2018). To get a broad knowledge of how the distance between rail and road of each country affect the trade flow of the country is also taken into account as a proxy of transportation. This model is aligned with Bensassi et al. (2015); Márquez-Ramos et al. (2011) studies. The OLS model of the augmented gravity model is as follows:

$$ln(EX)_{ijt} = \beta_0 + \beta_1 \, ln(GDP)_{it} + \beta_2 \, ln(GDP)_{jt} + \beta_3 \, ln(DIST)_{ij} + \beta_4 \, (Colony)_{i,j} + \beta_5 (Lang)_{i,j} + \beta_6 \, ln(TI)_{ijt} + \lambda_j + \varepsilon_{ijt} \qquad (3)$$

However, the alternative gravity model will be applied. Therefore, a Poisson regression model of the model (3.37) is as follows:

$$(EX)_{ijt} = exp(\beta_0 + \beta_1 \, ln(GDP)_{it} + \beta_2 \, ln(GDP)_{jt} + \beta_3 \, ln(DIST)_{ij} + \beta_5 \, (Colony)_{i,j} + \beta_6 (Lang)_{i,j} + \beta_7 \, ln(TI)_{ijt} + \lambda_j) + \varepsilon_{ijt} \qquad (4)$$

Where

ln EX_{ijkt-1} = Log of the value of Bangladesh's RMG exports in dollars ($) from exporter to the partner countries

ln GDP_{ikt} = Log of the effect of GDP in thousands of US dollars of the export country in time t

ln GDP_{jkt} = Log of the effect of GDP in thousands of US dollars of partner countries in time t

ln $Dist_{ij}$ =Log of distance in kilometres between exporter's capital and its partner country's capital.

TI = Transport infrastructure measures

Colonial = A dummy variable with a value of 1 with common land borders, otherwise 0

Language = A dummy variable with a value of 1 if the partners have similar

$€_{ijkt}$ = Error terms that capture unobserved effects on exports

There is no such econometrics estimator that would be strictly influential over all other methods. However, each method has its advantages and disadvantages. For instance, some methods help to take care of heteroscedasticity or zero problems from especially international trade research. On the other hand, some methods do not solve the multilateral dimensions of trade. Therefore, it becomes a good practice to include the most convincing estimation methods from the literature in order to check which method performs better (Head & Mayer, 2014). It is suitable to use different estimation methods to understand the deeper analysis of the implications of the results.

Therefore, the use of fixed effects estimation is the most preferable one in terms of avoiding potential bias (Cheng & Wall, 2004). Moreover, this study used pooled ordinary least square (OLS) and Poisson Pseudo-Maximum Likelihood (PPML). Therefore, the log of exports will not be used here.

In terms of the gravity model, it has been identified in the literature that heteroscedasticity is an issue to consider when estimating the gravity model Silva and Tenreyro (2006), Head and Mayer (2014) and Egger and Tarlea (2015). In the presence of heteroscedasticity, OLS is still unbiased; however, its estimates are inefficient, and hence hypothesis testing using the F-statistic and t-statistic is inconclusive. To correct the inconsistent estimation of the variance-covariance matrix, many researchers use robust standard errors most notably those generated using White's heteroscedasticity-consistent estimator. Although much research has corrected for the inconsistency in the variance-covariance matrix, the gravity model when estimated using OLS tends to exhibit significantly greater bias than other estimators; however, this might point to the violation of other assumptions such as the linear specification assumption and homogeneous elasticities.

Traditionally the multilateral gravity model was used to estimate using OLS techniques (Goméz & Milgram, 2009). To retain the zero trade flows in the sample requires an application of appropriate estimation techniques. A pooled OLS estimation method is the simplest and naïve estimation and is applicable for a pooled dataset on the simple OLS (Wooldridge, 2012). The pooled OLS estimation method in the gravity model follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it1} + \beta_2 X_{it2} + ...+ \beta_k X_{itk} + €_{it} \qquad t = 1,......,T \qquad (5)$$

Here, X_{ij} is the observation on the dependent variable for the cross-sectional unit (country) i in period t and e_{ij} refers a random disturbance term error. It is logical to start the estimation with pooled OLS which indicates the best econometric lines of best fit to show the connection between trade and GDP or trade and distance. In addition, in terms of the certain assumption regarding the error term $€_{ij}$, OLS is considered as a useful statistical method that enables us to conduct the estimation. Sometimes the bias in OLS is called heterogeneity bias and these biases are caused due to omitting a time-constant variable (Baltagi & Baltagi, 2008).

If all the above econometric properties requirements meet, then OLS estimates are considered unbiased, consistent, and efficient within the linear models. However, from the econometric point of view, the OLS estimation methodology has some criticism as a baseline estimator. For instance, one obvious limitation to the OLS regression is that this model cannot take into account zero trade flows. Thus, these zero observations are omitted from the sample estimates when the logarithms of the trade values are taken. Hence, an alternative gravity estimation model such as the Poisson pseudo-maximum likelihood (PPML) gravity model will be applied. Therefore, the PPML estimation is now widely using in the literature to ensure that results obtained using OLS are robust.

Furthermore, OLS estimation is biased individual heterogeneity. For this reason, Poisson pseudo-maximum likelihood estimator (PPML) with importer and exporter dummies will be employed to estimate the gravity model. This estimation is fitted to define the trade flows for each country which makes the PPML estimator unique (Fally, 2015). Unlike the OLS method which minimizes the sum of the residuals of squares, the PPML estimator estimates the parameter that maximizes the Poisson log-likelihood function to predict the sample data that has been observed. The underlying assumptions of the PPML estimator are that the conditional mean is correctly specified, and the conditional variance is proportional to its conditional mean. Additionally, the PPML estimator assigns an equal weighting to bilateral trade flows making it less susceptible to heteroscedasticity (Silva &

Tenreyro, 2006). The Poisson PML estimator was suggested to estimate the gravity equation of international trade by Silva and Tenreyro (2006). With a large N and T, the PPML estimator of the structural parameters is among the few nonlinear estimators that are free of asymptotic bias (Fernández-Val & Weidner, 2016) because the PPML estimator can completely project the exporter and importer dummies. In addition, using the PPML estimator when estimating the gravity equation is its ability to accommodate observed zero trade flows, which the log linearized gravity equation would eliminate.

It is suggested by Allen et al. (2020) that the gravity models can be estimated in levels with fixed exporters and importer effects by using the PPML estimator. To gain more robust results and to avoid the measurement problem, this study is adopted for the second gravity estimation the Poisson pseudo-maximum likelihood (PPML) estimation method proposed by Silva and Tenreyro (2006). However, they found that their OLS estimation results in certain variables overestimate such as colonial ties and geographical distance. Additionally, they described the differences between the two estimations as a result of heteroscedasticity. Recently, the PPML estimation is popular because it can avoid the problems of multicollinearity, heteroscedasticity, and autocorrelation.

Certain Studies from literature recommended applying the PPML method to get unbiased and more robust estimation results (Haq et al., 2013; Magerman et al., 2016; Westerlund & Wilhelmsson, 2011). It is considered one of the most suitable econometric methods due to its consistent and unbiased methodological nature (Álvarez et al., 2018). Silva and Tenreyro (2006) proposed an alternative robust gravity approach named PPML. This method can estimate the non-linear form of the gravity model, as well as this model, can deal with the zero trade issues. Moreover, the PPML method is proven as the most robust approach in the presence of heteroscedasticity which is quite a common issue with export data. Moreover, this estimation solves the zero trade flows between the two countries. The basic PPML model takes the following form where y_{it} is poison distributor:

$$y_{it} = \exp(\alpha + \beta_1 \ x_{it1} + \beta_2 \ x_{it2} + \cdots + \ \beta_k x_{itk}) + \ v_{it} \qquad (6)$$

The matrix representation of the mean of the predicted Poisson distribution:

$$E(Y|X) = \exp\,(\beta X)$$

β can be assessed for maximum likelihood under explicit conditions listed underneath. Generally, PPML implies that the estimation can't be unequivocally communicated by scientific equation and must be found numerically. From PPML estimation the likelihood mass capacity, the equation should be augmented:

$$L(\beta|X,Y) = p\,(y_1, \ldots, y_t|x_1, .., x_t;\, \beta) = \prod_{t=1}^{T} \frac{\exp(y_t \beta x_i).\exp\,[-exp\,(\beta x_i)]}{y!} \quad (7)$$

This model can be improved by the utilization of logarithm, which is a non-diminishing change that doesn't change the maximum. We, therefore, come to log-probability maximized to be:

$$l(\beta|X,Y) = \log[L(\theta|X,Y)] = \sum_{i=1}^{n} [\mathrm{y_i \beta x_i} - \exp\,(\beta x_i) - \log\,(y!)] \qquad (8)$$

Where the β is a derivative that has no closed-form solution and is typically handled by convex optimization. The conditional mean is correctly specified, the Poisson PML is a consistent estimator for the gravity equation and its estimates are not sensitive to estimation with an inflated number of zero trade flow or over-under-dispersion. These properties make it attractive given the persistent identification of the presence of heteroscedasticity and the share number of zero trade flows observed in the international trade data set, especially at the industry and product level. Moreover, Silva and Tenreyro (2006), pointed out that PPML estimation needed only consistent, correct specification of the conditional mean,

$$E(y_i|x) = exp\ (x_i\beta)$$

Standard econometric packages thus allow for y_t to be non-integer. Furthermore, the Poisson estimator does not take full account of the heteroscedasticity in the model. It calculates the covariance matrix, standard errors of the estimates, and confidence intervals by a robust covariance matrix estimator developed by Eicker (1963) and Wooldridge (2012).

Furthermore, Shahriar et al. (2019) and Baldwin and Okubo (2006) have effectively applied the PPML model in their estimations and examinations of the gravity conditions. It treats each zero comparably, yet two or three zeros address countries that are reasonable underneath the limit for conveying, while others address conditions with a low likelihood of export happening (Martin & Pham, 2015). An elective methodology is to utilize the (Pseudo) Poisson most extreme probability (ML) estimator. This strategy can be applied to the degrees of exchange, consequently evaluating straightforwardly the non-direct type of the gravity model and abstaining from dropping zero exchange.

PPML regression displays fascinating and valuable properties that can be exceptionally helpful for the estimation of trade gravity conditions. In particular, the estimation of gravity with the Poisson estimator while exporter and importer impacts are incorporated is steady with a more structural approach methodology (Anderson & Van Wincoop, 2003) that forces further limitations on exporter and shipper multilateral resistance terms. Moreover, the multilateral resistance indices can be neglected whenever a Poisson estimator with fixed impacts is utilized (Fally, 2015).

Every econometric method has its advantage and disadvantages and it cannot be concluded that one specific method is best than others. Therefore, it is a frequent practice in the literature to include more than one estimation method for the same database. However, the main difference among estimators is revealed by the magnitude of coefficients. These differences suggest the existence of a substantial bias in the OLS estimation. Whereas, PPML reduces the magnitude of the coefficients as well as the standard errors. According to Silva and Tenreyro (2006), PPML is the preferred estimation method in the presence of heteroscedasticity.

Data

The dependent variable is taken from 1990 to 2015, based on the availability of data, as the yearly value of readymade garment exports from the International Trade Centre (ITC) to the partner nations for $US. This study specifically examines how the trade flows in the areas stated above are affected by various forms of transport infrastructure. This means that transport infrastructure is divided into three distinct subsectors, namely, land transport, maritime transportation, and aviation, in which the data collection is provided by World Development Indicators. For the four sub-categories of transport infrastructures and proxies, we have chosen two indicators in each of the infrastructure variables, which describe road and rail transport. In addition to the variable overall traffic network in kilometres, variable rail lines (total route-km) were used as a proxy for land transportation. This approach employs varied railway lines as a proxy for land mobility (total route-km). For marine transport, this approach uses fluctuating container port traffic as an indicator (20-foot equivalent units). Airfreight (million tonne-kilometer), air transport and registered carriers' depart globally were considered as predictors of two factors for the air transport facilities.

To analyze, each sub-category of measurements related to transport will use the influence of transport infrastructure. In order to depict the transport medium, four indicators were selected. The two indicators used to depict land transport reflect rail lines and road networks while air carriers and freight for air transport indicate air traffic. Finally, the moods of sea transport are employed by container port traffic and linear shipping. To prevent the multicollinearity difficulties all the transportation proxies are estimated independently. It means the transportation infrastructure variables are regressed independently rather than putting them together in the empirical model to prevent the situation of multi-collinearity. In addition, the study is concerned mainly with the relative importance of Bangladesh's readymade garment export of several infrastructural sub-sectors.

Table 2: Description of Variables and Data Sources

Variables	Definitions	Data Source
EX	Value of readymade garment export (US$) from exporting country (Bangladesh) to importing countries	International Trade Centre (ITC)
GDP	GDP per capita	World Development Indicator
Distance	Distance in km between the capitals of countries i and j	CEPII
Common Language	Dummy variable taking the Value 1 for countries sharing the same official language, or 0 otherwise.	CEPII
Colonial Ties	Dummy variable Value 1 for countries having colonial ties, or 0 otherwise.	CEPII
Railway	Railways, goods transported (million ton-km)	World Development Indicator
Road	Road density (km of road per 100 sq. km of land area)	World Development Indicator
Air register	Air transport, freight (million ton-km)	World Development Indicator
Airfreight	Air transport, registered carrier departures worldwide	World Development Indicator
Port	Container port traffic (TEU: 20-foot equivalent units)	World Development Indicator

Results and Discussion

The aim of this study is to examine the impact of transport infrastructure on readymade garment export. This study used Panel data techniques because panel data sets are preferred in the gravity model research by most researchers (Kepaptsoglou et al., 2010). The models using ordinary least square (OLS) and Poisson Pseudo Maximum Likelihood (PPML). The PPML estimator is known to work in the presence of heterostedasticity and results in unbiased as we all as consistent estimators (Francois et al., 2013; Gómez-Herrera, 2013; Silva & Tenreyro, 2006).

We adopt the cluster option often used in gravity model analyses to avoid underestimated standard data error (Egger & Tarlea, 2015). The solid section is an effective technique to address the breach of the OLS assumption by modifying the standard error (heteroscedasticity). We use the cluster option, often used in gravity model studies, to prevent underestimated standard error in the data (Egger & Tarlea, 2015). The robust part is an efficient means of fixing the violation of the OLS premise by adjusting standard errors (heteroscedasticity). To models such as exporters/importers for fixed effects, we introduced country-specific dummy variables to control multilateral resistance conditions (Feenstra, 2002).

Table 3: Descriptive statistics of variables

Variable	Mean	Standard Deviation	Minimum	Maximum
RMG bilateral exports	639386.30	5029192.00	5.00	134000000.00
GDP exporter	683.43	158.26	459.61	1002.39
GDP importer	21316.98	20505.84	194.87	104965.30
colony	0.01	0.12	0.00	1.00
Common language	.0125	.1111291	0	1.00
Distance	6673.43	3625.30	674.16	17888.71
Air carrier exporter	18732.70	16300.28	6313.00	59064.00
Air carrier importer	341557.20	1116212.00	70.00	10100000.00
Air transport freight exporter	147.00	56.91	0.01	225.19
Air transport freight importer	1917.27	4748.75	0.01	40617.74
Container Port Traffic exporter	1081572.00	438641.70	456007.00	2044651.00
Container Port Traffic importer	6902937.00	16400000.00	23853.00	195000000.00
Rail exporter	775.18	121.23	525.00	952.00
Rail importer	171894.20	524017.80	1.87	2594631.00
Roads exporter	181.93	41.71	107.35	254.30
Roads importer	96.97	130.01	1.30	967.50

Note: the figures represent the raw data

Table 4: Correlation Matrix of Transportation moods

	Road	Rail	Port	Air Register	Airfreight
Road	1				
Rail	0.009	1			
Port	0.208	0.499	1		
Air register	0.360	0.657	0.738	1	
Air freight	0.28	0.533	0.782	0.829	1

By constructing dummies and then adding them as explanatory variables the fixed impact of the exporter and importer offers a consistent estimated for the model gravity. Descriptive statistics simply show, sum up and characterise data that provide valuable data for the investigation. Descriptive statistics enable us to investigate the characteristics of different analytical variables. Specifically, for each variable as indicated in Table 3, the mean, standard deviation, lowest and maximum values are shown. This table includes all variables used in both models. The central tendency and dispersion of a data collection are commonly studied using descriptive statistics. The central tendency measurements serve to describe the centre position of an average and median frequency distribution whilst the standard deviation measures are typically measured. The variables are sufficiently different. The first section indicates the variable, the average ready-made garment export is US$ 5.00 million and the highest US$ 134 million. Similarly, the sample of data varies greatly with all other variables. In order to check the degree of interdependence between the unblocked measurements, coefficients of correlation are calculated for the unbroken logistics measures. This will ensure that they are not included in a model of gravity equation if measures are correlated, distort the model coefficient estimates. Table 4 shows this with the pair correlation coefficients except for the cost of national logistics There is a significant degree of connection among the different transport measures of exporting countries. This means that the coefficient estimates shall be partitioned if all logistics performance measurements were taken in one regression. Each component is separately included in the gravity model to reflect its impact on bilateral exports in keeping with this finding.

Tables 5 and 6 show the impact of transportation infrastructure and on readymade garment export for POLS and PPML estimations respectively. Transportation infrastructure is an important aspect of the infrastructure as it is related to transportation costs. Panel data has some advantages over cross-sectional data, therefore this study used Panel data. Pooled OLS (Table 5) shows that transport variable Roads for exporters are negatively correlated with trade. This means the road transportation mood is not playing a significant role in facilitating the RMG export. In terms of other transport, mediums have given expected positive signs but the coefficients are not significant. However, using the estimate approach, the scale of the coefficients is different. For instance, in PPML regressions the estimated coefficients are less than in OLS (Silva & Tenreyro, 2006). The PPML estimator provides a relatively good prediction for trade explanatory factors. Concerning the control variables, GDP of the exporter, GDP importer, common language have a positive and significant coefficient and distance variable has a negative coefficient. In the gravity model literature, GDP and language are positive to trade but are expected to have a negative sign to distance (Shepherd, 2011). The estimates show that the GDP factors are substantial and positively linked to trade in both host and exporting nations. This shows that the size and capacity of the market increase trade. Both tables show that the export and importer GDP is theoretically and significantly positive. Bangladesh's GDP has increased by 1% and the print trade in RMG has risen.

Consequently, more economic growth needs to be achieved by Bangladesh and the foreign economy. The time-invariant coefficient of variables like distance and language also reveals the predicted findings for all proxies of infrastructure. Distance in all models is consistently negative and important. This is because the transport cost is higher as the distance between Bangladesh and the location of export increases to discourage exports. A major negative sign has therefore been observed. Further, as shown in the positive sign of the language, higher similarities in the official language spoken in Bangladesh and the importing countries attract more ready-made garments from Bangladesh.

However, the level of export from Bangladesh to others across the world is more essential than language in assessing the extent to which Bangladesh's economic development and distance are ready. The results show that all mood in travel is significant for ready-made garment products. The principal transport system is recognized to be roadways for both passengers and freight. Goods and goods will be carried by a truck on the roadways. The lowest quality roads are usually dirt roads or roads that are not properly constructed or maintained. Low-quality roads are popular in most underdeveloped countries as well as in rural areas. The PPML outcome from road infrastructure on trade is reported in Table 6.

Table 5: Transport Infrastructure and RMG Export (OLS results)

	Road	**Rail**	**Airport Freight**	**Air carrier**	**Port**
GDP exporter	1.102*** (0.651)	0.613 (2.559)	1.320*** (0.161)	0.893 (0.762)	0.123 (1.811)
GDP importer	0.170* (0.225)	0.705*** (0.139)	0.109 (0.114)	0.0288 (0.119)	0.821*** (0.134)
Distance	-0.307 (0.194)	-1.271** (0.419)	-.41618 (.26702)	-0.412 (0.256)	-.03156 (.1466)
Common Language	9.227 (1.226)	1.287 (0.225)	6.175 (0.772)	6.079 (0.762)	4.978 (0.643)
Roads exporter	-0.316 (5.320)				
Roads importer	-0.0069 (0.042)				
Railroads exporter		0.075 (2.031)			
Railroads importers		0.141* (0.064)			
Airfreight exporter			.01515 (.3149)		
Airfreight importer			.1725*** (.0389)		
Air carrier exporter				.2014 (1.303)	
Air carrier importer				.3836 (.0744)	
Ports exporter					0.777 (1.544)
Ports importer					0.037 (0.064)
Constant	-30.16* (14.06)	-35.78 (54.30)	-30.14*** (89.15)	-17.54 (27.52)	-28.62** (26.33)
Obs. R-squared	0.9604	0.9207	0.8589	0.8610	0.9402

Note: In OLS regression the gravity equation is estimated in its logarithmic form.

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Robust standard errors in brackets; Standard errors are in parentheses; ***, **, * indicates significance at the level 1%, 5%, and 10% level respectively.

Table 6: Transport Infrastructure and RMG Export (PPML results)

	Road	**Rail**	**Airport Freight**	**Air carrier**	**Port**
GDP exporter	1.155*** (0.140)	1.022*** (0.254)	1.008*** (0.080)	1.473*** (0.187)	0.634*** (0.163)
GDP importer	0.236 (0.293)	0.820*** (0.176)	0.765*** (0.046)	0.268 (0.191)	0.532* (0.262)
Distance	-0.268** (0.104)	-0.615*** (0.0170)	-0.673*** (0.095)	-0.176 (0.127)	-0.173 (0.219)
Common Language	7.123*** (1.219)	0.220 (0.656)	0.868*** (0.0695)	4.847*** (0.581)	1.673*** (0.250)
Roads exporter	1.157*** (0.303)				
Roads importer	0.328 (0.375)				
Railroads exporter		0.0024** (0.0713)			
Railroads importers		-0.127 (0.158)			
Airfreight exporter			0.0069** (0.011)		
Airfreight importer			0.0892** (0.0919)		
Air carrier exporter				0.168*** (0.0411)	
Air carrier importer				0.538 (0.191)	
Ports exporter					0.432** (0.0253)
Ports importer					0.201 (0.276)
Constant	-33.16*** (7.654)	-39.85** (6.414)	-31.85*** (4.696)	-43.12*** (4.675)	-29.58*** (5.089)
Obs. R-squared	.9806	.9560	.7489	.9605	.9667

Note: In PPML the gravity equation is estimated in this multiplicative form. Robust standard errors in brackets; Standard errors are in parentheses; ***, **, * indicates significance at the level 1%, 5%, and 10% level respectively.

The export and importer's variable GDP is substantial, and this is an exceptional conclusion since GDP examines the country's development level and because the countries are also developing products, which is likely to cost less trading. An increase in GDP will cut trade costs for exporters and importers. Furthermore, the results show that both exporters and importers mainly make use of internal road transport in garment products. The distance between the factory and the seaports, however, is far greater than the international distance. If road transit grows, the cost of trade will therefore decrease dramatically. Both exporters' and importers' road transport is a negative sign. It means that a 10% improvement in road infrastructure boosts trade for exporters by 1,15%, but that is also a positive percentage, which is 0,32%. This conclusion is similar to the study of Limao and Venables (2001), Buys et al. (2010) that indicate improvement in the road infrastructure made the commodities more assessable to transport and reduce the costs accordingly. This implies both exporter and importer countries' road networks are well-built to provide industry and consumers with convenient market access.

The railway coefficient is shown to be statistically positive and statistically significant in the PPML estimations (Table 6). (Table 5). It shows that the trading process will grow with the use of railways. Railways are considered an important aspect of the transportation system for hard infrastructure. In general, the railway industry is categorized by weight across the length of the line. Short-line railways generally connect corporations or companies to sources while large-line railways connect distant businesses and towns. The railways in Bangladesh consist of a normal track system of flat-foot steel wooden and ballasted steel (Liyanage et al. 2017). The ancient layout of the train system requires more repairs and maintenance thanks to the intensive use for transit. The railway coefficients of importers exhibit negative values in PPML It means that most importers may not use the internal conveyance of railways. Coşar and Demir (2016) state that weak domestic transportation infrastructure in underdeveloped nations is the most critical barrier in terms of access to the global market.

The ready-made garments products can simply be transported to seaports if road and railway networks are of enough quality that connects the different regions of the country. The lack of freight on the road due to government policy that favors passenger services and the absence of efficient administration is why rail transport in Bangladesh has a lower frequency (Mahmud, 2008). That might be owing to poor train quality in developing countries, such as Bangladesh, meaning that it depends significantly on other transportation networks for trading, such as ports, planes, highways rather than railways. At the same time, the railway coefficient of importers is showing positive and significant results, such that certain partner countries still have better railway systems, but for the trade-in ready-made garments products, the mood is not so cost-efficient.

In addition, the marginal effect of the rail network on ready-made garment export has the least influence, given that the transportation network does not help trade through cost reduction. Ready-made garment commodities are carried more frequently across the country via railways and roads as they are recognized to have a cost advantage over ships and air transport. However, the cost of transactions at borders and the distance between nations hinder shipments to the global market significantly. Bangladesh has no shared border, so, unfortunately, for bilateral trading, Bangladesh needs to depend on either air or water. Table 6 displays outcomes for air infrastructure comprise of air freight and air register on trade flow. Usually, airports are utilized less for readymade garment products. Bangladesh's air registry coefficient exhibits a negative trade sign. This suggests that an increase of 1% in the number of air trading registers will increase trade by 0.168%. This indicates that the cost of trade for certain garment products in air carriers is higher. However, these results show that the quality of airport transit must be improved in Bangladesh.

A trade facilitation system is the building of hard infrastructure that might minimize the transport costs of the exportation of readymade garment products. However, trade trends that tackle the effects of trade barriers give the calculation of their trade impacts, including local factors, GDP, and distance directly and indirectly. The impact of hard infrastructure transport costs on trade costs is discussed in this paper. The increased expenses of transit and subsequently the increased productivity of the market as possible obstacles to trade describe the poor infrastructure and longer distances.

Conclusion

The purpose of this study is to highlight the importance of various types of transport infrastructure such as land, sea, and air on ready-made garment export of Bangladesh. The investigation shows that the transport system in Bangladesh is badly developed. Because transport infrastructure can affect the costs of transport and consequently affect trade flows, relevant authorities must make every effort to improve transport efficiency. This analysis can assist policymakers in Bangladesh develop an infrastructure investment strategy that responds to the needs of the RMG sector. Moreover, transport infrastructure has the greatest influence on reducing trade costs in enabling the transit of goods from the border to the destination. In policy terms, actions to improve the quality of each mood of transport have the greatest impact on reducing the cost of trade. In addition, the implication is that the development of logistics and transport services, particularly in the export of ready-made garment items, is crucial to the development and enhance the use of transport infrastructure.

The influence of ROAD on RMG export is encouraging. It means expanding and upgrading the road network more effectively across the country. Most routes are paved roads that in the rainy seasons are inaccessible. It makes transporting RMG products to seaports for export therefore more complex for the authorities. In order for Bangladesh to have an integrated transport policy, resources and finances for the enhancements to the current road networks are explicitly provided. A significantly good impact on the RMG sector is a further key land transportation method RAIL. This shows that rail is a significant way for the preparation of RMG export. Many of the big cities have train links. Containers are mainly transported by rail from the plant to the port. However, the tracks of Bangladesh, as noted above, are old. Planned investment in track, signaling, rolling stock, maintenance, and human resource development can be important factors are important to the railway sector. With regard to AIR, there is a considerable and positive influence on prepared RMG exports.

The current study suggests that Bangladeshi policymakers must focus on strengthening the network of airports and expanding volumes, to enable larger ready-made garment production to be exported in particular to landlocked nations in diverse regions. In addition to developing airports facilities or boosting network of airlines in the pre-fabricated RMGs sector of Bangladesh, policy should be reinforced by the provision of more facilities for exporters. For example, due to weight constraints and higher carbon emissions, air transport costs are substantially higher than marine transportation.

However, air cargo is essential to serve the markets in which the shipment of goods requires speed and reliability. Sometimes problems of domestic gas or energy supply that increase export dependence on air freight to assure timely delivery, due to any domestic problem. This also reflects the desperate effort of the exporting enterprises to meet delivery times in the face of increased expenses of transit, therefore affecting their competitiveness. Those problems must thus be identified and dealt with by the authorities responsible, in view of the beneficial association between AIR and ready-made exports of garments, and they must take the appropriate measures to minimize the cost so that exports to the sector can further enhance significantly. Multi-modal transport, sound infrastructure, including continuous energy supply, shall be established through public-private initiatives. Also, as a consequence of the gravity model, Bangladesh's prepared export of RMG is significantly developing another area of physical infrastructure, namely seaports. Chittagong is usually a hub seaport on the world's primary container routing. The port of Chittagong, which manages around 85% of its trade commodities, suffers from labor difficulties, lack of management, and lack of equipment. Chittagong also believes the construction of deep seaports to be of strategic, economic, and political relevance as another hub of Asia. Further enhancements are therefore necessary to ensure that goods flows are smoother and services are more cost-effective. In addition it is important for enhancing port performance and efficiency to improve the terminal efficiency. In addition, port growth relies heavily on the ambition of two main players to focus and invest in shipping operators for their business, in surface transportation and inland facilities.

In order to develop the port, the Government must foster an environment with local and international investors. Finally, the government's attitude tends to be a driving force for economic development and overseas trade. Moreover, the findings reveal a significant significance for logistics infrastructure in facilitating bilateral RMG export, validating the concern of exporters and importers to improve transport quality moods. Diverse forms of infrastructure could have major impacts on the flows of RMG export. Investors usually seeking for developed infrastructure. So Bangladesh needs to further emphasize enhancing the total infrastructure system which is quite a crucial aspect for investment. Future research to explore how different types of infrastructure can influence trade, is advised in soft infrastructures, such as documents, allowances, licensing, and contract enforcement. This helps scientists and politicians understand the true problem and the necessity to enhance the infrastructure level to assist ready-made garment exports. In addition, to cover the border scenario of physical infrastructure variables, infrastructure measurements showing the quality of infrastructure in Bangladesh may also be taken into future research.

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