Pattern of International Trade in Ready Made Garments: Gravity Model Analysis

Hazera Akter[*]

Abstract: This study analyses the pattern of international Ready Made Garments (RMG) trade by applying the extended form of Gravity Model. Given the multiplicative nature of the gravity equation, a panel data consisting of RMG exports from 2001 to 2016 of the largest 20 exporters to each of their 6 importing countries was formed to estimate the model, subject to some diagnostic tests. Dependent variable 'export volume' is found negatively correlated with the independent variable 'distance'. The GDP of both the exporting and importing countries contributes to increasing trade whereas importing country's GDP carries more effect. Export is directed to lower populated importing nation and from larger populated exporting countries. Under dummy variables: having common border, similar time zone and duty free- quota free facility; contribute to raising export. The study will guide policy makers to perceive the pattern of international RMG trade. Such policy implication will ultimately drive national strategy development for being more competitive in international RMG market.

Keywords: International trade, Ready Made Garments, Gravity Model& Global market for RMG

I. INTRODUCTION

In a world without trade barriers, trade patterns are determined by the relative productivity of different countries (Hill, 2005 p.180). Countries are expected to specialize in products that they can make most efficiently, while importing products that they can produce less efficiently. International trade in Ready Made Garments (RMG) is also determined by some factors explaining productivity and competitiveness. The international RMG trade consists of import and export of the articles of apparel accessories both knitwear and woven items throughout the different countries. International differences in labour productivity (David Ricardo's Theory), proportions of factors of production (Heckscher-Ohlin Theory), ability of the firms within nation to capture first mover advantage and economies of scale (Paul Krugman's New Trade

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[*]Lecturer, Department of International Business, University of Dhaka, Dhaka, Bangladesh. Email: lubna17391@yahoo.com

Theory), domestic demand and domestic rivalry (Michael Porter's National Competitive Advantage) etc. explain most of the pattern of international trade in any product including RMG. This study covers top twenty exporters of RMG products to the world focusing their six largest importers, particularly of RMG products. According to 2016 trade statistics, China is the largest exporter with34% volume of RMG to the world; followed by Bangladesh exporting 8% and then Viet Nam exporting 6%.United States of America (USA) is the largest importer with 21%volume of RMG from the world; followed by Germany importing 9% and then Japan importing 7%. Such trade among these partners is subject to a competitive international market. There may have enormous factors facilitating each competing countries.

Gravity model has long been applied to explain bilateral trade flow between countries. However, the reviewed studies applying Gravity model on international trade flow comprises of Porojan (2001), Kepaptsoglou, Karlaftis & Tsamboulas (2010), Keum (2010),De Benedictis & Vicarelli (2005), Jafari, Ismail & Kouhestani (2011) etc. The major focus of these researches was on bilateral trade flows. In Bangladesh, Rahman (2003), Rahman, Shadat & Das (2006), Alam, Uddin & Taufique (2009) etc. were found to apply gravity model in analysing international trade, import inflows and bilateral trade with SAFTA countries accordingly. Therefore, there is found a research gap on international trade flow analysis on any specific sector or product. This is because; this study is expected to add value to literature particularly on explaining the pattern of international trade in RMG applying the extended form of Gravity model.

The remainder of the study is organised as follows: the second section provides with the background of international RMG trade. Section 3 contains literature review focusing the research works on international trade flow analysis utilising Gravity model. The next two sections demonstrate the methodology of the study and the dataset applied in analysis; followed by findings and discussion in Section 6. The last section summarises what has come to be understood about the pattern of international trade in RMG.

II. STRUCTURE OF INTERNATIONAL RMG TRADE

International RMG trade holds the export market of almost USD 436 billion following 2016 trade statistics of ITC Trade Map. China is the largest exporter of RMG with volume of USD 146 billion having negative growth of 10%. However, China is still very strong exporter with15 diversified partner countries and 55diversified RMG products. Bangladesh holds the second position in RMG export despite having much lower volume compared to China's. Bangladesh exported USD 26.26 billion. Bangladeshi export sector is very much concentrated to RMG which comprises 83% of total export of the country. The country is becoming competitive day by day with 7% annual growth rate and 9% competitiveness effect on global RMG market. Viet Nam comes after Bangladesh with RMG export volume of USD 24 billion that is only 11% of their national export. The

country has 40diversified products with only 4 diversified markets. Italy and Germany exports USD 20 and 17 billion RMG respectively. The export growth of Italy is only 3% with negative competitiveness effect. India and Turkey have almost similar RMG export volume of USD 16.96 and 16.30 billion accordingly with almost saturated growth rate. Spain and France export RMG of USD 12 and USD 10 billion respectively with very low annual growth rate (3% and 2% successively). Between these neighbouring countries, Spain has greater competitiveness impact (4%). Netherlands exported USD 9 billion which is the ninth largest per capita RMG export. Remaining ten countries under this study include Belgium, United Kingdom, Indonesia, Cambodia, United States of America, Poland, Pakistan, Sri Lanka, Mexico and Denmark. Among top twenty RMG exporters, nine are the European Union member countries. Bangladesh has become the most potential country here in spite of being a least developed country (LDC).

In the demand side of world RMG market, the USA is the largest importer with USD 84 billion, followed by Germany importing USD 35 billion and then Japan importing USD 26 billion. In case of international RMG trade, Duty Free- Quota Free (DFQF) facility granted by importers contributes highly to export growth of the supplier countries. DFQF facility for least developed and developing countries provided by the developed countries are arranged under World Trade Organization (WTO) umbrella framework. The most popular DFQF facilities are recorded under Generalized System of Preferences (GSP) from developed nations, tariff preferences for LDCs and special and differential treatment through Free Trade Agreements (FTAs). In addition to DFQF facility, the cheap labour force (Joarder, Hossain & Hakim 2010) for RMG sector in Bangladesh (USD 0.22 per hour),Cambodia (USD 0.33 per hour), Viet Nam (USD 0.38 per hour), India (USD 0.51 per hour), China (USD 0.55-1.08 per hour), Turkey (USD 2.44 per hour) etc. plays very important role to the respective country's RMG export growth. Thus, there may have enormous factors facilitating each competing countries in this trade.

III. LITERATURE REVIEW

Since there is no specific literatures available regarding the pattern of international RMG trade, relevant literature on both the structure of global RMG trade and application of gravity model, have been reviewed here.

International trade is an integral part of the total developmental effort and national growth of an economy (Miran et al. 2013). Quoting from Dreze (1961), Mathur (1999) said that country size and scale economies would be important determinants of trade. Textiles and garment represent the quintessential engines of industrial growth (Nadvi & Thoburn 2003). International textile & clothing industry has been governed since 1974 by a system of quotas known as the Multi-Fibre Arrangement (MFA) (Rahman & Anwar 2006). As per the WTO Agreement on Textiles and Clothing (ATC), all quota-imposing members of WTO were required to lift the entire range of quotas on textiles and clothing

as of 1 January, 2005. This was to be carried out in four phases, in ten years, beginning from 01 January, 1995.Sultana et al. (2011) performed a comparative analysis of MFA quota policy on RMG of Bangladesh. They found that despite the concern and fear of negative impact on the country in the aftermath of quota removal of RMG sector, it appeared with positive trends along with the substantial increasing rate of export amount, the number of jobs and industries and Gross Domestic Product (GDP) growth.

Joarder, Hossain & Hakim (2010) performed trend analysis for ten years and found that Mexico, CBA nations and CAFTA regions in the U.S. market and Turkey in the EU market lost their market share despite having preferential access and geographical proximity. In addition, all major apparel exporters except Bangladesh, Vietnam and China lost their market share since 2008 due to global recession in their export destinations. Their research revealed that Bangladesh not only upheld their past gains, but also improved their performance considerably during both post-MFA and recession periods. Aziz (2011) studied ready-made garments (RMG) export performance of India and its competitors with respect to the major import destinations. They found India in a position to increase its market share in RMG export to USA after the removal of Quotas. They examined the impact of abolishing of quota system (increase in export to USA by 3.02%) and economic crisis on RMG exports to its major markets in post quota regime (decline of 4.15%). They found that India's strength lied in its low cost skilled and unskilled labour, creative skills, variety, value addition, and the flexibility of operations, thus leading to the greater global market access.

This study investigates the pattern of international RMG trade utilising gravity model. In international trade analysis, the gravity model was first introduced by Tinbergen (1962) and Pöyhönen (1963) mainly to account for the patterns of bilateral trade flows among the European countries (Miran et al. 2013). Since then, the gravity model has been used and increasingly improved in empirical studies of international trade flows. Most familiar uses of the model relate to: examination of bilateral trade patterns in search of evidence on natural (non-institutional) regional trading blocs; estimation of trade creation and trade diversion effects from regional integration; and estimation of trade potential (Porojan 2001). Among many studies on international trade using gravity framework, a high percentage shares researches on predicting trade potentials. On the other hand, several studies have analysed trade enhancing impact of preferential trading agreements (Baier & Bergstrand 2002, 2009; Egger et al. 2011 etc.). These studies predict bilateral trade flows that can explain the economic benefits to economies (Eichengreen & Irwin 1998, Deardorff 1998 etc.), exercising both cross section and panel data approaches. In some cases, the panel data approach works better than the cross-section approach where panels can capture the relevant relationships among variables over time and monitor unobservable trading partner-pairs' individual effects (Miran et al. 2013). Present study employs panel data of top twenty RMG exporting countries over the years 2001 to 2013.

Jafari, Ismail & Kouhestani (2011) analysed the factors affecting export flows among the D8 countries- Malaysia, Iran, Turkey, Indonesia, Egypt, Bangladesh, Pakistan and Nigeria, through applying gravity model estimated using the Panel Corrected Standard Errors (PCSEs). They found both exporters' and importers' GDP significant with the coefficient value of 1.29 and 0.41 respectively. They also found distance with a negative relation (-0.53) with export. The exchange rate in exporting country had an impact with coefficient value of 0.13, but population of exporting countries was negatively correlated with their export (-o.93). They suggested the policy measures for improving transportation system to reduce trade costs.

Thapa (2012) estimate the trade potentiality of Nepal using gravity model. The gravity model simply explains that the volume of trade between pairs of countries is a positive function (0.63) of the economic size (Gross National Income) of two countries and negative function (-1.61) of the distance between them. The study has used coefficients of the model to predict Nepal's foreign trade for the year 2009. The trade potentiality is calculated with the help of the ratio of predicted trade to actual trade. The estimated result shows that Nepal has exceeded trade potentiality with her 10 trading partners, including giant neighbours India and China.

Miran et al. (2013) analysed the magnitude of the trade flows for raisin from Turkey and other exporting countries to its main importing countries. They identified the countries competing for the world Raisin Market, Chile, Greece, Iran, South Africa, Turkey, and the United States. They applied an econometric model derived from an extended form of 'Gravity Model' with a panel data from 1999 to 2008 of the most important six exporters of raisin and their importing countries. They found a sustainable export increase would await the raisin exporting countries for increase in welfare of the world over time (importer GDP coefficient 0.55 and exporter GDP coefficient 0.12). Similarly uninterrupted increase in population would contribute (0.25) to the sustainability of the countries' export of raisin. Cross country distances negatively influence (-1.03) the raisin export. In other words, countries that demand raisin would like to import it from relatively closer raisin producing countries in order to minimize transportation costs and duration.

Persson & Wilhelmsson (2007) analysed the effect of trade preferences to developing countries (African, Caribbean and Pacific (ACP) countries, Mediterranean preferences and the Generalized System of Preferences (GSP) by European Union) on developing countries' exports and whether the systems had different impacts on exports. They estimated a large sample of EU importers and developing country exporters over the period 1960-2002applying gravity model. They found that certain preference systems had large effects – the largest were found for the ACP countries, where the preferences increased exports by about 30%, followed by Mediterranean countries. The countries

joining the EU, ceteris paribus, were found to import less from developing countries as they become members.

Helpman, Melitz & Rubinstein (2007) developed a generalized gravity model of international trade with heterogeneous firms. The model accounted for self-selection of firms into export markets and their impact on trade volumes through two-stage estimation procedure that used an equation for selection into trade partners in the first stage and a trade flow equation in the second. In particular, the model predicted positive as well as zero trade flows across pairs of countries, and it allowed the number of exporting firms to vary across destination countries. They showed that traditional estimates were biased and that most of the bias was due not for selection but for omission of the extensive margin. Moreover, the effect of the number of exporting firms varied across country pairs according to their characteristics.

The present study analyses the pattern of international RMG trade with the special reference to top twenty RMG exporting countries. The international RMG trade has been investigated through estimated gravity model including both the variables related to economic size and the binary variables explaining various trade resistances or trade facilitating factors.

IV. METHODOLOGY

In 1962, Jan Tinbergen first explained about the application of gravity model in his seminal work stating that the size of bilateral trade flows between two countries can be approximated by a law called the 'gravity equation' by analogy with the Newtonian theory of gravitation. According to Tinbergen, volume of trade, capital flows, and migration of the people among the countries in the world can be explained by using Gravity Model (Dilanchiev 2012).The classical form of Tinbergen gravity model is defined as:

$$F_{ij} = G \frac{M_i^\theta M_j^\beta}{D_{ij}^\varepsilon}$$

Where, F_{ij} indicates interaction or flow between 'i' origin and 'j' foreign destination. M_i and $M_j$express the economic size of locations. If 'F' measures trade potential or bilateral trade, or trade flow then 'M' is gross domestic product (GDP) or Gross National Income (GNI) of each location. In the case of when 'F' measures flow of people (such as, immigration) then 'M' denotes size of population of the country. D_{ij} expresses the distance between two different places, the distances between capitals or sometimes distances between industrial centres of countries and 'G' is gravitational constant.

The gravity model of international trade is a simple empirical model for analysing trade flows between countries. The analytical base is as follows: "the trade flow between two countries is proportional to the product of each country's 'economic mass', generally measured by GDP, each to the power of quantities to be determined, divided by the distance between the countries' respective 'economic centres of gravity', generally their capitals, raised to the power of another quantity to be determined" (Christie 2002). The simplest form of the gravity model to estimate international RMG trade appears in the following modified form of Tinbergen gravity model:

$$TF_{ij} = k \frac{Y_i Y_j}{D_{ij}^2}$$ .... (1)

Where, TF_{ij} is the trade volume imported by the importing country 'j' from the identified exporting country 'i'; 'k' is constant that does not depend on i or j; such as the level of world liberalization. Y_i is measured as the Gross Domestic Product (GDP) of country iwhile Y_j is measured as the GDP of country j. D_{ij} is the distance between 'i' and 'j'. The model states that the bilateral trade flows is directly proportional to the product of the economic size (GDP or GNI) of countries 'i' and 'j' and inversely proportional to the distance between the two countries.

Deardorff (1998) showed that a gravity model can arise from a traditional factor-proportions explanation of trade. In general formulation, the gravity equation (1) has the following general multiplicative form (Bacchetta et al. 2012):

$$TF_{ij} = kS_i M_j \mathcal{O}_{ij}$$ .... (2)

where M_j denotes all importer-specific factors that make up the total importer's demand (such as, importing country's GDP, population) and S_i comprises exporter-specific factors (such as, exporter's GDP) that represent the volume exporters are willing to supply. Finally, $\mathcal{O}_{ij}$ represents the ease of exporter i to have access of market j (that is, the inverse of bilateral trade costs).

Given the multiplicative nature of gravity equation, the standard procedure for estimating gravity equation (2) for international RMG trade is simply to take natural logarithms of all variables and obtain a log-linear equation that can be estimated by ordinary least squares regression. This yields the estimated log-liner equation as follows:

$\log(TF_{ijt}) = \alpha + \hat{\beta}_1 \log(DIS_{ij}) + \hat{\beta}_2 \log(GDPm_{jt}) + \hat{\beta}_3 \log(GDPx_{it}) + \hat{\beta}_4 \log(Plm_{jt}) + \hat{\beta}_5 \log(Plx_{it})$
$+ \hat{\mu}_{ijt}...$ (3)

Where,

       α = the intercept term;

$\hat{\beta}$= the slope coefficients;

i = exporting countries where i=1,2,….20;

j = importing countries where j=1,2,….6for each exporting countries;

t= time period where t_1=2001,….t_{13}=2016;

TF_{ijt} = trade volume exported by the exporting country 'i' to the identified importing country 'j' along the study period (t);

DIS_{ij} = distance between exporting country 'i' and importing country 'j';

$GDPm_{jt}$ = Gross Domestic Product (Nominal) of importing countries (j) along the study period (t);

$GDPx_{it}$ = Gross Domestic Product (Nominal) of exporting country (i) along the study period (t);

Plm_{jt} = Population of importing countries (j) along the study period (t).

Plx_{it} = Population of exporting countries (i) along the study period (t).

The error term $\hat{\mu}_{ijt}$ is assumed to have zero mean and constant variance and not auto-correlated.

Equation (3) does not include all possible factors creating trade costs for the trading partners in case of international RMG trade. Typically, empirical studies proxy trade costs with bilateral distance. However, a number of additional variables are also customarily used. Anderson and van Wincoop (2003) showed that controlling for relative trade costs is crucial for a well-specified gravity model (Bacchetta et al. 2012). Most estimates of gravity models add a certain number of dummy variables to capture trade costs $Ø_{ij}$. Dummy variables of being in similar region and having sea route are used to reflect the hypotheses that transport costs increase with distance. Such costs are higher for remote countries but lower for neighbouring countries as well as countries with common border. Information or search costs are probably lower for trade between countries whose business practices, competitiveness and delivery reliability are well known to one another. Firms in adjacent countries, countries with a common language or other relevant features such as common currency and similar time zone are likely to prefer each other to firms operating in dissimilar environments. Tariff barriers are tested here in the form of dummies for existence of regional trade agreements among trading partners. The DFQF facility is available in RMG trade starting with GSP facility from developed countries. Thus, the estimated model including the effect of identified dummy variables is as below_

$\log(TF_{ijt}) = \alpha + \hat{\beta}_1 \log(DIS_{ij}) + \hat{\beta}_2 \log(GDPm_{jt}) + \hat{\beta}_3 \log(GDPx_{it}) + \hat{\beta}_4 \log(Plm_{jt}) + \hat{\beta}_5 \log(Plx_{it})$

$$+ \hat{\delta}_1 RGN_{ij} + \hat{\delta}_2 BRD_{ij} + \hat{\delta}_3 SR_{ij} + \hat{\delta}_4 CUR_{ij} + \hat{\delta}_5 LANG_{ij} + \hat{\delta}_6 TZ_{ij} + \hat{\delta}_7 RTA_{ij} + \hat{\delta}_8 DQ_{ij} +$$
$$\hat{\mu}_{ijt} \ldots \ldots \ldots \ldots \qquad (4)$$

Where,

> $\hat{\delta}$ = the slope coefficients of dummy variables;
>
> RGN_{ij} = '1' for being neighbouring countries or being in same region and '0' for otherwise.
>
> BRD_{ij} = '1' for having common border between exporting & importing countries and '0' for otherwise.
>
> SR_{ij} = '1' for having sea route between exporting & importing countries and '0' for otherwise.
>
> CUR_{ij} = '1' for having common currency in both exporting & importing countries and '0' for otherwise.
>
> $LANG_{ij}$ = '1' for having common language spoken in both exporting & importing countries and '0' for otherwise.
>
> TZ_{ij} = '1' for having similar time zone in both exporting & importing countries and '0' for otherwise.
>
> RTA_{ij} = '1' for being in a Regional Trade Agreement of exporting & importing countries and '0' for otherwise.
>
> DQ_{ij} = '1' for exporting countries' DFQF facility gained from importing countries and '0' for otherwise.

Final model estimation in equation (4) was performed exercising Pooled Ordinary Least Squares (POLS) regression with panel data on STATA software version-12.

V. DATA

There are near 200 RMG exporting countries in the world whose trade performance information is available through International Trade Centre (ITC) and COMTRADE (of the United Nations Statistics Division). According to Harmonized System (HS) Code-2012, the product lines under chapter 61 and 62 have been calculated to aggregate the RMG export or import volume. This study coverstop20 RMG exporting countries. The countries covered are China, Bangladesh, Viet Nam, Italy, Germany, India, Turkey, Spain, France, Belgium, Netherlands, United Kingdom, Indonesia, Cambodia, United States of America, Mexico, Sri Lanka, Pakistan, Denmark and Poland. For each of the exporting countries, data of 6 main RMG importing countries in terms of import volume with their several characteristics such as GDP, population and some dummy variables between 2001 and 2016 were collected to form a [20 (exporters) x 16 (years) x 6 (importers)] panel data. There is found no missing value in the dataset. The data has been

collected from ITC Trade Map, IMF World Economic Outlook databases, ITC Trade Competitiveness Map, Geo Dist database of CEPII, RTA database and websites likewww.countries-ofthe-world.com and www.timeanddate.com for developing ideas about some dummy variables.

VI. FINDINGS & DISCUSSION

In this study, gravity model was used to determine the effect of factors such as distance and income (GDP) which affect RMG export. For implementation of the model, at first, a distribution of RMG exporting countries was developed primarily. It explains these countries participation rate in global RMG supply which is 83%. Thus, this study is expected to be a representative one to draw the pattern of international RMG trade.

Then, six importing countries of each of the suppliers were identified wherein general countries were United States of America, Germany, Japan, United Kingdom, France and Spain. Table 2 presents descriptive statistics of the variables along the years 2001–2016.

Table 1: Distribution of exporting countries by volume

Exporters	RMG'16 (billion USD)	Proportion to World
World	435.57	
China	146.48	34%
Bangladesh	33.48	8%
Viet Nam	24.67	6%
Italy	19.97	5%
Germany	17.12	4%
India	16.96	4%
Turkey	16.30	4%
Spain	12.28	3%
France	10.01	2%
Netherlands	9.11	2%
Belgium	8.40	2%
United Kingdom	8.00	2%
Indonesia	7.17	2%
Cambodia	6.63	2%
United States of America	4.92	1%
Poland	4.84	1%
Pakistan	4.60	1%
Sri Lanka	4.60	1%
Mexico	4.06	1%
Denmark	3.94	1%
Total	*363.54*	*83%*

Source: Trade Statistics, 2016; ITC Trade Map

Table 2: Descriptive statistics of the variables

Variable	Unit	Mean	Minimum	Maximum
Volume of Export	thousand USD	1,282,244	261	32,700,000
Distance	km	4407	173	16,371
GDP of importing country	billion USD	3023	3.8	18569
GDP of exporting country	billion USD	1848	3.9	18569
Population of importing country	Individual(million)	78	1.1	323
Population of exporting country	Individual(million)	202	5.3	1383
Existing Sea route	0/1	0.57	0	1
Common border	0/1	0.30	0	1
Similar Region	0/1	0.50	0	1
Common Currency	0/1	0.29	0	1
Common Language	0/1	0.28	0	1
Time zone	0/1	0.55	0	1
RTAs	0/1	0.68	0	1
DFQFFacility	0/1	0.90	0	1

Source: Data Summary from Software Output

Before performing the regression analysis, the estimated model was tested by some diagnostic tests provided in appendix (software outputs). These tests were executed to check normality in residuals, autocorrelation, heteroskedasticity and multicollinearity. The kernel density estimate of residuals was plotted in appendix graph 1; requesting that a normal density be overlaid on the plot. The bandwidth for the residual curve is 0.19 which represents askewed curve close but sharpened to the true or normal density estimate. Thus, the plot presents the existence of minornormality within residuals which is also backed by Shapiro-Wilk W test for normal data. The estimated autocorrelation coefficient was found 0.63 by running Generalized Least Squares (GLS) regression with Autoregressive (AR) (1) disturbances. This coefficient value represents positive autocorrelation within the dataset. This was further verified through running Prais-WinstenAR(1) regression which provided DW statistic of 0.16. The DW statistic was transformed into the value 2.50 which reached coefficient estimates having no autocorrelation (column (4) in table 2).White's test and Breusch-Pagan test was performed to check heteroskedasticity. Both test null hypothesis that the variance of the residuals is homogenous. Since the null hypothesis is rejected, the variance was not homogenous or constant. These tests are very sensitive to model assumptions. Therefore it is a common practice to combine the tests with diagnostic plots to make a judgment on the severity of the heteroskedasticity and to decide whether any correction is needed for

heteroskedasticity. The commonly used graphical method is to plot the residuals versus fitted (predicted) values. If the model is well-fitted, there should be no pattern to the residuals plotted against the fitted values. In this study, the plot did not show too strong evidence. However, this low level of heteroskedasticity can be avoided by taking corrective measures. Variance Inflation Factor (VIF) was used to check multicollinearity. As a rule of thumb, a variable whose VIF values are greater than 10 should go through further investigation. Tolerance, defined as 1/VIF, is also used to check on the degree of collinearity ('tolerance value < 0.1' is comparable to a 'VIF of 10').Since no variable has multicollinearity problem, this can be avoided for further treatment.

Table 3: Summary of Regression Results (Dependent Variable: Log of Export Volume)

Independent Variables	(1) Coefficients without panel effect	(2) Coefficients with Fixed Effect Panel	(3) Coefficients with Random Effect Panel	(4) Coefficients with Prais-WinstenAR(1)	(5) Coefficients with Panel Corrected Standard Error
Log of Distance	-0.44 (0.05)***	omitted	-0.11 (0.18)	-0.24 (0.18)	-0.44 (0.02)***
Log of GDP of Exporting Country	0.30 (0.03)***	0.73 (0.12)***	0.87 (0.04)***	0.61 (0.07)***	0.30 (0.04)***
Log of GDP of Importing Country	1.19 (0.04)***	0.44 (0.11)***	0.43 (0.05)***	0.29 (0.07)***	1.10 (0.04)***
Log of Population of Exporting Country	0.20 (0.03)***	2.14 (0.82)	-0.28 (0.09)***	-0.15 (0.10)	0.20 (0.04)***
Log of Population of Importing Country	-0.53 (0.05)***	-1.07 (0.33)	-0.37 (0.11)***	-0.05(0.13)	-0.53 (0.04)***
Sea route	-0.26 (0.06)***	omitted	-0.02(0.24)	0.05 (0.23)	-0.26 (0.03)***
Common Border	0.87 (0.08)***	omitted	1.31 (0.31)***	1.26 (0.30)***	0.87 (0.04)***
Similar region	-0.49 (0.10)***	omitted	-1.51 (0.37)***	-1.24 (0.36)***	-0.49 (0.07)***
Common currency	-0.26 (0.08)***	omitted	-0.42 (0.27)	-0.33 (0.27)	-0.26 (0.05)***
Common language	-0.31 (0.07)***	omitted	-0.56 (0.25)**	-0.40 (0.24)*	-0.31 (0.05)***
Time zone	0.46 (0.10)***	omitted	0.12 (0.35)	0.01 (0.34)	0.46 (0.04)***
RTAs among partner countries	-1.09 (0.07)***	omitted	-1.51 (0.27)***	-1.17 (0.27)***	-1.10 (0.07)***
DFQF Facility	0.56 (0.10)***	omitted	1.35 (0.34)***	1.20 (0.34)***	0.56 (0.06)***
Constant	8.02	0.13	8.30	9.89	8.02
R-squared	*0.57*	*0.05*	*0.35*	*0.80*	*0.57*
Number of Observation= 1920					
Standard Errors are in the Parenthesis. *** represents significance at 1 percent; ** represents significance at 5 percent and * represents significance at 10percent.					

Source: Regression Coefficients from Software Output

Table 3 presents the regression results run in several steps under the estimated model. Regression was run at first without panel effect (column 1).It actually presents the regression coefficients without standard error caused by panel effect. Then, the coefficients were estimated through fixed effect (FE) panel (column 2). However, since the estimated model had dummy variables, the FE regression output omitted the variables for having similar time varying effect. Thus, the model was run with 'Random-effects GLS regression' (column 3) which proves inappropriate in Breusch and Pagan Lagrangian Multiplier test for current study. In process of finding autocorrelation status, the model was further run through Prais-WinstenAR(1) regression (column 4). And finally, the model was estimated applying linear regression with correlated panels corrected standard errors (PCSEs).These coefficients arenow without any autocorrelation and standard error problems. Observing all the coefficients under different regression model estimates, the coefficients under PCSEs (column 5) are appropriate one to go for further discussion on the significance of the identified variables for present gravity model. Here the coefficients of all the variables are accepted at 1% significance level.

In the regression results, coefficient of distance is -0.44%.Cross-national distance has a negative effect on the RMG trade. For 1% increase in the distance between exporter and importer, RMG export reduces by 0.44%. Thus, more appropriate as well as cheaper transportation systems need be developed for the RMG trade among far countries.

There is a positive relationship between GDP and trade flow. The GDP of both the exporting and importing country contributes to increasing international trade in RMG. For 1% increase in GDP of importing country, there is 1.20% raise in export. This may simply imply a macro-economic theory that citizen with higher income would consume more from global products. However, RMG exporting countries will benefit from such income rise in the importing countries. In addition, for 1% increase in exporter's GDP, there is 0.20% raise in export. Thus, importer's GDP carries more value in increasing trade flow among the countries. Therefore, income elasticity of importing countries is higher than that of exporting countries which indicates that the change in income level of the importing countries is more effective on the RMG trade. In other words, in case of a simultaneous increase in worldwide income, supply of RMG might be below the demand which may accelerate potential price rise of RMG products.

Population of importing country is negatively correlated with RMG export with coefficient value of -0.53%. Most of the countries in the RMG demand side have lower population. However, such lower population would not retard RMG export. This is because; present result indicates RMG export reduction in case of population increase in importing nation. On the other hand, supplying country's population shows positive correlation of 0.20%. Thus, an exporter will have 0.20% more export against 1% increase in their population. This indicates that the more will be population in exporting countries,

the more will be their labour force. Consequently, the larger population tends to provide cheaper and competitive (growing productivity) labour force to produce more for export purpose. Thus, the exporting countries were found to gain more from its larger population even transacting with lower populated importing nation like European countries.

Under dummy variables: where both the exporting and importing countries are in similar region, the RMG trade flow is found to have negative growth (-0.49%) than the countries with dissimilar region. Thus, RMG exports are mostly targeted to different regions. But the countries with common border experience positive growth of 0.87% in RMG trade. The countries in similar time zone are also found to have growing trade (0.46%) than the dissimilar one. The countries which are connected through sea route, are found to have less RMG trade (-0.26%) relation among them. Though connection through sea line is expected to exert lower transportation costs, this variable is negatively correlated with RMG trade flow. The model revealed that common currency is not an advantage in international RMG trade (-0.26%). As in the case of Euro Zone, differences in purchasing power of Euro across the EU countries are a drawback rather than an advantage. Moreover, the Asian countries export more to Western and European countries which is beyond the concern for common currency benefit. Present model shows that the RMG trading partners do not prioritize common language speaking countries (-0.31%).Moreover, RMG trade flow is less (-1.10) among the countries which have Regional Trade Agreements (RTAs). The fact that most of the RMG exporters do not have RTAs with importers, may explain the reason behind this scenario. However, the negative coefficient of RTAs can be ascertained by the role of DFQF facility (0.56%) in contributing to increasing RMG export.

VII. CONCLUSION

RMG is the major export item of Bangladesh holding 83% of total export. Therefore analysing and modelling international RMG trade carries great significance to the stakeholders of this sector to understand the RMG trade scenario. In fact, this analysis holds significant clues not only for Bangladesh but also for all countries related to RMG trade. The estimated gravity model has yielded results in line with theoretical expectations which are the basis for coping with competition in international RMG market. Increase in international trade will increase the welfare of RMG exporting countries primarily. For the importing countries, this will give rise to an opportunity of consuming more RMG products. It appears that exporters of RMG will positively be affected by the welfare increase worldwide. However, population increase in importing countries may not relate to the growth of RMG sales in those countries. On the other hand, exporters' population growth helps raise their RMG export. Cross countries' distances negatively influence RMG export. In other words, countries that demand RMG would like to import it from relatively closer RMG producing countries in order to

minimize transportation costs and duration. Exporting countries should develop some attractive pricing strategies or put differentiated products for international market to overcome the trade costs arisen from greater distance. Even transporting via sea lines does not bring extra advantages to increase RMG export to dispersed trading partners. Such case strengthens the need for price efficient RMG products. Though the countries with common border and similar time zone have increased RMG trade, countries in similar region as well as in RTAs are not prospective in increasing their RMG export. Moreover, common currency, common language and having sea routes are not advantageous to RMG export growth for having no positive contribution. The DFQF facility contributes positively to raise the RMG trade among the partners. Thus, for successful competition in international RMG market, having common border and DFQF access to importing countries' market play very important role. Beyond doubt, one factor is obviously nature blessed and another poses credit to the institutional arrangement in facilitating global trade by the WTO. As an LDC, Bangladesh benefits from DFQF facilities for experiencing tremendous growth in RMG export.

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APPENDICES

Before estimating regression model, Best Linear Unbiased Estimator (BLUE) is subject to some specification tests regarding the status of dataset. Such tests are basically based on the residuals of the regression model to have an unbiased estimator. The unobserved effect or residuals are also expected to be uncorrelated with all the explanatory variables in the model.

Graph-1: Kernel Density Curve

Kernel density estimate

kernel = epanechnikov, bandwidth = 0.1925
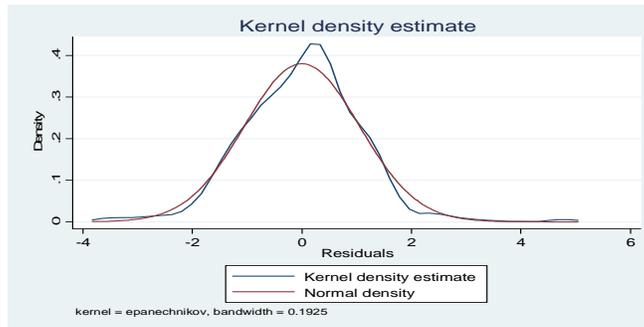
Software Output-1: Normality test for Residuals

```
              Shapiro-Wilk W test for normal data

    Variable │    Obs        W         V         z      Prob>z
─────────────┼───────────────────────────────────────────────
        uhat │   1920    0.98392    18.370    7.393    0.00000
```

Since the null hypothesis is rejected, the residuals do not have a normal distribution.

Software Output-2: White's test for Homoskedasticity

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(91)      =    1322.47
         Prob > chi2   =     0.0000

Cameron & Trivedi's decomposition of IM-test
```

| Source	chi2	df	p
Heteroskedasticity	1322.47	91	0.0000
Skewness	172.52	13	0.0000
Kurtosis	13.89	1	0.0002
Total	1508.88	105	0.0000

Software Output-3: Breusch-Pagan test for Homoskedasticity

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of l_exp

        chi2(1)       =    344.67
        Prob > chi2   =    0.0000
```

Since the null hypothesis regarding homoscedasticity is rejected here, there is heteroskedasticity problem in this dataset.

Graph-2: Graphical method for detecting heteroskedasticity
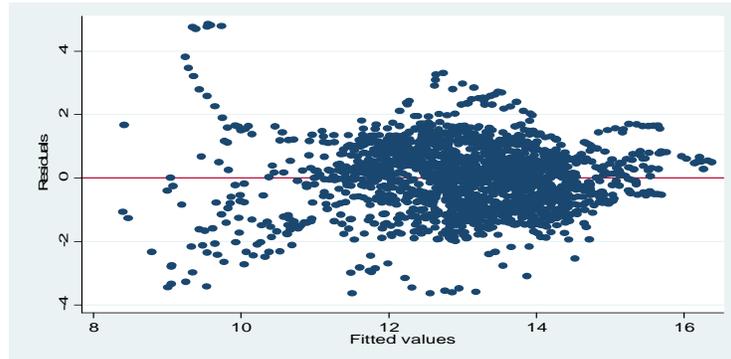
Software Output-4: Variance Inflation Factor (VIF) test for Multicollinearity

Variable	VIF	1/VIF
l_dist	6.47	0.154593
l_plm	5.34	0.187123
l_gdpm	5.19	0.192755
neighbhd	4.38	0.228444
l_gdpx	3.99	0.250712
timezone3	3.82	0.261650
l_plx	3.66	0.273367
com_border	2.49	0.400929
econ_coopr	2.24	0.446485
com_cur	2.02	0.496026
searoute	1.76	0.569441
com_lang	1.58	0.631432
dffacility	1.50	0.665156
Mean VIF	3.42	

Variance Inflation Factor (VIF) score more than 10 represents the problem of Multicollinearity which is absent in this dataset.

Software Output-6: Regression without Panel Effect

Source	SS	df	MS				
Model	2857.71851	13	219.824501				
Residual	2115.06032	1906	1.10968537				
Total	4972.77883	1919	2.59133863				

Number of obs = 1920
F(13, 1906) = 198.10
Prob > F = 0.0000
R-squared = 0.5747
Adj R-squared = 0.5718
Root MSE = 1.0534

l_exp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
l_dist	-.4447551	.0503741	-8.83	0.000	-.5435494	-.3459609
l_gdpm	1.102847	.0401661	27.46	0.000	1.024073	1.181621
l_gdpx	.3026604	.0277281	10.92	0.000	.2482799	.3570409
l_plm	-.5259444	.0501758	-10.48	0.000	-.6243497	-.4275391
l_plx	.1984134	.0330806	6.00	0.000	.1335353	.2632914
searoute	-.2602949	.064291	-4.05	0.000	-.386383	-.1342067
com_border	.8741044	.0828526	10.55	0.000	.7116131	1.036596
neighbhd	-.4945626	.1005981	-4.92	0.000	-.6918565	-.2972687
com_cur	-.2625328	.0750991	-3.50	0.000	-.4098179	-.1152477
com_lang	-.3077349	.0671396	-4.58	0.000	-.4394096	-.1760601
timezone3	.4566317	.0944716	4.83	0.000	.2713531	.6419103
econ_coopr	-1.090115	.0768161	-14.19	0.000	-1.240767	-.9394621
dffacility	.5570718	.0982577	5.67	0.000	.3643679	.7497757
_cons	8.017956	.4804999	16.69	0.000	7.075595	8.960317

Software Output-7: Fixed-effects Regression

```
Fixed-effects (within) regression              Number of obs      =       1920
Group variable: pairid                         Number of groups   =        120

R-sq:   within  = 0.4850                       Obs per group: min =         16
        between = 0.0489                                      avg =       16.0
        overall = 0.0549                                      max =         16

                                               F(4,119)           =      57.52
corr(u_i, Xb)  = -0.9125                        Prob > F           =     0.0000

                                    (Std. Err. adjusted for 120 clusters in pairid)

                                    Robust
        l_exp |     Coef.    Std. Err.      t     P>|t|     [95% Conf. Interval]
--------------+-------------------------------------------------------------------
       l_dist |         0   (omitted)
       l_gdpx |  .7271074   .1210478      6.01   0.000     .4874206    .9667942
       l_gdpm |  .4434397   .114311       3.88   0.000     .2170925    .669787
        l_plx |  2.140944   .8236355      2.60   0.011     .5100636    3.771825
        l_plm | -1.066994   .3331836     -3.20   0.002    -1.726731   -.4072573
     searoute |         0   (omitted)
   com_border |         0   (omitted)
     neighbhd |         0   (omitted)
      com_cur |         0   (omitted)
     com_lang |         0   (omitted)
    timezone3 |         0   (omitted)
   econ_coopr |         0   (omitted)
    dffacility|         0   (omitted)
        _cons |  .1327415   3.175781      0.04   0.967    -6.155621    6.421104
--------------+-------------------------------------------------------------------
      sigma_u | 3.6755441
      sigma_e |  .46803958
          rho |  .98404355   (fraction of variance due to u_i)
```

Since FE regression has some limitations in regressing on dummy variables, RE model needs run to get full output.

Software Output-8: Random-effects Regression

```
Random-effects GLS regression                  Number of obs      =       1920
Group variable: pairid                         Number of groups   =        120

R-sq:   within  = 0.4591                        Obs per group: min =        16
        between = 0.3405                                       avg =      16.0
        overall = 0.3553                                       max =        16

                                               Wald chi2(13)       =    1546.58
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =     0.0000
theta          = .87834453

        l_exp |     Coef.    Std. Err.      z     P>|z|     [95% Conf. Interval]
--------------+-------------------------------------------------------------------
       l_dist | -.1091582   .1801399     -0.61   0.545    -.4622259    .2439094
       l_gdpx |  .8652974   .0356822     24.25   0.000     .7953615    .9352333
       l_gdpm |  .4250532   .0503427      8.44   0.000     .3263832    .5237231
        l_plx | -.2778283   .0866971     -3.20   0.001    -.4477514   -.1079051
        l_plm | -.3654442   .1065987     -3.43   0.001    -.5743738   -.1565147
     searoute | -.0192233   .2415563     -0.08   0.937    -.4926649    .4542183
   com_border |  1.309266   .3118287      4.20   0.000     .6980934    1.92044
     neighbhd | -1.506468   .369262      -4.08   0.000    -2.230209   -.7827282
      com_cur |  -.424683   .2749684     -1.54   0.122    -.9636112    .1142453
     com_lang | -.5614358   .2546521     -2.20   0.027    -1.060545   -.062327
    timezone3 |  .1230293   .3510795      0.35   0.726    -.5650739    .8111325
   econ_coopr |  -1.51445   .2708375     -5.59   0.000    -2.045282   -.9836181
   dffacility |   1.34876   .3411866      3.95   0.000     .6800464    2.017473
        _cons |  8.301476   1.565928      5.30   0.000     5.232312    11.37064
--------------+-------------------------------------------------------------------
      sigma_u |  .95466967
      sigma_e |  .46803958
          rho |  .80621873   (fraction of variance due to u_i)
```

Software Output-9: Test for Random Effect model

```
Breusch and Pagan Lagrangian multiplier test for random effects

          l_exp[pairid,t] = Xb + u[pairid] + e[pairid,t]

          Estimated results:
                                 Var        sd = sqrt(Var)

                    l_exp |   2.591339       1.609764
                        e |   .2190611        .4680396
                        u |   .9113942        .9546697

          Test:   Var(u) = 0
                                 chibar2(01) =    7684.56
                                 Prob > chibar2 =   0.0000
```

The null for xttest0 is var(u) = 0. If that was the case then there are no random effects. A significant result rejects var(u)=0 in favor of var(u) > 0, in which case the pooled OLS model that assumes that the error process has vce = \sigma^2 I_{NT} is not the appropriate model. So a rejection (significant test result) implies that we should not use OLS (Ordinary Least Squares method).

Software Output-9: RE GLS regression with AR(1) disturbances

```
RE GLS regression with AR(1) disturbances        Number of obs     =       1920
Group variable: pairid                           Number of groups  =        120

R-sq:   within  = 0.4508                          Obs per group: min =         16
        between = 0.4027                                         avg =       16.0
        overall = 0.4078                                         max =         16

                                                 Wald chi2(14)     =     643.86
corr(u_i, Xb)      = 0 (assumed)                  Prob > chi2       =     0.0000
```

l_exp	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
l_dist	-.1852854	.1595637	-1.16	0.246	-.4980245	.1274536
l_gdpx	.7702495	.0492363	15.64	0.000	.6737482	.8667508
l_gdpm	.3645319	.059983	6.08	0.000	.2469674	.4820964
l_plx	-.2641511	.084416	-3.13	0.002	-.4296035	-.0986987
l_plm	-.1269843	.1128399	-1.13	0.260	-.3481465	.094178
searoute	-.0058505	.2113329	-0.03	0.978	-.4200554	.4083545
com_border	1.262167	.273244	4.62	0.000	.7266183	1.797715
neighbhd	-1.323459	.3251054	-4.07	0.000	-1.960654	-.6862646
com_cur	-.4440893	.2425942	-1.83	0.067	-.9195653	.0313866
com_lang	-.4397038	.2231364	-1.97	0.049	-.8770432	-.0023644
timezone3	.0604542	.3079074	0.20	0.844	-.5430332	.6639416
econ_coopr	-1.434362	.2408681	-5.95	0.000	-1.906455	-.9622694
dffacility	1.333923	.3055596	4.37	0.000	.735037	1.932809
_cons	8.856804	1.38934	6.37	0.000	6.133748	11.57986

```
rho_ar      .62930148     (estimated autocorrelation coefficient)
sigma_u     .87618287
sigma_e     .4108839
rho_fov     .81973133     (fraction of variance due to u_i)
theta       .7239168
```

Here the estimated autocorrelation coefficient is 0.63 (rho_ar) which represents positive serial correlation lying within the residuals of current dataset.

Software Output-10: Prais-WinstenAR(1) regression - iterated estimates

```
Prais-Winsten AR(1) regression -- iterated estimates
```

Source	SS	df	MS			
Model	1282.93119	13	98.6870148			
Residual	311.086651	1906	.163214402			
Total	1594.01784	1919	.830650257			

```
                                     Number of obs =       1920
                                     F( 13,  1906) =     604.65
                                     Prob > F      =     0.0000
                                     R-squared     =     0.8048
                                     Adj R-squared =     0.8035
                                     Root MSE      =       .404
```

l_exp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
l_dist	-.2366075	.1775065	-1.33	0.183	-.5847349	.1115199
l_gdpx	.609854	.0694281	8.78	0.000	.473691	.746017
l_gdpm	.2897125	.0689944	4.20	0.000	.1544001	.425025
l_plx	-.1491298	.1005305	-1.48	0.138	-.3462912	.0480317
l_plm	-.049668	.1298709	-0.38	0.702	-.304372	.205036
searoute	.0479053	.2342755	0.20	0.838	-.4115581	.5073686
com_border	1.256404	.3026556	4.15	0.000	.6628332	1.849975
neighbhd	-1.235068	.3605229	-3.43	0.001	-1.942129	-.5280074
com_cur	-.3316936	.2711413	-1.22	0.221	-.8634585	.2000713
com_lang	-.4013027	.2473749	-1.62	0.105	-.8864567	.0838512
timezone3	.011898	.3412853	0.03	0.972	-.657434	.68123
econ_coopr	-1.172735	.270469	-4.34	0.000	-1.703182	-.642289
dffacility	1.203726	.344649	3.49	0.000	.5277975	1.879655
_cons	9.891531	1.559423	6.34	0.000	6.833176	12.94989

```
rho      .9393964

Durbin-Watson statistic (original)      0.162990
Durbin-Watson statistic (transformed)   2.502159
```

Here the transformed **Durbin-Watson Statistic** is 2.50 which is near to 2. We know that if D-W Statistic is 2, it indicates zero correlation ($\phi=0$) between Error terms. So Autocorrelation problem in our data set has been resolved by **Prais-Winsten Autoregressive (AR1) model.**

Software Output-11: Estimated model for result interpretation

Since there prevail some estimated autocorrelation and heteroskedasticity problems in the dataset, the model for linear regression with 'Panels Corrected Standard Errors (PCSEs)' has been run to get rid of these problems.

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:    pairid                     Number of obs     =       1920
Time variable:     year                       Number of groups  =        120
Panels:            correlated (balanced)      Obs per group: min =         16
Autocorrelation:   no autocorrelation                        avg =         16
                                                             max =         16
Estimated covariances      =        7260      R-squared         =     0.5747
Estimated autocorrelations =           0      Wald chi2(13)     =   33975.22
Estimated coefficients     =          14      Prob > chi2       =     0.0000
```

l_exp	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
l_dist	-.4447551	.0241791	-18.39	0.000	-.4921452	-.397365
l_gdpm	1.102847	.0445758	24.74	0.000	1.01548	1.190214
l_gdpx	.3026604	.0435093	6.96	0.000	.2173838	.387937
l_plm	-.5259444	.042573	-12.35	0.000	-.6093859	-.4425029
l_plx	.1984134	.035982	5.51	0.000	.1278899	.2689369
searoute	-.2602949	.0332755	-7.82	0.000	-.3255135	-.1950762
com_border	.8741044	.0395531	22.10	0.000	.7965817	.9516271
neighbhd	-.4945626	.0655359	-7.55	0.000	-.6230105	-.3661147
com_cur	-.2625328	.0453309	-5.79	0.000	-.3513797	-.1736859
com_lang	-.3077349	.0525368	-5.86	0.000	-.410705	-.2047647
timezone3	.4566317	.0379033	12.05	0.000	.3823426	.5309208
econ_coopr	-1.090115	.0661449	-16.48	0.000	-1.219756	-.9604728
dffacility	.5570718	.0615862	9.05	0.000	.4363652	.6777784
_cons	8.017956	.3003788	26.69	0.000	7.429224	8.606687