Master's Thesis

# Determining the Export Value: A Panel analysis of the Gravity Model

## Research on Bangladesh: Cloth and Textile Sector

## -중력 모델을 이용한 방글라데시의 의류 수출 분석-

2022


The Graduate School of Hansung University

Major in International Trade and Economics

Dept. of International Trade and Economics

Abdullah Al Evan Bhuiyan

Master's Thesis
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Approved Bhuiyan Abdullah Al Evan Master Thesis in International Trade and Economics

Dec, 2021

Judge Chair 김 인 선(Sign)

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# Abstract

## Determining the Export Value: A Panel analysis of the Gravity Model

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The goal of this thesis is to determine the factors that influence Bangladeshi cloth and textile exports. Over a 15-year period, from 2000 to 2015, a comprehensive data set was created and used to evaluate the panel gravity model of Bangladeshi cloth and textile export streams to a total of 7 (SAARC nation) trade partners. In the first stage OLS estimation method is applying in the panel data. Then in the next steps, Random effect model is tested for the data set. In the third steps we employed the Fixed effect model. Then we estimate the Hausman test to choose the model between fixed and random. By utilizing the Hausman Test, REM is better than the FEM. Data selected for the thesis is strongly balanced data. The variable of per capita GDP is statistically significant. Also, distance between the exporting country and SAARC

countries. According to the REM result, closer the distance from the exporting nation, higher the trade occurs between Bangladesh and SAARC nations. Empirically, a 1% increase the distance will lead to decrease the trade value of cloth and textile by 1.05%. The variable of per capita GDP of SAARC nation also increases the trade value of cloth and textile in Bangladesh. Carbon emission has no statistically significant effect.

**Keywords**: Gravity Model, Panel Regression, Random Effect Model, Fixed Effect Model, Carbon Emission, Trade Value of Cloth and Textiles

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# Abbreviation

REM= Random Effect Model

FEM= Fixed Effect Model

RGDP= Real Gross Domestic Product

PGDP= Per Capita GDP

CO2= Carbon Emission (Kt)

BGMEA= Bangladesh Garment Manufacturers and Exporters Association

RMG= Readymade Garment

SAARC= South Asian Association for Regional Cooperation

# CHAPTER 1: INTRODUCTION

## 1. INTRODUCTION

The gravity model is used in this analysis to assess Bangladesh's bilateral trading with its SAARC and major trading partners. Gravity model used for foreign trade is focused on the premise that trade between nations is based on mass (GDP, population) and distance, like gravitational force. Models for the gravity of international trade and integration economies have been very common empirically to identify reforms. This model offers a convenient multivariate method for the influence assessment of preferential trading and international trade. Globally, foreign trade has been viewed as both an instrument and a precursor of economic development. (Helpman, 2011; Feenstra, 2004; Krugman & Obstfeld, 2002).

Bangladesh's export volume of ready-made garments (RMG) was approximately 27.95 billion US dollars in 2020. This was a decline from the previous year, when RMG exports in Bangladesh totaled slightly more than 34 billion US dollars. Bangladesh has had a steady GDP (gross domestic product) of 6.5 percent since 2004, and ready-made garments (RMG) play a major role in this.

Bangladesh quickly expanded its RMG exports by enchanting benefit of export allowances and preferential entry in major markets the European

Union [EU] along with the USA, as well as its surplus of low-cost female labor (Mahmud, 2008).

Bangladesh was one of the impecunious nations in the world since its independence in 1971. Due to the racist mindset and policies of the then-West Pakistani government, no major factories were established in Bangladesh when it was known as East Pakistan. As a result, restoring the war-torn nation with scarce capital proved to be the most difficult task. (BGMEA)

The readymade garment (RMG) sector, which is now Bangladesh's single largest export earner, has made a critical contribution to the nation' s and economy's reconstruction. The industry accounts for 83 percent of the country's gross export earnings(BGMEA). Readymade garment (RMG) is an important part of the GDP that improves our economic activities over the year.

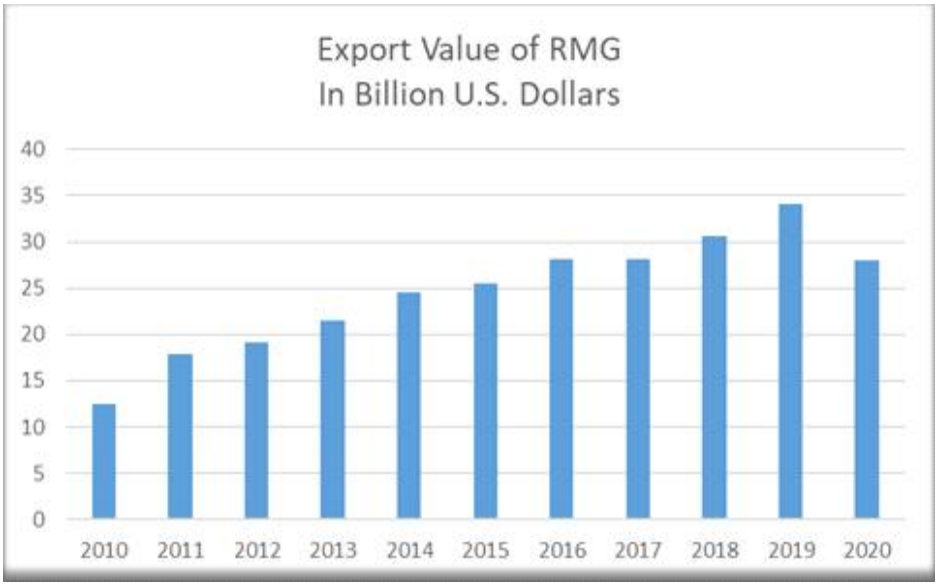
Over the past 25 years, Bangladesh garments industry has been a primary export division and a major foundation of foreign exchange. Currently, the nation produces over $5 billion in commodity value each year from textile exports. Around 3 million people are working in the sector, with 90 percent of them being women. There have been two significant non-market reasons that confirm the continuing growth of the textile industry: (a) the quota in the North American market in the Multi-Fiber Arrangement (MFA) and (b) the special entry into the European markets. The entire process is inextricably tied to the pattern of output rearrangement.

The gravity model is commonly used to describe foreign trade. It was derived from Newton's physics equation of gravity. Other researchers recently investigated the trade gravity model's theoretical dimensions. (Anderson, 2011; Anderson, 1979; Shahriar, Qian, Kea, & Abdullahi, 2019). Cardinale and Scazzieri (2019) recently stated that deliberations of market instruction, industrial promotion, and international trade have been directed in terms of domestic welfare since the early 17th century. Alternatively, international trade has a positive influence on a country's population.

Bangladesh's untapped export potential to the SAARC region is projected to be 93%. In 2014, the state's actual export to SAARC nations was $532.71 million, with a potential of $7.73 billion.

According to the statement published by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Bangladesh has the uppermost proportion of unexploited potential, followed by Pakistan (86%), Maldives (88%), Nepal (76%) and Afghanistan (83%). The export of Bangladesh to SAARC totaled $652.57 million from 2016 July to 2017 March, an increase from the previous year's export of $572.75 million

*Figure 1: Export value of RMG for Bangladesh*

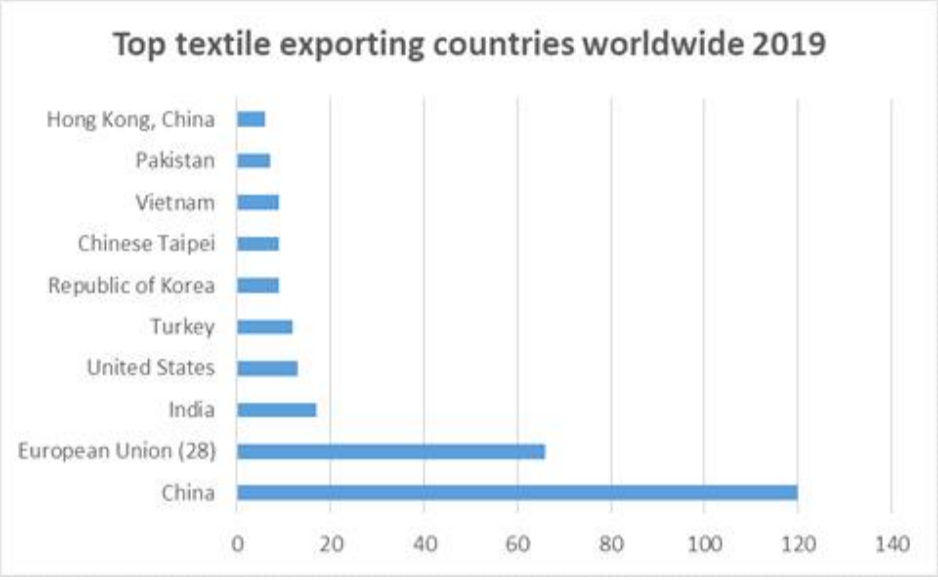



Source: Statista

Figure 1 shows the export value of Bangladesh in the Ready-Made Garments sector. The value of exporting RMG product is highest in 2019 which is a little bit lower in the following year. Figure 3 shows the top textile exporting countries worldwide in 2019.Figure 2 shows the leading clothing exporter in the world in 2019. Where Bangladesh is one of the top three highest exporters later than China and EU countries.

Exports of RMG goods from Bangladesh are also a central part of the global clothing supply chain. Bangladesh is competing well with other emerging markets like Vietnam, India, Cambodia and China.

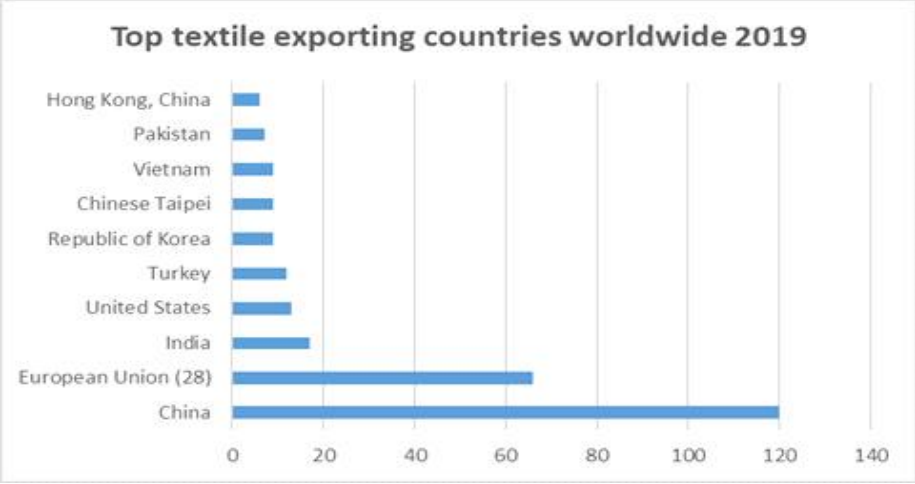
*Figure 2: Top Leading Clothing Exporters Nation in 2019*




Source: Statista

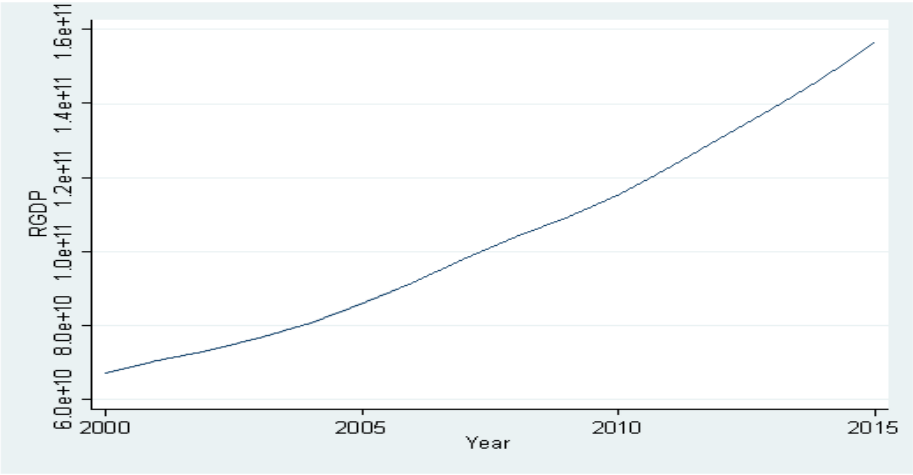
The GDP of Bangladesh is rising day by day. The following figure shows the trends of Real GDP and Per capita GDP of Bangladesh.

*Figure 3: Top Leading textile Exporting Nation in 2019*



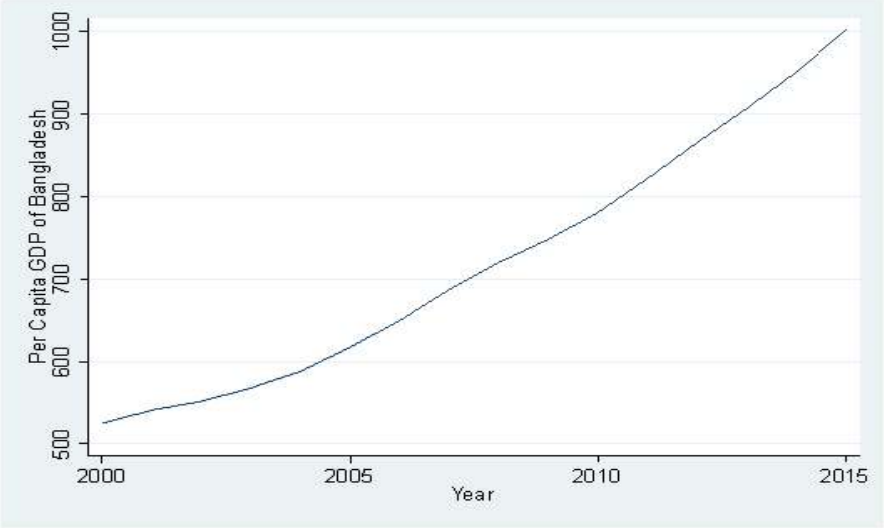

Source: Statista

Figure 4: RGDP




Source: Bangladesh Bureau of Statistic

Figure 5: Per Capita GDP

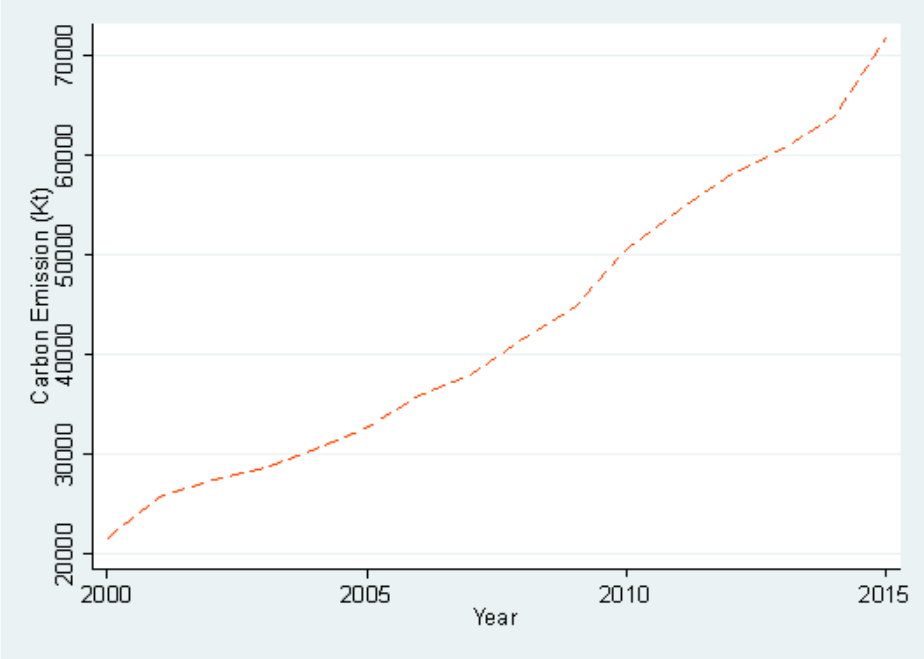



Source: Bangladesh Bureau of Statistic

The above figure shows the trends of Bangladesh GDP. The GDP of Bangladesh is upward because of various factors. Our per capita is also rising. In 2000, our per capita GDP was only 524 USD dollar and in 2015 it was 1000 USD. In the recent year our per capita GDP is more than 2000 USD dollar.

As our GDP and structural development occurred there is a concern about the environmental pollution. The world temperature is rising day by day. Our carbon emission is also rising.

Figure 6: Trends of CO2




Source: World Bank

This paper tries to find the bilateral trade between Bangladesh and SAARC nation by utilizing the Gravity model. Section 2 describes the literature of relevant field of Gravity Model. Section 3 tries to design the research framework and make the research hypothesis. The next chapter analyzes the Methodology of the thesis and also the data collection procedure. In chapter 4, I also attempt to analyze the panel regression method and the various test.

Chapter 5 will discuss the result of the model and next chapter 6 analyze the conclusion and recommendation of the thesis. References are also included in chapter 6.

# CHAPTER 2: REVIEW OF LITERATURE

## 2. LITERATURE REVIEW

Tinbergen (1962) proposed improving thebasic gravity model, suggesting that trade volumes with trading partners in any random country are avowedly proportional to their national revenue and linked to the terrestrial distance between the trading partners or vice-versa. The idea is that nations that have a bigger market are absolutely more favorable to trade, while bilateral trade will be depressed by distance (a proxy for transport costs). (Dell' Ariccia, 1999)

In addition, numerous experiments have been carried out in order to create a theoretical basis for the gravity model in international trade revisions after Anderson's (1979) groundbreaking paper. In the global trade there are generally three kinds of analytical models: Ricardian, the Heckscher - Ohlin (H-O). Study reveals that the gravity model conforms to these theoretical models (Evenett & Keller, 2002). The gravity conditions were calculated by Bergstrand (1989) from the trade model with the object separation and increasing size returns.

Helpman (1987) and Bergstrand (1989) suggested a scheme of explanations for the realization of gravity that is constant with advanced intra-industry and intra-industry speculations. Deardorff (1998) demonstrated the theoretical variations in the Ricardian and H-O models.

Clarete et al. (2000) employ the bilateral trade gravity model to assess the impact of various preferential trading agreements (PTAs) in the

Asia-Pacific region. They employ panel data and cross-section data estimate methods. Aside from taking into account the main drivers of the gravity model (GDP, population, distance, and so on), they incorporate dummies to assess the impact of PTAs on trade in the Asia Pacific area. Their findings reveal that PTAs have considerably contributed to global and regional trade expansion. The study shows that PTAs can create rather than detract commerce. Boris and Vedran (2002) use basic methods such as the trade openness ratio and trade concentration indices to examine the amount of trade integration within the Southeast Europe (SEE) area. The authors reach the conclusion that Croatia's target trade potential is within the EU and Central Europe Free Trade Agreement (CEFTA) nations. As a result, any additional trade liberalization with SEE nations should be supported by equivalent considerations for EU and CEFTA countries. Batra (2004) uses the augmented gravity model and ordinary least squares (OLS) methodologies to assess India's global trade potential. The model is used to study international trade flows before estimating India's trade potential with its partners. The model is reinforced by various conditioning factors that impact trade in addition to the fundamental variables, income, and distance. According to the report, India has the greatest trading potential in the Asia-Pacific area, followed by North America and Western Europe. The biggest opportunity for trade development resides with China, the United Kingdom, France, and Italy, if certain hurdles and restraints are eliminated. According to the findings, India may possibly increase its commerce with some other nations, particularly Central Asian states such as Turkmenistan, Georgia, and Uzbekistan, by tenfold or more. Baroncelli (2007) estimates the economic

potential between two nations using bilateral trade data for 166 countries from 1948 to 2000. (Pakistan and India). The model incorporates two dummies that represent the influence of I PTAs and (ii) a substantial military conflict between Pakistan and India in any given year. The data show that in the absence of conflict, commerce would have been $591 million in 2000, a $474 million peace dividend above the $117 million recorded trade that year. Similarly, when the peace dividend and RTA advantages are included in, the potential trade volume between Pakistan and India is $683 million. According to the study, the relationship between trade and conflict is negative and considerable. Khan (2000) used the gravity model to investigate the link between bilateral trade in Pakistan and economic, cultural, and geographical variables. The dependent variable is trade volume (exports and imports of 10 key commodities). The explanatory variables include the real tariffs, exchange rate, GDP product, distance, GDP per capita product, bordering countries, official language (English), and dummies to represent ASEAN, SAARC, EU, and NAFTA. The model covers ten commodities and contains 21 nations with data from 1985, 1990, and 1994. Except for the variable for the neighboring nation, which is negative, all of the factors are determined to be extremely significant. This can be linked to Pakistan's and India's past conflict. Sohn (2005) investigated the extent whereby the gravity model may be used to analyze South Korea's bilateral trade and thus be used in trade policy formation. The gravity model was considered to be the best instrument for explaining South Korea's bilateral trade flows as a single country scenario by the author. The coefficient on the trade variable revealed that trade flows in Korea are determined by

comparative advantage, income inequalities, and phases of development rather than economies of scale, as indicated in the Heckscher-Ohlin model for studying international trade patterns.

This work seeks to identify the factors and issues that influence clothing and textile(T&C) exports from Bangladesh. Panel analysis of gravity model for Bangladeshi cloth & textile exportation streams to 40 trades partners in total over a period of 27 years, covering the period 1990-17, wasdeveloped and used to estimate the specific data set. The findings indicated that imports have been the main determinants of textile exports in Bangladesh, including gross domestic product (GDP), per capita GDP and the true exchange rate. In addition, Bangladesh and its membership in the World Trade Organization has a clear positive yielding on T&C exports. There is no major impact on textile trade on the geographical gap. It has been established that the two vital export destinations for Bangladesh's garments are the EU and North American Free Trade Agreement countries.

For many factors, this research is a novel and valuable contribution: Firstly, this research survey contains Bangladesh's key trade partners. Second, the emphasis on the data review for the gravity panel exposes a significant study deficit on Bangladesh's export determinants. In future, this thesis will pave the way for further studies.(R. Rahman et al., 2019)

Frankel (1999) conducted research on the link between international commerce and living standards. It was discovered that income and trade are connected, making it difficult to determine the impact of trade on

living standards. The geographic considerations were used in the study to solve this issue. It is claimed that spatial trade variation can serve as a natural experiment for detecting trade impacts since geographic characteristics are not a result of income or government policy, and there is no plausible pathway through whom they influence income.

The gravity model has been widely employed in empirical research. The gravity model has been used in certain research to assess the impact of preferential free trade agreements. Akram (2004) used the gravity model to evaluate Pakistan's export potential with 154 nations, including the SAARC countries, for the country's primary 19 industries. Using cross-sectional data, the study's findings suggested a greater scale of export potential with a partner.

Rahman (2004) used panel data estimate techniques to analyze Bangladesh trade flows with its SAARC trading partners using a generalizable gravity model. They calculated the gravity model of trade and discovered that the size of the economies, per capita Gdp differentials of the countries involved, and openness of the trading nations all had a favorable impact on Bangladesh's trade.

Bhatachariya (2004) assessed India-Bangladesh bilateral trade flows using the gravity model in various tariff reduction scenarios and produced simulated results. These findings provided more evidence that India's exports will expand faster than its imports from Bangladesh.

Furthermore, using GTAP analysis, Reihan and Razzaque (2007) calculated the trade creation, trade diversion, and welfare implications for various regional integration and bilateral FT As in South Asia. The study's

findings indicate that the free trade agreement will benefit India, Sri Lanka, and the rest of South Asian countries save Bangladesh.

(Martinez-Zarzoso & Nowak-Lehmann, 2003)utilize the gravity trade model to evaluate Mercosur-European Union trade and trade prospects in light of recent negotiations between the two trade blocs. The model is tested on a selection of 20 nations, including the four official Mercosur members plus Chile and the fifteen European Union members. Panel data processing is used to separate the time-invariant country-specific effects and to collect the link between the related variables over time. We assume that the fixed impact gravity model is equivalent to the random effects' gravity model.

Moreover, a variety of factors, including exchange rates, income differences, infrastructure and are considered to be critical determinants of bilateral trade flows as they are applied to the conventional gravity equation.

Martinez-Zarzoso (2003) is to examine the factors affecting bilateral trade flows among 47 countries, with an emphasis on the impact of preferential agreements between several trading blocs and regions, including the North American Free Trade Agreement (NAFTA), the European Union (EU), the Caribbean Community (CARICOM), the Centro-American Common Market (CACM), and other Mediterranean countries (MEDIT). The time frame under consideration ranges from 1980 to 1999.

The authors develop a gravity equation that helps them to compare the weight of the power of preferential agreements and infer the importance of other elements of bilateral trade streams such as income levels, geographic proximity, cultural similarities, and population. The study is carried out for each year of the survey in order to capture the temporal progression of the effects of the various variables thought on exchange. The trade potentials arising from new free trade deals are estimated utilizing the prediction results as a base.

M. M. Rahman (2006) measured the trade gravity model (import and export sums), the export gravity model and the import gravity model. Their outcomes show that the economy's size, the per capita GNP differential of the nations involved, and the open trading nation have a positively related on trade in Bangladesh. The main determinants of the Bangladesh's export are: the exchange rate, total import demand in partner nations, and the openness of the Bangladesh economy.

These factors have a positive impact on exports in Bangladesh. Whereas the exchange rate has no impact on Bangladeshi's import rather imports are determined by inflation rates. There is an inverse association ship between transportation cost and Bangladesh's trade. Bangladesh's imports are also found to be severely affected by the border between Bangladesh and India. Bangladesh will do well by doing more withneighboring nations, as the country's particular results indicate. Bangladesh's trade and exports have a positive impact on multilateral resistance factors.

Mohammad Mafizur Rahman, (2010) attempts to detect the factors that impact export of Bangladesh. Panel estimation technique is used to detect the export trade form. The estimated outcomes divulge that the key contributors to Bangladesh ‘s exports are the openness of the Bangladesh economy, the exchange rate and partner countries ‘total import demand. These are affected export of Bangladesh positively. Transportation costs have an insignificant effect but negative on Bangladesh’s exports. The country specific results show that bordering nations have a greater impact on Bangladesh’s exports than other distant countries. As a result, Bangladesh should lower trade barriers, seek competitive currency depreciation, boost commodity efficiency, and extend product range.

Prasai (2014) inspects the Nepal’ s overall trade design by utilizing pooled ordinary least square (OLS) accompanied by one-year lag GDP.\- After economic liberalization, the economy is found structural shift in Nepal. In this analysis, a gravity model is used for a large panel dataset covering Nepal’s 94 trading partners over a 29-year period.

The outcomes seem robust to specification, trade determinants and time period. This analysis distinguishes exports and imports, rather than use the overall turnover of trade, according to a standard in this area. The analytical findings are reliable with the simple gravity model, as the analysis demonstrations positive economic dimensional coefficients and negative distance coefficients. In trade determinants after economic liberalization, there isno major systemic split. The findings of simulation compared real trade with the expected trade show that political decisions

as for instance the economic sanctions enforced by other countries do not distort Nepal's trade. The findings also show that trade with India is very significant compared to China. The findings show that Nepal wants to diversify trade in general and to profit from the trade agreements with China in particular.

The People's Republic of China and India, which have been exposed by trade strength indexes, have significant bilateral trade prospects. The free trade agreements between these countries are currently being negotiated based on their complementarities. This study attempts to quantify the potential advantages of both Indian and Chinese import profits or losses as a result of various preferential exchange agreements and FTAs in the gravity model. Empirical findings suggest that India's possible advantage on a short-term basis, owing to its high tariffs is comparatively smaller thanthat of China. India's profits in the long-term, though, are more than China when its tariff levels match. Free trade agreements are a win-win situation for all nations and correspond to their increasing foreign trade supremacy.(Bhattacharya & Bhattacharyay, n.d.)

(Kabir & Salim, 2010) scrutinize the trading design of Bay of Bengal Initiative for Multi SectoralTechnical and Economic Cooperation (BIMSTEC) by utilizing an augmenting gravity model. The econometric description surveyed Egger (2000, 2002), Serlenga and Shin (2007) and Baltagi et al. (2003). Diagnostic tests show that heteroscedasticity, serial correlating and contemporary correlation are permitted in the Prais Winsten Regression of panel-specific AR(1) in import and export panels. Regression

estimation demonstrates that BIMSTEC's imports pursue the hinder hypothesis, whereas the exports demonstrate Heckscher-Ohlin-Samuelson prototyping. Outcomes also recommend that the elasticity of distance is significant and negative. Real depreciation seems to be export enhancing and import-falling. Bilateral trade agreement and Common language are found to be export enhancing and import-reducing, respectively. Both local and target nation governance has a positive effect on bloc trade. Finally, membership is an indicator of the positive future of trade policy liberalizing within the union, accounting for nearly 29.0% of its export. The gravity model will therefore explain the nature of the trade in the block successfully.

(Akhter & Ghani, 2010) address the advantages of trade under the SAARC countries' free trade agreement. It investigates trade opportunities and the establishment of trade between Member States and non-Member States. The model of gravity was used to determine international trading flows for members and non-member countries and assess the trade consequences. The gravity model is evaluating into two investigates. The first study is focused on cross-sectional statistics for every year, and the next analytical investigation uses the pooled data for a measurement of the total trade impact and trade flows between 2003 and 2008. The findings from both methods illustrate that the predicted coefficients correspond to the model assumptions. Both analyzes suggest that both the Member States and non-member nations of the SAARC Regional Trade Agreement can distract the trade. Trade volumes will only rise until the key partners (Sri Lanka, Pakistan and India) conclude a regional trade deal.

Gul & Yasin, (2010) effort to guesstimate the Pakistan's trade potential, utilizing the gravity model. Data from the panel in four2 countries for the period 1981-2005 are being analyzed. The coefficients derived from the model then are utilized both in the world and within particular trading regions to foresee the trade potential of the nation. The outcomes disclose that Pakistan's trade potential is highest with countries in the European Union (EU), the Asia-Pacific region (the Association of Southeast Asian Nations [ASEAN]), the Middle East, North America and Latin America. Specifically, maximum potential exists with Bangladesh, Japan, Malaysia, Srilanka, New Zealand, Philippines, Sweden, Norway, Denmark and Italy. Pakistan should also discuss ways and means of further improving its trading ties with the countries involved and also concentrating on ASEAN, the Middle East and the EU in order as much as possible to expand its market share. Despite considerable potential, the amount of trade between Pakistan and the other members of the SAARC states and the Organization of Economic Cooperation (ECO) is very low. The social and political pressures between neighboring countries, particularly between India and Pakistan, the key players of the SAARC, are the main obstacles. The same barriers remain for NAFTA and for the EU, where the diplomatic considerations of Pakistani exports are adversely overwhelmed.

Irshad et al., (2018) tried to understand China's pattern of trade with OPEC members by using a gravity model from 1990 to 2016. The findings of the estimate show that the equation of gravity matches the data pragmatically. With nearly 73 percent of its oil originating from OPEC countries, China has become the world's largest oil importer. The

energy industry can actually be considered as the commodity with most trade and the main explanation for the rise, in the last two decades, in trade volumes between China and the OPEC countries. We also verified the positive effect on income, GDP, income and the openness to trade in China and in OPEC WTO member states of China, on Chinese bilateral trade with OPEC members. The negative effect on distance (trade costs) and the Linder hypothesis are supported. Bilateral exchange rate depreciation also has negative effects on Chinese bilateral trade with the OPEC.

Tourism is one of the Greek economy's biggest factors. During the Euro crises and credit with high fiscal and balance of payment (BoP) deficits the involvement of tourism to the Greek economy was particularly important. This research explores the effect of international tourism demand in Greece on socio-economic and geographic determinants.

A panel of data from 31 countries is used for the empirical research over the period 2001-2010. Panel data estimate shows a greater explanatory force for distance and exchange than relative rates and other factors, such as the transport infrastructure. In three out of eight specifications, the incomeis statistically important. Moreover, the market for tourism appears to be influenced by political stability. For Greece and its major tourism rivals, the figures are mixed for stable costs. Interesting results are that the International Tourist Arrivals in Greece appeared to have a negative effect during 2004. (Chasapopoulos et al., 2014)

The research aims to apply a widespread gravity model to the assessment by panel estimation methodology of the Sri Lankan exchange with its SAARC and major trading partners. The figures include 15 countries with 15-year commercial statistics (i.e., from 1994 to 2009). The first stage of OLS was used, while the second stage explored fixed effects and country-specific causes. At the third point, therandom effect was checked. The study showed that the concept of fixed effects was the best fit in Sri Lanka's bilateral trade model implementation. This has been verified by the Hausman specification test. Research has shown that Sri Lanka's bilateral trade with SAARC partners is not guided by geographical proximity. The study emphasizes that SAARC members require good economic integration to boost the intra-regional trades.(Indika, 2010)

This study looks at the links between economic growth, financial development, trade openness, energy consumption, and CO2 emissions in Indonesia by utilizing the time series data. Their findings ensured that the variables are cointegrated. This ensures that carbon emission and trade openness are cointegrated and they have long run association. (Shahbaz et al., 2013).

# CHAPTER 3: RESEARCH DESIGN

## 3. RESEARCH DESIGN

### 3.1. Objective of the Study

This section explains the research methods that will be employed and how empirical data will be collected. In addition, methodological flaws are discovered in the data's accuracy. The methodology section also contains details on the methods of analysis that will be utilized to analyze the empirical data.

Our paper is containing the empirical analysis of the bilateral trade of Bangladesh with the +SAARC nation by the concept of Gravity model. This paper tries to find the answer what factors are mostly affected the trade value of Bangladesh.

The objective of the paper is:

1. To calculate the percentage change of trade value of Bangladesh due to percentage change of Real GDP (Bangladesh and SAARC nation RGDP).

2. To calculate the percentage change of trade value of Bangladesh due to percentage change of Per Capita GDP of Bangladesh and SAARC nation.

## 3.2 Hypothesis of the Study

The null hypotheses listed below were also investigated in order to meet the study's major and particular objectives, as is required in quantitative research:

1. Real GDP of Bangladesh have no effect on export value of cloth and textile.

2. Real GDP of SAARC Nation have no effect on export value of cloth and textile.

3. Per Capita GDP of Bangladesh have no effect on export value.

4. Per Capita GDP of SAARC nation have no effect on export value.

5. Carbon Emission of Bangladesh have no effect on export value.

6. Carbon Emission of SAARC nation have no effect on export value.

7. Distance has no effect on export value.

# CHAPTER 4: METHODOLOGY

## 4. DATA AND METHODOLOGY

To analyze the gravity model in Bangladesh with the bilateral trade to the SAARC nation. The bilateral trade of Bangladesh which is export value of cloth and textile with the partner nation of Bangladesh. This research is based on the secondary data analysis of the Bangladesh export value of clothes and textile industries, GDP of the Bangladesh, GDP of the partners nation, the distance between Bangladesh and the trading nation. This study covers the 8 countries. Bangladesh bilateral trade with SAARC nations. The gravity model is utilized to identify whether bilateral trade of Bangladesh can be explicated by the economic factors together with GDP for partner nations, the real GDP, distance between importers and exporters. We gathered the data from 2000 to 2015 over the period of 16 years.

The trade gravity model is similar to the physics function of Newton, which defines the gravity force. The model describes the trade flow between a couple of nations as proportional, and invertly proportionate to their economic "mass" (national income). This model explains from Tinbergen (1962) and Poyhonen (1963), which demarcated the gravity model equation:

Where  is the value of the bilateral trade between country i and j, $GDP_I$ is the GDP

$$\mathbf{Trade_{IJ}} = \alpha \frac{\mathbf{GDP_I GDP_J}}{\mathbf{Distance_{IJ}}}$$

Bangladeshand $GDP_J$is the partner nation GDP. Distance ij is a measure of the bilateral distance between the two countries and $\alpha$ is a constant of proportionality. This paper decomposes the gravity model with adding the carbon emission Bangladesh and SAARC nation. In the gravity function equation logarithms, we obtain the linear form of the model as follows:

Here,

$$\ln TR_{ijt} = \alpha + \beta_1 \ln RGDP_{jt} + \beta_2 \ln RGDPBD_{it} + \beta_3 \ln D_{ij} + \beta_4 \ln PC_{jt} + \beta_5 \ln PCBD_{it} + \beta_6 \ln PCO2_{jt} + \beta_7 InBCO2_{it} + \varepsilon_{ijt}$$

j= Partner Nations and *t*= Year (From 2000 to 2015)

i = Bangladesh

$lnTR_{ijt}$=The natural log value of Bangladesh' s Textile & Clothes exports

$lnGDPBD_{it}$=The natural log of Bangladesh' s GDP

$lnGDP_{jt}$=The natural log distance between Bangladesh and SAARC nations

$lnD_{ij}$= The natural log of Per Capita GDP of Bangladesh

$lnPCBD_{it}$= The natural log of Bangladesh partners Per Capita GDP

$lnPC_{jt}$=The natural log of Bangladesh partners Per Capita GDP

$lnBCO2_{it}$=The natural log of Carbon Emission of Bangladesh

$lnPCO2_{jt}$=The natural log of Carbon Emission of Partners Nations

$\varepsilon_{ijt}$=Error Term

Data are collected from the various sources. The data of trade export value of Bangladesh is collected from world trade organization. Gross domestic product (GDP) for Bangladesh and other South Asian nations are gathered from the World Development Indicators from world bank. Also per capita GDP of Bangladesh and SAARC nation as well as carbon emission are collected from the same sources.

To analysis the Gravity model approach for Bangladesh, I use the econometric tools. Stata 15 is used for the research paper. The panel ordinary least square are used to analyze the effects of the distance and GDP of own country and GDP of other SAARC nation. Also, various diagnostic tests are performed to check the model.

## 4.1 Panel Regression

The gravity model is used in this research to examine trade theories with respect to the SARRC nation, and the panel data regression methodology is used to do the testing. This pooled data methodology, which incorporates both cross-sectional and time series data, allows us to estimate differences among nations while also estimating changes across time at the same time. Basic panel data regression models include the pooled ordinary least square model (POLS), the random-effects model (REM) and the fixed-effects model (FEM). These are significantly different from the way the intercept term is treated, which is the term that indicates the impacts of variables that are not included in the model.

Based on the premise that both the intercept and coefficient for each individual are constant across cross-sectional individuals in the POLS equation, we may derive the POLS model. While the POLS model allows for homogeneous intercepts across cross-sectional people and/or over time, the fixed-effects model (FEM) allows for heterogeneous intercepts across cross-sectional individuals and/or over time by utilizing a differential intercept dummy.

### 4.2 Fixed Effect Model

The fixed effect model is used to assess the impact of factors that are time invariant in order to determine their significance. A fixed effect model allows the intercept in the regression model to vary between cross sections, but it does not allow the intercept to vary over time in the regression model. The link between independent and dependent variables is investigated by this model within an entity, and the results are presented. Independent variables may or may not be influenced by the unique traits of each particular entity, depending on the situation.

### 4.3 Random Effect Model

In order to investigate the variations in error variance components over time periods or individuals, the random effect model is used. It is assumed in this model that the variance between individual will be random and uncorrelated with the explanatory variables that have been included in it.

In a random effect model, it has been presumed that there is no association between any predictor variable in the data and individual effect (heterogeneity). On the basis of this assumption, the model calculates the error variance particular to groups of people (or times).

## 4.4 Diagnostic Test

When deciding which model to utilize between a random effect model and a simple pooled OLS, Lagrange Multiplier tests are employed to help make the decision. Various tests are performed to check the random effects in the model. Here, null hypothesis is there is no random effect.

Detection of endogenous regressors (predictor variables) in a regression model is accomplished using the Hausman Test. Endogenous variables are variables whose values are dictated by the values of other variables in a system. The Hausman test can be used to identify the most appropriate model from among the fixed effect model and the random effect model, depending on the data. Because our study is based on a panel data set, we employ the Hausman test to determine which model is most appropriate.

# CHAPTER 5: RESULT AND DISCUSSION

## 5. RESULT AND DISCUSSION

### 5.1 Descriptive Statistics Analysis

The following table addresses the descriptive analysis of the bilateral trade flows of Bangladesh and SAARC nations for the cloths and textiles industry and the explanatory variables. The descriptive statistics are shown the mean, standard deviation of the variables.

Table 1: Descriptive Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| LTR | 96 | 6.634034 | 3.606113 | -.659712 | 12.69807 |
| LRGDP | 110 | 23.94337 | 2.305576 | 20.31048 | 28.46173 |
| LRGDPBD | 112 | 25.3344 | .2668718 | 24.92816 | 25.77715 |
| LD | 112 | 7.146153 | .7195213 | 5.905362 | 7.926963 |
| LPC | 110 | 7.232136 | .8828673 | 5.800012 | 8.93915 |
| LPCBD | 112 | 6.558628 | .2068556 | 6.263295 | 6.910141 |
| LCO2 | 112 | 9.241685 | 2.683766 | 5.736572 | 14.58108 |
| LBCO2 | 112 | 10.60504 | .3536504 | 9.98276 | 11.18011 |

The variable LTR has 96 observations with the mean value of 6.634 and the standard deviation (S.D.) 3.606. The maximum and minimum value of LTR is -0.659 and 12.69 respectively.

The variable LRGDP has 110 observations with the mean value of 23.94 and the standard deviation (S.D.) 2.305. The maximum and minimum value of LRGDP is 20.31 and 28.46 respectively.

The variable LRGDPBD has 112 observations with the mean value of 25.33 and the standard deviation (S.D.) .2669. The maximum and minimum value of LRGDPBD is 24.92 and 25.77 respectively. The variable LD has 112 observations with the mean value of 7.146 and the standard deviation (S.D.) .719. The maximum and minimum value of LD is 5.905 and 7.92 respectively.

The variable LPC has 110 observations with the mean value of 7.232 and the standard deviation (S.D.) .882. The maximum and minimum value of LPC is 5.800012 and 8.93915 respectively. In the same way we find the variables information.

### 5.2 Regression Analysis

#### 5.2.1 Pooled Regression

One sort of model with constant coefficients, relating to both intercepts and slopes, is the pooled regression model. Researchers can use this

approach to pool all of the data and perform an ordinary least squares regression model on it. The result of the pooled regression is given below.

### 5.2.2 Correlation Analysis

Table: 2

| | LTR | LRGDP | LRGDPBD | LD | LPC | LPCBD | LPCO2 | LBCO2 |
|---|---|---|---|---|---|---|---|---|
| LTR | 1.0000 | | | | | | | |
| LRGDP | 0.8116 | 1.0000 | | | | | | |
| LRGDPBD | 0.0800 | 0.0534 | 1.0000 | | | | | |
| LD | 0.1455 | 0.3153 | 0.1023 | 1.0000 | | | | |
| LPC | -0.0474 | -0.2243 | 0.2736 | 0.3101 | 1.0000 | | | |
| LPCBD | 0.0805 | 0.0530 | 0.9992 | 0.1009 | 0.2745 | 1.0000 | | |
| LPCO2 | 0.8213 | 0.9869 | 0.0514 | 0.2865 | -0.1978 | 0.0519 | 1.0000 | |
| LBCO2 | 0.0771 | 0.0510 | 0.9962 | 0.1025 | 0.2715 | 0.9941 | 0.0486 | 1.0000 |

By using the correlation analysis, we will know the exact and linear relationship among the variables. If there is an exact relationship exists between the variable, then there will be a problem for estimation. The following table shows correlation analysis for the variables.

The above correlation result shows the positive or negative relationship between the variables. The result shows that the variable LTR and LRGDP is the positive association which is 0.81. The variable LTR and LPC has a negative association. If LTR increases, the LPC decreases or vice-versa. And the negative association between LRGDP and LPC exist. Except these two negative association variables all other variables are positive association ship.

The correlation analysis can be shown according to trading partner nations.

Table3 : Correlation Analysis for Afghanistan

| | LTR | LRGDP | LRGDPBD | LD | LPC | LPCBD | LPCO2 | LBCO2 |
|---|---|---|---|---|---|---|---|---|
| LTR | 1.0000 | | | | | | | |
| LRGDP | 0.5579 | 1.0000 | | | | | | |
| LRGDPBD | 0.5542 | 0.9852 | 1.0000 | | | | | |
| LD | . | . | . | . | | | | |
| LPC | 0.5749 | 0.9934 | 0.9601 | . | 1.0000 | | | |
| LPCBD | 0.5665 | 0.9843 | 0.9998 | . | 0.9594 | 1.0000 | | |
| LPCO2 | 0.5579 | 0.9528 | 0.9160 | . | 0.9638 | 0.9134 | 1.0000 | |
| LBCO2 | 0.5891 | 0.9898 | 0.9974 | . | 0.9699 | 0.9974 | 0.9312 | 1.0000 |

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Table 4: Correlation Analysis for Bhutan

| | LTR | LRGDP | LRGDPBD | LD | LPC | LPCBD | LPCO2 | LBCO2 |
|---|---|---|---|---|---|---|---|---|
| LTR | 1.0000 | | | | | | | |
| LRGDP | -0.3525 | 1.0000 | | | | | | |
| LRGDPBD | -0.2721 | 0.9929 | 1.0000 | | | | | |
| LD | . | . | . | . | | | | |
| LPC | -0.3648 | 0.9996 | 0.9918 | . | 1.0000 | | | |
| LPCBD | -0.2636 | 0.9892 | 0.9992 | . | 0.9888 | 1.0000 | | |
| LPCO2 | -0.1335 | 0.8796 | 0.9151 | . | 0.8827 | 0.9266 | 1.0000 | |
| LBCO2 | -0.3119 | 0.9946 | 0.9960 | . | 0.9932 | 0.9934 | 0.9015 | 1.0000 |

Table 5: Pooled Regression

| Variables | Coefficient | t-value | p- value |
|---|---|---|---|
| LRGDP | .8560301 | 1.39 | 0.168 |
| LRGDPBD | -1.05214 | -0.04 | 0.970 |
| LD | -1.043233 | -2.95 | 0.004 |
| LPC | .9458755 | 3.10 | 0.003 |
| LPCBD | 1.0952 | 0.04 | 0.970 |

| | | | |
|---|---|---|---|
| LPCO2 | .5328266 | 1.04 | 0.301 |
| LBCO2 | .078022 | 0.01 | 0.992 |
| CONS | .2102544 | 0.00 | 1.000 |

| | | |
|---|---|---|
| Number of obs | = | 94 |
| F(5, 88) | = | 31.25 |
| Prob > F | = | 0.0000 |
| R-squared | = | 0.7178 |
| Adj R-squared | = | 0.6948 |
| Root MSE | = | 2.0121 |

The result of the table shows the pooled OLS estimation. Here the dependent variable is log of trade value of cloth and textiles with the SAARC nations. As we expect that if the GDP increases the trade volume will increase. According to the Pooled OLS estimation the per capita GDP of partner nations and distance variable are statistically significant. The probability value of these variables is lower than the significance level. Unfortunately, the expected value of RGDP is different for this analysis.

The Pooled OLS results suggest that if the GDP of partners increases by one percent, the bilateral trade between Bangladesh and SAARC nations increase to .85 percent holding the other variables constant. The sign of the distance variable is relevant. The closer to the

partner is the more bilateral trade occurred. Per capita GDP is a significant effect on the bilateral trade with the partners. If the per capita GDP of partner increases 1 percent, then the trade value will rise .94 percent, other variables held constant. If Bangladesh's per capita GDP rises by 1%, the country's cloth trade rises by 1.09 percent, assuming all other variables remain constant. On the other hand, if the partner country's carbon emissions rise by 1%, bilateral trade rises by 0.53 percent, assuming all other variables remain constant. Furthermore, if Bangladesh's carbon emissions rise by 1%, the trade value of cloth and textiles rises by 0.078 percent, assuming all other variables remain constant.

The pooled OLS doesn' t allow the intercept term varying over the time in terms of partner nation. In the panel analysis it is very significant to use the random and fixed effect model. Both the random effect and fixed effect model are significant. According to the F-test we find the model significance. The probability value of F test is lower than the 1% level of significance. But choosing the appropriate mode between random and fixed effect model, we perform the Hausman specification test. According to the Hausman specification test, the null hypothesis is random effect model is appropriate. And the alternative hypothesis is Fixed effect model is appropriate.

### 5.2.2 Fixed and Random effect Model

This section discusses the fixed and random effect model. The result of the Random and Fixed effect model is given below via the table.

Table 6: Random and Fixed Effect Model

| Variables | Random Effects | | Fixed Effects | |
|---|---|---|---|---|
| | Coefficient | p- value | Coefficient | p- value |
| LRGDP | .856 | 0.164 | 1.438 | 0.775 |
| LRGDPBD | -1.052 | 0.970 | 5.736 | 0.793 |
| LD | -1.043*** | 0.003 | | |
| LPC | .946*** | 0.002 | -3.58- | 0.399 |
| LPCBD | 1.095 | 0.970 | 5.421 | 0.810 |
| LPCO2 | .533 | 0.298 | 1.051 | 0.177 |
| LBCO2 | .078 | 0.992 | .721 | 0.897 |
| Constant | .21 | 1.000 | -129.842 | 0.716 |
| | *** p<.01, ** p<.05, * p<.1 | | | |
| | Prob: 0.0000 (F test) | | Prob : 0.0030 (F test) | |

It shows that the gravity models' entire effectiveness of statistical significance for knowledge assets and international trade flows is satisfactory. The LD and LPC are significant at 1% and 5% significance levels. Other variables are not statistically significant at 1% and 5% levels of significance. The value of R- 2 is 0.71 which is described by the 71% described by the explanatory variable and 29 percent are

explained by the residuals. And the F test shows the overall model performance in which the probability value is lower than the 1% and 5% significance level. The model is good.

As the distance between the two-trading nation is closer, then higher trade between the nation has occurred. India is the Bangladesh neighboring nation. According to the latest trade ministry statistics, India's exports to Bangladesh increased 46 percent year on year to $3.16 billion in January-March, placing it fourth after the United States ($15.41 billion), the United Arab Emirates ($5.34 billion), China ($5.92 billion). Indian goods exports to Bangladesh, which increased by 35.14 percent year on year to $0.95 billion in January and 17 percent to $0.94 billion in February, increased by 93.45 percent year on year to $1.26 billion in March.

Also the per capita GDP is statistically significant. Nation with the higher per capita GDP tends to live higher standard of living. As higher standard of living will encourage the foreign consumer to buy the products. Thus, SAARC nation with higher per capita GDP will increase the export value of cloth and textile.

In the fixed model, the distance variable is omitted because of the repeated values in the model with partners nation. In REM, the sign of LRGDPBD is negative which is not expected but in FEM the expected sign of LRGDPBD is positive. It shows that if the variable LRGDPBD increases 1%, then the value of LTR increases 0.793 percent, other variables keep constant. If the CO2 of Bangladesh increases 1%, it will lead to increase the export value of cloth and textile by 0.721 percent,

keeping other variables constant. If the CO2 of SAARC nation rises by 1% then the export value of cloth and textile will rise 1.051 percent. Higher carbon emission will lead to higher export value of cloth and textiles. The carbon emission is not statistically significant both fixed and random effect model.

For the variable of RGDP for Bangladesh and SAARC nation, it is very important to analyze the trade value.

Also, the carbon emission which is vulnerable to environment should be précised. Although according to Kuznets, there is a inverted U shape Kuznets curve between environmental degradation and the growth.

For further research policymaker should concern the stabilize the trade value of cloth and textile by adding foreign remittance, investment and so on. Because only these variables are not only the determinants of the trade.

### 5.2.3 Hausman Test

By choosing the FEM and REM, Hausman tests are used for these. The result of the Hausman test is below.

Table 7: Outcomes of Hausman Test

| | Coefficients |
|---|---|

| | (b ) | (B) | (b-B) |
|---|---|---|---|
| | sqrt(diag(V_b-V_B)) | | |
| | Fixed | Random | Difference |
| | | S.E. | |
| LRGDP | 1.4381 | .8560301 | .58207 |
| LRGDPBD | 4.970149 | | |
| LPC | 5.735907 | -1.05214 | 6.788046 |
| LPCBD | - | | |
| LPCO2 | -3.580156 | .9458755 | -4.526032 |
| LBCO2 | 4.209708 | | |
| | -5.42059 | 1.0952 | -6.51579 |
| | - | | |
| | 1.050547 | .5328266 | .5177207 |
| | .5769283 | | |
| | .7211069 | .078022 | .6430848 |
| | - | | |

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 4.56
Prob>chi2 = 0.6007
(V_b-V_B is not positive definite)

By testing the Hausman method we find the best model that fit according to these data. The hypothesis of the test are following:

$H_0$:REMisbetter

$H_A$:FEMisbetter

Here the probability value of chi () is 0.6007 which means that the null hypothesis of REM is appropriate may not be rejected. Result of the Hausman test confirms that the REM is better than the FEM. So, REM is good fit to analyze the data by approaching the Gravity model.

# CHAPTER 6: CONCLUSION

## 6. CONCLUSION

After the independence, Bangladesh has started its economy with a negative growth rate but over the year Bangladesh has gained consistent growth by accelerating the various factors. Now Bangladesh' s GDP is fiftyfold than the time of independence. Now Bangladesh has placed 39th in the world' s largest GDP ranking. In the last two decades, Bangladesh has gained a GDP growth rate of more than 6%, with long-term stable growth and extraordinary acceleration. This is possible due to the improvement of foreign remittance earnings, foreign reserve, ready-made garments (RMG), foreign investment, privatization, etc.

In Bangladesh's fast-rising economy, the textile and garment sectors are a primary source of growth. Textile and clothing exports are the main sources of foreign exchange revenues. Textiles, apparel, and ready-made garments (RMG) exports accounted for 77 percent of Bangladesh's total goods exports in 2002.

Bangladesh's GDP was estimated by the World Bank to be US$6.29 billion in 1972, and it is expected to grow to $368 billion by 2021, with exports accounting for $46 billion of that, with ready-made garments accounting for 82 percent of that. Bangladesh was the second-largest producer of garments in 2016, after only China. Bangladesh is the world's second-largest supplier of western fast fashion brands after China. 60% of western brand export contracts are with European customers, 30% with American buyers, and ten percent with others. Foreign investors hold just 5% of textile plants, with local investors

controlling the majority of manufacturing. In the fiscal year 2016-2017, the RMG business produced US$28.14 billion, accounting for 80.7 percent of total export profits and 12.36 percent of GDP; the industry was also adopting green manufacturing techniques.

The goal of this study was to establish a theoretical basis for applying the gravity model in bilateral trade analysis, as well as to use the gravity model to analyze Bangladesh's trade with its key trading partners using the panel data estimate technique. We've established that using the gravity model in practical bilateral trade research is theoretically justified.

The result suggests that the variables of Distance and Per capita GDP of SAARC nations are statistically significant. The value of R- 2 is 0.71 which is described by the 71% described by the explanatory variable and 29 percent are explained by the residuals. If the per capita GDP of the partner increases 1 percent, then the trade value will rise .94 percent, other variables held constant.

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# Appendices

The export value of the cloth and textiles from the SAARC nations data is given below the table.

## Export with SAARC country

| Year | Afghanistan | Bhutan | India | Maldives |
|---|---|---|---|---|
| 2000 | 272.528 | 340.108 | 2524.469 | |
| 2001 | 347.059 | 136.709 | 1161.613 | 5.024 |
| 2002 | 127.474 | 16.033 | 857.558 | |
| 2003 | 1.126 | 430.485 | 1280.786 | |
| 2004 | 0.743 | 581.124 | 31756.04 | |
| 2005 | | 146.217 | 70955.23 | 10.184 |
| 2006 | | 35.293 | 83972.21 | |
| 2007 | 1.989 | 15.602 | 246820.5 | 9.154 |
| 2008 | 6.318 | | 69223.41 | 1.171 |
| 2009 | 0.832 | | 169389.1 | 0.517 |
| 2010 | 45.794 | 1.198 | 184414.2 | 14.73 |
| 2011 | 224.982 | 8.359 | 260389.8 | 17.653 |
| 2012 | 68.927 | 5.749 | 269802.3 | 36.497 |
| 2013 | 86.221 | 160.653 | 231234.2 | 44.114 |
| 2014 | | | | |
| 2015 | 176.971 | 648.769 | 327115 | 92.22 |

# Export Value with SAARC nation

| Year | Nepal | Pakistan | Srilanka |
|---|---|---|---|
| 2000 | 7.279 | 25879.98 | 1812.487 |
| 2001 | 477.53 | 17236.05 | 1392.107 |
| 2002 | 169.975 | 23402.87 | 1391.606 |
| 2003 | 76.068 | 26742.79 | 2072.31 |
| 2004 | 139.919 | 27181.94 | 3242.649 |
| 2005 | 415.025 | 42851.22 | 4767.354 |
| 2006 | 156.058 | 39362.85 | 3363.326 |
| 2007 | 352.917 | 79249.86 | 3220.139 |
| 2008 | 69.324 | 65130.63 | 3891.363 |
| 2009 | 108.82 | 42712.61 | 7247.529 |
| 2010 | 83.914 | 70657.25 | 12928.52 |
| 2011 | 196.236 | 75753.86 | 22111.5 |
| 2012 | 140.176 | 58491.6 | 15793.07 |

# 국 문 초 록

## -중력 모델을 이용한 방글라데시의 의류 수출 분석-

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국 제 무 역 전 공
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이 논문의 목표는 방글라데시 옷감과 직물 수출에 영향을 미치는 요인을 파악하는 것입니다. 2000년부터 2015년까지 15년 동안 총 7개(SAARC 국가) 무역 파트너에 대한 방글라데시 의류 및 섬유 수출 스트림의 패널 중력 모델을 평가하는 데 포괄적인 데이터 세트가 생성되어 사용되었다. 첫 번째 단계에서는 패널 데이터에 OLS 추정 방법이 적용됩니다. 그런 다음 다음 데이터 집합에 대해 랜덤 효과 모형을 검정합니다. 세 번째 단계에서는 고정 효과 모델을 사용했습니다. 그런 다음 Hausman 검정을 추정하여 고정 모형과 랜덤 모형을 선택합니다. Hausman Test를 활용하여 REM이 FEM보다 좋습니다. 논문에 선택된 데이터는 균형이 잘 잡힌 데이터입니다. 1인당 GDP의 변수는 통계적으로 유의하다. 또한 수출 국가와 SAARC 국가 간의 거리도 표시됩니다. REM 결과에 따르면 수출국과의 거리가 멀수록 방글라데시와 SAARC 국가 간 교역량이 많아지는 것으로 나타났다. 경험적으로 거리가 1% 증가하면 천과 직물의 거래 가치가 1.05%

감소한다. SAARC 국가의 1인당 GDP 변수는 또한 방글라데시에서 옷감과 직물의 무역 가치를 증가시킨다. 탄소 배출은 통계적으로 유의미한 영향을 미치지 않는다.

키워드: [중력 모델, 패널 회귀 분석, 랜덤 효과 모델, 고정 효과 모델, 탄소 배출, 옷감과 직물의 거래 가치]