Mathematical models to explain the export of Bangladesh

A DISERTATION SUBMITTED TO BRAC UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS

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24th May, 2018

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Declaration

I, **Mohaiminul Haque** hereby declare that the thesis entitled 'Mathematical Modelsto Explain the Export of Bangladesh' is entirely a product of my personal creative process, meticulous research and rigorous endeavor. Also, I declare that, it contains no materials previously published or written by any other person and has neither been submitted nor accepted for an award of any kind or degrees from any university or an institute of higher education. Moreover, I declare that for some cases whatever the information is being collected from other published papers and articles that have been written with proper citation.

This research work was carried out with data from the Bangladesh Bank and Bangladesh Bureau of Statistics under the supervision of **Dr. Mohammad Rafiqul Islam**, Associate Professor, Department of Mathematics and Natural Sciences, BRAC University.

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Acknowledgement

I wish to convey heartfelt gratitude to my respected coordinator and supervisor**, Dr. Mohammad Rafiqul Islam**, Associate Professor, Department of Mathematics and Natural Sciences, BRAC University, who's extremely valuable mentorship, has been cardinal towards the completion of my research work.

Also, I would like to express my deepest gratitude to **Professor A F M Yusuf Haider**, the Chairperson, Department of Mathematics and Natural Sciences, for taking the valuable time to go through this research work on the day of my defense. Also, I would like to extend my heartfelt regards and gratitude to late **Prof. A. A. Ziauddin Ahmad**, the former Chairperson, Department of Mathematics and Natural Sciences, for providing me with the required mentorship that were elemental during my undergraduate studies in BRAC University.

Then, I would like to thanks **Dr. Hasibun Naher**, Associate Professor, Department of Mathematics and Natural Sciences, the adviser of Mathematics for the guidance to complete my undergraduate studies smoothly throughout the period.

Moreover, I am grateful to **Bangladesh Bank** and **Bangladesh Bureau of Statistics** as they have helped me by providing the necessary data for my research work.

Last but not the least, I am grateful beyond words towards my wonderful parents who have always been extremely supportive and have been my rock, through thick and thin. I am also grateful to all my respected and honorable faculty members and my friends for their encouraging support and helpfulness throughout my whole undergraduate life.

At the end, I am thankful to Almighty Allah for providing me strength to complete my thesis and as well as undergraduate life delightfully.

Sincerely,

Mohaiminul Haque

May 24, 2018

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Abstract

Export is a very important medium for a Nation to earn foreign currencies and specially for a country like Bangladesh to maintain their economy and GDP (Gross Domestic Product). In Bangladesh economy, a very significant percentage depends on export specially the RMG export holds 62% of total export which is the most successful export item for them. They particularly do high export of RMG to European nation and USA, who have become successful export partners of Bangladesh. It is very important to monitor the Export of Bangladesh and for this, many mathematical models have been used earlier. In continuation, in this research three renowned mathematical models/methods have been applied on the very recent **27** years export data (secondary data) collected from library and website of Bangladesh Bureau of Statistics and Bangladesh respectively along with the error calculation using RMSE (root mean sum squared error) to choose the best method for explaining the Bangladesh export progress. The three renowned mathematical methods like **Geometric method, Least square regression and Exponential method** have been used to forecast after calculating the overall growth rate by each method respectively. Finally, Exponential method has been selected as best fitted model of Bangladesh Export among these three which helps to speed up the business decision as time is less consuming to understand the performance of Bangladesh.

Key words: GDP, Export, RMSE, RMG

Abbreviations

GDP= Gross Domestic Product

WTO= World Trade Organization

OECD=Organization for Economic Co-operation and Development

FOB= Free on Board

IMF= International Monetary Fund

ELG= Export Led Growth

GATT=General Agreement on Tariffs and Trade

USITC= US International Trade Commission

EPB= Export Promotion Bureau

BEPZA= Bangladesh Export Processing Zones Authority

RMSE= Root Mean Sum Squared Error

RMG= Readymade garments

LDC = Least Developed Country

IGC = International Growth Centre

TTIP = Transatlantic Trade and Investment Partnership

PRI = Policy Research Institute

OLS= Ordinary Least Squares Method

1. Introduction

1.1.What is Export?

Export means all transfers of the ownership of goods from residents of a country to non-residents and services provided by resident's producers of the country to non-residents are to be covered. It is not simply to send goods or services across national borders for the purpose of selling and realizing foreign exchange. For many developing countries, exports also serve the purpose of earning foreign currency with which they can buy essential imports- foreign products that they are not able to manufacture, mine or grow at home. Developing countries, in other words, sell exports, in part, so that they can import. Exporting goods and services can also further advance developing nations' domestic economies.

Export is vital and only those exchange. Around those statement export is viewed as likewise "export led growth" theory or hypothesis or suspicion formation's advancement. Export headed development may be altogether disputable issue around the expressions and diverse slants for economists. Economists determinedly convictions that economy development will be measured by any means intricate which relies for different variables in trade, money aggregation (both physical and human), value fluctuation, wage dissemination and political condition and additionally a large number questionable quality (Emilio, 2001).

Starting with the most recent three decades fare headed development need been issue for considerable exploration and experimental examination (Mahadevan, 2007). The fare headed growth is constantly debated theme in the writing with respect to profession and improvement. The association between fares and monetary development may be a standout amongst the primary comprehensively investigated issues on the advancement and experimental written works. There may be argue once if nations ought to energize fare (export) segment on get financial development climaxed under which may be identifier similarly as Export- Led Growth (ELG), ELG demonstrates that nations receive an outside bearing tend to attain unrivaled investment exhibitions (Galimberti, 2009).

There are parts about diverse perspectives with respect to similar to fares as a motor for development or expect similar to it similarly as best handmaiden about growth and nonetheless morals, others recommend that there will be synchronous (existing) association the middle of

those two (Mohammad, Karunaratne 2004). Mossy cup oak (large portion) from claiming investigations focus on the relationship the middle of fares andGDP same time a few for example, such that keep tabs at relationship between fares also downright component gainfulness (TFP) development (Hatemi-J, Irandoust 2001), (Hacker, Hatemi-J 2003) and (Bernard &Jensen 2004), others for example, analyzed the association the middle of fares and work profit growth (Kunst, Marin 1989), (Marin 1992) and (Thangayelu, Rajaguru 2004). In wider level, "the centering of the civil argument is on if alternately not a nation will be finer served by arranging profession strategies to send out advancement or import substitution"(Giles & Williams 2000) and send out headed growth level headed discussion will be concentrate on will be a nation preferred transformed highly fare advancement alternately profession arrangements or with import substitution (Bhagwati, 1988).

Those hypothesis of neo- established exchange backs that fare could help budgetary development of the country while a portion contention that the controversies need aid exceptionally non-rational also there is not firm based starting with investment hypothesis (Dani, 1994), and countries' experimental confirmation for example, such that south Korea, Hong Kong, Singapore, Taiwan, Malaysia, Thailand and China defends the neo-classical contentions (Mohammad,Karunaratne, 2004). The breathtaking growth operations for these nations need inspired huge numbers with show exchange arrangement similarly as an essential part from investment improvement (Krueger, 1998) (Sachs, Warner 1995).

Consequently, the point for this investigation will be will analyze the send out headed development utilizing those standout amongst those creating nations. Those mostly concentrate on a solitary creating country, analyzing observationally the middle of those broadening of the send out and the monetary development of the organizations in the nation highly identify those country's fare projects and qualities also shortcomings. Thus, those last motivation behind this contemplate is on measure the noteworthiness about fares in the creating particular nation how fare heads development of the economy.

1.2.Globalization and Export

"Globalization" worries of the creating relationship about nations important starting with those developing global trade, finance, kin(people) and plans done we quit offering on that one widespread open advertise (one open universal market). Those principle components about this integrative are global exchange and cross-border investment streams.

Monetary globalization may be not another amazing advancement. There will be not specific meaning of globalization yet all the economists normally utilize the term(haul on allude) will worldwide reconciliation to commodity, capital and labor market (Bordo, Michael, Taylor 2003). There need been two periods of the Globalization (Baldwin, Martian 1999). Those initially period off proximately the mid-19th century and declined for the start for World War I and the second stage started in the outcomes of the World War II and prolongs today. Huge numbers economist contend that it started as promptly as those approve half of the nineteenth century and diminished because of the begin of World War I (Taylor, 2002), (Kenwood,Lougheed 1999). In the both stages about globalization those yield development and fast profession went together with the huge transforms in the globe economy. There is person precious Lessing starting with those historical backdrops that globalization need not been level transform. A number of universal organizations founded in the come around of planet War II - Globe Bank, worldwide money related trust (IMF), and all concurred upon on duties and trade (GATT), globe profession association (WTO) made to 1995. They at bring assumed an incredible part to swaying organized commerce as opposed to protectionism.

As stated by Mike Moore too days gone by executive all of the planet trade association (WTO) "Globalization need joined imperialism, colonialism, free enterprise and socialism done turning into a universally handy tag, which cam wood be wielded like a club over very nearly at whatever ideological boundary bearing. It will be the characterizing political budgetary, also social wonder of the new millennium" (Moore 2003, p. 15). There would parts for definitions provided for eventually high distinctive establishments alternately associations like reality bank (Stern 2002, p. 53), association for budgetary co-operation and improvement (OECD 2002, p. 20), worldwide monitory store (IMF) (Krueger, 2002) also clinched alongside straightforward terms globalization define similarly global exchange and broadening of business person organizations in the nation will in turn nation as far as mankind's power, items or

administrations. As stated by OECD's 2006 report card a standout amongst those imperative characteristics of the globalization is decreasing those obstructions for trades and remote immediate financing is getting to be vital calculate in those world-wide methodology of modern reforming and the development about truly worldwide commercial enterprises. (OECD, 2006).

In the most recent two decades, globalization need phenomenal dedicated a support with reality trade, need climbed one and a halftime snappier over universe output, and the variety need much been observable predominant in present a long time concerning illustration reality trade improvement accelerated altogether sturdily (Giurgiu, 2009). Those growth for fares furthermore imports as a proportion for GDP is always rising, reason behind that is numerous nations in the universe would providing for chance will do global exchange. An alternate purpose behind globalization will be quickly increment because of nothing trade, traditions unions anddifferentsorts of co-operation the middle of nations. As stated by Welfens (1999) characterizes an examination directing, including send out purposes of presentation also import infiltration might make recognized likewise sample for globalization and Heckscher purported that fare stream would establishment with respect to similar preference for trading and lending (Tayeb 2000, p. 15).

Each coin need pros and cons same similarly as globalization is likewise a disputable issue, there need aid some positives impacts and some would negative. So, at the same occasion when provides for profits and makes new dangers of the societies, people and financial frameworks. There are uncertainties that it may magnification those space the middle of rich and poor, may make inside the particular nation alternately cross the country, settling on new apprehensions to human security as far as money related instability, political, social unreliability and surroundings lack (Martens,Raza 2010). For other words, the advantageous, pioneering also dynamic parts about globalization need aid continuously annoyance, also as needs be a percentage more counteract, Toward strengths that make impedance and marginalization, for example, such that mass migration and number growth, those manifestation of infectious infections, stretching inequalities done improvement world-wide, climate fluctuation, an prompt passing of bio-diversity and the lack and contamination for characteristic assets (Rennen, Martens 2003).

1.3.Export led growth

The basic connection between monetary development and fares need in length been fringe also focal about significant dialog and discuss around the economists, government funded parts and trade experts. On the bases about hypothetical approach, there would four possible effects (Chen 2007). To start with bring about shortages may be that fare growth may be measured should make the primary causal from claiming a budgetary development previously, processing and job. It is known as Export-led Growth (ELG) theory. ELG growth will be sorted clinched alongside we quit offering on that one course thought from fare will horrible down-home item. The second come about may be growth determined fare theory expects that an expansion on GDP generally regulate should speaking to climb on fares (Bhagwati 1988). There will be particular case heading relationship starting with yield should fare for growth determined fare. Third and fourth conclusions likewise extremely vital can't ignorable which two-way heading association and impartial associations between monetary development and export (Grossman, Helpman 1991).

In the straightforward expressions fare lead growth is an investment advancement method which will be utilized eventually so that manufacturer country to another country will get similar advantage. Fare and remote exchange assume an extraordinary part to climb country's financial development and improvement. ELG model alternately system or theory will be primarily utilized to those counties in creating nations and created nations on produce reductions for one another. As stated by (Jung, Marshall 1985) send out headed Growth may be improved output, livelihood and utilization which regulates will ascent in the request for a country's yield.

There may be sure holding the middle of those fares and budgetary development it’s picked up starting with the remote businesses. For other saying camwood say that "export is a motor from claiming growth". As stated by (Awokuse, 2008), export could develop three ways; insend out (export), improvement might be a medium for yield growth straightforwardly and only aggregate (part of total output) yield. There will be interest about household results in the outside showcase which camwood purpose behind monetary development. Previously, yield through upgrade in the money and job in the division for send out. Second, send out development camwood likewise impact through different routes similar to vast number from claiming use ability, circulation for productive resource, economies from claiming scale improvement and also impulse about mechanical transformation flawlessness due to abroad (foreign markets) rivalry

(Helpman,Krugman 1985). With the help of the economies from claiming scale organizations alternately organizations or associations could take advantage on non-export division which will be remotely anyway internally it supportive with entire economy Growth. Third, broadening for fares gives remote trade which is vital to yield development (Esfahani, 1991). Accompanying specialists need (Feder 1982), (Ram 1985), (Tyler 1981), (Ukpolo, 1994), and (Bodman, 1996) those same idea on the send out andfinancial development relationship.

The models for (Edwards, 1991) propound coordination certain impacts starting with trade should growth are associated with altogether close originated highly (Lewis 1955) who argue that creating nations have additional joined mechanical transformation focal point over r of the globe which doesn't coordinated circuit. There would three primary gatherings which exceedingly intrigued on the send out execution; Initially is open - approach - makers, second administrators and third is analyst (Sousa et al. 2008) (Katsikeas, Leonidou,Morgan 2000). Public-policy-makers investigate that trading will be methodology should gather remote trade reserves, climbing vocation levels, exceptional profit and in that path expanding riches of the organizations in the nation (Czinkota, 1994). Managers, it will be vital since it supports corporate advancement and verify that firm ought to survive for in length expression (Samiee, Walters 1990) (Terpstra, Sarathy 2000). Investigate need likewise paramount part that they distinguish trading a testing and guaranteeing hypotheses over universal showcasing (Zou, Stan 1998).

There need aid best two perspective of the fare headed growth those initial will be that export headed development could produce benefit. In this way that particular nation could equalization their accounts and in addition diminishes the long-term debts and also creates material for those fares. Those second perspective is that fare headed growth which will be a significant part a greater amount disputable issue which increment the fare growth which supportive with expansion in the GDP of the country. As stated by (Thirlwal 2000, p. 6) economics hypotheses demonstrates that two sorts from claiming profits from profession liberalization which need subsistence advantage. Those two reductions are static additions and second dynamic additions. Static additions cam woodis attained toward those assets revamp from lease profitable division with higher sector, running on specialization. Those second changing additions include for universal trade, upgrade about investment also fast benefit advancement in view of theeconomics

of scale, inclining high finishing impacts and the procuring learning in regards overseas, uncommonly all around remote immediate financing.

As stated by Palley, a large portion from claiming East Asian nations needed a number from claiming antagonistic impacts because of significance once fare lead development. First, it prohibited that advancement of the local business sector growth. Second, it demonstrates that creating nations would race of the lowest part due to the administrative rivalry around themselves. Third, it makes clashes or issues the middle of the creating nations and created nations. Fourth, there is association between fares headed development and fiscal instability by creating overinvestment booms. Fifth, due to the vitality detract put ahead worldwide merchandise and product markets, this model need angered the long- pattern decrease in creating nations trade. However, not minimum those the majority import, send out headed growth need resisted those dependence about creating nations on the produced world, thus getting to be defenseless and decay those latter's business. Palley additionally contend that send out headed growth which will be utilized by the East Asian nations manifestation most recent decades yet all the its not any more best methodology (Palley, 2002).

1.4.Export led growth of Bangladesh

According to the theoretical and historical evidence Bangladesh should continue on a path of export-oriented development. Zaidi Sattar in his articles ‘Challenges of Export-Led Growth: Breaking into new markets and new products’ says that in the coming decades, export markets are vast, and trade openness in both goods and services with rapid spread of automated procedures for movement of goods and services, global integration of production networks, significant reduction of transportation costs and modernization of ports, customs administration and other trade infrastructure. Other than the limited domestic economy export markets will also play the role of main driver of employment for the huge numbers of labor force those who entering the labor market as an offshoot of demographic transition that Bangladesh is experiencing.

Day by day, trade patterns are experiencing changes and these are bringing challenges for the Bangladeshi exporters. A new trend that has evolved in the character of export- led- growth is the ‘unbundling’ of production across countries fostered by widespread trade liberalization, advances in ICT, and lower transportation costs. As a result, intermediate goods trade has

become the fastest growing segment of international trade, and major driver of export- led growth for many developing countries as well. These evolving trade patterns of the future will in large measure produce the prospects and actual shape of Bangladesh's export markets of the future, defining the possibility of job creation at home.

During **1960s** and **1970s**, the emergence of Tiger economies of East Asia dismissed the notion of 'export pessimism' for low- income and developing countries, an idea that was popularized wrongly, as historical evidence proved- under the ambit of Prebisch- Singer hypothesis. For the developing countries like Bangladesh those who struggling in economies Export- led growth soon became the mantra to come out of poverty. After the East Asia, export led growth soon became equal with episodes of trade liberalization, Zaidi.

Bangladesh has exported **$27 billion** worth of goods in **FY2012-2013** to over **150** countries of the world. Although geographical diversification of export destinations has been taking place, the fact remains that some **80% of Bangladesh export** went to USA and Canada in North America, the **27-member** countries of the European Union and Japan. These countries together make up more than one- half of the world's GDP of about **US$ 60 trillion**, also bookkeeping for the bulk of the **$300 billion** market for readymade garments. Therefore, the prospects of expanding Bangladesh RMG exports to these markets remain substantial as it now exports merely **$25 billion** worth, said by Zaidi Sattar.

1.5.Facts and Figure of economy

Bangladesh's export performance so far presents signs of strength in its export basket (Sattar, 2015). Export has a huge impact on the economy of a Nation like a developing country, Bangladesh whose huge percent of yearly Budget depends on Export that is, the foreign currencies.

The economy of Bangladesh has changed drastically in last **30 years**. The economy of Bangladesh is largely driven by its exports of ready-made garments (RMG), remittances and the domestic agricultural sector. Ready-made garments (RMG) industry that now ranks second in export in the world. Within a very short period of time it has become the largest export earner of the country through a major positive forward thrust in the early 90s (Shahriar, Banik, Habib, 2014). Bangladesh is expected to come out of the least developed country (LDC) bracket and

achieve the status of a mid-income country within the next seven years for making significant progress in some key areas. To take this challenge, faster and sustainable growth rate of export can play a vital role in the coming year. Bangladesh earned **US $ 30.3 billion** from exports in the **fiscal year 2015-2016** which was almost **17.34%** of GDP. The readymade garments (Clothing, textiles, Knitwear) comprise about **89%** of export whereas the major items are footwear and fish (mainly shrimp). The main destinations of export are USA, UK, Germany and European Union (EU). To make Bangladesh poverty free, it is very important to keep sustainable grown in the economy where export can play a vital role. This is for it necessary to analyze the trend of export over the years from different prospects. Vohra (2001) examined the relationship between the export and growth and showed that when a country has achieved some level of economic development than the exports have a positive and significant impact on economic growth. In the paper we will analyze the export of Bangladesh from the fiscal 1990 (1 July 1989 to 30 June 1990) to 2017 (1 July 2016 to 30 June 2017)

1.6.Background

That market-based economy about Bangladesh may be that 44th biggest in the planet clinched alongside ostensible terms, and**32nd** biggest toward obtaining control parity; it may be ordered around the next eleven rising showcase economies and a wilderness business sector. As stated by the IMF, Bangladesh's economy is the second speediest developing significant economy about **2016**, for a rate from claiming **7. 1%.** [16] [17] Dhaka and Chittagong are those vital budgetary focuses of the country, constantly home of the Dhaka stock trade and the Chittagong stock trade. Those monetary divisions about Bangladesh may be those second biggest in the subcontinent.

In the decade since **2004**, Bangladesh averaged a GDP Growth for **6.5%,** that need been generally driven toward its fares about primed made garments, remittances and the down-home Agricola division. Those nations over need sought after export-oriented industrialization, with its way fare parts incorporate textiles, shipbuilding, and fish. Furthermore seafood, jute also cowhide merchandise. It need additionally created independent commercial enterprises to pharmaceuticals, steel furthermore nourishment preparing. Bangladesh's telecommunication business need seen fast development through the years, getting high speculation starting with remote organizations. Bangladesh likewise needs generous saves from claiming characteristic gas also may be Asia's seventh biggest gas producer. Seaward investigation exercises are

expanding on its oceanic region in the cove of Bengal. It also needs vast stores for limestone. [18] Those administration pushes those advanced Bangladesh plan as and only its exertions will create the country's developing majority of the data innovation division. All these possibilities show a very bright future of Bangladesh as an exporter.

Export of Bangladesh is calculated with the help of FOB basis which is one of the renowned trade terms in the world. **Free on board (FOB)** is a trade term that indicates whether the seller or the buyer has liability for goods that are damaged or destroyed during shipment between the two parties. FOB is divided in two parts, one is FOB shipping point and another one is FOB destination. FOB shipping point means sale when shipped and FOB destination means sale when arrives. Bangladesh is the largest exporter of clothing in the world after China. The garment industry is the backbone of the development of the country. Bangladesh has the lowest labor-cost in the region which contributes to the competitive position of Bangladesh to attract clothing brands. The lucrative performance of export trade has been singlehandedly driven by the RMG sector, which has easily proved by its share in total exports rising from virtually nothing in 1980 to **81.13 percent** in 2013 (Razzaue,Eusuf, 2007).

1.7.Export Policy of Bangladesh

Export policy has been liberalized by the Government of the People's Republic of Bangladesh in order to keep pace with the present globalization system under WTO rules. The objectives of the Export Policy are:

- limit fabricating of send out related foundations similar to EPB (through its revamp to improve regulate efficiency), BEPZA, traditions department, territory and Seaports, Fisheries department, BSTI, tea sack table and exchange bodies;
- result diversification;
- create item nature also plan also handling from claiming halter smelter esteem products;

- embrace new methodologies to stretching send out products, guarantee handy utilization of it alternately workstation technology, E-commerce also other technologies;
- create important infrastructures and previously, obliged situations regressive and forward linkage commercial enterprises to guarantee preparation of greatest volume about exportable items;
- make new exporters and give at support with existing exporters furthermore create a business inviting environment;
- create master labor for trade;
- prepare profession bodies, agents and worried people with vital information once frameworks about planet exchanging.

1.8.Why Nations like to Export?

Since the beginning of the Industrial era almost three centuries ago, countries exported goods and services because:

- Individuals and firms have been able to produce more goods and services than can be consumed at home. This prompted a search for foreign opportunities to sell the “excess” production;
- Individuals and firms have been able to sell goods or services to other countries at higher prices they can obtain domestically.

1.9.Main Export items and Export Partners

Main items of export of Bangladesh are

- RMG
- Raw jute,
- Tea,
- Frozen food (Fish, shrimps, prawns etc.),

- Agricultural products,
- Jute products,
- Leather, Petroleum by products,
- Woven garments Knit wear,
- Chemical products (Pharmaceutical products),
- Footwear, Handicrafts,
- Engineering products,
- Ceramic products, and
- Others (Bicycle, Terry towel, home textiles, etc.).

The growth of knit garments export was facilitated by the remarkable free market access of EU during the period 1996-2005 resulted in the highest export share of RMG from Bangladesh (Haider, 2007).

The destination of the export products are counties like

- United States,
- Germany,
- United Kingdom,
- France,
- Spain,
- Italy,
- Canada,
- Belgium,
- China, and
- Japan.

But other countries with large population can be a good market for Bangladesh such as Australia, Brazil, Chile, China, India, South Korea, Mexico, Russia, South Africa and Turkey are looking to be the more promising markets, followed by Malaysia, New Zealand, Norway, Saudi Arabia, and Thailand (Sattar, 2015).

1.10.Recent performance of Bangladesh in Export

As we know, USA is the most successful export partner of Bangladesh and it is necessary to mention that almost **16.7%** (average) of total export. For the last two years, export of Bangladesh to USA has been decreased dramatically. Although, the imports of USA have been increased by **almost 7%** in 2017 compare to 2016. They have increased their import from Vietnam, China, India, Cambodia etc. compare to these countries the export percentage of Bangladesh to USA is in decreasing rate. The exporters and the Experts argue that there is no longer a chance to show the cause of World Economy for low percent of export to USA which is one the most successful exporter of Bangladesh. Because, World Economy has overcome their deflation which has started two years earlier and USA have increased their imports as well. It means for the decreasing rate of export to USA is due to the lack of ability of Bangladesh. It also indicates that the ability of businessman of Bangladesh have decreased compare to the competitive countries in the world which is not a good sign. Other than to improve the transportation system and sea port system it is quite difficult for Bangladesh to move out of this situation. Besides, Experts also think that businessman of Bangladesh should get enough opportunities like competitive nations businessman.

It has been observed from the information of US International Trade Commission (USITC) that from 2010 to 2015 only in the year 2014 the export of Bangladesh to USA has been decreased. In other 5 years, export has increased to USA. Basically, after that in 2016 and 2017 export has been decreased. It means that in 2017, Bangladesh has been unable to do the export at least up to the value of year of 2015. The Experts are claiming that USA has faced some deflation in their economy in 2015-2016 but they overcome that successfully. In the future, it is expected the import market of USA will be expanded. Although, their imports have been decreased in 2016 but it has been increased by **7%** in 2017. This excess demand can be a huge opportunity for Bangladesh. Other than this, USA also reduces their import from China as well. This is also a huge opportunity for Bangladesh. Other countries can take these opportunities except Bangladesh due to the lack of facility. According to the report of USITC, USA export **10.25%** higher in 2017 (11 months) compare to year 2016 from Vietnam, **8.9%** increase from China, **7.3%** from Cambodia and **5.65%** from India.

About this, Dr. Mustafizur Rahman (Centre for Policy, CPD) argues, 'Due to decrease of interior facility is the main cause to lose the market of USA in last two years. Every time fashion design is changing. For this 'lead time' is very important. Oven clothes are very popular in USA. The raw materials for oven clothes Bangladesh need to import and also there is the lacking of facility in the sea port. As a result, Bangladesh fails to export in the lead time. For this, most of the businessman force to export through air. Therefore, competitive ability between the businessmenhas been decreased. Compare to competitive countries our 'Cost of doing business' is very high. It is necessary to look after to minimize this problem. He also mentions that it is necessary to make sure the continuous supply of gas and 'quality' electricity. We also need to concentrate on Fashion design and look to produce high cost product.'

Dr. Ahsan H. Monsur (Policy Research Institute, PRI) says, 'Continuously, decline of export is risky. We are losing in the completive facility world. We need to overcome these. Due to Accord-Alliance our facility has increased but recently, it falls. Small factories have closed and large industries facilities have not increased up to the mark'. But he believes it is increasing.

This is a very complicate situation for Bangladesh to lose their most successful export partner. Other than USA, export to Germany has also decreased by **0.7%** in 2016 compare to 2015 and it is also expected if Bangladesh cannot improve their interior facilities then Germany also reduce their import significantly like USA which will be a significant lose for Bangladesh. But in the year, 2017 German traders feel Bangladesh's garment exports to Germany will continue to grow in future due to the high quality of products and competitive prices. Germany is the second largest export destination for Bangladeshi apparel after the US. As a member of the EU, Germany will continue its duty privilege for Bangladesh, said Manfred Junkert, DGM of the Confederation of the German Textile and Fashion Industry at a press conference on the sidelines of Heimtextil fair in Frankfurt recently.

Garment exports from Bangladesh to Germany have been increasing over the years. The Asian country exported garments worth **$4.65 billion** to Germany in 2015-16, **$4.33 billion** in 2014-15 and **$4.37 billion** in 2013-14, according to Export Promotion Bureau (EPB).

Talking about Brexit, Junkert said it was a serious issue for them as the UK is a big trading partner of Germany. If the UK leaves us (EU), there is a possibility of serious consequences for Germany, Junkert observed. The UK is the third largest export destination for Bangladesh after

the US and Germany, with Bangladesh shipping apparel worth **more than $3 billion** to the UK a year. As a trade bloc, the EU is the largest garment export destination for Bangladesh. It offers a zero-duty benefit since 1971 under its Everything but Arm scheme. Bangladesh exported garments worth **$17.15 billion** to the EU in fiscal 2015-16, **$15.36 billion** in 2014-15 and **$14.75 billion** in 2013-14, according to EPB.

On the Transatlantic Trade and Investment Partnership or TTIP, Junkert said negotiations have stalled now with the change in power in the US. Usually, signing a free trade agreement takes six to seven years. Germany will have to wait more than this time to sign the TTIP. It now depends on the US government, Junkert maintained.

There has been over **119%** growth in bilateral trade in goods and services between 2007 and 2012. The UK exported **$450 million** of goods and services to Bangladesh in 2013. **71%** of this was services. Exports of goods were **$131 million** in 2014. The UK's main exports to Bangladesh in 2013 were nuclear reactors for medical purpose, boilers, machinery and mechanical appliances / parts electrical machinery and equipment / parts, sound recorders and reproducers, television image and sound recorders and reproducers, and parts / accessories, iron and steel residues and waste from the food industries; prepared animal fodder.

The UK is the 3rd single largest destination for Bangladesh's exports, after the United States and Germany. Over the years Bangladesh's exports to the UK enjoys a steady annual growth. Total Bangladesh export to the UK in 2010-11 was **US$2.001 billion**, **33%** higher than the previous year. Some of the major British concerns present in Bangladesh include Aventis, Berger Paints, BOC Bangladesh, British American Tobacco, Cairn Energy, Duncan Brothers, GEC, GlaxoSmithKline, GCM Energy, HSBC, James Finlay, Meghna Energy, P&O Nedlloyd, Price Waterhouse Coopers, Reckitt Benckiser, Standard Chartered, Tetley, ACI, Tullow Bangladesh, Unilever and World-Tel. United Kingdom has been one of the top sources of remittance. At present, UK is then 5th largest source of remittance. Actual flow of remittance from UK in the period 2009-2011 is **$890 million.**

In the 2012-13 fiscal years Bangladesh exported **$2.2 billion** worth of goods to UK and imported $2 billion worth goods and services from UK.

In the year, 2016 total export percentage of Bangladesh to UK is **10.9%** which is an increase **1%** compare to 2015 and it is hoping that in 2017 it also increases like previous long term successful export history.

Bangladesh's exports to France will reach **$3 billion** very soon as it is witnessing a sharp growth every year, Commerce Minister Tofail Ahmed. "Since France is an important trade partner for Bangladesh and a great destination of RMG products especially, Bangladesh's export to EU country would soon exceed **$3 billion**," **Tofail said.**

According to the Export Promotion Bureau (EPB), Bangladesh earned **$1.85 billion** in the last fiscal year, up from **$1.74 billion** a year ago. Of this total, **$1.7 billion** came from the RMG products. In the same period, Bangladesh imported goods worth **$203 million**. Over all, in 2015 and 2016, the total export of Bangladesh remains same that is**, 6.1%** to France which is a good sign in 2017 it shows an increasing hope.

"Beyond the RMG sector, Bangladesh has taken initiatives to export pharmaceuticals, furniture, IT and leather products to France to enlarge export volumes as well as their value," the minister said. "To tap the opportunity, the government is providing cash incentives against the export potential products."

He also added that the Bangabandhu satellite would be completed by 2017. The project is being implemented with the cooperation of Agency for France Development, European Investment Bank and Asian Development Bank.

Other than USA, Germany, UK and France Bangladesh also like to export their items to Spain, Italy, Canada, Belgium, China, Japan and India significantly followed by descending order of magnitude in respect of Bangladesh export earnings (2016) and accounted for **5.8%, 4.6%, 3.1%, 2.8%, 2.7%, 2.7% and 2.6%** respectively, this is an increasing mode comparing to the previous year. In 2017, it is also hoping to increase significantly (Bangladesh Protidin Newspaper).

1.11.EPZ

Export processing zones (EPZs) are designated regions found over a large number worldwide Soutine nation which need aid intended should pull in remote capital (Pyle 2001), inside which those host country offers states positive position with seaward investment, for example, loose work laws, obligation free imports andexports (Mack andDi Mambro 2004). Presented Concerning illustration and only the advancement methodologies incorporated in the reality Bank's structural modification arrangements of the 1980s (Pyle 2001), EPZs produce critical employment; the technical, supervisory, and manageress levels need aid very nearly only possessed by men, same time women, who contain **65-90%** for workers done the greater part EPZs (Summerfield 1995), fill those easier level creation employments (Pyle 2001). Clinched alongside a portion cases, EPZs furnish exceptional attempting states for ladies over they could background in exchange employment, offer ladies the chance to accomplish some level from claiming money related independence, and coordinate ladies under the improvement process, in this way consenting with the ladies on advancement hypothesis (Martinez 2008). However, ladies previously, EPZs would present with greatly poor attempting states and paid exceptionally low compensation. Clinched alongside a few ways, the capacity of the ladies to succeed sexual orientation subordination in the home. Eventually Tom's perusing picking up outside vocation will be undermined toward the different manifestation of sexual orientation subordination that happens in the work environment.

To increase the inflow of foreign investment and to achieve rapid economic growth of the country, particularly through industrialization, special steps have been taken by the Government of Bangladesh since 1980 by setting up Export Processing Zones (EPZ) in the country. EPZ is also playing an important role to uplift the export of Bangladesh. Initially three special zones were set up in Chittagong (Halishahar), Dhaka (Savar) and Khulna (Mongla) where favorable facilities/assistance are provided to the potential investors both Bangladeshi and foreigners. The Chittagong Export Processing Zone (CEPZ) started from 1983-84 while the Dhaka Export Processing Zone (DEPZ) started from 1993-94. Later, EPZs have also been established in Mongla of Khulna, Ishwardi of Pabna,Comilla, Uttara of Syedpur in the district of Nilphamary, Adamjee of Narayanganj and Karnaphuli of Chittagong which are classified into three types i.e. A-type (100% foreign investment), B-type (Joint venture between Bangladeshi and foreigners)

and C-type (100% Bangladeshi enterprises)[Bangladesh Export Processing Zone Authority (BEPZA)].

Export processing zones, abbreviated as EPZ, are usually set up by governments of developing nations to encourage industrial and commercial economic export activity; they are a type of free-trade zone. Traders are typically exempt from certain taxes and other business regulations, according to The World Bank [World bank.com].

Basic objectives are the encouragement of non-traditional manufacturing exports because of increased multinational companies' inward investment, another form of indirect effect from the backward linkages. These will occur when EPZs companies buy inputs from companies in the host country (Furby, 2005). [Taken from Global Journal of Management and Business Research]

After independence, Bangladesh has faced severe economic crisis in which EPZ played an important role in terms of exports, investments and employment. Specially, it is needed to mention the particular year after 1990 according to OECD, 2007 and BEPZA, 2008-2009 as the most successful period. In comparison, according to WEPZA report of 2012, in China EPZ has brought most of the achievements especially in technology transfer, investment increase and unemployment decrease in last 10 years (decade).

1.12.Background of EPZ in Bangladesh

Since those freedom for 1971, Bangladesh need been battling will create the social, cultural, economic, political base of the nation thereabouts that those subjects'cam wood need an exceptional living caliber. For due course, to those advancement of the global trade, similar to a lot of people different countries, Bangladesh need made committed Export Processing Zones (EPZ) around those country which need ended up an engaging put to remote immediate financing (FDI). Huge numbers of specialists (Paul-Majumder and Begum2000; Hossain, Jahan andSobhan 1990; Muqtada, Singh and Rashid 2002; Islam. M. J. 2006) need demonstrated those splendid development about EPZs in the money house under entrepreneurial skills, states and regulations, EPZ's effect on the in general economy and its vitality in globalization and in addition importing the 'Know-How' with the table effectiveness in the generation. However, clinched alongside understanding will this it appears all the more critical with assess that part of

those monetary institutions, particularly the universal banks, concerning support up that growth for this significant division?

Export Processing Zones need aid particular sorts of organized commerce zone, set up toward those government. Particularly in the creating nations will push mechanical and business exports, likewise known as business improvement Zone (CDZ). On Bangladesh, the initial EPZ might have been established in Halishahar, Chittagongin 1983 and soon took after by the second EPZ established inSavar, Dhaka in 1993. Presently we bring eight (08) EPZs all over the country with the main situated at to be specific in Dhaka, Uttara (Nilphamari) and others atAdamjee, Chittagong, Comilla, Ishwardi, KarnaphuliandMongla. To our country those EPZs suit different sorts about commercial enterprises including textile, agro-based industries, chemicals, electrical supplies and components, and garments accessories, woven and sewed fabrics, cowhide items and foot-wear, pharmaceutical products, jute products, lab ware, do-it-without anyone else's help devices, furthermore equipment, musical instruments and so forth throughout this way, observing and stock arrangement of all instrumentation may be enhanced (improved). These commercial enterprises process to separate prestigious brands such as Nike, Reebok, H&M, GAP, j. C's. Penny, Wal-Mart, mothball Care, Tommy Hilfiger, Adidas, AmericanEagle, Phillip-Maurice, Decathlon, Konica, Nikon, Fuji, Olympus, Sony, Nissan, Mitsubishi and so forth throughout this way, observing and stock arrangement of all instrumentation may be clinched alongside. Our EPZ organizations need aid separated under three unique assemblies for Type-A (100% remote. Owned), Type-B (Joint wander the middle of remote and nearby companies) and ultimately Type-C. (100% generally owned) Also contingent upon those types, the organizations could need a considerable measure of. Chances including duty exception to 5-10 years, obligation and quota free entry with import. Furthermore export, no roof to investment, traditions freedom in plant webpage and great deal more. Those reasons those remote gurus are pulled in will our country with contribute are:

- foundation offices
- decrease about lead time
- cosset about finishing benefits of the business
- inviting approach about legislature
- Incentives

- signatory of MGA, ICSID, WIPO, OPIC
- Asia’s low cosset creation build
- more level work expense
- across the nation transportation offices and also right of the ocean ports and so on. (HSBC)

1.13.Advantages of EPZ

For again 130 countries giving EPZ's inside their borders, the points of interest from claiming making EPZ's show up should be thick, as clear to creating nations.

The self-evident reductions include:

• those expand to remote trade through expanded fares.

• employment production.

• remote immediate financing (FDI) of the group country.

• the acquaintance from claiming engineering under those country.

•and generating retrograde linkages from the EPZ of the provincial economy. Those in general reductions of the group nation would not unmistakably measurable. Similarly, as there would the beginning advancement costs of making the framework for those EPZ, and additionally those charge incentives advertised will outside speculation.

The place investigations need been performed on EPZ's for those world, a few countries show up with need benefited essentially toward those prologues from claiming EPZ's for example, such that China, south Korea, andIndonesia.

Same time it will be surmised that a percentage need not performed as well, for example, those Philippines, the place the where cosset from claiming framework outweighed the reductions (where the high cost of infrastructure outweighed the benefits.)

Investigations have inferred that nations for a surplus about shabby work could utilization EPZ's will expand employment and produce outside speculation.

1.14.Disadvantages of EPZ

Aggregations for example, the universal work privileges discussion (ILRF) bring discovered that on a percentage creating countries those dominant part of the laborers in the EPZ's would female Furthermore contain to the extent that ninety percent of the Shabby work pool.

A significant number economist need inferred that job clinched alongside EPZ's implies low wages, where worth of effort intensity, perilous attempting states Also concealment about work privileges. It may be regularly valid that the compensation clinched alongside EPZ' encountered with urban decay because of deindustrialization, innovation developed, government lodging is higher over the individuals accessible to rustic regions of the same country, particularly to women, it may be not generally the situation that compensation in EPZ's are higher over the individuals for tantamount fill in outside the EPZ's.

Numerous groups previously, rustic regions rely on upon the compensation sent again toward female specialists inside the EPZ.

Huge numbers legislatures that bring made EPZ's need acted against work development exercises inside EPZ's. The Different confinements looking into work developments that legislatures have made incorporate an aggregate or halfway boycott once exchange union activities, confinement of the extension for aggregate bargaining, and banning exchange union organizers.

Generally, significantly to Bangladesh, the government's approach about banning unions need best diminished following those building breakdown that murdered through 1100 specialists.

Perilous working states are a negative component that is frequently connected for EPZ's. Laborers need aid expected on fill in extended periods over physically risky conditions, including over the top commotion and heat, perilous manufacturing equipment, and uninspected structures. With no need for unique representation, there need to be steps that are carried out to transform those circumstances over a percentage processing plants.

As an ever-increasing amount EPZ's need aid created, there may be an impetus to keep cost devastationas low as could be allowed to be aggressive against different developing countries.

This implies that those laborers proceed with should endure the results for perilous attempting states.

2. Literature Review

In this section, a brief review will be provided on the existing literatures. Many persons have worked on the Export of Bangladesh and its consequences on the GDP. There is a strong relation has been tried to bring out between Export and GDP using various Mathematical models.

In the beginning, Shamsad Begum and Abdul F.M. Shamsuddin (1998) have studied on Exports and Economic Growth in Bangladesh based on a two sector Growth Model. They have discussed an Autoregressive Conditional Heteroscedastic(data with a different dispersion) Model of Economic Growth to disclose the volatility of the Economy of Bangladesh. Their investigation suggests that an increase in the share of investment in GDP significantly the growth rate of GDP in normal years but negligibly in the abnormal years means political wars natural disasters etc. Their model has been built on some assumptions that is, two sectors in the economy like the non-export and the export sectors of Bangladesh.

Dr. Md. Moniruzzaman in the year 2002 studies the long run relationship between export and import of Bangladesh since independence. Foreign trade acting an important role in economic development of a least developed country (LDC). Planning an appropriate trade policy mostly depends on the relationship between export and import. Here, he has used modern time series econometric techniques such as Co integration, Engale-Granger Causality analyses to trace out the relationship between export and import. Estimation of relationship is also conducted by OLS method. The study results show that both exports and imports are non-stationary at levels but they are stationary at the first difference with intercept and with intercept and trend. The Co integration test shows exports and imports are significantly co-integrated. The Engale- Granger causality test proofs that export has significantly cause import meaning that there is unidirectional causal relationship between export and import. The test results suggest that the policy makers should pay proper attention on export sector in designing trade policy of Bangladesh.

The International Trade Journal published article on topic 'Exports and Economic growth in Bangladesh: Has Manufacturing Exports Become a New Engine of Export-Led Growth?' by Mohammad Hossain & Neil Dias Karunaratne (2004) where they have empirically verified the export-led hypothesis for Bangladesh and examined whether manufacturing exports have become a new engine of the export-led growth in Bangladesh, replacing the total exports-engine, as claimed by the so called de novo hypothesis. They have used the empirical assessment based on the vector error correction modeling (VECM) with the help of quarterly data over the period 1974–1999 suggests that both total exports and manufacturing exports have had positive and statistically significant impacts both in the long run and the short run. Then, an encompassing test in conjunction with the various non-nested tests suggests that total exports, as opposed to manufacturing exports in isolation, is the dominant engine of the export-led growth. This counters the claim that manufacturing exports has become the sole determinant of the export-led growth in Bangladesh.

In the year 2005, Dr. Md. Rafiqul Islam has published a paper on comparative studying of dynamics and structure of gross domestic product (GDP) of Republic Bangladesh by using the data from 1990 to 2004. In this paper, he has forecasted the total export of Bangladesh for the year 2005 and 2006 using straight line method and parabola method and finally, he has chosen the best model to explain the export of Bangladesh according to the analysis.

Moreover, K. A. Al Mamun and H. K. Nath (2005) published an article 'Export-led growth in Bangladesh: a time series analysis' in journal 'Applied Economics Letter' examines time series evidence to investigate the link between exports and economic growth in Bangladesh. Using quarterly data for a period from 1976 to 2003 the article finds that industrial production and exports are co integrated. The results of an error correction model (ECM) suggest that there is a long-run unidirectional causality from exports to growth in Bangladesh.

Also, in 2005, Journal of Asian Economics published article on topic 'Testing export-led growth in Bangladesh in a multivariate VAR framework' by Jim Love and Ramesh Chandra. Although the link between trade and growth has long been discussed, systematic empirical investigation of the relationship has been undertaken only relatively recently. A number of time-series studies exist for individual countries in the area of export-led growth, but for Bangladesh there has been little work in this area. This study seeks to bridge an important gap in the literature and is

perhaps the first to use Johansen's multivariate framework taking the terms of trade as an additional variable for Bangladesh. The findings suggest that the direction of both long and short-term causality is from income to exports. This result is hardly surprising as, for most of the period covered, Bangladesh has followed an inward-looking strategy of development that discriminated against exports.

In the year 2008, Parves Sultan has worked on the topic 'Trade, Industry and Economic Growth in Bangladesh' where he has found that there is co-integration and long run relationship between GDP and industry value added in the bivariate co-integration test. They also perform causality tests which show that only import and/or export cannot contribute to the economic growth unless industrial sector is taken into account.

Earlier, Haydory Akbar Ahmed and Md. Gazi Salah Uddin (2009) have worked on the causal nexus between export, import, remittance and GDP growth for Bangladesh using annual data from 1976 to 2005. They have found in their workings that limited support in favor of export-led growth hypothesis for Bangladesh as exports, imports and remittance cause GDP growth only in the short run. To establish their research, they have collected the information from various renowned sources like UN Statistical Division website, Bangladesh Economic Review (2005) etc. All the workings they have been performed by the values of data in Logarithmic form as this transformation can reduce the problem of heteroscedasticity (data with a different dispersion) as log transformation compresses the scale in which the variables are measured (Gujrati, 1995).

In the year 2009, International Journals of Economics and Finance has published a paper of Jasim Uddin on the topic 'Time Series Behavior of Imports and Exports of Bangladesh: Evidence from co-integration Analysis and Error Correction Model' where he has worked on Johansen Co integration test which reveals long run equilibrium relation between the two variables export and import of Bangladesh.

Mohammad Mafizur Rahman (2010) has worked on the factors that affect the Export of Bangladesh using the Gravity Model analysis which reveals the main contributors to Bangladesh Export are exchange rate, partner nations total import demand and the openness of the Bangladesh economy. They have used panel data methodology for their empirical gravity model of export trade and in their estimation, they have used unbalanced panel data, and individual effects are included in the regressions.

Md. Moniruzzaman, MahamudulMannan Toy and A.B.M. RashedulHasan (2011) have researched on the Export Supply Model of Bangladesh using an Application of Co integration and Vector Error Correction Approaches. They have empirically tested the hypothesis, long run relationship and casualty between variables of the model. The VECM estimation shows the dynamics of variables in the export supply function and the short run and long run elasticity of export supply with respect to each independent variable. The error correction term is found negative which indicates that any short run disequilibrium will be turned into equilibrium in the long run. (Taken from International Journal and Financial Issues)

In 2012, IGC (International Growth Centre) published a paper on Export Dynamics in Bangladesh where Jonathan Eaton, James Tybout, Kala Krishna Bee Yan Aw and Andrés Rodríguez-Clare mentioned that successful economic development is invariably associated with growth and diversification of export-oriented industries. This study seeks to collect and analyze sources of data that illustrate the evolution of Bangladeshi exports over the last four decades and identify opportunities and challenges for future growth. Bangladesh's success in expanding apparel exports is unlikely to continue over the next decade. Therefore, Bangladesh should examine policies to encourage industry upgrading in apparel and diversification into their industries and countries. The main advantage Bangladesh has had in apparel is low wages, as opposed to high productivity. However, recent pressure for wage increases and unionization are halting this. There is not much evidence of a long-term trend toward quality upgrading or movement into more sophisticated products or into major new markets. Export diversification, as seen in Korea for example, is neither seen nor guaranteed. Despite accumulation of skills and knowledge, market and institutional failures imply that the emergence of new export industries is not as natural as it might seem.

Moreover, Md. TareqFerdous Khan and NobinkhorKundu (2012) have worked on the future contribution of Export and import to the value of GDP by using the records of past three decades. Their research provides an inconceivable growth of GDP, Export and Import for the year 1981-2010 (analyzed data by Box-Jenkins). They have used the data from "The World Development Indicators" published by the World Bank on April, 2011. They have used the Graphical representation to show the trend and growth of the indicators (export, import, GDP) and the major outcome of their paper is related to the forecasting of the indicators for the future. They

have chosen the Autoregressive Integrated Moving Average (ARIMA), the popular method and also widely known as Box-Jenkins Methodology (Box-Jenkins, 1976) to forecast the three-different series.

Muhammad. ShariatUllah and Farida Yeasmeen in 2014 have worked on 'FDI and Export Linkage revisited: The Case of Bangladesh', here they have discussed empirical research examines the export effect of foreign direct investment (FDI) with reference to Bangladesh economy. An export supply function extended with the FDI variable has been employed with board data. Econometric estimations unveil clear-cut contribution of inward FDI to boost export. Thus, this study ascertains that FDI and export are positively related to each other which mean trade and factor flows act as complements. Under such circumstance, higher growth of FDI will promote export growth.

Then, Mushfica Akhter (2015) have worked on the Impact of Export and Import on Economic Growth in Bangladesh where she has tried to show the positive impact of Export on Economic Growth and the opposite scenario for the import as well. To sum up her workings to the Impact of Export and Import on Economic Growth she has performed the following tasks which are necessary that is, find out the relative importance of the determinants of import and estimate an idea of the nature and relative importance of determinants of export. She has examined the export-growth nexus and import-growth nexus and investigates into the relationship between export, import and economic growth.

In the Bangladesh Journal Tariff and Trade (2015), Md. Abu Musa has written Export related compliance (Bangladesh perspective) provides a competitive advantage and facilitates access to export markets with the aim of one standard and one certificate which is globally recognized. In LDCs export related compliance is a crucial issue which is closely involved with employment generation, poverty reduction, economic growth and overall socio-economic development. Absence or deficiency of export related compliance may cause serious relegation of export because of non-confidence of the importing countries. This writing is an initiative to search out information about this issue.

Md. Khairul Islam and Md. Elias Hossain (2015) have published a paper on topic 'Domestic Demand, Export and Economic Growth in Bangladesh: A Co integration and VECM Approach'. Using co integration and error-correction mechanism techniques, this paper investigated the

causal relationship between domestic demand, export and economic growth using data pertaining to Bangladesh's final household consumption and government consumption as a measure of domestic demand, real exports, and real GDP over the period 1971–2011. It is found that final household consumption, final government consumption and export influence short-run and long-run economic growth. Thus, there is a dynamic relationship among domestic demand, export, and economic growth in Bangladesh. Moreover, economic growth in Bangladesh has an impact on its domestic demand and exports in the short-run, but in the long-run economic growth has an impact on final household consumption only.

In the year 2016, A.T.M. Adnan, AbdurRakib and Mizanur Rahman have worked on the topic 'Export trend of Bangladesh: the dominance of Ready-Made Garment Industry' which shows the absolute dominance of RMG as export items on other sectors. Since its inception in early 80's, it has established itself as a major source of export income for Bangladesh. Their study has conducted to identify different dimensions of export performance of Bangladesh primarily focusing on the ready-made garment industry of Bangladesh. They have used secondary sources for their research. The study reveals the absolute dominance of RMG sectors over other sectors of the country as its share is almost 81% of the export earnings (24.49 billion USD of RMG export earnings within 30.19 billion USD of total earnings from export in fiscal year 2013-14). Where export was 6.9 billion USD after the end of Multi Fiber Agreement (MFA) in 2005, the export income rose to 11.8 billion USD in 2008. The sector proves its competitiveness against the global and domestic challenges such as world recession, non-tariff barriers, domestic political violence, and compliance pressures as the sector had a turnover of 19.2 billion USD in 2011 and 24.5 billion USD in 2014 (regardless of world recession). The study shows that the EU (as a zone) has been the biggest market with 55% of the total RMG export earning followed by the United States (as a single country market) holds 23% and 14% of the total exports of Bangladesh exported to emerging markets such as, Australia, Brazil, China, Japan and South Africa. The study also reveals that Bangladesh has been mainly exporting low value-based products almost 80% and its high dependency on the EU and USA market. Both product and market diversification are needed for the sustainability of this industry. New markets such as Japan, Russia, and Brazil can be lucrative destination with both high and low value ended products. Cohesive actions from both government and entrepreneurs can ensure a luminous future for this industry.

Also, in 2016, Shapan Chandra Majumder and Md. MasudRana have worked on topic 'Trade Liberalization and Its Effects on the Economic Growth of Bangladesh: An Empirical Analysis' where it has been showed that the effectiveness of the trade policy on Bangladesh economy between the periods 1990 to 2010. This research analyzes the achievements of the economy regarding the important variables such as growth of GDP, export, import, exchange rate, terms of trade, and foreign reserve after the trade liberalization in 1990s. The study demonstrates that the inward policy of the trade liberalization reduces the import while the forward policy increases the employment, production, and export. Finally, liberalization policy improves overall economic indicators as GDP per capita, FDI, and remittances have been growing up since pre-liberalization. The study shows that both export and import have increased noticeably since liberalization, with import rising faster than export in the period immediately after liberalization.

In the year 2017, a paper is presented on the topic 'Consequences of Export on GDP of Bangladesh' by Dr. Md. Rafiqul Islam and MohaiminulHaque in the conference '1st International Conference on Business and Management' where the export growth rate and its impact on GDP of Bangladesh has been discussed.

Moreover, a paper published in 2018 title 'The Trend of Export and its consequences to GDP of Bangladesh' in Journal of Social Science and Humanities written by Dr. Rafiqul Islam and MohaiminulHaque where the mathematical method has been discussed to explain the export scenario of Bangladesh and to show the consequences on its GDP.

Also, in 2018 a paper titled 'The success of Export and its impact on GDP of Bangladesh' published in International Journal of Investment Management and Financial Innovations written by Dr. Mohammad Rafiqul Islam and MohaiminulHaque where Geometric method has been used to explain the growth rate of Export along with the Arithmetic method for comparison.

Other than above mentioned methods for the growth rate and forecasting there are also many renowned models by Principle of Least Squares like a straight-line method, second degree parabola, k^{th} -degree polynomial, Exponential curves, second degree curve fitted to logarithms etc. Here, for the growth rate calculation and forecasting Arithmetic method, Geometric method, Exponential method, Least-square regression method and parabolic method have been applied on data from 1990 to 2017. By applying these models to find the best suitable model for the original

data then with these models we have calculated the growth rate of Export and try to forecast the estimate value of total export for the next three years (2018-2020).

3. Methodology

The export data (secondary data) of Bangladesh for last 27 years have been collected from the website and library of Bangladesh Bank and Bangladesh Bureau of statistics respectively. After the collection of the data, a graph has been plotted to observe the pattern of overall export for this period. Then, applied three renowned mathematical methods to calculate the overall growth rate, r and by using the value of r (different value for each method) the export value of each year have been forecasted by considering the immediate previous year as base year like to forecast the value of 1991 we consider 1990 as the base year, for 1992 considering 1991 as the base year and so on. By using the three different value of r the export of Bangladesh has been forecasted and found all three methods results are very close to each other graphically. For this to make distinguish among them an error calculation renowned method named RMSE (Root Mean Sum Squared Error) has been used which helped to select the best fitted method/ model to express the export of Bangladesh.

Methods to calculate overall growth rate and forecast

3.1.Geometric growth rates:

Geometric growth rate is widely used for indicators on economic phenomena, such as GDP or trade (Kakwani, 1997,Mawson, P, 2002). For all international trade time series, the geometric growth rates are used (World Bank, 2015). Geometric growth rates are used for all indicators in all statistical publications and the online statistical database (ESCAP, 2015). The geometric growth rate represents compound growth over discrete periods, where the changes between two periods differ by a constant ratio. The formula to measure the average growth rate of the values say $Y_0, Y_1, \dots \dots Y_n$ over the period of n is:

$$r = \left(\frac{Y_n}{Y_0}\right)^{\frac{1}{n}} - 1$$

Where:

r = the growth rate over the year n

Y_n = the value at end year n

Y_0= the beginning year value

n = the number of periods between the beginning period and the end period (that is n-0=n)

To get the percentage growth rate then it will be multiplied by 100.It is noted that for 1-period interval geometric and arithmetic growth rates are equal, as the arithmetic and geometric formulae become equal.

The geometric growth rate formula is derived from the compound growth formula of

$$Y_n = Y_0(1 + r)^n$$

If the starting year and ending year is considered as Y_1 and Y_n respectively, the geometric growth rate for the values $Y_1, Y_2, \ldots \ldots Y_n$over the period of (n-1) will be

$$r = \left(\frac{Y_n}{Y_1}\right)^{\frac{1}{n-1}} - 1$$

n -1= the number of periods between the beginning period and the end period (that is n-1)

Like the arithmetic growth rate formula, the geometric growth also considers only the first and last observation of the time series, and not the intermediate values.

Geometric growth rate is widely used for indicators on economic phenomena, such as GDP or trade (Kakwani, 1997; Mawson, 2002; OCED, 1997; The World Bank, 2015)

3.2.Exponential growth rates:

The other function that can be used to calculate the growth rate is the exponential growth method. If the value in time grows (or decays) continuously over a period of time then a continuous change model for exponential growth can be used. Exponential growth rate method represents the limiting case of compounding; that is the compounding takes place continuously (the variable grows at a constant rate at every infinitesimal of time) (ESCAP, 2015).

The exponential growth rate is derived from the general model of exponential growth:

$$Y_n = Y_0 e^{nr}$$

Thus, the exponential growth rate r is calculated as:

$$r = \ln\left(\frac{Y_n}{Y_0}\right)/n$$

To get the percentage growth rate then it will be multiplied by 100. This exponential model can be used to predict population during a period when the growth of a population is continuous (OCED, 1997 & The World Bank, 2015). This method takes into account only the first and last value of the time series, and not the intermediate values like the arithmetic and geometric growth rates. Exponential growth rate will not correspond to the annual growth rate measured at one-year interval such as arithmetic or geometric rates do.

3.3.Least-squares Regression (log-linear) growth rates:

One common approach to measuring growth rates is the Least Squares or Ordinary Least Squares (OLS) approach. In fact, Kakwani (1997) notes that this is the most commonly used procedure for estimating growth rates. The regression method takes into consideration to all data points in the series; thus, it is the least likely to be biased by a randomly high or low beginning or ending year (The Treasury, 2002).

It is also known as log-linear least squares regression method as the time trend equation is obtained through a logarithmic transformation of the compound growth equation:

$Y_t = Y_0(1 + r)^t$

Where Y_0 is the value of the variable Y at time 0 (beginning year); Y_t is the value of the variable at time t and t is the time taking values 0.1, 2, ….n; and r is average growth rate over the n-period time series.

Taking natural logs on the both sides of the equation

$\ln Y_n = \ln Y_0 + n \ln(1 + r)$

Letting $\alpha = \ln Y_0$ and$\beta = \ln(1 + r)$, and adding a disturbance term ε, the equation becomes

$\ln Y_t = \alpha + \beta t + \varepsilon$

Where, t = 0, 1, 2 …n

Then regressing $\ln Y_n$ on time t by the Ordinary Least Squares (OLS) method, we obtain an estimate of the slope coefficient $\hat{\beta}$ and thus the compound rate of growth by regression method is obtained as follows**:**

$r = e^{\hat{\beta}} - 1$

Or, $r = \exp(\hat{\beta}) - 1$

To get the percentage growth rate then it will be multiplied by 100.

The regression growth rate is an average rate and is representative of the available observations over the entire period. It does not necessarily match the actual growth rate between any two periods. The least-squares growth rate can be used for any type of indicators as it does not assume any pattern of growth (Kakwani, 1997; Mawson, 2002; OCED, 1997; The World Bank, 2015).

Then, with the help of these values of r (least square method, geometric and exponential method) multiplied by 100 to convert into percentage the total export of Bangladesh has been forecasted and comparing between the forecasted and the original export value by the graph plot respectively.

4.Results and Analysis

With the above-mentioned method, a comparison is tried to do between the original export amount and the forecasted export amount to find a model to define the export of Bangladesh. For this, Least Square Regression, Exponential and Geometric method have been used.

4.1.Least Square Regression Method

In the data table, it is observed that there is frequent fluctuation between the original and forecasting value with small differences. Sometimes, the forecasting value is very accurate with the original value. For the forecasting, the overall export growth rate is calculated with the derived formula of least square regression method. Then, by using this growth rate value,r = 16.05% forecasting has been done from year to year (year wise) by considering the immediate previous year as the base year suppose, to calculate the forecasted value of the year 1991, the year 1990 is considered as the base year, similarly, to calculate forecasted value of 1992, the 1991 is considered as base year and so on upto year 2017.

Table1: Forecasting the export using least square regression

period	fiscal year	time,n	Total export (fob)(Croretk)	forecasting export (least square regression)
1989-1990	1990	0	5004	
1990-1991	1991	1	6125	5807.142
1991-1992	1992	2	7522	7108.0625
1982-1993	1993	3	8800	8729.281
1993-1994	1994	4	9799	10212.4
1994-1995	1995	5	13130	11371.7395
1995-1996	1996	6	13857	15237.365
1996-1997	1997	7	16564	16081.0485
1997-1998	1998	8	20393	19222.522
1998-1999	1999	9	20851	23666.0765
1999-2000	2000	10	24923	24197.5855
2000-2001	2001	11	32419	28923.1415
2001-2002	2002	12	30934	37622.2495
2002-2003	2003	13	33242	35898.907
2003-2004	2004	14	40581	38577.341

2004-2005	2005	15	50835	47094.2505
2005-2006	2006	16	62601	58994.0175
2006-2007	2007	17	78931	72648.4605
2007-2008	2008	18	87022	91599.4255
2008-2009	2009	19	97498	100989.031
2009-2010	2010	20	102148	113146.429
2010-2011	2011	21	144431	118542.754
2011-2012	2012	22	180313	167612.2485
2012-2013	2013	23	189437	209253.5429
2013-2014	2014	24	212915	219841.4559
2014-2015	2015	25	226522	247087.3293
2015-2016	2016	26	236802	262879.0811
2016-2017	2017	27	239656	274808.721
overall growth rate (over 27 years), r (regression method)				**0.160466724 =16.05%**

This method is used to plot the graph for the analysis of forecasted value and the original value by comparing the graph to determine the best fit graph model to explain the Total Export of Bangladesh. **Accordingly, the graph has been plotted below**:

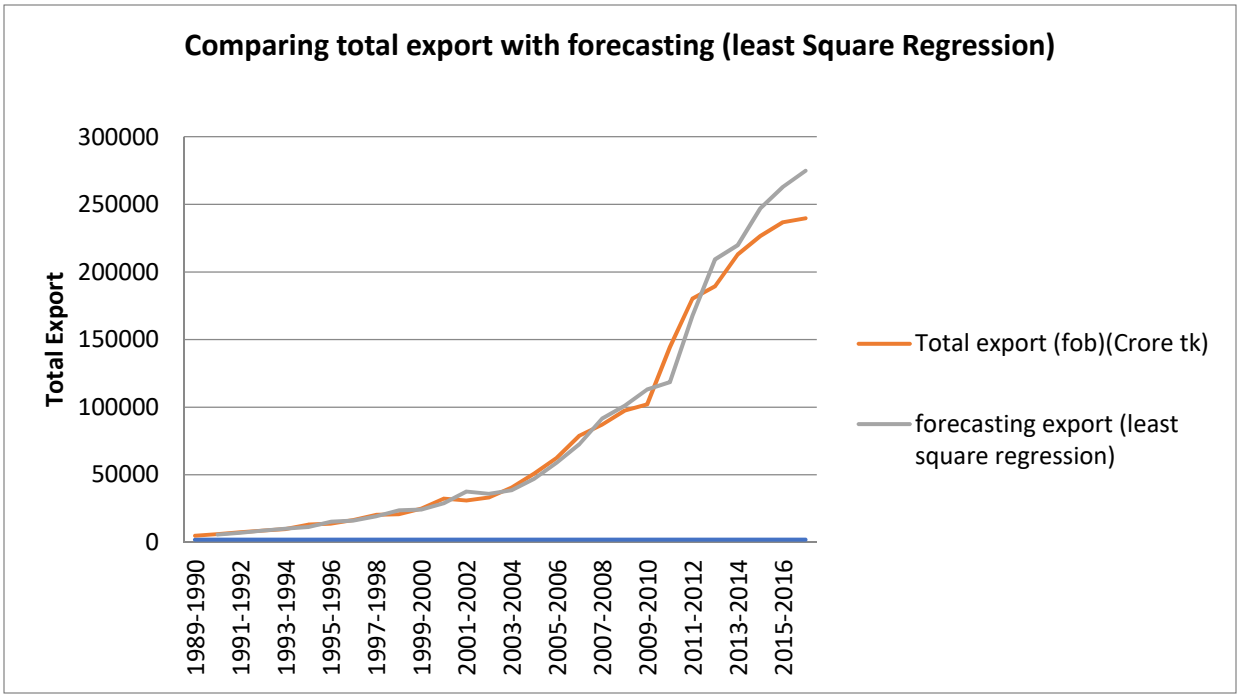

Figure1: *Comparing Export with Least Square Regression Method*

From the graph, it is observed that throughout the last twenty 27 years, total export has been increased which is very similar to the forecasted value of this method with slight fluctuation in the fiscal year 2011, 2014 and in 2017 fluctuation is slightly high that is, the forecasted value is slightly higher than the original one. But from 1990 to 2011 the value of both actual data and forecasted are very accurately estimated by this method.

4.2.Geometric Method

Here, the data and the forecasted value by this method have been displayed to observe the numerical fluctuation between the actual and the estimated one. Differences are very low in this method like the previous one. For this method, similarly, the overall growth rate, r = 15.4% is calculated by using the derived formula from general formula of geometric method. With the help of this value, the forecasted value from year to year (year wise) is calculated in this method by considering the immediate previous year as the base year like the previous method (for 1991 the base year is 1990 and for 1992 the base year is 1991 and so on).

Table2: Forecasting using Geometric method

period	fiscal year	time,n	Total export (fob)(Croretk)	forecasting export (geometric method)
1989-1990	1990	0	5004	
1990-1991	1991	1	6125	5775.1164
1991-1992	1992	2	7522	7068.8625
1982-1993	1993	3	8800	8681.1402
1993-1994	1994	4	9799	10156.08
1994-1995	1995	5	13130	11309.0259
1995-1996	1996	6	13857	15153.333
1996-1997	1997	7	16564	15992.3637
1997-1998	1998	8	20393	19116.5124
1998-1999	1999	9	20851	23535.5613
1999-2000	2000	10	24923	24064.1391
2000-2001	2001	11	32419	28763.6343
2001-2002	2002	12	30934	37414.7679
2002-2003	2003	13	33242	35700.9294
2003-2004	2004	14	40581	38364.5922
2004-2005	2005	15	50835	46834.5321
2005-2006	2006	16	62601	58668.6735
2006-2007	2007	17	78931	72247.8141
2007-2008	2008	18	87022	91094.2671
2008-2009	2009	19	97498	100432.0902
2009-2010	2010	20	102148	112522.4418
2010-2011	2011	21	144431	117889.0068
2011-2012	2012	22	180313	166687.8897
2012-2013	2013	23	189437	208099.538
2013-2014	2014	24	212915	218629.0601
2014-2015	2015	25	226522	245724.6763
2015-2016	2016	26	236802	261429.3386
2016-2017	2017	27	239656	273293.1882
overall growth rate (over 27 years),r(geometric method)				**0.154070322 = 15.41%**

Similarly, this method is also used to plot a forecasted view of total export comparing with the original one graphically. **The graph has been displayed below:**

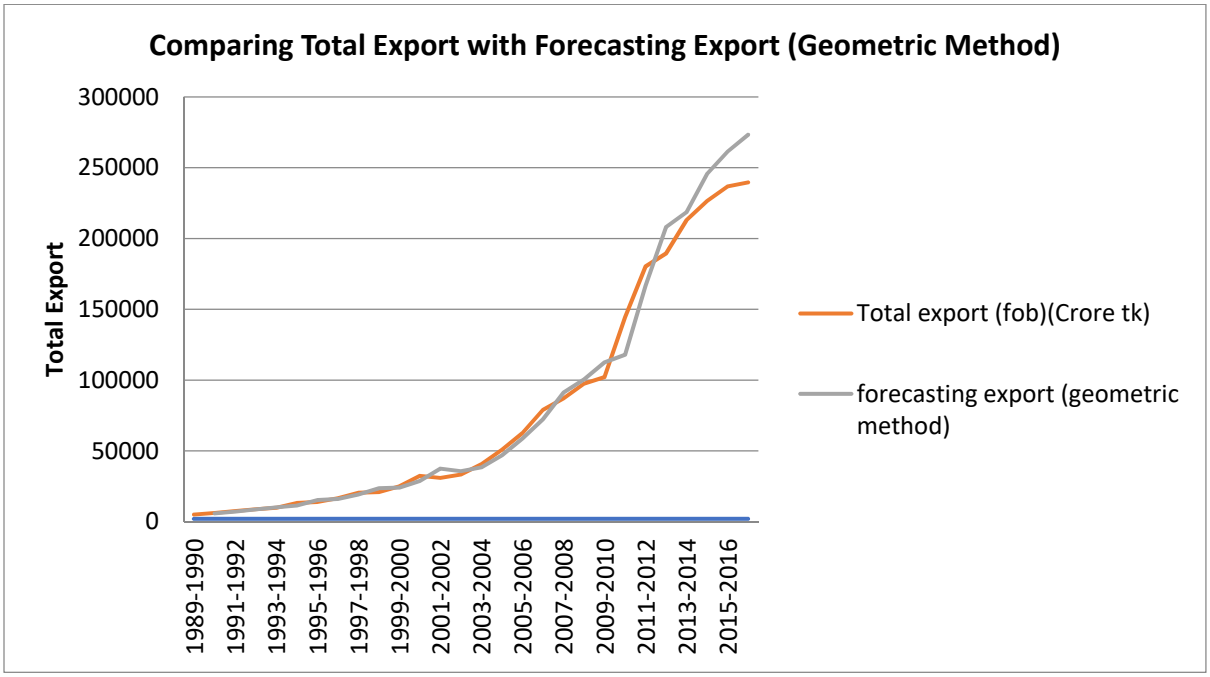

Figure2: *Comparing Export with the Geometric Method*

This graph also shows a very similar kind of pattern like the previous method. Here, are also some fluctuations between the estimated and original value that is sometimes the forecasted value is higher or lower than the original value. Specially, in 2017 this method also has similar kind of high fluctuation as the least square regression method.

4.3.Exponential Method

Moreover, the Exponential Method is also examined for the forecasting to compare the original data to decide the most reliable method to explain the Total Export of Bangladesh. Then, the value of overall growth rate, r = 14.3% is used to calculate the forecasted value which is given below:

Table3: Forecasting using Exponential method

period	fiscal year	time,n	Total export (fob)(Croretk)	forecasting export (exponential method)
1989-1990	1990	0	5004	
1990-1991	1991	1	6125	5772.68663
1991-1992	1992	2	7522	7065.888411
1982-1993	1993	3	8800	8677.487776
1993-1994	1994	4	9799	10151.80702
1994-1995	1995	5	13130	11304.26784
1995-1996	1996	6	13857	15146.95752
1996-1997	1997	7	16564	15985.63522
1997-1998	1998	8	20393	19108.46949
1998-1999	1999	9	20851	23525.65916
1999-2000	2000	10	24923	24054.01457
2000-2001	2001	11	32419	28751.53255
2001-2002	2002	12	30934	37399.02635
2002-2003	2003	13	33242	35685.90892
2003-2004	2004	14	40581	38348.45103
2004-2005	2005	15	50835	46814.82736
2005-2006	2006	16	62601	58643.98978
2006-2007	2007	17	78931	72217.41721
2007-2008	2008	18	87022	91055.94093
2008-2009	2009	19	97498	100389.8353
2009-2010	2010	20	102148	112475.1001
2010-2011	2011	21	144431	117839.4073
2011-2012	2012	22	180313	166617.759
2012-2013	2013	23	189437	208011.9841
2013-2014	2014	24	212915	218537.0761
2014-2015	2015	25	226522	245621.2923
2015-2016	2016	26	236802	261319.3472
2016-2017	2017	27	239656	273178.2053
overall growth rate(over 27 years), r (exponential method)				**0.142851361 = 14.3%**

After the data information, these are displayed in the plotting to see the pattern graphically.

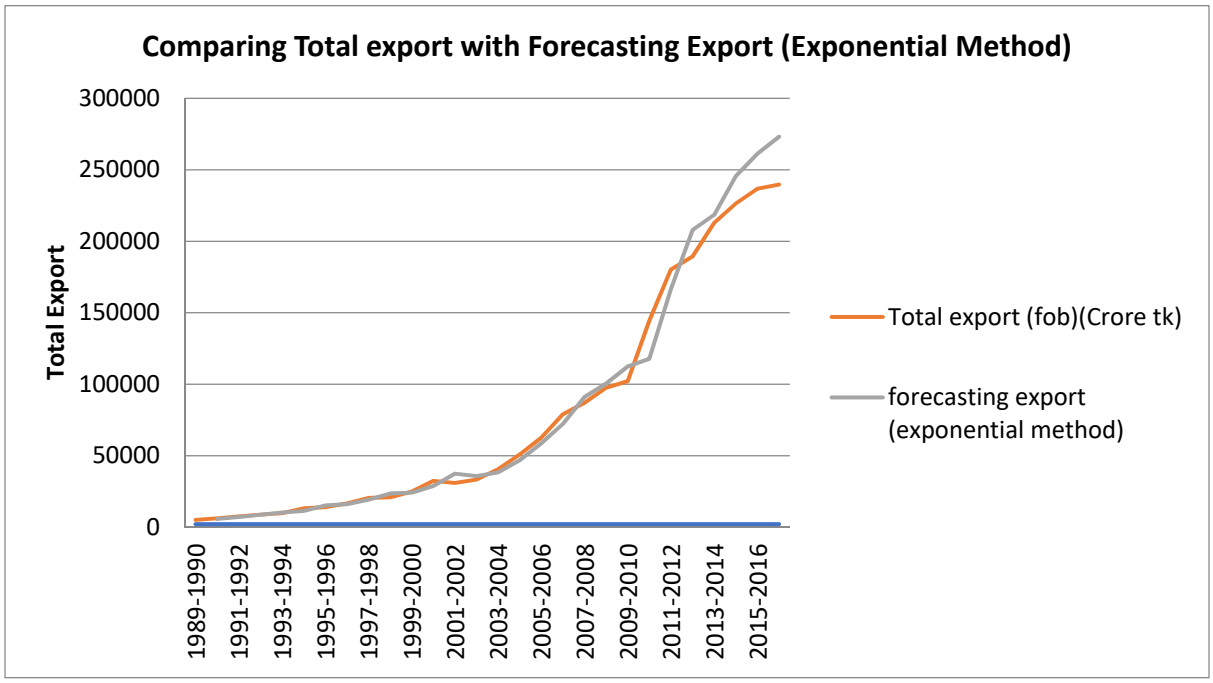

Figure3: *Comparing Export with the Exponential Method*

Finally, the last method shows approximately the same picture of previous two methods which means all three methods are giving very similar patterns with slight changes. So, for deciding the best method of explaining the export of Bangladesh we need to go for mathematical calculation.

Approximately, all three methods are very similar to each other. So, for the final decision Mathematical calculation has been done which gives more precious result.

4.4 Errorcalculations for analysis

Graphical views of all three methods are very similar, so, to decide the best method it is more effective to calculate the error of each method. In which method, error is the least amount that one is the best method among the used three methods.

For the mathematical error calculation there are many methods are available and they are:

- Mean sum squared error

- mean absolute error (based on median)
- Hodges's estimator
- James-Stein Estimator
- Mean percentage error
- mean square quantization error
- mean square weighted deviation
- mean squared displacement
- mean squared prediction error
- minimum mean squared error estimator
- peak signal- to- noise ratio
- root mean square deviation
- squared deviation

For the analysis, from the above-mentioned methods therootmean sum squared error method has been selected for the calculation of the error as it is well renowned method with its accuracy.

Done statistics, those intend squared slip (MSE) or intend squared deviation (MSD) from claiming an estimator (of a methodology to estimating a surreptitiously quantity) measures the normal of the squares of the errors alternately deviations—that is, those distinction between those estimators and the thing that is evaluated. MSE is a danger function, relating of the wanted worth of the squared slip misfortune alternately quadratic misfortune. The contrast happens due to arbitrariness alternately a direct result the estimator doesn't represent majority of the data that might prepare an additional exact gauge.

The MSE may be a measure of the personal satisfaction of an estimator—it is dependably non-negative, also values closer to zero need aid exceptional.

The MSE will be the second minute (about the origin) of the error and along these lines incorporates both those difference of the estimator also its inclination. To an impartial estimator, those MSE is the difference of the estimator. Similar to the variance, MSE need the same units from claiming estimation likewise those squares of the amount being assessed. For a similarity should standard deviation, taking the square root for MSE yields the root-mean-square slip alternately root-mean-square deviation (RMSE or RMSD), which need those same units similarly as the amount constantly estimated; for an impartial estimator, the RMSE may be those square root of the variance, known as the standard deviation.

Those MSE assesses the caliber of an estimator (i.e. a numerical capacity mapping an example from claiming information to a parameter of the populace from which the information is sampled) or a predictor (i.e. a work mapping discretionary inputs with an example about values for a portion irregular variable). Meaning of an MSE contrasts as stated by if one may be describing an estimator or a predictor, i.e. MSE= $\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$

If $\widehat{Y}_i$is a vector of n predictions, and y is the vector of observed values of the variable being predicted, then the within- sample RMSE of the predictor is computed as:

RMSE = $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y_i - \widehat{Y}_i)^2}$

Where,

n = number of year

Y_i **= Original Export**

$\widehat{Y}_i$**= Forecasted Export**

If the starting year and ending year is considered as Y_1 and Y_n respectively, the formula RMSE for the values $Y_1, Y_2, \ldots \ldots Y_n$over the period of (n-1) will be

RMSE= $\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2}$

Now, for all three methods the following data and the RMSE value calculation has been performed to decide the best method to explain the export of Bangladesh is given below:

4.4.1. Least Square Regression Method

For this method, the error has been calculated by considering each year forecasting value comparing with the original one. The following table gives procedure summary:

Table4: RMSE calculation of Least Square Regression Method

period	fiscal year	time, n	Total export, Y_i(fob)(Crore tk)	forecasting export, $\hat{Y}_i$(least square regression)	$(Y_i - \hat{Y}_i)$	$(Y_i - \hat{Y}_i)^2$
1989-1990	1990	0	5004			
1990-1991	1991	1	6125	5807.142	317.858	101033.7082
1991-1992	1992	2	7522	7108.0625	413.9375	171344.2539
1982-1993	1993	3	8800	8729.281	70.719	5001.176961
1993-1994	1994	4	9799	10212.4	-413.4	170899.56
1994-1995	1995	5	13130	11371.7395	1758.2605	3091479.986
1995-1996	1996	6	13857	15237.365	-1380.365	1905407.533
1996-1997	1997	7	16564	16081.0485	482.9515	233242.1514
1997-1998	1998	8	20393	19222.522	1170.478	1370018.748
1998-1999	1999	9	20851	23666.0765	-2815.0765	7924655.701
1999-2000	2000	10	24923	24197.5855	725.4145	526226.1968
2000-2001	2001	11	32419	28923.1415	3495.8585	12221026.65
2001-2002	2002	12	30934	37622.2495	-6688.2495	44732681.37
2002-2003	2003	13	33242	35898.907	-2656.907	7059154.807
2003-2004	2004	14	40581	38577.341	2003.659	4014649.388
2004-2005	2005	15	50835	47094.2505	3740.7495	13993206.82
2005-2006	2006	16	62601	58994.0175	3606.9825	13010322.76
2006-2007	2007	17	78931	72648.4605	6282.5395	39470302.57
2007-2008	2008	18	87022	91599.4255	-4577.4255	20952824.21
2008-2009	2009	19	97498	100989.031	-3491.031	12187297.44
2009-2010	2010	20	102148	113146.429	-10998.429	120965440.5
2010-2011	2011	21	144431	118542.754	25888.30891	670204538.2

2011-2012	2012	22	180313	167612.2485	12701.01552	161315795.3
2012-2013	2013	23	189437	209253.5429	-19816.70027	392701609.5
2013-2014	2014	24	212915	219841.4559	-6926.910994	47982095.91
2014-2015	2015	25	226522	247087.3293	-20565.07079	422922136.5
2015-2016	2016	26	236802	262879.0811	-26077.08106	680014156.4
2016-2017	2017	27	239656	274808.721	-35152.521	1235699733
					$\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$	3914946280
					MSE	144998010.4
					RMSE	12041.51196

From the above calculation, by using the formula of RMSE the error has been calculated for this method, the standard error/ deviation is 12041.52.

4.4.2.Geometric Method

For this method, the error has been calculated by considering each year forecasting value comparing with the original one. The following table gives procedure summary:

Table5: RMSE calculation of Geometric method

period	fiscal year	Time, n	Total export (fob)(Coretk)	forecasting export (geometric method)	$(Y_i - \hat{Y}_i)$	$(Y_i - \hat{Y}_i)^2$
1989-1990	1990	0	5004			
1990-1991	1991	1	6125	5775.1164	349.8836	122418.5335
1991-1992	1992	2	7522	7068.8625	453.1375	205333.5939
1982-1993	1993	3	8800	8681.1402	118.8598	14127.65206
1993-1994	1994	4	9799	10156.08	-357.08	127506.1264
1994-1995	1995	5	13130	11309.0259	1820.9741	3315946.673
1995-1996	1996	6	13857	15153.333	-1296.333	1680479.247

1996-1997	1997	7	16564	15992.3637	571.6363	326768.0595
1997-1998	1998	8	20393	19116.5124	1276.4876	1629420.593
1998-1999	1999	9	20851	23535.5613	-2684.5613	7206869.373
1999-2000	2000	10	24923	24064.1391	858.8609	737642.0455
2000-2001	2001	11	32419	28763.6343	3655.3657	13361698.4
2001-2002	2002	12	30934	37414.7679	-6480.7679	42000352.57
2002-2003	2003	13	33242	35700.9294	-2458.9294	6046333.794
2003-2004	2004	14	40581	38364.5922	2216.4078	4912463.536
2004-2005	2005	15	50835	46834.5321	4000.4679	16003743.42
2005-2006	2006	16	62601	58668.6735	3932.3265	15463191.7
2006-2007	2007	17	78931	72247.8141	6683.1859	44664973.77
2007-2008	2008	18	87022	91094.2671	-4072.2671	16583359.33
2008-2009	2009	19	97498	100432.0902	-2934.0902	8608885.302
2009-2010	2010	20	102148	112522.4418	-10374.4418	107629042.7
2010-2011	2011	21	144431	117889.0068	26542.05611	704480742.5
2011-2012	2012	22	180313	166687.8897	13625.37433	185650825.5
2012-2013	2013	23	189437	208099.538	-18662.69538	348296198.7
2013-2014	2014	24	212915	218629.0601	-5714.515201	32655683.98
2014-2015	2015	25	226522	245724.6763	-19202.4177	368732845.6
2015-2016	2016	26	236802	261429.3386	-24627.3386	606505806.5
2016-2017	2017	27	239656	273293.1882	-33636.9882	1131446975
					$\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$	3668409634
					MSE	135867023.5
					RMSE	11656.20107

From the above calculation, by using the formula of RMSE the error has been calculated for this method, the standard error/ deviation is 11656.20.

4.4.3.Exponential Method

For this method, the error has been calculated by considering each year forecasting value comparing with the original one. The following table gives procedure summary:

Table6: RMSE calculation of Exponential method

period	fiscal year	Time, n	Total export (fob)(Croretk)	forecasting export (exponential method)	$(Y_i - \hat{Y}_i)$	$(Y_i - \hat{Y}_i)^2$
1989-1990	1990	0	5004			
1990-1991	1991	1	6125	5772.68663	352.31337	124124.7107
1991-1992	1992	2	7522	7065.888411	456.111589	208037.7816
1982-1993	1993	3	8800	8677.487776	122.512224	15009.24504
1993-1994	1994	4	9799	10151.80702	-352.8070232	124472.7956
1994-1995	1995	5	13130	11304.26784	1825.732157	3333297.908
1995-1996	1996	6	13857	15146.95752	-1289.957524	1663990.415
1996-1997	1997	7	16564	15985.63522	578.3647818	334505.8208
1997-1998	1998	8	20393	19108.46949	1284.530508	1650018.625
1998-1999	1999	9	20851	23525.65916	-2674.659162	7153801.632
1999-2000	2000	10	24923	24054.01457	868.9854272	755135.6727
2000-2001	2001	11	32419	28751.53255	3667.46745	13450317.5
2001-2002	2002	12	30934	37399.02635	-6465.026351	41796565.71
2002-2003	2003	13	33242	35685.90892	-2443.908915	5972690.787
2003-2004	2004	14	40581	38348.45103	2232.54897	4984274.903
2004-2005	2005	15	50835	46814.82736	4020.172635	16161788.02
2005-2006	2006	16	62601	58643.98978	3957.010225	15657929.92
2006-2007	2007	17	78931	72217.41721	6713.582789	45072193.86
2007-2008	2008	18	87022	91055.94093	-4033.940926	16272679.39
2008-2009	2009	19	97498	100389.8353	-2891.835315	8362711.49
2009-2010	2010	20	102148	112475.1001	-10327.10013	106648997.1
2010-2011	2011	21	144431	117839.4073	26591.65566	707116150.7
2011-2012	2012	22	180313	166617.759	13695.50507	187566859.2
2012-2013	2013	23	189437	208011.9841	-18575.14147	345035880.6
2013-2014	2014	24	212915	218537.0761	-5622.531197	31612857.06
2014-2015	2015	25	226522	245621.2923	-19099.03373	364773089.6
2015-2016	2016	26	236802	261319.3472	-24517.3472	601100313.5

2016-2017	2017	27	239656	273178.2053	-33522.00531	1123724840
					$\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$	3650672534
					MSE	135210093.8
					RMSE	11627.98752

From the above calculation, by using the formula of RMSE the error has been calculated for this method, the standard error/ deviation is 11627.99.

4.4.4.Comparison of RMSE

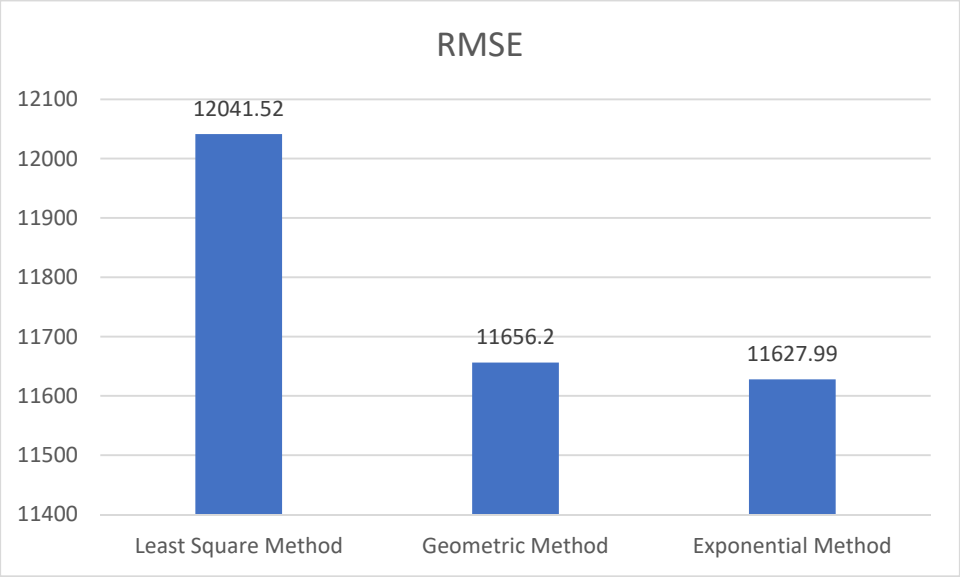

Figure 4: Comparison of RMSE

By comparing the RMSE value of three methods, it is finally decided that to explain the Bangladesh export, **The Exponential Method** is the best method among these three well known method as RMSE (standard deviation) of this method is the lowest one.

5.Conclusion

The mathematical modeling is a very essential instrument to use as an indicator in making some important decision in business world as well as in the scientific world. Similarly, in this paper three renowned mathematical models like **Geometric Method**, **Exponential Method** and **LeastSquare Regression Method** have been used to forecast the export of Bangladesh for the last **27 years.**

Firstly, some basic information of Export has been discussed in which we are gathering some important knowledge about **EPZ**. It is important for economy of Bangladesh as it helps to uplift the export for **last 27 years**. The Export of EPZ has increased at an average of **23.8%** per year from 1990 to 2017 in which share of EPZ to total export has increased from **2.22%** (1990) to **17.98%** (2016) significantly.

Moreover, it is necessary to know that Bangladesh have earned **US$ 30.3 billion in FY 2015-2016**from export in which **89% of export**(mainly RMG) goes to USA, United Kingdom, Germany and **27 members** of European Union only. This covers **almost 17.34%of GDP** of Bangladesh. For which, Bangladesh is still need to work on Globalization ability to increase their export partners to keep their export led growth.

Then, for each method **overall growth rate** is calculated which is used to forecast the export for each year. The overall growth rate for Least Square Regression, Geometric Method and Exponential Method are**16.04%, 15.4%** and **14.2%**respectively. Then, after the forecasting the comparison has been displayed graphically between the original data and the forecasted data for each year for each method. As, graphical representation for all three methods are very similar then this is why error calculation has been performed. After the error calculation analysis by **RMSE** (**Root Mean Sum Squared Error**), renowned error calculation method, Least Square Regression, Geometric method and Exponential Method, three models have been compared again using their error value **12041.52**, **11656.2** and **11627.99** respectively.

As the standard deviation (error) of Exponential Method is low compared with the other two methods named Least Square Regression and Geometric Method, therefore, it can be said that Exponential Method is the best method among this three to explain the export of Bangladesh.This exponential pattern shows the original behavior of Bangladesh Export with the help of which we can easily predict the position of Bangladesh export in the upcoming years by assuming the behavior of Exponential curve easily and less time consuming as well. As

Bangladesh Export have behaved like exponential graph, it is a good sign for export of Bangladesh because this graph indicates that something which increases with increasing rate along with the time.

6 References

[1]. Bangladesh Bank. Annual Review of Export Receipt, 2015-16.

[2] Rati Ram, “Exports and Economic Growth: Some Additional Evidence”, Economic Development and Cultural Change, Vol. 33, No. 2 (Jan., 1985), pp. 415-425, Published by: The University of Chicago Press.

[3] International Monetary Fund (IMF), 2015. World Economic Outlook 2015. IMF, Washington, DC.

[4] N. Kakwani, “Growth rates of per-capita income and aggregate welfare”, An international comparison. The Review of Economics and Statistics, 79(2): 201-211. 1997.

[5] P. Mawson, “Measuring economic Growth in New Zealand” New Zealand Treasury, Working Paper 02/14, 2002

[6] Organization for Economic Co-Operation and Development (OECD), 1997. Data and Metadata Reporting and Presentation Handbook.

[7] The World Bank, 2015a. [http://data.worldbank.org/about/dataoverview/methodologies], accessed 22 April 2015.

[8] United Nations Statistics Division (UNSD), 2015. National Accounts Statistics: Analysis of Main Aggregates, 2013.

[9] The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), 2015. STATS BRIEF, STATISTICS DIVISION, April 2015, Issue No. 07.

[10] Measuring Economic Growth in New Zealand (WP 02/14). Working Paper, 2002, Research and Policy, The Treasury, New Zealand.

[11] Bangladesh Bank “Annual Report (July 2015-June 2016)”, Published by Bangladesh Bank, 2017

[12] Bangladesh Bank, EXPORT RECEIPTS BY COMMODITIES/COUNTRIES, 2017.

[13] Bangladesh Bank, Annual Review of Export Receipt (2015-2016),

[14] K. A. Al Mamun, and H. K. Nath, “Export-led growth in Bangladesh: a time series analysis”, Applied Economics Letters, Vol.12, Issues 6, pp.361 –364. 2005.

[15] R. Kabir, “Estimating import and export demand function: The case of Bangladesh”, The Bangladesh Development Studies, 15(4), 115-127, 1988.

[16] J. Love and R. Chandra, Testing export-led growth in Bangladesh in a multivariate VAR framework”, Journal of Asian Economics, Vol. 15, Issue 6, pp.1155-1168, 2005.

[17] Z. Sattar, “Strategy for Export Diversification 2015-2020: Breaking into new markets with new Policy”, Research Institute of Bangladesh, 2015.

[18] M. Z. Haider, “Competitiveness of the Bangladesh Ready-made Garment Industry in Major International Markets”, Asia Pacific Trade and Investment Review, 3(1), 3-26, 2007, June.

[19] A. Razzaue& A. Eusuf, “Trade, Development and Poverty Linkage: Case Study of Ready Made Garment Industry in Bangladesh”, UnnayanShamannay, 2007, April.

[20] M. F Shahriar, B. P Banik& M. M. Habib, “A research framework of supply chain management in readymade garments industry of Bangladesh” International Journal of Business and Economics Research, 2014, 3(6-1): 38-44. doi: 10.11648/j.ijber.s. 2014030601.16,

[21] R.Vohra, “Export and economic growth: Further time series evidence from less-developed countries”, International Advances in Economic Research, 2001, Volume 7, Issue 3, pp 345–350.