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DRIVING FORCES OF MARINE FISHERIES AND SEAFOOD EXPORT OF BANGLADESH: AUGMENTED GRAVITY MODEL APPROACH

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ABSTRACT

Due to the gradual expansion of marine fisheries and seafood trade in the world market, marine economic sectors are emerging as an influential catalyst for the economic growth of Bangladesh as it possesses a long marine water area. This study aims at finding out the driving forces of marine fisheries and seafood export of Bangladesh. It applies augmented gravity model for a panel dataset of 40 countries of 1990-2011 and 17 countries of 2005-2011 for marine fisheries and seafood respectively and uses distance, two dummy variables namely regional trade agreement (RTA) and food safety standards (HACCP) along with some key macroeconomic variables. Some sensitivity tests have been conducted to obtain robust results. The mixed findings suggest that both RTA and HACCP have significant negative impact on the export of marine fisheries whereas RTA shows a positive impact on the export of seafood. Distance does not have a significant impact on either of the cases.

Contribution/ Originality: This study aims at finding out the driving forces of marine fisheries and seafood export of Bangladesh.

1. INTRODUCTION

In the present times, marine fisheries and seafood are playing an important role in the development of the world economy due to their increasing share in the world trade day by day. About 37% of the production value of seafood is traded internationally which is the highest among other food commodities like 9.8% of meat and 6.7% of milk and dairy products. It was estimated that 77% of world seafood production is put off to trade competition (Tveterås, Asche, Bellemare, Smith, & Guttormsen, 2012). Moreover, world fish export has also increased with an average annual growth rate of almost 7% from US $20.5 billion to US $77 billion in the 80s to 00s respectively (Mathiesen, 2012). By 2022 total world export of marine fisheries and seafood of the developing countries will contribute 68% of volume discerned to human consumption (Ahmed, 2006). If this is the situation in brief coastal countries have the opportunity to grasp the advantages from the ocean and marine sectors and they can be turned into a hub of economic development and prosperity of those countries by enhancing foreign trade.

Bangladesh has 480 km long seashore in the North and Northeast part of the Bay of Bengal. Moreover, as a seaside country, it inherits a total marine water area of about 48,365 sq. nautical miles almost as long as the total land area of the country. The Bay of Bengal Large Maritime Ecosystem Project run under the supervision of FAO in 2009 reported that marine fish and aquaculture captured by 4.5 million people from the Bay of Bengal each year is around 6 million tons. It constitutes 16% of world production and at least 20% of total production in Bangladesh (Bhuiyan & Alam, 2015). The contribution of marine sectors is only 2.5% of total export of Bangladesh, and within this portion of marine export, the shares of marine fisheries and seafood are 74% and 3.48% respectively as of 2014.

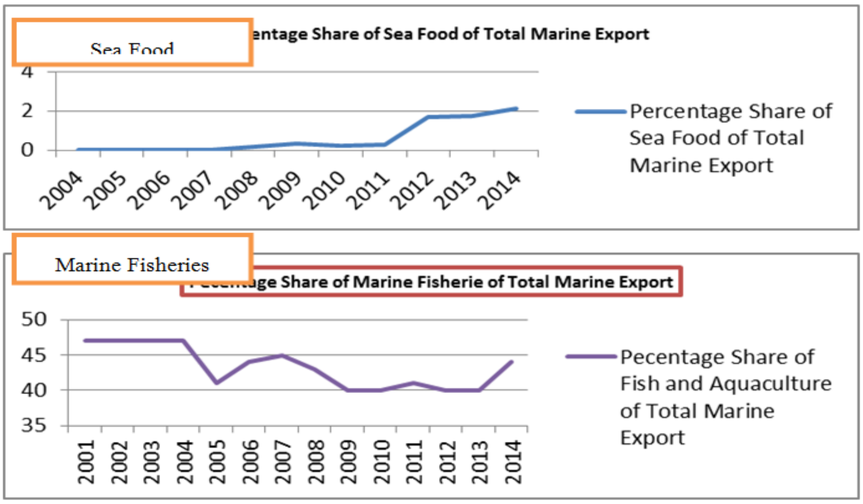
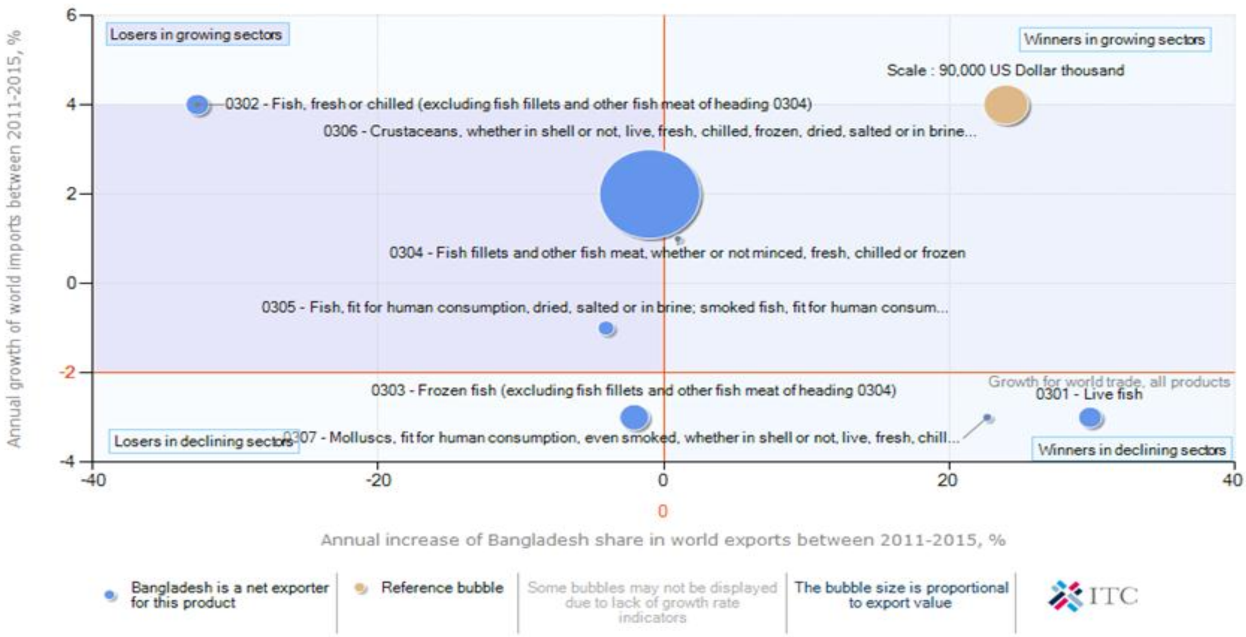


Figure-1. Percentage contribution of seafood marine fisheries sectors on total marine export.

Figure 1 and Figure 2 indicate the trends in the export situation of these two sectors from 2001 to 2015. Although marine fisheries export was in the fluctuating situation, it holds the highest share of earnings of US $671971 thousand in 2014 in total marine export. The export of this sector has decreased from US$ 636.46 million in 2011 to US$ 569.95 million in 2015 with an annual growth rate of -10.55%. On the other hand from 2011 seafood export is in increasing trend with the export earnings of US $31536 thousand in 2014. Here seafood export increased from US $4.76 million to US $13.31 million in 2011 to 2015 respectively with an annual rate of 180% which is a good sign for Bangladesh.



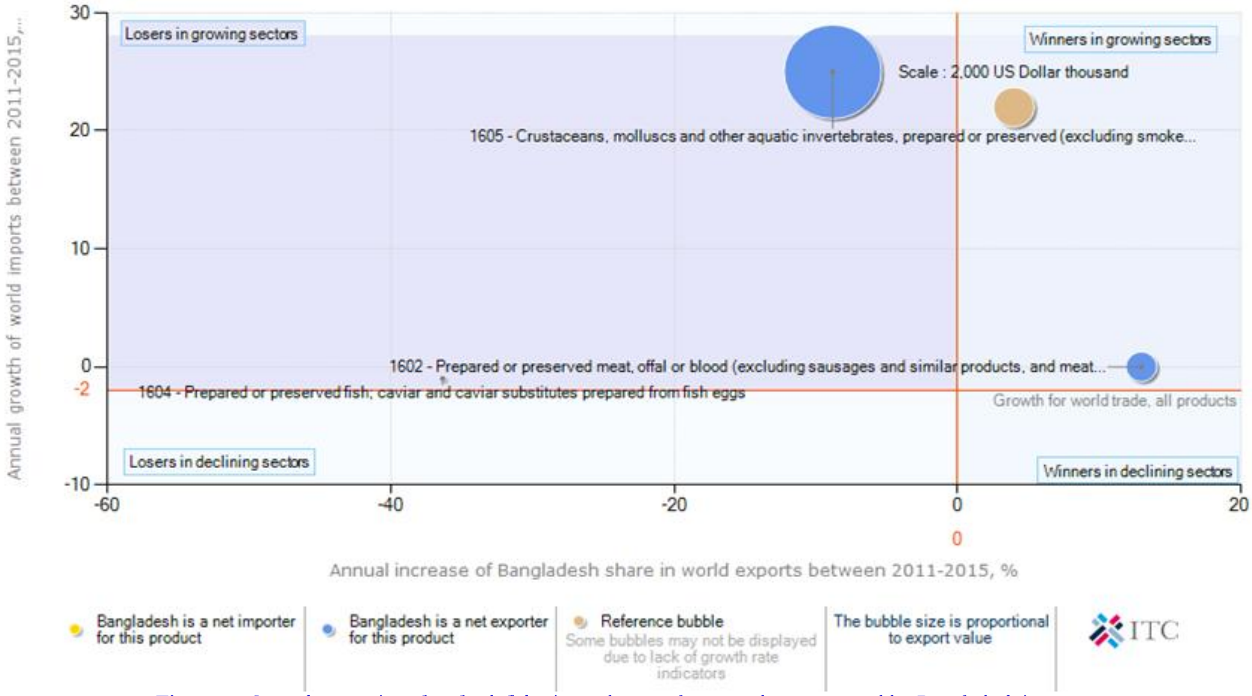


Figure-2. Growth scenarios of seafood, fisheries and aquaculture products exported by Bangladesh in 2015.

After the victory of the enormous maritime zone in 2014 which is more than 80% of Bangladesh's original land area marine-based economic activities, especially seafood marine fisheries sectors are emerging as increasingly important apparatus for the development of Bangladesh. Therefore it is important to find out the key macroeconomic variables which cause to boost the export of these two sectors. The purpose of this study is to test and find out the driving forces and their impact either positive or negative on marine fisheries and seafood export of Bangladesh.

The augmented gravity model was built-in from panel data from 1990 to 2011 assembled from different international organizations. Here seafood was considered as one individual sector and marine fisheries as another individual sector. The detailed compositions of these two sectors are given in Appendix A.

The remainder part of the report is arranged as follows: Section two discusses literature review; section three describes the methodology, data description, and estimation procedure; section four represents the results of the study followed by concluding remarks in section five.

2. LITERATURE REVIEW

To analyze international trade flows, Pöyhönen (1963) first introduced the gravity model. The key concept of gravity model is that trade flows between countries are positively related to their economic bulk. On the other hand, it is inversely associated with the geographic distance between the countries. Sometimes population; adjacency; common language; etc. are used as other explanatory variables to consider important determinants of potential trade restriction or trade facilitation.

Since its inception, gravity model has become a widely accepted instrument for empirical analysis of foreign trade flows. This model has been successfully applied to analyze the flows of trade between regions in general (Arghyrou, 2000; Breuss & Egger, 1999; Elliott, 2007; Filippini & Molini, 2003; Kangas & Niskanen, 2003; Papazoglou, 2007; Sohn, 2005) as well as trade flows of particular products (Kangas & Niskanen, 2003; Pelletiere & Reinert, 2004; Sarker & Jayasinghe, 2007). Some studies focused on identifying the effects of regional trade agreement, custom union and common market on international trade flows more specifically on trade creation or diversion (Arghyrou, 2000; Baier & Bergstrand, 2005; Bhattacharya & Bhattacharyay, 2007; Carrere, 2006; Egger, 2004; Endoh, 2010; Engelbrecht & Pearce, 2007; Fukao, Okubo, & Stern, 2002; Grant & Lambert, 2008; Kalirajan, 2007; Kang & Fratianni, 2006; Kepaptsoglou, Tsamboulas, Karlaftis, & Marzano, 2009; Kurihara, 2003; Lee & Park, 2007; Longo & Sekkat, 2004; Musila, 2005; Nowak-Lehmann, Herzer, Martinez-Zarzoso, & Vollmer, 2007; Paas & Tafenau, 2005; Park & Park, 2008; Peidy, 2005; Péridy, 2005; Roberts, 2010; Rose, 2000; Sarker & Jayasinghe, 2007; Soloaga & Wintersb, 1999; Tang, 2005; Wilson, Mann, & Otsuki, 2003) and some of the studies examined implications of trade policy and factors affecting trade flows. Because of widespread application of the model in different comprehensive studies in the last decades, it has been established as a major instrument for empirical analysis of trade flows (Augier, Gasiorek, & Lai Tong, 2005; Buch & Piazolo, 2001; Bun & Klaassen, 2007; Egger, 2008; Gopinath & Echeverria, 2004; Iwanow & Kirkpatrick, 2007; Kucera & Sarna, 2006; Martinezzarzoso & Suarezburguet, 2007; Melitz, 2005; Nitsch, 2000; Sapir, 2001).

Filippini and Molini (2003) focused only on the impacts of technological distance on trade flows between East Asian industrializing countries using the gravity equation approach. However, it did not consider the impacts of other trade variables on trade flows.

Abidin, Bakar, and Sahlan (2013) used the gravity model to find out the driving forces of export between Malaysia and OIC member countries and it indicated the consequence of size effects, economic openness of the countries, price rising rates, and the exchange rates as driving factors of Malaysia's exports to OIC countries.

Martinez-Zarzoso (2003) examined the determinants of bilateral trade flows among different trade blocs and areas, i.e., EU; NAFTA; CARICOM; CACM; MEDIT using gravity model and it found some forces like geographic proximity; income level; population; and cultural similarities have an impact on trade flows. Martínez-Zarzoso and Nowak-Lehmann (2003) conducted a study using gravity model, and they found infrastructure; income differences; the exchange rate has an impact on the bilateral trade flows.

Hatab, Romstad, and Huo (2010) found a result using gravity model that an increase in Egypt's GDP leads to a rise in Egypt's agricultural export flows, on the other hand, the increasing GDP per capita causes exports to fall. Kristjánsdóttir (2005) applied gravity model to find out the driving forces of export from Iceland, and this study concluded that size and wealth of the country does not have an impact on export but trade bloc and sector effects have an impact and in the case of marine products distance has a sensitive impact on export from Iceland.

In a recent study, Natale, Borrello, and Motova (2015) examined the influence of some macroeconomic variables on international seafood trade using gravity model and found that seafood trade is influenced by the country's preference to seafood; low labour cost of further processing; high per capita income; and production of the importing country.

However, this study does not represent any information for any individual country. Rabbani, Dey, and Singh (2011) used the augmented gravity model to show the driving forces of exporting catfish, basa and tra import of the USA from Vietnam, China, and Thailand and it concluded that population and GNI of all these countries; price of these products in the USA; country of origin and catfish labeling of exporting countries are the main forces behind the growth of trade of these products. Another study conducted by Lee. and Kennedy (2010) identified inter-product relationships between catfish and six imported seafood with co-integration analysis but these two studies did not include other factors that may have an impact on trade flows of seafood, for example, food safety standards (HACCP).

Carrere (2006) conducted a study using gravity model to show only the effects of the regional trade agreement on trade flows but no other determinants were considered there and it found there is an enormous impact of the regional agreement on increasing trade between member countries. Ligeon, Jolly, and Jackson (1996) identified that the US import demand for seafood using the double-log functional form and concluded that import price; GDP of USA; import quantity; and time trend have impact on import demand of seafood of USA.

Many studies applied gravity model to identify the impact of food safety and tariff measures on export. Anders and Caswell (2006) analyzed the impacts of food safety standards on seafood import of the USA, and this study found a negative impact of HACCP on developing countries' export of seafood whereas developed countries experienced positive effects. Some studies in the recent time (Nguyen & Wilson, 2009; Tran, Wilson, & Hite, 2013; Wilson. & Bray, 2010) utilized gravity model approach to observe the influence of food safety standards on seafood export to EU, Japan, and the USA and all of these studies were based on only one determinant ignoring other important variables.

Pace (2011) and Disdier and Marette (2010) empirically examined the impacts of tariff rates and non-tariff barriers on the export of seafood to the EU and different other countries with gravity model. Shepotylo (2016) showed the impact of nontariff barriers on the global seafood export using gravity model. Reports of Asche and Smith (2010) identified some determinants of trade flows of seafood and marine fisheries like seafood safety requirements; environmentally friendly product labeling; the demand of consumers; infrastructural development in the seafood sector; capital; tariff and non-tariff barriers; trade liberalization.

Due to the continuous expansion of the world's trade of marine fisheries and seafood day by day different coastal countries are paying their attention in the development of this sector to grasp the benefit instantly. Various factors are bearing the importance of influencing the trade of marine fisheries and seafood behind the scene as supported by Kepaptsoglou, Karlaftis, and Tsamboulas (2010) who identified that influencing forces of export and import are different for different countries or regions.

The studies presented thus far do not address the driving forces of export of both marine fisheries and seafood from a specific country perspective. Therefore a gap is noticed in explaining the influence of important trade variables which could determine the growth of export of marine fisheries and seafood of any country. Moreover, it is also a noticeable factor that Bangladesh has a high potentiality in marine sectors' export because of its long marine water zone, but no such study has ever been constructed on this vital economic sector for Bangladesh. Therefore, it is essential to analyze identifying the determinants of export of seafood and marine fisheries of Bangladesh which may open a new window for further study from different country perspectives.

3. METHODOLOGY AND DATA DESCRIPTION

This study was initiated to explore the driving forces of marine fisheries and seafood export of Bangladesh using gravity model. The first formal attempt to establish the theoretical foundation of the gravity equation from the model was made by Anderson (1979) and its application was further justified by other studies (Bergstrand, 1985; Bergstrand., 1989; Cantwell, Helpman, & Krugman, 1986). Finally, an operational model was derived by Anderson. and Van Wincoop (2016) based on manipulating the CEZ expenditure system. After that a number of empirical applications of gravity model contributed to its performance development, for example, some studies (Egger, 2000; Matyas, 1997; Wall & Cheng, 2000) improved econometric specifications, and other studies (Bergstrand, 1985; Bougheas, Demetriades, & Morgenroth, 1999; Helpman, 1987; Limao & Venables, 2001; Soloaga & Wintersb, 1999) contributed to refinement of explanatory variables. After its initiation, this model was extensively used by researchers to explain international trade flows.

Several researchers explained many reasons for emphasizing using the gravity model nowadays. Kepaptsoglou et al. (2010) argued that gravity model is a major instrument for explaining trade flows. Anderson. (2010) has recently identified gravity model as a strong instrument among the researchers due to its methodological developments. Also, many researchers used gravity model considering it as a natural method incorporating the aspect of geographical trade (Frankel, Stein, & Wei, 1997; Krugman, 1990).

According to Beghin and Bureau (2001) the model is fit for applying in case of a monopolistic competitive situation. The gravity model is also considered as important to use for ex-post and ex-ante analysis (Jayasinghe, 2003). Krugman. (1979) identified gravity model very crucial as it shows the geographical distance as a source of trade restriction to support the development of "new trade theory". As per Helpman. (1998) this model is apt mainly to explain the driving forces influencing trade flows. Moreover, Natale et al. (2015) identified that the gravity model has been applied in different studies to assess several aspects of seafood for example to assess the impact of non-tariff measures and food safety regulations on the seafood export to the US and the EU (Anders & Caswell, 2006; Disdier & Marette, 2010; Nguyen & Wilson, 2009; Pace, 2011; Tran et al., 2013; Wilson. & Bray, 2010) as well as to identify the driving forces of export of specific seafood products to the USA (Rabbani et al., 2011). Therefore gravity model can be a powerful tool to uncover the factors affecting the export of marine fisheries and seafood of Bangladesh. Here in this study, the export of marine fisheries and seafood was modeled as a function of the economic size of the partner countries, the distance between them and other factors that can either assist or impede the exports of these products.

The basic form of gravity model assumes that bilateral trade flows between countries are proportionate to the product of the economic size of the trading partners and reversely related to the geographic distance between them. According to the generalized or augmented form of gravity model of trade, the trade volume between pairs of countries is the function of their economic size; geographical distance; population; and a set of other explanatory variables and dummies that facilitate or restrict trade between partner countries.

Kepaptsoglou et al. (2010) have done a comprehensive study on the publication of the last decade which used gravity model and proposed the following standard form of gravity model equation for trade flows:

$$InExp_{ij} = \beta_0 + \beta_1 InGDP_i + \beta_2 InGDP_j + \beta_3 InPop_i + \beta_4 InPop_j + \beta_5 InDist_{ij} + \beta_6 A_{ij} + \alpha_{ij} \quad \ldots\ldots.. \quad (1)$$

Where, Exp_{ij} is the volume of trade from country i to country j, GDP_i, and GDP_j are GDP for country i and country j, Pop_i, and Pop_j are the population for country i and country j, Dij is the distance between countries i and j, A_{ij} represents any other factors aiding or preventing trade between the pairs of countries, and α_{ij} is error term.

In this study, an augmented form gravity model has been used where some other variables that assist or obstruct export of marine fisheries and seafood of Bangladesh are added to the standard form of gravity model. The model applied to this study is as follows:

$$InExp_{ij} = \beta_0 + \beta_1 InDist_{ij} + \beta_2 InGDP_i + \beta_3 InGDP_j + \beta_4 InPop_i + \beta_5 InPop_j + \beta_6 InGNI_i + \beta_7 InGNI_j + \beta_8 InCon_i + \beta_9 InProd_j + \beta_{10} RTA_{ij} + \beta_{11} HACCP_{ij} + \alpha_{ij} \quad \ldots\ldots\ldots \quad (2)$$

Here in the above regression model, i represent the countries importing marine fisheries and seafood from Bangladesh and j represent exporting country here Bangladesh.

Exp_{ij} is the volume of export; GDP denotes GDP of the countries; Pop is the number of population of all countries; GNI means GNI for importing and exporting countries; Con is the volume of consumption of marine fisheries and seafood of importing country; Prod is the volume of production of marine fisheries and seafood of Bangladesh; RTA is the dummy variable showing the presence or absence of a regional trade agreement between the countries; HACCP is the dummy variable indicating the implication of food safety regulation by the partner countries; Dist is the distance between exporting and importing countries, and α_{ij} is error term.

The variables used here were also introduced by different authors who used gravity model to identify bilateral trade flows. Most studies used export as the dependent variable to explain trade flows using gravity model (Kepaptsoglou et al., 2010). As explanatory variables GDP; distance; population are most commonly used in several studies (Filippini & Molini, 2003; Natale et al., 2015; Rabbani et al., 2011). The argument behind is that the higher GDP and population shows higher economic size of the country that results in higher trade flows. Natale et al. (2015) in identifying the determinants of international seafood trade used consumption of the importing country, production of exporting countries and their GNI as explanatory variables. Regional trade agreement (RTA) is also generally used as an explanatory variable to analyze the trade flows using gravity model. Although a number of studies relevant to this field found no clear-cut impact of trade agreement on trade flows (Endoh, 2010; Fukao et al., 2002; Musila, 2005; Roberts, 2010) the most recent study by Kohl, Brakman, and Garretsen (2013) identifies that different types of trade agreement impacts international trade differently. Moreover, a recent study regarding the determinants of international seafood trade by Natale et al. (2015) shows a significant positive impact of RTA on international trade of Seafood, fisheries, and aquaculture.

Finally considering the health risk associated with the marine fisheries and seafood products HACCP became mandatory in the USA in 1997 and followed by most of the western countries that make the export of marine fisheries and seafood difficult (Anders & Caswell, 2006). Therefore following some recent studies in the related field (Nguyen & Wilson, 2009; Tran et al., 2013; Wilson. & Bray, 2010) in this model HACCP was used as a dummy variable to show the impact of food safety standard on marine fisheries and seafood export of Bangladesh. At first, HACCP has been implemented in 1996 in Bangladesh.

This study is based on augmented gravity model which is plotted from annual data covering a period of 1990 to 2011. Here, export data of marine fisheries and seafood which is extracted from COMTRADE database. Among the explanatory variables, the production data of Bangladesh and consumption data of all importing countries were collected from FAOSTAT and all other variables represented here for both Bangladesh and all importing countries like GDP and per capita income, population, were collected from World Bank database; data on geographic distance and regional trade agreement between trading partners were assembled from CEPII and WTO (World Trade Organization) respectively.

For some countries, Bangladesh started to export marine fisheries around the year of 2000. In the Case of these countries the marine fisheries data does not cover from the year 1990 in this study. Moreover, some countries were excluded from the analysis because of the unavailability of several data, i.e., GNI, consumption. These issues make the panel data imbalanced. In the case of seafood, the scenario is different. Bangladesh started exporting seafood from 2005. As seafood data covers only the period of 2005-2011, it does not include the HACCP as a dummy variable in the regression equation of seafood export.

In this study all monetary values are in US dollars; production and consumption data in tons; the geographical distance between Bangladesh and its trading partners in km. Finally, regional trade agreement (RTA) and Hazard Analysis and Critical Control Points (HACCP) were articulated as dummy variables. Food safety standard (HACCP) was widely implemented in trading marine fisheries products in the international market since 1995. So as a dummy variable it takes zero from 1990 to 1995 and one for the rest of the years. Also in the case of RTA if there is any regional trade agreement or bilateral trade agreement between Bangladesh and the importing countries dummy variable was represented by a value of one otherwise zero.

3.1. Model Specification and Estimation Procedure

Testing for stationary is a compulsory process in analyzing panel or time series data. Use of nonstationary data in regression model gives a spurious result. Therefore, the stationary of panel data has been tested using Im-Pesaran-Shin (IPS) unit root. The result of the test for marine fisheries dataset shows that all the variables except export contain unit root. That means they are non-stationary. In the case of the seafood dataset, only population data of exporting and importing countries shows nonstationary characteristics. To solve this problem first difference of the variables was used which indicates that all these non-stationary data become stationary in their first difference.

According to Baltagi (2005) cross-sectional dependence is a problem in macro panels with long time series (over 20-30 years) but not much of an issue in micro panels (few years and a large number of cases). In this study data for marine fisheries is a macro panel (22 years and 40 countries) but data for seafood is microdata (7 years and 17 countries). Pesaran CD test was applied to test cross-sectional dependence of the two datasets. The result shows that the dataset for marine fisheries has cross-sectional dependency as expected for macro panel data. In the presence of cross-sectional dependency of panel data, Driscoll and Kraay (1998) proposed a nonparametric covariance matrix estimator that produces heteroscedasticity consistent standard errors that are robust to all forms of cross-sectional dependency (spatial or temporal). Hoechle (2007) proved Driscoll and Kraay standard errors produce significantly consistent results than those of other covariance matrix estimators in existence cross-sectional dependency in panel data, and it can be applied both in balanced and unbalanced panel data. As the dataset of marine fisheries shows cross-sectional dependence Driscoll and Kraay standard error regression has been applied. Driscoll and Kraay standard errors for coefficients can be applied for both pooled OLS/WLS and fixed effects (within) regression as proposed by Hoechle (2007). Finally, the Hausman test has been applied to decide which regression of Driscoll and Kraay (pooled OLS/WLS and fixed effects) gives a more consistent result. The result supports to use pooled OLS regression. As there is no cross-sectional dependency in the dataset of seafood as proved by Pesaran CD test standard random effect estimation procedure has been applied as per the result of Hausman test. Moreover, as two important variables of the regression are time-invariant (distance and RTA) random effect model is more consistent and efficient as suggested by Kmenta (1986).

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Analysis for Marine Fisheries

The summary statistics of the variables used in the regression equation were given in Appendix B. Table 1 represents the results of the regression model for the export of marine fisheries of Bangladesh. The below table shows both the result of Driscoll-Kraay Pooled OLS and Random-effects GLS regression for completeness in the result. As the Random-effects GLS regression model is affected by the Cross-Sectional Dependence problem that's why it does not show consistent result. Therefore the result of Driscoll-Kraay Pooled OLS is the primary source of discussion in the case of marine fisheries part of our study. However, in the analysis of the seafood sector, the result of the Random-effects GLS regression model will be discussed. Four specifications of each regression have been estimated by testing the impacts of new control variables in each step forward.

Table-1. Estimation result of the gravity model for marine fisheries.

	Driscoll-Kraay Pooled OLS Regression				Random-effects GLS regression			
Variable	**Column 1**	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**	**Column 7**	**Column 8**
Constant	1.3138 (0.082)***	3.0609 (0.012)**	.6523727 (0.775)	7.388693 (0.003)*	1.453661 (0.734)	3.153038 (0.469)	1.070059 (0.810)	7.704537 (0.927)
Distance	.8201 (0.000)*	.9033 (0.000)*	.9141972 (0.003)*	-.1157388 (0.762)	.766786 (0.505)	.8795605 (0.448)	.9288657 (0.430)	-.16004 (0.927)
GDP_i	-2.655 (0.151)	-3.6798 (0.084)***	-7.57167 (0.000)*	-8.221369 (0.003)*	-1.19058 (0.439)	-2.04065 (0.178)	-6.2542 (0.001)*	-6.896 (0.000)*
GDP_j	17.98678 (0.131)	9.0287 (0.194)	15.63423 (0.074)***	14.34088 (0.060)***	18.29588 (0.000)*	9.205419 (0.011)**	15.02766 (0.000)*	13.98075 (0.000)*
$Population_i$		17.861 (0.121)	24.73318 (0.129)	21.42335 (0.222)		21.22953 (0.298)	29.24431 (0.166)	21.06518 (0.311)
$Population_j$		-246.32 (0.003)*	-102.805 (0.347)	-300.8819 (0.003)*		261.2028 (0.000)*	-152.442 (0.018)**	-324.348 (0.000)*
GNI_i			6.196696 (0.405)	10.90632 (0.214)			9.769074 (0.061)***	12.56891 (0.016)**
$Consumption_i$			-.096587 (0.891)	-.1811695 (0.804)			.3320206 (0.539)	.2816507 (0.599)
GNI_j			45.63569 (0.269)	30.72926 (0.379)			35.15488 (0.020)**	23.96961 (0.115)
$Production_j$			-2.75337 (0.217)	-1.326083 (0.607)			-2.472017 (0.042)**	-1.24076 (0.316)
RTA Dummy				-.7664439 (0.004)*				-.7706656 (0.449)
HACCP Dummy				-1.164272 (0.030)**				-1.050399 (0.000)*
Number of observation	758	758	758	758	758	758	758	758
R^2 Overall Within Between	0.0300	0.0552	0.0696	0.0923	 0.0292 0.0403 0.0127	 0.0539 0.0838 0.0173	 0.0673 0.1062 0.0142	 0.0903 0.1305 0.0317
Prob > F Prob > chi2	0.0000	0.0000	0.0000	0.0000	 0.0000	 0.0000	 0.0000	 0.0000

Note: The table presents the results for the estimated coefficients and their p-values in parenthesis. i denotes Importing Countries and j denotes Exporting country (Bangladesh). R^2, Probability value and the number of observations are also reported. *, ** and *** denote statistically significant coefficient at 1%, 5% and 10% levels respectively.

The regression result shows that the export of marine fisheries of Bangladesh is facilitated by GDP and GNI of Bangladesh and population and GNI of importing countries whereas hindered by distance between partner countries; GDP and consumption of importing countries; exporting country' population and production as well as significantly hindered by regional trade agreement (RTA) and food safety standards (HACCP). This result of this study contradicts in some cases with a recent study made by Natale et al. (2015). The difference of the result can be because of sample selection and different macroeconomic scenarios of the countries. Natale et al. (2015) consider seafood trade between all countries of the world whereas this study deals only with Bangladesh. Moreover, the major importing countries of marine fisheries of Bangladesh are the USA and the EU so influencing factors can be different here.

These positive and negative relationships between dependent variable export and other independent variables add a robust result when some sensitivity tests have been done. In each column added control variables result in more diversifying scenarios. Column 1 of Table 1 shows the result of the basic gravity model which includes only distance and GDP of the partner countries. The results shows that the impact of distance and GDP of Bangladesh is positive and impact of GDP of importing countries is negative on export of marine fisheries of Bangladesh, whereas except the distance; GDP of both exporting and importing countries are statistically insignificant which indicates export of marine fisheries is hindered by GDP of importing countries but favored by distance and GDP of exporting countries. This result shows that if the GDP of Bangladesh grows well, that has a positive influence on the increasing export of marine fisheries and in the case of the positive impact of the distance the reason is that Bangladesh export a major portion of marine fisheries to the USA and European countries and they have a high demand for these products. As a result, distance does not play as a major hindrance to export to these countries.

Here, in column 2, the impact of the population of the partner countries was shown as new control variables on export and at the same time the consequence in case of distance and GDP. The regression result in column 2 indicates that the population of importing and exporting countries have positive but insignificant and significant negative impact respectively on the export of marine fisheries. The impact of distance; GDP of the countries remain stable. The reason behind that is the increased population of Bangladesh indicates more consumption of these products as Bengali is called as "Mache Vatha Bengali", which means people of Bangladesh prefer to take fish in every meal with rice. Moreover, in the case of importing countries, the increased population may indicate increased consumption of marine fisheries which may result in increasing import.

In column 3 GNI and consumption of importing countries and GNI and production of Bangladesh were further included as control variables. The regression result shows the positive impact of GNI and the negative impact of production and consumption on the export of marine fisheries of Bangladesh. Still, the same scenarios can be notified of the positive and negative influence of other variables. Moreover, the population of exporting countries has the same impact as in the previous model, but here it shows an insignificant impact. Here export of marine fisheries is positively associated with GNI of exporting and importing countries although both show insignificant impact.

According to Rabbani et al. (2011) marine fisheries include both luxury items whose consumption changes with the level of income as well as necessary items whose consumption is not highly influenced by the changes of income level but it changes with the level of the total population. The positive relationship between the export of marine fisheries and GNI of importing countries indicates that Bangladesh export mainly expensive marine fisheries items whose demand increases with the growth of income level of importing countries. In the same way increase in the consumption of marine fisheries in importing countries occurs because of the increased consumption of non-expensive items as a consequence of population growth. As Bangladesh usually exports expensive fisheries items consumption shows a negative relationship with the export of marine fisheries. Moreover, Bangladesh experienced a drastic fall in the export of marine fisheries since 1995 due to not implying with HACCP (food safety standard) although production level continued to grow. The importing countries can adjust their increasing consumption by importing from other countries because of the decreasing export of Bangladesh. That is why consumption shows a negative relationship with the marine fisheries export of Bangladesh. This situation was identified by Anders and Caswell (2006) who concluded that the negative effect of HACCP was experienced by the developing countries whereas its impact on developed countries was positive. This situation was identified in column 4 by adding two important dummy variables namely RTA and HACCP. As discussed before, HACCP plays a significant negative impact on the export of marine fisheries of Bangladesh. The drastic change after the inclusion of these two variables occurs in the case of the relationship between distance and export (from positive to negative). The reason behind is that Bangladesh has RTA with regionally less distant Asian countries like China; India; Sri Lanka; Pakistan; Vietnam; South Korea; and Indonesia whereas most of the exports are directed to long distant countries like the USA; the EU; Canada; Australia. So, there is an enormous negative correlation between RTA and distance (Appendix C.1). Therefore RTA changes the relationship between export and distance.

4.2. Analysis of Seafood

Table 2 set out the result of the regression model for the seafood export of Bangladesh.

Table-2. Estimation result of the gravity model for seafood.

Variable	Column 1	Column 2	Column 3	Column 4
Constant	-99.51138 (0.000)*	-158.1158 (0.000)*	-159.3314 (0.408)	-168.961 (0.380)
Distance	-.9393869 (0.331)	-.7060427 (0.577)	-1.339322 (0.387)	.2790379 (0.890)
GDP_i	1.578179 (0.000)*	1.845213 (0.000)*	3.147597 (0.000)*	3.309392 (0.000)*
GDP_j	7.853578 (0.000)*	12.01599 (0.000)*	-11.60865 (0.856)	-11.45379 (0.858)
$Population_i$		1.587561 (0.973)	-22.53715 (0.716)	-26.0783 (0.669)
$Population_j$		1729.417 (0.022)**	1827.418 (0.225)	1819.931 (0.227)
GNI_i			-.3461636 (0.726)	.2517254 (0.816)
$Consumption_i$			-1.115177 (0.128)	-1.430027 (0.061)***
GNI_j			6.529124 (0.942)	5.514898 (0.951)
$Production_j$			36.25807 (0.322)	36.60205 (0.317)
RTA Dummy				1.478961 (0.217)
Number of observation	119	102	102	102
R^2				
Within	0.1856	0.2231	0.2437	0.2445
Between	0.6503	0.6225	0.7039	0.7399
Overall	0.3222	0.3815	0.4263	0.4410
Prob > chi2	0.0000	0.0000	0.0000	0.0000

Note: The table presents the results for the estimated coefficients and their p-values in parenthesis. i denotes Importing Countries and j denotes Exporting country (Bangladesh). R^2, Probability value and the number of observations are also reported. *, ** and *** denote statistically significant coefficient at 1%, 5% and 10% levels respectively.

The result of a basic form of gravity model reported in column 1 shows distance has a negative but insignificant impact and GDP of all countries has a positive and significant impact on the seafood export of Bangladesh. These results imply that the seafood export of Bangladesh is hindered by geographical distance and favored the GDP of importing and exporting countries.

In column 2 when the population of both importing and exporting countries was added as control variables the same situation prevails in case of distance; GDP in the previous column and at the same time population of all countries favor the export of seafood while the only population of Bangladesh enters significantly between the control variables. This result indicates that increasing population in both exporting and importing countries can cause the growth of the export of seafood in Bangladesh.

The impact of the population of importing countries and the GDP of exporting on the export of seafood drastically changes from positive to negative where GDP of the exporting country becomes insignificant when GNI; consumption; and production were further included as control variables in column 3. Furthermore, among these four control variables, GNI and consumption of importing countries have a negative impact, but all of them are statistically insignificant where GNI and production of exporting countries have a positive but insignificant impact on the export of seafood.

In column 4 RTA dummy variable was controlled that shows a positive impact on the export of seafood of Bangladesh where the impact of other variables remains the same except distance. The reason behind is the same as in the cause of marine fisheries export described earlier.

The regression result of the model used in this study is supported by a recent study done by Natale et al. (2015) except for the case of distance and consumption of seafood of importing countries. Because of highly negative correlation (shown in Appendix C.2) between RTA and distance the impact of distance changes from negative to positive after including RTA dummy.

Again based on the study done by Rabbani et al. (2011) the negative relationship between the export of seafood and consumption indicates that Bangladesh exports expensive items whose export does not increase with increasing consumption. This is supported by the negative correlation between GNI of importing country with seafood export in column 3.

5. CONCLUSION

Bangladesh is a coastal country with a large maritime area as big as the country's land area. Because of the continuous growth of marine fisheries and seafood products trade in the world market Bangladesh has a high potentiality of trade in these sectors in the international market. The purpose of this study is to identify the driving forces of export of marine fisheries and seafood products of Bangladesh using augmented gravity model.

Data from 40 countries for the period of 1990-2011 and 17 countries for the period of 2005-2011 for marine fisheries and seafood respectively were used for the study. Using augmented gravity model the impact of three key variables, i.e., distance; GDP of the countries on the export of marine fisheries and seafood of Bangladesh were identified and in addition to these three key variables some more control variables were also added in different steps to bring out the diversifying dimensions in the results.

The result indicates several important points. First, from the Driscoll-Kraay Pooled OLS test it is found that marine fisheries export of Bangladesh is attracted by GDP, GNI of Bangladesh and population, GNI of all importing countries whereas all of them show statistically insignificant results at the end. Second, marine fisheries export in Bangladesh is hindered by GDP, the population of importing countries; RTA; and HACCP significantly and on the other hand also by importing countries' consumption; distance; and Bangladesh's production but insignificantly. Fourth, seafood export of Bangladesh is positively attracted by GDP, GNI of importing countries; population, production, GDP of Bangladesh; distance; RTA; and whereas only importing countries' GDP bears the significant effect on the export of seafood. Fifth, the insignificant and negative impact of consumption and population of importing countries and the GDP of Bangladesh on the export of seafood of Bangladesh can also be noticed.

Overall observations relating to the driving forces of marine fisheries and seafood export have some significant policy implications. In the case of marine fisheries export, HACCP and RTA play a crucial role. Considering the health risk related to the seafood products food safety standards called HACCP were mandatorily implemented by the USA on export and import of seafood products and consequently followed by most of the developed economies.

Bangladesh could not comply with the policy instantly which drastically affected the export of marine fisheries and seafood export of Bangladesh. Still, Bangladesh is not capable of complying with the HACCP standards efficiently, and the situation prevails till now. Another important factor is regarding regional trade agreement. A major portion of the export of marine fisheries and seafood is directed to long distant countries, i.e., the USA; The EU; Australia; Canada, etc. but the irony is that Bangladesh does not have any bilateral trade agreement with these countries. Most RTAs of Bangladesh are with the countries nearby, i.e., China; India; Pakistan; Vietnam; Indonesia; Srilanka, etc. So, proper policies should be implemented to these issues to boost the export of marine fisheries and seafood in Bangladesh. Besides attempts should be made to increase the production of these products as the potentiality of this vast water area could not be utilized for the lack of proper and efficient policies.

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Appendices

A. Detailed Description of Marine Fisheries and Seafood

- Marine fisheries products consist of the following items:

Aquatic Animals; Aquatic Plants; Crustaceans; Marine Fish; Molluscs; Aquatic Products, for example: Crustaceans; whole frozen Fish; whole fresh Fish; cured or smoked Fish, and fish meal fit for human consumption; Molluscs; Fish fillets and pieces, fresh, chilled or frozen; Live, fresh, chilled, frozen aquatic invertebrates other than crustaceans and molluscs.

- Seafood products consist of the following items:

Fish, Seafood; Shrimp; Crab, for example: Prepared/preserved Crustaceans & molluscs; Prepared or preserved meat, meat offal or blood; Prepared/preserved fish & caviar; Sausages and similar products, of meat, offal or blood; Extracts & juices of meat, fish, crustaceans & molluscs.

B. Summary Statistics

B.1 Marine Fisheries

Variable	Observation	Mean	Std. Dev.	Min	Max
Export	798	9080200	2.45e+07	0	2.17e+08
Distance	798	5964.208	2850.746	1421.938	12680.43
RTA	798	.2406015	.4277168	0	1
GNI_i	798	23425.81	16699.99	980	99740
GDP_i	798	9.32e+11	1.98e+12	5.59e+09	1.55e+13
$Consumption_i$	798	1941535	9653249	7	8.75e+07
HACCP	798	.7681704	.4222654	0	1
$Population_i$	798	1.08e+08	2.60e+08	766611	1.34e+09
GNI_j	22	1551.818	592.0958	850	2780
GDP_j	22	6.10e+10	2.77e+10	3.10e+10	1.29e+11
$Population_j$	22	1.31e+08	1.50e+07	1.06e+08	1.53e+08
$production_j$	22	223263.9	117790.3	96218	514417

B.2 Seafood

Variable	Observation	Mean	Std. Dev.	Min	Max
Export	39	363924.2	630312.6	126	3068869
Distance	119	7079.523	3408.706	2010.818	12680.43
RTA	119	.2352941	.4259761	0	1
GNI$_i$	119	30608.91	19641.41	1040	99740
GDP$_i$	119	1.68e+12	3.34e+12	6.28e+09	1.55e+13
Consumption$_i$	119	1283392	1668409	1450	7291000
Population$_i$	119	6.24e+07	7.49e+07	2263604	3.12e+08
GNI$_j$	7	2301.429	345.5637	1800	2780
GDP$_j$	7	9.41e+10	2.25e+10	6.94e+10	1.29e+11
Population$_j$	7	1.48e+08	3726790	1.43e+08	1.53e+08
production$_j$	7	2656207	358776.3	2215957	3124677

C. Correlation Matrix of the Variables

C.1 Marine Fisheries

Variable	Export	Distance	GNI$_i$	GDP$_i$	Consump$_i$	Pop$_i$	RTA	HACCP	GNI j	GDPj	Prod$_j$
Export	1.0000										
Distance	0.0831	1.0000									
GNI$_i$	-0.0271	-0.1415	1.0000								
GDPi	-0.0345	-0.1331	0.4917	1.0000							
Consump$_i$	-0.0066	0.0049	0.0260	0.0715	1.0000						
Population$_i$	0.0313	-0.2610	-0.2684	0.1066	0.0138	1.0000					
RTA	0.0313	-0.7830	0.2318	0.1325	-0.0161	0.0868	1.0000				
HACCP	0.0010	-0.0054	-0.0308	-0.004	-0.0252	0.0170	-0.022	1.0000			
GNI$_j$	0.1735	0.0073	0.2377	0.3176	0.0218	0.0708	-0.023	0.2817	1.0000		
GDP$_j$	0.1437	-0.0042	-0.0713	0.1677	0.0421	0.0301	-0.011	0.2850	0.1476	1.0000	
Production$_j$	-0.0306	-0.0032	-0.1474	-0.249	0.0269	-0.0002	0.0012	0.1877	-0.154	0.2128	1.0000
Population$_j$	-0.1970	-0.0066	0.0526	-0.166	0.0080	-0.0782	0.0332	-0.5836	-0.671	-0.459	0.0255

C.2 Seafood

Variable	Export	Distance	GNI$_i$	GDP$_i$	Consump$_i$	RTA	GNI$_j$	GDP$_j$	Prodj	Pop$_i$	Pop$_j$
Export	1.0000										
Distance	0.2346	1.0000									
GNI$_i$	0.2454	0.5610	1.0000								
GDP$_i$	0.5129	0.5750	0.6241	1.0000							
Consump$_i$	0.3650	0.3816	0.5213	0.8639	1.0000						
RTA	-0.1364	-0.8244	-0.6539	-0.459	-0.2181	1.0000					
GNI$_j$	0.3051	0.0000	0.0465	0.0643	0.0035	-0.0000	1.0000				
GDP$_j$	0.3229	0.0000	0.0454	0.0621	0.0031	0.0000	0.9952	1.0000			
Production$_j$	0.3334	-0.0000	0.0430	0.0556	0.0028	0.0000	0.9710	0.9852	1.0000		
Population$_i$	-0.2508	-0.4174	-0.0082	-0.488	-0.5777	0.1547	-0.022	-0.0230	-0.023	1.0000	
Population$_j$	-0.0897	0.0000	-0.0366	-0.044	-0.0032	-0.0000	-0.718	-0.6697	-0.661	0.0002	1.0000