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Future Contribution of Export and Import to GDP in Bangladesh: A Box-Jenkins Approach

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Abstract

The paper provides evidence of inconceivable growth of the macro-economic indicators Gross Domestic Product (GDP), Export of Goods and Services (EXPORT) and Import of Goods and Services (IMPORT) over the past three decades. The percentage of GDP occupied by each of the EXPORT and IMPORT indicator is in significant level in recent time though their contribution were little in 1981. The time series analysis by Box-Jenkins approach based on data from 1981 to 2010 indicates that the growth of the indicators will continue in the future. The forecasted GDP demonstrate the huge expansion of the different sectors within the country by 2015. The future contribution of EXPORT in GDP demanded that EXPORT will be the significant contributor in the country's economy. On the contrary, a significant percentage of GDP will continue to be used for import of goods and services in future.

Key words: ARIMA Model, Growth, Trade Deficit

1. Introduction

The Gross Domestic Product (GDP), Export of Goods and Services (EXPORT) and Import of Goods and Services (IMPORT) are the most important macro-economic indicators for a country. These indicators are the integral part of the total developmental effort and national growth of all economies including Bangladesh. The increased level of export of goods and services can play an important role in the development plan of Bangladesh where foreign exchange scarcity constitutes a critical bottleneck. The EXPORT can largely meet 'foreign exchange gap' and EXPORT growth would increase the IMPORT capacity of the country which would boost up industrialization as well as overall economic activities.

Despite high pressure on the IMPORT bills due to price hike of crude oil and other essential commodities in international market, Bangladesh's foreign trade remains at a satisfactory level (Bangladesh Economic Review, 2010). However, the balance of trade of Bangladesh remained in deficit. The objective of trade policy throughout the 1990's was to promote rapid export growth by reducing and eliminating the anti-export bias prevalent in the economy (Shahabuddin et al, 2004). Regardless of the structural limitations of the Bangladesh economy, the EXPORT sector performed well throughout the 1990s. The EXPORT growth rate of Bangladesh was privileged than the EXPORT growth rate of the SAARC countries. The IMPORT growth rate, to contrast, of Bangladesh was also privileged than that of the

SAARC countries during the 1980s and 1990s. Bangladesh's EXPORT and IMPORT share as percentage of SAARC countries has also ever-increased over the years (Roy, 1991).

Economic forecasting is a critical element of effective decision making for business and policy makers in governments around the world (Kargbo, 2007). Information of the current status of the different economic indicators is the most important ingredient for making economic policy of a country. Forecasting is the tool by which future status of the indicators can be known so that the country can make the future economic policy based on the information available at present time. In order to forecast, Cleary and Levenbach (1982), Andersen (1980), and Pankratz (1983) point out that the Box-Jenkins approach is a powerful and flexible method for short term forecasting because ARIMA models place more emphasis on the recent past and where structural shifts occur gradually, rather than suddenly.

The main purposes of the paper are to show the growth of the macro-economic indicators GDP, EXPORT and IMPORT, to measure the contribution of EXPORT and IMPORT to the GDP from the existing data set and to forecasts all the three considered series from 2011 to 2015 and lastly to measure the future contribution of EXPORT and IMPORT to GDP from the forecasted results.

2. Review of Literature

Various studies were carried out to show the relationship among the macroeconomic indicators. Many economists considered 'foreign trade' as the 'Engine of Growth' because it facilitates the specialization in the production of goods and services. Economic theories suggest that export earnings reduce the dependence on foreign aid, augment the base of industrialization, increases foreign exchange earnings, create employment opportunities, helps in transformation of the economic structure etc. Empirical evidences support that there exist positive correlation and strong causality between foreign trade and economic growth and development of many countries (Balassa, 1978). Tyler (1981), in his study, discussed the relationship between export and growth in the developing 55 countries with medium income and stated that in these countries in the period 1960 - 1977, there is a strong relation between export performance and growth of GNP. Jung and Marshal (1985) studied the time series data between 1950 and 1980 for 37 developed countries by using the Granger Causality test and exhibited that there was a causal relationship between the increase in export and economic growth. Roy (1991) in his study analyzed the determinants of export performance of Bangladesh using an econometric analysis and demonstrated that the export performance of Bangladesh is associated with greater commodity diversification of exports. In a study over the 1962-1992 periods, Begum and Shamsuddin (1998) find that export growth significantly increases economic growth through its positive impact on total factor productivity in Bangladesh.

Hossain and Karunaratne (2004) found the evidence of export-led growth for Bangladesh in both the long run and short run using quarterly data from 1974 to 1999. A study carried out by Hossain and Alauddin (2005) examined the process of Bangladesh's trade liberalization and its impact on the growth and structure of exports, imports, GDP and other relevant macroeconomic variables with particular emphasis on exports. Yusoff (2005) attempted to explain the structure and trends of Malaysian bilateral exports and imports and their effect on the economic growth for the data 1974-2004 by applying Granger Causality test. It was concluded that bilateral import had more contribution on economic growth, when compared to bilateral export. As a result, it was identified that both foreign trade variable had a causality relationship with economic growth. Bahmani-Oskooee and Oyolola (2007) work

with 44 developing countries over the periods 1960-2002. They indicated an export-led growth for Bangladesh in the long run. Rahman (2009) examined the contributions of exports, foreign direct investments, and remittances to GDP of South Asian countries including Bangladesh. Krugman and Obstfeld (2009) argued, a group of Asian economies achieved high rates of economic growth and did so via a process that involves rapid growth of exports rather than substitution of domestic production for imports. Jiyang and Wen (2009) studied the relationship between foreign trade and economic growth in China using the data from 1990 through 2007 and it was evident that there was causality between foreign trade and economic growth. Çetinkaya and Erdogan (2010) stated in their study that in terms of especially developing countries, the relationship between foreign trade and economic growth continues to be an issue keeping its validity in both theoretical literature and empirical literature.

3. Data and Methodology

The paper used the data of the three indicators such as GDP, EXPORT and IMPORT for the past three decades starting from year 1981 to 2010 from the "World Development Indicators 2001" published on April, 2011 by The World Bank.

The growth of the indicators between years and over the years is showed by percentage change of the respective year or period. The graphical presentation is also adopted to show the trend and growth of the indicators. On the other hand, the percentage occupied by EXPORT and IMPORT in GDP respectively measures the contribution of both the indicators in GDP.

The major outcome of the paper is highly related to the forecasting of the indicators and doing the same operations discussed above. The autoregressive integrated moving average (ARIMA) which is very popular and also widely known as Box-Jenkins methodology (Box and Jenkins, 1976) is adopted to forecast the three different series.

The diagnostic check of the stationarity of the considered series is carried out by two different methods. One of them is correlogram analysis based on both sample autocorrelation function (ACF) and partial autocorrelation function (PACF). The other one is the unit root test by both Dickey-Fuller (DF) test and Augmented Dickey-Fuller (ADF) test.

The best fitted model for GDP, EXPORT and IMPORT are chosen by running several models with the help of Akaike information criteria (AIC), Bayesian information criteria (BIC), mean absolute error (MAE), mean absolute percentage error (MAPE) and root mean squared error (RMSE) (Greene, 2003) . Further, the diagnostic check of the selected models is carried out by modified Box-Pierce (Ljung-Box) LB statistic (Ljung and Box, 1978) which is defined as:

$$LB = n(n+2)\sum_{k=1}^{m}\left(\frac{\hat{\rho}_k^2}{n-k}\right) \qquad (3.1)$$

Where, n is the sample size and k represents the number of lag and for large sample the LB statistic follows the chi-square distribution with m degrees of freedom.

The details of the models used for forecasting the respective series are presented in the following sub-sections.

3.1 ARIMA Model for GDP

The best identified model for forecasting the GDP series is ARIMA (1,2,1). The specification of the identified model and description of the model including relevant parameters are presented below:

$$GDP_t = \alpha + 2 * GDP_{t-1} - GDP_{t-2} + \beta_{11}\Delta^2 GDP_{t-1} + \varepsilon_t - \gamma_{11}\varepsilon_{t-1} \qquad (3.2)$$

where, GDP_t is the original GDP series at time t, α is the constant, GDP_{t-i} is the ith $(i = 1, 2)$ period lag value of the original GDP series, β_{11} is the autoregressive coefficient, $\Delta^2 GDP_{t-1} = (GDP_{t-1} - 2 * GDP_{t-2} + GDP_{t-3})$, ε_t is the white noise stochastic error term at time t, γ_{11} is the moving average coefficient and ε_{t-1} is the one period lag value of the stochastic error term.

3.2 ARIMA Model for EXPORT

The ARIMA (0,2,1) model is identified as the best model for forecasting the export of goods and services. The identified model can also be labeled as first-order moving average model of integrated EXPORT series of order two. The model specification is as follows:

$$EXPORT_t = \phi + 2 * EXPORT_{t-1} - EXPORT_{t-2} + u_t - \gamma_{21}u_{t-1} \qquad (3.3)$$

where, $EXPORT_t$ is the original EXPORT series at time t, ϕ is the constant, $EXPORT_{t-i}$ is the ith $(i = 1, 2)$ period lag value of the original EXPORT series, γ_{21} is the moving average coefficient, u_t is the white noise stochastic error term at time t and u_{t-1} is the one period lag value of the stochastic error term.

3.3 ARIMA Model for IMPORT

In order to forecast the import of goods and services, the ARIMA (0,2,1) model is identified as the best model. The model specification is as follows:

$$IMPORT_t = \theta + 2 * IMPORT_{t-1} - IMPORT_{t-2} + v_t - \gamma_{31}v_{t-1} \qquad (3.4)$$

where, $IMPORT_t$ is the original IMPORT series at time t, θ is the constant, $IMPORT_{t-i}$ is the ith $(i = 1, 2)$ period lag value of the original IMPORT series, γ_{31} is the moving average coefficient, v_t is the white noise stochastic error term at time t and v_{t-1} is the one period lag value of the stochastic error term.

## 4. Results

4.1 Growth of GDP, EXPORT and IMPORT

The data from 1981 through 2010 is used to show the growth of the considered indicators GDP, EXPORT and IMPORT. The statistics presented in Table 4.1 showed the growth of the indicators in two different dimensions. The first one is the growth in 2010 from the preceding year 2009 and the second one is the growth in 2010 from 1981 starting or initial year of the data used to find out the findings of the paper. The trends of all of the indicators are exhibited for all the years under review in Figure 4.1.

Table 4.1: Statistics on GDP, EXPORT and IMPORT and Their Growths

(USD in million)

Indicators	2010	2009	1981	Growth		Growth Rate (%)	
				2010 over 2009	2010 over 1981	2010 over 2009	2010 over 1981
GDP	100,076	89,360	19,763	10,716	80,313	11.99	406.38
EXPORT	18,547	17,361	1,042	1,186	17,505	6.83	1679.94
IMPORT	24,945	23,727	2,866	1,217	22,079	5.13	770.38

Inconceivable growths are observed for every indicator from 1981 to 2010. The value of GDP was only USD19,763 million in 1981, whereas the values were USD89,360 million in 2009 and USD 100,076 million in 2010 (see Table 4.1). The GDP increased by USD10,716 million with a significant growth rate of around 12 percent in 2010 over 2009. A commendable growth of GDP was observed over the period 1981 to 2010. The amount of growth during this period was USD80,313 million with a remarkable growth rate of around 406 percent. In other words, it can be interpreted that the GDP in 2010 was around 5 times of the amount of GDP that was in 1981.

Figure 4.1: Trend of GDP, EXPORT and IMPORT (US $ in million)
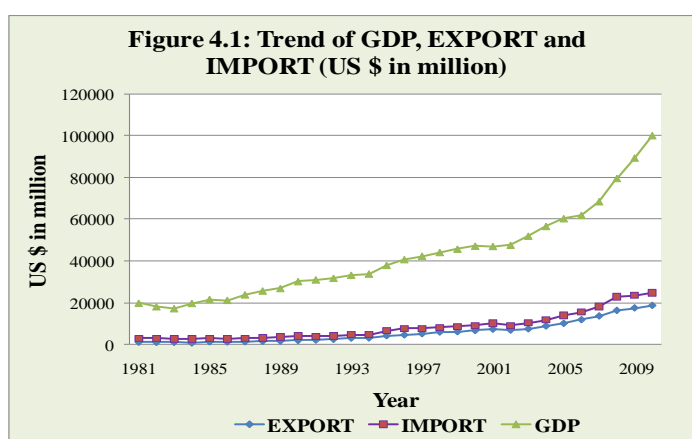
Similar trends are observed for both the EXPORT and IMPORT series. The value of the exported goods and services (EXPORT) in 2010 was USD 18,547 million followed by USD 17,361 million in 2009. The growth of EXPORT in 2010 over 2009 was USD 1,186 million which showed the growth rate of around 07 percent. Over the period, 1981-2010, the EXPORT increased by USD 17,505 million with an unbelievable increasing rate of around 1,680 percent. But, the growth in the recent years is higher compared to very past years since where the increased amount during the 30 years under review was USD 17,505 million, in 2010 the increased amount was USD 1,186 million which was around 07 percent of the total increased amount. The EXPORT is lowest in terms of volume and highest in terms of growth in all the years under review among the series taken into consideration in this study. The increasing trend was also observed for the IMPORT series. The amount for imported goods and services in 2010 was USD 24,945 million against USD 23,727 million in 2009 and USD 2,866 million in 1981. The growth in 2010 over 2009 was USD 1,217 million with an increasing rate of around 05 percent and the increased amount in 2010 over 1981 was USD 22,079 million with an increasing rate of around 770 percent.
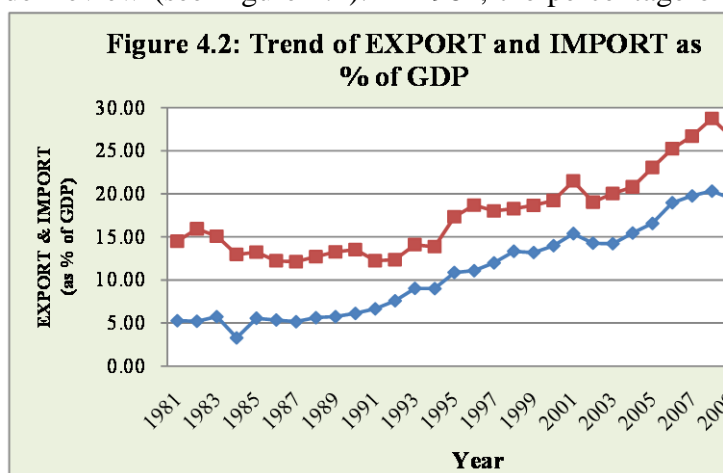
4.2 EXPORT and IMPORT as a Percentage of GDP

The contribution of EXPORT and IMPORT on GDP are shown in Table 4.2 by percentage occupied by each. In this subsection, 10 years including initial five years and recent five years are considered from the considered data for previous three decades (1981-2010) to show the contributions.

Table 4.2: EXPORT and IMPORT as Percentage of GDP

Variables	Recent 5 Years					Initial 5 Years				
	2010	**2009**	**2008**	**2007**	**2006**	**1985**	**1984**	**1983**	**1982**	**1981**
GDP (US $ in million)	100,076	89,360	79,554	68,415	61,901	19763	18087	17156	19670	21613
EXPORT as % of GDP	18.53	19.43	20.34	19.78	18.97	5.27	5.21	5.74	3.28	5.55
IMPORT as % of GDP	24.93	26.55	28.75	26.70	25.24	14.50	15.94	15.08	12.96	13.23

In 1981, the contribution of EXPORT in GDP was 5.55 percent compared to 13.23 percent IMPORT which revealed that the trade balance which is in fact trade deficit in the context of Bangladesh was around 8 percent. The gap between EXPORT and IMPORT was higher from 1981 to 1984 among all the years under review (see Figure 4.2). In 1982, the percentage of GDP for IMPORT was more than 15 percent and started to decrease afterwards and lies below 15 percent up to 1994. On the other hand, percentage contributed in GDP by EXPORT was around 5 percent from 1981 to 1987 except around 3 percent in 1982. After that an increasing trend is observed. The contribution of EXPORT to GDP rose to more than 10 percent in 1995 while the IMPORT was more than 17 percent of the GDP.

Figure 4.2: Trend of EXPORT and IMPORT as % of GDP

Later on, the trend of percentage of GDP contributed by EXPORT and IMPORT are very much similar. The percentages presented in the Table 4.2 under the heading of recent 5 years unveil a significant growth of both the export and import of goods and services. In 2007 to 2010, the contribution of EXPORT to GDP was around 18 to 20 percent whereas the value of IMPORT was around 25 to 29 percent. During this time, the trade deficit was highest in 2008 and which was around 8 percent of the GDP. In 2010, the EXPORT was 18.53 percent and IMPORT was 18.93 percent of the GDP which indicated the trade deficit of 6.40 percent of the GDP.

4.3 Forecasted EXPORT and IMPORT and Their Percentages in Forecasted GDP

**Table 4.3: Forecasted EXPORT and IMPORT and Their Percentages in Forecasted GDP (2011-2015)**

Year	Forecasted Value (USD in million) of			Forecasted EXPORT as % of Forecasted GDP	Forecasted IMPORT as % of Forecasted GDP
	GDP	**EXPORT**	**IMPORT**		
2011	100,527 (77,380-123,673)	17,406 (14,784-20,028)	23,353 (18,240-28,465)	17.31	23.23
2012	109,180 (82,663-135,697)	18,845 (15,966-21,724)	25,205 (19,528-30,881)	17.26	23.09
2013	118,256 (88,539-147,972)	20,342 (17,214-23,469)	27,135 (20,902-33,369)	17.20	22.95
2014	127,733 (94,973-160,494)	21,897 (18,526-25,267)	29,145 (22,357-35,933)	17.14	22.82
2015	137,598 (101,933-173,263)	23,510 (19,901-27,119)	31,233 (23,891-38,574)	17.09	22.70

Note: ( ) *represents the 95% confidence interval.*

The forecasted values of GDP, EXPORT and IMPORT for the next five years from 2011 to 2015 by the methods discussed above are presented in Table 4.3. Furthermore, the percentage occupied by EXPORT and IMPORT are also given in the Table 4.3. The trends of the series are visualized in Figure 4.3, where the black circle points indicating the forecasted values of the corresponding series.

The analysis revealed that the forecasted GDP in 2011 is USD100,527 million which is USD451 million higher from the previous year's actual GDP (see Table 4.3 and Table 4.1). In 2015, the volume of GDP will be USD137,598 million resulting a total increase of USD37,522 million during the forecasted 5 years compared to 2010.

In other words, an yearly increase amount of GDP during these 5 years will be around USD7,504 million. The value of the exported goods and services will be USD17,406 million in 2011 and increased to USD23,510 million by 2015. At the same time, the forecasted value of the imported goods and services will be USD23,353 million for 2011 and increase to USD31,233 million by 2015. The growth of the EXPORT

Figure 4.3: Trend of GDP, EXPORT and IMPORT with Their Forecasted Values (US $ in million)

and IMPORT value will be USD6,140 million and USD7,880 million respectively within the forecasted period.
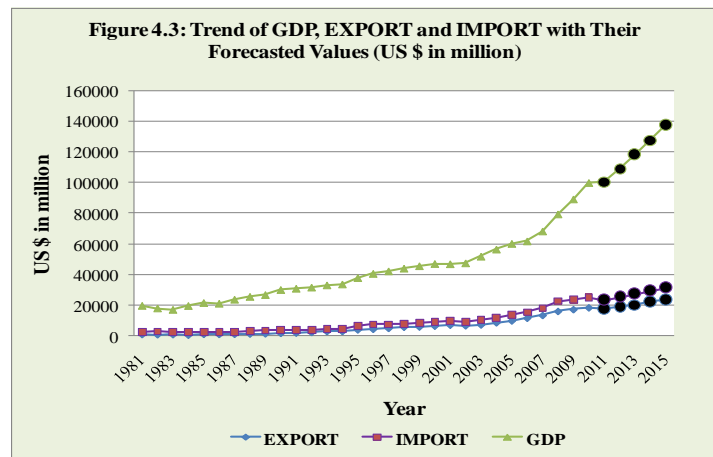
The forecasted result indicates that the contribution of EXPORT to GDP will be around 17 percent for the next five years. The percentage of GDP for imported goods and services will be around 23 percent in all the years forecasted in this paper. As a result, the forecasted trade deficit from 2011 to 2015 will be around 6 percent which is slightly lower compared to trade deficit level of 2010. The forecasted percentage of EXPORT and IMPORT in forecasted GDP is slightly decreasing as the volume increased in GDP is higher compared to volume of EXPORT and IMPORT.

5. Conclusion

The trend of the series GDP, EXPORT and IMPORT are increasing and showed an inconceivable growth in every series over the years under review. The volume of GDP raised from USD19,763 to USD100,076 million at a growth of around 406 percent in the past three decades from 1981 to 2010 indicates a huge expansion of the different sectors within the country. The value of the EXPORT increased to USD18,547 million in 2010 from 1981 at a remarkable growth rate of around 1,680 percent placed it to the dominant macro-economic indicator in the economy of Bangladesh. The growth rate of around 770 percent resulted the value of IMPORT USD24,945 million in 2010 starting from 1981. The contribution of EXPORT in 2010 was 18.53 percent of the GDP which was around 13 percentage points higher from the contribution that was in 1981. This evidence corroborated that now a days Bangladesh economy is not only dependent on agriculture, EXPORT is another significant contributor. The imported value of the goods and services (IMPORT) was 13.23 percent of GDP in 1981, whereas the percentage was 24.93 percent in 2010. During the review time, the trade deficit also decreased to around 6 percent from 8 percent.

The forecasted value of GDP, EXPORT and IMPORT uphold the same increasing trend from 2011 to 2015. The forecasted value of GDP will be USD100,527 million in 2011 and raised to USD137,598 million by 2015 which showed the indication of boost up the economy of Bangladesh. The country will get USD23,510 million by exporting goods and services in 2015 which is around 26 percent higher than that the level in 2010. The result implies that the EXPORT sector is the highly prospective sector for the country. To meet the future demand, the country will have to import for USD31,233 million which is around 25 percent higher from the 2010 level. The forecasted contribution of EXPORT to the forecasted GDP will be around 17 percent in all the 5 years considered for forecasting whereas the percent for IMPORT will be around 23 percent. According to the forecasted result, the trade deficit will go below 6 percent of the GDP in 2015.

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