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ECONOMIC SCRATCH ON THE FUTURE GROWTH PATH OF BANGLADESH: AN ARIMA APPROACH

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ABSTRACT

The purpose of this study is to investigate the future growth path (growth rate) of Bangladesh. Bangladesh is one of the fastest-growing nations in the world. To secure sustainable and spontaneous economic development, contentious increasing economic growth is a prerequisite. In this paper, Autoregressive Integrated Moving Average (ARIMA) model is used to track down the future growth path of Bangladesh. Time series data from year 1972 to 2018 has been utilize to predict the economic growth for year 2019 to 2028. By using the ARIMA approach it has been found that next 10 years (2019-2028) the GDP growth of Bangladesh will be reduced from the current growth rate. The average GDP growth rate from the year 2019-2026 will be clustered near 5% and in the year 2027 it will be peak by 8.77% and the following year growth rate will be consolidated by 1.39%.

Contribution/ Originality: In this study by using time series data and ARIMA model I forecast the economic growth of Bangladesh. The investigation is reviled a downward trend of economic growth of Bangladesh. So, the result will help the policymaker to redesign the fiscal, monetary and trade policies which will protect the growth rate of Bangladesh from future degeneration.

1. INTRODUCTION

Bangladesh is one of the fastest-growing developing nations in South Asia. The economy of this country is the 39th largest in the world considering the nominal market value and 30th largest by purchasing power parity (Riaz & Rahaman, 2016). It is also promoted as the next eleven emerging market middle- income economies. In the first quarter of the year 2019, the growth of GDP was 7.2% which was made this country the 7th fastest economy around the world (International Monetary Fund, 2020). Though Bangladesh has several problems like natural disasters, political unrest and degradation of the environment but despite all those things its economic growth is a miracle because this country tries to reduce their dependence on traditional sectors like agriculture and move to modern sectors like industry and service, such type of initiative panegyrized Bangladesh as the new tiger economy in Asia (Islam, 2019). There are many economical obstacles behind the development of Bangladesh apart from those problems Government and the policymakers of this country try to accelerate economic growth through different strategies (Mohajan, 2013). The reality is that from the last decade this country is doing better which is reflected through the different macroeconomic indicators. External factors like export, import, remittance, foreign

investment, and foreign aid have an influential impact on the economic growth of Bangladesh (Hosen, Islam, Tapu, Mia, & Begum, 2016). Industrial value-added has played a vital role in the economic growth of Bangladesh along with the influence of external sectors (Sultan, 2008). Bangladesh is now one of the leading economies in Asia and this country can redundant the stigma of "Bottomless Baskets" by taking different types of micro and macro-level policies (Helal, 2013).

The GDP skeleton of Bangladesh is 302.57 billion US dollars in 2019 which is 0.25 percent of world GDP (Trading Economics, 2020). Gross domestic product is considered as the market price of the final goods and services which are produced by the economy in a given period of time for a say one fiscal year. There are several components includes in the GDP calculation such as personal consumption expenditure, investment spending, government fiscal inducement, taxation, and net export (the difference between export and import). Calculation of the GDP is critical but comprehensive for all economies because the major macroeconomic policy such as fiscal policy, monetary policy, and tread policy is focused and synthesis on the volume of GDP of an economy. There are several procedures by which we can calculate the GDP of a country such as the expenditure approach; the production approach and the income approach.

The growth of GDP plays a crucial role in the development process of Bangladesh. There are many components in the economy which enhance the development process of a country. Those factors are good governance, political stability, trade policy, education policy, public health, environmental stability, commitment to the egalitarian in the considering of asset distribution so on. From all of those factors, the most influential factor of development is economic growth. GDP growth works as fuel for the development process of the economy. The government of the People's Republic of Bangladesh is focused on rapid and stable economic growth which is clear from the last three five-year planning (sixth, seventh, and eighth five-year plan). In the base year of the sixth five-year plan, the GDP growth rate was 6.1% which increased by 8% at the end of the sixth five-year plan and the average growth rate was 7.3% (International Monetary Fund, 2015). In the sixth five-year plan the hardcore poverty was reduced by 31.5% to 22.5% and about 10.4 million people were employed (International Monetary Fund, 2015). In the 7th five years planning the targeted economic growth is 7.4% but in the fiscal year 2019 (2019-20) the actual GDP growth achieved by 5.4% which is 2% less than the average GDP growth rate of the 7th five-year plan (Planning Commission, 2015). The comparative analysis of planned GDP growth and actual GDP growth is demonstrated in the table underneath,

Table 1. Plan and actual GDP of five year economic planning of Bangladesh.

Name of Plan	Duration of Plan	Actual GDP	Planned GDP
First Five Year Plan	1973-1978	4.0	5.5
Second Five Year Plan	1980-1985	3.8	5.4
Third Five Year Plan	1985-1990	3.8	5.4
Fourth Five Year Plan	1990-1995	4.2	5.0
Fifth Five Year plan	1997-2002	5.1	7.1
Sixth Five Year Plan	2011-2015	6.3	7.3
Seventh Five Year Plan	2015-2020	-	7.4

Source: Bangladesh Bureau of Statistics.

From Table 1, it is clear that Bangladesh unable to achieve the planned GDP growth rate in any five-year plan. There are different reasons behind that like political instability, military government, corruption, natural calamities, and world economic recession. But the scenery is worse after the pandemic COVID-19 outbreak around the world. Coronavirus throttle the economic growth in two ways; the first is due to this virus to maintain the social distance most of the financial market, corporate office, production, and trade shout down and the second is the expansion of this virus creates uncertainty in consumption, investment and international trade (Ozili & Arun, 2020).

An unprecedented disruption to the global economy is causing due to the COVID-19 pandemic. Most of the social-economic variables are affected badly due to the pandemic (Eusuf & Rahaman, 2020). The economic crisis due

to this pandemic would be atrocious than the Great Depression of the 1930s and the Global Financial Crisis in the year 2008-2009 and as well as the global economy would shrink by 3.0% in the year 2020 (International Monetary Fund, 2020). The economic conditions of the poorest country will be affected intensively. From the study of the World Bank, the global economy will decline 2.1-3.9 percent due to COVID-19 (World Bank Group, 2020). By using the general equilibrium model, it is found that the world economy could reduce GDP between $5.8 trillion to $8.8 trillion, which could be 6.4% to 9.7% of the global GDP (Asian Development Bank, 2020).

In this research paper, I try to forecast the GDP of Bangladesh from the year 2019-2028 by using Autoregressive Integrated Moving Average (ARIMA) procedure. ARIMA model can provide better forecasting prediction in the case of high-frequency time series data. It is very useful to forecast the stock price, oil price, and price of those goods which fluctuated over time. ARIMA model is one of the best-used methods to predict the time series forecasting e.g. GDP growth, inflation, stock price, the demand for goods, industrial supply, and so on (Dong, Li, & Gong, 2017). In this paper I first focused on the intensive literature evidence after that I mention the scope of this study then the methodology of this study has been described. After that, I focus on the data and common statistical properties, and then by using the Box-Jenkins procedure I estimate the model and use the estimated result to forecast the economy of Bangladesh from the year 2019-2028. I also discuss some policy relevance in the section on policy and recommendation.

2. LITERATURE REVIEW

GDP is the production of final goods and services which are produced in a country in a particular year. GDP not only measures the economic output of a country but also measures the economic fluctuation of a nation (Wei, Bian, & Yuan, 2010). Gross domestic product (GDP) is the market price of all final goods and services which is produced within a country in a particular time frame (Alsinglawi, Alwadi, Aladwan, & Saleh, 2019). Gross Domestic Product (GDP) is one of the most vital macroeconomic variables. We consider it the barometer of an economy.

From the research of Andrei (2011) used the ARIMA model to forecast the GDP of the United States of America from the year 1947 (first quarter) - 2010 (third quarter) and they isolated the study in the way that the ARIMA (1, 1, 1) model was appropriate for the forecasting of data. In that study, they used four (4) ARIMA equation combinations to select the optimal equation for the forecast. On the basis of classical criteria, adjusted R-square and F test they selected the desired model ARIMA was (1, 1, 1). From the study of Abonazel and Abd-Elftah (2019) on the economy of Egypt, they track down the movement of GDP from the year 1965 to 2016 by using the ARIMA model. In this study, the optimal ARIMA order was (1, 2,1). By using the optimal ARIMA order (1, 2,1) they forecast the GDP for the next ten (10) years.

Research has been conducted on the GDP of Manufacturing Industries in Bangladesh for the next thirteen years (Bhuiyan, Ahmed, & Jahan, 2008). To select the best growth model they used different types of statistical procedures like R^2, Adj R^2, AIC, BIC, AME, RMSE, and MAPE. The best appropriate model for this study is the quadratic type of growth model. From the basis of this model, it is found that the GDP of the Manufacturing Industry is slowly-increasing. The GDP of Shaanxi is a province of the People's Republic of China that had been forecasted by the ARIMA model (Wei et al., 2010). In that forecasting procedure, researchers used ARIMA (1, 2, 1), model. In this research manuscript, they used AIC criteria to select the appropriate ARIMA model. They calculated the model and compare it to the actual GDP from the year 2002-2007. The relative error of the model was 5% which is considered as an acceptable fitting.

A study has been attempted by Maity and Chatterjee (2012) on the economy of India to forecast the GDP on the basis of previous sixty (60) years data of Indian GDP. Data has been collected from the different publications of the Reserve Bank of India. ARIMA (1, 2, 2) model is used to estimate the coefficient of Autoregressive and Moving average model. All coefficients are statistically significant and the forecasting of GDP for India is increasing trend over time. In Greece, the Box-Jenkins methodology is used to forecast GDP on the basis of time series data from

year 1980 to 2013 (Dritsaki, 2015). For that study ARIMA (1, 1, 1) model is used to forecast real GDP for years 2015, 2016, and 2017. The outcome of this study demonstrates that Greece's real GDP rate is steadily improving. ARIMA (2, 2, 2) model is used to forecast the GDP of Kenya on the basis of the time-series data from the year 1960-2012. On the reliability of the AIC criterion, the model is the best model to forecast the GDP of this country. The forecast value of GDP for the next 5 (five) years is significant in the 95% level of confidence interval (Wabomba, Mutwiri, & Fredrick, 2016). From the study of Uwimana, Xiuchun, and Shuguang (2018) on the major economy of Africa has been forecasted GDP by using the ARIMA model. Data has been collected from the year 1990 to 2016 and the model is used to forecast the future value of GDP to 2030 and the result shows that an increasing GDP growth where the average speed of the economy of Africa will be of 5.52% and the GDP could achieve $2185.21 billion to $10186.18 billion. In Jordan, ARIMA (2, 2, 1) model is used to forecast GDP from year 1978 to 2017 (Alsinglawi et al., 2019).

An ARIMA model is used to forecast inflation in the Irish economy (Meyler, Kenny, & Quinn, 1998). In this research paper, they concentrate their focus to select the optimal ARIMA model which reduces the out-of-sample error and ensures an in-sample outcome through pursuing a significant level of goodness of fit. To forecast the inflation in the economy of Nigeria (Olajide, 2012) introduces ARIMA (1, 1, 1) methodology. In this research, the researchers incorporate the time series data on inflation in the economy of Nigeria from the year 1961-2010. The expected inflation on the base of the ARIMA procedure is 16.27% in the year 2011. Inflation is a potential threat to most of the developing nations around the world. African nation Ghana (Alnaa & Ahiakpor, 2011) is one of the most venerable economic situations due to inflation. To forecast the expected inflation an ARIMA (6, 1, 6) model is used to detect the future inflation rate of Ghana by considering data from the year 2000 to 2012 (monthly data) and the prediction result is impressive because the root means squared error (RMSE) is calculated 0.115453 which indicate that the prediction of the model is efficient to predict the future value of inflation in Ghana.

A study conducted by Almasarweh and Alwadi (2018) on the banking data from the Amman stock market (ASE) in Jordan to forecast the stock price fluctuation by using the ARIMA model. Data has been collected on a daily basis from the year 1993 to 2017. The result of this study shows that forecasting based on the ARIMA model is significant for short-term speculation. So, the investor can use the ARIMA model to take the decision on their investment. Such type of research study has been conducted by Almasarweh and Alwadi (2018) on the published stock price data from the New York Stock Exchange (NYSE) and Nigerian Stock Exchange (NSE) on the basis of the advantage of the ARIMA model. The outcome of the study emphasizes the short-term prediction is significant for the taking decision by the investor.

A study has been conducted to forecast the production of sugarcane in Indian from the year 1950 to 2012 (Manoj & Madhu, 2017). In this research paper 2, 1, and 0 orders ARIMA model is used for forecasting the production of sugarcane. The result has demonstrated that the annual sugarcane production grows in 2013 and will a sharp ablution in the year 2014. The average forecast growth of sugarcane production approximately 3% year-on-year. From the study of Stergiou and Christou (1996) on the forecasting, the monthly fisheries catch in Greek water from the year 1964 to 1980 using the ARIMA approach to optimize forecasting procedure. In the case of the Greek pilchard fishery which was very difficult to forecast because of the frequent changes in oceanographic and biological condition but the research is founded that the ARIMA procedure can forecast it. ARIMA approach has been used to forecast the demand in a food company by using the historical time series data (Fattah, Ezzine, Aman, El Moussami, & Lachhab, 2018). In this study, the researcher utilizes the available time-series data and uses the most used Box-Jenkins methodology to forecast the future demand for food for a particular industry. By using the Akaike criterion, Schwarz Bayesian criterion, maximum likelihood, and standard error, they select that the ARIMA order of the optimal model is 1, 0, and 1. That means that the model has one autoregressive term, the series is stationary at level (so, d=0) and the model has one moving average term.

Forecasting the price of any consumer item is necessary for the consumer to make their decision of consumption level in such a way that minimizes their cost but maximizes the utility. The forecast mechanism of pricing in the power sector (electricity market) is essential for both the producer and consumers to set their pricing strategies in such a way that ensures minimum distortion loss in the economy (Nogales, Contreras, Conejo, & Espínola, 2002). In this research paper, two alternative forecasting models (one is dynamic regression and another is a transfer function model) used to determine electricity price in the USA.

3. MOTIVE OF THE STUDY

The economy of Bangladesh is considered a developing market economy in South Asia. Bangladesh is the 39th largest economy in terms of economic activities and the 30th largest economy in terms of purchasing power parity (Wikipedia, 2020). From the study of Asian Development Bank (2020) the expected growth rate of the GDP of Bangladesh will be 7.8% at the end of the year 2020, which will be increased by 8.0% in the year 2021. This is the highest expected GDP growth rate compared to other countries in South Asia. According to the study of Trading Economics (2020) the expected output of Bangladesh (GDP) in the year 2020 will be near to 300 billion in the real term. This type of economic scenery may captivate the mass community in the country. In this study I try to forecast the GDP growth of Bangladesh by using ARIMA model and demonstrate that government and policymaker should concern about the future growth path of Bangladesh.

4. METHODOLOGY

ARIMA model or ARIMA approach is a combination of two procedures; the first one is the Autoregressive moving average model and the second procedure is the Box-Jenkins approach. So, the methodology of this paper has been developed in a way that helps to understand the basic ARIMA model and as well as the selection of the appropriate model by using the Box-Jenkins procedure (Asteriou & Hall, 2015).

4.1. ARIMA Model

This model is a combination of three mathematical consequences which makes this model comprehensive for the use of a single time series variable. This model is developed by Box and Jenkins in the year 1976 (Box, Jenkins, Reinsel, & Ljung, 2016). The first part of this model is the autoregressive (AR) process which implies that the dependent variable is the function of the past value of its own. The autoregressive model is that model which takes the lagged value of the dependent variable (Gujarati & Porter, 2008). The autoregressive model can be written as AR(1) or AR(2) or AR(p). The number in parentheses indicates the number of lagged values in the model. The generalized form of AR(p) is.

$$Y_t = \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \cdots + \theta_p Y_{t-p} + u_t \quad (1)$$

In the Equation 1, Y_t *is the dependent variable at time* t; Y_{t-p} *is the* p *order lag value of* Y_t; u_t is the Gaussian error or white noise process and this error term is independently and identically distributed *(iid)* random variables with $E(u_t) = 0$ and the variance, $var(u_t) = \sigma^2$; i.e. $u_t \sim iid(o, \sigma^2)$ (Abonazel & Abd-Elftah, 2019). This model is also known as the long-run memory model because it adds all past value of dependent variable. This attitude of the model is given in Equation 2.

$$Y_t = \sum_{i=1}^{p} \theta_i Y_{t-i} + u_t \quad (2)$$

There are some statistical properties of the model which is explain below.

$$E(Y_t) = E(Y_{t-1}) = E(Y_{t+1}) = 0 \quad (3)$$

$$Var(Y_t) = var(\emptyset Y_{t-1} + u_t) = \emptyset^2 \sigma_y^2 + \emptyset_u^2 = \frac{\emptyset_u^2}{1 - \emptyset^2 \sigma_y^2} \quad (4)$$

$$Cov(Y_t, Y_{t-k}) = \emptyset^k \sigma_y^2 \quad (5)$$

$$Cor(Y_t, Y_{t-k}) = \frac{Cov(Y_t, Y_{t-k})}{\sqrt{Var(Y_t)Var(Y_{t-k})}} = \frac{\emptyset^K \sigma_y^2}{\sigma_Y^2} = \emptyset^K \quad (6)$$

Equation 3 representing the expected value of the ARIMA model whereas Equation 4, Equation 5 and Equation 6 represent the variance, co-variance and correlation of the model respectively. Moving Average (MA) process indicate the forecast of a variable say, Y_t on the basis of past or lagged value of error term (Gujarati & Porter, 2008). The first order moving average model is represented by Equation 7;

$$Y_t = u_t + \gamma u_{t-1} \quad (7)$$

The general form of MA model for order " q" is demonstrated by Equation 8;

$$Y_t = u_t + \gamma_1 u_{t-1} + \gamma_2 u_{t-2} + \cdots + \gamma_q u_{t-q} \quad (8)$$

The Equation 8, can be express as a compact form and represent by Equation 9

$$Y_t = u_t + \sum_{j-1}^{q} \gamma_j u_{t-j} \quad (9)$$

One of the important properties of the MA model is invertibility[1], which means that the time series Y_t can be represented by finite-order MA or convergent autoregressive process (Asteriou & Hall, 2015). The statistical properties of moving average (MA) model are,

$$Var(Y_t) = Var((u_t + \gamma u_{t-1}) = \sigma_u^2 + \gamma^2 \sigma_u^2 = \sigma_u^2(1 + \gamma^2) \quad (10)$$

$$Cov(Y_t, Y_{t-1}) = \gamma \sigma_u^2 \quad (11)$$

$$Cor(Y_t, Y_{t-1}) = \frac{Cov(Y_t, Y_{t-1})}{\sqrt{var(Y_t)var(Y_{t-k})}} \quad (12)$$

Equation 10 shows the variance of the MA model, whereas Equation 11 represents the covariance of the model and the correlation of the model has been explained by Equation 12.

In the time series variable, any kind of forecasting procedure based on the stationary of the series (Gujarati & Porter, 2008). ARMA model only implies when the series is stationary (Asteriou & Hall, 2015). Most of the macroeconomic variable like as GDP, Inflation, export, import, and so on has time series trend which creates the serious issue of non-stationary implies time-varying mean and variance (Greene, 2012). The shortcomings of the non-stationary time series variable are that it reduces the strength of the forecasting process. To solve this problem, the researcher generates a captivating procedure to de-trend the series by using difference which is recognized as a

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[1] $Y_t = u_t + \gamma u_{t-1}$

$Y_t = (1 + \gamma L)u_t \qquad [Taking\ Lag\ Operation]$

$u_t = \frac{Y_t}{(1+\gamma L)}$

If $|\gamma| < 1, then\ we\ can\ write$

$u_t = Y_t(1 - \gamma L - \gamma^2 L^2 - \gamma^3 L^3 + \cdots)$

Now consider $MA(1)$

$Y_t = u_t - \gamma u_{t-1}$

Solving the previous equation in terms of u_t and take the lagged for one period,

$u_{t-1} = Y_{t-1} - \gamma u_{t-2}$

Substitute this equation in first equation,

$Y_t = u_t - \gamma(Y_{t-1} - \gamma u_{t-2}) = u_t - \gamma Y_{t-1} + \gamma^2 u_{t-2}$

Lagging and one period difference of above equation,

$Y_t = u_t - \gamma Y_{t-1} + \gamma^2 Y_{t-2} - \gamma^3 u_{t-3}$

stationary process or integrated process. The order of the integrated process is reviled by order "d", which indicate the number of difference needed the time series variable to be stationary.

Now the basic $ARIMA\ (p, d, q)$ model is illustrated by Equation 13:

$$\Delta^d Y_t = \alpha_0 + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \cdots + \theta_p Y_{t-p} + \gamma_1 u_{t-1} + \gamma_2 u_{t-2} + \cdots + \gamma_q u_{t-q} + u_t \quad (13)$$

4.2. Box-Jenkins Procedure

Box and Jenkins developed an ingenious procedure in which one can easily select the accurate order of the ARIMA model (to select the optimal order of p,d & q) (Box & Pierce, 1970). This procedure is based on the principle of parsimony, which implies that the model should not be the redundant stigma of over parametrized equations which may increase the value of R^2 but reduce the level of degrees of freedom (Asteriou & Hall, 2015). The ARIMA approach is a combination of four (4) indissoluble steps. Every step ensures the procedure of the next steps. In Figure 1, those stages and activities of each stage are portrayed.

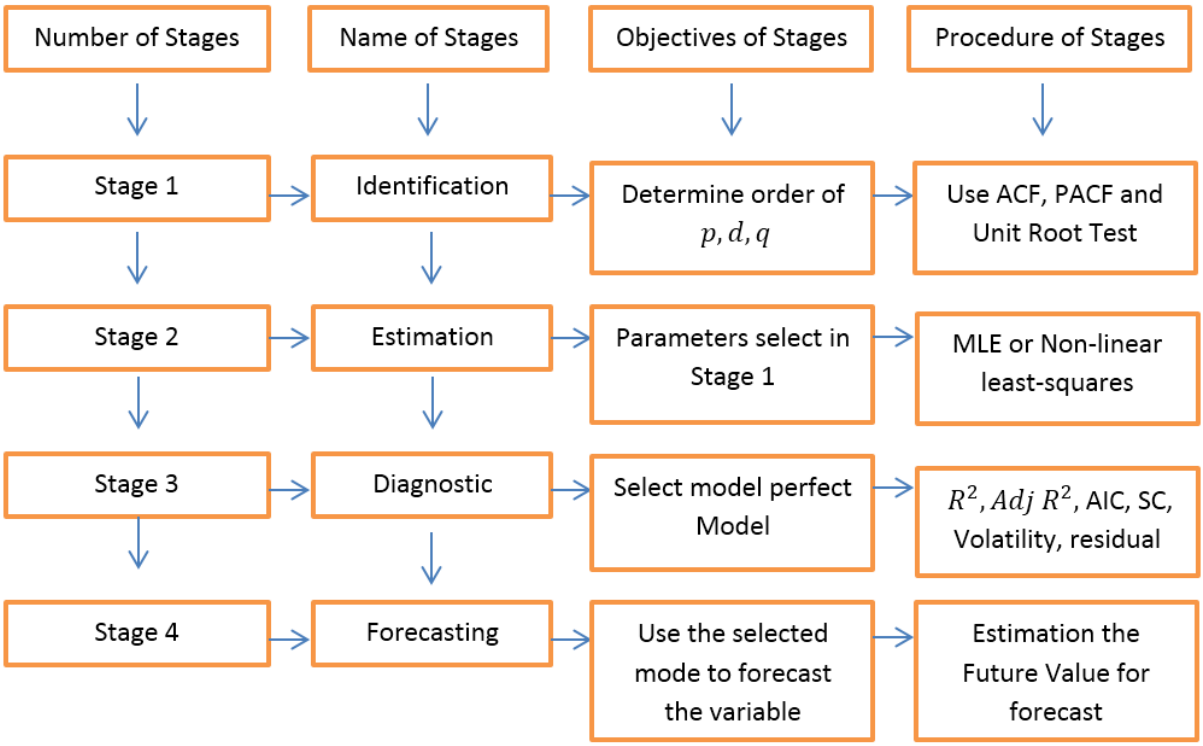


Figure 1. Stages and statistical procedure of ARIMA model.

The first stage, Identification of model; in this stage, the order of Autoregressive function, Moving average function, and deference order has been selected on the basis of Auto-correlation function (ACF), Partial Autocorrelation function (PACF), and unit-root test. Using the ACF function the order of MA (q) has been selected, the order of AR (p) selected through the PACF. The difference order or integrated order d has been selected on the basis of unit root test; it calculated the difference of the time series data is needed to stationary from a non-stationary series (Asteriou & Hall, 2015).

The second stage, Estimation of the model; using the precise Algorithms after selecting the perfect order of ARIMA (p,d,q) model; maximum likelihood estimation (MLE) or non-linear least-squares estimation is used to estimate the model (Abonazel & Abd-Elftah, 2019).

The third stage, Diagnostic check; it is the most critical stage because in this stage the accurate model has been selected from the alternative competitive model. In this stage, we should focus on R^2, Adj R^2, volatility coefficient, AIC criteria, SC criteria, and residual diagnostics. That model is perfect in which the value of R^2, Adj R^2 is high;

the magnitude of volatility coefficient, AIC criteria, SC criteria is minimum and the distribution of residual from the estimated model is white noise (Ma, Hu, Lin, & Han, 2018).

The fourth stage, Forecast; after confirming the appropriate model on the basis of diagnostic checking then we can use the model for the forecasting procedure which is the core objectives of the ARIMA approach.

5. DATA DESCRIPTION

In this research manuscript, the real value (million $) of GDP (Gross Domestic Product) in Bangladesh has been considered from the year 1972 to 2018. The data has been collected from the world's largest and most reliable source (World Development Indicators, 2020). The alignment of the series GDP which is denoted here through BGDP demonstrate through Figure 2.

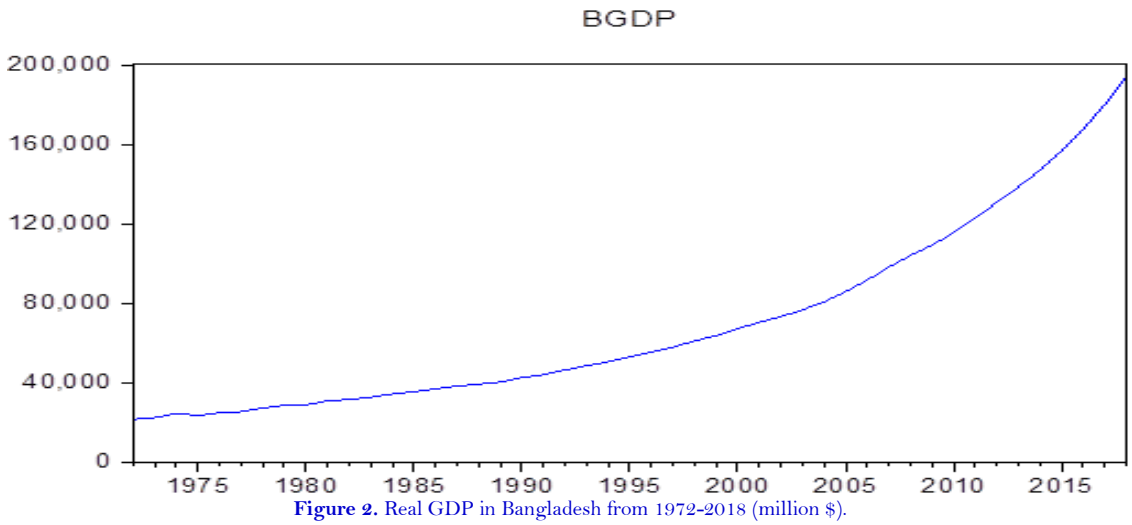


Figure 2. Real GDP in Bangladesh from 1972-2018 (million $).

From the Figure 2, it is clear that BGDP is increased gradually from the year 1972-2018 and the upward trend implies the non-stationary phenomenon of the series.

The basic statistical pattern of the series has been exposing in Table 2.

Table 2. Basic Statistical information of BGDP from 1972-2018.

Mean	Median	Maximum	Minimum	Skewness	Kurtosis
69674.44	52933.64	194146.2	21475.76	1.07	3.13

The average GDP of Bangladesh is 69674.44 million US$, the maximum and minimum value of GDP is 194146.2 and 21475.76 million US$ respectively. The skewness and kurtosis of the series is 1.07 and 3.31 gradually.

6. RESULT AND ANALYSIS

6.1. Identification; Determine the p, d, q Order in ARIMA Model

The pattern of the time series data from the year 1972 to 2018 has been shown in Figure 2, from the pattern of the series it has been assumed that the series may have the problem of unit root because the series has an upward trend over the time. The autocorrelation (AC) and partial autocorrelation (PAC) value demonstrate in Figure 3.

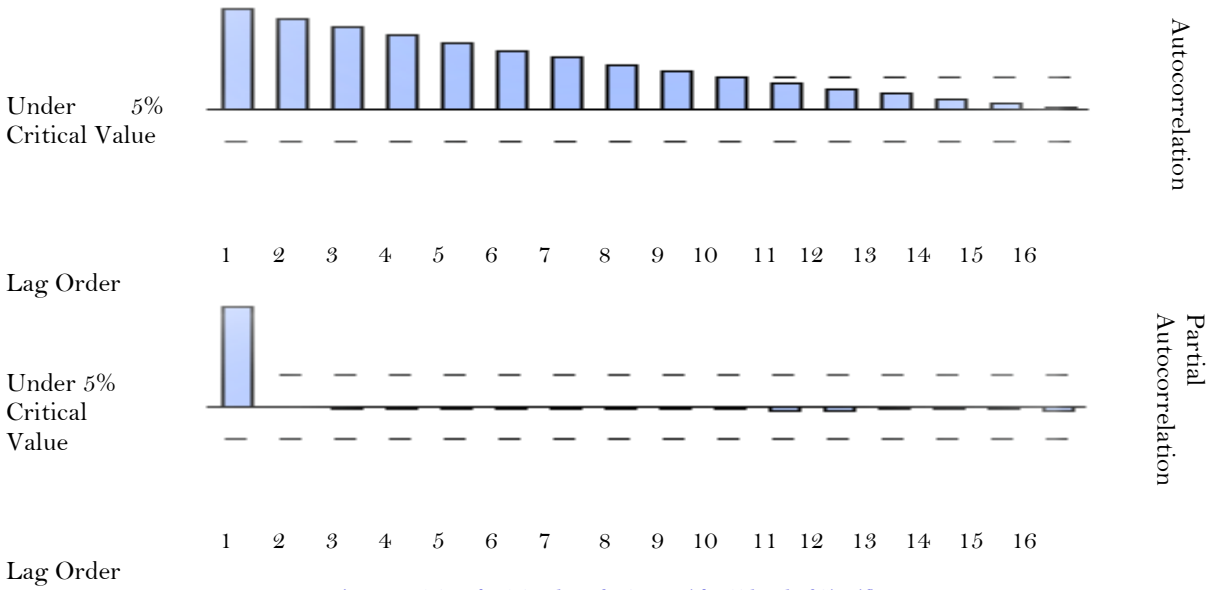


Figure 3. AC and PAC value of BGDP with 5% level of Significant.

Most of the value of the ACF is out of 5% critical boundary and the value gradually reduced and on the other hand the first lag of PACF is significantly different from other but the PACF of second lag to last lag is bound to the critical level. From the correlogram analysis it is clear that there is a high probability of non-stationary problem in series BGDP. For more precise out-come Augmented Dickey-Fuller (ADF) unit root test has been shown in Table 3.

Table 3. ADF unit root test.

Name of Test	t-Stattistics	P-value	Level of Significance
Augmented Dickey-Fuller test	5.45	1.00	AT 1% (-3.58) AT 5% (-2.92) AT 10% (-2.60)

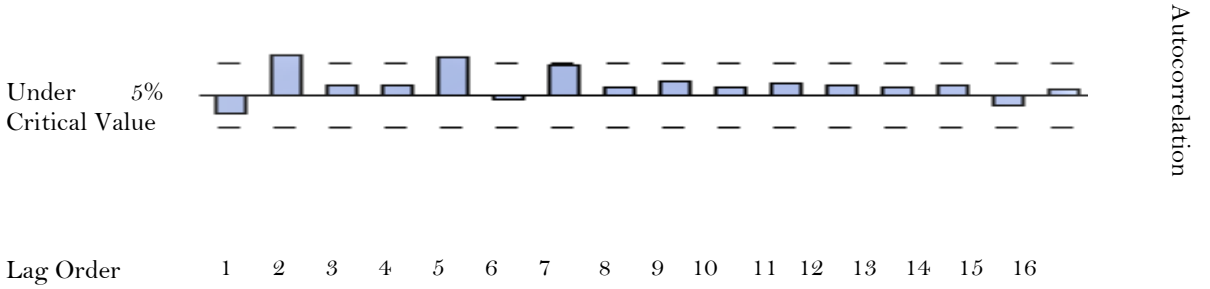
Hypothesis; $H_0 = Series\ has\ the\ problem\ of\ Unit-root.$

$H_A = Series\ is\ Stationary$

The p-value of the unit-root test does not comply that the series is stationary but it has the problem of unit-root. To implement of the ARIMA model at first it has been ensured that the series is stationary. Now by ensuring the log transformation and taking first difference we can solve the problem of non-stationary of series BGDP. The new transferred model is.

$$d(lBGDP_t) = lBGDP_{t-1} - lBGDP_{t-2}$$

The ACF and PACF of the new transferred series is given in Figure 4.



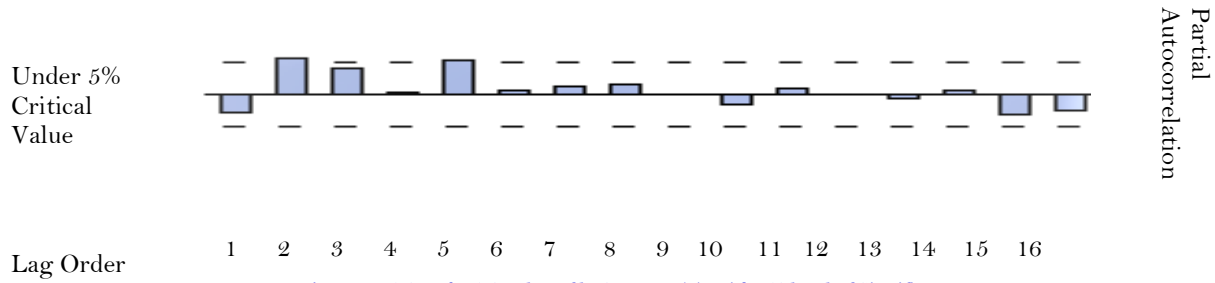


Figure 4. AC and PAC value of lBGDP at I(1) with 5% level of Significant.

Most of the value of ACF and PCF function are in the critical boundary, so we can say that the first difference of the log series of BGDP is stationary. So, in this ARIMA model the order of $d = 1$.

Now by using Figure 4, the order of AR and MA function has been determined. To select the order of AR we should focus of the value of PACF in Figure 4. Only the lag 2 and lag 5 are significantly differing from other lags. In this model the order of AR that means $p = 2 \; or \; p = 5$. In the same process ACF is used to select the order of MA model. From the Figure 4, it has been clear that only lag 2 and lag 5 significantly differ from other value of ACF. So, the order of MA model is $q = 2 \; or \; q = 5$.

So the combination of different ARIMA structure is,

ARIMA(1, 1, 1) ARIMA(2, 1, 1) ARIMA(1, 1, 2) ARIMA (2, 1, 2)
ARIMA(2, 1, 5) ARIMA (5, 1, 2) ARIMA (5, 1, 5)

6.2. Estimation; Selection of Desire Model

In this paper seven (7) competitive model of ARIMA forecasting function with different order of p, d, q has to estimate. But the problem is that who to select the most appropriate ARIMA model for forecast. To solve this problem we keep our concentration of some statistical measures. Those measures are given in Table 4.

Table 4. Comparative analysis of different alternative ARIMA model.

Name of Model	Number of Significant Coefficient	Volatility Cof.	Adj. R square	AIC	SC	HQ
ARIMA(1, 1, 1)	2	0.00	-0.00	-4.81	-4.65	-4.75
ARIMA(2, 1, 1)	3	0.00	0.12	-4.93	-4.77	-4.87
ARIMA(1, 1, 2)	2	0.00	0.09	-4.90	-4.74	-4.84
ARIMA (2, 1,2)	2	0.00	0.09	-4.90	-4.74	-4.84
ARIMA(2, 1, 5)	3	0.00	0.26	-5.07	-4.91	-5.01
ARIMA (5, 1,2)	3	0.00	0.28	-5.08	-4.92	-5.02
ARIMA (5, 1,5)	3	0.00	0.26	-5.04	-4.88	-4.98

The model which has the great number of significant coefficient, which is highest value of $Adj\ R^2$, lowest value of volatility, AIC, SC and HQ is selected the best model for forecasting. In the Table 4, it has been discovered that ARIMA model in order (5, 1, 2) highest number of significant coefficient but the problem is that there is also three competitive model which has same number of significant coefficient. But the $Adj\ R^2$ value of ARIMA (5, 1, 2) model is greater than other model's $Adj\ R^2$ value, and the value of volatility coefficient, AIC, SC and HQ is minimum for the model ARIMA (5, 1, 2) model. So, we consider that the most efficient model to forecast GDP on Bangladesh is ARIMA (5, 1, 2) model. Now the estimation outcome of this model is given.

$$D(LBGDP) = C(1) + [AR(5) = C(2), MA(2) = C(3),$$

$$D(LBGDP) = 0.05 + [AR(5) = 0.61, MA(2) = 0.24$$

Table 5. Estimation of ARIMA (5, 1, 2) model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.05	0.00	7.42	0.00
AR(5)	0.61	0.128	4.78	0.00
MA(2)	0.24	0.22	1.05	0.29
SIGMASQ	0.00	0.00	4.33	0.00

The value of Mean Squared Error (MSE) is 0.021(in Table 5) which is minimum compare to the alternative models. So, the model which is used for the forecast GDP of Bangladesh is represent by Equation 14.

$$\Delta lBGDP = 0.05 + 0.61lBGDP_{t-1} + 0.61lBGDP_{t-2} + 0.61lBGDP_{t-3} + 0.61lBGDP_{t-4} + 0.61lBGDP_{t-5} + 0.24\,\varepsilon_{t-1} + 0.24\,\varepsilon_{t-2} + \varepsilon_t \quad (14)$$

In Equation 14, it has been described that the lBGDP from lag 1 to 5 has positive innovation on the $\Delta lBGDP$ at current period and this sequence has been used to calculate the forecast value of the GDP growth rate of Bangladesh.

6.3. Diagnostic Check; Residual and Stability Test

6.3.1. Normality Test for the Residual

The normal distribution of the residual is the pre-request of to forecast a series on the basis of ARIMA model. In the Figure 5, the normal distribution of residual of ARIMA (5, 1, 2) is represent that the residual of the estimated model normally distributed around the 0 (zero).

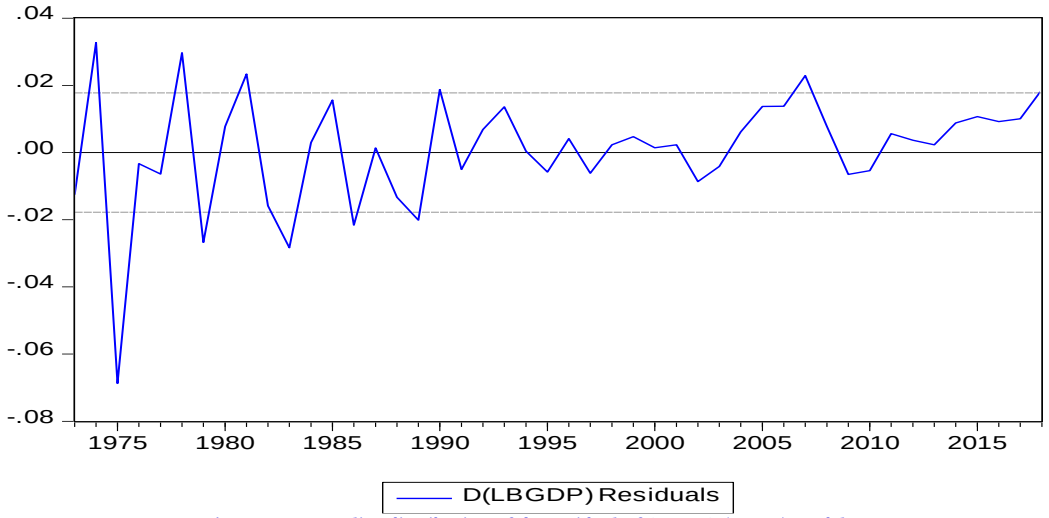
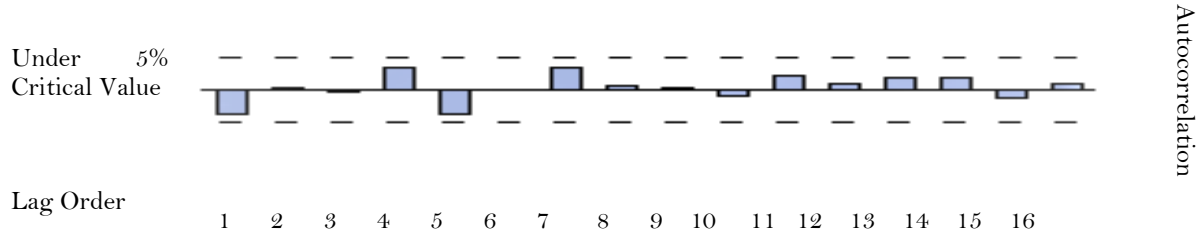


Figure 5. Normality distribution of the residual of ARIMA (5, 1, 2) model.

6.3.2. Correlogram Test of the Residual

It is very basic test which ensure that the all information of the objective variable is reflected in the chosen model. Correlogram test of residual in ARIMA (5, 1, 2) model is given in Figure 6.



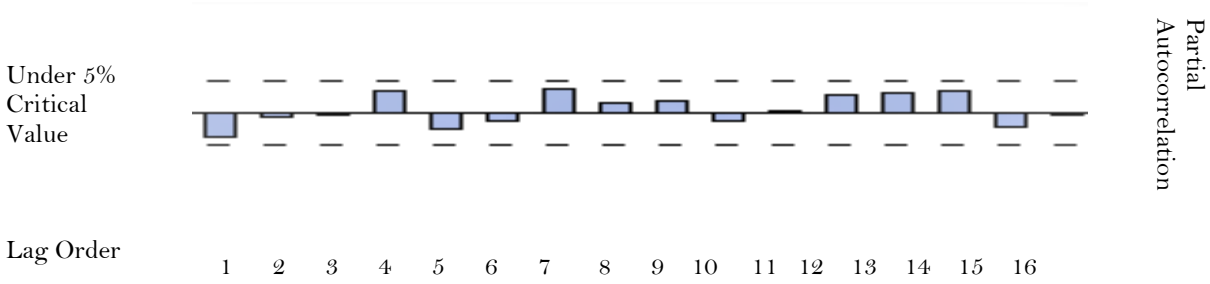
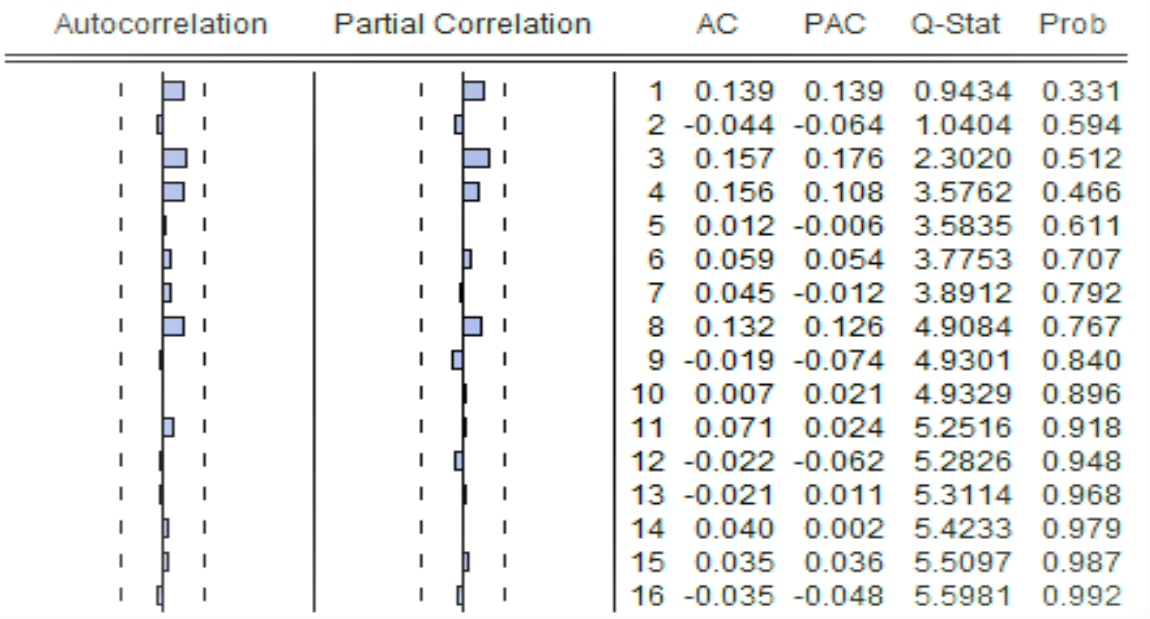


Figure 6. Correlogram of Residual.

All the lags value of ACF and PACF is lies in the 95% confidence interval. It implies that all the information has been accommodate in the ARIMA (5, 1, 2) model to forecast the future value of GDP of Bangladesh.

6.3.3. Ljung-Box Autocorrelation Test

Autocorrelation problem is encountered when the errors are correlated. The presence of Autocorrelation reduces the acceptability of a model. Ljung-Box Q-statistics is used to identify the autocorrelation problem of the model. In Figure 7.



	Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
1			0.139	0.139	0.9434	0.331
2			-0.044	-0.064	1.0404	0.594
3			0.157	0.176	2.3020	0.512
4			0.156	0.108	3.5762	0.466
5			0.012	-0.006	3.5835	0.611
6			0.059	0.054	3.7753	0.707
7			0.045	-0.012	3.8912	0.792
8			0.132	0.126	4.9084	0.767
9			-0.019	-0.074	4.9301	0.840
10			0.007	0.021	4.9329	0.896
11			0.071	0.024	5.2516	0.918
12			-0.022	-0.062	5.2826	0.948
13			-0.021	0.011	5.3114	0.968
14			0.040	0.002	5.4233	0.979
15			0.035	0.036	5.5097	0.987
16			-0.035	-0.048	5.5981	0.992

Figure 7. Autocorrelation outcome.

The ACF and PACF value for 16 lags bounded between 95% confidence interval. The probability value (p-value) of all Q-state value is greater than 5% implies that all residual of the ARIMA (5, 1, 2) model is free from the stigma of Autocorrelation.

6.3.4. Forecast GDP of Bangladesh on the Base of ARIMA (5, 1, 2) Model

From the previous study of the result and analysis section, it is clear that ARIMA (5, 1, 2) is an efficient model for forecasting the GDP of Bangladesh. The different type of diagnostic checks ensures that the forecasting based on the estimated ARIMA model would be able to track down the time path of GDP. Within the sample, forecasting has been shown in Figure 8, from the figure it is clear that the difference between the forecasted GDP and actual GDP is insignificant. In the year 1975-2010, the actual GDP and forecasted GDP are very close to each other. After the year 2010, the forecasted GDP is slightly decayed than the actual GDP. The actual GDP and forecasted are

analogous within the sample boundary in the viewpoint of influx but after the year 2010, the forecasted GDP underestimates the actual GDP which is very captivating in this research analysis.

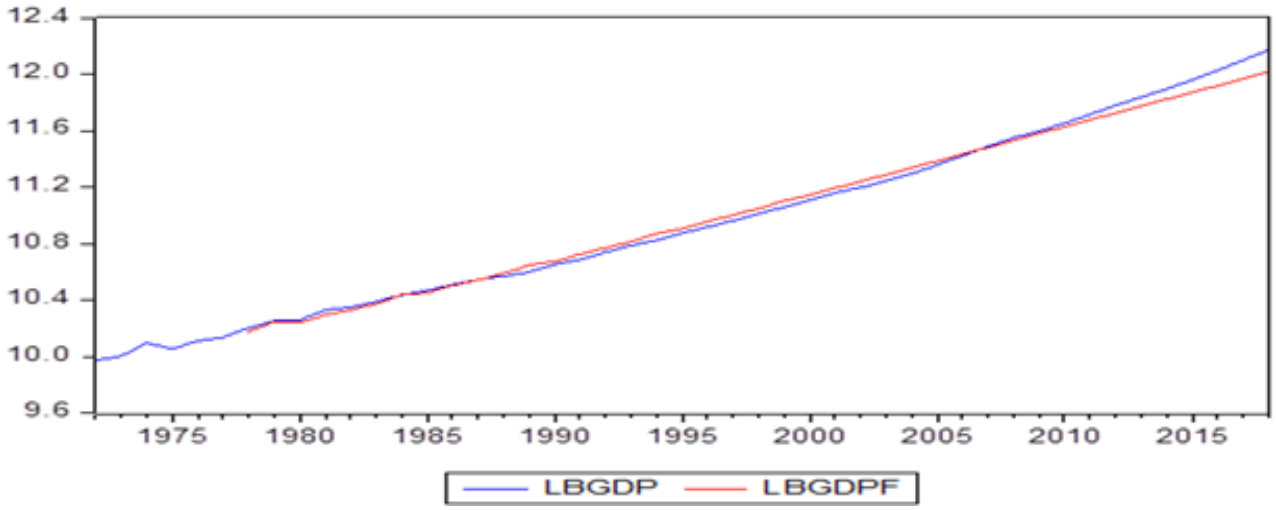


Figure 8. Forecast GDP within the sample.

In Figure 9, the forecasted length of GDP has been demonstrated from the year 2019 to 2028.

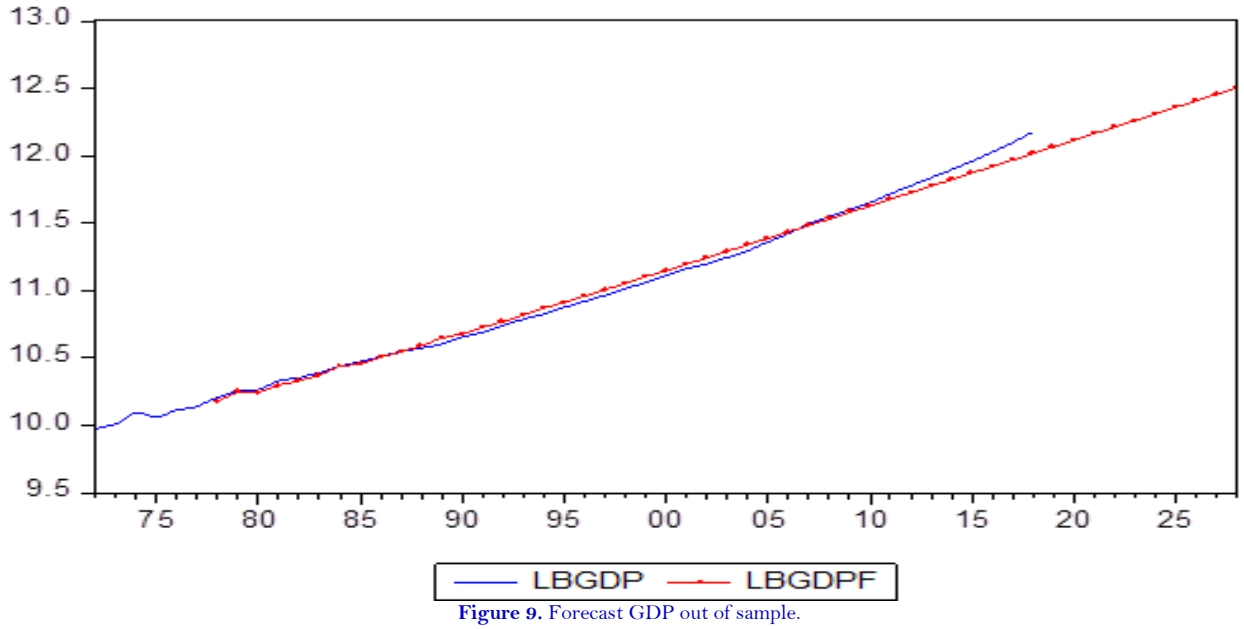


Figure 9. Forecast GDP out of sample.

The forecasted GDP from the yeas 2019-2028 will be increased over the time. The actual scenery of the forecasted GDP of Bangladesh has been described in Table 6.

From the table in below, it is clear that all the forecast value is statistically significant because it stay between the 95% confidence boundaries. The lowest forecasted GDP is 174360.4522 million US dollar in year 2019 and the highest GDP is 270614.34361 million US dollar in year 2028. When we observe the forecasted growth rate of GDP we examine that the average rate of economic growth of Bangladesh is 5 to 4 percent from the year 2019-2026 but in the year 2027 the forecasted GDP growth is 8.77 percent and in year 2028 the GDP growth dramatically decline to 1.39 percent.

Table 6. Forecasted GDP from 2019-2028.

Year	Forecasted GDP (log)	95% confidence interval		Forecasted GDP ($, in million)	Forecasted Growth Rate of GDP
		Lowe Boundary	Upper Boundary		
2019	12.23	12.20	12.26	174360.45	5.08
2020	12.29	12.25	12.34	182926.55	4.91
2021	12.36	12.30	12.41	192140.08	5.03
2022	12.42	12.36	12.49	201747.05	4.99
2023	12.49	12.42	12.57	211864.03	5.01
2024	12.55	12.46	12.64	222586.26	5.06
2025	12.62	12.51	12.72	233622.06	4.95
2026	12.68	12.56	12.80	245381.64	5.03
2027	12.74	12.61	12.88	266892.17	8.77
2028	12.81	12.66	12.96	270614.34	1.39

7. POLICY RECOMMENDATIONS

In this study, it has been shown that the GDP growth of Bangladesh is fairly stable from the year 2019 to 2016. At that period, the average growth rate will be around 5% which is illustrated on Figure 10. In year 2027 GDP growth rate of Bangladesh will be increased by 8.77 which is decline by 1.39 per cent in the following year. So the future growth of GDP is not the desired level according to the Government forecast. The Government of the People's Republic of Bangladesh forecasted that in the next ten (10) years the GDP will be conversing into double-digit. According to my opinion government should concern on the increase of domestic consumption and production. The government should take the strategy to increase the income of marginal people of this country because those groups of people have a high level of marginal propensity to consume (MPS). The government should design the safety net in such a way that increases the real output of the nation. The government should take an expansionary fiscal and monetary policy which will help to increase the real output. Growth sensitivity of any particular sector should be reconsidered and the income deviation between higher income class and lower income class must be reduced by introducing dynamic and attractive tax and income redistribution policies. Government has been carried on multi-dimensional poverty elevation projects across the nation. The objectives of those project is that to improving the lifestyle of the marginal people and to accelerate the economic growth. But due to lack of cooperation of local government, political authorities and lack of administrations skill most of the cases those projects are the symbol of wastage of money which reduce the productivity of the nation and increase the inflationary pressure and the ultimate consequence of such phenomenon is to distortion loss in production which follows a subsequence reduction of national output and economic growth. To accelerate the national output and to protect the decline the economic growth in future (according my study) the government should introduce inclusive development projects which ensure to achieve the potential output using available resources. Because for the sustainable development government must ensures spontaneous and consistent economic growth over the time.

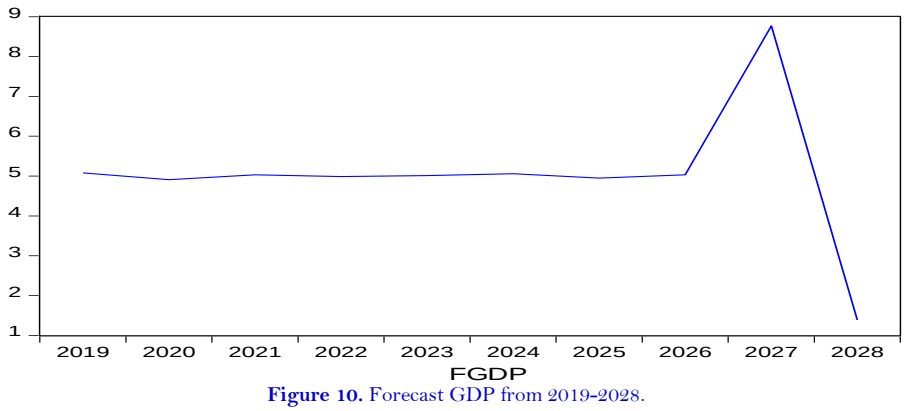


Figure 10. Forecast GDP from 2019-2028.

8. CONCLUSION

Due to the pandemic Covid-19, the real output falls around the world. It creates a potential threat to most of the developing nations like Bangladesh by reducing the growth of the economy. In this paper, I try to portray the future economic growth path of Bangladesh. By using the ARIMA model I try to forecast the real GDP growth of Bangladesh from the year 2019-2028. In this paper, ARIMA (5, 1, 2) model is used to estimate the real output growth and it has been found that the growth of real output will decline than the plan of the policymakers of Bangladesh. From the year 2019 to 2026 the real output growth of Bangladesh will converge between 4 to 5 percentage points. In the year 2027, it will be increased by 8.77% than reduced by 1.39% in the flowing year. To stable the economic growth and enhance economic development the Government should rethink and redesign the monetary, fiscal, and trade policy.

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