

A Causal Linkage between Economic Growth and Selected Macroeconomic Variables in Bangladesh: An Econometric Analysis

Md. Jahedul Islam^{1*}, Jasmin Akter², Shampa Chakraborty³

^{1,2}Assistant Director, Research Department, Bangladesh Bank, Head Office, Dhaka-1000, Bangladesh

³Additional Director, Chief Economist Unit (CEU), Research Department, Bangladesh Bank, Head Office, Dhaka-1000, Bangladesh

Abstract: Bangladesh's economy is mainly sustained by some notable macroeconomic variables. This study examines the short-run dynamics as well as in the long-run relationship between some selected macroeconomic variables and economic growth in Bangladesh using time series econometric tools. The variables contemplated are exports, imports, foreign remittance inflows, exchange rate, external debt, and the industrial price index (As proxy of GDP). Monthly period of data from January 2010 to June 2022 has been considered during this time series analysis. All variables are found stationary at their first difference under the ADF stationary test. As a result, Johansen multivariate cointegration test has been applied. This cointegration test is affirmed that the GDP of Bangladesh and the selected macroeconomic variables are cointegrated which imparts a clear indication of long-run association. To analyze the practicable endogenous relationship between the said variables, Granger causality test is performed to help scrutinize whether macroeconomic variables are stimulating the GDP or not. It is found that there is bidirectional causality between GDP and export, external debt and GDP, and remittance and GDP. The government and the central banks' insightful policies need to be improved more to keep macroeconomic variables up in the future.

Keywords: *Macro-economic variables, Granger Causality, Cointegration, Economic Growth, Variance decomposition. Views expressed in this article are the authors own. This does not necessarily reflect the views of the organization they work. All remaining errors are the author's own.*

Introduction: The world economy is experiencing several economic challenges due to the Russia-Ukraine conflict and the lingering COVID-19 pandemic. While the economies of the world were recovering to their pre-COVID-19 trend, the war further triggered the economic crisis.

The International Monetary Fund (IMF) anticipated that the global economy would contract from 6.0 percent in 2021 to 3.2 percent in 2022 and 2.7 percent in 2023 in its World Economic Outlook (WEO) of October 2022 [1]. Except for the global financial crisis and severe phase of the COVID-19 pandemic, this is the worst growth profile since 2001.

Turning to the emerging economy like Bangladesh that is not fully immune from the spillover effects of the sluggish growth of the world economy. This spillover effect from the world crisis reflects weaker-than-expected growth in different macroeconomic indices in Bangladesh.

Bangladesh was one of the fastest growing economies and consistently high over a decade crossing 7.0 percent landmark in FY16 and 8.0 percent milestone in FY19. However, the GDP growth decreased to 3.45 percent in FY20 after the inception of Covid-19 in 2020 [2]. But once more, in FY21, Bangladesh's economy began to improve by 6.94 percent. According to the provisional estimates of Bangladesh Bureau of Statistics (BBS), the GDP growth registered 7.25 percent in FY22 that is 0.05 percent higher than the target and 0.31 percent higher than the previous fiscal year (6.94 percent) [2].

Despite the global COVID-related disruptions and Russian invasion to Ukraine, Bangladesh's export earnings reached an all-time high of USD 52.08 billion in FY22. As usual, Export Promotion Bureau (EPB) claimed that Readymade Garments (RMG) fetched the lion's share, receiving USD 42.61 billion, which was 34.38 percent higher than that of the previous year, exceeding the growth target of 19.73 percent [3]. Strong export growth supported by rebounding RMG demand from corresponding buyers and a rise in domestic demand with an improving trend in labor income and remittance inflows have maintained the recovery.

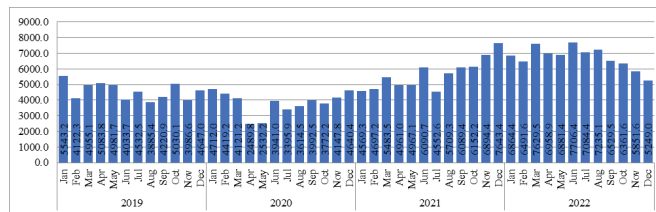


Fig. 1: Recent Trend of Import Payments. (Source: Monthly Economic Trends, Bangladesh Bank).

Article history:
 Received 22 March 2023
 Received in revised form 23 August 2023
 Accepted 25 October 2023
 Available online 15 November 2023

Corresponding author details: Md. Jahedul Islam
 E-mail address: jislam224@gmail.com
 Tel: +8801754468660

Copyright © 2023 BAUET, all rights reserved

Import volume increased to a record high in FY22. Growth for import payments has been projected at 30.0 percent in FY22 and 12.0 percent in FY23. Besides, import growth was recorded in capital machineries at 59.4 percent in FY22 [4].

The import payment was lowest at USD 2489.8 million in April 2020 due to outbreak of COVID-19 (Fig. 1). In contrast, the import payment was highest at USD 7706.4 million in June 2022 due to slowdown the tendency of COVID-19 and increasing the local domestic demands. In 2022, the import payments increased moderately by 19.22 percent to USD 80843.5 million from USD 67810.0 million than that of the previous year. This high payment is mainly aided by the high import cost of intermediate raw materials (raw cotton, synthetic/mixed yarn, fabrics, and textiles), chemical products, chemical fertilizer, capital machinery, edible & refined oil, and iron & steel scrap etc. In addition, commodity prices, industrial raw materials price, other consumer goods price, and the cost of international transportation are also rising. Thus, the domestic inflation scenario will face extra pressure in the recent months.

Remittance inflows stood at USD 21031.68 million in FY22 showed a lower growth (-15.12 percent) that was USD 24777.71 million in FY21 (Table 1). Remittance-GDP ratio was 4.56 percent in FY22. The remittance inflows in FY22 represent the large number of workers entering the international labor markets after the relaxation of COVID-19 restriction.

Table 1: Recent Trends of Remittance Inflows from FY19 to FY22
(In Million USD)

Fiscal Year	Remittance Inflows (Million USD)	Growth
2018-19	16419.70	9.60
2019-20	18205.00	10.87
2020-21	24777.71	36.10
2021-22	21031.68	-15.12

Source: Bureau of Manpower, Employment and Training (BMET).

During FY21, remittance earning was striking with 36.10 percent growth amid COVID-19. There were some effective factors behind this remittance boom. At that time, the illegal channel/Hundi system has become stuck up because of global movement restriction. Expatriates remit money through legal channels rather than Hundi as no option was opened. Rather than this, they sent more money as the financial cushion for their family. Nevertheless, remittance earning has slightly dropped from the start of FY22 due to the sluggish economic recovery of the international labor market cause of the COVID pandemic and the ongoing Russia-Ukraine conflict.

Bangladesh's Real Effective Exchange Rate (REER) trend has been steadily increasing day by day. Fig. 2 shows that, the exchange rate was in volatile before April 2022 and after that time the trends is increasing day by day up to December 2022. In association with that, the increasing demand for US dollars on the local market has imposed pressure on the exchange rate. The current exchange rate is Tk. 107.50 /USD on May 9, 2023, which was Tk. 84.81 per USD on 30 June, 2021 [4].

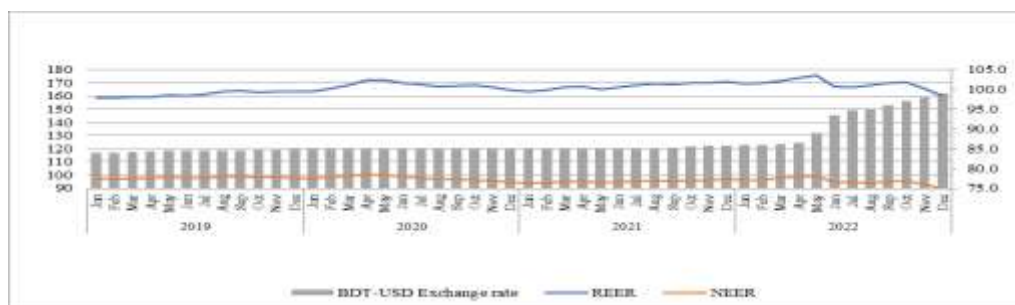


Fig. 2: Recent Trends in REER, Nominal Effective Exchange Rate (NEER) & BDT-USD Exchange rate. (Source: Bruegel, 2023 and Bangladesh Bank, 2023).

Bangladesh Bank depreciated the taka several times from June 2021 to June 2022 and taka is also losing value against the US dollar. In the area of L/C openings, settlements, and the interbank dollar market, Bangladesh Bank was not able to impose its "managed float" in any scenario (as also for export settlements and remittance flows). Exports are becoming less competitive and remittance flows are also being disincentivized. As a result, the motive of depreciation does not become effective. Moreover, the depreciation of taka is too little and too late. For this reason, foreign reserve is declining. Therefore, through the "managed float", the concern about "imported inflation" could not be addressed in any way.

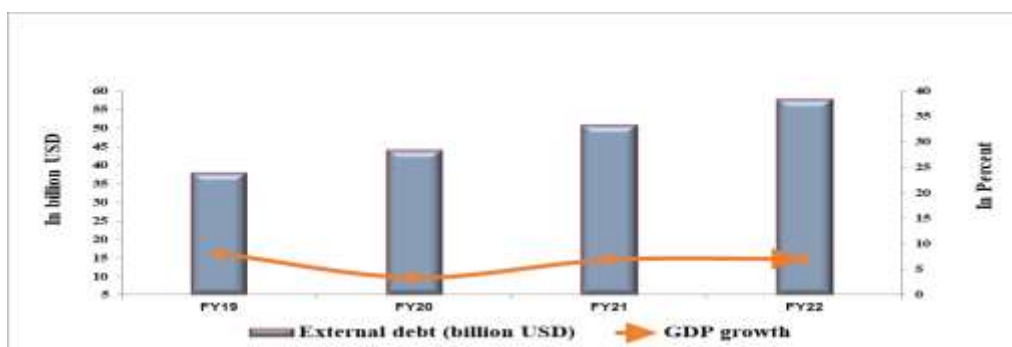


Fig. 3: Recent Trend of External Debt and GDP Growth (Source: Bangladesh Bank).

Total external debt of Bangladesh was increased by USD 15.39 billion to USD 50.88 billion at the end of December 2021 [4]. Long-term debt placed at USD 72.71 billion, or 80.1 percent of the total debt and short-term debt amounted to USD 18.09 billion or 19.9 percent of total debt. Besides, public sector debt reached USD 67.71 billion (74.6 percent of total debt) and private sector debt placed at USD 23.08 billion (25.4 percent of total debt) at the end of December 2021. Ratio of external debt to GDP increased to 12.52 percent in 2022 from 12.22 percent in 2021 [4]. Trends of external debt and GDP growth are shown in Fig. 3.

Gross Domestic Product (GDP) is essentially a summary of all finished goods and services generated over a specific period inside the country's economy. However, the industrial output index is used as a proxy in this study as a stand-in for GDP due to the lack of monthly basis GDP data. It is crucial to determine the elements that have both long and short-term effects on Bangladesh's GDP while keeping in mind all the economic variables mentioned in the study. The independent variables chosen for the study are those that are anticipated to have some degree of direct and indirect impact on GDP growth. The study's objective is to assist policymakers in creating sound plans based on the correlations between the aforementioned variables.

For many developing nations including Bangladesh, the main sources of foreign exchange and outside financing have been external debt, exchange rates, exports, imports, and overseas remittance inflows. Depending on the stage of financial development, substantial research has been done on the theoretical and empirical significance of external influences on economic growth. Numerous academic studies have shown that remittances, currency rates, and external debt all have a favorable impact on economic growth over the long and short terms.

Foreign remittances are the second source of external financial inflows for developing nations after FDI [5]. Remittances, on the one hand, have multiplier effects on consumption, improved financial intermediation, and use of foreign exchange, which boost economic growth. On the other hand, under other circumstances, they may undermine productivity and inflows may result in an appreciation in the real exchange rate of the recipient country, which would impede growth [6]. Additionally, Tahir, Khan, and Shah looked at how imports, FDI, and remittances from outside affected Pakistan's economy [7]. They discovered that remittances have contributed to a rise in foreign exchange reserves and the stabilization of the domestic economy.

On the one hand, Ajmi, Aye, Balcilar, and Gupta have purposefully investigated a study in South Africa to trace the impact of economic growth on export performance. Using data from the years 1911 to 2011 in South Africa, they applied the hypothesis of bidirectional links between exports and GDP, which was confirmed by a linear and non-linear test of Granger causality and found no conclusive evidence of such a relationship [8].

Makun, however, used the Autoregressive distributed lag (ARDL) and discovered that imports have a negative impact on economic growth over the long run [9]. Remittances, on the other hand, had a favorable long-term and short-term impact on the economic progress of the Fiji Islands. A currency's exchange rate determines the rate at which it can be converted into another, simplifying international transactions [10]. Undoubtedly, a country's real exchange rate will have an impact on its macroeconomic circumstances. Based on five-year average data for a panel of over 150 countries, M.M. Habib, E. Mileva, and L. Stracca investigated how changes in the exchange rate affected economic growth and discovered that a real appreciation (depreciation) significantly lowers (raises) annual real GDP growth, especially for developing nations [11].

Contrarily, Tang B (2015) uses a cointegrated VAR (CVAR) model to investigate the connection between the real exchange rate (RER) and economic growth in China [12]. However, that analysis showed that there are no immediate links between the RER and China's long-term economic growth. Additionally, the weaker RMB exchange rate has not benefited the Chinese economy.

In Addition, through the construction of infrastructure, capital accumulation, and human resource development, external debt is a vital source of funding economic growth in developing nations like Bangladesh. Based on data from 1970 to 2009, Ramzan M. & Ahmad E. (2014) investigated the effects of external debt on economic growth in Pakistan and discovered that the external debt had a negative impact [13]. Besides, the study also discovered that the bilateral, rather than the multilateral, component of total external debt slows down economic growth.

In order to test the claim that there is a dynamic relationship between foreign debt and growth, Wang R, Xue Y, and Zheng W (2021) examined the predictive ability of external debt as an indicator for economic growth using data from LMCs (low- and middle-income countries) between 1970 and 2018, where panel regression was performed [14]. However, the results advocated that higher overall, long-term, or external public debt is consistently predictive of weaker short- and medium-term growth. Notwithstanding, there have not been many studies on how macroeconomic factors like exports, imports, exchange rates, external debt, and remittance affect a country's economic growth. Most of the literatures are based on the bilateral relationship between two or three variables and are mostly examined using panel data. Very few of literature explored the selected several macroeconomic variables impacts of the economic growth in Bangladesh perspectives. However, the global present volatile economic scenario has also raised the necessity for such study.

Research Methodology

Data: The study covers the data of GDP, export, import, exchange rate, remittance, and external debt from the period January 2010 to June 2022. Here, Industrial Price Index (IPI) has been used as proxy of GDP.

Data Collection Methodology: Data has been collected on monthly basis. Data of IPI has been piled up from the Bangladesh Bureau of Statistics (BBS) [2]. Export, import, exchange rate and remittance data gathered from the various issues of Monthly Economic Trend (MET) published by Bangladesh Bank. Data of external debt collected from the Foreign Direct Investment Survey Report, a half yearly publication of Bangladesh Bank and later converted to monthly data using Chow-lin method.

Data Analysis Methodology: Data has been analyzed by using E-views 11 econometric software. Correlation, regression, and other necessary test have been performed to accomplish the essential goals.

Augmented Dickey-Fuller (ADF) Test for Stationarity: To check the stationarity of the variables data from all the variables were first tested for a unit root. Here, the data set was subjected to the Augmented Dickey-Fuller (ADF) stationarity test to detect any potential unit roots problems. It is necessary to check time series data for stationarity before continuing because the presence of unit roots would cause the regression to be spurious. Once the variables are found to be stationary, a cointegration test is to be followed.

Johansen Multivariate Cointegration Test: In this study, the Johansen approach is used to check for cointegration. In nature, it indicates whether or not the variables have long-term relationships. The trace test and the maximum Eigen value test for cointegration were developed by Johansen (1988). Here, an Unrestricted VAR of the following form for this purpose is to be estimated:

$$\Delta x_t = \alpha + \beta_1 \Delta x_{t-1} + \beta_2 \Delta x_{t-2} + \beta_3 \Delta x_{t-3} + \dots + \beta_{k-1} \Delta x_{t-k+1} + \beta_k \Delta x_{t-k} + u_t \quad \text{eq. 1}$$

Where, Δ is the difference operator; x_t is a $(n \times 1)$ vector of non-stationary variables (in level); and u_t is the $(n \times 1)$ vector of random errors. The matrix β_k contains information on long-run relationship between the variables. If the rank (usually denoted by r) of $\beta_k = 0$, the variables are not cointegrated. Whereas, if rank is equal to 1, there exists one cointegrating vector and finally if $1 < r < n$, there are numerous cointegrating vectors.

The Granger Causality Test: One of the significant topics that has received extensive study in empirical macroeconomics and empirical finance is the Granger causality test, which Granger established in 1969. According to cointegration investigation, when two variables are cointegrated, at least one causal direction must exist. There are four possible outcomes for the Granger causality test (Granger 1969) if x and y are taken as the relevant variables: It follows that (i) x Granger causes (ii) y Granger causes (iii) Granger causes both x and y to affect the other, and (iv) neither of the Granger-caused variables affects the other. The causality tests between all the relevant variables are carried out in this study. For this the following set of equations are estimated:

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \dots + \alpha_1 X_{t-1} + \beta_1 Y_{t-1} + \dots + \beta_1 Y_{t-1} + u_t \quad \text{eq. 2}$$

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \dots + \alpha_1 Y_{t-1} + \beta_1 X_{t-1} + \dots + \beta_1 X_{t-1} + v_t \quad \text{eq 3}$$

Vector Error Correction Model: A vector error correction model is used to correct both short-run changes in variables and their deviations from equilibrium after one or more cointegrating vectors have been discovered. Additionally, it demonstrates how quickly variables—particularly the dependent variable—return equilibrium following changes in other variables.

Results: The following Table 2 presents the descriptive statistics and the correlation matrix of GDP, Exchange rate, Export, External debt, Import and Remittance for the period January 2010 to June 2022. The dependent variable GDP varies from 90.78 to 348.45 with a mean of 193.24. Exchange rate varies from 69.20 to 85.61 with an average of 79.59. Similarly, Export ranges from 520.01 to 4727.53 with average of 2669.33, External debt ranges from 615061.00 to 3872370.00 with a mean of 1965395.00, import varies from 1818.60 to 6152.20 with the average of 3609.19 and that of remittances range from 827.96 to 2598.21. Standard deviation indicates the volatility of the variables in this period. On the other hand, correlation matrix presents that GDP is highly correlated with the variables.

Table 2: Descriptive Statistics and Correlation Matrix.

Variable	Descriptive Statistics					
	GDP	Exchange rate	Export	External debt	Import	Remittance
Mean	193.24	79.59	2669.33	1965395.00	3609.19	1289.39
Median	182.42	79.13	2740.67	2075356.00	3446.45	1212.35
Maximum	348.45	85.61	4727.53	3872370.00	6152.20	2598.21
Minimum	90.78	69.20	520.01	615061.00	1818.60	827.96
Std. Dev.	70.50	4.55	675.36	964456.60	912.96	323.99
Skewness	0.41	-0.71	-0.16	0.09	0.56	1.32
Kurtosis	1.93	2.81	3.12	1.88	3.05	4.79
Jarque-Bera	10.67	12.03	0.68	7.62	7.32	60.37
Observations	142	142	142	142	142	142
Correlation Matrix						
GDP	1.00	0.82	0.82	0.95	0.85	0.80
Exchange rate	0.82	1.00	0.65	0.76	0.72	0.69
Export	0.82	0.65	1.00	0.75	0.82	0.62
External debt	0.95	0.76	0.75	1.00	0.81	0.72
Import	0.85	0.72	0.82	0.81	1.00	0.60
Remittances	0.80	0.69	0.62	0.72	0.60	1.00

Source: Author's calculation

Table 3: Regression Result.

Dependent Variable: GDP				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Exchange rate Export	-0.33	0.11	-3.14	0.00
External debt	0.01	0.00	3.70	0.00
Import	4.42	2.40	18.42	0.00
Remittances	0.01	0.00	4.21	0.00
Remittances	0.05	0.01	7.81	0.00
R-squared	0.96	Mean dependent var.	193.24	
Adjusted R-squared	0.96	S.D. dependent var.	70.50	
S.E. of regression Sum squared resid. Log likelihood Durbin-Watson stat	14.62	Akaike info criterion	8.24	
	29272.49	Schwarz criterion	8.34	
	-579.82	Hannan-Quinn criter.	8.28	
	0.42			

Source: Author's calculation

Table 3 represents the OLS estimates. The goodness of fit as indicated by R^2 is 96% which shows that 96% of the variability in GDP can be explained by the independent variables.

Table 4: Unit Root Test Result.

Variables	Augmented Dicky Fuller (ADF)	
	Level	1st Difference
GDP	-0.23	-10.41*
Exchange rate	-0.73	-4.05*
Export	-0.97	-11.31*
External debt	1.01	-8.70*
Import	-0.68	-13.36*
Remittances	-2.10	-19.43*

(*) shows 1% level of significance.

Source: Author's calculation

The study confirms that variables under the examination are integrated of order one. In Table 4, ADF test outcomes show that all series are in unit root at level but are stationary at first difference or $I(1)$. However, the Johansen multivariate cointegration test is performed to determine whether there is a long-run relationship between the variables.

Table 5: Johansen Cointegration Test.

Variable: GDP, Exchange rate, Export, External debt, Remittances				
Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None	121.0654*	95.75366	56.46557*	40.07757
At most 1	64.59983	69.81889	34.70606*	33.87687

Source: Author's calculation

Table 5 depicts the Johansen cointegration test outcomes. One cointegrating equation is shown by the Trace test, and two are found by the Max-Eigen value at the 5% level. For choosing the maximum lag length, Schwarz and Akaike information criteria are used.

Granger Causality Analysis: The pair-wise Granger causality test result shows in Table 6 that the various variables granger-cause GDP at 5% level of confidence. It is found that there is bidirectional causality between GDP and export. This finding implies that both GDP and export granger cause each other in Bangladesh. Also, there is bidirectional causality between External debt and GDP, which implies that External debt granger cause GDP and vice versa in Bangladesh. Besides, there is bidirectional causality between remittance and GDP and vice versa. Furthermore, there is bidirectional causality running from remittance to export and vice versa. Besides, there exists bidirectional causality between Import and External debt and vice versa.

Table 6: Granger Causality Test.

Null Hypothesis	F-Statistic	Probability	Decision
Export does not Granger cause GDP	4.73434	0.0036	Reject
GDP does not Granger cause Export	4.51631	0.0047	Reject
External debt does not Granger cause GDP	4.66157	0.0040	Reject
GDP does not Granger cause External debt	3.70484	0.0134	Reject
Exchange rate does not Granger cause GDP	1.04217	0.3761	Do not reject
GDP does not Granger cause Exchange rate	0.76368	0.5163	Do not reject
Import does not Granger cause GDP	0.28944	0.8330	Do not reject
GDP does not Granger cause Import	1.71333	0.1671	Do not reject
Remittance does not Granger cause GDP	4.31802	0.0061	Reject
GDP does not Granger cause Remittance	2.69192	0.0486	Reject

Source: Author's calculation

However, there is no causality running from GDP and Import. Also, GDP does not granger cause Exchange rate and Exchange rate does not granger cause GDP.

Table 7: Vector Error Correction Model.

	D(GDP)	D(Exchange rate)	D(Export)	D(External Debt)	D(Import)	D(Remittance)
CointEq1	-0.02 [-5.24]	-4.43 [-0.49]	-0.50 [-6.05]	-1.78 [-0.26]	0.05 [0.58]	-0.17 [-5.60]
D(GDP(-1))	-0.38 [-1.93]	0.00 [0.41]	-6.83 [-1.32]	1202.93 [2.81]	-20.33 [-3.71]	3.41 [1.82]
D(GDP(-2))	-0.10 [-0.45]	0.01 [0.94]	0.72 [0.13]	692.40 [1.47]	6.32 [1.04]	3.50 [1.69]
D(Exchange rate(-1))	0.83 [0.27]	0.56 [6.54]	-24.61 [-0.31]	-5892.85 [-0.89]	22.45 [0.27]	8.15 [0.28]
D(Exchange rate(-2))	-3.42 [-1.12]	-0.26 [-2.99]	-95.98 [-1.21]	-4697.02 [-0.72]	-14.26 [-0.17]	-39.62 [-1.39]
D(Export(-1))	0.03 [3.55]	-0.00 [-0.47]	0.62 [3.02]	-20.49 [-1.21]	0.64 [2.94]	0.10 [1.36]
D(Export(-2))	0.00 [0.88]	-0.00 [-0.84]	0.12 [0.56]	-31.10 [-1.80]	-0.37 [-1.67]	-0.08 [-1.03]
D(External Debt(-1))	8.79 [1.77]	-2.30 [-1.66]	0.00 [2.44]	0.12 [1.14]	0.00 [1.31]	0.00 [2.69]
D(External Debt(-2))	0.00 [2.86]	-2.37 [-1.62]	0.00 [2.28]	0.25 [2.27]	-0.00 [-0.47]	0.00 [0.85]
D(Import(-1))	-0.01 [-2.80]	1.09 [0.09]	-0.23 [-2.01]	-6.03 [-0.64]	-0.51 [-4.24]	-0.08 [-1.88]
D(Import(-2))	-0.00	4.40	-0.04	4.17	-0.20	-0.06

	[-1.11]	[0.05]	[-0.41]	[0.57]	[-2.09]	[-1.90]
D(Remittance(-1))	-0.01 [-0.60]	0.00 [0.71]	-0.19 [-0.65]	9.89 [0.41]	-0.10 [-0.32]	-0.47 [-4.45]
D(Remittance(-2))	0.02 [1.80]	0.00 [0.50]	0.51 [1.70]	59.67 [2.42]	0.11 [0.36]	0.00 [0.07]
C	-3.08 [-1.44]	0.18 [2.98]	-104.75 [-1.88]	12473.25 [2.72]	38.38 [0.65]	-34.36 [-1.71]
Note. [] denotes t statistics. Source: Author's calculation.						

Table 7 displays the VECM outcome. The dependent variable's convergence to the same value is shown by the error correction term (ECT) marked by "CointEq1". The ECT is statistically significant at 0.02, indicating that errors from the previous year will be adjusted at a rate of 2% the next year.

Variance Decomposition: Another supplementary test, the variance decomposition analysis, has been employed with Granger causality test to reinvestigate the sample impacts. The outcome shows how much of the GDP's own shock is accounted for by its own movements and selected macroeconomic variables over the course of the 10-month forecast period. The findings in Table 8 demonstrate that as the time horizon is extended up to 10 months, the amount of GDP variance that can be explained on one's own decreases. At horizon 2, own accounts for 96% of the GDP variance. Consequently, when the horizon is raised to 10, 55% of the GDP variance can be accounted for by itself. It emphasizes the possibility that, over longer time periods, variations in other macroeconomic parameters may cause variations in GDP.

Table 8: Variance Decomposition of GDP.

Period	S.E.	GDP	Import	Export	External Debt	Remittance	Exchange Rate
1	14.24	100.00	0.00	0.00	0.00	0.00	0.00
2	15.29	95.73	0.25	0.22	1.22	2.57	0.01
3	16.50	88.75	0.33	4.17	1.70	5.04	0.01
4	18.22	73.12	0.74	18.73	1.51	5.81	0.08
5	19.44	65.08	0.80	26.55	1.44	6.05	0.08
6	20.56	60.40	1.01	30.31	1.74	6.26	0.28
7	21.95	59.95	0.90	30.22	2.46	5.88	0.58
8	23.04	59.28	0.90	30.57	2.56	5.96	0.72
9	24.26	57.59	0.93	31.85	2.66	6.24	0.73
10	25.28	55.32	0.98	33.63	2.85	6.52	0.70

Table 9: Sensitivity Analysis.

Test Statistics	LM Version (Prob.)	F-Version (Prob.)
a. Serial Correlation	43.48126 (0.1829)	
b. Heteroskedasticity		1.190795 (0.3170)
c. Normality	4.115733 (0.127726)	

The study also conducted sensitivity analysis to check for serial correlation and heteroscedasticity. The results are reported in Table 9. These results affirm the absence of serial correlation and heteroscedasticity problems. Additionally, it proved that the model was normally distributed.

Conclusion and Policy Recommendation: The study applied vector error correction approach and Granger causality test in modelling the linkage between GDP growth of Bangladesh and some selected macro variables like external debt, exchange rate, exports, imports, and foreign remittance inflows using monthly time series data from January 2010 to June 2022. Variables have found I(1) resulted from ADF unit test, and cointegrated from Johansen cointegration test. The estimated error term coefficient is significant and holds negative sign that depicts economy will be corrected at 2 percent speed in a year. Furthermore, pair-wise Granger causality test revealed bidirectional causality between GDP and export, GDP and remittance, and GDP and external debt which is supported from that of the short run dynamics of vector error correction model. Hereby, bidirectional causality indicates that export, remittance, and external debt impact GDP and, if GDP increases or decreases, the export, remittance and external debt will be increased or decreased. In addition, the ongoing external and domestic challenges may keep Bangladesh's macroeconomic factors under pressure in the coming years. These pressures may further deteriorate the upcoming growth, as predicted by various international organizations, due to the Russian-Ukraine war and global price hike.

References

- [1] International Monetary Fund (2022, October) World Economic Outlook (imf.org)
- [2] Bangladesh Bureau of Statistics (2023, February) বাংলাদেশ পরিসংখ্যান ব্যুরো-গণপ্রজাতন্ত্রী বাংলাদেশ সরকার (bbs.gov.bd)
- [3] Export Promotion Bureau (2022, July)Export Promotion Bureau-Government of the People's Republic of Bangladesh (epb.gov.bd)
- [4] Bangladesh Bank (2023, February) Bangladesh Bank (bb.org.bd)
- [5] The World Bank, 2023, Bangladesh. <https://data.worldbank.org/country/BD>
- [6] Meyer, D., & Shera, A. The impact of remittances on economic growth: An econometric model, *Economia*, 18(2), (2017) 147–155.
- [7] Tahir, M., Khan, I., & Shah, A. M. Foreign remittances, foreign direct investment, foreign imports and economic growth in Pakistan: A time series analysis. *Arab Economic and Business Journal*, 10(2), (2015) 82–89.
- [8] Ajmi, A. N., Aye, G. C., Balcilar, M., & Gupta, R. Causality between exports and economic growth in South Africa: Evidence from linear and nonlinear tests, Working Papers 201339. University of Pretoria, Department of Economics (2015).
- [9] Makun, K.K. Imports, remittances, direct foreign investment and economic growth in Republic of the Fiji Islands: An empirical analysis using ARDL approach, *Kasetsart Journal of Social Sciences*, 39 (3), (2018) 439-447
- [10] Madura, J. Financial markets and institutions. Cengage learning. (2014).
- [11] M.M. Habib, E. Mileva, L. Stracca The real exchange rate and economic growth: Revisiting the case using external instruments, *Journal of International Money and Finance* 73 (Part B), (2017), 386-398.
- [12] Tang, B., Real Exchange Rate and Economic Growth in China: A Cointegrated VAR Approach, *China Economic Review*, 34, (2014), 293-310
- [13] Ramzan M, Ahmad E, External debt growth nexus: Role of macroeconomic policies, *Economic Modelling*, 38, (2014), 204-210
- [14] Wang R, Xue Y, and Zheng W, Does high external debt predict lower economic growth? Role of sovereign spreads and institutional quality, *Economic Modelling*, 103, (2021).