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The Effect of Inflation and Unemployment on GDP: Evidence from Bangladesh

Sojib Bhawmick[1], Shamima Akter[2] & Fazlul Haque[3]

[1,2]Department of Economics, Dhaka International University, Dhaka-1212, Bangladesh

[3]Department of Sociology, Dhaka International University, Dhaka-1212, Bangladesh

Corresponding Author: Sojib Bhawmick**, Email:** sojibbhawmick.diu@gmail.com

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ABSTRACT

This study aims to investigate the impact of inflation and unemployment on GDP in Bangladesh from 1991 to 2021. The study utilizes unit root tests, the Autoregressive Distributed Lag (ARDL) Bound test, and the Error Correction Model (ECM) to analyze the relationships between these variables. The results indicate that GDP and inflation are stationary at both the level and first difference, while unemployment is stationary at the first difference and at the same time all three variables are stationary at the first difference. The ARDL Bound test reveals that both inflation and unemployment are harmful to GDP, hindering its growth over time. The F-statistics indicate a consistent relationship between the variables. The Error Correction Model shows a high correlation between the variables in both the short- and long-term, accounting for 82% of the equilibrium deviation. The findings suggest that policymakers should pay attention to the levels of inflation and unemployment in the country, as they have a significant impact on GDP growth.

Keywords: GDP, Inflation, Unemployment, Augmented Dicky-Fuller, Bangladesh

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INTRODUCTION

An economy's overall health is influenced by the complex interactions between Gross Domestic Product (GDP), inflation, and unemployment. Bangladesh, a South Asian country with a population of over 160 million, has struggled economically over the past few decades. Due to a high population density, limited resources, and a lack of infrastructure, the country has had difficulty establishing sustained economic growth.

The economic production of a nation is typically measured using the Gross Domestic Product (GDP). Many studies on GDP, its measurement, and its effects on various facets of a country's economy have been done over the years. Bangladesh's GDP has grown significantly in recent years: one of the world's swiftly-growing economies, the GDP of Bangladesh increased at an average pace of 6.4% per year between 2010 and 2019, according to the World Bank (World Bank, 2021). Any key part of Bangladesh's economy is agriculture: Agriculture continues to be a major engine of economic activity in Bangladesh, employing around 40% of the labour force and contributing about 15% of GDP, despite the expansion of other sectors like manufacturing and services (World Bank, 2020). Investment in infrastructure, including roads, bridges, and ports, has helped to promote trade and commerce, resulting in a rise in economic activity and the creation of jobs. Infrastructure development has been a primary driver of economic growth in Bangladesh (Islam et al., 2019). Although Economic growth has assisted in lowering poverty and raising living conditions for many Bangladeshis, income inequality continues to be a significant problem.

A crucial economic indicator, a measurement named inflation shows how quickly prices for goods and services are growing overall. Excessive inflation can weaken consumers' purchasing power and make a country's exports less competitive. The Bangladesh Bureau of Statistics reports that from 2015 to 2019, the country's average annual inflation rate was 5.6%. (Bangladesh Bureau of Statistics, 2020). This is much less than the nation's typical inflation rate throughout the 1990s, which was roughly 7-8%. (Rahman, 2015). In Bangladesh, the cost of food is a major factor in inflation. Food expenses make up a sizable portion of household spending in Bangladesh, and fluctuations in food costs can have a substantial impact on overall inflation. According to a 2017 study by Ahmed and Hossain, Bangladesh's overall inflation is strongly and significantly impacted by the rise in food prices. In Bangladesh, monetary policy has been successful in containing inflation: The Bangladesh Bank, the nation's central bank, has employed several strategies to reduce inflation, including limiting bank lending, managing

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exchange rates, and establishing interest rates. According to a study by Ahsan et al. (2018), Bangladesh's monetary policy has been successful in containing inflation, especially in recent years. Bangladesh is susceptible to climate change, which can result in crop failures and other disruptions to the food supply, which might increase inflationary pressures. In Bangladesh, particularly in rural regions, climatic shocks like floods and cyclones might cause inflationary pressures, according to a study by Sarker et al. (2018).

The fraction of the workforce that is not now employed but is actively looking for a job is known as joblessness. It is a crucial economic metric that reveals the state of the labour market and the economy as a whole. Bangladesh's unemployment rate is high: The unemployment rate in Bangladesh was 4.2% in 2019–20, according to the Bangladesh Bureau of Statistics. Yet, because so many employees are employed in the unofficial sector or are underemployed, the actual unemployment rate might be greater (Bangladesh Bureau of Statistics, 2020). Bangladesh's youth unemployment problem is a serious issue. Young people in Bangladesh have a difficult time obtaining work, especially in the formal sector. According to a report by Islam and Islam (2019), Bangladesh had a 10.6% young unemployment rate and a 31.7% underemployment rate in 2017. In Bangladesh, women confront considerable obstacles to employment: Social conventions that limit women's mobility and access to education and training are among the primary obstacles that prevent them from finding employment in Bangladesh. In Bangladesh, women made up just 36% of the labour force in 2016, according to a study by Rahman and Rahman (2018), and they were disproportionately employed in low-wage, unstable jobs. Reducing unemployment in Bangladesh requires investment in education and training: Enhancing worker education and training options may assist Bangladesh to reduce its unemployment and underemployment rates. High food prices and supply chain disruptions have made inflation a recurring problem for the economy.

It found a positive rapport stands between GDP per capita and long-term economic growth made by Mankiw, Romer, and Weil in a fundamental paper published in 1992. Also, they found that countries with higher initial GDP per capita levels tended to increase more slowly than those with lower initial GDP per capita levels, suggesting that poorer countries have more opportunity for growth than richer ones.

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LITERATURE REVIEW

The sustainability of an economy can also be determined by looking at macroeconomic metrics like GDP, inflation, and unemployment. Due to the negative correlation between GDP and unemployment, GDP growth can simultaneously raise inflation and lower unemployment. Rising inflation occurs from an increasing economy whereas dropping unemployment does not, similar to how inflation and unemployment are negatively associated. In his work, Mahammad Ramzan (2021) postulates that ECM demonstrates that the link between variables in Pakistan is statistically negligible. The result, however, is significantly influenced by generalizing Hansen's threshold model, which examines the connection between economic development, inflation, and unemployment in developing nations. Moreover, an ADF method reveals that economic expansion, inflation, and are independent of one another in Bhutan. In addition, inflation has a negative long-term and short-term association with unemployment (Ugyen Tenzin 2019). On the other hand, a study by Marwa and Chokri (2019) using Granger Causality testing and ARDL discovered a similar association between economic expansion and inflation and between economic expansion and unemployment.

According to Sumartini and Riswanto's (2017) extrapolation using a simple regression and simple correlation approach, Indonesia's economic growth is slowed down by inflation and unemployment at exponential rates. In contrast, economic growth and inflation in Africa show a nonlinear relationship. As a result, for the continent's middle-income countries, reduced inflation rates are a sign of strong economic growth (Ndoricimpa 2017). Also, a study that was carried out in Iraq to examine the reliability of the Philips Curve theory was able to conclude that unemployment and inflation, both of which are normally detrimental to a nation's economic growth, are in balance (Lucy and et al. 2017). Once more, the OLS diagnostic reveals that in Nigeria, RGDP, inflation, and unemployment all have long-term relationships—more specifically, inflation and unemployment are positively related to RGDP (Abdusalam et al. 2016). The outcome of the conducting varies amongst economies. A study's conclusion could be true for one economy while being false for another. Nikolaous and Pavlos employed the ARDL and ECM models in 2016 to check the protracted directional link between growth and inflation, as well as the unidirectional connection that exists between growth and joblessness in Greece. Yet, unemployment and inflation have a large and negative influence on economic expansion over the long run, implying that if unemployment and inflation both surpass a certain threshold, economic growth would be diminished (Mehrnoosh and Feizolah 2016).

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The economic principles that govern the economy have a considerable impact on variables like joblessness and inflation. The coefficient of determination shows how effective monetary and fiscal policies are at lowering inflation and unemployment (G. Jelilov et al. 2016). While inflation and joblessness both hurt Nigerian economic growth, interest rates have a significant positive impact, according to OLS. It is intriguing that global and domestic supply networks, rather than total demand, may be responsible for the link between price inflation and economic expansion (M Yelva et al. 2015). Moreover, Malam and Auwal's (2015) research using OLS and ADF shows that, whereas inflation has a telling influence on economic expansion, unemployment has little to no impact. Moreover, the factors' dependency may shift over time. An ADRL approach, on the other hand, asserts that there is a long-run causal connection among parameters since the three variables are stable at the starting difference (M Shahid, 2014). For an economy, inflation is a blessing, but if it rises faster than anticipated, it can choke off economic progress. The projected inflation level for developing nations like Nigeria is found to be 13% using the threshold regression model. Mild economic growth is observed below the predicted inflation rate, whereas at levels above those levels, the economy stagnates (Bawa and et al. 2012). A VAR model is used by Chang and Liu (2012) to elicit the findings of the investigation: in the near run, economic growth and unemployment move in the same direction, however inflation and unemployment move in opposition. An equilibrium relation endures across time. The threshold model determines that the outcome is significant for emerging countries both economically and statistically (Alexander Bick, 2010The inflation threshold differs between industrialized and developing economies; in the former, it has a severe negative impact when the rate reaches about 8%, while in the latter if it stays around 3%, the growth rate is inverted. Moreover, there is a divergence in the nonlinearities between industrial and emerging economies (Burdekin et al. 2004). The study of GDP growth and inflation in Fiji discovered a little negative association between the two variables, and the link is one-way from inflation to growth (V Gokal and et al. 2004).

As inflation is a vital issue in Bangladesh nowadays, the prices of necessary goods are increasing exponentially. So, the purpose of this study is to ascertain how Bangladesh's economic development is impacted by inflation and unemployment.

RESEARCH METHODOLOGY

Research Design

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An analysis of the short- and protracted associations between parameters is done in this phase of the study using a quantitative correlation approach. The association between GDP growth, inflation, and unemployment are evaluated using a range from -1 to 1. The correlation will also validate how inflation and unemployment affect Bangladesh's GDP.

Data Collection

To concentrate on the outcome, this research utilizes secondary series data for the periods of 1991 to 2021 for GDP, inflation, and unemployment. To extrapolate a result among factors, annual percentage time-series statistics from the World Bank, Bangladesh Bureau of Statistics, IMF, and ILO are collected.

Model Specification

Multiple regression analysis is used to calculate prospective outcomes by estimating the connection between variables. The multiple regression model is as follows:

$$\ln GDP_t = \beta_0 + \beta_1 \ln INF_t + \beta_2 \ln UNE_t + \mu$$

where,

GDP= Gross Domestic Product

INF = Inflation

UNE = Unemployment

μ = Error Term

t = 1991-2021

Research Statistics

EViews and MS Excel are the statistical programs used in this study to look into the relations between both the dependent and independent variables.

Unit Root Method

To assess if a time-series parameter has a constant or quasi-trend, apply the unit root test to the data. A unit root occurs when the data's mean and variance do not remain constant over time. A typical unit root test is the Augmented Dickey-Fuller (ADF) test, which looks for stationarity in a univariate series of time series. The ADF approach is used to assess if the initial difference in the data is stable.

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The unit root null hypothesis is ignored and the data are viewed as stationary if the test statistic is smaller than the crucial value.

Lag Selection Criterion

The best lag value for time series variables is estimated while accounting for overfitting using the Akaike Information Criterion (AIC), Schwarz Criterion (SC), Final Prediction Error (FPE), and Hannan-Quinn Information Criterion.

The row with the most star (*) marks represent the study's recommended lag time.

ARDL Bound Test

A statistical test known as the ARDL (Autoregressive Distributed Lag) bound test is utilized to assess if two or more variables in a time series of data have a protracted interconnection. The test is intended to assess whether cointegration (a situation in which variables are not independent but rather move together over time) is present.

ARDL(p,q,r) Model: $\delta_1 GDP_{t-1}$

$$\ln GDPt = \alpha + \beta_1 INF + \beta_2 \ln UNE + \sum_{p}^{i=1} \delta_1 \ln GD P_{t-i} + \sum_{q}^{j=1} \delta_2 IN F_{t-j} + \sum_{r}^{k=1} \delta_3 \ln UN E_{t-k}$$

The F-statistic for the cumulative significance of the lagged variables may be obtained after estimating the ARDL(p,q,r) model. Hypothesis H0 of no cointegration is denied and a long-term connection among the variables is inferred if the computed F-statistic is higher than the higher critical value from the pertinent table.

Error Correction Technique

The ECM approach computes a dependent variable's short-term trajectory in terms of both its unique historical values and the historical values of one or more independent variables. After then, an error-correction component is included to account for long-term deviations from equilibrium. The error correction model is

$$\Delta GDP_t = \alpha + \beta_1 \Delta GDP_{t-1} + \beta_2 \Delta INF_t + \beta 3 \Delta UNE_t + \lambda ECM_{t-1} + \varepsilon_t$$

The ECM_{t-1} term represents the restoration of GDP to its long-run expected level. It is determined as the difference between the GDP's predicted long-run equilibrium level and its

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actual value during the prior era (t-1). To guarantee convergence to equilibrium, the coefficient, which measures how quickly GDP adjusts to its long-run equilibrium level, should be negative.

Residual Diagnosis Test

To assess the behaviour of the variables in the residual diagnosis test, autocorrelation and heteroscedasticity were undertaken. The Serial Correlation LM test is performed after creating a regression model and obtaining the residuals. The hypothesis (H_0) of the test states no statistical link in the residuals, whereas hypothesis H_1 states that there is. Heteroscedasticity can affect the significance of the model's independent variables and lead to inaccurate and biased parameter estimations. The Glejser test is employed to confirm the heteroscedasticity problem. If the null hypothesis is accepted, heteroscedasticity is not a problem.

CUSUM Stability

The cumulative sum is applied to show the stability of this research, which gauges if the study is valid or not. Often, process shifts or drifts in mean values or other parameters are tracked using the CUSUM chart.
On the graph, the total number of deviations from the goal value or mean is shown over time.

RESULT AND DISCUSSION

Descriptive Statistics

This result is an overview of the study where it shows a total of 31 observations of time series data.

Table 1: Descriptive Statistics

	GDP	INF	UNE
Mean	5.596637	6.093600	3.747097
Median	5.442686	5.702070	4.120000
Maximum	7.881915	11.39517	5.420000
Minimum	3.448021	2.007174	2.200000
Std. Dev.	1.177735	2.242715	0.915053
Skewness	-0.069858	0.169121	-0.238932
Kurtosis	2.127810	2.977563	2.015487
Jarque-Bera	1.007804	0.148427	1.546928
Probability	0.604169	0.928473	0.461412
Obs.	31	31	31

Source: The Author

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The mean and median values are both around 5.5 for GDP, around 6 for unemployment and around 3.7% for inflation. The distribution is approximately symmetric (skewness = -0.07) and has a moderate level of kurtosis (2.1) for GDP. The distribution is slightly right-skewed (skewness = 0.17) and has a high level of kurtosis (2.98) for unemployment as well as the distribution is slightly left-skewed (skewness = -0.24) and a moderate level of kurtosis (2.02), for inflation which suggests that there may be some outliers in the data. Per the Jacque - bera test, the distribution is normal for all variables.

Unit Root Tests Results

The empirical econometric analysis approaches fixing the non-stationary issue in 31 years of yearly time series data. The extensively used method of stationary is the Augmented Dicky-Fuller test that accesses the state of time series data trend or without trend, subsequently ADF test.

Null hypothesis (H_0): Established root for variables.

H_1: No established unit root for variables.

Table 2: Trend and Intercept

	Augmented Dickey-Fuller Unit Root Test							
Variables	t-Stat.	5% Critical value	P value	Decision	t-stat	5% critical value	P value	Decision
GDP	-5.437	-3.568	.0006	I(0)	-8.073	-3.574	.0000	I(1)
INF	-4.062	-3.568	.0172	I(0)	-7.375	-3.580	.0000	I(1)
UNE	-2.937	-3.568	.1657	I(1)	-5.404	-3.587	.0008	I(1)

Source: The Author

Following the data above, the absolute values for the test statistic of r GDP and inflation are 5.347 and 4.062, respectively, which are more than the 5% critical value of 3.568, indicating that it is stable at level form I. (0). At the same, the null hypothesis for unemployment cannot be accepted and it is stationary after first difference I (1).

Results of Lag Length Criteria

The lag selection process is employed to anticipate the current value of the dependent variable by portraying past dependent values. Table 3 serves as a basis to perform the VAR lag validation set.

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Table 3: Lag Selection

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	141.0139	NA	4.1307	9.9319	10.0734	9.97629
1	113.9092	46.7323*	1.1913	8.6834	9.24917*	8.86058
2	102.7741	16.8947	1.0531*	8.5362*	9.52625	8.84623*

Source: The Author

Note 1: (*) Indicates lag order selected by the criterion.

LL = Log Likelihood, LR = Likelihood Ratio, FPE = Final Prediction Error, AIC = Akaike Information Criterion, HQIC = Hannan-Quinn Information Criterion, SBIC = Schwarz Bayesian information criterion

The result in table 3 presents the optimal lag value of time series variables. The star (*) mark determines optimum lag. The maximum number of star marks of FPE, AIC, and SBIC on row 3 deduces that the optimum lag is 2 for all variables.

Bound Test for Co-Integration

The following table shows the outcome of the ARDL bound testing technique for a long-term connection:

Null Hypothesis (H0): No long-run association
Alternative Hypothesis (H1): Long-run association

The higher F-statistics determine the rejection of the null hypothesis.

Table 4: Co-integration

Variable	F-Stat.	Lower Critical Value		Upper Critical Value		t-statistics	Co-integration
		10%	5%	10%	5%		
GDP	8.5077	4.19	4.87	5.06	5.85	5.36	Present

Source: The Author

The Computed F-statistic of 8.50 exceeds the top 5% important criterion, according to the findings (5.85). The lengthy correlations between the variables are shown, which is a noteworthy finding in economic research.

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ARDL (1, 0, 0) Model Long Run Coefficients Calculated Using the ARDL Model and AIC

Table 5: (Dependent variable= GDP)

Variables	GDP (1, 0, 0)			
	Coefficient	S. Error	t-statistics	Probability
INF	-0.088326	0.057769	-1.528951	0.1458
UNE	-0.679823	0.313090	-2.171330	0.0453
Constant	8.196001	1.432396	5.722280	0.0000
Trend	0.177722	0.041168	4.317050	0.0005

Source: The Author

The coefficient for INF is -0.088326, which means that, when UNE is held constant, an increase in INF of one unit is accompanied by a loss in GDP of 0.088326 units. According to the UNE coefficient of -0.679823, a one-unit rise in UNE corresponds to a 0.679823-unit loss in GDP while holding INF constant. The GDP value that is anticipated when INF and UNE are both zero is represented by the constant term, 8.196001. INF's t-statistic is -1.528951, whereas UNE's t-statistic is -2.171330. The constant term is statistically significant, as shown by the big t-statistic for the constant. The p-values for each coefficient, are used to test whether the coefficient is equal to zero, which is the null hypothesis. The p-value of 0.1458, which is more than 0.05, indicates that the INF coefficients are not statistically relevant even at the 5% threshold of significance. The UNE coefficient is clinically meaningful at the 5% level of significance, as indicated by the p-value of 0.0453, which is less than 0.05. The constant term is statistically relevant, as evidenced by its extraordinarily low p-value.

Error Correction Model

Table 6: ECM Test

Variables	GDP (1, 0, 0)			
	Coefficient	S. Error	t-statistics	Probability
ECT(-1)	-0.821337	0.184130	-4.460650	0.0001
Une	-0.439125	0.434815	-.1.009914	0.3218
Inf	0.040682	0.064984	0.626029	0.5368
R^2	0.520178			
Ad. R^2	0.464814			
F-statistic	9.395580			

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F-significance	0.000223			
Durbin-Watson	2.185568			

Source: The Author

The table presents the following information:

In other words, a one-unit increase in the delayed error correction term corresponds to a 0.821337 unit decrease in economic growth. ECT(-1) correlates with -0.821337. The error correction term functions as a method to restore the dependent variable to its long-run equilibrium level, as indicated by its negative sign. The t-statistic for ECT(-1) is -4.460650 at the 5% threshold for statistical significance. The p-value of 0.0001 indicates that the coefficient for ECT(-1) is clinically meaningful at the 5% level of significance. The amount of variability in the dependent variable is explained by the independent variables and the error correction term is measured by the R-squared value of the ECM. The independent variables and the error correction term account for approximately 52% of the diversity in economic progress, according to the R-squared value of 0.520178. 0.464814 is the revised R-squared value. The F-statistic evaluates the regression model's overall statistical significance. The ECM is statistically significant at the 5% level of significance, according to the F-statistic of 9.395580. The residual autocorrelation is tested using the Durbin-Watson statistic, which is 2.185568. The value in this table is unimportant, and a value near 2 indicates that there is no autocorrelation.

The Diagnostic Test

To confirm the stability of the study, a post-estimation diagnosis procedure using serial correlation and the heteroscedasticity test is used. The outcome is evaluated using the following hypothesis: Serial Correlation;
Null hypothesis (H0): No serial correlation
Heteroscedasticity (H0): There is no heteroscedasticity.

Table 7: Diagnosis Test

Item	Test applied	Chi-square	Prob
Serial Correlation	Breusch-Godfrey	0.2092	0.2667
Heteroscedasticity	Glejser	0.5948	0.6309

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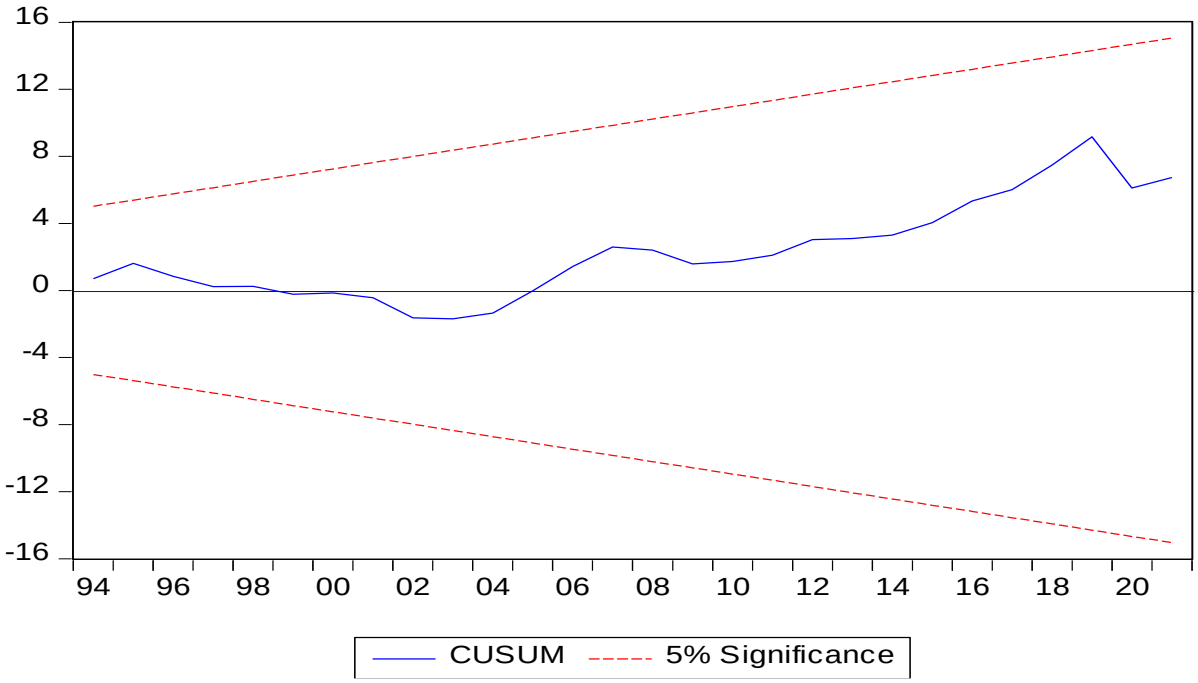
The test statistic in this instance is 0.2092, and the p-value is 0.2667. As the p-value is higher than 0.05 (with a 5% significance level), we do not rule out hypothesis h0 and conclude that serial correlation is not present in Model 1 residuals. The null hypothesis is that there is no serial correlation in the residuals, while the alternative hypothesis is that there is a serial correlation.

The Glejser measure is used to find heteroscedasticity in a regression model's residuals. The test statistic is 0.5948 in this instance, while the value p statistic is 0.6309. We cannot reject the null hypothesis and infer that the residuals contain no indication of heteroscedasticity because the p-statistics value is bigger than 0.05.

Model stability check

Cumulative Sum (CUSUM)



Source: The Author

Brown et al (1975) developed the Cumulative Sum of recursive (CUSUM) approach to assess the consistency of the estimated coefficient of the domestic solution for Bangladesh. The CUSUM plot fails to meet the 5% threshold of severity, which indicates that the variables are stable over time. The regression coefficient is so appropriate and trustworthy for determining policies.

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CONCLUSION

This paper extracts a revealing interconnectedness between GDP, unemployment, and inflation using and emphasizing the aforementioned time-series data from Bangladesh between 1991 and 2021. The Bund Test expresses a long-run connection between variables, which is a significant result in the context of economic study, more specifically, a unit change in inflation and unemployment negatively impacts the GDP. Besides, the Error Correction Model reveals, one unit increase in lagged error correction term is associated with a -0.821337 unit decrease in Economic Growth, which means the error correction adjusts the dependent variable in the long-run equilibrium level by 82 per cent every year. Furthermore, Heteroscedasticity Glejser Test and Serial Correlation LM Breusch-Godfrey show that there is no heteroscedasticity and autocorrelation problem respectively.

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