



Original Research

The Nexus Between Economic Growth, Inflation and Unemployment: A Vector Error Correction Model

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Abstract

The dynamic relationship between inflation, unemployment, and economic progress is an extensively researched subject with significant ramifications for policy formulation in every economy. However, Bangladesh continues to face the challenges of elevated inflation and unemployment. So, we provide attention to investigating this relationship over the period from 1993 to 2023. We investigate this relationship using vector error correction model (VECM) and also employ the Johansen co-integration test to show the long-run relationships among the variables. To accomplish this, we collect data from the reputable Macrotrends website, specifically dedicated to Bangladesh, which is available at <https://www.macrotrends.net/countries/BGD/>. The results show that inflation and unemployment have a significant positive relationship with gross domestic product. It implies that inflation tends to affect economic growth and that unemployment does not hamper the economic development of our country. To check the accuracy of our results, we furthermore use the CUSUM tests, which show that the regression results are valid and can be used to formulate policy because they do not intersect the 5% critical lines.

Keywords— *Economic Development, Inflation, Unemployment, VECM, Bangladesh*

Introduction

Maintain low or moderate level of inflation and keeping unemployment at a stable level has become a major macroeconomic issue in a developing country like Bangladesh. Depending on the degree and cause of inflation, it can either stimulate or hinder economic growth. In certain circumstances, inflation can lead to increased business investment and consumption, while in others, it can reduce purchasing power and negatively impact the economy. Unemployment is another critical factor that can impact both inflation and economic growth. High levels of unemployment can reduce consumer spending, increase social welfare costs, and contribute to inflation. But, in some situations, economic development can happen even when unemployment is rising. This is called "jobless growth." This phenomenon is seen in economies experiencing structural transformation, characterized by expansion propelled by capital-intensive sectors rather than labor-intensive businesses. In these situations, GDP goes up, but new jobs don't come along as quickly. This makes for an unexpected positive link between unemployment and growth. While these three macroeconomic indicators have been extensively studied on a global scale, there remains a lack of comprehensive understanding of

their dynamics combined within the specific context of Bangladesh. Hence, we address this knowledge gap by utilizing the vector error correction model (VECM) as an analytical framework, drawing upon existing scholarly literature as the theoretical basis.

Literature Review

Inflation and economic development

Achieving rapid and sustainable economic growth is the main objective of most countries, but it can be challenging to accomplish because of several factors that influence economic growth. Inflation is among the numerous variables that can forecast economic growth [1]. However, the relationship between the two remains a debatable topic in both theoretical and empirical research [2]. Previous research and theoretical frameworks suggest that there might be no correlation [3], [4] [5], [6], or a negative correlation [7],[8] between them. Even though there is no empirical evidence to support this claim, the study conducted by [9] revealed that a significant portion of the population continues to maintain the notion that inflation exerts a detrimental influence on the economy. The findings of [10],[11], and [12] that indicate nations with exceptionally high or low rates of inflation have an impact on economic growth are supported by this study. However, certain instances have demonstrated a favorable link in the association [13], [14]. [15] showed that there exists a strong and persistent positive correlation between the level of inflation and growth.[16] later confirmed these findings. The study conducted by [17], which covered the period from 1978 to 2010, did not identify any clear relationship between them.

Unemployment and economic growth

The paramount objectives of both developed and emerging economies are to diminish unemployment and attain a substantial pace of economic expansion. Economic development and job creation are crucial macroeconomic indicators that significantly impact the performance of a nation's economy. These two vital factors are essential components of economic policy, particularly in emerging nations. [18] found a direct correlation between a 1% drop in joblessness and a 3% gain in output growth. A study by [19] showed that it persisted throughout the postwar period in 16 OECD nations. There is compelling evidence indicating that structural deficiencies emerged in the 1970s, resulting in a decrease in productivity and a rise in unemployment rates in numerous nations. A study by [20] in Australia found a link between higher worker productivity and lower production, which could contribute to higher unemployment rates. According to the calculations, to decrease the number of unemployed by 1%, the pace at which real output grows must surpass 2.4%. However, in times of economic recession, this percentage increases to 4.53%. [21] established a negative correlation between Iran's unemployment rate and GDP growth. In their study by [22] argue that Eastern European nations demonstrate a positive association between economic expansion and joblessness. Particularly, a 1% rise in GDP results in a 0.08% decrease in the jobless rate. [23] studied relationship between economic expansion, inflation, and joblessness in Bhutan from 1998 to 2016. The study showed no link between economic prosperity and lower unemployment, but it did discover a link between rising jobless rates and growing economies. [24] also found a consistent correlation between real

GDP, unemployment, and inflation in Nigeria from 1981 to 2014. But the researchers' findings were only partially consistent with Bangladesh. [25] observed a direct relationship between economic expansion and joblessness, however, [26] identified an inverse relationship. [27] also discovered a reverse correlation between the rate of economic growth, as measured by the GDP, and the level of unemployment. The document is structured as follows: Section three explains data sources and econometric methodology. Section four presents the theoretical framework. Section 5 and 6 provide a summary of the findings and policy implications.

Materials and Methods

The data was sourced from the reputable Macrotrends website, specifically dedicated to Bangladesh, and is available at <https://www.macrotrends.net/countries/BGD/>. Macrotrends gets formal data from global organizations such as IMF and World Bank, also from national sources. This makes sure that the data is accordant and reliable across lengthy periods of time. This makes it a quality dataset for econometric modeling from 1993 to 2023. Even so, it is important to acknowledge that dependence on a singular database may poorly reflect country-specific intricacies. For instance, information from the Bangladesh Bureau of Statistics (BBS) or the International Monetary Fund's (IMF) International Financial Statistics might make the statistics completer and more reliable. However, Macrotrends was selected for this study because of its accessibility, dependability, and uniformity across all three principal variables of interest. Subsequent study should endeavor to integrate numerous datasets to validate the robustness of findings. The study utilizes a four-step process to ensure the excellence and reliability of the findings: Unit root test, Lag length selection, Cointegration test and Vector error correction model (VECM).

Result and Discussions

Unit root test

We use ADF [28] and Phillips -Perron [29] unit-root tests to evaluate the stationary characteristics of the data sets. The test results in Tables 1 and 2, when considering their first differences, indicate that the variables $\Delta \ln IFR$, $\Delta \ln UMPR$, and $\Delta \ln GDP$ are I (1) series.

$$\Delta x_t = \delta_0 + \delta_1 t + \delta_2 x_{t-1} + \sum_{i=1}^m \alpha_i \Delta x_{t-i} + u_i \quad (1)$$

Table 1. The ADF Unit root test

Critical values	1%	5%	10%	t-statistics	Prob*
$\Delta \ln GDP$	-3.679322	-2.967767	-2.622989	-8.339848	0.0000
$\Delta \ln IFR$	-3.689194	-2.971853	-2.625121	-7.407185	0.0000
$\Delta \ln UMPR$	-3.699871	-2.976263	-2.627420	-5.451831	0.0001

Table 2 The Phillips-Perron test.

Critical values	1*	5%	10%	Adj. t-statistics	Prob*
$\Delta \ln GDP$	-3.679322	- 2.967767	-2.622989	-13.62652	0.0000
$\Delta \ln IFR$	-2.967767	-	-2.625121	-10.57054	0.0000

		2.971853			
$\Delta \ln \text{UMPR}$	-2.622989	- 2.976263	-2.627420	10.33885	0.0000

Source: EViews output

Lag selection

After successfully conducting the unit root test, the lag sequence requirements are employed to ascertain the maximum lag length for the model. The results regarding the duration of lag are presented in Table 3. Therefore, the study employs SIC [30] criteria to determine the optimal lag length, which confirms 1.

Table 3. Results of lag duration

Lags	LL	LR	FPE	AIC	SC	HQ
0	-140.9385	NA	4.109253	9.926790	10.06823	9.971089
1	-113.1730	47.87141*	1.132357	8.632634	9.198401*	8.809818*
2	-102.9369	15.53068	1.064916	8.547373*	9.537484	8.857464

Source: EViews output

The Johansen and Juselius Approach

After selecting the integration sequence, the [31] method is used to perform the cointegration test, which involves two tests: the maximum-likelihood and trace tests, to identify the number of cointegrating vectors [32]. According to the academic community, the presence or absence of a trend within two or more series does not affect their consistency if they have a significant connection over a prolonged period. Johansen provided two statistical techniques to estimate the number of cointegration vectors. The objective was to handle the problem of spurious regression, which occurs when a model suggests a significant correlation between variables that don't have a causal connection. One cointegrating equation has been shown to be statistically significant at the 5% level, as indicated by Table 4.

Table 4. Results of Trace tests

CE(s)	Eigenvalue	Trace Statistic	0.05(Critical Value)	Prob. **
none*	0.472668	33.02411	29.79707	0.0205
at most 1	0.364822	14.46627	15.49471	0.0710
at most 2	0.043990	1.304626	3.841465	0.2534

Source: EViews output

Normalized cointegrating coefficients (standard error in parentheses)

An equation format can be employed to show the findings of the results presented in Table 5.

$$\ln \text{GDPR} = -0.364357 \ln \text{IFR} - 0.741837 \ln \text{UMPR}.$$

The findings indicate that over an extended period, inflation has a favorable and substantial influence on economic expansion. Unemployment is positively correlated with output. This suggests that unemployment does not hinder Bangladesh's economic progress.

Table 5. The results of normalized coefficients

Cointegrating Equation(s):	Log-likelihood	-110.1700
InGDP	InIFR	InUMPR
1.000000	-0.364357	-0.741837
	(0.10157)	(0.23283)

Source: EViews output

Vector error correction model (VECM)

In the preceding section, we established a stable and enduring link between variables by employing the Johansen test. Subsequently, the VECM was employed to examine transient fluctuations and enduring relationships among variables. In these cases, two distinct types of long-term and short-term equations emerged, the first one is as follows:

$$GDP_t = \beta_0 + \beta_1 + IFR_t + \beta_2 UMPR_t + u_t \quad (2)$$

In this equation, economic growth, inflation, and unemployment indicators are represented by GDP, IFR, and UMPR, respectively. The short-term equation is as:

$$\Delta GDP_t = a_1 + \sum_{i=1}^m \gamma_1 \Delta GDP_{t-i} + \sum_{i=1}^m \delta_1 \Delta IFR_{t-i} + \zeta_1 \Delta UMPR_{t-i} + \theta_1 ECT_{t-1} + e_{1t} \quad (3)$$

Here, the symbol Δ here stands for the difference operator, and m stands for the quantity of delays. ECT represents the error terms that result from the long-term connection.

Table 6. Results of vector error correction models

	Coefficient	Std. Error	t-Statistic	Prob.
ECT-1	-0.713289	0.229071	-3.113829	0.0047
(2)	-0.249297	0.214251	-1.163574	0.2560
(3)	-0.093050	0.084564	-1.100351	0.2821
(4)	-0.817948	0.470427	-1.738734	0.0949
(5)	0.139752	0.188794	0.740232	0.4663

Source: EViews output

Here, C (1) coefficient = residual of cointegrating vector with 1-period delay, including inflation, unemployment, and GDP growth rate. The figure -0.71389, means 71.3% of the deviation from equilibrium caused by the shock that the previous year has been fixed is now moving back toward the long-term equilibrium. The variable being looked at was statistically significant because the p-value, which was 0.004, was less than the 5% level of significance. Moreover, the results exhibits both statistical significance and a negative coefficient, indicating the presence of an ongoing causal connection between inflation, joblessness, and the pace of economic growth. The coefficient C (2) in the short-term model suggests that a 1% rise in InGDP is linked to a decline of around 0.24% in InGDP itself. The coefficients of C (3) and C (4) show that a small increase of 1% in the INIFR and InUMPR variables will cause a decrease of 0.09% and 0.81% in those variables, respectively. The variable C, with a value of 5, denotes the constant or intercept term.

Rank test

Furthermore, we use the Wald test with the joint null hypothesis of coefficients from C (3) = C (4) = 0. Table 7 presents empirical data indicating that the chi-square probability value

associated with the test statistic surpasses the predetermined significance threshold of 5%. Therefore, a statistically significant likelihood of 5% suggests the absence of any evidence supporting short-term causality.

Table 7. The results of Wald test

Test Statistic	Test Value	DF	Probability
F-statistic	1.854004	2,24	0.1783
Chi-square	3.708008	2	0.1566

Source: EViews output

Breusch-Godfrey serial correlation test

The diagnostic test results reported in Table 8 indicate no serial correlation and heteroskedasticity as confirmed by the Breusch-Godfrey serial correlation test.

Table 8. The results of serial correlation test

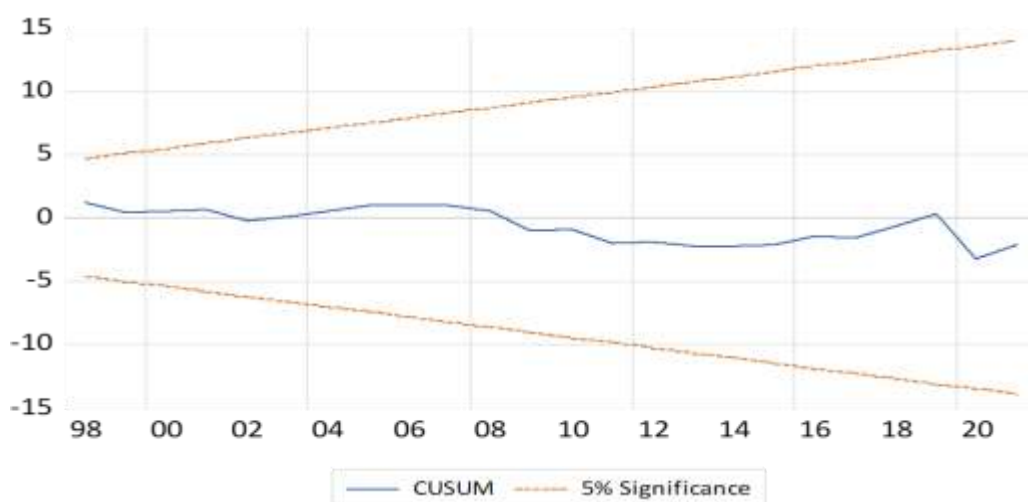
F-statistic	3.472371	Prob. F (1,23)	0.0752
Obs * R-squared	3.803919	Prob. Chi-square (1)	0.0511

Source: Author's calculations using EViews

Cumulative Square of Recursive Residuals

Aside from carrying out diagnostic procedures, it is crucial to conduct stability testing on historical data. We employ the CUSUM test. Figure 1 presents the results, which show that the CUSUM plot doesn't intersect the %5 crucial lines, demonstrating the validity of the regression coefficients and their applicability to the formulation of policy.

Figure 1. Cumulative Square of Recursive Residuals (CUSUM)



Source: Author's calculations using EViews

Limitations of the study

This study is subject to several limitations. First, it relies on secondary time-series data, which may be prone to measurement errors or data gaps. Second, the analysis is restricted to

economic growth, inflation, and unemployment, while other relevant macroeconomic and structural variables were not considered. Third, the Vector Error Correction Model assumes linear relationships and long-run equilibrium, which may not fully reflect complex economic realities. Lastly, the findings are context-specific and may not be directly generalizable to other countries or time periods.

Conclusion and Future Directions

A review of existing literature highlights the adverse effects of inflation and unemployment on economic growth, though their scale and consistency vary across models and national contexts. In Bangladesh, our findings confirm a long-run equilibrium among inflation, unemployment, and growth, but the relationships are nuanced. Both inflation and unemployment show positive correlations with GDP. While moderate inflation aligns with structuralist views of growth stimulus, the unemployment-growth link is unusual and may reflect jobless growth driven by capital-intensive sectors such as garments and manufacturing. This outcome could also partly stem from data limitations. The results reveal the complexity of Bangladesh's macroeconomic dynamics and suggest caution in interpreting the unemployment-growth relationship. Although rising unemployment has not yet hindered growth, sustainable development will require labor market reforms, targeted job creation, and skill enhancement to ensure more inclusive and equitable economic progress.

Future studies could expand the analysis by incorporating additional macroeconomic and institutional factors, such as fiscal policy, trade openness, or technological development, to capture a more comprehensive picture of economic dynamics. Researchers may also apply nonlinear or advanced econometric models to account for structural breaks and asymmetric relationships among variables. Moreover, cross-country or panel data studies could provide comparative insights and enhance the generalizability of results. Finally, examining sector-specific impacts of inflation and unemployment on growth may offer more targeted policy implications.

Policy Implications

Although the outputs of our estimated models demonstrated that unemployment and inflation do not inhibit our nation's economic progress. Despite those relationships, the task of mitigating unemployment and inflation while fostering sound economic growth presents intricate economic issues, frequently requiring a trade-off among macroeconomic factors. These findings have significant policy implications, as they suggest that inflation is beneficial to growth and that higher economic growth may lead to inflation. This fits with structuralist ideas, but we should be careful because higher inflation can cause inflationary spirals that go beyond a safe level, as shown by higher inflation elasticities. According to [33], "Chronic inflation tends to resemble smoking; once you get the habit, it is very difficult to escape a worsening addiction." However, our empirical studies suggest that policymakers should consider certain ideas to effectively manage those issues. For instance, Bangladesh's economy is heavily dependent on agriculture and the ready-made garment sector.

Encouraging individuals with diverse academic and professional experiences to explore career opportunities in those sectors could be a potential solution to address the high unemployment rate. It is also crucial to launch government incentives and assistance programs accessible to the ready-made garment (RMG) business. Due to the country's extensive pool of exceptionally proficient laborers, which is accessible to all nations. In 2022, the worldwide labor market underwent a substantial contraction due to escalating geopolitical tensions, disruptive supply chain issues, inconsistent recovery from pandemics, and the Ukraine crisis. A period of stagflation has ensued as a consequence of these factors; it is marked by substantial price increases and sluggish economic expansion. In such circumstances, the central bank could potentially exert significant influence over foreign currency devaluation, maintain price stability, regulate inflation, and foster an environment that is favorable for economic expansion by enacting sensible and cautious measures. And finally, prioritizing the adoption of risk management protocols is essential to minimize potential obstacles, such as political instability.

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Authors Contributions

Conceptualization, study design and writing-original draft, Statistical data analysis were contributed by Iqbal Hossain. Data collection, Data entry, Statistical data analysis and figure preparation were done by Shohal Hossain. All authors read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that they do not have any conflict of interest.

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