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Evaluating the Long-Run Dynamics of Inflation, Unemployment, and Exchange Rates on Economic Growth: An Econometric Analysis of Time Series Data from Bangladesh with Verification of Okun's Law

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ABSTRACT

The foreign exchange rate, jobless rate, rate of inflation, and real GDP have always been considered to be the most burning issues for the world. This study seeks to analyze the effects of exchange rates, unemployment rates, and price levels on real GDP from 1991 to 2023, utilizing time series statistical methods. The research utilized sophisticated econometric techniques to analyze the findings. The series' stationary properties were initially assessed using the Augmented Dickey-Fuller unit root test. The Johansen co-integration approach determines the variables' long-term relationship. Granger casualty test was used to determine factor causal linkages. The empirical findings from the cointegration test indicate that, over the long term, both the exchange rate and the inflation rate exert a significant positive influence on the real gross domestic product (RGDP) in Bangladesh. On the contrary, the unemployment rate adversely affects real Gross Domestic Product (RGDP) in Bangladesh, this signifies that why Okun's Law has the existence in Bangladesh. The findings from the vector error correction model (VECM) suggest that inflation and unemployment are expected to reach equilibrium following a period of error correction; however, the exchange rate and real GDP show minimal significant adjustment towards achieving long-run equilibrium. The results of the Granger test indicate a bilateral causal relationship between unemployment and the exchange rate. The findings derived from the impulse response function show that in a very few cases the external shocks have been neutralized for a certain period of time but in most cases the external shocks have not been neutralized.

Keywords: RGDP, Exchange Rate, Unemployment Rate, Inflation Rate, ADF, Co-integration, VECM, Impulse Response

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INTRODUCTION

Bangladesh's GDP growth rate in 2024- 25 is projected to be around 4% which is a significant downgrade from the 5.7% growth rate in 2023-24 (WDI,2016). According to the most recent ADB report, growth in Bangladesh's gross domestic product is anticipated to be 5.1% in the fiscal year 2024. Global trade heavily influences the financial advancement of a nation, and in the modern economy, economic development and international trade are the two most well-known ideas. For international trade, the exchange rate plays an important role. Economic development contributes to raising the country's true per capita pay, which can be sustained over a considerable period.

The primary issue facing all developing nations worldwide is unemployment. Unemployment means being able to work with the current salary but unable to find work. The unemployment rate in Bangladesh in 2024 was Approximately 4.45 percent (WDI, 2016). After experiencing a decrease in 2010 and 2011, the unemployment rate in Bangladesh has stabilized at around 4.45% (WDI, 2016). When the quantity of individuals seeking employment exceeds the number of job openings in the labor market, economists characterize this situation as unemployment. However, there is no other nation in the world facing the challenge like Bangladesh. Most people in Bangladesh like to supplement their income by working, but they are unable to find work. Bangladesh has a high unemployment rate, which is one of the things impeding the nation's economic growth. It is very challenging to assess the overall unemployment rate in a nation like Bangladesh due to the expanding issues of underemployment and unemployment that exist there. It is now acknowledged as a country in the process of developing. Many factors contribute to the increase in the rate of GDP growth. The Inflation rate has the ability to influence the unemployment rate.

Inflation is defined as the gradual fall in the currency's ability to purchase goods and services. From 2012 to 2022, Bangladesh's average consumer price inflation rate stood at 6.2%, exceeding the regional average of 2.1% for the Asia-Pacific region (Focus Economics, 2025In 2023, the inflation rate in Bangladesh, measured by the GDP deflator, was 6.9%, as reported by the World Development Indicators (WDI).

An additional significant macroeconomic element influencing a nation's economy is the real exchange rate. The real exchange rate significantly impacts the progression of economic

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growth. The unemployment rate of every country's economy can be easily measured as a result of the actual exchange rate. A positive relationship exists between the real exchange rate and the unemployment rate.

At the end of 2023, the exchange rate of the Bangladeshi currency stood at BDT 106.3095 per USD. This figure represents an increase compared to both the end of 2022, which also recorded BDT 106.3095 per USD, and the rate from a decade prior, which was BDT 77.67 per USD (WDI). The exchange rate indicates the value at which one currency can be swapped for another. Most exchange rates are categorized as floating, meaning their values vary in response to market dynamics, including supply and demand.

Unemployment is the biggest problem in any country. In Bangladesh, this problem is now acute. In our nation, the number of unemployed workers is enormous. According to the World Development indicators, the unemployment rate in Bangladesh in 2023 was 4.5 percent. Despite the fact that our economy has grown steadily as anticipated, the unemployment issue has not changed. Each year, a significant number of students in our country successfully complete their higher secondary education, However, the constraints of limited capacity in public universities, coupled with poverty and increasing educational costs, have created significant challenges, many individuals are unable to pursue higher education due to their financial constraints. The high dropout rate among students is the primary reason why the higher education attainment in our country falls short of expectations (Akter,2018). Poverty and unemployment are Bangladesh's biggest issues. This complicated issue won't get any easier if Bangladesh doesn't generate enough employment possibilities. The majority of our nation's young and educated citizens struggle with unemployment. A significant number of individuals in Bangladesh are without employment. According to the Bangladesh Bureau of Statistics (BBS), the unemployment rate stands at 4.18% of the nation's labor force. A report from the Bangladesh Bureau of Statistics indicates that there are still 3.4 million individuals without employment, despite the creation of new jobs (Alam et.al, 2020). Unemployment feeds the poverty cycle's vicious cycle. Investments are low in Bangladesh, which leads to poor employment, low income, low savings, low productivity, and vice versa. The main and most important effect of unemployment in rural areas is migration to metropolitan areas. The aims of the research are outlined below.

i) to determine whether, from Bangladesh's perspective, there is a long-term relationship

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among RGDP, inflation, unemployment, and exchange rates.

ii. to check whether the Okun's law has the validation in Bangladesh.

iii. To analyze the impact of external shocks on the variables.

THEORETICAL BACKGROUND

There are several types of theory regarding inflation and unemployment, exchange rate and real GDP as well as the connection between unemployment and real GDP. This study mainly focuses on some important theories based on, Keynesian, and neo-Keynesian school of thoughts. These theories suggest how unemployment, exchange rate, and inflation rate affect the production of an economy.

The theory of unemployment proposed by Okun

Arthur Melvin Okun, a prominent neo-Keynesian economist, is mainly known for Okun's law which describe the observed relationship between a country's GDP and unemployment levels, stating that an increase of 1 percent in unemployment results in a 2 percent decline in real GDP. Therefore, according to this theory, there exists a significant negative relationship between a nation's unemployment rate and its production levels.

The relationship between inflation and unemployment theory.

Alban William Housego, commonly known as "A. W." or "Bill Phillips.", is renowned for his significant contributions to the analysis of the Phillips curve. The analysis of the Phillips curve indicates that, in the long term, money is neutral with respect to real GDP and employment. However, in the short term, money exhibits non-neutrality when alterations in the money supply are unexpected (James C.W. Ahiakpor, 2009). The Philips curve is an economic concept that posits a consistent and negative correlation between inflation and unemployment in the short term. It asserts that economic growth is accompanied by inflation, which subsequently results in an increase in employment and a decrease in unemployment in the short term.**The Balassa-Samuleson effect**

The Balassa -Samuelson effect is an economic theory which explains how vibrations in productivity growth between sectors in different countries can impact exchange rates.

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According to this theory, when a country experiences productivity gains in its tradable goods sectors, the prices of those goods remain relatively stable or even decline due to increased competition and potentially lover cost. On the contrary the prices of non-tradeable goods (Like services and labor) tend to rise as demand increase due to higher income resulting from the productivity gains in tradeable good sector. The result is that the countries with higher productivity growth in tradeable good sector will experience the recognition of their actual exchange rate which will ultimately affect the macroeconomic indicators like international trade, economic growth, employment etc. Therefore, the exchange rate fluctuation has impact on economic growth, employment as it changes the volume of net export of tradeable goods in the international market.

LITERATURE REVIEW

A study by Alam et al. (2020) explored the effects of GDP, inflation, population, and foreign direct investment (FDI) on unemployment in Bangladesh, utilizing time series data spanning from 1995 to 2019. The research utilized the Augmented Dickey-Fuller test to assess whether the variables were stationary or non-stationary. The study also applied a cointegration test alongside a Granger causality test to assess the long-term equilibrium connection within the factors. The investigation concluded that GDP and FDI significantly contribute to alleviating the unemployment problem in Bangladesh. The examination likewise found unidirectional causal association between unemployment and finacial factors in Bangladesh.

Alhabees et al. (2012) investigated how economic growth and unemployment were correlated in Jordan and several other Arab nations during the duration from 2006 to 2011. The authors employed Okun's Law to elucidate the connection between economic expansion and fluctuations in the unemployment rate. Based on this methodology, addressing unemployment is closely linked to the overall health of the national economy. The economy's Expansion rate exceeds the baseline or intrinsic boundary. The findings of their research indicated a negative correlation between economic growth and unemployment rates. In certain Arab nations, such as Algeria, it appears improbable that unemployment rates will decline, despite experiencing positive growth rates. The authors proposed various strategies aimed at fostering economic growth and reducing unemployment levels.

Aina Zabri and Abu (2022) researched Concerning the connection between GDP, inflation,

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Joblessness and currency conversion rate in Malaysia. The goal of this article was to assess the link between Malaysia's GDP, inflation, unemployment, and exchange rate from the beginning of 2010 to the beginning of 2022. The outcomes of the investigation demonstrate that there exists an inverse relationship between GDP and both unemployment and inflation rates. Nonetheless, the connection between GDP and the exchange rate is positively correlated.

Bakhshi and Ebrahimi (2016) examined unemployment as a significant challenge confronting global economies, particularly in newly developing countries like Iran. As a result, numerous researches have been conducted to examine the macroeconomic factors that influence unemployment. his analysis aimed to explore the connection between exchange rates and unemployment in Iran, drawing on annual data from a 30-year timeframe, specifically from 1981 to 2012. The research acknowledges the recent volatility in exchange rates that has affected numerous significant variables in the Iranian economy. The actual exchange rate and unemployment were examined employing an autoregressive econometric model that incorporates distributed lag effects in order to meet the study's goals. The five primary variables in this model were the overall economic output, international trade figures, currency valuation, and jobless rate. The research revealed that the expansion of the economy had a significant and beneficial influence on unemployment levels. The findings also indicated an inverse correlation between the exchange rate and the levels of unemployment.

In a study conducted by Cashell in 2004, The interplay between inflation and unemployment was examined. The timeframe for the research spanned from 1960 to 1998. According to the author, inflation is influenced by changes in the unemployment rate was extremely low. In his paper, he suggested to calculate the Joblessness rate on the basis of natural rate hypothesis. The rate of unemployment below 5% will ultimately lead to an uptick in inflation levels.

Gur and Betül Gür (2015) carried out an analysis to examine the determinants impacting the level of unemployment in the emerging BRIC nations, namely Brazil, Russia, India, and China. The timeframe between 2001 and 2012 is covered by the study. The research method is based on panel data analysis. Databases such as The World Bank, the Organization for Economic Co-operation and Development (OECD), and Bloomberg are used to collect data. The analysis indicates that inflation is the main driver behind the rise in unemployment within the BRIC nations, with population growth being the subsequent contributing factor. The primary economic elements contributing to a decrease in unemployment include the growth of gross

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domestic product, the volume of trade, overall investment levels, and the expansion of industrial production.

The research conducted by Islam and Muhammed Sahajalal in 2019 provided an empirical analysis of the interconnections among GDP, exchange rates, inflation, and unemployment in Bangladesh. This study looks at 29 years of data to determine the effects of GDP growth, inflation, real exchange rates, and unemployment levels on the economic landscape of Bangladesh. The essence of this research is mostly quantitative. This study has only used secondary data. The dataset has been analyzed using SPSS version 20 and EViews 9 to determine the goals of this work by the application of various tests, such as Anova, Graph, Simple Regression, and Descriptive Statistics. This study also demonstrates how growth percentage of GDP, price level, and Currency conversion rate all affect Bangladesh's unemployment rate. This study's outcomes reveal that the GDP growth rate has a negligible negative influence on Bangladesh's unemployment rate.

A study was carried out by Pascual et al. in 2020 to assess the dynamics between aggregate economic output, inflation, and Joblessness in the Philippines over the years 1970 to 2011. The Engle-Granger assessment was applied to test the cointegration of the factors but the study showed no Cointegration occurring among the factors. The results of the Granger causality test revealed no evidence of causal links between the variables. However, the study, after employing the VAR model, demonstrated a relationship between GDP and the Consumer Price Index (CPI), between GDP and unemployment, and between CPI and unemployment.

In 2020, research was conducted by Shrikant Krupasindhu Panigrahi and his team on the influence of inflation, Interest charges, and unemployment on the economic development within ASEAN countries. The research explores the extended period relationship between these attributes and GDP growth in the ASEAN-5 countries, specifically Malaysia, Indonesia, Thailand, Singapore, and the Philippines, from 1995 to 2018, relying on Panel data of a secondary nature sourced from the World Bank database. Based on statistical findings, there exists a considerable and progressive and enduring connection between interest rates and inflation level and economic growth; yet, the link between the unemployment rate and economic growth is weak at best. The results of Granger's test of causality showed a link between interest, Joblessness, inflation, and rates of economic advancement.

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Sahin (2016) examined the empirical link between the unemployment, GDP, overseas direct investment and the inflationary rate in order to assess the factors that contributed to unemployment in China from 1982 to 2014. The long-term estimated results show a significant negative link between China's jobless rate and GDP. While the short-term results indicate a negative and insignificant association between GDP, inflation, and Cross-border direct investment and the unemployment rate. The price level and foreign direct investment exhibit a favorable yet negligible correlation with the unemployment rate.

Udo and GAYOVWI (2019) investigated on the association between joblessness, inflation, and economic advancement in Nigeria. This Investigation utilized yearly information spanning from 1981 to 2017on the following variables like government expenditure (GEX), unemployment rate (UER), inflation rate (IFR), and real gross domestic product (RGDP). Most of the information was obtained from the 2017 statistical bulletin published by the Monetary Authority of Nigeria. The conclusions drawn from the Johansen co-integration test indicated a distinct long-run the association of the unemployment rate, price level, aggregate government spending, and real gross domestic product in Nigeria. According to the empirical analysis's short-term findings, Nigeria's Inflation-adjusted gross domestic product and the Proportion of unemployed individuals showed a negligible and inverse association. This minor effect is expected that unemployment and inflation hinder Nigeria's economy's expansion. The findings also demonstrated that government spending has a direct and substantial role in explaining Nigeria's economic expansion.

METHODOLOGY

Data

The study particularly relies on secondary data of Bangladesh from 1991 to 2023. Data on real GDP, exchange rate, inflation, and unemployment rate are sourced from the World Development Indicators database. Data on official exchange rate, and real GDP are transformed into logarithms to achieve uniformity and enhance the impact of time series analysis while mitigating the issue of heteroscedasticity. Econometric results based on the dataset have been obtained by statistical package STATA 12 and Eviews 9.5.

Methodology

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This research centers on the examination of how the official exchange rate, interest rate, and unemployment rate influence real GDP in Bangladesh over both short and long durations. To examine the dynamic linkage among variables the study makes use of Vector Autoregressive (VAR) modeling. The steady state in the long run is examined using Johansen and Juselius (1998) co integration test. The study also tried to examine the nature of causality among variables under the study by employing Granger Causality test. Finally, an impact of external shocks to the restricted VAR model has been shown by Impulse Response Function (IRF) analysis. The study incorporates the following econometric model:

$$LnRGDP = \beta_1+\beta_2 lnEx+\beta_3 Un+\beta_3 INF+\mu$$

In this framework, Ln corresponds to the natural logarithm, RGDP is the Real Gross Domestic Product, Un indicates the unemployment rate, INF represents the inflation rate and μ stands for the error term

Assessment of Integration: The Unit Root Test

The analysis implements the ADF method to assess the presence of unit roots in the variables associated with time series

The ADF analysis approximates the ensuing general regression.

$$\Delta Y_t = \alpha_1 + \alpha_2 + \beta\, Y_{t-1} + \Omega i \sum_{i=1}^{m} \Delta Yt\text{-}1 + \eta_i \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

In this equation, ΔY_t is calculated as Y_t minus Y_{t-1}, where Y refers to the variable being analyzed. The variable m indicates the lag of the dependent variable, assessed through the Akaike Information Criterion, and ηi represents the stochastic error term. The ADF technique examines the hypothesis of Ω=0, which denotes that the series is a unit root and thus non-stationary. If the null hypothesis is rejected at a given level of significance, it indicates a different scenario (usually at 5% or 1%) then It can be inferred that the series maintains a stationary characteristic

The cointegration test

The concept of cointegration was initially presented by Engle and Granger in 1987, illustrating that time series data classified as I (1) can possess meaningful interpretations. They showed

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that if two or more series are individually integrated in some order but some linear combination of them has an integration, in that case the series are called cointegrated. The analysis of cointegration under the Johansen method is based on two statistics, which are formulated in the following manner:

$$\lambda_{trace(r)} = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i) \quad \text{..... (ii)}$$

and

$$\lambda_{\max(r,r+1)} = -T \ln(1 - \hat{\lambda}_{r+1}) \quad \text{..... (iii)}$$

In this context, r represents the count of cointegrating vectors according to the null hypothesis, while λ_i denotes the estimated value of the i^{th} eigenvalue derived from the matrix. Intuitively, as λi increases, the value of ln $(1 - \lambda_i)$ becomes increasingly negative, resulting in a larger test statistic. There is an association between each Eigen value with its cointegrating vector called Eigenvectors. A significantly Greater than or less than zero Eigen value denotes a noteworthy existence of cointegrating vectors.

The λ_{trace} statistic is a joint test that evaluates the null hypothesis, which maintains that the number of cointegrating vectors is limited to r or fewer, in contrast to the alternative hypothesis, which posits that there are more than r cointegrating vectors. The process begins with p Eigenvalues, from which the largest is sequentially eliminated. The value of λ_{trace} equals 0 when all λ_i are equal to 0 for i ranging from 1 to g.

The λ_{max} test performs individual assessments for each eigenvalue, with the null hypothesis positing that the number of cointegrating vectors is r, in contrast to the alternative hypothesis of r+1.

Granger Causality Assessment

For the purpose of applying Granger causality test to the two-time series, Y_t and X_t,

the following models should be executed:

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$$Y_t = \delta + \sum_{i}^{I+r} \alpha_{1t} y_{t-i} + \sum_{i}^{I+r} \beta_{1t} x_{t-i} + \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

$$X_t = \delta + \sum_{i}^{I+r} \alpha_{2t} x_{t-i} + \sum_{i}^{I+r} \beta_{2t} y_{t-i} + \varepsilon_{2t} \ldots\ldots\ldots\ldots\ldots \text{(v)}$$

Where r represents the Integration sequence and α and β are the coefficients of the variables and ε_{1t} and ε_{2t} represent the error terms associated with white noise. The null hypothesis asserts that the lagged value of one variable does not lead to changes in the other variable, while the alternative hypothesis implies the existence of a causal relationship from one variable to the other.

Impulse Response Analysis Function

The Impulse Reaction Function demonstrates the manner in which fluctuations in one variable, resulting from an external shock, affect other variables throughout a given time period. Considering the bivariate framework of the preceding two equations, the IRF equation can be written as

$$\boldsymbol{\Omega} = \boldsymbol{\phi}_i B^{-1} \boldsymbol{\Lambda}^{1/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(vi)}$$

B^{-1} serves as the matrix of coefficients for all variables at the specified time t. $\boldsymbol{\Lambda}^{1/2}$ refers to the lower Cholesky decomposition of the variance-covariance matrix of μ_i, while $\boldsymbol{\phi}_i$ signifies an additional matrix that illustrates the impact of a one-unit increase in the error term at time t (μ_t) on the value of the other variable at time t+s.

RESULT AND DISCUSSION

This section outlines the results of different time series models that the study aimed to interpret. It starts with the unit root test, then cointegration test, after then VECM and finally impulse response function.

Table 1: *Findings from the Augmented Dickey-Fuller (ADF) test*

Variables	ADF (Intercept)		ADF (Trend and Intercept)		Integration Order
	Level	1st	Level	1st	

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		Difference		Difference	
RGDP (LnRGDP)	14.97842	-7.502535***	3.558928	-4.345882***	I (1)
Exchange Rate (LnEX)	-0.331764	-4.768687***	-2.345061	-4.651387***	I (1)
Unemployment rate (UN)	-1.943442	-5.480455***	-2.839082	-5.624565***	I (1)
Inflation rate (INF)	-5.076827***	-8.803881***	-5.102901***	-8.677653***	I (1)
Notes: ***, ** and * indicate rejection of the null hypothesis (variables are unit root/ non-stationary) at the 1%, 5% and 10% level respectively.					

As presented in Table 1, every variable demonstrates stationarity at the first difference at a significance level of 1%, both with and without the inclusion of a trend. Therefore, it can be asserted that the time series being examined are Integrated of first order, referred to as I (1).

Cointegration

As the variables exhibit first difference integration, classified as I (1), this paper proceeds to assess their co-integration (see Table 2 &3). The Johansen test statistics reveal a rejection of the null hypothesis indicating the absence of co-integrating vectors in both the trace and maximum eigenvalue forms of the test.

Table 2: *Unrestricted Cointegration Rank Test Using the Trace Method.*

Maximum rank	Eigen value	Trace value	Critical value (0.05)	p value
None *	0.539269	42.51232	40.17493	0.0285
At most 1	0.359204	18.48915	24.27596	0.2254
At most 2	0.140474	4.692785	12.32090	0.6110
At most 3	0.15177	5.102948	12.511798	0.5817
The presence of an asterisk (*) signifies the rejection of the hypothesis at a significance level of 0.05				

Since the null hypothesis of no cointegration is not accepted at 5 percent level (Trace statistics= 42.51232 > critical value = 40.17493), there is a state of equilibrium within the factors in the long run.

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Table 3: *Evaluation of Unrestricted Cointegration Rank Using Maximum Eigenvalue*

Maximum rank	Eigen value	Trace value	Critical value 0.05	p value
None *	0.539269	25.79637	24.95921	0.0422
At most 1	0.35204	13.02317	17.79730	0.1810
At most 2	0.140474	4.692607	11.22480	0.5217
At most 3	0.152337	5.32456	7.45321	0.5123
The presence of an asterisk (*) signifies the rejection of the hypothesis at a significance level of 0.05				

The maximum eigen value test indicates the disapproval of the null hypothesis at 5 percent level, therefore, the research paper has found cointegration within the factors over an extended period. The long-term effects of exchange rates, inflation, and unemployment on the real GDP of Bangladesh

Table 4: *Normalized values of cointegrating coefficients*

Cointegrating equations(s)	Coint Eq[1]	SE	t statistics
LnRGDP	1.000000		
LnEX	-1.483255	0.09891	14.99600**
Unemployment (Un)	0.642218	0.07737	8.30060***
Inflation (INF)	0.03493	0.01279	2.731039**

The results of the normalized cointegrating coefficients indicate that unemployment and inflation are positively correlated to the long-term trajectory of real GDP while exchange rate has an adverse effect on real GDP in Bangladesh. Over an extended period of time, for every parentage increase in unemployment rate real GDP goes down by 0.642218 percent. Similarly, 1 percent increase in inflation rate reduces real GDP by 0.03493 percent and 1 percent increase in exchange rate boosts up real production of the economy by 1.483255 percent.

Since the variables are interconnected through cointegration in the long run, we may proceed with the Vector Error Correction Model (VECM) to analyze how the variables adjust to achieve their long-term equilibrium

Table 5: Vector Error Correction

Equations of Cointegration	Coint Eq1	SE	t statistics
D(LnRGDP)	1.448029	1.97996	0.73134

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D(LnEX)	0.062408	0.02255	2.76729
D(Un)	-.811933	0.31951	-2.54119
D(INF)	-9.161727	4.51231	-2.03038

The error correction coefficient reflects the speed at which the model reestablishes equilibrium following disturbances. The negative and statistically significant coefficients for Un and INF indicate a convergence from short-lived dynamics to long-lasting stability. The adjustment coefficients are 0.811933 percent for Un and 9.161727 percent for INF, demonstrating the degree of transitioning to a state of long-term balance in cases of disequilibrium. In contrast, the positive adjustment coefficients for LnEX and LnRGDP suggest a lack of meaningful adjustments towards long-term equilibrium.

Table 6: *Granger causality test (lags 2)*

Null hypothesis	Obs	F value	P value
LnEx does not have a Granger causal relationship with LnRGDP	31	3.17384	0.0584
LnRGDP does not have a Granger causal relationship with LnEX	31	1.79293	0.1864
INF does not have a Granger causal relationship with LnRGDP	31	0.47352	0.6281
LnRGDP does not have a Granger causal relationship with INF	31	0.27119	0.7646
Un does not have a Granger causal relationship with LnRGDP	31	3.15754	0.0592
LnRGDP does not have a Granger causal relationship with Un	31	2.05915	0.1479
INF does not have a Granger causal relationship with LnEX	31	0.07442	0.9285
LnEX does not have a Granger causal relationship with INF	31	0.87254	0.4298
Un does not have a Granger causal relationship with LnEX	31	3.75463**	0.0369
LnEx does not have a Granger causal relationship with Un	31	6.47908***	0.0052
Un does not have a Granger causal relationship with INF	31	0.21431	0.8085
INF does not have a Granger causal relationship with Un	31	0.01515	0.9850

The Granger causality test suggests that if the p-value is higher than the 5 percent critical value, the null hypothesis remains unchallenged. The results obtained from the Granger test indicate a bilateral causal link between unemployment and the exchange rate.

Impulse Response Function

The impulse reaction function illustrates the impact on a particular variable due to the external shocks on itself or on other variables. The horizontal axis of the figure represents a ten-year period following a shock in the VAR model, while the vertical axis indicates the estimated

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value of a response variable in reaction to an external shock. From the diagrams, it is observed that the response of exchange rate from its own shock and from other variables shocks is not neutralized rather it gets worsened while inflation and unemployment gradually adjusts towards the long run equilibrium following an external shock of the variables.

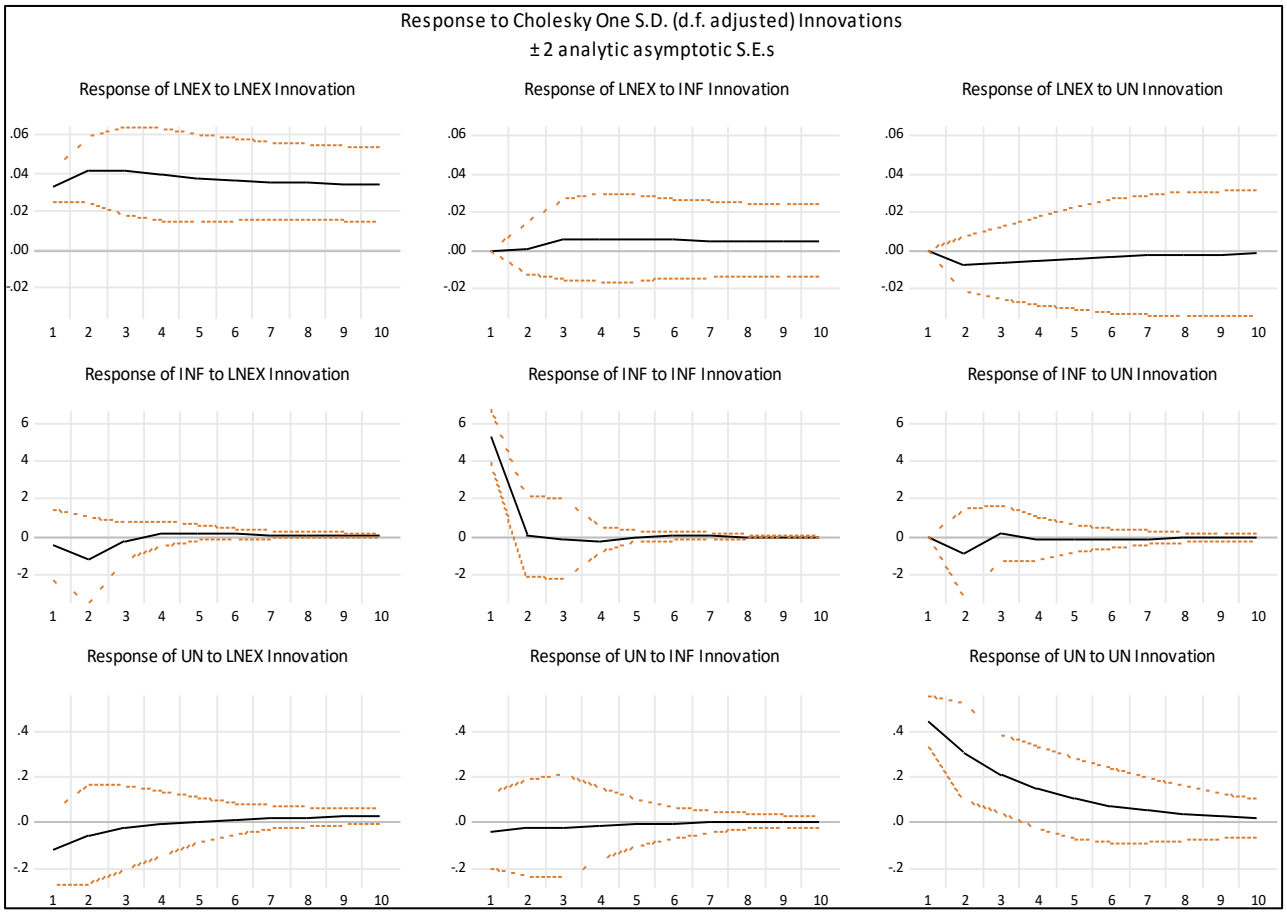

Figure 1: Impulse Response Function

Diagnostic Test

The data is normally distributed and there are no multicollinearity and heteroscedasticity exist in the model.

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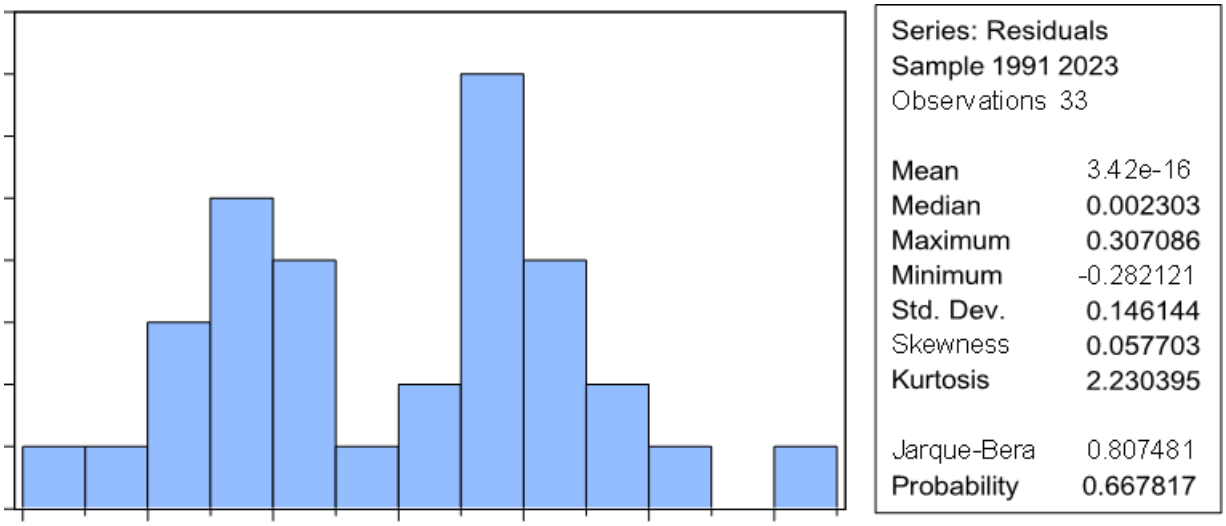

Figure 2: Normality Test

The following tables present the outcomes of multicollinearity and heteroscedasticity.

Table 7: *Multicollinearity test*

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.469947	635.9679	NA
LNEX	0.049067	1133.320	5.210835
INF	3.18E-05	2.688514	1.043462
UN	0.004741	95.92326	5.113149

Table 8: *Heteroscedasticity test*

Breusch-Pagan-Godfrey (Ho: No Heteroscedasticity)			
F-statistic	2.856072	Prob. F (3,28)	0.0549
Obs*R-squared	7.497848	Prob. Chi-Square (3)	0.0576
Scaled explained SS	3.531565	Prob. Chi-Square (3)	0.3167

CONCLUSION AND RECOMMENDATION

This analysis explores the effects of the exchange rate, unemployment rate, and inflation rate on Bangladesh's real Gross Domestic Product (RGDP) throughout the period spanning from 1991 to 2023. The data was first evaluated for stationarity utilizing the Augmented Dickey-Fuller test (ADF), revealing that it achieved stationarity at the first difference. In addition, the Johansen test statistics indicate a non-acceptance of the null hypothesis, which posits the absence of cointegrating vectors, in both the trace and maximum eigenvalue forms of the test.

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The data was further tested for normalized cointegrating coefficients. The findings indicate that over an extended period of time unemployment and inflation are inversely related to RGDP but exchange rate is positively correlated to RGDP in Bangladesh. Therefore, the findings of the study have shown that the Okun's Law has the validation in Bangladesh. As we tested that a negative correlation exists between unemployment rates and Gross Domestic Product (GDP). so that there exists an existence of Okun's Law in Bangladesh. The findings from the Granger test reveal bilateral causal relationship between unemployment and exchange rate. Impulse response function shows that in most of the cases the external shocks have been neutralized. but in few cases the shocks have not been eliminated. Individuals responsible for shaping policies ought to prioritize the development and implementation of strategies that lead to an enhancement in real GDP. To stimulate economic growth, governments can employ several methods, including offering tax incentives or refunds, easing regulatory constraints, and allocating funds for infrastructure development. An economy's growth is directly correlated to its exports. If exports increase more quickly than imports, nothing can prevent an economy from developing. One component of aggregate demand (AD) is export. Growing exports will contribute to rising AD and accelerate economic expansion. In order to raise our GDP, policymakers should therefore attempt to determine the most effective means of increasing our nation's exports. Investment from businesses can also accelerate a nation's GDP growth rate.

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