EXTERNAL DEBT, INFLATION AND UNEMPLOYMENT NEXUS IN BANGLADESH: AN EMPIRICAL ANALYSIS USING THE AUTOREGRESSIVE DISTRIBUTED LAG-BOUND TESTING APPROACH

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Abstract

Over recent years, Bangladesh has been challenged with rising external debt, higher inflation and unfavourable unemployment. The nation has to implement smart policy changes to lessen its influence on economic prosperity. This study looks at the connection between public external debt, inflation and unemployment in Bangladesh using data from 1983 to 2023. The ARDL framework is used to estimate the variables. The study shows that inflation correlates significantly negatively with external debt, whereas total reserve and current account balance show significant positive relationships with external debt in the long run. However, in the short run, total reserve shows a negative relationship with external debt. External debt, personal remittance and gross capital formation show significant positive correlations with unemployment in the long run. In the short run, external debt and unemployment are positively correlated, while personal remittance and gross capital formation show negative correlations. In light of the results, the study suggests that the government should implement balanced budget targets to prevent excessive borrowing and effective debt management strategy for maintaining economic stability. The promotion of agriculture and targeted investments in infrastructure projects are suggested in this article. These programs will promote increased economic growth, the creation of new job opportunities, and eventually lead to sustainable development.

1. Introduction

The sharp increase in government debt over the previous few decades has significantly drawn attention in academia in recent times (Saani *et al.,* 2024; Beqiraj *et al.,* 2018; Akram, 2016). Bangladesh's gross public debt currently stands at around 40.30% of GDP (IMF, 2025). Public debt is an essential source of funding for a government to support public spending and close budget deficits.

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The growing public debt would be connected to the deterioration of several indicators of macroeconomics, such as GDP growth rates, exchange rates, inflation, unemployment, and stock market prices, among others. Out of them, unemployment, inflation, and public debt, by interacting, can significantly affect the stability and overall economic health of a country (Saani *et al.,* 2024). Higher public debt levels are generally associated with higher unemployment and lower inflation rates (IN), whereas lower public debt levels are normally associated with higher inflation and lower unemployment rates (UR) (Dumitrescu *et al.,* 2022).

Inflation is the general term used to describe the gradual rise in the general price level of goods and services. Because of supply-side limitations, monetary instability, and political unpredictability, inflation can be high in developing nations (Gopinath, 2022). Unemployment is the number of persons who are able and willing to work but are unable to find a job. Significant social and economic costs can result from unemployment, especially in emerging nations, where it can cause inequality and poverty (Barber, 2023). In the case of Bangladesh, both inflation and unemployment show an upward trend.

Bangladesh's external debt stock (ED) has been rising gradually, driven mainly by increased borrowing to finance infrastructure projects, development programs, and to support the economy during global challenges, including the COVID-19 pandemic. An economy experiences an ex ante discrepancy between total supply and total demand when government debt increases. It may also subtly impede economic expansion. The total ED of Bangladesh amplified US$5 billion in 1983 to US$101 billion in 2023. The rise represented the resumption of the long-term upward trend that has continued in Bangladesh over the past 40 years (Figure 1). Inflationary pressures, high interest rates, devaluing local currencies, and uncertainty about global economic growth are among the factors contributing to Bangladesh's rising indebtedness pressures following the COVID-19 epidemic, as evidenced by the 2023 increase in the ED (World Bank, 2024).
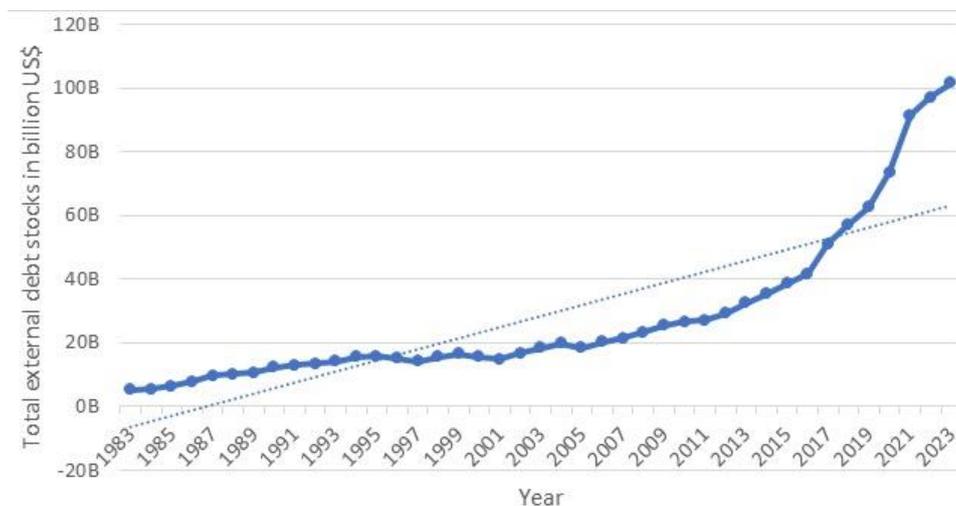

Figure 1: Trend in total external debt stocks for Bangladesh in billion US$ from 1983 to 2023
Data Source: World Bank, 2025.

According to the World Bank (2024), interest rates have risen to their highest level in 20 years due to strict monetary policy in high-income nations, and central banks have maintained rates high in an attempt to reduce inflationary pressures. Higher global interest rates have not only made freshly contracted borrowing more expensive for Low- and Middle-Income countries (LMICs), but they have also raised interest expenses on existing debt commitments that were negotiated at variable rates. This cost has hampered economic progress by taking funds away from other important sectors, such as infrastructure development and social services. Moreover, interest payments on Public and Publicly Guaranteed (PPG) debt increased by 62 per cent to US$12.5 billion in 2023, with the largest annual increase occurring in the South Asia area. The two countries with the biggest increases were Bangladesh and India, where interest payments rose by over 90% in 2023.

According to the data retrieved from the World Bank's World Development Indicator (WDI) Database, public debt in Bangladesh has increased over the years. This can be assumed to have resulted from the GDP of Bangladesh declining by 3.44% and an increase in inflation to 5.6% in the year 2020. After that, it went up to 35.61 % and hovered for years till the current. According to World Bank data, between 2020 and 2023, Bangladesh experienced a notable increase in inflation rates. In 2020, the inflation rate was approximately 5.6%, rising to 7.69% in 2022. This upward trend continued in 2023, with inflation reaching 9.88%. In 2023, the inflation rate further escalated to about 9.02%. The COVID-19 epidemic (or pandemic?) had a substantial effect on Bangladesh's economy, leading to a rise in unemployment in 2020. The gradual decline in unemployment rates in subsequent years suggests a recovery trend.

ER, ED, and IN are all connected and causally related to one another. High levels of ED result in lower growth. When a government incurs high levels of ED, it may finance this debt by borrowing, which may cause inflation. IN correlates negatively with ED in both the short run (SR) and long run (LR). Governments often use borrowing to fund stimulus programs aimed at reducing UR. ED correlates positively with unemployment in both the SR and LR (Saani *et al.,* 2024).

For Bangladesh, as of now, no attempt has been made to look at the relationship between UR, ED, and IN all at once. Although some of these indicators have been examined in previous studies (such as Das (2025); Ahmed and Hossain (2023); Siddika and Emon (2022); Islam and Sahajalal (2019)) however, there is disagreement among previous studies in the literature regarding which variable leads and which lags in the correlation chain.

Hence, this study's main goal is to investigate the nexus between UR, ED, and IN in Bangladesh. This study could be crucial for designing strategies that can manage ED without triggering IN or increasing UR. By analysing the effects of IN on ED, and IN and ED on UN, the paper can help to determine the threshold beyond which ED might become unsustainable, leading to economic instability. It can provide insights into maintaining economic growth while managing ED levels. This study will also provide policy recommendations. Policymakers may create policies that reduce economic instability, promote job creation, and support sustainable economic growth by examining the relationship between inflation, public debt, and unemployment in the unique context of Bangladesh.

The remainder of the paper is structured in the following way. The study gaps and literature review are covered in the second section, followed by research methods in the third, data analysis in the fourth, key findings and comments in the fifth, and the study's conclusion and policy recommendations in the final section.

2. Review of related literature

There is a great deal of interest in both theoretical and empirical literature regarding the relationship between ED and the UN and IN. Researchers and policymakers generally agree that a sustained rise in ED raises the UR and puts inflationary pressure on the economy.

Saani et al. (2024) examined the connection among unemployment, governmental debt, and inflation in Ghana using data from 1990 to 2022. The variables were estimated using the ARDL framework. Inflation and governmental debt were found to be related over the LR. Notably, IF and ED have a negative connection in both SR and LR. Remittances showed a negative LR link with UR, whereas public debt showed a positive correlation with UR in both the SR and LR. Similarly, Musa and Yaqub (2024) established a favorable (positive) LR relationship between ED and UN in Nigeria.

Das (2025) presented detailed effects of several factors on public debt from 1975-2022.Exports and GDP growth significantly increase public debt, whereas inflation and imports considerably diminish it in LR. Import, government spending, and FDI meaningfully decrease public debt in SR.

In order to help policymakers understand the causal relationship between the variables, Evans (2022) examined whether external debt, inflation, and unemployment all contribute to Ghana's economic progress. The period covered by the data was 1991–2021. The study's conclusions show that while GDP decreased, inflation and foreign debt rose, and unemployment had no effect on inflation. GDP had a negative effect on the unemployment rate, but external debt had a favourable effect.

Research by Joy and Panda (2019) on India's external debt from 1980 to 2017 identified two key findings. First, external debt itself significantly increased inflation while reducing non-developmental spending. Second, the cost of paying back that debt (servicing) had the opposite effect: debt servicing was linked to lower inflation but higher non-developmental spending. Additionally, debt servicing was also positively and substantially correlated with gross domestic savings and exports.

For 26 developing countries, Abbas et al. (2024) found a direct, positive impact of external debt (ED) on unemployment (UN). This strong finding is echoed by Alnaa and Matey (2023), whose research on 25 sub-Saharan African countries concluded that ED has a statistically significant positive association with UN.

In Bangladesh, Islam and Hossain (2024) discovered that ED significantly and favorably affects GDP growth. This positive link is supported by Ahmed and Hossain (2023), who, using the VECM model, reported that external debt positively affects economic growth in the LR. Earlier research on Bangladesh by Farhana and Chowdhury (2014), however, identified a negative impact of foreign debt on the country's growth.In Somalia, the VECM analysis by Mohammed and Abdi (2024) revealed that GDP growth is negatively associated with ED.

Siddika and Emon (2022) determined that Bangladesh's external debt burden has increased in the LR due to currency rate depreciation and a negative fiscal balance.

In their study covering 1980–2011, Bal and Rath (2014) employed ARDL and ECM techniques to explore how public debt affects economic growth in India. Their results point to a significant long-run equilibrium relationship between the two variables. While the study effectively captures both short-run and long-run dynamics, it mainly highlights the sustained impact of public debt on growth, indicating the need for careful debt management policies.

Using ARDL techniques on data from 1980–2015, Igberri et al. (2016) found that public debt exerts a significant short-run effect on unemployment and negatively influences economic growth in Nigeria.

Islam and Sahajalal (2019) contribute to the Bangladesh macro-labour literature by estimating the effects of GDP growth, inflation and the real exchange rate on unemployment for 1971–2018. They find that , GDP growth reduces unemployment in line with Okun's law, a depreciation (or real exchange-rate shock) is associated with higher unemployment, and inflation has a small negative coefficient that lacks statistical significance.

Gwazawa et al. (2021) further elaborated on the issue in Nigeria, noting that while an increase in government debt causes more unemployment in the LR, external debt is a greater contributor to unemployment than domestic debt.

In the Ghanaian context, Hilton (2021) highlights contrasting dynamics between public debt and growth across different time horizons. No short-run causality is detected, yet their long-run linkage proves significant. Investment spending behaves differently: its interplay with GDP is adverse in the short run but turns mutually reinforcing over the long run. Government consumption fails to produce any short-run causal effect on GDP. Interestingly, public debt exerts inflationary pressure in the short run, suggesting that debt accumulation immediately transmits into rising price levels even when growth effects remain muted.

Milhana and Jayawickrama (2023) aimed to identify the LR impact of domestic and external debt on inflation in Sri Lanka using quarterly data from the period from 2010 to 2023. They concluded that both domestic and external debt significantly and positively impact inflation (IN) in Sri Lanka, with external debt having a higher effect.

For Pakistan, evidence presented by Siddiqui et al. (2022) shows that public debt functions as an important determinant of price instability. Their results indicate a long-run equilibrium between inflation and national debt, with debt accumulation consistently raising inflation. The study also emphasises the broader policy message that fiscal measures in indebted economies can significantly shape inflation outcomes.

Maina et al. (2024) noted that in Kenya, higher public debt can cause money supply and IN to rise, thus increasing inflation pressures.

According to Rafie and Lekhal (2025), the sustainability of public external debt in North African countries is closely linked to foreign reserves and exchange rate arrangements. Sufficient reserves serve as a safeguard against external economic shocks, stabilizing debt levels.

İlhan (2023) analyzes eight emerging market economies from 2005 to 2020 and finds that economic growth helps reduce external debt, whereas trade openness, inflation, and domestic credit contribute to higher debt levels, with exchange rate fluctuations showing no significant effect. Similarly, Harsono, Kusumawati, and Nirwana (2024) focus on selected ASEAN developing countries and report that inflation and interest rates are negatively associated with external debt, while exchange rate depreciation and trade openness increase debt accumulation.

Although there are some studies (Das (2025), Ahmed and Hossain (2023) Siddika and Emon, (2022)) related to ED in Bangladesh, no attempt has been made to look at the relationship between unemployment, public debt, and inflation simultaneously so far. Moreover, there are a lot of studies about ED, IN and UN in many other countries. Nevertheless, most of the studies focus on specific factors influencing ED, IN and UN, use a limited time frame, and there is no policy recommendation for reducing ED, and most of them do not address the LR sustainability of debt and its potential impact on future inflation. Consequently, this study tries to fill those gaps.

3.   Data and methodology

3.1 Variable description

To study the nexus of ED, IN and UN in Bangladesh, this study uses annual data spanning from 1983 - 2023 extracted from the World Bank's World Development Indicator (WDI) database. The names of the variables, their symbols, measurement units and sources of data are given below:

Table 1: Variable description

Names of the Variables	Symbols	Measurement Unit	Sources of Data
External debt	ED	External Debt stock (% of GDP)	WDI
Inflation rate	IN	Inflation, GDP deflator (annual %)	WDI
Unemployment rate	UR	Unemployment, total (% of total labour force)	WDI
GDP growth	GDP	GDP growth (annual %)	WDI
Trade	TR	Trade (% of GDP)	WDI
Current account balance	CA	Current account balance (% of GDP)	WDI
Total reserves	TRE	Total reserves, including gold (billion US$)	WDI
Personal remittances	PR	Personal remittances, received (% of GDP)	WDI
Gross capital formation	GCF	Gross capital formation (% of GDP)	WDI

3.2 Empirical model specification

According to earlier studies, the prevalent elements that significantly contribute to ED include IN, GDP, CA, TRE and TR (Harsono et al. (2024), Yilhan (2023)) . And

UR is affected by IN, GDP, ED, GCF, and PR (Evans (2022), Abbas et al. (2024), Alnaa and Matey(2023)). After confirming that all of the variables had long-term associations, this study logically moved on to ARDL model estimation. According to the following specifications, the first model estimates the impact of IN on ED:

$$ED = f(IN, GDP, TRE, TR, CA) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

The second model, which calculates how ED affects UR, is described as follows:

$$UR = f(ED, IN, GDP, GCF, PR) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(2)$$

These two models are employed in this study. In the first model, the response variable is ED, the main explanatory variable is IN, and the other explanatory variables are CA, TRE, and TR. In the second model, the response variable is UR, the main explanatory variable is ED, and the other explanatory variables are IN, GDP, GCF, and PR.

Rationale for variables in model 1

External debt stock (ED): The core independent variable. High debt levels can lead to increased interest payments, crowding out private investment, and potentially hindering economic growth.

Inflation (INF): There is a complex relationship between inflation and external debt, with high external debt potentially contributing to inflation and inflation affecting the real value of debt. A high external debt can increase inflation by raising debt servicing costs and requiring the government to increase money supply or taxes, while inflation can reduce the real burden of the debt, making it easier to service in the LR. Some studies show that a 1% increase in external debt can lead to a 0.8% increase in prices, though the SR impact can be negative (Milhana and Jayawickrama (2023).

GDP: The connection between a nation's GDP and its external debt is typically intricate and non-linear. While moderate levels of external debt may stimulate economic growth, surpassing a certain point can hinder the economy.

Current account (CA): A nation running a current account deficit frequently relies on external borrowing to finance it. In turn, a sizable or ongoing deficit can drive up external debt, particularly when the shortfall is covered through borrowing rather than productive investment. This interplay is often cyclical, with each element affecting the other, potentially posing economic risks if not carefully managed.

Total reserve (TRE) : The link between a country's total reserves and its external debt is intricate and can be either positive or negative, depending on the purpose of the debt and the economic context. Generally, reserves act as a safeguard against external shocks and reflect a nation's ability to repay its debt, thereby affecting its creditworthiness.

Trade (TR) : A nation's trade performance has a direct impact on its capacity to service and repay external debt. At the same time, external debt can finance trade and development initiatives, yet if mismanaged, it may become a liability that limits the country's trade potential.The model likely explores how debt affects a country's trade balance and competitiveness.

Rationale for variables in model 2

External debt (ED): The connection between external debt and unemployment is multifaceted and can be either positive or negative, depending on the utilization of borrowed funds. In many developing nations, poorly managed debt or spending on non-productive activities often correlates with higher unemployment. On the other hand, when external debt is invested in productive areas such as infrastructure, industry, or technology, it can stimulate economic growth and create jobs, producing a negative relationship between debt and unemployment.

Inflation(INF): The primary link between inflation and unemployment is inverse: low unemployment often coincides with higher inflation, while high unemployment is generally associated with lower inflation. This dynamic is captured by the Phillips Curve, which highlights a short-term trade-off between the two.

GDP: Economic growth is generally associated with lower unemployment. This variable helps capture the overall economic climate.

Gross Capital Formation (GCF): Gross capital formation and unemployment generally share an inverse relationship, where rising capital investment tends to reduce unemployment. Increased investment in assets such as machinery and infrastructure stimulates economic growth, generates employment, and expands production, thereby lowering the unemployment rate.

Personal Remittance (PR): Inflows of remittances can boost domestic consumption and potentially support employment. The model may explore how debt policies interact with remittance flows.

Equations (1) and (2) can be shown econometrically in the following Equations (3) and (4):

$$ED_t = \alpha_0 + \alpha_1 IN_t + \alpha_2 TRE_t + \alpha_3 CA_t + \alpha_4 GDP_t + \alpha_5 TR_t + \varepsilon_t \qquad (3)$$

$$UR_t = \beta_0 + \beta_1 ED_t + \beta_2 IN_t + \beta_3 GDP_t + \beta_4 GCF_t + \beta_5 PR_t + \mu_t \qquad (4)$$

Because it can handle different levels of integration and is thought to be better than popular cointegration models like the Phillip-Ouliaris, Johansen, and Engle Granger tests, which can estimate SR and LR estimates at the same time, the ARDL model is used (Isık *et al.*, 2013). One advantage of the ARDL model is that SR and LR parameters can be estimated simultaneously. ARDL can be applied when the series are I (0), I (1), or a combination of the two. The ARDL models estimated are specified as follows:

$$\Delta ED_t = \beta_0 + \beta_1 ED_{t-1} + \beta_2 IN_{t-1} + \beta_3 TRE_{t-1} + \beta_4 CA_{t-1} + \beta_5 GDP_{t-1} + \beta_6 TR_{t-1} + \sum_{i=1}^{n} \gamma_1 \Delta ED_t + \sum_{i=1}^{q} \gamma_2 \Delta IN_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta TRE_{t-i} + \sum_{i=1}^{q} \gamma_4 \Delta CA_{t-i} + \sum_{i=1}^{q} \gamma_5 \Delta GDP_{t-i} + \sum_{i=1}^{q} \gamma_6 \Delta TR_{t-i} + \varepsilon_t \qquad (5)$$

β represents the LR parameters, while γ_1 to γ_6 correspond to the SR coefficients. Here, *n* indicates the lag length for ED, and *q* denotes the lags for the explanatory variables. To capture the SR dynamics, the ECM is formulated, which can be expressed as follows:

$$\Delta ED_t = \sum_{i=1}^{n} \alpha_1 \Delta ED_{t-j} + \sum_{i=1}^{q} \alpha_2 \Delta IN_{t-j} + \sum_{i=1}^{q} \alpha_3 \Delta TRE_{t-j} + \sum_{i=1}^{q} \alpha_4 \Delta CA_{t-j} + \sum_{i=1}^{q} \alpha_5 \Delta GDP_{t-j} + \sum_{i=1}^{q} \alpha_6 \Delta TR_{t-j} + \theta ECM_{t-j} + \mu_t \qquad (6)$$

The coefficient Ɵ in the ECM is generally anticipated to be significantly negative, as it regulates the speed at which the system returns to its LR equilibrium.

$$\Delta UR_t = \beta_0 + \beta_1 UR_{t-1} + \beta_2 ED_{t-1} + \beta_3 IN_{t-1} + \beta_4 GDP_{t-1} + \beta_5 GCF_{t-1} + \beta_6 PR_{t-1} + \sum_{i=1}^n \theta_1 \Delta UR_{t-i} + \sum_{i=1}^n \theta_2 \Delta ED_{t-i} + \sum_{i=1}^n \theta_3 \Delta IN_{t-i} + \sum_{i=1}^n \theta_4 \Delta GDP_{t-i} + \sum_{i=1}^n \theta_5 \Delta GCF_{t-i} + \sum_{i=1}^n \theta_6 \Delta PR_{t-i} + \varepsilon_t \tag{7}$$

Likewise, in Equation (7), Δ signifies the difference operator, β_0 denotes the intercept, while β_1 to β_6 capture the LR parameters, and Θ_1 to Θ_6 represent the SR coefficients. Accordingly, the ECM framework for estimating the SR dynamics can be specified as follows:

$$\Delta UR_t = \sum_{i=1}^n \alpha_1 \Delta UR_{t-j} + \sum_{i=1}^n \alpha_2 \Delta ED_{t-j} + \sum_{i=1}^n \alpha_3 \Delta IN_{t-j} + \sum_{i=1}^n \alpha_4 \Delta GDP_{t-j} + \sum_{i=1}^n \alpha_5 \Delta GCF_{t-j} + \sum_{i=1}^n \alpha_6 \Delta PR_{t-j} + \gamma ECM_{t-1} + \mu_t \tag{8}$$

It is anticipated that the error correction term's (γ) coefficient will be statistically significant and negative. The pace of correction of deviations from the LR equilibrium is indicated by γ. After estimating both the SR and LR coefficients, the model undergoes essential diagnostic and stability checks to ensure it is reliable, free from serial correlation, and not affected by heteroskedasticity.

4. Data Analysis

4.1 Summary of descriptive statistics

To illustrate the distribution and trends of the variables, a descriptive analysis is performed. In Table 2, ED has the second-highest mean value, 27.77, behind TR with 29.66. The nation's average CA balance is -0.366%, representing a budgetary imbalance and a possible tendency to borrow money to cover the shortage. It is found that TR is the most volatile variable while UR is the least. Moreover, standard deviation quantifies the degree to which the observed variables deviate from the mean. IN has a mean of 6.86% which has substantial price variations between 0.155% and 27.850%. Bangladesh's UR fluctuates between 0.920% to 5.400% with a mean of 3.456%, reflecting a relatively stable rate. The average GDP of the nation is 5.297%, indicating strong economic growth and favourable prospects for the future.

Table 2: Descriptive statistics of the variable

Variable	Observation	Mean	Maximum	Minimum	Std. dev.
ED	41	27.77132	44.48178	14.97179	8.167784
IN	41	6.861737	27.85074	0.155518	4.879407
UR	41	3.456122	5.400000	0.920000	1.129567
GDP	41	5.297998	7.881915	2.416257	1.341543
TR	41	29.66346	48.11092	16.68780	9.145440
GCF	41	23.82418	32.21373	15.47344	5.614238
TRE	41	26.63023	77.66278	4.972374	21.35526
CA	41	-0.36620	3.470233	-3.820364	1.658875
PR	41	5.158273	10.59151	2.255417	2.531250

Source: Author's calculation, 2025

4.2 Test of Unit Root

This study uses time series data. The study's findings ought to be reliable and consistent if the data are stationary. Therefore, the data should be converted into stationary data if they are nonstationary (Gujarati and Porter, 2009).

The purpose of the unit root test is to examine the stationarity of time series variables and determine whether a unit root exists. The variable might be referred to as I(0) if it is stationary at the level. If not, after taking into account a certain level of differentiation, it can be stationary. For instance, a variable is regarded as I(1) or integrated at first order when it is stationary following first differencing, and I(2) when it is stationary following second differencing (Gujarati and Porter, 2009).

Table 3: Augmented Dickey Fuller test

	Level Form		First Difference		
	ADF		ADF		
Variable	Intercept	Trend and intercept	Intercept	Trend and intercept	Order of integration
ED	-0.0431	-0.2018**	-0.7227***	-0.9754***	I(0)
IN	-0.8923***	- 0.8967***	-1.4866***	-1.4866***	I(0)
UR	-0.2315**	-0.8995***	-2.4179***	-2.3946***	I(0)
GDP	-0.4956***	1.0538***	-2.1237***	-2.1215***	I(0)
TR	-0.0849	-0.1219	-0.9428***	-0.9533***	I(1)
GCF	-0.0061	-0.1773	-0.7799***	-0.7712***	I(1)
TRE	-0.4155	-1.0612***	-1.3612** *	-2.4605***	I(0)
CA	-0.3406*	-0.3355	-1.8902***	-1.9281***	I(1)
PR	-0.0720	-0.5286***	-0.6766***	-0.6909***	I(0)

Source: Author's calculation, 2025.

***, ** and * represent significant at 1%, 5% and 10% level respectively.

Table 3 shows that the variables ED, IN, UN, GDP, TRE and PR appear stationary at the level. All variables become stationary when we convert them to first differences. There is a mixed kind of I (0) and I (1) data. The ARDL model will be used in this study for further processing of the data (Pesaran, Shin & Smith, 2001).

4.3 Lag length selection

Choosing the right criterion for the lag is crucial. There are several aspects available to choose from when choosing a lag. This study will choose the lag that the Akaike Information criterion recommends. According to Akaike Information Criteria, this study uses lag 1 and lag 3 for models 1 and 2, respectively.

4.4 Bound testing

Since the dataset includes both I(0) and I(1) variables, the ARDL bounds testing approach is the most suitable method for this model. The ARDL bounds test captures both SR and LR dynamics simultaneously. It is particularly advantageous for studies

with relatively small sample sizes, as it tends to yield more efficient and reliable results (Omoniyi & Olawale, 2015). Another strength of ARDL is that every variable does not need to be integrated in the same sequence. It can be applied when variables are a mix of I(0), I(1), or even fractionally integrated. Thus, the method works whether the regressors are entirely I(0), entirely I(1), or a combination of both. Ultimately, this approach provides consistent and unbiased estimates of the LR relationships (Alimi, 2014).

In Table 4, as the F statistic in model 1 is 6.64, which is greater than the upper bound at 1%, this study does not accept the null hypothesis and acknowledges the existence of an LR association. Thus, this study will use ARDL to conduct the LR, SR and ECM here. On the other hand, as the F statistics in model 2 is 12.75, which is greater than the upper bound at 1%, this study does not accept the null hypothesis and acknowledges the existence of an LR association. Thus, this study will use ARDL to conduct the LR, SR and ECM here.

Table 4: Bound test for cointegration

Bound test for ED (model 1)			
	Critical values		F-statistics
Level of Significance	Lower bound	Upper bound	
10%	3.032	4.213	6.64
5%	3.577	4.923	
1%	4.885	6.55	
Bound test for UR (model 2)			
	Critical values		F-statistics
Level of Significance	Lower bound	Upper bound	
10%	2.306	3.533	12.75
5%	2.734	3.92	
1%	3.657	5.256	

Source: Author's calculation, 2025.

4.5. ARDL estimation

Table 5 illustrates the estimated LR results for both models. In model 1, IN is significant at 1% level, showing that higher IN is associated with lower ED. IN reduces the real value of ED, or countries may borrow less externally when domestic IN is high because foreign investors demand higher interest rates. The GDP coefficient is negative but statistically insignificant. Suggests GDP growth may help reduce reliance on ED, but the effect is weak. TRE is significant at the 10% level and has a very small but positive effect, which indicates that as TRE increases, ED slightly increases in the LR. Possible reasoning is that higher TRE may encourage governments to borrow more externally, since they feel safer having a buffer stock. TR is not significant at conventional levels, negative relationship suggests that TR reduces reliance on ED. However, statistical insignificance means the evidence is not

strong. CA has a positive and significant relationship means a worsening CA (deficit) raises ED. When imports are greater than exports, governments finance the gap by borrowing abroad.

Table 5: Long-run estimated results

Variables	Coefficients	Std. errors with Probabilities
Dependent variable: External debt – Model 1		
IN	-0.239457	(0.064379)***
GDP	-0.086397	(0.365420)
TRE	1.37E-10	(8.03E-11) *
TR	-0. 112888	(0.080461)
CA	0.771999	(0.283499)**
R^2	0.959884	
Adjusted R^2	0.942054	
F-statistic	53.83703	
Dependent variable: unemployment rate – Model 2		
ED	0.060839	(0.032368)*
IN	-0.007883	(0.020226)
GDP	-0.08855	(0.086283)
PR	0.087568	(0.043857) *
GCF	0.422742	(0.112275) ***
R^2	0.886879	
Adjusted R^2	0.847872	
F-statistic	22.73631	

Note: The numbers indicate the parentheses value of standard errors.

***, ** and * represent significant at 1%, 5% and 10% level.

Source: Author's calculation 2025.

For model 2, ED shows that higher ED is associated with higher UR. An increasing ED can lead to higher UR if the borrowed funds are not invested in productive economic development or if they are mismanaged. GDP coefficient is negative but statistically insignificant, which suggests GDP growth may help reduce UR, but the effect is weak. The UR falls as GDP rises, because a growing economy indicates an increase in the production of goods and services, which in turn requires more labour to meet higher demand. UR falls as IN rises because of increased aggregate demand, which leads to businesses hiring more workers to meet demand and workers demanding higher wages. This phenomenon, described by the Phillips curve, suggests a SR inverse relationship where a booming economy with low UR leads to higher prices as businesses compete for scarce labour and resources, causing inflation. PR shows that higher PR is associated with higher UR. GCF shows a positive and significant relationship. An increase in GCF can lead to rising UR if the newly formed capital is labour-saving or if economic growth from the investment does not generate enough new jobs to absorb the workforce, as seen when construction or manufacturing sectors experience capital-intensive growth.

4.6 Error Correction Model

Table 6: Estimated short-run results

Variable	Coefficient	Probability	Coefficient	Probability
C	17.97802	0.0000	-6.350224	0.0000
	(2.687616)		(0.661214)	
Trend	-0.281730	0.0000	-0.074245	0.0000
	(0.046081)		(0.0105)	
D(TRE)	-4.66E-11	0.5416		
	(7.55E-11)			
D(ED)			0.013389	0.6656
			(0.030664)	
D(PR)			-0.118504	0.2322
			(0.097140)	
D(GCF)			-0.041976	0.7556
			(0.133557)	
CointEq-1	−0.287604	0.0000	-1.087254	0.0000
	(0.042281)			
R-squared	0.564521		0.752968	
Log likelihood	-77.20264		−17.41361	
DW stat	1.665119		2.368181	
F-statistic	15.55586		20.72678	
Prob (F-stat)	0.000001		0.0000	

Note : The number indite the parenthesis value of t-ratio.

***, ** and * represent significant at 1%, 5% and 10%.

Source: Author's calculation, 2025.

First difference of TRE has a negligible and statistically insignificant SR effect on ED. CointEq (-1) is highly significant, and the negative sign is expected and required for error correction models. This means the system corrects about 28.76% of the disequilibrium from the previous period per time period. The model is stable and converges to the LR equilibrium.

In model 2, the first difference of ED has a positive, insignificant effect. It suggests that an increase in ED raises UR in the SR. The first difference of PR has a negative and insignificant effect. Suggests an increase in participation rate reduces UR, which is counterintuitive, and could be due to SR labour market dynamics. Moreover, D(GCF) is negative but not statistically significant, which suggests SR investment does not have a strong effect on UR.

CointEq (-1) is highly significant and negative. It confirms the existence of an LR equilibrium and shows the speed at which unemployment adjusts back to equilibrium after a shock. The coefficient implies that 108.7% of the deviation from the LR equilibrium is corrected each period. This means convergence happens relatively fast.

4.7 Diagnosis tests

Diagnostic tests serve as useful indicators of the model's competency. In this research, the Breusch-Pagan test is applied to check for heteroskedasticity, for normality the Jarque-Bera test is sed, and the LM test for serial correlation. As shown in Table 7, the probability values of the F-statistics exceeded the conventional 5% level of significance, demonstrating that the data follow a normal distribution and that the models are free from serial correlation or heteroskedasticity.
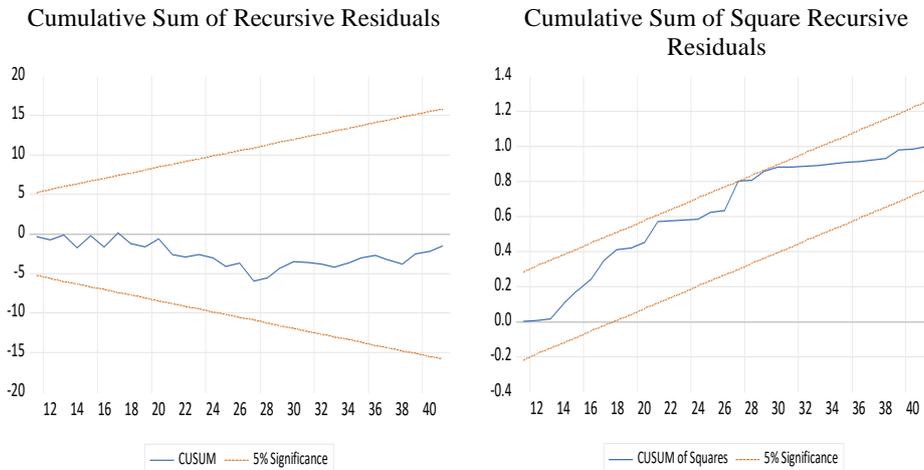
Table 7: Residual and stability test results

|	Effect of inflation on external debt - Model 1		
Method	F-Statistic	Prob. square	Prob. of chi
Serial correlation	0.278	F (1,30) ¼ 0.6016	0.5441
Heteroscedasticity	2.062495	F (8, 31) ¼ 0.0712	0.0846
Normality (Jarque-Bera)	0.498207	0.779499 Normal	
CUSUM	Within 5% critical region	Stable	
CUSUMSQ	Within 5% critical region	Stable	
Effect of external debt on unemp	Loyment- Model 2		
Method	F-Statistic	Prob. square	Prob. of chi
Serial correlation	2.605193	F (1,30) ¼ 0.1177	0.0650
Heteroscedasticity	1.025010	F (8, 31) ¼ 0.4475	0.4023
Normality (Jarque-Bera)	0.149830	0.927822 Normal	
CUSUM	Within 5% critical region	Stable	
CUSUMSQ	Within 5% critical region	Stable	

Source: Author's calculation, 2025.

In Figures 2 and 3, the plot of the cumulative sum of recursive residuals (CUSUM) and CUSUM of squares (CUSUMSQ) statistics falls within the critical bounds of the 5% confidence interval of parameter stability. These results demonstrate that there are no parameters and error variances instability in the ARDL models. Thus, the models are structurally stable.

Figure 2: The stability test (Model 1)

Cumulative Sum of Recursive Residuals

Cumulative Sum of Square Recursive Residuals

Source: Author's calculation, 2025.

Figure 3: The stability test (Model 2)

Cumulative Sum of Square Recursive Residuals

Cumulative Sum of Square Recursive Residuals
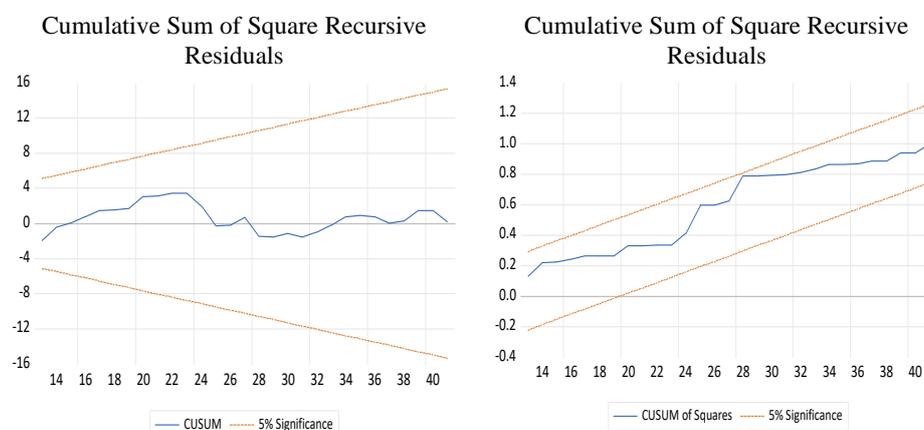
Source: Author's calculation, 2025.

5. Findings and Discussions

5.1 Major findings

To find out the interplay of ED, IN and UR, this study has explored several major findings. At first, this research has gone through the ADF under the unit root test to investigate the stationarity and integration order of the variables. The result shows that the variables are mixed stationary. To explain the LR relationship among each variable, this research has conducted the ARDL approach. According to the result, it can be concluded that the LR relationship exists among all the variables. Moreover, it is also found that the IN, CA and TRE are significant to interpret ED in LR, whereas insignificant LR relation between ED with GDP and TR respectively. Moreover, ED, GCF and PR are significant to interpret UR in the LR, whereas insignificant LR association between UR with IN and GDP.

5.2 Discussions

This study observes from the data analysis section that IN correlates negatively with ED and UR. Inflation and unemployment have a negative correlation primarily due to the relationship described by the Phillips curve, which posits a short-run trade-off between the two. When the economy is strong with low unemployment, demand for labour is high, leading to higher wages and increased consumer spending, which in turn pushes prices up (inflation). Conversely, when unemployment is high, consumer demand and wages are lower, which tends to slow price growth. In Bangladesh, Islam and Sahajalal (2019) found a non-significant negative correlation between IN and the UN. However, for 25 sub-Saharan African countries, Alnaa and Matey (2023) reported that IN correlate positively with UN.

 To slow down the economy, the central bank may respond to rising inflation by increasing interest rates. The cost of borrowing for the government increases with higher interest rates, potentially deterring additional debt accumulation. A large body of studies have yielded similar conclusions, namely that IN correlates negatively with ED. A working paper by Saani et al. (2024) demonstrated a negative relation between ED and IN. Reina (2025) looked at inflation and joblessness in Colombia over the past two decades (2007–2024) and found that they are negatively linked. Essentially, when unemployment falls, inflation typically rises (or vice versa).Despite findings elsewhere indicating that inflation correlates negatively with external debt, research by Joy and Panda (2019) on India's economy (1980–2017) shows a more nuanced picture. They found that the total volume of external debt significantly boosted inflation while simultaneously reducing non-developmental government spending. Milhana and Jayawickrama (2023) also concluded that both domestic and external debt significantly and positively impact inflation (IN) in Sri Lanka, with external debt having a higher effect. Siddiqui et al. (2022) also established a steady LR link between inflation and national debt in Pakistan, with public debt having a positive and statistically significant impact on IN.

In Bangladesh, UR and ED are positively correlated, according to this study. In response to rising unemployment and slow economic growth, governments often increase spending to stimulate the economy. This might include unemployment benefits, public works programs, and other social support measures. To finance this increased spending, governments may borrow more, which increases ED. This outcome also supports the study result of Gwazawa et al. (2021). Alnaa and Matey (2023), also concluded that ED has a statistically significant positive association with UN.

GDP growth has a negative relationship with UR and with ED. The inverse association between GDP growth and the UR is the best explained by the concept known as Okun's Law. According to this principle, higher GDP growth generally corresponds to a decrease in the UR, while slower or negative GDP growth is often associated with higher UR (Martin, 1993). Abbas et al. (2024) similarly found that GDP growth has a negative impact on the UN across 26 developing countries.

GDP correlates negatively with ED because when a country's GDP rises significantly, its ED often falls because the rising economic output makes the country more capable of repaying its debts, thus reducing the debt-to-GDP ratio, which measures relative debt burden. Earlier research on Bangladesh by Farhana and

Chowdhury (2014), also identified a negative impact of foreign debt on the country's growth. The VECM analysis by Mohammed and Abdi (2024) revealed that GDP growth is negatively associated with ED. The nation's capacity to repay its current debt can be enhanced by a greater GDP and even attract more investment, potentially reducing the need for new borrowing. Clements et al. (2003) show that reductions in ED raise per capita growth, implying a negative debt–growth link when debt is high. Several recent studies suggest a beneficial role for debt. Islam and Hossain (2024) discovered that ED significantly and favorably affects GDP growth.

In this study, CA balance correlates positively with ED. ED acts as a key source of funding for the CA deficit, implying a positive relationship between ED and the CA balance. Similar relationship between ED and the CA balance also found by Yıldız (2019).

This study finds that TRE correlates positively with ED in the LR. Nawshin et al. (2024) showed that Bangladesh uses TRE as collateral to facilitate additional ED, suggesting that TRE and ED have a beneficial association. In contrast Richard and Ovuokeroye (2021) find a statistically significant negative relationship between external debt (EXDT) and external reserves (EXRS). according to the study when a country borrows abroad, interest and principal repayments must be met in foreign exchange, high external debt raises scheduled outflows that reduce reserves.

TR has a negative relationship with ED. When TR increases, ED may fall because increased TR generates higher foreign exchange earnings through exports, which can be used to repay or reduce existing debt and reduce the need for new external borrowing. Additionally, more open economies tend to experience higher economic growth and productivity. Shamim et al. (2017) find that increasing ED in Pakistan significantly damages export performance, indicating a negative linkage between ED and TR. Some studies also shows positive relationship between TR and ED. Harsono et al. (2024) found that trade openness has a positive and significant impact on external debt. More trade is associated with more borrowing.

GCF formation correlates positively with UR in the LR. The positive correlation arises because when investments are directed toward capital-intensive projects, such as automation or large-scale infrastructure, they might reduce the need for human labour, especially in sectors where technology replaces manual work. This can lead to a rise in UR as workers are displaced by machines. Pasara and Garidzirai (2020) suggest that increases in GCF are associated with higher UR in the South African context throughout the time spent studying. GCF correlates negatively with UR in the SR because higher GCF often signifies increased investments in infrastructure, machinery, and other productive assets. These activities demand labour, leading to job creation and a reduction in UR.

UR and PR have a beneficial association, according to this study. Remittance inflows generally reduce UR by enabling investments and smoothing consumption, but a rise in UR alongside remittances can occur if remittances facilitate labour withdrawal from the market, or if they enable companies to hire overseas workers or engage in investments that displace domestic labour Another reason is that increased remittances can lead to higher reservation wages, causing job seekers to reject more offers and prolonging their unemployment, thereby increasing the overall UR. Biplob and Siddiqee (2024) demonstrate that higher remittance inflows are associated with

increased unemployment in both the SR and LR in Bangladesh. Some research also indicates that external financial inflows tend to decrease unemployment. Asad et al. (2016) concluded that the favorable impact of remittances on production and economic activity is expected to cause a decline in the nation's unemployment rate. This finding is reinforced by Mazher et al. (2020), who further discovered that both foreign remittances and foreign direct investment (FDI) reduce unemployment rates over the LR in Pakistan.

6. Conclusions and policy recommendations

This study aims to investigate the connection between UR, IN, and ED in Bangladesh. Annual data from 1983 to 2023 is taken from the WDI to do the study. To explore the complexities and comprehend the LR and SR dynamics among the variables, the ARDL technique is utilized. The study outcomes find an LR association between Bangladesh's ED and IN, CA, TRE, GDP, and TR. This study also discovered that while ED, GCF and PR have a positive and strong association with UR, IN, and GDP exhibit a negative LR association with UR. This might be the result of the Bangladeshi government borrowing too much, which is driving out businesses, or credit rating downgrades that make it harder for the government to attract international investment. This works against the expansionary strategies that are being implemented to create jobs in both the LR and the SR. In SR and LR, inflation has a negative and significant correlation with ED, which is contrary to our expectations. The government may experience a reduced real burden when inflation increases if it incurs debt with fixed interest rates or debt denominated in local currency. GDP produced a statistically insignificant and negative effect on Bangladesh's ED burden over the SR and LR. The TR of Bangladesh affects ED negatively, and it is not significant. A more open economy, with fewer trade barriers, can boost exports. These exports bring in foreign currency (forex), increasing the country's forex reserves. Finally, CA correlates positively with ED in the LR. According to the study, the government of Bangladesh should prioritize borrowing domestically over borrowing abroad and consider taking out foreign debts with set interest rates or choosing loans denominated in local currency.

To address ED, IN and UR effectively, a balanced approach combining fiscal, monetary, and structural policy recommendations can be beneficial. Firstly, the burden of ED might be lessened in both SR and LR by making investments in essential infrastructure and encouraging manufacturing and agriculture to boost economic activity. The government should also start an import substitution push and encourage the export of a wider variety of manufactured goods in order to improve the trade balance. Therefore, by properly leveraging trade, the government can lessen the burden of debt. Secondly, implementing balanced budget or surplus targets can prevent excessive borrowing. This can involve reducing non-essential government expenditures and focusing on priority areas such as infrastructure, health, and education. Thirdly, effective debt management is essential for maintaining economic stability. By issuing bonds with staggered maturity dates, governments can smooth out repayment schedules, avoiding large debt repayments in any single year, which can prevent fiscal strain. Fourthly, periodic debt sustainability analyses are needed to help policymakers assess whether the current debt level is manageable in the medium to long run and whether adjustments are needed. Fifthly, in cases of very high debt,

restructuring through lower interest rates or extended maturities can alleviate the debt burden. Negotiating favourable terms with lenders may prevent default and stabilize finances. Sixthly, improving tax collection efficiency, reducing tax evasion, and expanding tax bases can increase revenue without significantly impacting middle-income households. Seventhly, the central bank can increase interest rates to curb inflation by reducing borrowing and spending. Eighthly, incentivizing production and addressing supply chain bottlenecks can alleviate inflation pressures, especially in critical sectors like energy, food and housing. Ninthly, coordinating with labour unions to promote moderate wage increases can avoid a wage-price spiral, where rising wages increase costs and push inflation higher. Tenthly, government incentives for high-potential sectors like technology, green energy, and healthcare can drive job growth. Public-private initiatives can further accelerate this in emerging or critical industries. Eleventhly, modernize agriculture and introduce agro-processing units to absorb rural unemployment. Twelfthly, promoting entrepreneurship and supporting small and medium-sized enterprises with tax breaks, grants, and simplified regulations can create jobs and reduce unemployment over the long term. Lastly, create a business-friendly environment to attract investment in labour-intensive sectors.

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