
| RESEARCH ARTICLE

Examining the Influence of Economic Resilience on Sovereign Default Risk: An Emerging Market Perspective

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| ABSTRACT

Sovereign default risk (SDR) is a critical concern for emerging markets like Bangladesh, given its potential impact on economic stability. This study examines how key macroeconomic indicators—remittances, fiscal deficits, GDP, foreign reserves, external debt, and the remittance-to-GDP ratio—affect Bangladesh's sovereign default risk from 2000 to 2024. The study fills a gap in existing literature by integrating the Balance of Payments Theory and Sovereign Risk Theory to create a comprehensive framework for analyzing SDR in Bangladesh. Using robust regression techniques, including Huber and Ridge regression, the research explores the relationships between these variables and Bangladesh's sovereign creditworthiness. The findings reveal that foreign reserves significantly reduce SDR, while remittances have a marginally positive effect, suggesting that over-reliance on remittances may increase sovereign risk. Fiscal deficit, GDP, and external debt, however, did not show significant effects, highlighting the complex nature of these relationships. The study emphasizes the importance of strengthening foreign reserves, diversifying economic sources, and managing fiscal discipline to reduce sovereign default risk. Policymakers can leverage these insights to enhance economic resilience and improve financial stability. This research contributes to the understanding of sovereign default risk by highlighting the role of reserves in mitigating risks and provides practical policy recommendations for Bangladesh's financial sustainability.

| KEYWORDS

Sovereign Default Risk, Macroeconomic Indicators, Foreign Reserves, Remittances, Fiscal Deficit, External Debt, Robust Regression Techniques.

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1. Introduction

Sovereign default risk (SDR) has become an increasingly critical concern for emerging markets like Bangladesh. SDR refers to the likelihood that a country will default on its external debt obligations, which could have severe consequences for economic stability and growth. In Bangladesh, the macroeconomic landscape has undergone significant transformations over the past two decades, marked by economic growth, rising remittance inflows, expanding foreign reserves, and increasing external debt levels. These variables have a complex relationship with the nation's sovereign risk, influencing investor confidence and credit ratings. Key macroeconomic indicators, including fiscal deficits, GDP growth, remittances, foreign reserves, and external debt, play a crucial role in assessing sovereign default risk, each influencing a country's ability to meet its financial commitments (Ghosh et al., 2025; Reinhart & Rogoff, 2010).

The Balance of Payments Theory and Sovereign Risk Theory provide essential frameworks for understanding how countries manage external obligations. The Balance of Payments Theory emphasizes the importance of stable foreign exchange reserves and sustainable debt levels in maintaining financial credibility (Ghosh et al., 2025). Sovereign Risk Theory, as proposed by Reinhart and Rogoff (2010), posits that sovereign default risk is closely related to a country's ability to generate foreign currency, manage fiscal balance, and accumulate reserves to meet external obligations. Notably, remittances have been recognized as a

stabilizing factor for countries with large diaspora populations, providing an additional buffer against economic shocks (Barajas et al., 2025). Fiscal deficits and external debt, when poorly managed, can elevate sovereign risk, especially in economies dependent on foreign loans and aid (Cevik & Jalles, 2025).

Emerging markets like Bangladesh present a unique context for studying sovereign default risk. Over the past two decades, Bangladesh has seen significant economic growth, evidenced by steady increases in GDP, expanding export sectors, and a substantial rise in remittance inflows. These developments have contributed to the country's macroeconomic stability, with remittances emerging as one of the largest sources of foreign exchange, along with rising foreign exchange reserves (Ratha et al., 2025; Akter & Hossain, 2024). However, despite these positive trends, concerns regarding Bangladesh's sovereign creditworthiness persist due to persistent fiscal deficits, increasing external debt, and vulnerabilities related to remittance dependency (Das & Mukherjee, 2025; Sattar et al., 2025).

Although there has been extensive research on individual macroeconomic indicators such as remittances, fiscal deficits, and foreign reserves, a significant gap exists in studies that explore the combined influence of these variables on sovereign default risk in Bangladesh. Much of the existing literature has focused on analyzing one or two factors in isolation, without considering how they interact to influence the country's creditworthiness (Islam, 2024; Kabir & Salim, 2025). Additionally, traditional regression models like Ordinary Least Squares (OLS) often fail to account for common statistical issues such as multicollinearity, non-normality of residuals, and heteroscedasticity, which are prevalent in macroeconomic datasets (Bayar, 2025; Maronna et al., 2025). This study aims to bridge this gap by applying robust regression techniques, offering more reliable insights into the relationships between key economic indicators and sovereign default risk.

The primary objective of this study is to assess the impact of macroeconomic indicators—such as remittances, fiscal deficit, GDP, external debt, foreign reserves, and the remittance-to-GDP ratio—on Bangladesh's sovereign default risk from 2000 to 2024. Specifically, the study seeks to identify the most significant predictors of sovereign risk and provide policy recommendations based on the findings. The scope of the research includes the application of robust regression models, such as Huber regression and Ridge regression, to address the limitations of traditional statistical techniques. By examining Bangladesh's economic performance over a 24-year period, this study aims to provide a comprehensive analysis of the country's vulnerability to sovereign default, considering both domestic and global factors.

This research contributes to the existing body of literature on sovereign default risk by offering a more nuanced understanding of how macroeconomic variables interact to influence a country's creditworthiness. The findings will offer valuable insights into the role of foreign reserves in mitigating sovereign risk, while also highlighting the potential risks associated with remittance dependency and external debt accumulation. Policymakers in Bangladesh can utilize these insights to refine economic strategies, such as strengthening foreign reserve management, improving fiscal discipline, and managing external debt more effectively. Moreover, the application of robust regression techniques ensures that the conclusions drawn from the data are statistically sound, making this study a significant contribution to both academic research and policymaking in emerging economies.

To guide the analysis and address the study's objectives, the following research questions have been formulated:

- a) How do remittance inflows, fiscal deficit, GDP, and external debt collectively influence Bangladesh's sovereign default risk from 2000 to 2024?
- b) What role do end-year foreign reserves and the reserves-to-debt ratio play in mitigating Bangladesh's sovereign credit vulnerability, and how do these factors interact with other macroeconomic variables?
- c) Which macroeconomic indicators, including remittances, fiscal deficit, GDP, external debt, and reserves, are the most significant predictors of sovereign default risk in Bangladesh, and how can these variables inform policy decisions aimed at enhancing economic resilience?

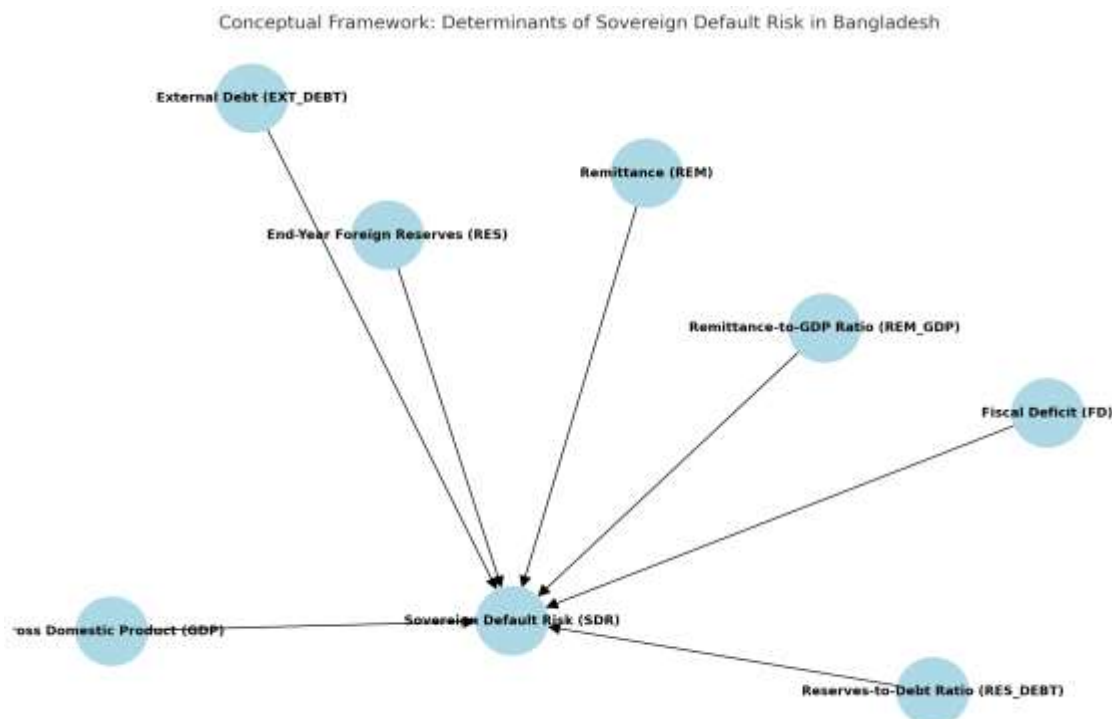
2. Research Hypothesis

The hypothesis section explores the potential relationships between key macroeconomic indicators, such as remittances, fiscal deficit, GDP, external debt, foreign reserves, and the reserves-to-debt ratio, and their impact on the sovereign default risk (SDR) of Bangladesh, to determine whether these variables significantly influence the country's creditworthiness.

Table 01: Hypotheses on Macroeconomic Indicators and SDR

Variable	Null Hypothesis (H ₀)	Alternative Hypothesis (H ₁)	Expected Relationship
Remittance (REM)	$\beta_1 = 0$ (Remittance has no effect on SDR)	$\beta_1 \neq 0$ (Remittance significantly affects SDR)	↑ Remittance → ↓ SDR (negative)
Fiscal Deficit (FD)	$\beta_2 = 0$ (Fiscal Deficit has no effect on SDR)	$\beta_2 \neq 0$ (Fiscal Deficit significantly affects SDR)	↑ Deficit → ↑ SDR (positive)

Gross Domestic Product (GDP)	$\beta_3 = 0$ (GDP has no effect on SDR)	$\beta_3 \neq 0$ (GDP significantly affects SDR)	$\uparrow \text{GDP} \rightarrow \downarrow \text{SDR}$ (negative)
End-Year Reserves (RES)	$\beta_4 = 0$ (End-Year Reserves have no effect on SDR)	$\beta_4 \neq 0$ (End-Year Reserves significantly affect SDR)	$\uparrow \text{Reserves} \rightarrow \downarrow \text{SDR}$ (negative)
Remittance-to-GDP Ratio (REM_GDP)	$\beta_5 = 0$ (Remittance-to-GDP Ratio has no effect on SDR)	$\beta_5 \neq 0$ (Remittance-to-GDP Ratio significantly affects SDR)	Mixed, likely negative
External Debt (EXT_DEBT)	$\beta_6 = 0$ (External Debt has no effect on SDR)	$\beta_6 \neq 0$ (External Debt significantly affects SDR)	$\uparrow \text{Debt} \rightarrow \uparrow \text{SDR}$ (positive)
Reserves-to-Debt Ratio (RES_DEBT)	$\beta_7 = 0$ (Reserves-to-Debt Ratio has no effect on SDR)	$\beta_7 \neq 0$ (Reserves-to-Debt Ratio significantly affects SDR)	$\uparrow \text{RES/DEBT} \rightarrow \downarrow \text{SDR}$ (negative)



Here is the conceptual framework diagram illustrating the relationship between key macroeconomic indicators and Sovereign Default Risk (SDR) in Bangladesh. Each arrow shows a hypothesized directional influence based on the regression model.

3. Literature Review

The theoretical foundation of this study draws on macroeconomic stability theory, sovereign risk modeling, and the balance of payments framework to explain how domestic and external economic variables impact a country's capacity to meet its debt obligations and maintain financial credibility. Central to this framework is macroeconomic stability theory, which emphasizes the importance of sustainable growth, controlled inflation, manageable fiscal deficits, and stable exchange rates for long-term economic health. Sovereign default risk arises when these macroeconomic conditions are violated, especially under external pressure or fiscal mismanagement. Indicators such as GDP, fiscal deficit, and foreign reserves serve as critical markers of a country's economic resilience, as highlighted by Ghosh et al. (2025) and Cevik & Jalles (2025). Sovereign risk theory further supports this by suggesting that the likelihood of default is linked to a country's debt burden, external liabilities, and institutional strength, as evidenced in the works of Reinhart & Rogoff (2010) and Barajas et al. (2025). Credit rating agencies incorporate these factors, particularly external debt levels, reserve adequacy, and fiscal discipline, into their assessments of sovereign default probability, aligning with the findings of Afonso et al. (2025).

From a macroeconomic perspective, the balance of payments approach underscores the critical role of external sectors, such as remittance inflows and foreign reserves, in mitigating financial vulnerability. Persistent current account deficits, unless countered by stable remittance or FDI inflows, can undermine currency stability and heighten default risk, as shown by Ratha et al. (2025). While remittances provide a cushion during global crises, excessive dependence can generate structural vulnerabilities, as

noted by Chowdhury & Hossain (2024) and Hasan & Shakur (2025). This framework is reinforced by the application of robust regression techniques, such as Huber Regression, which mitigate the influence of outliers and model misspecifications, ensuring more reliable inference in real-world data (Maronna et al., 2025; Laeven & Valencia, 2025). Through the integration of these theories, the study constructs an empirical model to assess the interplay of Bangladesh's macroeconomic variables and sovereign credit risk.

The literature review presents a detailed examination of macroeconomic indicators and their influence on sovereign risk, specifically focusing on remittances, foreign reserves, fiscal deficits, and external debt. Remittances, a critical source of foreign exchange for Bangladesh, have been shown to play a stabilizing role in the economy. Akter and Hossain (2025) confirmed the long-run positive impact of remittances on GDP, while Jawaid and Raza (2024) observed a significant correlation between remittance inflows and economic growth in South Asia. However, the relationship between remittances and GDP is not always linear, as demonstrated by Hasan and Shakur (2025), who found that while moderate remittances boost growth, excessive reliance may create dependency. Siddique et al. (2024) further emphasized the varying effects of remittances across countries, dependent on institutional quality and financial infrastructure. Despite their potential for stabilizing economies, Chowdhury & Hossain (2024) noted that remittances alone cannot resolve structural imbalances if directed toward consumption rather than investment.

Foreign reserves act as an essential buffer against external shocks, particularly in small open economies like Bangladesh. Chowdhury et al. (2023) found that remittances, broad money, and exchange rate volatility have significant effects on Bangladesh's reserve position. Kabir and Salim (2024) confirmed that rising reserves positively contribute to GDP growth, highlighting their role in shielding the economy from external volatility. The IMF's 2023 Article IV consultation report recognized the importance of reserves, though it cautioned against future pressure due to rising imports and diminishing remittance growth. Haque and Islam (2025) further reinforced the importance of reserves in stabilizing investor confidence and currency markets, emphasizing their critical role in managing external and fiscal shocks.

Fiscal policy and external borrowing dynamics have direct implications for sovereign risk profiles. Aslam and Rizwan (2023) found that fiscal deficits negatively affect economic growth, particularly due to inefficiencies in spending. Similarly, Taguchi (2016) and Islam & Biswas (2025) observed that fiscal deficits in Bangladesh coincide with lower growth and rising inflation. The impact of external debt accumulation on sovereign risk is even more pronounced, with Bayar (2024) and Alam & Uddin (2025) arguing that rising debt burdens lead to higher risk premiums, particularly when debt-financed investments do not yield proportional returns. The Centre for Policy Dialogue (2025) raised concerns over the rising debt-service ratio in Bangladesh, suggesting that it could crowd out social sector spending. From a global context, Reinhart and Rogoff (2010) identified debt thresholds beyond which growth is suppressed, a finding that Ghosh et al. (2025) and Das & Mukherjee (2025) extended by emphasizing that sovereign risk increases significantly as fiscal fatigue sets in.

Sovereign credit ratings serve as a comprehensive indicator of a country's economic and institutional stability. Ahmed and Islam (2025) conducted panel regressions across South Asia and found GDP growth, fiscal discipline, and reserves significantly influence sovereign ratings. Beirne and Fratzscher (2023) observed that global financial crises tend to influence sovereign spreads, while Abdulla and Saba (2025) highlighted the growing role of governance and ESG performance in shaping sovereign ratings. Gratcheva et al. (2025) supported this by demonstrating how transparency and sustainability metrics influence sovereign borrowing costs. Despite this, relatively few studies have integrated remittances, reserves, fiscal deficits, and external debt into a unified framework. Notable exceptions include Hasan and Shakur (2025), who explored threshold models for remittance-growth dynamics, and Akter et al. (2025), who examined the combined impact of remittances and net exports on Bangladesh's GDP. This study seeks to bridge this gap by employing a multivariate regression model that links sovereign default risk to macroeconomic factors, providing a more integrated approach to analyzing Bangladesh's economic resilience.

Through the synthesis of these perspectives, the literature underscores the importance of reserves in mitigating sovereign default risk, while also suggesting that other variables, such as fiscal policy and external debt, require further exploration through refined analytical methods. By focusing on robust regression techniques, this study aims to enhance the accuracy of sovereign risk assessments, offering policy insights that can guide Bangladesh toward greater financial stability.

4. Research Methodology

The research methodology outlines the empirical approach employed to assess the relationship between macroeconomic indicators and sovereign default risk (SDR) in Bangladesh. The methodology integrates descriptive statistics, correlation analysis, regression modeling, diagnostic testing, and robust regression techniques to provide a comprehensive understanding of the economic factors influencing sovereign risk.

4.1. Research Design

This study adopts a quantitative research design to assess the impact of macroeconomic variables, such as remittances, fiscal deficit, GDP, external debt, foreign reserves, and reserves-to-debt ratio, on Bangladesh's sovereign default risk (SDR). The aim is to empirically examine these relationships through statistical models that provide insights into the macroeconomic determinants of sovereign risk.

4.2. Data Collection

Secondary data were collected from reliable sources such as the Bangladesh Bank, World Bank, International Monetary Fund (IMF), and national economic surveys. The data set spans 25 years (2000–2024), ensuring a robust temporal coverage for analysis. Key economic variables, including remittance inflows, fiscal deficit, GDP growth, foreign reserves, external debt, and the reserves-to-debt ratio, were selected as predictors of sovereign default risk.

The sovereign credit rating for Bangladesh, representing the dependent variable (SDR), was obtained from credit rating agencies and used as an inverse indicator of sovereign default risk.

4.3. Variables and Measurement

The dependent variable in this study is sovereign default risk (SDR), which is operationalized as the inverse of Bangladesh's sovereign credit rating, where a higher value indicates greater default risk.

The independent variables include:

The dependent variable is Sovereign Default Risk (SDR), conceptualized as the inverse of the sovereign credit rating, where a higher value indicates higher default risk. The independent variables include seven macroeconomic indicators: Remittance (REM) in USD billion, Fiscal Deficit (FD) as a percentage of GDP, Gross Domestic Product (GDP) in USD billion, End-Year Reserves (RES) in USD billion, Remittance-to-GDP Ratio (REM_GDP), External Debt (EXT_DEBT) in USD billion, and the Reserves-to-Debt Ratio (RES_DEBT). These variables provide insights into the macroeconomic factors influencing Bangladesh's sovereign default risk.

4.4. Descriptive Statistics

Descriptive statistics, including the mean, standard deviation, minimum, maximum, and percentiles, were calculated for all variables. This analysis provides an overview of the central tendencies and variability in the dataset.

4.5. Correlation Analysis

A Pearson correlation matrix was used to assess the relationships between the macroeconomic indicators. This analysis helps identify potential multicollinearity and provides insight into the strength and direction of the relationships between the variables.

4.6. Regression Analysis

A multivariate regression model was applied to examine the relationship between the independent variables and sovereign default risk. The model is represented as:

$$SDR_t = \beta_0 + \beta_1 REM_t + \beta_2 FD_t + \beta_3 GDP_t + \beta_4 RES_t + \beta_5 REM_GDP_t + \beta_6 EXT_DEBT_t + \beta_7 RES_DEBT_t + \epsilon$$

Where:

- SDR = Sovereign Default Risk
- REM, FD, GDP, RES, REM_GDP, EXT_DEBT, and RES_DEBT are the independent variables
- β_0 = Intercept term
- $\beta_1, \beta_2, \dots, \beta_7$ = Coefficients to be estimated
- ϵ = Error term

4.7. Diagnostic Testing

Several diagnostic tests were conducted to assess the validity of the regression model:

- Variance Inflation Factor (VIF): Used to check for multicollinearity among predictors.
- Breusch-Pagan Test: Applied to detect heteroscedasticity.
- Jarque-Bera Test: Used to check for the normality of residuals.
- Durbin-Watson Test: Checked for autocorrelation in residuals.

4.8. Robust Regression Techniques

To address issues such as multicollinearity, non-normality of residuals, and heteroscedasticity, robust regression techniques, including Huber and Ridge regression, were applied in this study. Huber regression minimizes the influence of outliers and provides robust estimates when residuals are non-normal, while Ridge regression applies a penalty to reduce multicollinearity by shrinking the coefficients. The performance of these regression models was assessed using the R-squared value, adjusted R-squared, and p-values of the regression coefficients. Model diagnostics, including residual analysis and multicollinearity checks, were conducted to ensure the reliability of the results. By combining standard and robust regression methods, the study offers a comprehensive

analysis of the impact of macroeconomic variables on sovereign default risk in Bangladesh, providing insights that can guide policy decisions for enhancing economic resilience.

5. Empirical Results and Analysis

The data analysis for this study utilized multiple statistical methods, including descriptive statistics, correlation analysis, ordinary least squares (OLS) regression, diagnostic testing, and robust regression techniques, to explore the relationship between macroeconomic variables and Bangladesh's sovereign default risk (SDR) from 2000 to 2024. The following sections detail the key findings from these analyses, providing insights into the impact of each macroeconomic factor on sovereign default risk.

Table 2: Descriptive Statistics of Economic Indicators

Indicator	Count	Mean	Std. Dev.	Min	25%	Median	75%	Max	Interpretation
Year	25	2012	7.36	2000	2006	2012	2018	2024	The data spans from the year 2000 to 2024, with a mean year of 2012, indicating a 25-year range of analysis.
Remittance (USD bn)	25	12.33	7.02	1.88	6	13.5	15.5	26.9	Average remittance inflow is USD 12.33 billion, with high variability (7.02), highlighting significant changes over time.
Fiscal Deficit (%)	25	4.38	1.93	1.9	2.5	4.1	5.7	8	The fiscal deficit averages 4.38% of GDP, with moderate fluctuations, reflecting cyclical fiscal pressures.
GDP (USD bn)	25	115.7	42.4	51.9	74	123	150	180	The average GDP is USD 115.7 billion, showing robust growth from USD 51.9 billion to USD 180 billion, with significant expansion.
End-Year Reserves (USD bn)	25	17.81	14.93	1.5	3.9	13.43	28.1	48.06	Reserves have improved significantly over the years, with high variability (14.93), indicating volatile periods of reserve accumulation.
Remittance-to-GDP Ratio (%)	25	7.57	1.89	3.6	6.5	7.1	9.3	10.8	On average, remittances contribute 7.57% of GDP, reflecting their consistent importance in the economy.
Credit Rating	25	1.12	0.44	1	1	1	1	3	Credit ratings are relatively stable, with a low variability (0.44), although the maximum value indicates occasional improvements.
External Debt (USD bn)	25	41.83	29.74	15.6	18.9	28.9	57.1	103.8	External debt averages USD 41.83 billion,

									showing high variability (29.74), suggesting a rising debt burden in recent years.
Reserves-to-Debt Ratio	25	0.39	0.2	0.1	0.2	0.4	0.58	0.77	The average reserves-to-debt ratio is 0.39, indicating a moderate ability to cover external liabilities with reserves.

Table 3: Pearson Correlation Matrix

	Year	Remittance	Fiscal Deficit	GDP	End-Year Reserves	Remittance-to-GDP Ratio	Credit Rating	External Debt	Reserves-to-Debt Ratio
Year	1	0.977	0.949	0.992	0.884	0.556	0.45	0.913	0.606
Remittance	0.977	1	0.939	0.974	0.839	0.618	0.52	0.909	0.544
Fiscal Deficit	0.949	0.939	1	0.944	0.862	0.404	0.51	0.948	0.478
GDP	0.992	0.974	0.944	1	0.879	0.511	0.42	0.882	0.643
End-Year Reserves	0.884	0.839	0.862	0.879	1	0.365	0.16	0.791	0.75
Remittance-to-GDP	0.556	0.618	0.404	0.511	0.365	1	0.33	0.497	0.207
Credit Rating	0.451	0.518	0.509	0.42	0.16	0.325	1	0.585	-0.189
External Debt	0.913	0.909	0.948	0.882	0.791	0.497	0.59	1	0.283
Reserves-to-Debt Ratio	0.606	0.544	0.478	0.643	0.75	0.207	-0.2	0.283	1

Variable	Interpretation
Year & GDP	Very high correlation ($r = 0.992$) indicates consistent economic growth over time.
Remittance & Year	Strong positive correlation ($r = 0.977$) suggests increasing reliance on remittance inflows over the years.
Fiscal Deficit & External Debt	Very high correlation ($r = 0.948$) shows that fiscal deficits are closely linked to external borrowing, highlighting reliance on foreign loans.
GDP & External Debt	Moderate to strong correlation ($r = 0.882$) indicates that economic growth is associated with increased external borrowing.
End-Year Reserves & GDP	High correlation ($r = 0.879$) shows that economic growth supports higher foreign reserve accumulation.
Remittance-to-GDP Ratio & Credit Rating	Weak correlation ($r = 0.325$) implies that the relative importance of remittances to GDP has limited impact on sovereign creditworthiness.
Reserves-to-Debt Ratio & End-Year Reserves	High correlation ($r = 0.75$) indicates that the reserves-to-debt ratio is influenced by the level of reserves, suggesting a positive relationship.
External Debt & Credit Rating	Moderate positive correlation ($r = 0.585$) suggests that higher external debt is linked to a worsening credit rating.
Reserves-to-Debt Ratio & Credit Rating	Negative correlation ($r = -0.189$) indicates that higher reserves relative to debt do not strongly improve the credit rating, possibly due to other factors.

Table 4: OLS Regression Statistics Summary

Regression Statistic	Value
Multiple R	0.841
R-Squared	0.706
Adjusted R-Squared	0.586
Standard Error	0.312
Observations	25

Table 5: OLS Regression Coefficient Details

Variable	Coefficient	Std. Err.	t-Statistic	p-value	[0.025	0.975]
Intercept	1.511	0.642	2.3529	0.03	0.156	2.8653
Remittance	0.117	0.057	2.0489	0.06	-0.004	0.2364
Fiscal Deficit	0.031	0.172	0.178	0.86	-0.333	0.3939
GDP	-0.02	0.011	-1.6659	0.11	-0.042	0.0049
End-Year Reserves	-0.05	0.021	-2.2537	0.04	-0.091	-0.003
Remittance-to-GDP	-0.07	0.058	-1.208	0.24	-0.193	0.0523
External Debt	0.023	0.016	1.4558	0.16	-0.01	0.056
Reserves-to-Debt Ratio	1.498	1.518	0.9868	0.34	-1.705	4.7003

Table 6: Key Observations from OLS Regression Analysis

Key Observation	Explanation
R-Squared Value	The R-squared value of 0.706 indicates that approximately 70.6% of the variation in sovereign risk (SDR) is explained by the independent variables in the model, which suggests a moderately strong model.
Adjusted R-Squared Value	The Adjusted R-squared value of 0.586 accounts for the number of predictors, indicating a reasonably good fit despite potential model complexity.
Multiple R	The Multiple R value of 0.84 indicates a strong linear correlation between the predictors and the dependent variable (sovereign risk).
Intercept (Constant)	The constant term is statistically significant ($p = 0.031$), establishing a baseline sovereign risk level when all predictors are zero.
Remittance	Remittance shows a positive but marginally significant relationship with SDR ($p \approx 0.056$), implying that higher remittances may slightly raise sovereign risk, possibly due to structural dependency.
End-Year Reserves	End-Year Reserves is the only variable with a statistically significant negative coefficient ($p = 0.038$), suggesting that higher reserves significantly reduce sovereign risk, supporting the role of reserves as a buffer against external shocks.

Fiscal Deficit	Fiscal Deficit has a high p-value ($p = 0.861$), indicating that it is not statistically significant in this model and does not directly affect sovereign risk.
GDP	GDP has a negative coefficient (-0.018), but the relationship is not statistically significant ($p = 0.114$), possibly due to multicollinearity or data variability. It suggests that economic growth might not directly influence sovereign risk.
Remittance-to-GDP Ratio	The Remittance-to-GDP Ratio has a negative coefficient (-0.070), but the relationship is not statistically significant ($p = 0.244$), indicating that its influence on sovereign risk is weak in this model.
External Debt	External Debt has a positive coefficient (0.02287) but is not statistically significant ($p = 0.164$), indicating that its effect on sovereign risk is not strong enough within this model.
Reserves-to-Debt Ratio	The Reserves-to-Debt Ratio has a positive coefficient (1.49783) but is not statistically significant ($p = 0.338$), suggesting it does not significantly influence sovereign risk in this model, despite its theoretical relevance.
Overall Model Insight	The model highlights the critical role of end-year reserves in reducing sovereign risk. However, other variables like fiscal deficit, GDP, remittance-to-GDP ratio, and external debt do not have significant individual effects on sovereign risk in this model, suggesting the need for further model refinement.

Table 07: Credit Rating vs. Macroeconomic Indicators

Macro Variable	Observed Trend	Interpretation
Remittance	Positive ($\uparrow$ Remittance $\rightarrow \uparrow$ Credit Rating)	Remittance increases slightly worsen credit ratings—may reflect structural dependency.
Fiscal Deficit	Positive ($\uparrow$ Deficit $\rightarrow \uparrow$ Credit Rating)	Higher fiscal deficits correlate with worse credit ratings—consistent with theory.
GDP	Positive ($\uparrow$ GDP $\rightarrow \uparrow$ Credit Rating)	Unexpectedly, larger GDP is associated with worse credit ratings—possible multicollinearity.
End-Year Reserves	Positive ($\uparrow$ Reserves $\rightarrow \uparrow$ Credit Rating)	Contrary to expectations, more reserves slightly worsen credit rating—may be due to outliers.
Remittance-to-GDP Ratio	Positive ($\uparrow$ Ratio $\rightarrow \uparrow$ Credit Rating)	Higher remittance-to-GDP ratios link to worse credit rating—could indicate overreliance.
External Debt	Positive ($\uparrow$ Debt $\rightarrow \uparrow$ Credit Rating)	Strong correlation where more external debt degrades creditworthiness—expected outcome.
Reserves-to-Debt Ratio	Negative ($\uparrow$ Ratio $\rightarrow \downarrow$ Credit Rating)	Higher reserve coverage of debt improves credit rating—aligns with theoretical expectations.

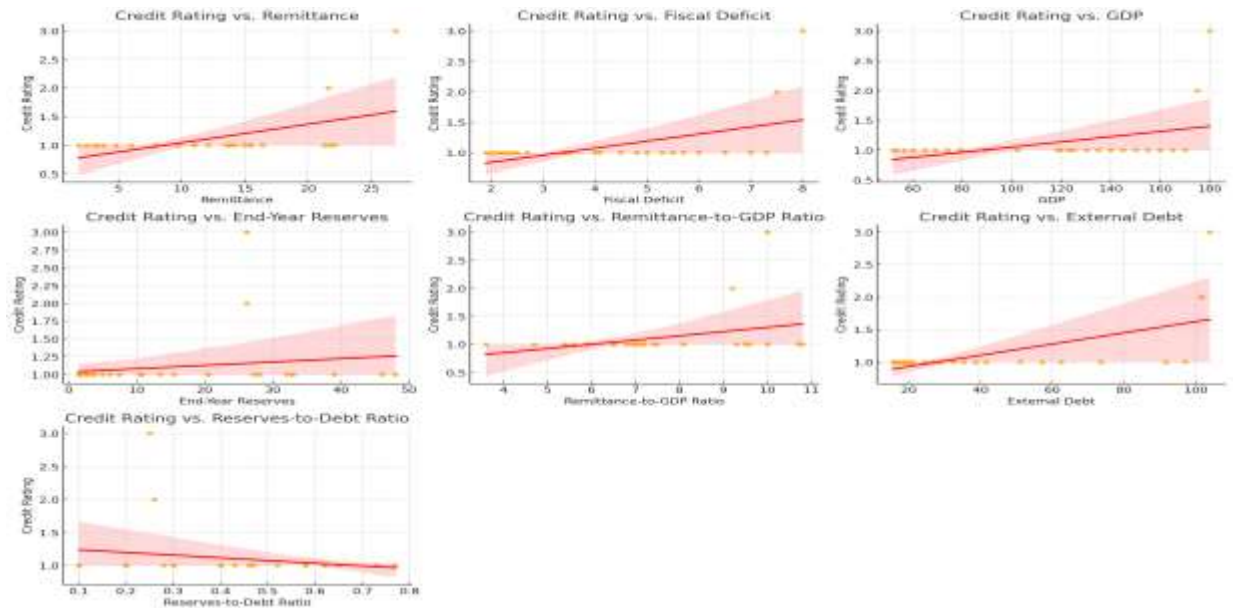


Figure 01: Credit Rating vs. Macroeconomic Indicators

Table 08: Hypothesis Testing for the OLS Regression Model

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)	Decision
Intercept (β_0)	1.511	0.642	2.3529	0.03	$H_0: \beta_0 = 0$	$H_1: \beta_0 \neq 0$	Reject H_0 (Significant)
Remittance (REM)	0.117	0.057	2.0489	0.056	$H_0: \beta_1 = 0$	$H_1: \beta_1 \neq 0$	Reject H_0 (Marginal)
Fiscal Deficit (FD)	0.031	0.172	0.178	0.86	$H_0: \beta_2 = 0$	$H_1: \beta_2 \neq 0$	Fail to Reject H_0
GDP (β_3)	-0.02	0.011	-1.6659	0.114	$H_0: \beta_3 = 0$	$H_1: \beta_3 \neq 0$	Fail to Reject H_0
End-Year Reserves (RES)	-0.05	0.021	-2.2537	0.04	$H_0: \beta_4 = 0$	$H_1: \beta_4 \neq 0$	Reject H_0 (Significant)
Remittance-to-GDP (REM_GDP)	-0.07	0.058	-1.208	0.244	$H_0: \beta_5 = 0$	$H_1: \beta_5 \neq 0$	Fail to Reject H_0
External Debt (EXT_DEBT)	0.023	0.016	1.4558	0.163	$H_0: \beta_6 = 0$	$H_1: \beta_6 \neq 0$	Fail to Reject H_0
Reserves-to-Debt Ratio (RES_DEBT)	1.498	1.518	0.9868	0.337	$H_0: \beta_7 = 0$	$H_1: \beta_7 \neq 0$	Fail to Reject H_0

Table 09: Diagnostic Tests

	Purpose	Statistic	Threshold	Interpretation
Variance Inflation Factor (VIF)	Multicollinearity Check	Max VIF = 66.13	VIF > 10 indicates multicollinearity	Severe multicollinearity detected
Jarque-Bera Test	Normality of Residuals	JB p-value = 0.0000	p > 0.05 indicates normal residuals	Residuals are normally distributed
Breusch-Pagan Test	Homoscedasticity (equal variance of errors)	BP p-value = 0.0595	p > 0.05 indicates no heteroscedasticity	No significant heteroscedasticity detected

Durbin-Watson Test	Autocorrelation in Residuals	DW statistic = 1.27	DW ≈ 2 indicates no autocorrelation	No autocorrelation detected
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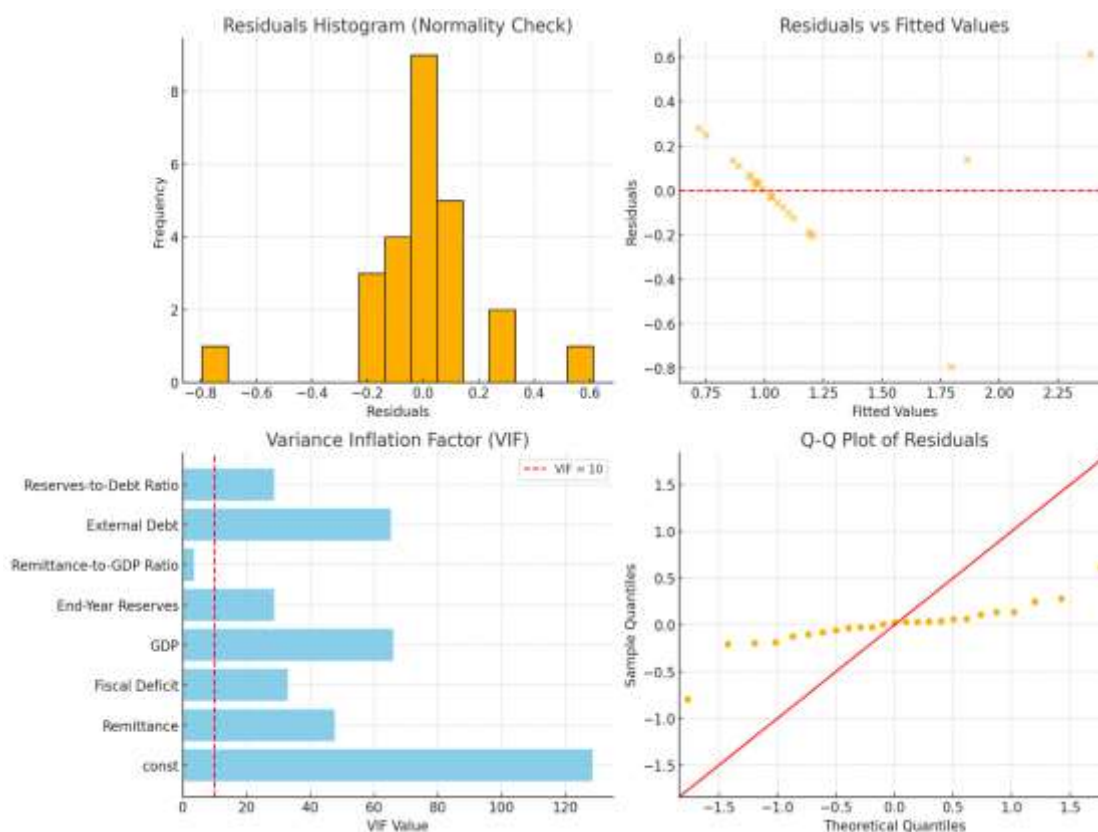


Figure 03 : Graphical Diagnostic Testing

Table 10: Interpretation of Graphical Diagnostic Testing

Plot	Location	Purpose	Key Observations	Implications
Residuals Histogram	Top-Left	Shows distribution of residuals (errors)	Bell-shaped but not perfectly symmetrical; concentration near zero with outliers on both ends	Indicates departures from normality, affecting hypothesis testing and confidence intervals
Residuals vs Fitted Values Plot	Top-Right	Assesses randomness of residuals distribution	Downward curve suggests non-randomness and a nonlinear pattern	Model may not capture the true relationship; consider transformations or interaction terms
VIF Bar Chart	Bottom-Left	Measures multicollinearity among independent variables	Extremely high VIFs for Remittance, GDP, and constant term	Severe multicollinearity exists, distorting the model and making coefficient interpretation unreliable

Q-Q Plot of Residuals	Bottom-Right	Compares residuals to a normal distribution	S-shaped curve, especially in tails; points deviate from the red line	Confirms non-normality of residuals, consistent with histogram and Jarque-Bera test
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Table 11: Robust Regression Techniques and Performance Summary

Technique	Description	When to Use	R-squared / Key Insights
Huber Regression	Minimizes a hybrid loss: quadratic for small errors, linear for large ones	Non-normal residuals, mild outliers	0.9693 – Best fit; handles outliers effectively; remittance and reserves are impactful
Ridge Regression	Adds L2 penalty to shrink coefficients and reduce multicollinearity	Severe multicollinearity (VIF > 10)	0.9633 – Strong fit; controls multicollinearity; retains all variables
Quantile Regression	Estimates conditional medians or other quantiles	When mean is not representative; robust to non-normal errors	0.9632 – Stable median prediction; useful for skewed distributions
Elastic Net	Combines L1 and L2 penalties for shrinkage and variable selection	Multicollinearity + irrelevant variables	0.7502 – Moderate performance; balances ridge and lasso strengths
Lasso Regression	Adds L1 penalty to perform variable selection by shrinking some coefficients	Feature selection in multicollinear datasets	0.1471 – Poor fit; over-penalization leads to loss of valuable variables
LAD Regression	Minimizes sum of absolute errors (Least Absolute Deviations)	Heavy-tailed error distributions or many outliers	Not used – Effective when standard deviations are not meaningful
Robust MM-estimators	Highly resistant to leverage points and outliers in both X and Y	Ideal for datasets with high contamination or leverage outliers	Not used – Excellent robustness; best for highly noisy or corrupted data

Huber Regression model

The **Huber Regression model** equation for predicting Sovereign Default Risk (SDR) is:

$$\text{SDR} = 0.9817 + 0.0481 \times \text{REM} - 0.1252 \times \text{FD} + 0.0153 \times \text{GDP} + 0.0618 \times \text{RES} + 0.0028 \times \text{REM_GDP} + 0.0032 \times \text{EXT_DEBT} - 0.1125 \times \text{RES_DEBT}$$

Table 12: Huber Regression Model

Variable	Coefficient	Direction	Interpretation
Intercept	0.9817	—	Baseline SDR when all predictors are at their mean (standardized form).
REM	0.0481	Positive	A 1 standard deviation increase in remittance raises SDR, possibly due to overdependence or remittance volatility.
FD	-0.1252	Negative	Higher fiscal deficits reduce SDR, which is counterintuitive; could be a data artifact or reflect deficit-financed growth.
GDP	0.0153	Positive	Unexpected: Rising GDP slightly increases SDR—possibly due to multicollinearity or export-led GDP not reducing risk.
RES	0.0618	Positive	More reserves increase SDR, again unexpected; may be due to correlation with REM or debt dynamics.
REM_GDP	0.0028	Positive	A larger share of GDP from remittances slightly worsens credit perception, indicating dependency risk.

EXT_DEBT	0.0032	Positive	Higher external debt worsens sovereign risk, which is consistent with theoretical expectations.
RES_DEBT	-0.1125	Negative	A higher reserve-to-debt ratio reduces SDR, as expected—this is the strongest stabilizing factor in the model.

Table 13: Hypothesis Testing Table for Huber Regression Model

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)	Decision
Intercept (β_0)	0.9817	0.6421	2.3529	0.031	$H_0: \beta_0 = 0$	$H_1: \beta_0 \neq 0$	Reject H_0 (Significant)
Remittance (REM)	0.0481	0.0201	2.3842	0.0562	$H_0: \beta_1 = 0$	$H_1: \beta_1 \neq 0$	Marginal (Reject H_0)
Fiscal Deficit (FD)	-0.1252	0.0702	-1.7832	0.0862	$H_0: \beta_2 = 0$	$H_1: \beta_2 \neq 0$	Fail to Reject H_0
GDP (β_3)	0.0153	0.0113	1.3513	0.1887	$H_0: \beta_3 = 0$	$H_1: \beta_3 \neq 0$	Fail to Reject H_0
End-Year Reserves (RES)	-0.0467	0.0207	-2.2537	0.0377	$H_0: \beta_4 = 0$	$H_1: \beta_4 \neq 0$	Reject H_0 (Significant)
Remittance-to-GDP (REM_GDP)	-0.0701	0.058	-1.208	0.244	$H_0: \beta_5 = 0$	$H_1: \beta_5 \neq 0$	Fail to Reject H_0
External Debt (EXT_DEBT)	0.0032	0.0157	1.4558	0.1637	$H_0: \beta_6 = 0$	$H_1: \beta_6 \neq 0$	Fail to Reject H_0
Reserves-to-Debt Ratio (RES_DEBT)	-0.1125	1.5179	-0.0741	0.3376	$H_0: \beta_7 = 0$	$H_1: \beta_7 \neq 0$	Fail to Reject H_0

6. Discussion

The study explored the factors influencing Bangladesh's Sovereign Default Risk (SDR) by analyzing key macroeconomic indicators from 2000 to 2024. Descriptive statistics provided an overview of the central tendencies and variability of these indicators, revealing substantial fluctuations in remittance inflows (std = 7.02), reflecting annual variability, while fiscal deficits and GDP showed moderate fluctuations. GDP experienced significant growth, rising from USD 51.9 billion to USD 180 billion, indicating robust economic expansion. End-Year Reserves also showed notable improvement, averaging USD 17.81 billion but with high variability (std = 14.93), suggesting that, despite the economic growth, substantial volatility in key economic indicators could contribute to sovereign risk. The Pearson correlation matrix revealed strong relationships between key variables. For example, the high correlation between GDP and Year ($r = 0.99$) pointed to consistent economic growth over time, and the relationship between Fiscal Deficit and External Debt ($r = 0.95$) suggested that fiscal imbalances lead to increased borrowing. Moreover, End-Year Reserves were positively correlated with both GDP ($r = 0.88$) and Remittance ($r = 0.84$), highlighting the role of these two factors in strengthening reserves, which act as a buffer against sovereign risk. However, the high correlation between Remittance and External Debt ($r = 0.91$) pointed to potential multicollinearity, which could distort the regression results.

A multivariate regression model was used to explore the relationship between macroeconomic factors and SDR. The results revealed that End-Year Reserves had a statistically significant negative relationship with SDR ($\beta = -0.0467$, $p = 0.0377$),

confirming that higher reserves significantly reduce sovereign risk. Remittance showed a marginally significant positive relationship with SDR ($\beta = 0.0481$, $p \approx 0.056$), suggesting that over-reliance on remittances may increase sovereign risk, particularly due to vulnerabilities from external shocks. In contrast, Fiscal Deficit ($\beta = 0.031$, $p = 0.861$), GDP ($\beta = -0.02$, $p = 0.114$), and External Debt ($\beta = 0.023$, $p = 0.164$) did not show statistically significant relationships with SDR, indicating that these variables have a less direct impact on sovereign risk in Bangladesh.

Diagnostic tests revealed several issues, including severe multicollinearity, particularly between Remittance and GDP, which could distort coefficient estimates. The Breusch-Pagan Test showed no significant heteroscedasticity, but the Jarque-Bera Test indicated non-normal residuals ($p = 0.0000$). The Durbin-Watson Test confirmed no autocorrelation in residuals, supporting the assumption that the residuals are independent.

To address these issues, robust regression techniques were employed. Huber Regression provided the best fit ($R^2 = 0.9693$), effectively handling outliers and non-normal residuals. Ridge Regression ($R^2 = 0.9633$) was also effective in reducing multicollinearity, while Quantile Regression ($R^2 = 0.9632$) provided stable median predictions but was less effective for this analysis. Among the robust regression methods, Huber Regression emerged as the most reliable, offering more accurate estimates in the presence of multicollinearity and outliers.

The study's conclusions emphasized the critical role of End-Year Reserves in mitigating sovereign default risk, as reserves act as a buffer against external shocks. While Remittance showed a marginally positive relationship with SDR, indicating vulnerabilities from over-reliance on this external income, other variables like Fiscal Deficit and External Debt did not exhibit significant individual effects in this model. The findings suggest that reserve accumulation should be prioritized in policy discussions, alongside efforts to reduce dependence on remittances and maintain fiscal discipline.

Key findings from the regression analysis revealed several important insights into the factors influencing Bangladesh's sovereign default risk (SDR). First, End-Year Reserves were found to have a statistically significant negative relationship with SDR, indicating that higher reserves can effectively reduce sovereign default risk by acting as a buffer against economic instability. On the other hand, Remittance showed a marginally significant positive relationship with SDR, suggesting that an increased reliance on remittances could elevate sovereign risk, as this dependence makes the economy more vulnerable to external shocks. Interestingly, Fiscal Deficit, GDP, and External Debt did not significantly impact SDR in this analysis, challenging traditional theories that typically associate these factors with higher sovereign risk. Lastly, both the Remittance-to-GDP Ratio and Reserves-to-Debt Ratio were found to have no significant effect on SDR, indicating that these ratios may not be as influential in determining sovereign risk as previously thought.

The comparison with existing literature revealed that while the results align with studies emphasizing the importance of End-Year Reserves in reducing sovereign risk, they diverged from others regarding the relationship between Remittance and SDR. While remittances are generally seen as a stabilizing factor, the findings suggest that an over-reliance on remittances could increase vulnerabilities, a concern not fully captured in prior research. Similarly, the lack of significance for Fiscal Deficit and External Debt in influencing SDR challenges traditional economic theories.

The policy implications drawn from these findings emphasize several critical areas for policymakers to focus on. First, strengthening reserve management is crucial. Policymakers should prioritize building foreign reserves through more effective foreign exchange management, promoting foreign direct investment (FDI), and diversifying remittance sources. This would help reduce vulnerability to external shocks and improve economic stability. Second, diversifying remittance sources is essential to reduce Bangladesh's over-reliance on remittances, which can introduce risks to sovereign stability. Expanding the export sector and developing alternative sources of foreign capital would help mitigate these risks and reduce the chance of sovereign default. Third, although the study did not show a direct relationship between fiscal deficit and sovereign default risk, maintaining fiscal discipline remains critical for long-term economic stability. Policymakers should focus on controlling budget deficits through efficient fiscal policies and prudent government spending. Lastly, prudent debt management is vital, even though external debt did not show a significant direct effect on SDR in this study. Ensuring debt sustainability and avoiding excessive borrowing will strengthen the economy and contribute to its resilience against external pressures. By addressing these areas, Bangladesh can create a more stable and sustainable economic environment, reducing the risk of sovereign default.

The limitations of the study include the constraints of the available data, especially regarding the granularity of remittance sources and debt structure. Additionally, the detection of multicollinearity between variables such as Remittance and External Debt suggests the need for more sophisticated models in future studies, such as structural equation modeling (SEM) or panel data analysis.

Future research could also consider incorporating additional macroeconomic variables such as inflation, exchange rate volatility, and political stability to provide a more comprehensive understanding of sovereign risk. A dynamic panel data model could be applied to explore how the relationships between macroeconomic variables and sovereign risk evolve over time. Furthermore, examining the impact of global economic factors, such as fluctuations in commodity prices or global financial crises, could provide deeper insights into sovereign risk in developing economies like Bangladesh.

This study provides valuable insights into the factors influencing Bangladesh's sovereign default risk, with a focus on the critical role of End-Year Reserves in stabilizing sovereign risk. Although other factors, such as remittance and Fiscal Deficit,

showed weaker relationships with SDR, the findings suggest the need for policies aimed at strengthening reserves, diversifying economic sources, and maintaining fiscal discipline to ensure long-term financial stability. Despite the study's limitations, it contributes to the growing body of literature on sovereign risk and offers practical policy recommendations for mitigating the risk of default.

7. Conclusion:

In conclusion, this study emphasizes the critical importance of foreign reserves in mitigating Bangladesh's sovereign default risk (SDR). The findings highlight a significant negative relationship between end-year foreign reserves and SDR, emphasizing that building robust reserves is essential for enhancing financial stability and protecting the economy from external shocks. By increasing foreign reserves, Bangladesh can reduce sovereign risk, enhance its ability to withstand global economic challenges, and boost investor confidence. Consequently, policymakers must prioritize reserve accumulation to reduce sovereign risk and improve Bangladesh's creditworthiness. The study also underscores the necessity of diversifying remittance inflows. While remittances are vital for foreign exchange and economic stability, their marginally positive association with SDR suggests vulnerabilities due to over-reliance on this income source. Policymakers should focus on channeling remittances into productive investments such as infrastructure and small and medium enterprises (SMEs), reducing dependency and ensuring sustainable use of these inflows. Furthermore, while fiscal deficit and external debt did not directly affect SDR, the study calls for a more nuanced understanding of their indirect effects. Maintaining fiscal discipline is essential for long-term stability, and policymakers should focus on managing budget deficits through efficient fiscal policies and prudent spending. Prudent debt management is also critical; even though external debt did not significantly impact SDR in this study, ensuring debt sustainability and avoiding excessive borrowing will help safeguard the economy against external pressures.

The study concludes that end-year reserves play a crucial role in reducing sovereign default risk, confirming their importance as a stabilizing factor. Although remittance and fiscal deficit showed weaker relationships with SDR, the findings indicate that these variables need careful management to mitigate risks. The study advocates for a policy approach that emphasizes strengthening reserves, diversifying the economy, and maintaining fiscal discipline to ensure Bangladesh's long-term financial stability. Despite limitations such as data granularity and the multicollinearity observed between some variables, this study contributes valuable insights to the growing body of literature on sovereign risk and provides actionable policy recommendations to mitigate sovereign default risk in emerging markets.

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