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Factors Affecting the Foreign Currency Reserves in Bangladesh: An Empirical Study

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Abstract

Background: Foreign currency reserves are a crucial determinant of growth and stability in Bangladesh, where domestic fiscal and monetary policies have offset trade deficits. This study attempts to examine the macroeconomic factors determining reserve accumulation, focusing on their significance in preventing vulnerabilities.

Research Questions: Specifically, the study analyzes the key macroeconomic variables (exports, imports, remittances, external debt, FDI, HDI, GDP, and savings) that have a significant positive or negative effect on the foreign currency reserve of Bangladesh. What are the key factors that determine the foreign currency reserve in Bangladesh? What is the direction, magnitude, and significance of the relationships? And in response to trade deficits and development needs, can they promote economic stability through reserves as influenced by remittances and imports?

Theoretical context: Foreign currency reserves are the backbone of Bangladesh's economic stability, as they mitigate the trade deficit and shocks. Precautionary motive theory captures reserves accumulation as a hedge against crises, complemented by remittances and FDI.

Methodology: Based on secondary data sourced from the World Bank and UNDP from the year 1990 to 2022, this quantitative research considers foreign currency reserves as the dependent variable and regresses the independent variables (exports, imports, remittances, external debt, FDI, savings, HDI, and GDP) using Stata. Analysis includes bivariate and multiple regression, ADF unit root test, Johansen cointegration, and diagnostic tests for robustness.

Key Findings: Reserves are positively driven by exports, GDP, remittances, and external debt (all $p<0.01$), and are depleted by imports, FDI, and HDI ($p<0.001$). The model explains 97.4% variance ($R^2=0.974$) and guides the policy for enhancing export growth, curbing imports, and achieving balanced development.

Keywords: Foreign Currency Reserve, Export, Import, Remittance, FDI.

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1. Introduction

Foreign exchange reserves are one of the vital elements of a country's economic development that protect the country from outside invasion and make foreign trade easier. These reserves of foreign currencies are held in the form of foreign currencies, gold, and other global assets, mainly by the central banks, which assist a nation in preserving its economic stability and the smooth operation of its financial system. Various domestic and international factors have made it difficult to maintain an adequate amount of foreign currency reserves for Bangladesh. This research has been conducted to determine the most influential factors to Bangladesh's foreign currency reserves with special attention to variables like export, import, remittance, external debt, FDI, population growth, savings, HDI, and GDP. The Foremost and crucial facets of Bangladesh's Foreign currency reserves are provisions from remittance earnings from its massive number of workers abroad. Remittances are among the chief stimulants of Bangladesh's economic growth and foreign currency reserves (Chowdhury, 2014). Remittance is an important component of foreign reserves, especially in the case of trade deficits and external economic problems (Islam, 2022). The importance of remittance was recognized during the global financial crisis, when global economic downturns were experienced. Nevertheless, the inflow of remittances to Bangladesh remained stable, and it was a stabilizing force for the country's reserves (Chowdhury, 2014).

Bangladesh, a nation with heavy dependence on imports, particularly raw materials for manufacturing and export industries has pushed its foreign reserve levels to the limit. Bangladesh's growing Ready-Made Garments (RMG) sector, which brings in a significant share of its export earnings, is heavily dependent on raw materials sourced from foreign countries, making it susceptible to any disruption in the global supply chain. Buy/sell volatility in global products and import prices, notably on energy and raw materials, is exerting intense pressure on reserve levels (Khan et al., 2020). Any disruption in the global supply and demand for Bangladesh's exports, especially around the time of economic transitions in big markets like Europe and the United States, will lead to a decrease in foreign currency reserves, as export proceeds will diminish. Inflation and exports are two other key determinants of foreign currency reserves of Bangladesh. Currency depreciation may cause a country to lose reserve value, ultimately, if foreign debt is denominated in foreign currencies.

Exchange rate stability is influenced by reserve management- central banks generally intervene to smooth currency volatility in the foreign exchange market (Asikullah & Hossain, 2023). However, such interventions can deplete reserves if the currency is under-selling pressure. Inflationary pressures in local and international markets make the raw material imported costlier, disrupt the mainstream of foreign currency, and put an extra burden on foreign reserves. The global economic and geopolitical situation has turned out to be a fresh hurdle for Bangladesh's foreign currency reserves. Oil price fluctuations, the presence of trade wars, and supply chain interruptions impact the cost of Bangladesh's imports directly, which leads to further aggravation in the depleting reserves (Hui, 2022). The effect of war in global energy markets like Russia-Ukraine is also a famous problem, and this has increased oil and gas prices due to fewer imports all over the world, and it affects the countries' reserve levels as well.

The potentials as well as the determinants of foreign exchange reserves in the Bangladesh economy call for an analysis of several economic variables. This study focuses mainly on the identification

and analysis of determinants affecting the foreign currency reserves of Bangladesh. Analysis of the effect of Exports, Imports, remittances, external debt, FDI, population growth, savings, HDI, and GDP on the reserve level, the study can give accurate results and insight into the influenced economy. This study will enable policymakers to focus on critical areas to bring down and enhance the level of foreign currency reserves, along with easy and robust economic growth.

1.1 Rationale of the Study

Foreign exchange reserves are important in contributing to the stability and growth of the economy, from trade balancing to responding to crises in hard times. Bangladesh has difficulty maintaining reserves because of trade fluctuations, deficits, reliance on remittances, and external debt. Understanding the determinants of reserves will also be crucial for policy formulation, as the country moves towards achieving Least Developed Country (LDC) status. This research will provide empirical insights into the primary macroeconomic factors influencing reserves, highlighting an unexpected negative correlation with HDI. The results provide support for policymakers to formulate action plans for sustainable reserve management and economic growth.

1.2 Research Questions

The study was conducted to find the solutions to the following questions:

a) What are the main macroeconomic (exports, imports, remittances, external debt, FDI, HDI, and GDP) drivers of the foreign currency reserves level in Bangladesh that have significant positive or negative impacts?
b) What is the direction, magnitude, and significance of the relationships of the independent variables (exports, imports, remittances, external debt, FDI, HDI, and GDP) with foreign currency reserves in Bangladesh?
c) In a situation of trade deficits and development strains, to what extent do foreign currency reserves, under the impact of such factors as remittances and imports, bolster economic stability in Bangladesh?

1.3 Research Objectives

The objective of this study is to find out the key factors that influence the foreign currency reserve in Bangladesh.

a) To identify the major macroeconomic determinants of foreign reserves in Bangladesh (exports, imports, remittances, external debt, FDI, HDI, and GDP) and segregate those that have positive effects on reserves, and those that have a negative impact.
b) To evaluate the direction, size, and impact of the relationships between the independent variables (exports, imports, remittances, external debt, FDI, HDI, and GDP) and foreign currency reserves via multiple regression.

c) To examine whether foreign currency reserves played a part in establishing economic stability in Bangladesh and to determine the extent to which positive factors counteracted outflow risks for the development of sustainable policies.

2. Literature Review

The Bangladesh Bank also depends on the foreign currency reserves to ensure economic stability. These reserves act as a medicine for the economy, as a dependable source that backs the local currency for international investors or buyers. This research was focused on the impacts of different economic factors and foreign currency reserve-related issues in the context of Bangladesh's financial system. The study employs both macro-level and micro-level (firm-level) variables to illustrate the monetary policy and its effects better. This study investigates the major determinants of foreign currency reserves in Bangladesh, such as exports, imports, remittances, external debt, FDI, population growth, savings, HDI, GDP, and global economic performance, which themselves influence the level of currency reserves.

Rise in remittance earnings and huge trade potential are found to be the significant factors raising Bangladesh's foreign currency reserve. Remittance is the core and crucial part of foreign currency as it directly increases the reserve level, which offers financial comfort against foreign austerity and contributes to stabilizing the economy. Trading facilities stimulate exports, and exports stimulate foreign investment, which further raises the reserves. It is found that remittance gains and reserve levels are positively related as higher levels of remittances attract greater reserve, which in turn has a positive impact on the country's position in the global market (Nobi et al., 2022). The RMG sector is a major contributor to the foreign reserve in Bangladesh and to the thriving textile industry of the country. Raw materials procurement, in particular, has had a necessary influence on the balance of payments due to the nation's reliance on imports for the RMG sector. Trade balance mainly influences the levels of Bangladesh's foreign currency reserves, and an increase in imports without any increase in exports can result in its reserve level falling (Alam & Adeyinka, 2021). More than 80% of Bangladesh's total export earnings come from the RMG sector, which relies heavily on raw materials imports from other countries, especially from the textile sector. When global supply chains are disrupted (as we have seen during the COVID-19 pandemic), the country experiences rising costs for raw materials imports, which has a direct impact on its reserves (Banik, 2023). The global demand for products exported by Bangladesh, particularly in the key international markets such as the US and the EU, fluctuates with global economic changes, interrupting the inflow of foreign currency reserves.

The challenges posed by imports alter the global prices of products and services, especially oil prices, which positively influence Bangladesh's foreign currency reserves. (Golder et al., 2020) notes that as prices of energy rise, import costs rise, leading to the depletion of foreign currency reserves. In the period of rising oil prices, the outflows of reserves became unstoppable, especially when earnings from exports cannot cover import bills. There is inflationary pressure on the economy, especially on imported raw materials, and that impacts the foreign currency reserves being held (Mostafa, 2020). Increasing inflation reduces the value of purchasing power and forces the country to import more materials, leading to a strain on foreign currency reserves. These modifications may lead to a cycle in which reserves diminish as the nation has to allocate more of its other resources yet reserves to pay for the imports. As inflation is increasing due to the

appreciation, the central bank may have to take monetary policy preventive measures, such as raising the interest rate, to dampen inflation, which may affect the exchange rate and the degree of reserve stability.

The influence of Bangladesh's external debt on the foreign currency reserves has been an important factor. As the country's debt grows externally, so does its burden of debt-servicing, which calls for massive outflows of foreign exchange. (Ahmed et al., 2022) state that the rising levels of external debt – especially with the growing investments in infrastructure development projects in Bangladesh through international loans, have been an additional pressure on foreign reserves. This problem is reflected when global monetary policies result in interest rate hikes by the US Federal Reserve, dramatically increasing borrowing costs for developing countries.

Financial conditions across the world have made it better for Bangladesh to pay its foreign debt, but its reserves are now under another kind of pressure. An expanding GDP is generally representative of a more active and stable economy, which consequently may have a positive impact on earnings and foreign exchange utilization. (Ali & Alam, 2023) stated that the growth of the economy leads to exports earning high profits in foreign currency inflow. In the case of Bangladesh, the rapid growth of GDP, primarily the RMG sector, strongly impacts the consistent increase of foreign reserves. The authors argued that a good GDP allows the country to accumulate a gargantuan reserve since it can earn more foreign currency in the process of increased trade and investments globally.

Sometimes, GDP and foreign currency reserves are hard to calculate, as increasing GDP can surely increase reserve levels. Changes in GDP can cause changes in reserves (Shikha et al., 2023). Commodity problems, for example, a natural disaster or a global economic crisis, may limit growth in GDP and lead to a reduction in foreign currency reserves. Bangladesh encountered slow and unexpected GDP growth during the COVID-19 pandemic, and so export earnings declined, as well as foreign reserves nominally declined. Bangladesh's foreign reserves exhibit a complex and nonlinear relationship with the major economic indicators that necessitate the most effective policy-making and implications (Salan et al., 2023). South Asian inflation is mainly explained by GDP growth; HDI has a negligible role in explaining the inflation level (Islam, 2022). This leads policymakers in the direction of letting GDP growth be the variable to guide their management of the stability of growth in prices within a safe zone. While GDP has a larger influence on national savings than foreign currency reserves, it has a larger impact on national savings than foreign currency reserves. This indicator values savings: the rationale is that this could be a more helpful step for consistency in the growth of the economy of Bangladesh.

Bangladesh's reliance on the US dollar for its foreign reserves reflects the country's exposure to currency risk. (Goswami et al., 2025) proposed that this risk may be mitigated by switching reserve holdings and taking a dynamic approach towards a superior monetary management system in terms of stabilization of Bangladeshi taka value. Diversifying foreign exchange reserves with as many major currencies as possible could increase financial stability and lower external shocks. Also, this study focuses on the importance of healthy economic policies and systems like strategic reserve management and enhancement of savings initiatives to long-term financial sustainability. The existing reserve has discussed the outlines of foreign currency reserves in Bangladesh. Still, there is a slight gap in measuring the impact of the economic situation in the phase of globalization, and

with several important factors like Exports, imports, remittances, external debt, FDI, savings, HDI, and GDP influencing reserves**,** but they have not been thoroughly explored. As Bangladesh is becoming more involved in international markets, analyzing these factors could create some valuable information for policymakers to increase reserves and ensure economic stability and growth.

2.2 Theoretical Framework

Foreign exchange reserves also have an important role in maintaining macroeconomic stability in Bangladesh, a developing nation facing trade deficits and external shocks. It is based on two interrelated theoretical foundations: ex international trade theory developed by classical economists, such as David Ricardo, and further formalized by the Heckscher-Ohlin model (1919), which declares that the trade balance will influence the reserves because exports create foreign exchange inflows for accumulation of reserves whereas imports, especially those of raw materials for RMG industry, causes foreign exchange outflows and deficits. This is consistent with the precautionary motive of accumulating reserve, as described in (Obstfeld & Rogoff, 1996) who regards reserves as protection for sudden capital flight, terms-of-trade deterioration, or other contingency like the COVID-19 pandemic in case of Bangladesh, remittances and FDI continue to be treated as non-debt creating inflows which facilitate the formation of such a precautionary buffer and reduce exposure to risk from external debt and development stress. Combined, these findings suggest that there would be a positive impact of export, GDP, remittances, external debt, FDI, and saving on reserves and imports, and possibly HDI-led demands would flip the sign, which further motivates the following empirical regression model to derive policy-relevant implications about the reserve adequacy from this study.

3. Methodology of the Study

This Research is concerned with using a quantitative research method to find out the determinants or indicators of foreign currency reserves in Bangladesh. Secondary data were taken from a trustworthy international organization, the World Bank Data Bank, and UNDP for 22 years' time-period, i.e., from 1990 to 2022. This paper considers exports, imports, remittances, external debt, Human Development Index (HDI), and Gross Domestic Product (GDP) as major macroeconomic indicators and studies whether these independent variables have any effects on foreign currency reserves as the dependent variable. The natural logarithm (ln) is used for data analysis to make the data in a linear manner. In this study, several regressions were fitted to test the relationship between the independent variables and foreign currency reserves as the dependent variable. Stata version 19 was employed for data processing and performance, regression modeling, and hypothesis testing for statistical analysis. As the data is time series, the robustness check, autocorrelation, multicollinearity is checked for the validity of data as well as the study model. The deductive research approach has applied here to find the key determinants of foreign currency reserve in Bangladesh. This study identifies one model, which is as follows-

$$FER_t = \beta_0 + \beta_1 EXP_t + \beta_2 GDP_t + \beta_3 IMP_t + \beta_4 EXTD_t + \beta_5 REMI_t + \beta_6 FDI_t + \beta_7 HDI_t + \varepsilon_t$$

Where,

FER = Foreign Exchange Reserve

EXP = Export

GDP = GDP (Gross Domestic Product)

IMP = Import

EXTD = External Debt

REMI = Remittance

FDI = FDI (Foreign Direct Investment)

HDI = HDI (Human Development Index)

β_0= Intercept or Constant

$\beta_1\beta_2\beta_3\beta_4\beta_5\beta_6\beta_7$= Regression Coefficient

ε_t= Error term

4. Definition of Variables

Variable	Description	Reference
Exports (EXP)	Foreign sales of goods or services after domestic satisfaction increase foreign reserves and the strength of the economy. Bangladesh's exports are vulnerable to exchange rate fluctuations.	(Rahman et al., 2020)
Imports (IMP)	Goods/services purchased from outside the country to fulfill its demand, excessive purchases from outside destabilize the reserves and lead to trade deficits.	(Hosen, 2023)
Remittances (REMI)	Money earned by expats that work overseas helps support the continuing growth of income, reserves, and the GDP.	(Sarkar, 2015)
External Debt (EXTD)	External borrowings for development or deficit financing from the foreign creditors. It is the summation of all outstanding liabilities owed to non-residents.	(Uddin et al., 2022)
Foreign Direct Investment (FDI)	Foreign investment brings in capital, employment, and technology, and is affected by interest rates and inflation rates.	(Chowdhury, 2014)
Human Development Index (HDI)	Based on life expectancy, education, and income, a higher HDI means higher economic strength and reserves.	(Moon et al., 2024)
Gross Domestic Product (GDP)	Value of domestic final output of goods/services in total; a high GDP implies a strong economy that overwhelmingly attracts investors.	(Hasan & Nishi, 2019)
Foreign Reserve (FER)	A nation's foreign holdings (currency, bonds, deposits) are used to stabilize the exchange rate and the economy.	(Wijnholds, 1977)

5. Result Analysis

5.1 ADF test

The descriptive analysis of the level and the first difference of many economic variables to check their stationarity is presented in Table 1. It was conducted with the help of the Augmented Dickey-Fuller (ADF) test, based on the null hypothesis that the time series variables are non-stationary. The unit root is always determined or displayed by the ADF test. The table includes variables such as FER (Foreign Exchange Reserves), EXP (Exports), GDP (Gross Domestic Product), IMP (Imports), EXDT (External debt), Remi (Remittances), FDI (Foreign direct investment), and HDI (Human Development Index). From all variables are non-stationary at the level form since t-statistics of all variables are greater (less negative) than the 5% critical value (-3.572) and consequently the null hypothesis of a unit root is accepted. However, the t-statistics of all non-stationary variables go below the critical value (-3.576) at first difference, indicating that they are I (1). All the economic variables in the data seem to be an I (1) process; this result implies that further econometrics investigation is based on first differencing. Stationary data usually conduct more accurate and reliable predictions of the data for analysis.

By using the varsoc command in Stata 19 to decide upon the optimal lag length for ADF and cointegration tests, following Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC). Results suggested lag order 4 among the lags (0–4) tested as optimal, with the smallest AIC (−495.375), HQIC (−491.521), and SBIC (−483.07). We thus used lag 4 in our following unit root and cointegration examinations to guarantee model robustness.

Table 01: ADF test measures the unit root at the level and first difference of the original series

Variable	ADF test at the level			ADF test at first difference			Status
	t-statistic	5%Critical Value	Decision	t-statistic	5%Critical Value	Decision	
FER	-1.560	-3.572	Non-stationary	-4.186	-3.576	Stationary	I(1)
EXP	-2.264	-3.572	Non-stationary	-5.523	-3.576	Stationary	I(1)
GDP	-1.470	-3.572	Non-stationary	-4.419	-3.576	Stationary	I(1)
IMP	-2.846	-3.572	Non-stationary	-5.562	-3.576	Stationary	I(1)
EXDT	0.436	-3.572	Non-stationary	-5.070	-3.576	Stationary	I(1)
REMI	-0.493	-3.572	Non-stationary	-4.052	-3.576	Stationary	I(1)
FDI	-2.070	-3.572	Non-stationary	-5.595	-3.576	Stationary	I(1)

HDI	-2.194	-3.572	Non-stationary	-8.180	-3.576	Stationary	I(1)

After using the Augmented Dickey-Fuller test to predict a unit root in the residual series of the estimated equilibrium connection. Consequently, the alternative and null hypotheses are:

H0: The root, which is a unit of the residual series, is either GDP, HDI, remittances, exports, imports, foreign debt, and FDI.

H1: There is no root with unity in the residual series or in the following variables: GDP, HDI, remittances, exports, imports, foreign debt, and FDI.

Table 02: Johansen tests for cointegration of all variable series

Model Residuals	**Trace Statistic**	**5% Critical Value**	**Results**
Trend: constant	272.9136	156.00	Reject H_0

Table 2 examines whether the variables have a long-run relationship and an equilibrium level. The model includes a constant level shift but not a deterministic trend since it presupposes a stochastic trend in the residuals. The null hypothesis (H_0) of no cointegration is rejected since the trace statistic 272.9136 is much higher than the 5% critical value 156. Although there may be short-term volatility, this result indicates a stable long-term relationship between the two variables as it confirms the two are cointegrated.

5.2 OLS Regression Results

Table 03: Results of Ordinary Least Square (OLS) Linear Regression

Variables	**Coefficients**
Exports (EXP)	2.900*** (0.669)
Gross Domestic Product (GDP)	1.646*** (0.585)
Imports (IMP)	-3.267*** (0.752)
External Debt (EXTD)	1.995*** (0.550)
Remittances (REMI)	1.015*** (0.239)
Foreign Direct Investment (FDI)	-0.029 (.064)
Human Development Index (HDI)	-27.086*** (4.824)
Constant (Intercept)	-64.762*** (8.797)
*** 1% level of significance; **5% level of significance; Standard error in parenthesis.	

Table 3 reports the results of linear regression analyses of the impact of economic factors on the foreign exchange reserves (FER). The results indicate that exports (EXP), GDP, remittances (REMI), and external debt (EXDT) have a positive and significant impact on FER. In contrast, the impacts of imports (IMP), FDI, and HDI have negative influenced on foreign currency reserve in Bangladesh. Although FDI has negative impact on foreign reserve in Bangladesh, it is not statistically significant at 5% level of significant.

According to the table, when 1% increase in exports, GDP, remittances, and external debt, the foreign exchange reserve of Bangladesh will increase by 2.9%, 1.646%, 1.015%, and 1.995%, respectively. Exports and remittances contribute to wholesome reserves through more foreign currency inflows, and GDP growth and external borrowing add to reserves by way of more trade and transient capital inflows. On the other hand, a percentage increase in import (IMP) leads to a 3.267% decline in the foreign currency reserve for the reason of increased foreign payments, while surprisingly the HDI has a negative effect on the foreign exchange reserve in Bangladesh by 27.086%, probably indicative of foreign consumption. There is no significant effect of Foreign direct investment (FDI). Collectively, these results emphasize that trade, remittances and economic growth play a pivotal role in reserve building in Bangladesh.

Table 04: Model Summary

F (7, 25)	Probability> F	R-squared	Adj R-squared	Root MSE
133.78	.000	0.9740	0.9667	0.2084

The summarized output of a regression is given in Table 4. The F-statistics (133.78) indicates the general importance of the model, and the p-value (Prob> F) of 0.000 verifies a very great statistical significance. The independent variables explain 97.4% of the variation of the dependent variable as suggested by the R-squared value of 0.9740. Adjusted r-squared (0.9667) considers the number of predictors, it still explains high amount of variance without suggesting any potential overfitting. The model explains the foreign currency reserve in Bangladesh with these seven selected variables. The root means squared error of this model is 0.2084 which represents that the prediction may deviate by 20.84% of the model from the actual value in the dataset.

6. Diagnostic Test

6.1 Ramsey Reset Test

We use a simple linear regression model. So, we need to see whether there is any specification problem. To test specification errors, we use the Ramsey RESET test.

Table 05: Test of specification error (linktest)

	Coefficients	Std. Error	t	Sig.	Result
hatsq	-.0422576	.0295749	-1.43	0.163	Accept H_0

Table 05 presents the results of the linktest for the misspecification errors. The hatsq coefficient is -0.0423 with standard error 0.0296. The t-statistics is -1.43, and the p-value is 0.163, so the value of the coefficient is statistically insignificant at conventional levels of significance. We fail

to reject the null hypothesis (H_0) for the higher p-value than 0.05, meaning that the model is specified correctly. This means the model has no evidence of misspecification.

6.2 Test of Autocorrelation (Durbin-Watson Test)

Table 06: Autocorrelation test (Durbin-Watson 'd' statistic)

Model	**Critical upper value of Durbin-Watson(d_U) at 5%**	**Model d**	$D_L<d<d_U$	**Results**
	2.085	1.740	0.927 <**1.740**<2.085	Inconclusive

Table 06 displays the results of the test for autocorrelation that identifies the autocorrelation in the error term. The Durbin-Watson d-statistics is 1.740 with a critical lower limit (dL) = 0.927 and upper bound (dU) =2.085 for the 5% level of significance. Since d lies between dL and dU (0.927 < 1.740 < 2.085), the test results are inconclusive. This implies that we cannot say if the residuals are autocorrelated. Additional testing, for instance, the Breusch-Godfrey test, is necessary to obtain better clarification. Here, the hypothesis is:

H0: no positive autocorrelation

Or

H0: no negative autocorrelation

H1: There is positive or negative autocorrelation

Table 07: Breusch-Godfrey LM test for autocorrelation

Lags(p)	**Chi2**	**df**	**Prob> chi2**	**Result**
1	0.237	1	0.6265	Accept H_0 H_0 = no serial correlation
2	0.383	2	0.8259	
3	1.047	3	0.7898	
4	6.335	4	0.1755	

Table 07 presents the outcome of the Breusch-Godfrey LM test of autocorrelation, which tests whether residuals of the model are serially correlated to different lag orders. The null hypothesis (H0) states that there is no serial correlation in the residuals. The test results show that for lag 1 the Chi-square is 0.237 and the p-value is 0.6265. In the same manner, the Chi-square statistics for lags 2–4 are equal to 0.383, 1.047, and 6.335, respectively, and their corresponding p-values are 0.8259, 0.7898, and 0.1755. All p-values are >0.05; the null can't be rejected for each lag. This indicates that there is no significant serial correlation in the residuals, implying that the model satisfies the condition of having independent error terms. For this, we must test heteroscedasticity.

6.3 Test of Heteroskedasticity

Table 08: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

	chi2(1)	**Prob> chi2**	**Result**
Variables: fitted values of FER	2.08	0.1489	Accept H_0

			H_0 = Constant variance (free from heteroskedasticity)

Table 08 test used to test for heteroskedasticity checks if the variance of residuals in a regression model is constant (homoskedasticity) or varies significantly with the values of fitted independent variables (heteroskedasticity). The null hypothesis ($H0$) assumes that the residuals have a constant variance, and the model is not heteroskedastic. The value of the test statistic ($\chi 2$) is 2.08, with a p-value equal to 0.1489. Because the p-value is above the usual significance level of 0.05, there is no evidence to reject the null hypothesis. The test is thus that the residual variance is constant, and the model is not heteroskedastic. This confirms the validity of the regression model because the condition for homoskedasticity is satisfied, which includes unbiased coefficient estimates and unbiased standard errors.

6.4 Correlation Analysis

Table 09: Correlation Test

	FER	EXP	GDP	IMP	EXDT	REMI	FDI	HDI
FER	1							
EXP	0.9368	1						
GDP	0.9547	0.9653	1					
IMP	0.9457	0.9951	0.9789	1				
EXDT	0.9455	0.9148	0.9807	0.9391	1			
REMI	0.9311	0.9846	0.9413	0.9803	0.8932	1		
FDI	0.7804	0.9100	0.8216	0.8814	0.7314	0.9121	1	
HDI	0.9287	0.9798	0.9833	0.9812	0.9528	0.9647	0.8814	1

Correlation among the independent variables were examined prior to regression analysis. All the selected factors of this model are positively correlated with each other. This high correlation is not surprising because the GDP in Bangladesh depends on its trade (export and import) performance and human development progress. Although this collinearity makes the individual coefficients less interpretable, it does not affect our ability to predict or explain variance in the outcome. A series of robust checks were conducted by carrying out alternative specifications (omitting overlapping variables and accounting for stepwise selection).

6.5 Multicollinearity Test

Table 10: VIF Test

Variable	**VIF**	**1/VIF**
EXP	276.55	0.003616
GDP	143.86	0.006951
IMP	317.39	0.003151
EXDT	61.87	0.016162
REMI	43.62	0.022927
FDI	13.34	0.074947

HDI	85.59	0.011683

Multicollinearity was assessed using a Variance Inflation Factor (VIF) test. Results of the VIF indicate that VIF values were higher than standard cut-off point of 10 indicating multicollinearity between GDP, exports, imports, and HDI. This result is in line with the structural character of the Bangladeshi economy, where GDP heavily depends on trade and development indicators.

6.6 Ridge Regression to Avoid Multicollinearity

Table 11: Result of Ridge Regression to Avoid the Multicollinearity Problem

Variables	**Coefficients**
Exports (EXP)	0.1482818
Gross Domestic Product (GDP)	0.2045032
Imports (IMP)	0.1616578
External Debt (EXTD)	0.3218522
Remittances (REMI)	0.1369797
Foreign Direct Investment (FDI)	0.033195
Human Development Index (HDI)	1.788238
Constant (Intercept)	-2.265107
R-square	0.8840
Alpha	0.0000
Lambda	1.2158

Ridge regression estimates coefficient of a study model by adding penalty term to diverge the coefficient value towards 0. The penalty term of the ridge regression addresses the multicollinearity issue and makes the model less variance. For this model of the ridge regression, the R-square value is 0.8840 which infers that 88.40% of the variance of the foreign currency reserve in Bangladesh is explained by the selected 7 independent variables. The R-square also represents the goodness fit of this study model of the determinants of the foreign exchange reserve. All the selected independent variables are statistically significant for foreign exchange reserve in Bangladesh although all coefficient shows positive impact on the dependent variable. The coefficient value is lower than the simple OLS regression model. However, the model is more stable to explain the factors of foreign currency reserve in Bangladesh by solving the multicollinearity issue. The alpha value of this model is 0.0000 which indicates the model is pure ridge regression and the model is generalized to explain by the predicted variables.

6.7 Robustness Test

Table 12: Result of Robust Regression

Variables	**Coefficients**
Exports (EXP)	3.92666*** (0.3816113)
Gross Domestic Product (GDP)	1.90946*** (0.3337789)

Imports (IMP)	-4.905829 *** (0.4290161)
External Debt (EXTD)	1.938529*** (0.3133724)
Remittances (REMI)	1.346439*** (0.1360078)
Foreign Direct Investment (FDI)	-0.1289567*** (0.0366677)
Human Development Index (HDI)	-25.51885 *** (2.750759)
Constant (Intercept)	-61.54407*** (5.016368)
Probability of F	0.0000
*** 1% level of significance; Standard error in parenthesis.	

Robust regression renders a reliable analysis of a model by reducing the outlier data effect. The probability of the robust regression is 0.0000 which is statistically significant at 1% level of significance. In table 12, all the coefficient value of this study model is statistically significant at 1% level of significance. Export, GDP, external debt liability, and remittance have the positive impact on foreign currency reserve in Bangladesh while import of goods and services, FDI, and HDI have the negative influence on foreign exchange reserve in Bangladesh. Constant of this model is also statistically significant with negative correlation on foreign reserve. Compared to other selected variables, export has the highest positive influence on foreign currency reserve in Bangladesh whereas HDI has the largest negative impact on foreign exchange reserve in Bangladesh. The result infers that when export increases, the foreign currency reserve also increases.

7. Findings of the Study

The study has conducted to find out the key factors that determine the foreign currency reserve in Bangladesh and its relationship with impact. The model is designed to find the objectives of this study. After analyzing the data, the study model is reliable and valid by ensuring that all the economic variables are non-stationary at the level. A long-term equilibrium and relational link between important variables are established through the Johansen cointegration test. The truthfulness of the results is ensured by model diagnostics, which verify proper specification, homoskedasticity, and the absence of serial correlation. Additionally, the multicollinearity of the data is addressed by the ridge regression. Finally, robust regression has accommodated outlier data issues and makes the study model more reliable. Regression results show that while imports, FDI, and HDI hurt foreign exchange reserves whereas exports, GDP, remittances, and external debt liability all significantly increase the foreign currency reserve. When the exports to foreign countries increase in Bangladesh, the foreign currency reserve will positively increase and make the country more stable by holding large amount of foreign currency. GDP growth that helps to produce more goods and services and export more and attracts foreign investors to invest in that country also enhances the foreign currency reserve. Remittance is another key factor of positive impact on foreign currency reserves. For Bangladesh, remittance plays a vital role for increasing the foreign currency reserve because a portion of the population of Bangladesh is working in

foreign countries. The remittance also makes the economic stability by increasing the foreign currency reserve and making the country payment of the import goods and services value and external debt liability. The foreign debt in foreign currency also increases the foreign currency reserve but later it creates an obligation to pay the debt with interest. The import shows the negative impact on foreign currency reserve in Bangladesh. When the import increases, the foreign currency is required to pay the trade amount. The FDI is negatively influenced on the foreign currency reserve in Bangladesh because the foreign exchange rate of Bangladesh is depreciating and attracting more foreign investors to invest with low cost and higher return opportunity. The HDI is negatively influenced of Bangladesh's foreign currency reserves. The negative impact of HDI on foreign currency infers that the standard of living increased in Bangladesh and it increases the demand for more imported goods which reduces the foreign currency reserve in Bangladesh. The foreign currency reserves make a country's economic stability by balancing the net trade balance and sustaining during world economic shocks.

8. Conclusion

Foreign currency is responsible for ensuring the infrastructural development and economic stability of a country. It also provides safety from foreign threats and shocks and provides a smooth experience of running a stable economy. A quantitative approach was used to conduct this research and also to find the impact of several factors affecting the foreign currency reserve and its impact on the economy. Analyzing the variables using multiple regression analysis to discover the effect of macroeconomic variables like exports, imports, GDP, remittances, external debt, FDI, and HDI. The findings show that the variables have a significant impact on reserve levels, with a surprising result, showing an adverse effect on the HDI. This will not just contribute to the economy but also help policymakers to make the right decisions to improve the economic condition of Bangladesh.

The results explain that exports, GDP, remittances, and external debt have positive effects on foreign currency reserves, implying that pursuing the promotion of exports in the context of stable economic growth with a robust and steady stream of remittances leads to an increase in reserves. Imports are detrimental to foreign reserves, implying that reliance on imported goods, mainly raw materials, can result in a falling reserve level and contribute to the generation of economic risks. Surprisingly, the study also finds a negative relationship between HDI and foreign reserves, saying that higher spending costs on infrastructural development activities may lead to increased foreign currency outflows, because our economy has spent much on the development, even though we are taking loans. Still, it also makes contributions to the development activities like the Padma Bridge, which is an example for HDI, showing a negative relationship with foreign reserves.

The study is valid and reliable to use for policymaking by conducting different tests and robust checks of the data and results, i.e. the ADF test was done to confirm that the selected variables are time-stable and significantly linked to foreign reserves. Since the value of R-squared is high and the F-statistics are significant, the model is well fitted to explain the variation of reserves. Also, the Ramsey RESET test confirms the adequacy and the dependability of the model.

From the policy implication, this result reiterates the need for a stable trade regime, sound and strategic debt management, and effective and efficient use of remittances to ensure the stability of the foreign reserves. Policymakers should work on strengthening and protecting the export industries, reducing unnecessary and harmful imports, and ensuring stable remittance inflows. The

unexpected negative impact of HDI suggests that infrastructural development spending and more luxurious good imports should be managed carefully and in a specific amount to avoid excessive foreign currency outflows.

Overall, this study provides strong evidence and information on the factors affecting Bangladesh's foreign currency reserves. Future research can expand on this by including additional or other macroeconomic indicators like population growth, interest rate, exchange rate, specific freelancers' outsourcing income, etc., comparing these findings with different economies, or incorporating a qualitative study for a deeper understanding of reserve management. An unexpected negative link is shown by the Human Development Index (HDI), which indicates the need for more research.

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