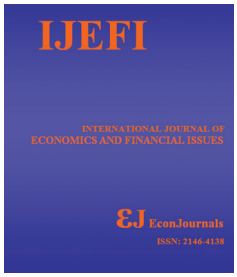

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Determinants of Foreign Exchange Reserve of Emerging Economy: Time Series Evidence from Bangladesh

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ABSTRACT

This paper contributes to existing literatures through investigating the elements influencing Bangladesh's foreign exchange reserves covering the period from 1972 to 2023. In fact, this study analyzes the impact of several macroeconomic variables, including exports, imports, economic growth, trade balance, remittances, external debt, foreign direct investment (FDI), broad money, real interest rates, exchange rates, and trade openness, using an ordinary least squares (OLS) regression model on the foreign exchange reserves. The findings demonstrate that while trade balance, real interest rates, and trade openness show negative connections, exports, imports, economic growth, remittances, foreign debt, FDI, and broad money have major positive influence on the reserves. With a R^2 value of 0.9877, the model shows a great explanatory power and indicates that the chosen variables almost completely explain the variance in foreign exchange reserves. Without the evidence of heteroscedasticity, multicollinearity, or autocorrelation, diagnostic tests validate the robustness of the model. The results highlight the need of keeping balanced trade policies and supporting favorable conditions for exports, remittances, and FDI to guarantee a steady buildup of foreign exchange reserves, thereby ensuring Bangladesh's economic resilience and stability.

Keywords: Foreign Exchange Reserve, Foreign Direct Investment, Gross Domestic Product Growth, Remittance, Ordinary Least Squares
JEL Classifications: F30, F36, F65

1. INTRODUCTION

Foreign exchange reserves are vital assets held by countries in foreign currencies, primarily composed of hard currencies like the U.S. dollar, euro, and yen, as well as gold, IMF special drawing rights (SDRs), and other assets. For Bangladesh, as for many other developing countries, maintaining an adequate level of foreign exchange reserves is critical for macroeconomic stability. It ensures that the country can meet its international financial obligations, cover the costs of imports, and maintain stability in its currency, among other things. Over the years, Bangladesh's foreign exchange reserves have witnessed fluctuations influenced by several factors. Let's delve into the prominent factors affecting the foreign exchange reserve of Bangladesh. One of the primary sources of foreign exchange for Bangladesh comes from its exports, especially the ready-made garments (RMG) industry, which is the largest contributor to the country's export earnings. Additionally, remittances sent home by Bangladeshi expatriates play a crucial role in boosting the country's foreign exchange reserves.

The cost of imports, particularly of essential commodities like oil, significantly affects the reserves. If the cost of imports surpasses the earnings from exports and remittances, it can lead to a reduction in the foreign exchange reserve. FDI inflows bring in significant amounts of foreign currency into the country. Sectors like telecommunications, power, and textiles are some of the major FDI recipients in Bangladesh. Aid, loans, and grants from international agencies and foreign countries can augment the reserves. However, loan repayments can also deplete them, depending on the net balance.

The Bangladesh Bank (the central bank of Bangladesh) actively intervenes in the foreign exchange market to stabilize the

Bangladeshi Taka. These interventions can affect the foreign exchange reserves depending on whether the bank buys or sells foreign currency. In addition, global economic shocks, trade wars, or significant financial market disruptions can impact Bangladesh's trade balance, FDI inflows, and remittances, thereby affecting its foreign exchange reserves. The expectation of currency depreciation or appreciation can lead to speculative buying or selling of currencies, which can influence the level of reserves.

Bangladesh is prone to natural disasters like cyclones and floods. Such events can adversely affect the country's export capacity, and the subsequent need for reconstruction might increase imports, both of which can impact the reserves. The global COVID-19 pandemic serves as a relevant example of how external shocks can affect trade, remittances, and foreign reserves (Hossain, 2021). Moreover, Political stability in the country can foster investor confidence, promote FDI, and have a positive impact on foreign exchange reserves. Conversely, political unrest and uncertainty can deter foreign investments.

The foreign exchange reserve of Bangladesh, like that of any other country, is influenced by a complex interplay of domestic and international factors. This study focuses on the determining factors of the foreign exchange reserve of Bangladesh. In many studies the factors that have been founded responsible for influencing the foreign reserve include GDP (gross domestic product) growth, interest rate, foreign debt, financial stability, export, import, inflation, exchange rate, capital inflows, trade openness, net foreign asset, GNI (gross national income), FDI (foreign direct investment), money supply, current account and capital account balance, and monetary policy rate (Olokoyo et al., 2009). Bangladesh is lagging behind in the rank of freest economy as per Economic Freedom Index of 2022, which was 137th from 120th in 2021 because of inferior law, property rights, government fidelity and judicial feasibility. The foreign reserve of Bangladesh has been skyrocketing since 2002. In FY 2021-2022, it stood at USD 41826.7 million which declined to USD 31203 million in FY 2022-2023. Hence the economy of the country has been stuck and the bargaining power of the country has been desolated (Alam et al., 2021). To take a recent viewpoint, it can be said that the worldwide chaos, e.g., COVID-19 pandemic, Russia-Ukraine war, natural calamities, and political vulnerabilities are making the foreign currencies volatile. Monitoring these factors closely and adopting prudent macroeconomic and monetary policies are essential to ensure that the reserves remain at an adequate level, bolstering economic resilience against potential shocks.

The next sections of this paper consist of review of relevant literatures followed by data and methods, empirical discussion with conclusion and policy implications.

2. REVIEW OF LITERATURE

Historically the foreign reserves of Bangladesh have not found to be much promising. But Bangladesh had been accumulating a high level of foreign reserves in past few years. A careful analysis of the costs and benefits of reserves accumulation and sterilization has been felt as a need. Several theories and empirical studies have found countable factors that affect the foreign exchange reserve of Bangladesh. Many factors are found to affect the foreign exchange reserve positively while some affect negatively; and out of those some factors are proved to be statistically significant and a few are not.

It has been decided that stockpiling reserves of foreign currency is a far more prudent strategy. An examination conducted by Islam (2010) on Bangladesh's foreign exchange reserve has brought attention to potential dangers, such as differences in interest rates between Bangladesh and developed markets. The study also proposes that Bangladesh should consider transitioning towards a more open financial system. As per the research of Fukuda, et al. (2012), open economies with a well-defined strategy aim to increase their reserves to lower the costs of liquidity risk. After laying this groundwork, the author argued that increasing reserves causes a simultaneous increase in liquid and total debt while reducing the maturity of debt. Foreign financial inflows may reduce the effectiveness of government tax and non-tax efforts, as per the study of Murshed (2019). Additionally, an increase in inflows may require the government to reallocate external money away from allocation to investment in the productive sections of the economy and towards servicing external debts. The allocation of foreign financial inflows, he concludes from his study of the vector error correction model, is a critical factor in increasing the size of public expenditure in Bangladesh. Furthermore, Ito and McCauley (2020) conducted an analysis of the currency composition of official foreign reserves and found a significant correlation between currency composition, domestic currency fluctuations, and trade currency invoicing. To assert the overall effect, it is said that foreign debt is positively and significantly related to financial stability and economic progress, as per Ali (2022). However, there is a detrimental effect of external debt on economic growth.

The quantitative elements that affect Bangladesh's foreign exchange reserve have been the subject of numerous theoretical and empirical studies. Many factors have a positive effect on the country's foreign exchange reserve, while others have a negative one. Statistical significance is shown for some factors while it is not shown for others.

Sanusi et al. (2019) examined the factors influencing foreign exchange reserves in South African countries. They employed the autoregressive distributive lags (ARDL) approach to analyze the data. The variables employed in his analysis encompassed foreign reserves, capital inflows, exports, inflation, exchange rates, and imports. Based on the empirical findings, it has been determined that exports, inflation, exchange rate, and imports exhibit statistical significance. Furthermore, it has been observed that export, inflation, and exchange rate exert a positive influence on the foreign reserves of South African nations, whereas import is associated with a negative impact on foreign reserves. It has been determined that capital influx exhibits a positive correlation, albeit not a statistically significant one. Nurjanah and Mustika (2021) conducted a study on the impact of imports, foreign exchange reserves, external debt, and interest rates on currency exchange rates against the U.S. dollar in Southeast Asian nations. Using data from 2010 to 2017 and a multiple regression model,

they determined that the exchange rate, foreign debt, and imports are substantially positively affected, while the interest rate has a negligible effect. Suman and Aman (2021) looked into what factors influence the value of the Indian rupee. Their research showed that the foreign reserve is barely affected by variables like oil and non-oil imports, as well as external commercial financing and money supply.

In a study conducted by Olokoyo et al. (2009), various econometric techniques such as autoregressive distributive lags (ARDL), vector error correction, and Wald tests were employed. The findings of the study indicated that GDP and trade have a positive influence on foreign reserves. This suggests that in the long run, an increase in the size of the economy and trade openness would lead to the accumulation of foreign reserves. On the other hand, the level of foreign capital inflow and inflation exhibit a negative association with foreign reserves. Rahim and Alam (2013) examined the concept of foreign reserves within the context of Bangladesh. The researchers employed a range of variables, including exchange rate, opportunity cost of holding reserves, external debt, foreign direct investment, current account balance, capital account balance, capital movement, international reserves, GDP, interest rate, inflation, stock exchange operations, political stability, economic strength, and economic openness. Because World international reserves holdings rising significantly, it has been dominating in the hands of a few countries making Nigeria the twenty-fourth foreign reserve-holding country in the world in 2011.

Irefin and Yaaba (2011) analyzed the factors that affect Nigeria's foreign reserves in their research. To investigate a variant of the econometric "Buffer Stock Model," they used an autoregressive distributed lag (ARDL) approach. The fundamental result of this study was the discovery of a long-term correlation between reserves and their underlying causes. There was a statistically substantial positive correlation between reserves and lagging indicators including the monetary policy rate (MPR), the exchange rate, and the log of imports. To better understand what drives Bangladesh's foreign exchange reserves, Chowdhury et al. (2014) performed an empirical study whereas diagnostic tests were used to improve the modeling process, and the augmented Dicky Fuller (ADF) unit root test was used to check for stationary. The co-integrating relationship between the variables was determined using the Engle-Granger residual-based co-integration approach. This research confirmed previous results that a number of variables significantly affect Bangladesh's foreign exchange reserves. These variables include the exchange rate, remittances, home interest rate, broad money, UPI of export and import, and GDP per capita. However, the import coefficient and the home interest rate coefficient both point in the opposite direction of what was expected. Since foreign aid contributes so little to GDP, the researchers concluded that the positive link between foreign aid and foreign reserves is not statistically significant.

Uddin et al. (2017) used the ordinary least squares (OLS) method to analyze the causes of capital flight. The purpose of this study was to identify the most important factors that contribute to capital flight, with a particular emphasis on the role played by external debt, FDI flows, foreign reserves, interest rate differentials, and current account surplus. An important positive correlation between interest rate differentials and capital flight was found in the study. The research also showed that changes in foreign debt are positively related to the phenomena of capital flight. The analysis did show a weak negative correlation between the monetary policy rate (MPR) lag and reserves, but this link was not statistically significant. This finding agreed with what we know about the factors that affect savings from the vast majority of empirical studies. The GDP was not correlated with foreign currency reserves in any meaningful way. According to Khomo et al. (2018), Eswatini's foreign exchange reserves were heavily impacted by the country's GDP per capita, government expenditure, exchange rate fluctuations, and developments in the country's current account. The findings revealed a negative relationship between international reserves and government spending and current account vulnerability while a positive relationship was observed between GDP per capita and exchange rates. Bošnjak et al. (2020) stated that for certain quantiles, the level of the real exchange rate and the monetary aggregate (M2/GDP) are important. The real effective exchange rate, monetary aggregates (M2/GDP), and GDP level all had significant effects on North Macedonia's foreign exchange reserves. The technique was descriptive, making use of a tried-and-true time series analysis.

Suripto et al. (2022) discovered in their study on factors affecting Indonesia's foreign exchange reserves that exports have a positive and instantaneously significant effect on foreign exchange reserves; this was because of international trade employment. However, it had no significant effect over time. The short-term effects of foreign debt were positive and significant, but long-term effects were neither negative nor insignificant. In this study, the partial adjustment model analysis was utilized. Both in the immediate and long term, imports have a negative and significant impact. In addition, it was discovered that interest rates had no effect either in the short or long term. Gajurel (2022) employed an autoregressive distributed lag (ARDL) model and analyzed impulse response functions (IRF) to ascertain the impact of various factors on the foreign exchange reserve. The findings revealed that gross fixed capital exerts a negative influence on the foreign exchange reserve in the long run. Conversely, net flows of foreign direct investment, GDP per capita, inflation, and the official exchange rate were found to have a positive effect. Furthermore, the impact of trade and the current account balance on reserves were found to be favorable, albeit insignificantly significant. In the medium term, it was observed that factors other than the official exchange rate exert a positive influence on the foreign exchange reserve, whilst the official exchange rate exhibits a negative impact. Salan et al. (2023) employed a time series analysis to examine the correlation between the aggregate reserve of Bangladesh and several financial indicators spanning the years 1976-2020. The authors have identified a nonlinear association between observable variables through the use of the generalized additive model (GAM). The linear link between NFA (net foreign assets), NDC (net domestic credit), GNI (gross national income), and the dependent variable has been seen. A correlation was identified between the response variable and the covariates.

Considering these discussions, we have constructed the following hypothesis to assess the predictive relationship between foreign exchange reserve and several determinants as discussed:

H_o: There is no significant relationship between foreign exchange reserve and other determinants such as export, import, economic growth, external debt, trade balance, remittance, FDI, broad money, real interest rate, exchange rate and trade openness.

H_1: There is a significant relationship between foreign exchange reserve and other determinants such as export, import, economic growth, external debt, trade balance, remittance, FDI, broad money, real interest rate, exchange rate and trade openness.

3. DATA AND METHODS

This is an explanatory investigation revealing the impact of export, import, economic growth, external debt, trade balance, remittance, FDI, broad money, real interest rate, exchange rate and trade openness on the foreign exchange reserve of Bangladesh since its inception in 1972. The data set for the explanatory variables has been collected from the official website of World Bank spanning from 1972 to 2023 yielding a sample size of 52. The usual form of foreign exchange reserve is a function of following determinants:

$$FER_t = f(EXP_t, IMP_t, EG_t, TB_t, RMT_t, ED_t, FDI_t, M2_t, RIR_t, EXR_t, TO_t) \quad (1)$$

Using the transformation of natural log in all explanatory variables, the following equation has been constructed to estimate the earlier equation:

$$ln(FER_t) = \beta_1 + \beta_2 (lnEXP_t) + \beta_3 (lnIMP_t) + \beta_4 (lnEG_t) + \beta_5 (lnTB_t) + \beta_6 (lnRMT_t) + \beta_7 (lnED_t) + \beta_8 (lnFDI_t) + \beta_9 (lnM2_t) + \beta_{10} (lnRIR_t) + \beta_{11} (lnEXR_t) + \beta_{12} (lnTO_t) + \mu \quad (2)$$

The details of each variable including notation, explanation and expected sign of coefficients are mentioned in the following Table 1.

Since Table 1 consists of the list of explanatory or independent variables affecting the dependent variable measured with foreign exchange reserve of Bangladesh, we have adopted ordinary least squares (OLS) method to estimate the impact of these explanatory variables as per following model derived from equation 02:

$$\ln(FER)_t = \alpha_t + \sum_{k=1}^{11} \beta_t \ln(X)_{tk} + \mu_t \quad (3)$$

Where, α = Constant of the model, β = Coefficient of the explanatory variable and μ = Error term of the model

In addition, we have also conducted some diagnostic checks including model specification test, multicollinearity test, heteroscedasticity, and autocorrelation test of the estimated model.

4. EMPIRICAL RESULTS WITH DISCUSSION

Before estimating the model using OLS method, the descriptive statistics consisting of mean, standard deviation, minimum, maximum and number of observation corresponding to each variable is mentioned in the following Table 2.

This Table 2 shows the descriptive statistics for the variables of the model that let us ascertain their statistical traits. Except for the log of remittance and national external debt, all of the variables have rather modest standard deviations. The ranges' gaps were noted as somewhat mild.

According to the estimated coefficients corresponding to each explanatory variable reported in Table 3, the coefficient of 92.033 for exports is highly significant ($P < 0.001$), indicating that an increase in exports is strongly associated with an increase in foreign exchange reserves. This result is consistent with the balance of payments theory, where increased exports lead to higher foreign currency earnings, subsequently bolstering a country's reserves. According to Krugman and Obstfeld (2009), export growth is a critical determinant of reserve accumulation in emerging markets, as it directly enhances the current account balance. In contrast, imports have a positive and significant coefficient of 35.935 ($P < 0.001$). This suggests that while imports typically represent an outflow of foreign exchange, in this model, they are associated with increased reserves. This might reflect a situation where imported goods enhance the productivity of an economy, leading to a more robust export sector and, indirectly, higher reserves. Mishkin (2007) found that imports can stimulate economic activity by providing access to critical inputs which could enhance export potential for a country.

Economic growth, with a coefficient of 1.7612 and a $P = 0.016$, has a positive and significant impact on foreign exchange reserves. Economic growth generally leads to increased national income, which can support both higher savings and investment, thereby improving the current account and augmenting reserves. As noted by Dornbusch (2001), sustained economic growth is essential for stable reserve accumulation. The coefficient for trade balance is −23.802, which is statistically significant ($P = 0.038$). This negative relationship suggests that a deteriorating trade balance (greater deficits) is associated with a reduction in foreign exchange reserves. This is consistent with standard macroeconomic theory, where persistent trade deficits deplete reserves as more foreign currency is required to pay for imports than is earned from exports (Brancaccio and Saraceno, 2017).

Remittances have a positive coefficient of 0.4284, with a $P = 0.001$, indicating a significant positive impact on foreign exchange reserves. Remittances are an essential source of foreign exchange for many developing countries, contributing directly to reserve accumulation (Chowdhury and Chakraborty, 2021). According to Ratha (2005), remittances provide a stable source of foreign currency, often exceeding other capital inflows such as FDI in many countries. The coefficient for external debt is 1.1337 with a $P = 0.046$, indicating a significant positive relationship with foreign exchange reserves. This could suggest that external borrowing, if managed prudently, can contribute to reserve accumulation by financing productive investments that ultimately enhance export capacity. However, this relationship also depends on the terms of the debt and its use (Reinhart, 2009).

Table 1: Description of variables included in the model

Variables	Notations	measurement Method	Expected impact	References	Sources of data
Dependent variable					
Foreign exchange reserve	FER	Log of foreign exchange reserve	N/A	(Sanusi et al., 2019; Rahim and Alam, 2013; Irefin and Yaaba, 2011)	World Bank
Independent variables					
Export	EXP	Log of total export	Positive	(Sanusi et al., 2019; Chowdhury et al., 2014)	World Bank
Import	IMP	Log of total import	Negative	Sanusi et al. (2019), Irefin and Yaaba (2011)	World Bank
Economic growth	EG	Log of GDP growth over the years	Positive/Negative	(Olokoyo et al., 2009; Rahim and Alam, 2013)	World Bank
Trade balance	TB	Log of balance of trade	Positive	(Khomo et al., 2018; Gajurel, 2022)	World Bank
Remittances	RMT	Log of total remittance inflow	Positive	(Chowdhury et al., 2014)	World Bank
External Debt	ED	Log of total external debt	Negative/Positive	(Nurjanah and Mustika, 2021; Rahim and Alam, 2013)	World Bank
Foreign direct investment	FDI	Log of FDI	Positive	(Olokoyo et al., 2009; Rahim and Alam, 2013; Chowdhury et al., 2014)	World Bank
Broad money	M2	Log of total M2 currency	Positive	(Chowdhury et al., 2014; Bošnjak et al., 2020)	World Bank
Real interest rates	RIR	Log of difference between nominal rate and inflation	Positive	(Rahim and Alam, 2013; Chowdhury et al., 2014)	Bangladesh Bank
Exchange rates	EXR	Log of average annual exchange rate between USD and BDT	Positive/Negative	(Sanusi et al., 2019; Nurjanah and Mustika, 2021; Rahim and Alam, 2013; Irefin and Yaaba, 2011)	Bangladesh Bank
Trade openness	TO	Log of balance of trade to GDP ratio	Positive/Negative	(Olokoyo et al., 2009; Gajurel, 2022)	World Bank

Source: Authors' contribution

Table 2: Descriptive statistics for each variable in the model

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
FER	52	4.0496	0.45837	3.2253	4.6566
EXP	52	0.15145	0.03239	0.1044	0.2016
IMP	52	0.21069	0.04182	0.1571	0.2795
EG	52	0.0608	0.01140	0.0345	0.0788
TB	52	−0.05924	0.0125262	−0.0779	−0.0349
RMT	52	4.01532	0.2678389	3.486	4.3941
ED	52	4.50669	0.2174945	4.2224	4.9611
FDI	52	0.008815	0.00433	0.001	0.0174
M2	52	0.54495	0.06284	0.427	0.645
RIR	52	0.0443	0.04396	−0.136	0.084
EXR	52	1.86281	0.05528	1.76	1.9287
TO	52	0.36214	0.073747	0.2627	0.4811

Source: Authors' estimations based on STATA

Table 3: Output of coefficients of the model

Dependent variable: Foreign exchange reserve	Estimation model		
	OLS coefficients	Standard error	P-value
Independent variables			
EXP	92.033***	6.1541	0.000
IMP	35.935***	5.1449	0.000
EG	1.7612**	0.5172	0.016
TB	−23.802**	8.5751	0.038
RMT	0.4284***	0.0439	0.001
ED	1.1337**	0.0656	0.046
FDI	13.952***	0.7483	0.000
M2	2.0773***	0.2901	0.003
RIR	−0.4532**	0.0594	0.027
EXR	0.1868*	0.0836	0.091
TO	−54.614***	2.6891	0.000
Constant	−3.9284***	0.8943	0.000
Observations		52	
F		58.38***	
R^2		0.9877	
Adjusted R^2		0.9708	
Root MSE		0.0783	

Source: Authors' estimations based on STATA. *, **, *** reveal the respective significance levels of 10%, 5%, 1%

FDI shows a positive and highly significant coefficient of 13.952 ($P < 0.001$). This underscores the role of FDI as a key driver of reserve accumulation, as it brings in foreign currency and often leads to increased exports through enhanced productive capacity. According to Dunning (1993), FDI not only provides capital inflows but also contributes to technology transfer and market access, which can bolster export performance and reserves. The coefficient for broad money is 2.0773, with a $P = 0.003$, indicating a significant positive impact on foreign exchange reserves. An increase in M2 suggests higher liquidity in the economy, which can support economic activity and, in turn, enhance reserve accumulation through higher exports and controlled inflation. This relationship is supported by the monetarist view, as outlined by Friedman (1997). Real interest rates have a negative coefficient of −0.4532, with a $P = 0.027$, indicating that higher real interest rates are associated with lower foreign exchange reserves. Higher interest rates may lead to capital inflows in the short term, but they can also suppress economic growth and export competitiveness, leading to reduced reserves over time (Taylor, 1993).

Exchange rates have a coefficient of 0.1868, with a marginal significance ($P = 0.091$). A positive coefficient suggests that a depreciation of the domestic currency (which increases the exchange rate) might be associated with higher reserves, possibly due to improved trade balances as exports become cheaper for foreign buyers (Uddin, et al. 2013). However, this relationship can vary depending on the exchange rate regime and the elasticity of exports (Krugman, 1989). The coefficient for trade openness is −54.614, with a $P < 0.001$, indicating a significant negative impact on foreign exchange reserves. While trade openness generally facilitates economic growth, it can also lead to higher imports, which may outpace export growth and thus reduce reserves if the current account deteriorates. This finding aligns with Rodrik (1998), who argues that the benefits of trade openness depend on the structure of the economy and its ability to compete globally.

In this model, $R^2 = 0.9877$ means that approximately 98.77% of the variation in the foreign exchange reserves is explained by the independent variables included in the regression (such as exports, imports, FDI, etc.). This R^2 value of 0.9877 is extremely high, indicating that the model fits the data very well. In financial and macroeconomic modeling, an R^2 this high suggests that the chosen predictors are highly effective in explaining the fluctuations in foreign exchange reserves. However, a high R^2 alone doesn't guarantee a good model, as it may sometimes indicate over fitting, where the model is tailored too closely to the specific dataset. Therefore, it's essential to also look at other indicators, such as the Adjusted R^2. The adjusted R^2 value of 0.9708 still indicates a very good fit, meaning that around 97.08% of the variance in foreign exchange reserves is explained by the model, even after accounting for the complexity introduced by multiple independent variables. This small decrease from the R^2 value shows that most of the independent variables are likely contributing meaningfully to the explanation of the dependent variable, and the model isn't over fitting.

The F-test indicates that the independent variables, as a group, significantly explain the variation in the dependent variable (Stock and Watson, 2015). This reinforces the validity of the model, confirming that the chosen set of predictors is collectively useful in explaining the changes in foreign exchange reserves. In this model, F-statistic (58.38) with a very low P-value ($P < 0.001$) suggests that the overall model is statistically significant. This means that at least one of the independent variables is significantly associated with the foreign exchange reserves, and the model provides meaningful insight into how these factors influence FER.

In summary, the combination of high R^2 and adjusted R^2 along with a significant F-test statistic, suggests that the model is well-specified and provides a reliable explanation of how the independent variables affect foreign exchange reserves of Bangladesh.

Considering this statement, we have also conducted model specification test using regression error specification test (RESET) originated by RAMSEY to validate the findings of well-specification of model as depicted below in Table 4.

The output of the RAMSEY RESET test statistic evidences that the null hypothesis of no omitted variable bias has been failed to reject at 5% level of significance which clearly states that this estimated model doesn't suffer from any omitted variable bias which alternatively espouses that this model is well-specified and provides a reliable explanation of how the independent variables affect foreign exchange reserves.

Moreover, another problem named heteroscedasticity refers to the situation in which the variance of the errors (the residuals) in a regression model is not constant across all levels of the independent variables. In other words, the spread or dispersion of the residuals changes depending on the value of the independent variables. This violates one of the key assumptions of ordinary least squares (OLS) regression, which assumes homoscedasticity, meaning that the error terms have constant variance (Wooldridge, 2010). We have adopted Breusch-Pagan/Cook-Weisberg test for heteroscedasticity to check whether our estimated model suffers from non-constant error variance as depicted below in Table 5.

The output of B-P/C-W test statistic evidences that the model doesn't suffer from the problem of non-constant error variance as the null hypothesis of constant variance is failed to reject which

Table 4: Ramsey RESET test for omitted variable

Omitted variable bias test (FER) **H_0: Model has no omitted variables**	
F-test statistic	2.59
P-value	0.1659

Source: Authors' estimations based on STATA.

Table 5: Breusch-Pagan/Cook-Weisberg test for heteroscedasticity

Heteroscedasticity test (FER) **H_0: Constant variance**	
Chi-square statistic	0.07
P-value	0.7914

Source: Authors' estimations based on STATA

Table 6: Test of multicollinearity

Variables	FER	
	VIF	1/VIF
EXP	2.47	0.404858
IMP	2.53	0.395257
EG	1.79	0.558659
TB	1.67	0.598802
RMT	1.50	0.666667
ED	1.96	0.510204
FDI	4.64	0.215517
M2	2.54	0.393701
RIR	1.13	0.884956
EXR	1.72	0.581395
TO	1.17	0.854701
Mean VIF	2.10	

Source: Authors' estimations based on STATA

Table 7: Durbin's alternative test for autocorrelation

Autocorrelation test (FER) H_0: no serial correlation	
Chi-square statistic	0.548
P-value	0.4592

Source: Authors' estimations based on STATA

alternatively suggests that error term of the estimated model has constant variance over the period.

The following Table 6 reports the value of variance inflation factor (VIF) to detect the presence of multicollinearity among the explanatory variables of the model. The mean VIF has been found to be 2.10, which is below benchmark of 5. This lets us accept the null hypothesis and conclusively determine the absence of the multicollinearity problem in the model.

In addition, we have also executed the test of serial auto-correlation for our estimated model using Durbin Watson's (DW) alternative test for autocorrelation as reported in the following Table 7.

So, we can't reject the null hypothesis and confirm that first-order autocorrelation doesn't exist in the model by looking at the results of the DW's test for autocorrelation in this Table 7 that evidences the absence of first-order autocorrelation in the model.

5. CONCLUSION AND POLICY IMPLICATIONS

This study serves an in-detail analysis of the determinants of foreign exchange reserves in Bangladesh, an emerging economy. The favorable and important influence of the factors imply that sustaining and expanding the reserves will depend on policy actions meant to increase export competitiveness, enable remittance inflows, and draw FDI. On the other hand, the negative correlation between trade balance and foreign exchange reserves emphasizes the need of cautious control of import levels relative to export profits to avoid reserve depletion. Furthermore, although statistically significant, the negative impact of trade openness on reserves plugs to the need of careful management even if more integration into the global economy might promote development and avoid too strong import dependency that might strain the reserves. Furthermore, the need of keeping a balanced interest rate policy is linked negatively with the real interest rates, since too high rates could discourage investment and economic activity, so reducing reserves.

The empirical findings stipulate that exports, imports, economic growth, remittances, external debt, foreign direct investment (FDI), and broad money positively impact reserves, underscoring their critical roles in economic stability. Conversely, the negative relationships observed with the trade balance, real interest rates, and trade openness highlight areas that could potentially weaken reserve accumulation if not carefully managed. Moreover, it is also found that the model has no omitted variable bias as well as no multicollinearity, heteroscedasticity and autocorrelation.

Given these consequences, the government should keep carrying out programs meant to improve the export sector's competitiveness, especially in value-added sectors, thereby guaranteeing a consistent flow of foreign money. Reducing transaction costs and rewarding expatriates will help to strengthen the routes for remittance inflows, hence augmenting reserves (Karim, et al. 2020). Policies that foster a positive investment environment that is, those that guarantee political stability, enhance infrastructure, and provide fiscal incentives can draw more FDI, therefore promoting reserve accumulation (Hossain, 2021). To reduce the negative effects on reserves, trade openness must be balanced by, when practical, policies promoting import substitution. Preventing capital flight and preserving trust in the economy which in turn maintains foreign exchange reserves dependent on keeping a reasonable interest rate environment and guaranteeing fiscal discipline. By implementing these policy changes, Bangladesh can enhance its foreign exchange reserves which are essential for maintaining economic stability and resistance against outside shocks. Future studies should concentrate on the dynamic effects of worldwide economic developments on the reserves and investigate the possible influence of newly developed financial instruments on reserve management policies.

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