

Capital Flows in Bangladesh

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Abstract

This paper aims to estimate a sterilization coefficient to assess the extent to which the Central Bank of Bangladesh (Bangladesh Bank) sterilized capital inflows, and to estimate an offset coefficient to assess the extent to which the central bank's domestic-market activities spurred additional capital inflows. Monthly data from 2013M1 to 2023M12, available in various government publications, have been used in the analysis. The sterilization coefficient was estimated from the monetary policy reaction function, while the capital-flow equation was used to estimate the offset coefficient. Multiple regression was applied to estimate the effects of the explanatory variables. The control variables included are the index of industrial production (IIP), the money multiplier for broad money M2 (MM2), the spread between the central bank policy rate and the effective federal exchange rate (IF), the spread between the policy rate and the call money rate (DS), the nominal USD/BDT exchange rate (NER), and remittances (REM). The results from the two equations across all specifications show that sterilization coefficients are higher than offset coefficients, suggesting that the Central Bank of Bangladesh could mitigate the impact of foreign capital inflows.

Keywords: Central Bank · Capital flows · Sterilization Coefficients · offset coefficients

JEL Classification: E41 · E52

1. Introduction

The ability to run an efficient monetary policy in an open economy with a fixed exchange rate largely depends on how monetary policy instruments interact with capital inflows. Capital inflows create appreciation pressures that the central bank neutralizes through foreign-exchange interventions (i.e., purchases of foreign currency in the market) to maintain exchange-rate stability. However, these purchases increase international reserves and the money supply, which can build up inflationary pressures and run counter to the central bank's key objective. Therefore, central banks tend to conduct sterilization policies, estimating that the rise of inflationary pressures in the absence of sterilization would be detrimental to financial stability and the economy as a whole.

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Analysis of sterilization policy in the available literature is typically based on estimates of two coefficients. The first, called the sterilization coefficient, measures the intensity of sterilization, i.e., the share of money created by foreign-exchange interventions that the central bank neutralizes through other monetary policy measures. Second, the extent to which this policy type spurs additional capital inflows from abroad can be estimated by calculating the so-called offset coefficient. Bangladesh provides a pertinent case for examining these mechanisms. Growing trade openness, large remittance inflows, gradual financial liberalization, and recurring exchange-rate pressures have complicated the conduct of monetary policy. The Bangladesh Bank has actively intervened in the foreign-exchange market while pursuing domestic objectives related to inflation and growth.

This article estimates the sterilization and offset coefficients for Bangladesh to assess the effectiveness of monetary policy in managing domestic liquidity under external shocks. Using an open-economy empirical framework, the study contributes evidence on monetary constraints and policy effectiveness in a developing economy context.

2. Objectives

The study aims to investigate the following:

- a. The money market scenario and the extent of capital flow in the last ten years using monthly data from 2013M1 to 2022M12.
- b. To estimate the sterilization and offset coefficients and their implications.

3. Data and Methodology

The primary data sources have been the various publications of the Bangladesh Bank, including the Weekly Economic Indicator, the Fortnightly Economic Indicator, the Monthly Economic Indicator, the Monthly Economic Trend, and the Quarterly. In addition, online data from the IMF, the WB WDI, and CEIC have been used. Statistics from the Bangladesh Bureau of Statistics and the Ministry of Finance have also been used, particularly for macroeconomic variables. Data from the ADB, OECD, World Bank, and IMF have also been used. To examine levels and trends, charts, percentage distributions, growth rate formulae, and regression techniques have been applied.

All ratios are estimated by the author. The Pooled Ordinary Least Squares (OLS) has been used to estimate the effects of the explanatory variables. GLS random- and fixed-effects (group variable: Months) models for panel data have also been used to estimate the effects of the explanatory variables. The regression equations have been estimated using Stata 14.

4. Sterilization

4.1 Sterilization: Meaning

Sterilization involves actions taken by the central bank to offset the monetary expansion caused by increased foreign currency inflows. When foreign currency enters the country, it increases the central bank's foreign exchange reserves. This, in turn, increases the domestic money supply, since these reserves are typically exchanged for the local currency. While foreign currency inflows may strengthen the currency and provide liquidity to the economy, they can also lead to inflation if not managed properly. This is because an increase in the money supply can push up demand, potentially leading to an overheated economy. Sterilization helps ensure that the increase in foreign reserves does not lead to excessive domestic currency circulation or inflation.

4.2 Sterilization Methods of Bangladesh Bank

Bangladesh Bank has several tools and methods to sterilize the impact of foreign currency inflows. The main goal is to absorb the excess liquidity created by foreign exchange interventions, thereby preventing inflationary pressures. Here are the key mechanisms employed:

a. Open Market Operations (OMO)

The primary tool used by the Bangladesh Bank for sterilization is Open Market Operations (OMOs). OMOs involve buying and selling government securities (such as treasury bills or bonds) in the open market.

Selling Government Securities: When the Bangladesh Bank receives foreign currency inflows, it can sell government securities (bonds or treasury bills) in the domestic market. By selling these securities, the central bank effectively withdraws domestic currency from circulation. This reduces the money supply, neutralizing the inflationary effects of increased foreign reserves.

Example: Suppose Bangladesh receives a significant inflow of remittances. This increases foreign currency reserves, potentially leading to more local currency (BDT) in circulation. To counter this, Bangladesh Bank may sell government bonds or treasury bills in the market. When commercial banks or financial institutions purchase these bonds, they pay in local currency, which is then absorbed by the central bank, reducing the money supply.

b. Foreign Exchange Intervention

When foreign exchange inflows increase, Bangladesh Bank might directly intervene in the foreign exchange market to stabilize the currency or manage reserves. This can be done by buying or selling foreign exchange in the market.

Example of Buying Foreign Currency: If remittances flood the market and put upward pressure on the Bangladeshi Taka (BDT), the central bank can

intervene by buying US dollars or other foreign currencies. This removes local currency from circulation and prevents excessive Taka appreciation, maintaining balance in the foreign exchange market.

Example of Selling Foreign Currency: In another scenario, if the Bangladesh Bank wants to limit the appreciation of the Taka, it might sell US dollars from its reserves and exchange them for Bangladeshi Taka. This increases the local currency supply but will be offset by other sterilization measures.

c. Increase in Policy Interest Rates

Another indirect form of sterilization is adjusting interest rates (such as the repo rate or reverse repo rate). When the Bangladesh Bank perceives inflationary pressures from foreign currency inflows, it may raise interest rates to absorb excess liquidity. Higher interest rates make borrowing more expensive, helping curb domestic credit growth and easing inflationary pressures.

Example: Suppose remittance inflows increase significantly during a certain period, leading to more local currency circulating in the economy. In response, the Bangladesh Bank may raise interest rates, making borrowing less attractive. This reduces credit expansion, thereby absorbing some of the additional liquidity from the economy.

d. Utilizing the Bank's Foreign Exchange Reserves

Bangladesh Bank also manages its foreign exchange reserves to help sterilize the effects of inflows. When reserves rise, the central bank's ability to intervene in the foreign exchange market increases, but the central bank may also need to manage how these reserves are used.

For instance, if foreign reserves are too high, the Bangladesh Bank might decide to diversify reserves into assets that do not create inflationary pressure, such as gold, international bonds, or other foreign assets. While this does not sterilize liquidity in the traditional sense, it prevents too much of the foreign currency inflow from being directly exchanged for local currency.

Examples of Sterilization in Action

Example 1: Remittance Inflows

Remittances play a critical role in Bangladesh's economy, with billions of dollars flowing into the country each year. These inflows can increase foreign exchange reserves but can also create inflationary pressures if not sterilized. Let us look at an example:

Scenario: Assume that in a given year, Bangladesh receives \$10 billion in remittances. This increases Bangladesh Bank's foreign currency reserves. If the central bank does not act, the influx of dollars would increase the domestic money supply, putting upward pressure on inflation.

Sterilization Action: In response, Bangladesh Bank could sell Bangladesh Government bonds (or treasury bills) to commercial banks or investors in the local market. This would reduce the amount of local currency in circulation. By doing so, the central bank offsets the increase in the money supply caused by the remittance inflows.

Example 2: Foreign Direct Investment (FDI)

Suppose Bangladesh also experiences a surge in foreign direct investment (FDI), another form of capital inflow. This will increase foreign exchange reserves but can also affect the local money supply.

Scenario: FDI inflows of \$2 billion increase Bangladesh's foreign exchange reserves.

Sterilization Action: Bangladesh Bank may intervene in the foreign exchange market by selling some of its reserves to stabilize the Taka. It may also conduct open-market operations by selling government securities to absorb additional BDT into the system, thereby preventing inflation.

Example 3: Volatile Capital Flows

At times, capital inflows can be volatile, leading to temporary liquidity surges in the economy. If Bangladesh Bank anticipates such volatility—such as during a global financial crisis or shifts in global risk sentiment—it may adopt preemptive measures.

Scenario: Following a surge in capital inflows due to an international crisis or an improved global risk outlook, Bangladesh Bank might face increased pressure to manage excessive liquidity.

Sterilization Action: Bangladesh Bank can conduct open market operations, such as selling government bonds, and/or raise its policy interest rates to absorb excess liquidity and prevent the economy from overheating.

5. Findings and Analysis

5.1 Some Stylized Facts on Money Supply

Movements in various types of money supply, the Money multiplier of broad money, Net Domestic Assets (NDA), Net Foreign Assets (NFA), and the income velocity of money are depicted in charts 1-6.

5.1.1 Movement of M0 M1 M2 and M3

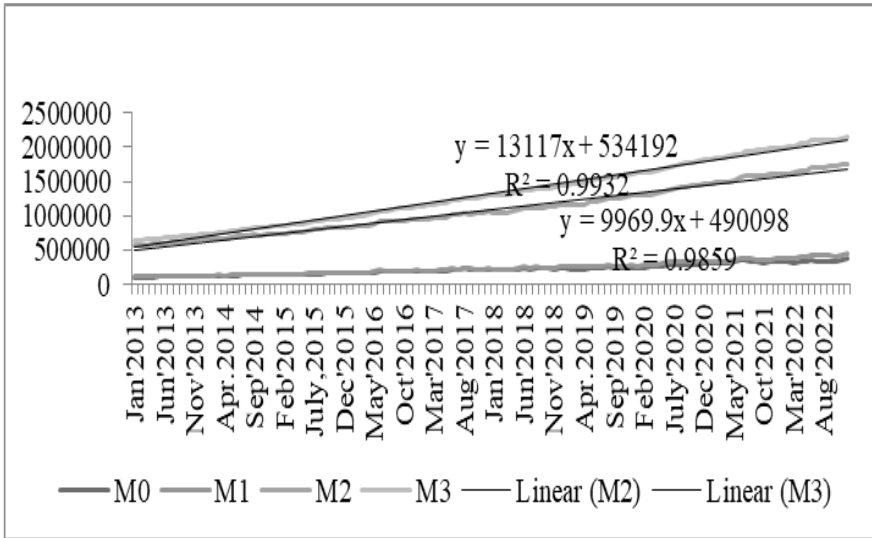


Chart 1. Movement of M0, M1, M2, and M3. BDT Crore

Source & Note: Bangladesh Bank, Author's Analysis

Chart 1 shows the movement of Bangladesh's money supply measures (M0, M1, M2, and M3) over time, from January 2013 to December 2022. From the chart, it appears that all money supply measures trend steadily upward, indicating overall growth in liquidity. The purple line (M3) is the highest and steepest, showing that the broad money supply expanded the most in absolute terms. M2 is slightly below M3 but shows a very similar upward trajectory, reflecting strong growth in savings and near-money assets. M1 rises gradually, with some acceleration after 2020. M0 grows the slowest and remains much smaller, reflecting limited growth in physical currency relative to bank-based money. The linear trend lines fitted to M2 and M3 show a very strong fit. The steeper slope of M3 indicates that it expanded faster than M2. The chart illustrates a long-term expansion of the money supply, especially in broader measures (M2 and M3), with particularly strong and consistent growth over the decade shown, highlighting increasing liquidity and monetary expansion in the Bangladesh economy.

5. 1. 2 Movement of Money Multiplier of M2 and M3

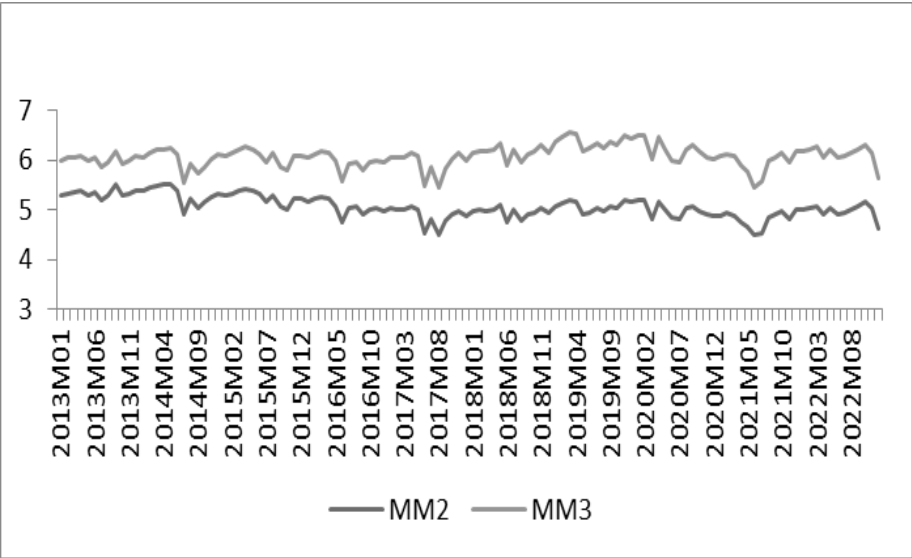


Chart 2. Movement of Money Multiplier of M2 and M3
Source and Note: Bangladesh Bank, Author’s Analysis

Chart 2 shows the movement of MM2 obtained as $M2/RM$ and MM3 obtained as $(M3/RM)$ over time, from January 2013 to December. 2022. Throughout the entire period, the red line (MM3) stays above the blue line (MM2), indicating that the broader money measure remains larger. Both series fluctuate within a narrow range. MM2 oscillates around 5.0, while MM3 fluctuates around 6.0, which is their respective monthly average. Both lines exhibit frequent ups and downs, suggesting short-term cash flow fluctuations rather than long-term growth. Noticeable dips occur around 2014–2015, 2017, and 2020–2021, with partial recoveries afterward. The blue line shows sharper drops and more pronounced swings than MM3, suggesting narrower money components react more quickly to economic or policy changes. There is no clear long-term upward or downward trend. This chart highlights the relative behavior and stability of modified money supply measures. While absolute money supply (M2 and M3) grows steadily over time, MM2 and MM3 move within bands, capturing short-term liquidity cycles and policy effects rather than long-term expansion.

5. 1. 3 Movement of NFA, NDA and RM

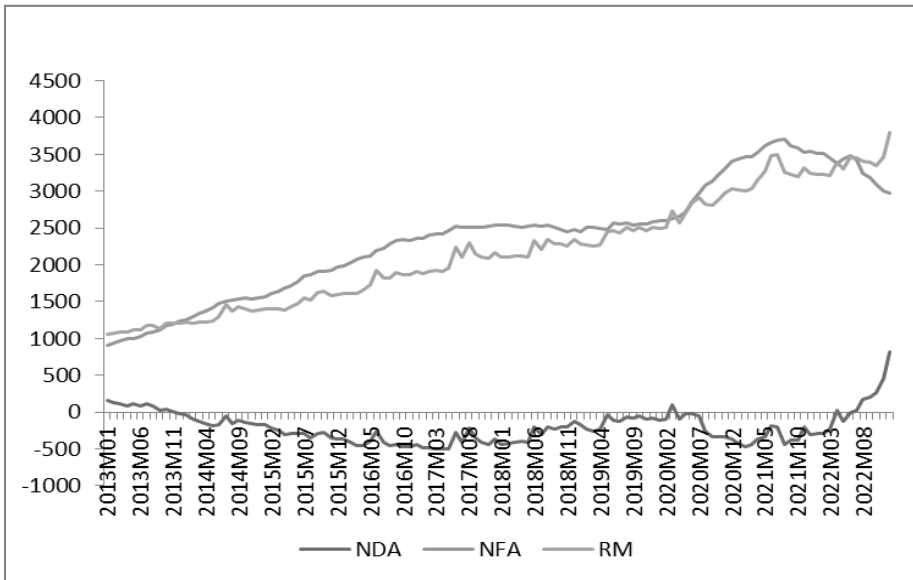


Chart 3. Movement of NFA, NDA & RM of Central Bank. BDT Billion

Source & Note: Bangladesh Bank, Author's Analysis

Chart 3 illustrates the changes in the Net Foreign Assets (NFA), Net Domestic Assets (NDA), and Reserve Money (RM) of the Bangladesh Bank, measured in billion Bangladesh Taka (BDT), over the period shown.

Net Foreign Assets (NFA): NFA reflects the central bank's holdings of foreign currency assets minus foreign liabilities. Movements in NFA indicate changes in foreign exchange reserves driven by balance-of-payments conditions, export–import dynamics, remittances, and foreign capital flows.

Net Domestic Assets (NDA): NDA represents the central bank's domestic assets, including credit to the government and financial sector, net of other domestic liabilities. Changes in NDA mainly capture the stance of domestic monetary and fiscal operations, such as government borrowing from the central bank.

Fluctuations in RM reflect the combined impact of movements in NFA and NDA. Periods of rising RM can be attributed to increases in NFA (e.g., reserve accumulation) and/or expansion in NDA (e.g., domestic credit growth). A decline in NFA accompanied by a rise in NDA suggests that domestic asset expansion may be offsetting external reserve losses to maintain liquidity.

5. 1. 4 Movement of Share (%) of NDA and NFA in RM

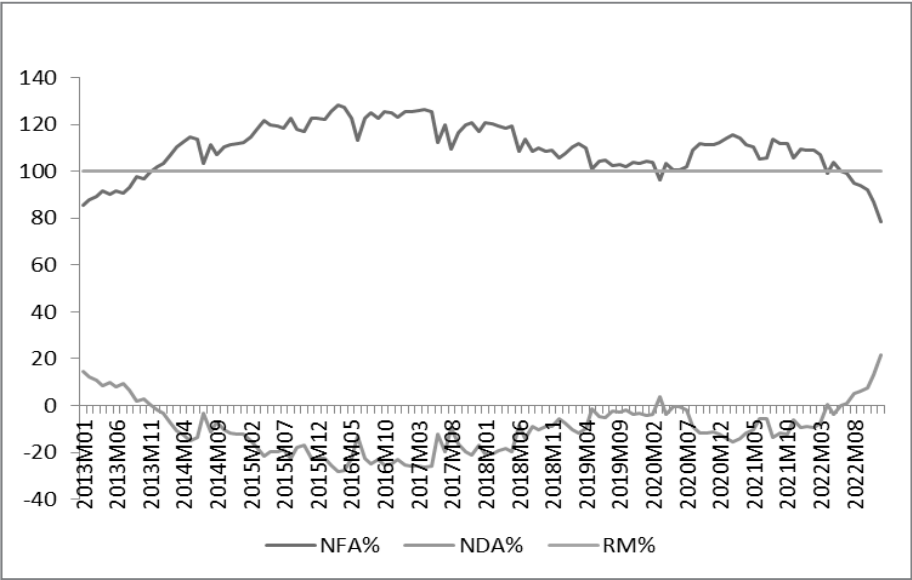


Chart 4. Movement of Share (%) of NDA and NFA in RM
Source & Note: Bangladesh Bank, Author’s Analysis

Chart 4 shows how Net Foreign Assets (NFA) and Net Domestic Assets (NDA) contribute, in percentage terms, to Reserve Money (RM) over the period 2013–2022. Here, RM% (green line): Fixed at 100%, since RM is the total composed of NFA and NDA. We find that NFA’s share of RM dominates. The blue line remains mostly above 100%, indicating that NFA has been the dominant source of reserve money. NFA’s share rises from below 100% in 2013 to a peak of around 120–130% during the mid-2010s, reflecting the strong accumulation of foreign reserves. On the other hand, the NDA’s contribution to RM is negative. The red line remains largely below zero, indicating that NDA often makes a negative contribution* to RM. This suggests contractionary domestic operations or central bank sterilization to offset excess liquidity generated by high NFA. There has been a recent deterioration in the NFA share. Towards 2021–2022, the NFA share declines sharply, falling close to or below 100%. At the same time, the NDA share turns positive, indicating increased reliance on domestic assets to support reserve money amid declining foreign reserves. While NFA was the main driver of RM for most of the period, recent years show weakening external buffers and a growing role for NDA. This shift has important implications for monetary stability, external vulnerability, and central bank policy choices.

5. 1. 5. Movement of Δ NDA and Δ NFA

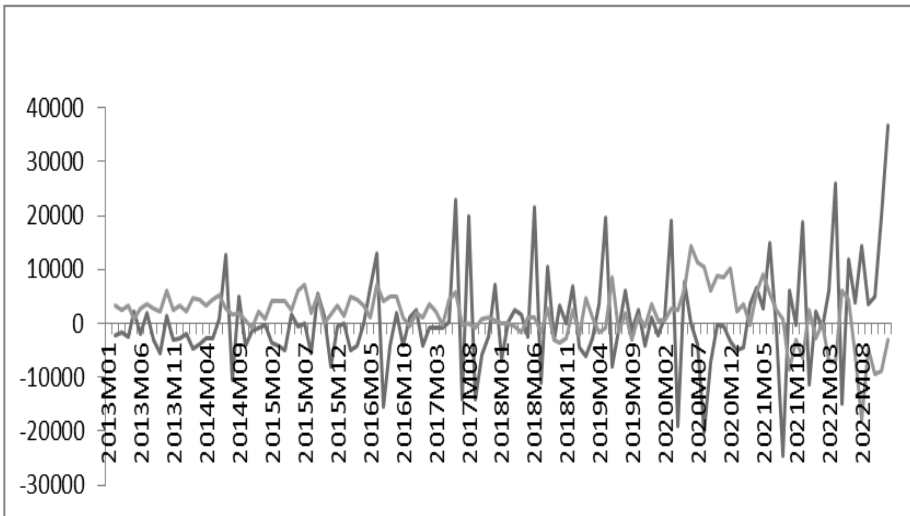


Chart 5. Movement of Δ NDA and Δ NFA

Source & Note: Bangladesh Bank, Author's Analysis;

Δ NDA means a change in NDA, also called the 1st difference of NDA. Similarly for Δ NFA.

Chart 5 presents the changes (first differences) in Net Domestic Assets (Δ NDA) and Net Foreign Assets (Δ NFA) of the central bank. The chart focuses on period-to-period changes, highlighting short-term dynamics. Δ NDA captures the incremental change in the central bank's domestic assets, reflecting variations in domestic credit—particularly credit to the government and the financial sector. Positive values indicate expansionary domestic operations, while negative values signal contraction. Δ NFA measures changes in foreign assets, mainly driven by movements in foreign exchange reserves due to trade balances, remittances, capital flows, and exchange rate interventions. Positive values imply reserve accumulation; negative values indicate reserve depletion. Both Δ NDA and Δ NFA exhibit high volatility, with frequent switches between positive and negative values, suggesting short-term monetary and external-sector adjustments. Periods of negative Δ NFA often coincide with positive Δ NDA, suggesting that domestic asset expansion may have been used to offset foreign reserve losses and stabilize reserve money. Conversely, a strong positive Δ NFA reduces the need for domestic asset expansion, sometimes accompanied by a lower or negative Δ NDA.

By focusing on first differences, the chart reveals policy responses and shocks affecting the central bank's balance sheet more clearly than level data, making it useful for analyzing the monetary policy stance, external pressures, and liquidity management.

5. 1. 6. Income Velocity of Money

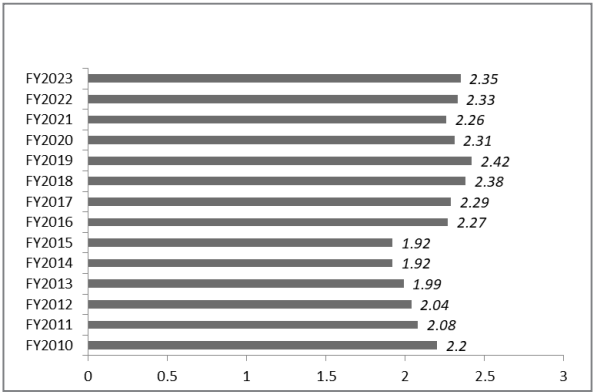


Chart 6. Income Velocity of Money (GDP/M2)
Source & Note: Bangladesh Bank, Author’s Analysis

Chart 6 depicts the income velocity of money, measured as the ratio of nominal GDP to M2, using data from the Bangladesh Bank. Income velocity indicates how frequently money circulates in the economy to generate income and output. A higher velocity implies that each unit of money is used more frequently in transactions, reflecting stronger economic activity or more efficient use of money. A lower velocity suggests that money is circulating more slowly, which may be associated with higher savings, increased liquidity preference, or weaker demand conditions. The velocity of money shows fluctuations over time, reflecting changes in economic activity, monetary expansion, and financial behavior. A declining trend during 2010-2015 indicates that M2 has been growing faster than GDP, implying rising liquidity but slower circulation of money. Periods of stabilization or mild recovery in velocity during 2016-2019 may correspond to improvements in economic activity or normalization after shocks. The income velocity of money is a crucial indicator linking monetary aggregates to real economic performance. Persistent declines in velocity can weaken the transmission of monetary policy, while stable or rising velocity enhances the effectiveness of changes in the money supply on GDP.

6. Capital Inflow
6. 1 Foreign Assistance

The two major sources of foreign capital inflow in Bangladesh are(a) assistance from the development partners of Bangladesh, bilateral and multilateral agencies, and (b) foreign direct investment(FDI). Bangladesh has been experiencing a massive inflow of foreign assistance, both grants and loans, since its independence in 1971. Most of this foreign assistance is negotiated by the Economic Relations Division of the Ministry of Finance. These are regularly published in their annual flagship publication in great detail. Bangladesh has so far received 122472 million US\$ as of June 2023.

Apart from this, there are some other channels through which external assistance is negotiated. These include IMF credits and some special borrowings by the Ministry of Food, Bangladesh Shipping Corporation, Bangladesh Biman, Bangladesh Petroleum Corporation, BPDB, BTCL, BTRC, assistance for Defense, NGOs, and the private sector. Foreign assistance made available through the NGO Affairs Bureau comprises grants and loans. A total of US\$ 14367.81 million has been received on this account from 1989/90 to 2022-2023. Since independence, total commitment and disbursement of Budget support were US\$11081.45 million and US\$ 10282.51 million, respectively. In FY 2022-23, commitments and disbursements of budget support were US\$1875.28 million and US\$1769.32 million, respectively. (ERD, 2023).

Table 1 and Chart 8 present the amounts of assistance negotiated through the ERD during FY2020 to FY2023, their relationship with GDP, and per capita assistance in US\$. At present, foreign assistance accounts for about 2.5% of GDP. During the period shown in the table, per capita assistance has increased from US\$ 15.07 in FY2010 to US\$ 58.11 in FY2023.

Table 1. Foreign Assistance Inflow (Disbursement)

Financial Year	Disbursement US\$ million	Disbursement as % of GDP	Per Capita Inflow
FY2010	2227.8	1.93	15.07
FY2011	1776.7	1.38	11.86
FY2012	2126.5	1.59	14.03
FY2013	2811.0	1.87	18.29
FY2014	3084.4	1.78	19.80
FY2015	3043.1	1.56	19.27
FY2016	3563.9	1.61	22.29
FY2017	3677.2	1.47	22.72
FY2018	6369.4	2.32	38.91
FY2019	6542.6	2.16	39.51
FY2020	7381.7	2.28	44.10
FY2021	7957.6	2.24	47.00
FY2022	10969.3	2.58	64.22
FY2023	10012.9	2.38	58.11

Source & Note: ERD, Bangladesh Bank and Author's Analysis

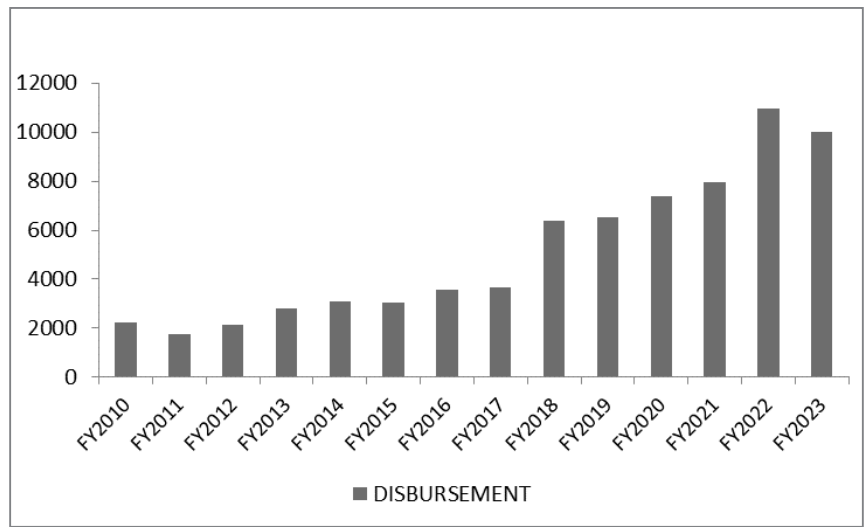


Chart 7. Disbursement of Foreign Assistance. US\$ million
Source & Note: ERD, Bangladesh Bank and Author’s Analysis

6.2 Foreign Direct Investment (FDI)

Compared to foreign assistance, foreign direct investment (FDI) is a relatively recent phenomenon in Bangladesh. Information on FDI is available from FY1997, when it received US\$ 366.85 million in net FDI inflows. However, the extent of FDI continued to rise steadily, reaching US\$ 3,249.68 million in FY2023. Table 2 and Charts 9 & 10 provide detailed information on net FDI inflows from FY2020 to FY2023. The net FDI inflow works through three distinct operational procedures: equity capital, reinvested earnings, and intra-company transfers. The total net FDI inflow was US\$ 911.07 in FY2010, which increased to US 3249.68 in 2023, depicting a CAGR of 10.27%. The share of FDI to GDP was 0.79% in FY2010, which, with slight variation in the mid-way, remained at about the same level in recent years. The per capita FDI inflow, which was US\$ 6.18 in FY2010, reached about US\$ 60 in recent years, about 10 times higher.

Table 2. Net FDI Inflow by Components, FY2010-FY2023

Financial Year	Equity Capital	Reinvested earnings	Intra-company Transfers	Total Net FDI Inflow	Share of Total Net FDI Inflow in DP%	Per capita Net FDI inflow	Gross FDI Inflows	Share of Gross FDI Inflow in GDP %
FY2010	515.14	331.10	66.78	913.02	0.79	6.18		
FY2011	249.95	445.19	83.9	779.04	0.60	5.20		
FY2012	454.1	542.35	198.43	1194.88	0.89	7.88		
FY2013	761.03	645.64	323.96	1730.63	1.15	11.26		
FY2014	233.84	795.78	450.72	1480.34	0.86	9.50		
FY2015	528.03	1141.34	164.5	1833.87	0.94	11.61		
FY2016	595.55	1154.45	343.53	2003.53	0.90	12.53		
FY2017	1006.74	1253.00	195.07	2454.81	0.98	15.17		
FY2018	614.76	1253.44	712.24	2580.44	0.94	15.76		
FY2019	1195.2	1363.46	1330.33	3888.99	1.29	23.48		
FY2020	727.93	1510.09	132.43	2370.45	0.73	14.14	3232.81	1.00
FY2021	816.17	1585.94	105.2	2507.31	0.71	14.80	3386.86	0.95
FY2022	346.94	2044.79	47.9	3439.63	0.80	20.13	4635.67	1.09
FY2023	795.94	2370.54	83.2	3249.68	0.77	18.86	4428.09	1.05

Source & Note: Bangladesh Bank, Author's Analysis. Blank Cell indicates non-availability of data.

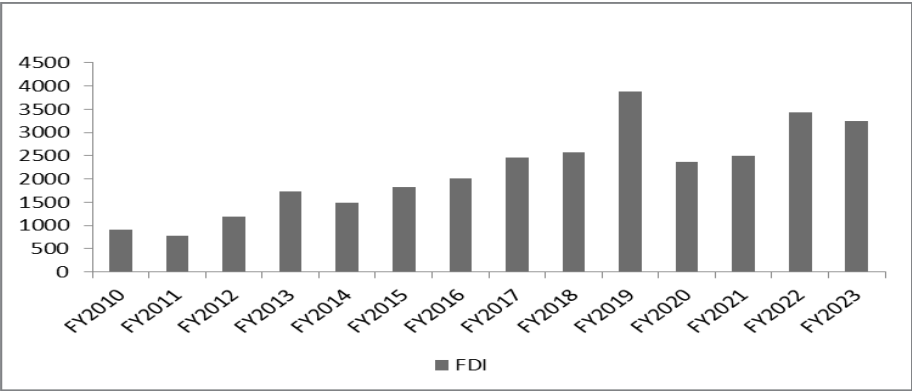


Chart 9: Net FDI Inflow. US\$ million
Source & Note: BB (2024), BB FDI-External Debt (Jan-June 2023) and Author’s Analysis.

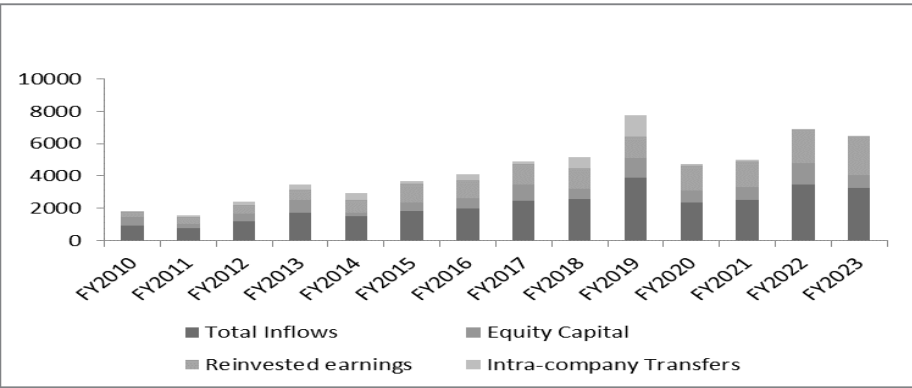


Chart 10: Net FDI Inflow By Types
Source & Note: BB (2023), BB FDI-External Debt (Jan-June 2023) and Author’s Analysis.

6.3 Remittance

International remittances increase the central bank’s Net Foreign Assets (NFA), which, in turn, affects the monetary base, the money supply, and, eventually, inflation. In the Kouri–Porter/Mundell–Fleming framework, remittances are a non-debt-creating foreign exchange inflow. For Bangladesh, they directly affect the balance of payments, influence net foreign assets (NFA) via central bank foreign exchange purchases, trigger sterilization operations that affect NDA, and affect liquidity and the money supply independent of capital market openness. Bangladesh Bank also tends to sterilize the effect of remittances on inflation. Given the growing importance of workers’ remittances as a stable source of foreign exchange in Bangladesh, remittance inflows are incorporated as an additional explanatory variable in both the sterilization and offset equations. Remittances, unlike interest-sensitive capital flows, represent

quasi-exogenous balance-of-payments inflows and therefore directly influence reserve accumulation and the central bank's liquidity management operations.

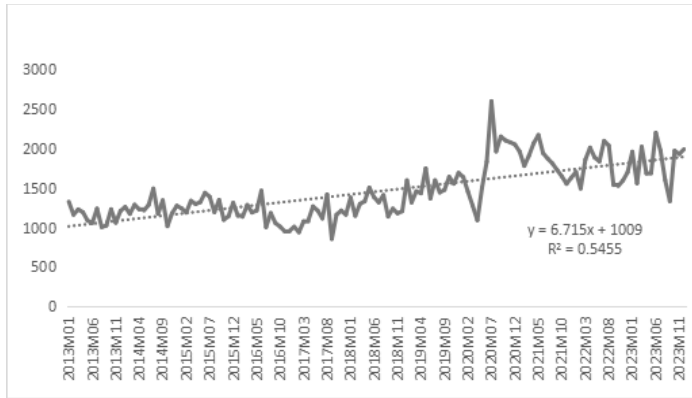


Chart 11. Monthly Remittance. US\$ million
Source & Note. BB. Monthly Economic Trends. Author's analysis

The chart shows monthly remittance inflows (million US\$) over the study period. The fitted trend line ($y = 6.715x + 1009$) indicates steady, positive growth in remittance inflows over time. The positive slope implies that, on average, monthly remittances have been increasing consistently. The ($R^2 = 0.5455$) suggests that about 55% of the variation in remittances is explained by the time trend alone. This indicates a strong underlying trend, but also substantial short-term fluctuations driven by other factors. Remittances fluctuate considerably around the trend, reflecting seasonality, migration cycles, global economic conditions, and exchange-rate incentives. Periods of relative stability are interspersed with sharp spikes and drops. A pronounced surge is visible around 2020–2021, with remittances peaking well above the historical average. The sharp rise during crisis periods (e.g., around 2020) suggests that remittances act as a counter-cyclical buffer, supporting domestic income and consumption when other external flows weaken. This period is followed by higher volatility, but at a new, higher level than in the pre-2020 period. After the peak, remittances decline somewhat but remain structurally higher than in earlier years, suggesting a lasting upward shift rather than a temporary shock. The sustained upward trend implies that remittances have become an increasingly reliable source of foreign exchange, helping to finance imports and support the balance of payments. While beneficial, growing reliance on remittances may increase vulnerability to external shocks in host countries, underscoring the importance of export diversification and domestic job creation. Overall, the chart indicates that remittances have evolved from a stable but modest flow into a key structural pillar of external financing, with important implications for macroeconomic management and long-term development strategy.

7. Capital Outflow

7.1 The net capital Outflow during the last five financial years is shown in Table 3. The net capital outflow was US\$25.97 million in FY2019, reached a high of US\$70.71 million in FY2022, and decreased again to US\$32.22 million in FY2023.

Table 3: Net FDI Outflow by Components. FY 2019-FY 2023

Financial Year	Equity Capital	Reinvested earnings	Intra-company Transfers	Total Net FDI outflows	Share of Total Net FDI outflow in GDP%	Per capita Net FDI outflow	Gross FDI Outflows	Share of Gross FDI Outflow in GDP%
FY2019	1.63	22.26	2.08	25.97	0.007	0.16	37.37	0.011
FY2020	14.94	19.59	-24.00	10.52	0.003	0.06	37.52	0.010
FY2021	4.13	27.79	27.42	59.34	0.014	0.35	65.17	0.016
FY2022	6.89	20.63	43.19	70.71	0.015	0.41	75.92	0.016
FT2023	11.68	41.42	-20.88	32.22	0.007	0.18	67.43	0.015

Source & Note: BB (2023), BB FDI-External Debt (Jan-June 2023), and BB earlier issues.

7.2 Capital Outflow: Capital Flight/Money Laundering

Apart from the ways mentioned above, there are other means, which are known as illicit money transfers, as labeled by Global Financial Integrity. According to a 2021 Global Financial Integrity (GFI) report, \$61.6 billion was smuggled out of Bangladesh from 2005 to 2014. Bangladesh loses \$8.27 billion annually to trade misinvoicing. By 2030, GFI predicts this could exceed \$14 billion annually. The glaring discrepancy between data from the Export Promotion Bureau and Bangladesh Bank is an eye-opener on direct capital flight—a \$12 billion gap between export shipments and actual receipts from abroad, usually attributed to exporters' delays in repatriating export earnings. Last September, customs authorities found 33 ready-made garment factories and buying houses laundered at least BDT 821 crore in the previous six years. The launderers resorted to two tactics – under-invoicing and using incorrect shipping codes. Experts fear this is only the tip of the iceberg of TMBL in Bangladesh. (GFI,2021)

8. Model Specification

There are two empirical approaches to assess the impact of a country's central bank's sterilization policy on the domestic monetary base. The first approach, based on Cumby and Obstfeld (1981), uses only the central bank's monetary policy reaction function to determine the sterilization coefficient.

On the contrary, the second approach, centered on Kouri and Porter (1974), argues that net domestic assets and net foreign assets mutually affect one

another. In other words, both variables are endogenous to the model. Therefore, according to them, the monetary policy reaction function can be converted into a capital flow equation by merely reversing it, as both variables, i.e., net domestic assets and net foreign assets, are endogenous to the model. Thus, sterilization and offset coefficients can be estimated from the same function/ equation by merely inverting one for the other.

Following Kouri and Porter (1974), we also assume net domestic assets (ΔNDA) and net foreign assets (ΔNFA) to be endogenous and estimate sterilization and offset coefficients for Bangladesh from the following empirical models, respectively:

$$\Delta NDA_t = \alpha_0 + \alpha_1 \Delta NFA_t + \alpha_2 \Delta MM_{2t} + \alpha_3 \Delta IIP_t + \alpha_4 \Delta IF_t + \alpha_5 \Delta DS_t + \alpha_6 \Delta NER_t + REM_t + U_t \quad (1)$$

$$\Delta NFA_t = \beta_0 + \beta_1 \Delta NDA_t + \beta_2 \Delta MM_{2t} + \beta_3 \Delta IIP_t + \beta_4 \Delta IF_t + \beta_5 \Delta DS_t + \beta_6 \Delta NER_t + REM_t + V_t \quad (2)$$

The first equation is the famous monetary policy reaction function, used to evaluate the effectiveness of the central bank's sterilization policy in neutralizing the impact of foreign capital inflows on domestic monetary conditions. The sterilization coefficient is estimated from this reaction function. The coefficient of net foreign assets (ΔNFA) in equation (1), i.e., is the sterilization coefficient whose value is expected to be negative and ranges between 0 and -1. First extreme value (i.e., 0) implies no sterilization at all, and the second extreme value (i.e., -1) means full sterilization of the effect of foreign assets on domestic assets (ΔNDA). Any value between these two extremes implies a partial impact of the central bank's sterilization policy on domestic monetary conditions. A higher sterilization coefficient value is consistent with a more effective sterilization policy and vice versa.

Equation (2) is merely a reverse of equation (1) and is termed the capital flow equation (Kouri & Porter, 1974). It measures how foreign capital or net foreign assets respond to changes in domestic monetary conditions. β_1 In equation (2), the offset coefficient estimates how the central bank's efforts to sterilize the impact of foreign exchange reserves on the domestic monetary base are neutralized by fresh capital inflows. Like α_1 the expected value of β_1 is between 0 and -1. Both extreme values represent the absence and the full offsetting effect of net foreign assets on sterilization interventions, respectively. Full offsetting effect i.e. $\beta_1 = -1$ implies that net domestic assets and net foreign assets are perfect substitutes of each other suggesting any change in one is reflected in equal and opposite changes in the other. Conversely $\beta_1 = 0$ suggests imperfect substitutability between net foreign and domestic assets, implying that the former do not respond to any changes in the latter. The

value of the offset coefficient between these two extremes indicates the partial neutralization, or offsetting, effect of the fresh inward capital movements on the sterilization policy.

Other variables used in equations (1) and (2) are quantum index of industrial production (ΔIIP), money multiplier of broad money M2 ($\Delta MM2$), difference of call money rate and US three months commercial paper rate (ΔIF), difference of policy rate and call money rate (ΔDS), and nominal US\$/BDT exchange rate (ΔNER). Used as a proxy of real gross domestic product/income, ΔIIP is expected to have a positive effect on domestic and foreign assets (Ljubaj et al, 2010). Hence, the expected values of α_3 and β_3 are positive. The interest rate differential (ΔIF) is calculated as the difference between the domestic and foreign interest rates. The coefficients of ΔIF , i.e., α_4 and β_4 in equations (1) and (2), respectively, are conditional on the comparative value of the domestic and foreign interest rate.

α_4 in equation (1) will be negative if the domestic rate of interest is higher than the foreign rate of interest because credit (net domestic assets) is inversely related to the interest rate. It will be positive in the opposite case, because a comparatively higher foreign interest rate will cause domestic capital to flow out in search of higher profits abroad. On the contrary, the β_4 in equation (2) will be positive if the domestic rate of interest is greater than its foreign counterpart, as foreign capital inflows are positively associated with the domestic interest rate. The coefficient of the nominal exchange rate, α_6 , in equation (1) is assumed to be positive because central banks raise domestic credit to offset the appreciating effect of foreign inflows on the local currency, aiming to improve the competitiveness of domestic goods in international markets. Conversely, β_6 in equation (2) is expected to have some negative value as foreign inflows are inversely related to the domestic real exchange rate (Cumby & Obstfeld, 1981; Ljubaj et al, 2010; RBI, 2018; Khushik et al, 2021). The following paragraph is a quote from the RBI analysis on the Indian economy.

‘Sterilization operations, if undertaken through the sale of domestic securities, can put upward pressure on Domestic interest rates, which, in turn, can widen interest rate differentials. In such a scenario, sterilization Operations can trigger higher capital inflows. Thus, the change in net domestic assets (NDA) can be offset by a change in net foreign assets (NFA). Empirically, the extent and effectiveness of a central bank’s sterilization operations can be measured by computing the sterilization and offset coefficients, which range from 0 to -1. The sterilization coefficient measures the extent to which the NDA of a central bank changes in response to a change in NFA, while the offset coefficient measures the extent to which a decrease/increase in NDA causes an increase/decrease in NFA. A value of -1 for the sterilization coefficient

suggests complete sterilization, i.e., no impact of capital flows on the reserve money; a value of 0 would imply that the central bank's forex intervention is fully sterilized. A value of -1 for the offset coefficient suggests the complete ineffectiveness of the central bank in sterilizing capital flows, i.e., complete attenuation of monetary control. An offset coefficient of -1 can also indicate perfect capital mobility, while a value of 0 implies no capital mobility (RBI, 2018).

8.1 Data and Variables used in Regression Analysis

To examine the relationship between the dependent variable and the explanatory variables, the standard regression model is used, and it could be defined as follows for observation month t

$$\text{where } \Delta Y_t = \alpha_0 + \beta X_{it} + \varepsilon_{it} \quad i = 1, \dots, N \quad (1)$$

ΔY_t is the change in the dependent variable (ΔNDA_t or ΔNFA_t) of the Central Bank in the month t

(α_0, β) is a vector of parameters

X_{it} is a vector of explanatory variables, ε_{it} is a stochastic error term

The description of variables and their measurements is given in Table 4.

Table 4: Description of the variables used in the regression models

Variable	Description
NDA _t	Net domestic assets of the Central Bank in month t . Crore BDT
NFA _t	Net foreign assets of the Central Bank in month t . Crore BDT
MM2 _t	Money Multiplier of broad money M2 obtained as M2/RM in month t
MM3 _t	Money Multiplier of broader money M3 obtained as M3/RM in month t
IIP _t	Index of Industrial Production used as a proxy for economic growth/GDP in month t
IF _t	Spread between the central bank's call money rate and the effective federal exchange rate (US three-month commercial paper rate) in month t
DS _t	Spread between the policy rate and the weighted average call rate of the Central Bank in month t .
NER _t	Nominal exchange rate USD/BDT in month t
REM _t	Remittance million US\$ in month t million US\$

Source & Note: In the regression analysis, all variables were used in first differences. Descriptive Statistics of the study variables used in the regression analysis are shown in Table 5

Table 5. Descriptive Statistics

Variable	Observation	Mean	Std dev	Minimum	Maximum
NDA _t	120	-20058.4	275796	462342.8	1442188
NFA _t	120	238319.9	78085.5	100134	387438.6
RM _t	120	218261.4	75019.37	106243.7	380011.7
M2 _t	120	1093243	349212.6	562476.8	1754176
M3 _t	120	1327767	457830.7	637746.2	2144175
MM2 _t	120	5.06	0.22	4.48	5.51
MM3	120	6.08	0.21	5.44	6.55
IIP _t	120	345.6	105.2	185.7	570.60
IF _t	120	3.97	2.19	0.26	10.14
DSt	120	1.50	1.52	-3.04	4.58
NER _t	120	82.21	4.63	77.40	8.86
REM _t	120	1418.45	334.93	56.87	2598.21

Source & Note: Author’s analysis.

The correlation matrix of the study variables used in the regression analysis is shown in Table 6.

Table 6: Correlation Matrix Of The Study Variables

	NDA _t	NFA _t	MM2 _t	IIP _t	IF _t	DSt	NER _t	REM _t
NDA _t	1							
NFA _t	-.2107	1						
MM2 _t	0.1481	-.7195	1					
IIP _t	-.0041	0.9311	-0.5883	1				
IF _t	0.3803	-.7936	0.6859	0.7179	1			
DSt	-.7838	0.4137	-0.4770	0.2320	-.7554	1		
NER _t	0.4033	0.7485	-0.4645	0.8389	-.5453	-0.0948	1	
REM _t	0.1365	0.6916	-0.4154	0.7149	-0.3605	-0.0156	0.6257	1

Source & Note: Author’s analysis. Any correlation coefficient higher than 0.2107 is statistically significant at the 5 percent level.

Regression Results.Table 7a. Regression Results of Sterilization (Δ NDA). Equation (1)

Independent Expected variables sign	Regression coefficient (standard error)		
	Pooled OLS	GLS Random Effects. Group variable (Months)	GLS Fixed effect. Group variable (Months)
Model	(1a)	(1b)	(1c)
Δ NFA -	-0.87*** (.06)	-0.91*** (.06)	-0.93*** (.07)
Δ MM2 -	-2602.04*** (2016.04)	-51074.76*** (1974.65)	-50103.02*** (2059.44)
Δ IIP +	2.44 (7.26)	-.73 (7.23)	-2.72 (7.57)
Δ IF -	-1121.69 (1609.75)	-724.93 (1546.75)	-531.61 (1589.52)
Δ DS -	-872.85 (1585.92)	-613.09 (1543.47)	-527.25 (1597.18)
Δ NER +	1456.76** (561.77)	1170.54** (537.17)	988.73* (552.20)
Δ REM -	.615 (1.51)	1.31 (1.48)	1.70 (1.54)
CONSTANT	1465.72*** (315.06)	1604.60*** (491.82)	1714.20*** (306.51)
R squared (Overall)	.9024	0.9009	.8984
Sigma_u		1364.75	1524.39
Sigma_e	.	2738.46	2738.46
rho		.1989	.23657
Wald Chi2		1122.45	
F	146.55		153.36
P value	.0000	.0000	.0000
Durbin's Chi2	2.20		
N	120	120	120

Source & Note: Author's analysis.

* statistically significant at the 10 percent level, ** statistically significant at 5 percent level, *** statistically significant at 1 percent level. The models were estimated using STATA 14. In the regression analysis, all variables were first-differenced.

Interpretation of Sterilization Regression Results

The coefficient of ΔNFA is negative and highly significant across all three models. This confirms partial sterilization, indicating that increases in net foreign assets are systematically offset by reductions in net domestic assets. $\Delta MM2$ exhibits a large and statistically significant negative coefficient, implying that monetary expansion is strongly countered through sterilization operations. The coefficient for ΔNER is positive and statistically significant, suggesting that exchange rate depreciation is associated with an expansion of NDA, reflecting central bank intervention. The quantum index of industrial production used as a proxy for GDP growth (IIP), Spread between the central bank's call money rate and the effective federal exchange rate-US three-month commercial paper rate (IF). Spread between the policy rate and the weighted average call rate of the Central Bank (DS). had no significant effect on ΔNDA . The effect of remittances (ΔREM) is positive, but the coefficient remains statistically insignificant across all models, implying a limited direct impact on NDA adjustments.

Model Performance

All models demonstrate excellent explanatory power with R^2 close to 0.90. The significant Wald χ^2 and F statistics confirm the overall model's validity.

The results indicate that the monetary authority actively sterilizes foreign exchange inflows, as evidenced by the negative and highly significant coefficient on changes in net foreign assets (ΔNFA) across all specifications. However, the coefficient remains below unity, implying partial sterilization and suggesting that external inflows continue to exert some expansionary pressure on domestic liquidity.

The strong negative effect of broad money growth ($\Delta MM2$) underscores the central bank's reliance on domestic monetary instruments to absorb excess liquidity. While effective in the short run, the magnitude of this response raises concerns regarding the fiscal and quasi-fiscal costs of sustained sterilization. The positive and significant association between changes in the nominal exchange rate (ΔNER) and net domestic assets indicates that exchange rate considerations influence liquidity management, highlighting a trade-off between exchange rate stabilization and monetary independence.

Other variables, including fiscal-related and remittance flows, are insignificant, suggesting that sterilization policy is primarily driven by external sector dynamics. Overall, the findings support the need for complementary policies, including greater exchange rate flexibility and deeper financial markets, to enhance the sustainability of monetary control.

Table 7b . Regression Results of Offset (Δ NFA) . Equation (2)

Independent Expected variables sign		Regression coefficient (standard error)		
		Pooled OLS	GLS Random Effects. Group variable(Months)	GLS Fixed effect. Group variable(Months)
Model		(2a)	(2b)	(2c)
Δ NDA	-	-0.71*** (.05)	-0.70*** (.06)	-0.70*** (.05)
Δ MM2	-	-39792.4*** (3064.63)	-39523.52*** (2875.25)	-36040.02 *** (3018.75)
Δ IIP	-	6.43 (6.64)	4.67 (6.48)	2.57 (6.57)
Δ IF	+	-42.73 (1457.29)	49.65 (1375.25)	733.76 (1378.31)
Δ DS	+	674.97 (1433.11)	815.28 (1325.78)	1097.015 (1382.54)
Δ NER	-	379.43 (521.37)	336..38 (420.75)	-24.00 (486.84)
Δ REM	+	0.1354 (1.36)	0.1267 (1.36)	1.324 (1.34)
CONSTANT		1819.81*** (258.76)	1843.61*** (285.75)	1954.41*** (233.86)
R squared		.6619	.6618	.6643
Sigma_u			335.54	1543.20
Sigma_e			2377.83	2376.60
rho			.0195	.2872
Wald Chi2			225.65	
F		31.05		34.68
P value		.0000	.0000	.0000
Durbin's Chi2		1.956		
N		120	120	120

Source & Note: Author's analysis.

* statistically significant at 10 percent level, ** statistically significant at 5 percent level, *** statistically significant at 1 percent level. The models were estimated using STATA 14. In the regression analysis, all variables were first-differenced.

Interpretation of Offset Regression Results (ΔNFA)

Table 7b reports the estimation results for the offset equation, in which changes in net foreign assets (ΔNFA) are regressed on changes in net domestic assets (ΔNDA) and other control variables. Across pooled OLS, GLS random effects, and GLS fixed effects models, the coefficient on ΔNDA is negative and highly statistically significant. This provides strong evidence of an offset effect, indicating that expansionary domestic monetary policy is associated with a reduction in foreign reserves. The magnitude of the coefficient (around -0.70) suggests a strong but incomplete offset, implying that roughly 70 percent of changes in domestic assets are offset by capital flows.

The coefficient on the broad money multiplier ($\Delta MM2$) is also large, negative, and highly significant across all models. This indicates that increases in domestic liquidity lead to substantial reserve outflows, further reinforcing the existence of strong external adjustment mechanisms that constrain monetary policy effectiveness.

Other explanatory variables—including the quantum index of industrial production used as a proxy for GDP growth (IIP), the Spread between the central bank's call money rate and the effective federal exchange rate-US three-month commercial paper rate (IF). Spread between the policy rate and the weighted average call rate of the Central Bank (DS). Remittance (REMIT) had no significant effect on ΔNFA . Overall, the models explain about two-thirds of the variation in ΔNFA , and the diagnostic statistics confirm a good overall fit. The results imply limited monetary policy autonomy, as domestic policy actions are largely offset by external sector responses.

This study evaluates the effectiveness of monetary policy in an open economy by jointly examining sterilization and offset mechanisms. The results from Tables 7a and 7b provide consistent evidence that the monetary authority faces significant constraints in managing domestic liquidity amid external and internal shocks. The sterilization estimates show that the central bank actively adjusts net domestic assets in response to changes in net foreign assets, confirming the presence of a sterilization policy. However, the magnitude of the coefficients indicates that sterilization is only partial, allowing foreign reserve movements to continue affecting domestic liquidity. Exchange rate movements also play a significant role, highlighting the close interaction between monetary policy operations and exchange rate management.

The offset results reveal a strong counteracting response from the external sector, with expansionary domestic monetary actions triggering capital outflows and reserve losses. This high degree of offset substantially weakens the effectiveness of discretionary monetary policy and limits monetary autonomy. Overall, the coexistence of partial sterilization and strong offset

effects suggests structural limits to monetary policy effectiveness, underscoring the need for complementary policies such as greater exchange rate flexibility, improved policy coordination, and deeper financial markets.

9. Cross Country Comparison

Tables 8 and 9 provide information on sterilization and offset coefficients obtained from research conducted in peer countries.

Table 8. Cross-country comparison of sterilization coefficient

Countries	Sterilization Coefficient	Sample Period	Frequency
Bangladesh/a	-0.87 to-0.93	2013M01-2022M12	Monthly
India/b	-0.83	1994-03	Monthly
Pakistan/b	-0.87	Jul 00-Dec 03	Monthly
Korea/b	-0.90	1980-89	Monthly
Brazil/b	-1.76	1955-71	Yearly
Chile/b	-1.22	1955-71	Yearly
Hungary/b	-1.00	1992-97	Monthly

Source & Note. a/ equation (1) and table 7 (a) of author's analysis.
b/Jan, Elahi and Zaid (2005)

Table 8 presents a cross-country comparison of sterilization coefficients, showing how actively different central banks offset changes in foreign assets through domestic monetary operations in some emerging developing economies. The table shows that many emerging economies practice strong sterilization policies, often close to or exceeding full offset. This reflects efforts to maintain monetary control and price stability amid volatile capital flows and external shocks. Brazil, with a sterilization coefficient of -1.76, and Chile, with a sterilization coefficient of 1.22, suggested more than full sterilization, possibly due to aggressive domestic tightening during 1955-71. Our estimates compare well with findings from other countries.

Table 9. Estimates of Sterilization and Offset Coefficients

Author	Time period	Method	Sterilization Coefficient	Offset coefficients
Matin (2024)/a	2013M01-2022M12	OLS, GLS	-0.87 to -0.93	-0.70 to -0.71
Pattanaik (1997)/b	1993M04-1997M03	OLS	-	-.30
Pattanaik (2004)/b	1993M04-2003M12	ECM	-0.82	-
RBI (2004)/b	1994M04-2003M09 & 1995M10-2003M09	OLS	-0.92 & -0.65	-
RBI (2005)/b	1995M10-2004M03	OLS	-0.63	-
Ouyang & Rajan (2008)/b	1990Q01-2004Q04	2SLS	-1.10	-0.79 to -0.84
Sen Gupta & Sengupta (2013)/b	1990M01-2010M08	OLS	-0.21 to -0.61	-
RBI (2018)/b	1997M07-2017M10	2SLS	-1.03	-0.83
RBI (2021)/b	2006M01-2016M06 & 2016M07-2019M12	OLS	-0.04 & -0.42	-0.21 & -0.31

Source & Note: A. Author’s analysis equation (1) and (2); B. Grewal & Trivedi (2022).

Table 9 presents the findings on sterilization and offset coefficients as obtained in various analysis. Most of the findings are based on data on Indian economy. The estimated sterilization coefficients in Bangladesh are negative and close to unity (−0.87 to −0.93), indicating near-complete offsetting of foreign reserve flows through domestic operations during 2013–2022. This suggests that foreign exchange interventions were systematically sterilized, limiting the impact of reserve accumulation on domestic liquidity and placing the recent period at the upper end of estimates reported in the literature. The offset coefficients are also negative and sizeable (−0.70 to −0.71), implying substantial but incomplete capital-flow responses to domestic monetary actions. While increased capital mobility has strengthened offset effects, they remain well below unity, allowing the monetary authority to retain some degree of policy autonomy. Taken together, the results describe a regime of active foreign exchange intervention supported by sustained sterilization under conditions of partial capital mobility, consistent with a managed exchange rate framework.

10. Conclusion

This study jointly examines the sterilization and offset mechanisms to assess the effectiveness of monetary policy in an open economy. We explored the extent to which the Central Bank of Bangladesh, Bangladesh Bank, sterilized capital inflows by estimating a sterilization coefficient, and the extent to which the central bank's domestic-market activities spurred additional capital inflows by estimating an offset coefficient. Monthly data from 2013M01 to 2023M12, available in various government publications, have been used in the analysis. The sterilization coefficient was estimated from the monetary policy reaction function, while the capital-flow equation was used to estimate the offset coefficient. The multiple regression technique has been applied to estimate the effects of the explanatory variables. The control variables included are the quantum index of industrial production(IIP), money multiplier of broad money M2(MM2), spread between central bank policy rate and effective federal exchange rate(IF), spread between policy rate and call money rate (DS), and the nominal BDT/US\$ exchange rate (NER). The results from the two equations across all specifications show that sterilization coefficients are higher than offset coefficients, suggesting that the Bangladesh central bank could mitigate the impact of foreign capital inflows on the domestic money base. Taken together, the coexistence of partial sterilization and a strong offset effect suggests that monetary policy faces structural constraints under conditions of capital mobility and exchange rate considerations. These findings underscore the need for complementary policy measures, including greater exchange rate flexibility, improved policy coordination, and deeper financial markets, to enhance the sustainability and effectiveness of monetary control.

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