The Key Drivers of Inflation in Bangladesh: A VECM Approach

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Abstract

Inflation is one of the main challenges for the contemporary Bangladesh economy. According to the Bangladesh Bureau of Statistics (BBS), consumer price index (CPI) based inflation was recorded at above 9 percent throughout the second half of FY24. Addressing persistent inflation requires the necessity for conducting an analysis to identify the key drivers of inflation in Bangladesh. This paper aims to explore the key drivers of inflation in the economy of Bangladesh from FY 2014 to FY 2024. The data has been collected from the Statistics and Research Department of Bangladesh Bank. It employs a vector error correction model (VECM) to assess the short-run dynamics and long-run equilibrium relationship among the variables. Findings from the VECM approach demonstrated that the variables are co-integrated in the long run. Moreover, broad money supply, energy prices, and exchange rates had a significant impact on inflation in Bangladesh over the short and long run. Precisely, a 1% rise in the broad money supply, energy prices, and exchange rate (i.e., depreciation) will drive inflation in Bangladesh by 40%, 22%, and 18%, respectively, in the long run. Finally, the policy implications of the study propose that accommodative monetary policy in coordination with fiscal policy and initiatives against some non-economic factors like syndicates, hoarding, etc. is required to curb inflation in Bangladesh.

Keywords: inflation, money supply, energy prices, exchange rate.
JEL classification: E31, E51, E39, F31.

Introduction

Price level stability is a pivotal challenge for Bangladesh at present. The general level of prices for goods and services increasing over time is called inflation. It can affect individuals, businesses, and even the overall economy. As inflation rises, real wages reduce, the purchasing power of money falls, and ultimately downgrades the living standard of people. It negatively affects savings, investment, and ultimately economic growth if it's higher than the interest rates. Persistently high inflation destroys purchasing power and real incomes, intensifying income inequalities (Monetary Policy Statements (MPS) of BB, July-December 2024). If the demand for goods and services in an economy

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exceeds its production capacity, it can lead to demand-pull inflation. On the other hand, when the cost of production increases due to several factors like supply chain disruption, higher cost of raw materials, increased import prices, etc., it drives towards cost-push inflation. The classical theory suggests that inflation is primarily a monetary phenomenon. If the central bank prints more money than real GDP growth, this excess money drives inflation. According to Milton Friedman, 'inflation is always and everywhere a monetary phenomenon'. The main concern of the Keynesian theory was how aggregate supply and demand affect inflation in the economy.

After its independence in 1971, Bangladesh faced inflationary pressure due to the destruction of infrastructure, supply chain disruptions, and shortages of essential goods. During the 1980s, inflation stabilized due to the market-oriented reforms. However, inflation further fluctuated in the 1990s caused by agricultural dependency and natural disasters like floods and cyclones, which hampered the food supply chain. In the 2000s, Bangladesh experienced moderate inflation rates, averaging around 6–8%. The 2007–08 global food crisis severely impacted Bangladesh, owing to its dependency on imports of essential food items like rice and wheat. The country experienced the highest inflation rate at 12.67% in September 2011. After 2011, the inflation rate decreased and became moderately stable in mid-2022. During mid-2022, geopolitical tensions, such as the Russia-Ukraine confrontation and turmoil in the Middle East, hamper supply chain disruption in the global market for essential commodities like food grains, energy, etc., which drives up food and energy prices, increases the import cost for most of the import-dependent countries like Bangladesh and ultimately leads to the cost-push inflation (MPS, July-December 2024).

The inflation in Bangladesh over the last decade fuelled by several factors like excess supply of money, government borrowing, exchange rate fluctuations (i.e., depreciation), driving prices for necessary products like food and energy in the local market, as well as some non-economic factors like syndicate, hoarding, etc. The factors that are the main drivers of inflation in Bangladesh include increases in M2, credit to the private sector, market capitalization, government borrowing, remittances, exchange rate fluctuations, and market syndicates (Bangladesh Bank, IMF, and CPD, 2007). The government had taken excess liquidity from the Bangladesh Bank as a part of an expansionary fiscal policy, which increased money supply, raised aggregate demand, and led to demand-pull inflation. Hossain and Islam (2013) found that the money supply affects inflation in Bangladesh. Bangladesh imported food grains like wheat, edible oil, and energy products like imported oil, LNG gas, etc. from Russia and Ukraine; the supply chain has been hampered excessively due to

the war, which pushed up the import cost for food and energy prices and further drove inflation in the domestic market. Ahmed and Das (2007) explored that Bangladesh experienced inflationary pressure due to global food and energy prices. Inflation is further fuelled by the depreciation of BDT[2] against the US dollar, which raised import costs and continued to increase inflationary pressures. The main factors that drive global inflation in the long term include supply constraints and the depreciation of the domestic currency (Khathlan, 2011). Due to the formation of syndicates by some unethical businessmen, hoarding of agricultural products, regional price differences, and higher input costs drive higher food prices in the domestic market, which ultimately elevates the price level. According to the Bangladesh Bureau of Statistics (BBS), point-to-point inflation was recorded at 9.41 percent in December 2023, which raised to 9.72 percent in June 2024. Food inflation jumped to 10.42 percent in June 2024 from 9.73 percent in June 2023. Apart from these, there are some non-food factors, especially the increase in transportation costs due to the rise of energy prices, which hiked the inflation rate. Non-food inflation was recorded at 9.15 percent in June 2024 from 8.52 percent in December 2023 (BBS). As per the latest data from BBS in November 2024, headline inflation stood at 11.38 percent, whereas food inflation was recorded at 13.80 percent.

Against this backdrop, it is necessary to conduct a study to explore the key drivers of inflation in Bangladesh. Throughout the identification of the true determinants behind this elevated price level, it would be really helpful for the concerned authorities to take proper initiatives to curb inflation in Bangladesh. The chart below displays the trends of the inflation rate in Bangladesh from FY2014 to FY2024.

[2] BDT states Bangladeshi currency (Taka).

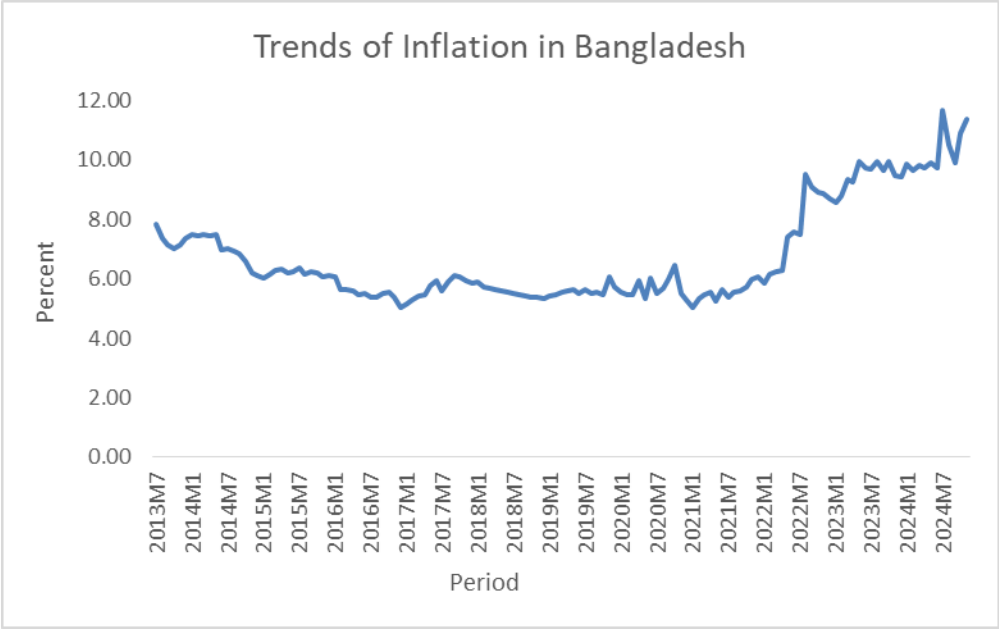

Figure-1: trends of inflation rate in Bangladesh from FY2014 to FY2024
Data source: Bangladesh Bureau of Statistics; Base: 2020-21.

Objectives of the Study

The general objective of this paper is to assess the key drivers of inflation in Bangladesh from FY2014 to FY2024. The specific objectives are:

i. To investigate the key drivers of inflation in Bangladesh.
ii. To assess whether these factors truly affect the inflation in Bangladesh or not.
iii. To recommend some policy measures to curb inflation in Bangladesh.

Contribution to the Field of Knowledge

The paper explores the key drivers of inflation in Bangladesh from FY2014 to FY2024. It identifies broad money supply (M2), energy prices, and exchange rates as the primary determinants, with long-run impacts of 40%, 22%, and 18% on inflation, respectively. It contributes to the field by offering a context-specific, data-driven analysis of inflation in a developing economy and bridging gaps in the literature on Bangladesh's inflation dynamics. It provides actionable insights for policymakers, emphasizing the need for coordinated monetary and fiscal policies, addressing non-economic factors, and stabilizing

exchange rates. So, the paper makes a valuable contribution by identifying specific macroeconomic drivers of inflation, employing a robust econometric framework, and providing insights to guide targeted policy interventions in Bangladesh.

Literature Review

The reviewed studies highlight the key drivers of inflation, including broad money supply, energy prices, exchange rates, and external shocks such as import prices and geopolitical events. Various econometric methods, such as VECM, ARDL, and SVAR, are used to analyse inflation dynamics. In Bangladesh, inflation is also influenced by structural issues, such as syndicates and supply-side inefficiencies. The studies emphasize policy measures like controlling the money supply, addressing non-economic factors, and promoting technological advancements. However, gaps remain, as factors like wage dynamics, political stability, and recent global trends are underexplored. Overall, these studies contribute to understanding inflation dynamics in developing economies like Bangladesh by identifying key drivers, employing robust methodologies, and providing actionable policy insights while highlighting critical areas for further research.

Some local and international studies have been reviewed to identify the drivers that significantly influence the inflation scenario in Bangladesh, which are as follows:

Habanabakize and Dickason-Koekemoer (2024) analysed a comparative analysis between intrinsic and extrinsic drivers of inflation as well as investigated both internal and external drivers of inflation in South Africa. They adopted the Johansen cointegration test, vector error correction approach, impulse response function, and variance decomposition, covering the quarterly data from 1994 to 2022. They found that external factors mainly drive inflation in South Africa, as compared to internal factors. Moreover, trade openness, exchange rates, and imported prices elevated inflation as external factors, while sustainable government expenditure, interest rates, and net export prices were internal factors that also drove inflation in South Africa. The study underexplored key external factors, like geopolitical events, and internal factors, such as GDP, lending rate, broad money supply, and labour dynamics. Methodological reliance on linear models may miss complexities, while the time frame and data frequency might fail to capture transformative events or trends.

Ahmad et al. (2024) assessed the impacts of oil prices, technological advances, and labour market dynamics on inflation in South Asian countries from 1995 to 2022 employing the Panel ARDL model under the title ‘Effect of the

Supply-Side Factors on Inflation in South Asia: An Analysis of Oil Price, Technology, and Labor Market Dynamics'. The findings showed that oil prices elevated price levels in South Asian economies. Technological advancement could reduce inflationary pressures, and short-term demand-pull inflation results due to labour tightening. Moreover, cost-push inflation might take place if wages increase gradually over time. The study focused on supply-side factors and oil prices while demand-side variables, fiscal and monetary policies, and other global factors that influence inflation were ignored. Challenges in measuring technology and informal labour, along with potential endogeneity issues and data reliability concerns, further weaken the study's robustness and applicability.

Biswas (2023) looked at the consequences of factors like GDP, broad money supply, and exchange rate on inflation in Bangladesh under the title 'Inflation Dynamics of Bangladesh: An Empirical Analysis' covering the sample period from 1986 to 2021. The Johansen co-integration test is adopted to confirm the presence of a long-run relationship among the selected variables, and the Vector Auto Regression (VAR) method is adopted to assess the causal relationship among them. According to the results, one period lagged inflation and money supply had a considerable positive impact on inflation. However, the lagged GDP and exchange rate have a negative impact on the inflation of the current period, which is not statistically significant. The study neglected key factors like fiscal policy and global risks and oversimplified causal methods. The 1986–2021-time frame may not capture recent global influences. Additionally, the emphasis on lagged variables overlooks contemporaneous effects and forward-looking expectations.

Dey and Salma (2023) investigated whether money supply determines inflation in Bangladesh in the long run and short term, entitled 'Does Money Supply Matter for Inflation in Bangladesh? An ARDL Investigation' covering from 1986 to 2021. The auto-regressive distributed lag (ARDL) model is adopted to assess the long-run and short-run consequences of money supply on inflation in Bangladesh. The findings showed that broad and narrow money supplies have an optimistic and considerable influence on inflation in the long run. The study concludes that the money supply drives increasing inflation in Bangladesh. The study ignored other inflation drivers like fiscal policies and global factors and failed to capture recent trends or global influences. It overemphasized money supply while neglecting factors like wage pressures and political instability.

Islam et al. (2022) investigated major macroeconomic determinants of inflation in Bangladesh using the sample from 1981 to 2020 employing an ARDL Bound Test Approach. They showed that gross domestic product, broad money supply, export growth, import growth, and growth of population had statistically

different but significant impacts on inflation, and all these regressors are the key determinants of inflation in Bangladesh. Moreover, it is notable that broad money supply and import growth had a positive impact on inflation over the long and short run during the sample period. The study overlooked factors like wage dynamics, labour conditions, political instability, fiscal policy and exchange rates. The 1981–2020 period may not capture recent economic shifts or global events.

Hossain and Raghavan (2019) examined drivers of inflation and inflation volatility and their effects on macroeconomic fluctuations in Indonesia and Thailand. They adopted the SVAR approach, covering the monthly data from 2000 to 2015. The empirical findings display that inflation is more responsive to external shocks than domestic ones in both Indonesia and Thailand, but inflation volatility is similarly vulnerable to both. A positive inflation shock has negative impacts on domestic output for emerging countries. Positive output shocks decrease inflation, in line with the monetary interpretation of inflation. The study neglected important domestic factors like wage dynamics and political instability, and potential endogeneity issues that could affect the validity of the results. It simplifies inflation volatility dynamics without exploring underlying causes.

Ellahi (2017) inspected the determinants of inflation in Pakistan and did an econometric analysis covering the period from 1975 to 2015, employing the ARDL model to examine the effects of each regressor on inflation. They found that money supply and national expenditure had a considerable impact on inflation in the long run. Apart from these, imports of goods and services have positive effects on inflation. None of the variables didn't determine inflation in the short run. The study recommended some policies to keep inflation at the required level. The study simplified short-run dynamics without exploring potential causes for the lack of impact and excluded key factors like wage dynamics and political instability. The ARDL model may miss short-term fluctuations or structural changes, and the 1975-2015 period may not account for recent economic shifts.

Rahman (2015) inquired the core elements from the supply side of the commodity market that were the driving causes of food inflation in Bangladesh over the years. The empirical findings suggested that both demand-side and supply-side factors drive inflation in Bangladesh. Apart from these, non-economic factors, along with economic factors, are also responsible for the recent price hike in Bangladesh. The study neglected demand-side influences, fiscal policies, and monetary interventions and overlooked global economic factors like international commodity prices, trade policies, and geopolitical risks.

Additionally, structural issues in Bangladesh's agricultural sector may be overlooked.

Emran and Islam (2013) conducted a study entitled ‘Assessing the Relationship between Inflation and Some Other Macroeconomic Variables in Bangladesh: An Econometric Analysis’ using the data from 1987 to 2011. The findings indicate that a long-run relationship between inflation-money supply and inflation-remittance exists over the sample period. An increase in the money supply and the inflow of remittances by 1 billion taka will lead to a rise in inflation of 0.00347 and 0.289 percentage points, respectively. They didn’t find any long-term relationship between exports and GDP growth on the CPI. The study did not account for external shocks, such as global price fluctuations or financial crises. The relationships explored may be oversimplified, not addressing complexities like non-linear dynamics or time lags.

Arif and Murtoza (2012) investigated ‘Determinants of Inflation in Bangladesh: An Empirical Investigation’, covering the period from 1978 to 2010. The Johansen-Juselius cointegration test has been adopted to find out a long-term relationship between these variables. They found that regressors like GDP, broad money, government expenditure, and imports have a positive impact on inflation in the long run, except for government revenue and exports. A 1% increase in the broad money supply and government expenditure will lead to a rise in inflation of 47% and 34%, respectively. In the short run, the money supply is the main determinant of inflation in Bangladesh. The study overlooked the impact of external shocks, such as global crises or trade policies. The treatment of short-run dynamics is simplistic, and the reliance on cointegration analysis may not capture short-term fluctuations or structural changes.

The outcomes of the reviewed literature suggest that several factors, including the broad money supply, remittances, sustainable government spending, interest rates, lending rates, exchange rates, exports and imports of goods and services, energy prices, and more, have a significant impact on inflation in Bangladesh and other nations. However, the existing studies had some limitations like the absence of enough quantitative analysis of variables of interest, proper explanation of the methodological approach, limitation of variables, exploring the research gap, future analysis to enhance the study, etc. Apart from the limitations, the empirical studies allow us to take a broader analysis considering the new factors, approaches, etc. So, from the analysis of local and international studies, we may conclude that broad money supply, energy prices, and exchange rates are the key drivers of inflation.

Methods and Data

A sample of monthly data from FY14 to FY24 was examined to assess the long-term co-integration of the model's variable of interest and regressors, as well as to capture the influence of those determinants on Bangladesh's inflation rate. The data came from the Bangladesh Bank's Statistics Department's Monthly Economic Trends report. The Research Department under Bangladesh Bank (BB) generated the energy index (CPI_ENY). The monthly CPI index has been used to represent the inflation rate in the Bangladesh economy, which is the variable of interest. The explanatory variables are broad money supply, energy index, and exchange rate. The natural logarithm was adopted for all variables in the model.

Model Specification

The econometric model is specified to assess whether these explanatory variables affect the inflation rate in Bangladesh as follows:

$$(\ln CPI)_t = \alpha_0 + \beta_1(\ln M_2)_t + \beta_2(\ln CPI\_ENY)_t + \beta_3(\ln ER)_t + \mu_t \ldots\ldots \text{(i)}$$

Dependent Variable

$(\ln CPI)_t$: inflation rate

The natural logarithm of the Consumer Price Index (CPI) represents the inflation rate in Bangladesh. It measures the overall price level of goods and services in the economy at time t.

Explanatory Variables

$(\ln M_2)_t$: Broad Money Supply

The natural logarithm of broad money supply (M2) at time t, includes cash, demand deposits, and near money. It represents the total amount of liquid assets available in the economy and is a key determinant of inflation according to monetary theory.

$(\ln CPI\_ENY)_t$: Energy Price Index

The natural logarithm of the energy price index at time t. This index, calculated by the Research Department of Bangladesh Bank, captures fluctuations in energy prices, such as fuel and electricity, which significantly affect inflation by increasing production and transportation costs.

$(lnER)_t$: Exchange Rate

The natural logarithm of the exchange rate (Taka per US Dollar) at time t. Exchange rate fluctuations, especially depreciation, influence inflation by increasing the cost of imported goods and services, leading to imported inflation. α_0 and μ_t represent the intercept and white noise error terms, respectively.

This model captures how changes in money supply, energy prices, and exchange rates affect inflation in Bangladesh, with the coefficients (β_1, β_2 and β_3) representing the elasticity of inflation with respect to each variable.

It is worth mentioning that lending rates and GDP growth are important factors influencing the inflation rate in Bangladesh. Although I included both variables in my model, they were not statistically significant during the estimation process for the specified period. Therefore, I omitted these two variables from the final model.

Estimation Technique:

Testing Stationary

The unit root test is just an alternative to the correlogram for assessing stationary. Stationary tests incorporate mainly the Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests.

a) Augmented Dickey-Fuller (ADF) test

The most widely used experiment for confirming stationary for a time series is the ADF test, which is an extension of the Dickey-Fuller test with upper-order lags to detect the higher-order autocorrelation with a loss of degree of freedom and structural change. According to Dickey and Fuller (1981), ΔCPI_{t-i} can be added as the lagged difference form for embracing serial autocorrelation. The equations of the ADF test including both trend and intercept for our model are as follows:

$$\Delta CPI_t = \propto_0 + \propto_1 CPI_{t-1} + \propto_2 t + \sum_{i=i}^{n} \beta_i \Delta CPI_{t-i} + \epsilon_t \ldots \text{(ii)}$$

$$\Delta M2_t = \propto_0 + \propto_1 M2_{t-1} + \propto_2 t + \sum_{i=i}^{n} \beta_i \Delta M2_{t-i} + \epsilon_t \ldots \text{(iii)}$$

$$\Delta CPI\_ENY_t = \propto_0 + \propto_1 CPI\_ENY_{t-1} + \propto_2 t + \sum_{i=i}^{n} \beta_i \Delta CPI\_ENY_{t-i} + \epsilon_t \ldots \ldots \text{(iv)}$$

$$\Delta ER_t = \propto_0 + \propto_1 ER_{t-1} + \propto_2 t + \sum_{i=1}^{n} \beta_i \Delta ER_{t-i+} \epsilon_t \ldots \text{(v)}$$

Where ΔCPI_t, $\Delta M2_t$, ΔCPI_ENY_t and ΔER_t are first difference for CPI, M2, CPI_ENY and ER respectively. ϵ_t represents the white noise error term.

b) Phillips-Perron (PP) test

Phillips Perron (1998) uses a nonparametric unit root trial technique to examine if the data series is I(1) or not. The PP test yields good results even in the presence of an unknown higher-order autocorrelation, which may lose degrees of freedom and heteroscedasticity. It uses the Newey-West estimator, which corrects for any serial correlation and heteroskedasticity without adding additional lagged terms to the model. The equations of the PP test for our model are as follows:

$$\Delta CPI_t = \propto_0 + \propto_1 CPI_{t-1} + \epsilon_t \ldots\ldots\ldots\ldots \text{(vi)}$$
$$\Delta M2_t = \propto_0 + \propto_1 M2_{t-1} + \epsilon_t \ldots\ldots\ldots\ldots\ldots \text{(vii)}$$
$$\Delta CPI\_ENY_t = \propto_0 + \propto_1 CPI\_ENY_{t-1} + \epsilon_t \ldots\ldots \text{(viii)}$$
$$\Delta ER_t = \propto_0 + \propto_1 ER_{t-1} + \epsilon_t \ldots \text{(ix)}$$

Where ΔCPI_t, $\Delta M2_t$, ΔCPI_ENY_t and ΔER_t are first difference for CPI, M2, CPI_ENY and ER respectively. ϵ_t represents the white noise error term.

VAR model for Lag selection:

Optimal lag length selection is fundamental for the Vector Error Correction Model (VECM) model. Aikaike's information criterion (AIC) and final prediction error (FPE) (Akaike 1969), Hannan-Quinn criterion (HQC) (Hannan and Quinn 1978) and Schwarz information criterion (SIC) (Schwarz 1978) are some of the most popular criteria which are applied for this study. The simple dimension for lag selection with the dependent and explanatory variables can be expressed as follows:

$$CPI_t = f(M2_t, CPI\_ENY_t, ER_t) \ \epsilon_t \ldots\ldots \text{(x)}$$

Where the target variable CPI growth rate (CPI_t) is depended on the regressors broad money supply ($M2_t$), energy index (CPI_ENY_t) and exchange rate (ER_t).

Vector Error Correction Model (VECM)

A Vector Error Correction Model (VECM) is a type of econometric model that is particularly useful for analysing the dynamic relationships between co-integrated time series. It captures the long-run and short-term dynamics between the dependent and explanatory variables as well as adjusting short-term deviations to move back towards long-run equilibrium.

Analysing time series properties is essential to ensure stationarity, avoid spurious regression, and determine the order of integration of variables. This

process helps in selecting the appropriate econometric model, such as VAR or VECM, and in assessing long-term relationships through co-integration. It also ensures robust and reliable results for data-driven decision-making by meeting key assumptions, such as no autocorrelation and homoscedasticity, thereby enabling accurate and meaningful analysis.

Assumptions of the Vector Error Correction Model (VECM)

To apply the VECM effectively, certain assumptions must be satisfied. First, it is crucial that the variables under consideration are non-stationary at their levels but become stationary after first differencing, indicating they are integrated of order one I(1). This ensures that the relationships among the variables are meaningful. Additionally, the variables must exhibit at least one co-integrating relationship, meaning that a linear combination of the variables is stationary even though the individual variables are not. This co-integration indicates a long-term equilibrium relationship among the variables. Another key assumption is the selection of an appropriate lag length, which ensures that the model captures the underlying dynamics accurately without overfitting or underfitting. The model also includes an error correction term (ECT), which adjusts short-term deviations from equilibrium to restore the long-term balance. For the VECM to be valid, the ECT coefficient must have a negative sign and be statistically significant. Moreover, the residuals in the model must be white noise, which means they should have a zero mean, constant variance (homoscedasticity), and no serial correlation. It is also important that the data used in the model are free from structural breaks or regime shifts, as these can distort the results and lead to inaccuracies.

Steps for Implementing VECM

To implement the VECM, the process begins with testing the stationarity of the variables using methods such as the Augmented Dickey-Fuller or Phillips-Perron tests. Once stationarity is confirmed at the first difference, the optimal lag length is determined using criteria like the Akaike Information Criterion or Schwarz Criterion. The next step involves testing for co-integration among the variables using the Johansen Co-Integration Test. If co-integration is present, the VECM is specified and estimated with an error correction term, which captures both the short-term dynamics and long-term equilibrium relationships. After estimation, the model's long- and short-term coefficients are analysed, including the significance of the error correction term. Finally, diagnostic tests - such as checks for autocorrelation, heteroscedasticity, and normality of residuals - are conducted to ensure the robustness and reliability of the model.

Since the preconditions are met, i.e., all the variables in our model are stationary at I(1) and co-integration is found among the variables of interest following the results of the Johansen co-integration test. So, it allows us to employ the VECM approach to capture the short-term dynamics and the adjustment speed to long-run equilibrium following the regression equation. Thus, the fundamental VECM equation for the model is as follows:

$$\Delta lnCPI_t = \sigma + \sum_{i=1}^{\rho-1} \alpha_i \Delta lnCPI_{t-i} + \sum_{l=1}^{\rho-1} \propto_i \Delta lnM2_{t-l} + \sum_{j=1}^{\rho-1} \beta_i \Delta lnCPI\_ENY_{t-j} + \sum_{m=1}^{\rho-1} \delta_i \Delta lnER_{t-m} + \lambda_1 ECT_{t-1} + \mu_{1t}$$

……..(xi)

From equation (xi), we have the co-integrating relationship between the dependent variable CPI and the regressors like M2, CPI_ENY and ER as well as their first difference are, ΔCPI_{t-i}, $\Delta M2_{t-l}$, ΔCPI_ENY_{t-j} and ΔER_{t-m}. The coefficients like α_i, $\propto_i$, β_i and δ_i capture the short-term dynamics between the variables and the lagged differences like $\Delta lnCPI_{t-i}$, $\Delta lnM2_{t-l}$, $\Delta lnCPI\_ENY_{t-j}$ and $\Delta lnER_{t-m}$ allowing the model to account for short-term interactions between the dependent variable and the regressors; ECT_{t-1} represents the error correction term and λ_1 is co-efficient of the ECT_{t-1} which represents the speed of adjustment, indicating how much of the deviation from long-term equilibrium is corrected each period, i.e., it measures the speed at which our co-integrating equation converges to the long-run equilibrium.

Results and Analyses

Stationarity of the Unit Root Test

The stationarity and order of integration of the time series must be checked to apply the VECM approach as well as to avoid any spurious results. The time series requires to be integrated to I(1) by the VECM approach, but not to I(2). ADF and PP tests are widely used approaches to verify if the time series is stationary and that they are in the appropriate order. Table 1 presents the outcomes of the unit root test.

Table 1: findings of the unit root test

Variables	Augmented Dickey-Fuller (ADF)			Phillips-Perron (PP)		
	Level	1st Difference	Decision	Level	1st Difference	Decision
CPI	-2.4585	-5.6563***	I (1)	-1.1636	-9.8950***	I (1)
M2	-1.1917	-6.6182***	I (1)	-2.0122	-14.4430***	I (1)
CPI_ENY	-3.3502	-9.7800***	I (1)	-3.4801	-9.7971***	I (1)
ER	-2.9150	-6.0277***	I (1)	3.6813	-5.9921***	I (1)

*, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. *All variables are in natural logarithm form. Source: Author's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

All the variables like CPI, M2, CPI_ENY, and ER are stationary at I(1), i.e., after taking the first difference based on the outcomes of the ADF and PP tests. Since all the variables are stationary at I(1), it allows us to adopt the VECM approach in case any co-integration is found among the selected variables.

VAR Lag Order Selection Criterion

It is mandatory to select the optimal lag length before estimating any cointegration for the proposed VECM model. The VAR model's lag length criteria are applied to detect the optimal lag length. The VAR lag order selection result is displayed in Table 2.

Table 2: VAR lag order selection

Lag	Log L	LR	FPE	AIC	SC	HQ
0	834.5811	NA	3.32e-11	-12.77817	-12.68994	-12.74232
1	1770.550	1799.940	2.37e-17	-26.93153	-26.49037	-26.75228
2	1820.831	93.60115*	1.40e-17*	-27.45894*	-26.66486*	-27.13628*

*Dictates lag order designated by the criterion. LR: sequential modified LR test statistics (each test at 5% level). Source: Researcher's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

Following the AIC, LR, FPE, SC, and HQ criteria, the optimal lag is 2 for the VECM model for the study. Since all the criteria proposed 2, the maximum lag length 2 is fitted for the VECM model of CPI with the regressors (M2, CPI_ENY, and ER).

Johansen Test of Cointegration

To ensure the presence of a long-run relationship among the variables of interest, the Johansen test of cointegration is applied with 2 lags, and the results are demonstrated in Table 3.

Table 3: Johansen co-integration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistics	0.05 Critical Value	Prob.** Critical Value
None *	0.439057	101.1851	47.85613	0.0000
At most 1 *	0.127143	26.60562	29.79707	0.1117
At most 2 *	0.058280	9.063709	15.49471	0.3595
At most 3	0.010162	1.317666	3.841465	0.2510

Trace test indicates 1 cointegrating equation(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Max-eigenvalue)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistics	0.05 Critical Value	Prob.** Critical Value
None *	0.439057	74.57951	27.58434	0.0000
At most 1 *	0.127143	17.54191	21.13162	0.1479
At most 2 *	0.058280	7.746043	14.26460	0.4051
At most 3	0.010162	1.317666	3.841465	0.2510

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

The outcomes of the trace test and max-eigenvalue test indicate that there is at least 1 co-integrating equation(s) found at the 0.05 level, which means that the null hypothesis of no co-integration is rejected, and co-integration exists between CPI and the regressors of the model. From the Johansen normalization interpretation, it is evident that all the regressors have a positive impact on CPI (since the signs are reversed in the long run), and they are statistically significant at the 1% level. So, it can be concluded that there is a long-run relationship between inflation and the model regressors. Since all of the variables are stationary at I(1) and co-integration is established between the variable of interest and the regressors, it is recommended to apply the VECM approach to assess whether these drivers truly affect the inflation in Bangladesh or not.

Results of Vector Error Correction Model (VECM)

The VECM approach is useful in estimating the desired level or period for returning to an equilibrium state following a shock, either foreseen or unforeseen, to any or some of the model's variables. So, this model captures the long-run and, most importantly, short-term dynamics amid the dependent and explanatory variables. Table 4 presents the long-run estimates of the VECM model.

Table 4: long-Run dynamics of the VECM model

	Constant	CPI	M2	CPI_ENY	ER
Coefficient	3.779	1.00	-0.395	-0.219	-0.177
Std. Deviation	-	-	0.0083	0.0421	0.0507
t-statistics	-	-	-47.4656***	-5.2296***	-3.4903**

*, ** and *** indicate significance at 10%, 5%, and 1% levels, respectively.
*All variables are in natural logarithm form. Source: Author's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

Therefore, the ECT can be presented as follows:

$$ECT_{t-1} = 1.00 lnCPI_{t-1} - 0.395 lnM2_{t-1} - 0.219 lnCPI\_ENY_{t-1} - 0.177 lnER_{t-1} + 3.779$$

….(xvii)

The equation (xvii) states that, as expected, M2, CPI_ENY, and ER have a positive and significant impact on CPI, which means that these regressors truly affect the price level of Bangladesh in the long run as well as being the key drivers of inflation in Bangladesh. On average, a 1% increase in M2, CPI_ENY, and ER will drive inflation in Bangladesh by 40%, 22%, and 18%, respectively. As mentioned earlier, the short-run dynamics of the model describe the convergence path, i.e., if any kind of shock caused temporary disequilibrium. The short-run dynamics of the VECM model are displayed in Table 5.

Table 5: short-run dynamics of the VECM model

Dependent Variable: ΔCPI			
Regressors	Coefficient	Std. Deviation	t-statistics
Constant	0.0046	0.0011	4.2364***
ECT_{t-1}	-0.5025	0.0636	-7.9000***
ΔCPI(-1)	0.3166	0.0763	4.1489***
$\Delta M2(-1)$	-0.1952	0.0816	-2.3913***
ΔCPI_ENY(-1)	0.0186	0.0611	0.3046
$\Delta ER(-1)$	0.2140	0.0849	2.5206***

*, ** and *** indicate significance at 10%, 5%, and 1% levels, respectively.
*All variables are in natural logarithm form. Source: Author's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

The co-integrating and long-run equation can be written as follows:

$$\Delta lnCPI = 0.0046 - 0.5025\,ECT_{t-1} - 0.395\,lnM2_{t-1} - 0.219\,lnCPI\_ENY_{t-1} - 0.177\,lnER_{t-1} + 3.779$$

….(xviii)

The most important component of the short-run dynamics is ECT_{t-1} is presented in Table 6.

Table 6: error correction term

*, ** and *** indicate significance at 10%, 5%, and 1% levels, respectively. Source: Author's own calculation in e-views 13. Data source: Statistics department of Bangladesh Bank (BB), internal calculation of research department, BB.

The coefficient of the ECT_{t-1} is -0.5025, which is an adverse sign and less than 1, as well as exhibits strong significance even at the 1% level. The negative sign states that the short-run dynamics act to move back toward equilibrium. Moreover, the ECT coefficient value of -0.5025 signifies the pace of adjustment to equilibrium, which means that the preceding deviation from long-run equilibrium is corrected in the existing period as an adjustment at a speed of 50.25 percent. These characteristics propose a long-term interaction between CPI and the model regressors.

VECM Model Fitness Checking

To examine the robustness and adequacy of our estimation, we employed the normality test, serial correlation analysis, as well as the heteroscedasticity test. Table 7 defines the results of the diagnostic tests for the estimated model.

Table 7: diagnostic test

Diagnosis	Test Statistic (F)	P-value
VECM Serial Correlation LM Test (H_0: No serial Correlation up to 2 lags)	0.20478	0.8009
VECM Heteroscedasticity Test (H_0: Homoscedasticity)	0.6296	0.6422
VECM Normality (Jarque-Bera) Test (H_0: Normally Distributed)	0.6832	0.7106

Source: Author's own calculation in e-views 13. Data source: Statistics Department of Bangladesh Bank (BB), internal calculation of Research Department, BB.

Based on the outcomes of F-statistics with high probability values, the calculated model successfully passes diagnostic tests for residual serial correlation, heteroscedasticity, and non-normality. Thus, we may infer that our model is a good fit because it met all clinical trials. Moreover, the investigation's long-run and short-run inferences are strong since the trials indicate that the regression coefficients are typically constant across the period of the sample, as the blue band is within the two red bands at the 5% level for both CUSUM and CUSUMSQ tests (see Figures 2 and 3 in the Appendix).

So, the diagnostic test of the model successfully overcomes every basic property of the VECM model, i.e., the absence of autocorrelation, homoscedasticity, normal distribution, as well as the stability of the regression

coefficients with the CUSUM and CUSUMSQ tests, which we briefly clarified in the methodology section.

Analyses

Since the VECM model captures the long-run and short-term dynamics between the dependent and explanatory variables, from the Johansen normalization interpretation it is clear that all of the regressors have a positive impact on CPI and they are statistically significant even at the level of 1%. So, it can be said that a long-run relationship exists between inflation and the regressors of the model.

The ECT equation states that, as expected, all the regressors like M2, CPI_ENY, and ER have a positive and significant impact on CPI, which means that these factors truly influence the inflation of Bangladesh in the long run.

From the ECT equation, on average, a 1% rise in broad money supply (M2) will drive inflation of Bangladesh by 40% in the long term, which is similar to the findings of Kazi Mostafa Arif and Munshi Murtoza (2012), who found that a 1% increase in the broad money supply will lead to a rise in inflation of 47%; Sudip Dey and Umme Salma (2023), who also showed that a 1% increase in the broad money supply will elevate inflation of 27%; Dewan Muktadir-Al-Mukit (2018); Gautam Kumar Biswas (2023); Rejoana Islam, Refat Ferdous, Nahida Sultana, and Marzia Nomi (2022); as well as Sheikh Jafar Emran and Mohammad M. Islam (2013). So, a broad money supply is one of the key determinants of inflation in Bangladesh.

The other regressor energy index (CPI_ENY) is another key driver of inflation in Bangladesh. A 1% increase in the energy index, in particular, will result in a 22% increase in inflation, as demonstrated by the findings of Maaz Ahmad et al. (2024), who discovered that oil prices increased inflation in South Asian economies.

The third regressor exchange rate (ER) also elevates inflation in Bangladesh. Particularly, a 1% increase in the exchange rate (i.e., depreciation) will lead to a rise in inflation by 18%, which is similar to the findings of Dr. Sayera Younus (2014), who showed that a one percent increase in the exchange rate (i.e., depreciation) would drive the price level by 23 percent in Bangladesh.

The coefficient of ECT (-0.5025) signifies the speed of adjustment to equilibrium, which means that the earlier deviation from long-run equilibrium is adjusted in the current period as an adjustment at a speed of 50.25 percent. Thus, the system takes a maximum of 2 months to act to converge to long-run equilibrium, which recommends the presence of a long-term relationship between CPI and model regressors.

Since the model has successfully passed all clinical tests, it is free from serial correlation, and heteroscedasticity as well as the residuals are normally distributed. In conclusion, stability checks further verify that the blue band is within the two red bands at the 5% level for both the CUSUM and CUSUMSQ, so the parameters of the model are stable, appropriate, and unwavering. So we conclude that the model met all the basic assumptions of the VECM model.

The findings of the study explicitly indicate that we achieved the objectives of our research. Besides, the findings are consistent as well as validated and supported by the findings of the existing study and theories, i.e., co-integration is found among M2, CPI_ENY, ER, and CPI, which clearly state that broad money supply (M2), energy index (CPI_ENY), and exchange rate (ER) truly influence inflation in Bangladesh across both periods of time. So, we may conclude that M2, CPI_ENY, and ER are the three key determinants of inflation in Bangladesh. Now we will investigate how M2, CPI_ENY, and ER drive a country's inflation.

Broad Money Supply

The simple quantity theory of money states that other things remain constant, an increase in the money supply typically elevates the price level, resulting in inflation. Excess supply of money promotes higher spending, which boosts demand for goods and services more, leading to demand-pull inflation. Since the money supply expands rapidly, it drives up wages and input costs as companies cause cost-push inflation, where higher production costs force consumers to pay higher prices.

Energy Price

Energy prices are a key driver of inflation because energy is an underlying input in almost every sector of the economy. Higher energy prices directly hit the cost of living of households, which raises the overall Consumer Price Index (CPI). Rising energy drives up transportation costs for consumers. Higher energy costs can raise the price of agricultural products, including food items, contributing to food inflation. Employees may ask for more money to maintain rising living costs due to increased energy prices. Higher energy prices result in supply disruptions. This is particularly impactful in countries that heavily rely on energy imports, as the higher import drives domestic inflation rates.

Exchange Rate

A depreciation in the exchange rate means that the domestic currency becomes weaker compared to foreign currencies, which makes imports more expensive, like electronics, machinery, food, fuel, energy prices, etc. Since energy is an essential input, higher energy prices indirectly push up costs across the economy. A depreciated exchange rate makes it more expensive to buy foreign goods and services like raw materials or intermediate goods; the overall production costs rise, consequently leading to imported inflation. As imported goods become more expensive due to depreciation, consumers may shift their demand toward domestically produced goods, which creates upward pressure on prices for local goods, resulting in demand-pull inflation. Overall, exchange rate depreciation generally contributes to higher inflation in the economy.

Based on the analyses, it is concluded that broad money supply, energy prices, and exchange rate are the three key drivers of inflation in Bangladesh.

Conclusion and Policy Implication

The aim of this study is to investigate the key drivers of inflation in Bangladesh from FY2014 to FY2024. The data was assembled from the Bangladesh Bank's Statistics Department and Research Department. The unit root test (ADF) is used to ensure the stationarity and integration order of the data. Moreover, the VECM approach is adopted to examine if the selected variables are co-integrated, i.e., whether these regressors influence inflation in Bangladesh or not. Finally, clinical and stability tests are embraced to verify if the model is appropriate and stable.

The findings of the VECM test specify that all the variables are co-integrated, indicating a long-run relationship between inflation in Bangladesh and the model regressors. In Bangladesh, inflation is highly impacted by broad money supply (M2), energy costs (CPI_ENY), and exchange rates (ER) in both the short and long term. Precisely, a 1% rise in M2 leads to an almost 40% rise in inflation, whereas a 1% increase in CPI_ENY and ER corresponds to a 22% and 18% drive in inflation in Bangladesh, respectively.

Finally, the clinical tests of the model successfully meet up with every basic assumption of the VECM model, i.e., absence of autocorrelation, homoscedasticity, and normal distribution, as well as fulfil the stability requirement of the regression coefficients with the CUSUM and CUSUMSQ tests, which further ensure that our model is appropriate and stable throughout the sample period.

Bangladesh Bank (BB) and the Government of the People’s Republic of Bangladesh have jointly taken many initiatives to control the rising trend of

inflation in Bangladesh. For more than a year, BB has pursued a contractionary monetary policy, considerably raised the policy rate while demotivated fresh high-powered money issuance for government spending. The government is supporting these efforts by lowering tariffs on specific commodities, extending social protection programs such as Open Market Sales (OMS), and inaugurating the Family Card. Recently, BB increased the policy rate to 10.00 percent, the SDF rate to 8.50 percent, and the SLF rate to 11.50 percent. Additionally, BB took several endeavours to bring down inflation in Bangladesh, some of which were notable: Implementing the interest rate corridor (IRC) and raising the policy interest rate by 200 basis points in FY24 were two important policy actions taken under a contractionary policy stance during H2FY24[3]. The policy interest rate corridor came down from ±200 to ±150 basis points, and the practice of devolving T-bills and T-bonds on BB was nullified, considering the multiplier effect of high-powered money on inflation. In addition, lending and deposit rates for various financial operations rose significantly in H2FY24, although the interbank call money rate was promptly managed throughout the Interest Rate Corridor (IRC).

Finally, in addition to BB's initiatives, the government must act decisively to ensure good governance by doing away with unethical practices like hoarding, syndicating, and deliberate supply chain disruption by some dishonest businessmen in the local market to mitigate inflationary pressure in Bangladesh.

The inflation rate of the Bangladesh economy could be influenced by a wide range of significant macroeconomic factors, including money supply, exchange rates, world food prices, energy prices, imports, exports, remittances, interest rates, policy rates, unexpected shocks, non-economic factors, etc. Out of all of them, I have chosen some macroeconomic factors, like M2, CPI_ENY, and ER, to investigate the impacts of those factors on the inflation rate of Bangladesh. Furthermore, I explored how those factors affected the inflation scenario in Bangladesh from FY2014 to FY2024. In the future, along with GDP growth and lending rates, more variables, as well as incorporating a wider period, would have to be considered to conduct future research in a broader scope regarding the inflation scenario in Bangladesh.

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[3] H2FY24 states the second half of fiscal year 2024.

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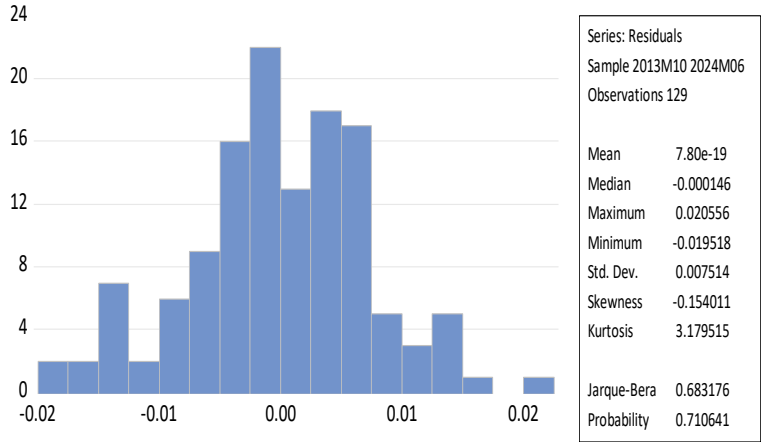
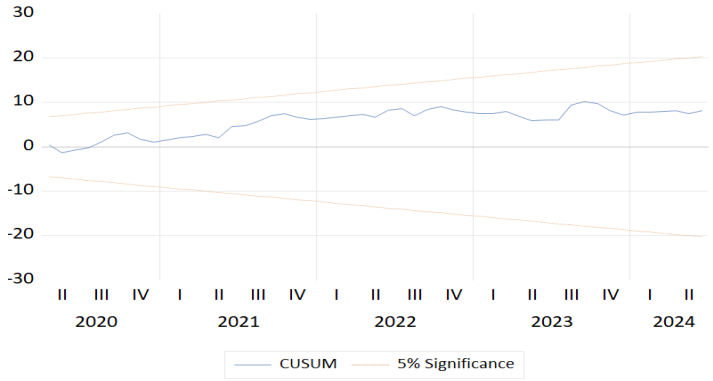
Appendix

Normality Test:



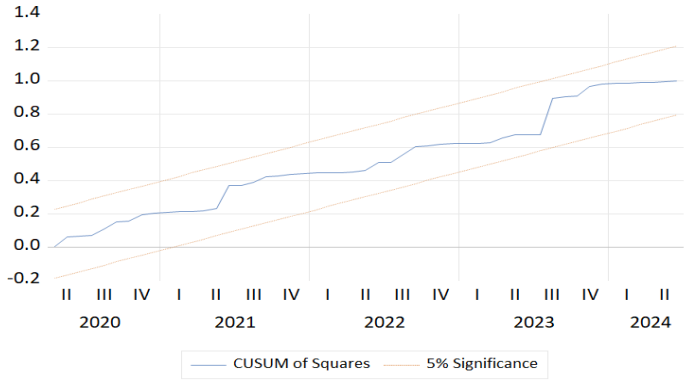
Source: Authors' own Calculation in E-Views 13. Data Source: Statistics Department of Bangladesh Bank (BB), internal calculation of Research Department, BB.

CUSUM Test:



Source: Authors' own Calculation in E-Views 13. Data Source: Statistics Department of Bangladesh Bank (BB), internal calculation of Research Department, BB.

CUSUMSQ Test:



Source: Authors' own Calculation in E-Views 13. Data Source: Statistics Department of Bangladesh Bank (BB), internal calculation of Research Department, BB.