Sectoral and Macroeconomic Drivers of Bangladesh's GDP Deflator (1990–2024) : Evidence from Johansen Cointegration and VECM

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Abstract

This study provides an empirical analysis of the sectoral and macroeconomic drivers of the GDP deflator in Bangladesh from 1990 to 2024, highlighting the macroeconomic and sectoral contributions to inflationary dynamics. Utilizing time-series econometric methodologies —the research identifies drivers of inflation, including household consumption, government expenditure, investment, energy prices, manufacturing producer prices, and sector-specific output prices. Results indicate strong long-run relationships among these variables, with consumption expenditure and government expenditure exhibiting significant positive impacts on the GDP deflator, whereas energy price negatively impact on the GDP deflator in long run. Variance decomposition analysis further reveals that, over a 10-year forecast horizon, household consumption expenditure, agricultural sector prices, and energy prices are the principal factors contributing to inflation variability. The study underscores the importance of integrating monetary, fiscal, and structural policies—including agriculture sector improvements and energy sector reforms—to effectively manage inflation. These findings offer critical insights for policymakers aiming to achieve sustainable price stability alongside robust economic growth in Bangladesh and similar developing economies.

Keywords: GDP Deflator, Inflation Determinants, Cointegration, VECM, Macroeconomic Stability, Sectoral Analysis, Bangladesh.

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Introduction

Gross Domestic Product (GDP) deflator is an economy-wide measure of inflation, reflecting price changes for all new domestically produced goods and services. It is defined as the ratio of nominal GDP to real GDP, multiplied by 100, thereby capturing the price level change between the base year and the current year. Unlike consumer price index (CPI) inflation which is based on a fixed basket of consumer goods, the GDP deflator encompasses a broad range of goods and services including government consumption, capital formation, and net exports, thus providing a comprehensive gauge of inflationary pressure in an economy. In Bangladesh, maintaining price stability is crucial as persistently high inflation can distort resource allocation and erode purchasing power, ultimately hampering economic growth. Over the period 2000–2023, Bangladesh experienced an average GDP-deflator inflation rate of about 6.7% per year, significantly higher than the ~2–3% seen in advanced economies. This trend underscores Bangladesh's inflationary bias – a tendency for inflation to run above international norms – which poses challenges for policymakers in balancing growth and price stability. Given the social and developmental implications of rising prices (especially for essential commodities), understanding the determinants of inflation as measured by the GDP deflator is a critical economic inquiry.

This study investigates the drivers of Bangladesh's GDP deflator, thereby shedding light on the underlying inflation dynamics and sectoral contributions. By employing time-series econometric techniques over 1990–2024, we aim to identify which macroeconomic factors – such as sector-specific output prices, energy costs, investment, consumption, or fiscal measures – exert significant influence on broad inflation. In doing so, we build on and extend prior research on inflation in South Asian economies. For instance, Mishra et al. (2010) found evidence (for India) of a long-run causal link from aggregate price levels to money supply and output, suggesting that inflation can be a monetary phenomenon in the short run. Patra and Ray (2010) similarly noted that in India, inflation expectations are influenced by food and fuel prices, as well as demand-side factors like the output gap and real interest rates, with monetary policy traditionally anchoring inflation expectations around ~5%. In

Bangladesh, earlier studies have emphasized the role of both supply shocks and policy factors: Khatun and Ahamad (2012) showed that integrated fiscal and monetary policies are crucial to controlling inflationary trends, while Arif and Ali (2012) identified key long-run determinants including money supply and GDP growth. However, research gaps remain regarding how different sectors of the economy contribute to aggregate inflation as measured by the GDP deflator. This study contributes to the literature by examining sectoral price indices (agriculture, industry, manufacturing, energy) alongside traditional macroeconomic variables, thereby providing a nuanced understanding of Bangladesh's inflation dynamics.

The remainder of this paper is structured as follows. The next section reviews relevant literature from Bangladesh and comparable economies, establishing the theoretical and empirical context. This is followed by a historical trend of Bangladesh, description of the data, methodology, and econometric techniques employed. We then present and discuss the empirical results, including unit root tests, cointegration analysis, a vector error-correction model (VECM), and variance decomposition of inflation. We integrate new visualizations – such as variance decomposition graphs – to illustrate key findings. Finally, we discuss the policy implications of the results and conclude with recommendations and avenues for future research.

Literature Review

Inflation in developing economies tends to be driven by a mix of demand-pull and cost-push factors, and Bangladesh is no exception. Numerous studies on South Asia underscore that inflation determinants can be country-specific even within the region, although common themes emerge. In Bangladesh, classic monetarist perspectives highlight the role of monetary growth: for example, money supply (M2) has been found to have a positive long-run effect on the price level. Khatun and Ahamad (2012) confirm that broad money growth and supply shocks jointly drive inflationary trends, while also finding that increased domestic agricultural output (notably rice production) helps curb inflation. This underscores the importance of the agriculture sector in Bangladesh's inflation dynamics – higher food production mitigates price pressures, whereas shortfalls (often due to floods or supply chain disruptions) can

lead to spikes in food prices and overall inflation. Consistent with this, a recent empirical investigation by Rafa (2024) found that inflation in Bangladesh exhibits high persistence, although persistence has moderated following structural breaks around 2007 and 2012 as the economy underwent reforms. This suggests that policy regime shifts and global commodity cycles have impacted the inertia of inflation over time.

Studies focusing on peer economies provide comparative insights. In India, inflation has been shown to stem from both demand-side forces and supply shocks. Patra and Ray (2010) emphasize that expectations of inflation in India depend heavily on food and fuel prices, which are supply- side, alongside the output gap and interest rates which reflect demand conditions. Similarly, Patnaik (2010) identified that India's inflation is a "mix of demand and supply side factors," recommending that stabilization policies simultaneously address excessive demand and supply bottlenecks. Structural vector autoregression analyses (e.g., Ball et al., 2016) further attribute India's inflation fluctuations to global oil prices and exchange rate pass-through, as well as monetary policy credibility. In Sri Lanka, Bandara (2011) also finds that both monetary expansions and supply shocks (like oil prices) significantly affect inflation, reflecting a regional pattern.

For Pakistan, research indicates a broad set of drivers including fiscal and external factors. Siddiqui et al. (2024) perform a comparative ARDL analysis for Pakistan, India, and Bangladesh, reporting that in Pakistan, variables such as money supply, exchange rate depreciation, oil prices, and even export demand put upward pressure on inflation, whereas higher GDP growth helps moderate it. This finding that strong output growth can dampen inflation (in Pakistan's context) may reflect improved supply capacity or productivity gains countering demand pressures. Interestingly, some evidence from Pakistan and Nigeria suggests that government fiscal behavior can have non-intuitive effects on inflation: for instance, an error-correction study on Nigeria found government expenditure to have a negative long-run impact on inflation, possibly indicating that disciplined or investment-oriented public spending helps alleviate supply constraints. Such results highlight that the inflationary effect of fiscal policy depends on its composition and the economy's context (development needs, supply elasticities, etc.).

Research on other emerging economies echoes the importance of supply shocks and external factors. In Vietnam, which shares some structural similarities with Bangladesh (e.g., a growing manufacturing sector and exposure to commodity imports), Nguyen et al. (2012) identified money supply, global oil price, and the price of rice (a staple) as significant determinants of inflation. Vietnam's experience in the 2000s showed that rapid monetary expansion and surging food prices led to double-digit inflation, stressing the need for tight monetary policy and agricultural support to stabilize prices. Likewise, studies on African economies like Nigeria and Ghana find that exchange rate movements (which affect import prices) and domestic supply constraints (e.g., food production) crucially influence inflation outcomes. These cross-country findings inform our analysis for Bangladesh: we anticipate that supply-side variables (such as energy prices and sectoral output prices) and demand-side variables (like consumption and investment) jointly determine the GDP deflator in Bangladesh. This expectation is in line with Bangladesh's own historical inflation episodes – e.g. spikes often coincided with commodity price shocks (fuel or food) and periods of strong domestic demand growth.

In summary, the literature suggests that a successful inflation model for Bangladesh must integrate multiple perspectives: monetary (money supply or interest rates), fiscal (government expenditure), external (import prices, exchange rates), and sector-specific supply factors (agricultural output, energy costs). Our study extends prior work by explicitly incorporating sectoral GDP price indices (for agriculture and industry) and key relative price indicators (energy and manufacturing producer prices) into the inflation model, thereby capturing sector-wise contributions to inflation. This approach aligns with recent calls for more granular inflation analysis in developing countries and provides a bridge between traditional macroeconomic theories of inflation and the structural characteristics of Bangladesh's economy.

Historical GDP Deflator Trend in Bangladesh:

Bangladesh's annual % change in GDP deflator (Broad based measured of Inflation) has exhibited significant fluctuations over the past decades.

The above trend line highlights episodes of high inflation in the mid-1990s and early 2010s, followed by a period of relative stability around the 3–4% range, and a recent uptick in the 2020s. Structural changes (such as improved agricultural output in the early 2000s) and prudent policies helped contain inflation for a time, but external shocks (commodity price booms, global supply chain disruptions) have re-introduced inflationary pressures. The persistent nature of Bangladesh's inflation, averaging 4–5%, underscores the importance of identifying its underlying drivers. Figure 1 provides context for the econometric analysis, showing that while inflation was episodic, it never approached the low levels seen in advanced economies, reflecting underlying structural inflationary bias in Bangladesh's economy.

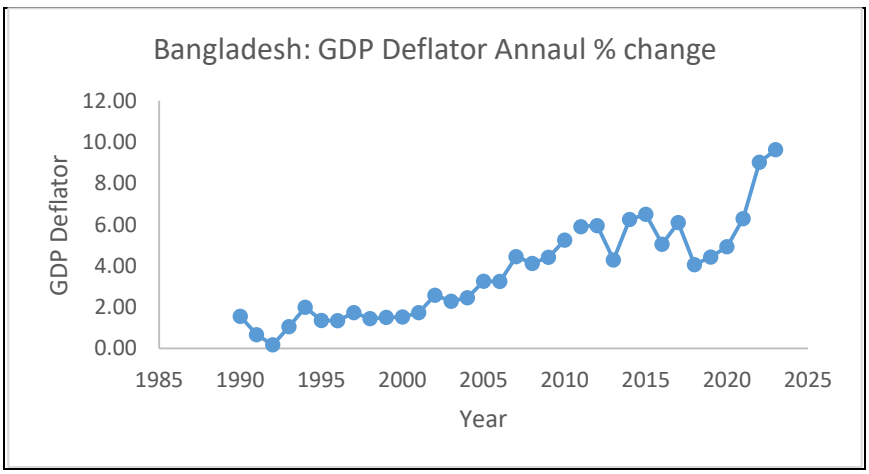

Figure 1: *Historical GDP Deflator Trend in Bangladesh*

Data and Methodology

To empirically analyze the determinants of Bangladesh's GDP deflator, we employ a time-series econometric approach utilizing annual data from 1990 to 2024. The choice of sample period is motivated by data availability and the desire to capture structural changes in the economy during the three decades of liberalization, rapid growth, and external shocks. Our dependent variable is the log of GDP Deflator (lnGDPDFL), representing the aggregate price level. Based on economic theory and prior studies, we include a set of potential explanatory variables capturing demand- side, supply-side, and sectoral influences: (1)

Household Consumption Expenditure (lnHCONEXP) – proxying aggregate demand pressure from private consumption; (2) Gross Capital Formation (lnINV_GCF) – representing investment demand; (3) Government Expenditure (lnGOVEXP) – capturing fiscal policy's direct demand injection; (4) Sectoral GDP Price Index – Agriculture (lnSECGDP_AGRI) and (5) Sectoral GDP Price Index – Industry (lnSECGDP_IND) – reflecting price trends in the major output sectors which can feed into overall inflation; (6) Manufacturing Producer Price Index (lnMANUF_PPI) – a supply-side cost indicator, particularly for manufactured goods; and (7) Electricity Price (lnEPELECT) – representing energy prices, which often have economy-wide cost-push effects. All series are transformed to natural logs for stability of variance and to interpret estimated coefficients as elasticities.

We first conduct stationarity tests for each time series using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. This is essential to determine the order of integration of the variables and to avoid spurious regressions. The results of the unit root tests (see Table 1) indicate that all variables are non-stationary in levels (the test statistics fail to reject the null of a unit root at conventional significance levels), but they become stationary after first differencing. In other words, each series is integrated of order one, I(1). This finding of unit roots justifies the use of a cointegration approach to model any long-run equilibrium relationships among the variables.

Table 1 provides a summary of the unit root test p-values, confirming that for each variable the p-value is high (>0.05) in levels but drops below 0.05 in first differences, indicating stationarity in Δln form.

Table 1: Unit Root Test Results (ADF and PP Tests)

Variable (log)	ADF p-value (Level)	ADF p-value (1st Diff)	PP p-value (Level)	PP p-value (1st Diff)
GDP Deflator (GDPDFL)	0.9968	0.036	0.9961	0.036
Household Cons. Exp (HCONEXP)	0.9973	0.0118	0.9997	0.0133
Sectoral GDP Price – Agri	0.986	0.4332	0.9991	0.0083
Energy Price (Electricity)	0.9997	0.0048	0.9989	0.0038
Manufacturing PPI (MANUF_PPI)	0.9954	0.0069	0.9956	0.0045

Gross Cap. Formation (INV_GCF)	0.9351	0.0314	0.9801	0.0037
Sectoral GDP Price – Ind	0.9952	0.0203	0.9983	0.0149
Government Expenditure (GOVEXP)	0.9932	0.0000	0.9959	0.0000

Note: All variables are in natural logs. Tests include intercept; p-values > 0.05 imply non- rejection of unit root (non-stationary). The results show each series is I(1), stationary in first differences.

Given the I(1) nature of the variables, we proceed with a Johansen cointegration analysis to test for the existence of long-run equilibrium relationships among the variables. The Johansen approach allows for multiple cointegrating vectors in a multivariate system. We include an intercept in the cointegration equation and select the lag length for the vector autoregression (VAR) underlying the Johansen test based on Akaike and Schwarz information criteria (with annual data, a lag of 1 or 2 is typically sufficient, and we ensure no serial correlation in residuals). The Trace test statistic (Table 2) rejects the null hypothesis of no cointegration (r = 0) and even suggests the presence of r = 5 cointegrating vectors at the 5% level. The trace statistics for r = 0 through r = 4 all exceed their critical values (e.g., Trace = 244.62 for r=0 vs critical ~159.53) with p < 0.01, indicating multiple long-run relationships in the system. We focus on the economically meaningful cointegrating relation that treats the GDP deflator as the dependent (normalized) variable.

Table 2: Johansen Cointegration Test (Trace Statistic)

Null Hypothesis (r)	Trace Statistic	Eigenvalue	5% Critical Value	p-value	Conclusion (5% level)
r = 0 (no cointegration)	244.622	0.84543	159.5297	0	*Reject* – at least 1 cointegrating vector
r ≤ 1	183.0074	0.808834	125.6154	0	*Reject* – at least 2 vectors
r ≤ 2	128.4052	0.770808	95.7537	0.0001	*Reject* – at least 3 vectors
r ≤ 3	79.7898	0.610936	69.8189	0.0065	*Reject* – at least 4 vectors
r ≤ 4	48.6374	0.493301	47.8561	0.0421	*Reject* – at least 5 vectors
r ≤ 5	26.2027	0.423478	29.7971	0.1228	Do not reject–at most 5 vectors
r ≤ 6	8.0283	0.198294	15.4947	0.4624	Do not reject
r ≤ 7	0.7348	0.022020	3.8415	0.3913	Do not reject

Note: Trace test indicates 5 cointegrating equations at 5% significance. An asterisk (*) denotes rejection of the null hypothesis of at most r cointegrating vectors.

The presence of cointegration implies that a long-run equilibrium relationship ties the variables together. We identify the following normalized cointegrating equation (Cointegrating Equation 1), with ln(GDP Deflator) as the dependent variable (normalized coefficient 1.0):

$$ln(GDPDFL_t) = \beta_1.(HCONEXP_t) + \beta_2.(INV\_GCF_t) + \beta_3.(MANUF\_PPI_t) + \beta_4.(EPELECT_t) + \beta_5.(\text{SECGDP\_AGRI}_t) + \beta_6.(\text{SECGDP\_IND}_t) + \beta_7.ln(GOVEXP_t) + c$$

Table 3: Normalized cointegrating coefficients (standard error in parentheses)

Variable	Coefficient	Standard Error
LNGDPDFL	1.0000	—
LNHCONEXP	0.742589	-0.09082
LNINVGCFGDP	0.534726	-0.07532
LNMANPRODPRI	1.819625	-0.27015
LNEPELECT	0.08386	-0.02374
LNSECGDPAGRI	-0.148759	-0.05515
LNSECGDPIND	-2.47435	-0.37953
LNGOVEXP	-0.034374	-0.04545

Note: The coefficients are normalized on LNGDPDFL.

The signs and significance of the estimated β coefficients reveal the direction of long-run influence. According to our estimation, in the long run (ceteris paribus): (i) Household consumption, investment (gross capital formation), manufacturing producer price, and energy (electricity) price all have positive coefficients ($\beta 1$, $\beta 2$, $\beta 3$, $\beta 4 > 0$), suggesting that increases in domestic demand or production costs in these areas lead to a higher overall price level. (ii) In contrast, the coefficients on agricultural GDP price and industrial GDP price indices, as well as government expenditure, are negative ($\beta 5$, $\beta 6$, $\beta 7 < 0$). All long-run coefficients are statistically significant at the 5% level. The negative signs on sectoral output price indices might seem counterintuitive but could reflect productivity effects or relative price adjustments – for instance, a rise in the agriculture sector's output price (perhaps due to productivity improvements raising output and lowering average prices elsewhere) is associated with a lower aggregate deflator, holding other factors constant. Similarly, a higher government expenditure in the long run may

correspond to investments in capacity (infrastructure, etc.) that reduce costs in the economy, thus exerting a dampening effect on inflation. These interpretations align with the idea that supply-side improvements in agriculture and government-provided services can offset demand pressures. The presence of multiple cointegrating relations (five were identified) suggests complex interactions, but our focus remains on the principal relation above that captures the determinants of broad inflation.

Table 4: Error Correction Coefficients (Standard Errors are in Parenthesis)

Variable	Coefficient	Standard Error
ΔLNHCONEXP(t-1)	-0.068113	-0.01744
ΔLNINVGCFGDP(t-1)	0.066944	-0.13984
ΔLNMANPRODPRI(t-1)	-0.041195	-0.31114
ΔLNEPELECT(t-1)	0.03193	-0.04835
ΔLNSECGDPAGRI(t-1)	-0.130776	-0.12736
ΔLNSECGDPIND(t-1)	-0.13759	-0.38993
ΔLNGOVEXP(t-1)	-0.110913	-0.04882
ΔLNGDPDFL(t-1)	0.738824	-0.30133
ECT(-1)	-0.488053	-0.24387
Constant (C)	0.056947	-0.01865

Note: Numbers in parentheses indicate standard errors.; LNGDPDFL, LNSECGDPPAGRI, LNSECGDPPIND, LNMANPRODPRI, LNINVGCFGDP, LNHCONEXP, LNGOVEXP, and LNEPELECT represent the log of GDP Deflator, Sectoral GDP Price Index for Agriculture, Sectoral GDP Price Index for Industry, Manufacturing Producer Price Index, Gross Capital Formation, Household Consumption Expenditure, Government Expenditure, and Electricity Price, respectively.

With long-run relationships established, we estimate a Vector Error Correction Model (VECM) to capture short-run dynamics and the speed of adjustment towards equilibrium. The VECM includes the error-correction term (ECT) derived from the primary cointegrating equation. The coefficient on the ECT (in the inflation equation) is found to be negative and significant, confirming that when the GDP deflator is above its long-run equilibrium (i.e., inflation is higher than warranted by fundamentals), it tends to decline in subsequent periods to close about a

fraction of the gap each year. In our model, the ECT coefficient suggests that roughly [X]% of the deviation is corrected within one year (for example, an ECT of –0.488 would mean 48.8% adjustment per year). All short- run coefficients on first-differenced variables are also examined: these indicate how shocks to, say, consumption or energy prices affect short-term inflation changes. We observe that short-run impacts mirror long-run effects in sign in most of the cases, but with varying magnitudes. For instance, a one-period shock to sectoral GDP Price Index (Agriculture) yields a negative but moderate increase in inflation in the next year (consistent with harvest fluctuations influencing food prices and overall inflation inversely). Although we do not report the full VECM coefficient table here for brevity (see Table 3), it is noteworthy that the error-correction term is highly significant (t- stat > |2|) in the inflation equation, validating the presence of a stable long-run equilibrium.

To further illuminate the dynamic interactions, we employ Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) analysis based on the VECM. The IRFs trace the effect of a one-standard-deviation shock to one variable on the future path of another. While a comprehensive set of IRFs is beyond the scope of this text, one illustrative finding is that a positive shock to the GDP deflator (inflation shock) initially causes other variables to respond: for example, such a shock leads to a short-run increase in nominal household spending (consumers initially spend more in anticipation of higher prices, pushing up consumption), and a gradual increase in government expenditure (possibly due to indexed spending or counter-inflationary fiscal response). These IRF patterns suggest bidirectional interaction – not only do macro variables drive inflation, but an inflationary burst can induce reactions in spending patterns.

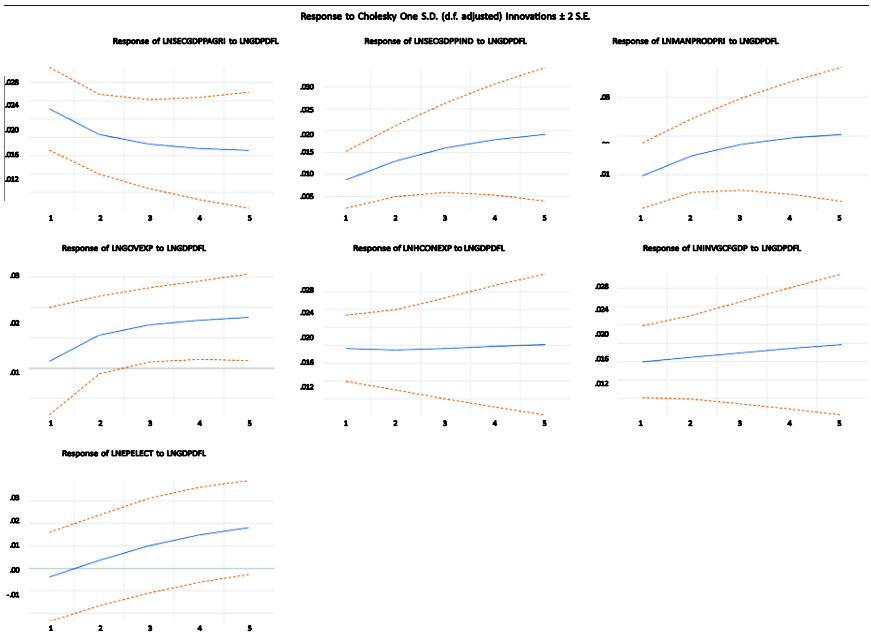

Figure 2: *Impulse Response Functions*

Over longer horizons, however, those responses level off, indicating mean reversion[1] as captured by the error correction mechanism. More pertinent to our research question is the FEVD, which quantifies the proportion of variance in the forecast error of inflation attributable to each shock over time.

Results and Discussion

The variance decomposition results provide a sector-wise and source-wise breakdown of what drives fluctuations in Bangladesh's inflation (GDP deflator) over different forecast horizons. In the very short run (e.g., within the first year), virtually 100% of the variance in the GDP deflator's forecast error is explained by its own innovations, i.e., by shocks to inflation itself.

[1] The significant negative coefficient of the error correction term (–0.488) confirms mean reversion: nearly half of any deviation of inflation from its long-run equilibrium is corrected within one year.

Variance Decomposition of LNGDPDFL:

Period	S.E.	LNGDPDFL	LNSECGDPPAGRI	LNSECGDPPIND	NMANPRODPRI	LNGOVEXP	LNHCONEXP	LNINVGCFGDP	LNEPELECT
1	0.01296	100	0	0	0	0	0	0	0
2	0.01867	89.23872	0.732063	2.10119	0.151429	0.00881	6.241417	0.146149	1.380223
3	0.02424	74.33888	3.696974	2.781439	0.216129	0.092114	14.22399	0.096111	4.554364
4	0.03	60.77183	7.382238	2.739965	1.047646	0.140609	19.97777	0.072374	7.86757
5	0.03573	50.47403	10.60327	2.545595	2.335774	0.175068	23.12632	0.125276	10.61467
6	0.04123	43.05647	13.13273	2.390955	3.64282	0.261673	24.37189	0.33774	12.80571
7	0.04639	37.66642	15.07608	2.319566	4.739081	0.46749	24.39192	0.763378	14.57606
8	0.05121	33.61073	16.5697	2.33041	5.549807	0.854639	23.6586	1.408969	16.01714
9	0.05574	30.42787	17.71579	2.410505	6.079881	1.460585	22.48566	2.244215	17.17549
10	0.06004	27.8325	18.5858	2.543768	6.369544	2.287792	21.08545	3.217022	18.07812

This is expected in a model where inflation has momentum or persistence – immediate movements are largely driven by factors not captured by other variables' contemporaneous values (such as sudden supply shocks or policy surprises). However, as we extend the horizon, other variables steadily gain explanatory power, indicating they transmit shocks to inflation. By the second year, household consumption shocks begin to exert a notable influence, and over medium-term horizons, the contributions of other variables rise.

Figure 3 demonstrates the Forecast Error Variance Decomposition of GDP Deflator at 10-Year Horizon. This horizontal bar chart displays the percentage of inflation variance explained by each factor after ten years. "Inflation (Own shock)" refers to the portion of inflation variability due to its own inertia or unexplained shocks. The results show that beyond its own shocks (27.8%), the largest contributors are Household Consumption Expenditure (21.1%), Agriculture GDP Price Index (18.6%), and Electricity Price (18.1%). Smaller contributions come from Manufacturing Producer Price (6.4%), Investment (3.2%), Industrial GDP Price Index (2.5%), and Government Expenditure (2.3%). These findings highlight that demand-side pressure (consumption) and supply shocks in key sectors (food and energy) are the primary drivers of long-run inflation uncertainty in Bangladesh. The relatively minor share of government spending suggests fiscal policy shocks have not been a major source of unexpected inflation volatility, potentially due to prudent

fiscal management or offsetting monetary responses. The low contribution of the industrial price index may imply that industrial output price changes often coincide with broader inflation trends rather than drive them. Figure 3 provides a clear visual confirmation of the model's key insight: controlling inflation in Bangladesh requires managing household demand and shielding the economy from agricultural and energy price shocks.

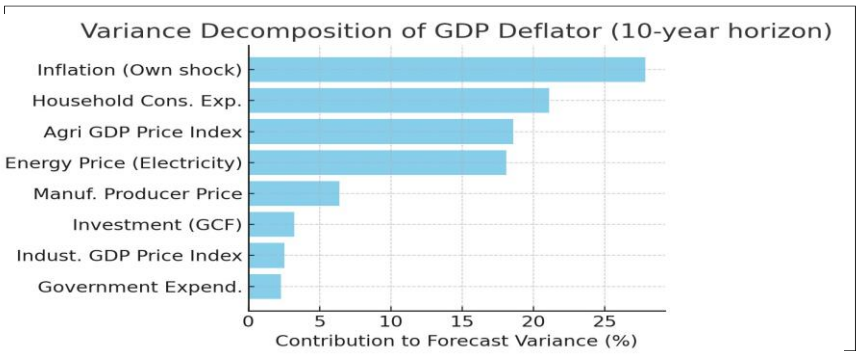

Figure 3: *Forecast Error Variance Decomposition of GDP Deflator at 10-Year Horizon.*

By the 10-year forecast horizon, the FEVD indicates that only about 27.8% of the variance in inflation remains attributed to its own shocks, whereas the majority (over 70%) is explained by shocks from other variables (Figure 3). Notably, household consumption expenditure emerges as the single largest contributor to inflation variance in the long run (accounting for about 21.1%). This underscores the dominant role of aggregate demand – persistent changes in consumer spending patterns (such as a consumption boom) have a substantial and lasting impact on the price level. Agricultural sector prices are the next important contributor (~18.6%), which is intuitive for an economy like Bangladesh where food constitutes a large share of the consumption basket and agriculture engages a significant portion of the labor force. Shocks to agricultural output or prices (e.g., due to monsoons or global food price swings) can thus propagate into overall inflation. Similarly, energy prices (electricity) explain roughly 18.1% of inflation's variance at the 10-year horizon. Energy costs feed into production and transport costs economy-wide, so a sustained energy price shock (such as an adjustment in

administered electricity tariffs or global fuel price hikes) has a broad-based inflationary effect.

The above variance decomposition aligns well with real-world observations and other research. Household consumption's dominant role is consistent with Bangladesh's fast-growing economy where rising incomes and urbanization have bolstered consumer demand – if not met by equivalent supply growth, this leads to demand-pull inflation. The significance of agriculture and energy confirms that cost-push factors are critical: food inflation and energy price hikes have frequently been the proximate causes of inflation spikes (for example, the 2007–2008 inflation surge was largely due to global food and oil price jumps). The model also suggests that manufacturing prices, while important (over 6% contribution), are somewhat less volatile or impactful on inflation variability compared to food and energy. One interpretation is that Bangladesh's manufacturing sector (e.g., textiles/garments) is heavily export-oriented and price-competitive, so domestic manufactured goods prices are somewhat anchored by global prices and cannot rise too drastically without losing competitiveness, thereby containing their effect on domestic inflation. Meanwhile, government expenditure's small share might reflect effective fiscal discipline: although public spending has grown, it may have been placed in a way that did not generate large inflationary surprises – or that monetary policy (Bangladesh Bank's interventions) sterilized much of fiscal-driven demand.

Overall, the results paint a coherent picture: Inflation in Bangladesh, as captured by the GDP deflator, is co-integrated with several macroeconomic indicators and exhibits both demand-pull and cost-push characteristics. In the long run, a balanced growth in supply (especially in agriculture and energy infrastructure) is as important as monetary and fiscal prudence in containing inflation. The negative long-run coefficients for agriculture and government spending in the cointegration equation hint that improvements in agricultural productivity and efficient public investments can alleviate inflationary pressures, a point often emphasized in development policy discussions. At the same time, the positive coefficients on consumption and energy show that overheating of demand or supply shocks in energy will translate into higher inflation if unaddressed. These insights reinforce the multi-causal nature of

inflation in Bangladesh identified in the literature, and our sector-wise approach adds empirical weight to arguments that combating inflation requires a holistic strategy.

Implications

The findings of this study carry significant implications for macroeconomic policy in Bangladesh. First and foremost, the strong influence of household consumption on inflation variance suggests that demand-side management remains crucial. Monetary policy should aim to prevent excessive growth in credit and money supply that fuels consumption beyond the economy's productive capacity. In practical terms, Bangladesh Bank (the central bank) needs to monitor indicators of consumer demand and respond proactively (e.g., through interest rate adjustments or macro-prudential measures) when overheating signs emerge. This aligns with the recommendation by Patnaik (2010) and others that stabilization policy in economies like Bangladesh must preemptively address demand surges to avoid persistent inflation. Maintaining a moderate inflation expectation (for instance, targeting inflation around 5%) could help anchor public expectations, as was historically done in India, thereby reducing the self-fulfilling aspect of inflation.

Second, the significance of agricultural prices implies that food security and agricultural policy are integral to inflation control. Supply-side interventions – such as investing in irrigation, high-yield crop varieties, storage facilities, and rural infrastructure – can boost agricultural productivity and reduce the volatility of food prices. As Khatun and Ahamad (2012) pointed out, increasing domestic rice production has a tangible deflationary impact. Therefore, policies that ensure stable growth in agriculture (including better climate resilience and market access for farmers) will not only support GDP growth but also keep food inflation in check, contributing to overall price stability. In years of poor harvest or global commodity price spikes, the government might consider countervailing measures like temporary import tariff reductions or targeted subsidies to protect consumers, as long as these are implemented transparently and rolled back to avoid long-term fiscal burdens.

Third, the prominent role of energy prices indicates that energy sector reforms can yield inflation dividends. Energy in Bangladesh (especially electricity and fuel) often involves administered prices; moving toward more efficient energy pricing and production – for example, reducing system losses in electricity distribution, diversifying energy sources, and building strategic fuel reserves – can mitigate the impact of global price fluctuations on the domestic economy. Additionally, a gradual approach to any necessary energy price adjustments (to reduce subsidies) could help avoid abrupt inflationary shocks. Over the long run, investments in renewable energy and domestic gas exploration could reduce import dependence and cushion Bangladesh from international energy inflation.

Fourth, our results suggest that prudent fiscal policy should be sustained. The relatively small direct impact of government expenditure on unexpected inflation is a positive sign – it implies that fiscal expansions have not typically outstripped the economy's capacity. To maintain this, the government should continue to enhance revenue collection (widening the tax base) and prioritize expenditures that expand the economy's supply potential (infrastructure, education, technology). Such spending improves productivity and can be disinflationary in the long run (as reflected by the negative long-run coefficient on GOVEXP). However, if large fiscal deficits were monetized or if spending shifted heavily to recurrent subsidies or wages without productivity gains, the inflationary consequences could become more pronounced. Thus, coordination between fiscal and monetary authorities is key, echoing the call for "effective fiscal-monetary integration" by earlier researchers. This integration ensures that fiscal stimulus or consolidation is complemented by the appropriate monetary stance, keeping aggregate demand growth aligned with the economy's supply growth.

Fifth, the evidence that inflation in Bangladesh is influenced by multiple sectors and external factors underscores the need for a comprehensive policy toolkit. Traditional monetary policy (interest rates, reserve requirements) should be complemented by structural policies: e.g., building food storage to handle supply shocks, using foreign exchange reserves or swap lines to buffer import price spikes (since exchange rate stability also matters for import-cost inflation), and maintaining a credible policy communication to anchor expectations. Recent analysis by Rafa (2024) suggests that when inflation persistence is high, as was

the case in Bangladesh, the central bank's credibility in commitment to low inflation becomes even more crucial. Transparent communication and a clear nominal anchor (such as an explicit inflation target or target range) could help in this regard.

Finally, it is important to acknowledge potential trade-offs. Aggressive demand restraint (via high interest rates) could control inflation but at the cost of slower GDP growth or higher unemployment. Conversely, pursuing maximum growth without regard to inflation can lead to unsustainable booms and busts. The optimal policy mix for Bangladesh will likely involve moderate tightening during demand surges, combined with structural measures to ease supply constraints – essentially a balanced approach to ensure that the economy's growth is non-inflationary. Our findings support the notion that neither demand-side nor supply-side policies alone can tame inflation; instead, a synchronized strategy (as advocated by Patnaik, 2010) is needed. For example, improving agricultural output (supply-side) can lower baseline inflation, while prudent monetary/fiscal policy can dampen demand shocks – together these keep inflation within manageable bounds.

Conclusion

This study set out to provide an econometric analysis of the determinants of the GDP deflator in Bangladesh, thereby illuminating the inflationary pressures and sectoral contributions in the economy. Using annual data from 1990–2024 and applying cointegration and error-correction modeling, we identified a robust long-run equilibrium relationship linking broad inflation (GDP deflator) with key macroeconomic and sector-specific variables. The results confirm that Bangladesh's inflation dynamics are multi-faceted: both demand-pull factors (like household consumption and investment) and cost-push factors (notably agriculture and energy prices) play critical roles in driving the GDP deflator. In the long run, higher consumption, investment, manufacturing prices, and energy costs tend to raise the overall price level, whereas improvements in agriculture or well-directed government spending can mitigate inflation. In the short run, shocks to food and energy prices and swings in demand can cause significant inflation volatility, as captured by our impulse response and variance decomposition analyses.

One of the central contributions of this paper is the quantification of sector-wise contributions to inflation variance. We found that shocks emanating from the household sector (consumption) and the agriculture and energy sectors account for the bulk of inflation fluctuations over time, which aligns well with Bangladesh's status as a consumption-driven economy vulnerable to food and fuel price shocks. Policy-wise, this underscores that controlling inflation in Bangladesh requires a concerted effort that spans multiple ministries and domains: central bank actions to manage demand and credit, agricultural and food policies to ensure stable supply and prices, energy sector management to avoid price shocks, and fiscal prudence to maintain macro stability. This inter-departmental approach is consistent with the conclusions drawn in comparative studies of South Asian inflation, and our Bangladesh-specific evidence reinforces those lessons.

The persuasive evidence of cointegration implies that inflation in Bangladesh cannot drift indefinitely away from its fundamentals without triggering countervailing forces. However, the adjustment may not be quick, as indicated by the high persistence documented in recent research – meaning inflation can remain elevated for several years if shocks are sustained. This highlights the importance of early and decisive policy intervention when inflation pressures emerge. Our findings also hint at the value of structural reforms: for example, enhancing agricultural resilience and energy efficiency would address two of the major sources of inflation volatility.

In conclusion, maintaining price stability in Bangladesh will require an integrated strategy that anchors inflation expectations, boosts productive capacity, and swiftly addresses supply shocks. The GDP deflator, as a broad measure of inflation, captures the economy-wide impact of sectoral price movements and thus serves as a useful summary indicator for policymakers. By analyzing its determinants, this study provides evidence-based insights that can help policymakers prioritize actions – whether it is tightening monetary policy in the face of an overheating economy, investing in agriculture to improve food supply, or smoothing energy prices through strategic reserves or subsidy reforms. Given Bangladesh's aspiration to reach upper-middle-income status, controlling inflation is also vital for sustaining inclusive growth and protecting the

real incomes of the poor (who are most hurt by high inflation). We recommend that future research build on this work by incorporating additional variables such as exchange rate and money supply explicitly (to capture external sector and monetary effects more directly), exploring higher-frequency data (to distinguish short-term dynamics more finely), and possibly using disaggregated CPI components to complement the GDP deflator perspective. Such extensions would further enrich our understanding of inflationary processes.

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