Determinants of Private Investment in Bangladesh: The Roles of GDP Growth, Public Investment, and Real Interest Rate

Abdul Mannan[1], Asif Iqbal[2]

Abstract

This study examines the dynamic interrelationships among private investment growth, public investment growth, GDP growth, and the real interest rate in Bangladesh using annual data from 1976 to 2024. A vector autoregression (VAR) model with four lags is estimated to capture feedback effects and temporal dependencies among these macroeconomic variables. The results indicate that private investment growth is strongly influenced by lagged GDP growth, reflecting the accelerator mechanism of economic expansion. Public investment growth exerts a weaker but positive effect on private investment, emerging at longer lags and suggesting limited crowding-in effects. The real interest rate displays positive associations with private investment growth at multiple lags, implying that interest rate movements in Bangladesh may reflect procyclical conditions rather than conventional credit-cost dynamics. Impulse response functions confirm that shocks to GDP and public investment generate short-lived but positive responses in private investment growth, while real interest rate shocks elicit volatile yet transitory effects. These findings highlight the dominant role of output growth in driving private investment and underscore the nuanced interactions between fiscal and monetary conditions in shaping investment dynamics. The results carry implications for growth-oriented policy design, particularly in balancing public investment strategies with monetary conditions to foster private sector expansion.

Keywords: Private Investment, Public Investment, Real Interest Rate, GDP Growth, Bangladesh, VAR Model.

JEL Classification: E22, E20, E62, E43, O40, C32

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[1] Abdul Mannan, currently works as Deputy Secretary, Macroeconomics Wing, Finance Division.

[2] Asif Iqbal, currently works as Deputy Secretary, Macroeconomics Wing, Finance Division and PS to Finance Adviser.

1. Introduction

Investment is one of the most critical determinants of economic growth in both developed and developing economies. It creates new opportunities for goods and employment (Checchi and Galeotti, 1993), improves productivity through introducing new and modern technologies and increases competitiveness in domestic as well as in foreign markets (Anderson, 1990). Investments are broadly categorized into two categories: public and private. Both forms contribute significantly—albeit in different ways—to the expansion of productive capacity, technological progress, and overall economic development. While public investment generally creates the foundational infrastructure and social services necessary for growth, private investment drives innovation, efficiency, and employment. Though, empirical evidence suggests that private capital is more productive than public capital (Erden and Holcombe, 2006), much of the literature has put importance on the public investment as well, for example there is argument that the US productivity slowdown (in 1970s) was mainly caused by the decline in public infrastructure spending (Aschauer, 1989a).

Public and private investment may play complimentary roles. Public projects—such as highways, energy grids, and educational institutions—create an enabling environment that private firms rely upon to thrive. Especially, in economies with significant infrastructure deficits, public investment tends to raise the expected returns to private projects, thereby encouraging firms to expand production and undertake new ventures. In turn, a vibrant private sector generates tax revenues and employment, which allows governments to sustain public investment. Conversely, underinvestment in public goods may limit the private sector's growth potential. This complementary relationship has been evidenced in Aschauer (1989b), and Munnell (1990). However, some studies including Tatom (1991), Holtz-Eakin (1994), and Evans and Karras (1994) find that public investment does not have any significant impact on private sector productivity. Furthermore, the positive spillover effect hinges on the efficiency and quality of public spending; misallocated or politically motivated projects may fail to generate complementary private investment (Calderón & Servén, 2010). In addition, the timing of these effects is asymmetric: while private investment responses can be

relatively swift when bottlenecks are removed, the gestation period of large-scale public projects often delays their impact on private sector activity.

Furthermore, public investment can also produce a "crowding-out" effect when it is financed through substantial government borrowing. According to the loanable funds theory, increased public sector demand for funds raises the equilibrium real interest rate, thereby increasing the cost of capital for private investors (Elmendorf & Mankiw, 1999). Wai and Wong (1982) for five developing countries and Nazmi and Ramirez (1997) for Mexico show that public investment crowds out private investment. This dynamic is particularly evident in economies with limited domestic savings and underdeveloped capital markets, where government borrowing competes directly with private sector financing. Higher real interest rates reduce firms' willingness to invest, particularly in capital-intensive sectors, and may shift financial flows toward safer government securities instead of productive private projects. Furthermore, when government debt accumulation erodes fiscal credibility, risk premiums rise, compounding the upward pressure on real interest rates and deepening private sector retrenchment (Baldacci & Kumar, 2010).

On the other hand, Real interest rates—calculated by adjusting nominal rates for inflation—serve as a key factor in determining borrowing costs and returns on savings, thereby shaping investment choices throughout the economy. (Blanchard & Johnson, 2013). In general, investment and real interest rates are inversely related. Private investment is highly responsive to real interest rates, as they directly influence firms' marginal cost of capital and the anticipated profitability of long-term projects. Low real interest rates lower borrowing costs, increase the net present value of investment projects, and encourage capital formation (Jorgenson, 1963). Conversely, rising real rates may diminish investment appetite by raising hurdle rates for profitability. This negative relationship has been confirmed in empirical works such as Greene and Villanueva (1991). However, the responsiveness of private investment to interest rate changes depends on structural factors such as financial market depth, credit availability, and investor confidence. In advanced economies with developed financial systems, the elasticity of private

investment to interest rate changes is often moderate, whereas in developing economies, where access to finance is constrained, even modest rate increases can sharply curtail private investment activity (Servén, 2003). In the short run, changes in real interest rate may generate positive impact on private investment in some economies while it may have negative impact in others (Bano, 2018).

The growth of gross domestic product (GDP) is widely regarded as a critical determinant of private investment dynamics, particularly in developing economies. Higher GDP growth signals expanding market opportunities, increased aggregate demand, and improved profitability expectations for private firms, thereby stimulating investment activity (Aghion et al., 2005). This relationship is consistent with accelerator theory, which posits that private investment responds positively to changes in output due to the need to expand productive capacity (Jorgenson, 1971). Empirical studies on developing countries, including those in South Asia, demonstrate that robust economic growth enhances investor confidence and reduces uncertainty, encouraging capital formation in the private sector (Ghura & Goodwin, 2000). Empirical analysis specific to Bangladesh supports this view: national income (real output) has a significant long-run positive effect on private investment (Kamrul Hassan & Salim, 2011). However, the magnitude of this impact often depends on complementary factors such as financial market depth, infrastructure availability, and macroeconomic stability, which mediate the transmission of growth to investment decisions (Servén, 2003; Blejer & Khan, 1984).

Understanding the interplay among private investment, public investment, GDP growth, and real interest rates is essential for designing policies that foster sustainable economic expansion, particularly in developing economies with shallow capital markets and limited fiscal space (Barro, 1990). The relationships among these variables are inherently dynamic and evolve with prevailing macroeconomic conditions. During periods of economic slack—such as recessions—public investment can stimulate aggregate demand and accelerate GDP growth without exerting significant upward pressure on real interest rates, as excess capacity tempers inflationary pressures (Keynes, 1936). In such circumstances, fiscal multipliers are typically larger, and

crowding-in effects dominate, encouraging private investment. Conversely, during phases of full employment or supply-side bottlenecks, additional public expenditure may overheat the economy, driving up real interest rates and potentially crowding out private investment (Auerbach & Gorodnichenko, 2012). Moreover, the stance of monetary policy critically shapes these dynamics: an accommodative policy can stabilize real interest rates, enabling simultaneous growth in public and private investment and reinforcing GDP expansion, whereas policy tightening to combat inflation may offset the positive spillovers from public spending by dampening private sector investment responses.

2. Review of Literature

Empirical evidence on the interaction of private investment growth with public investment, GDP growth, and real interest rate is mixed and context dependent. Luintel and Mavrotas (2005) found the cross-country heterogeneity is an acutely important facet of private investment behavior and it must be addressed heterogeneity in private investment behavior. The effect of real interest rate and public investment on private investment to be country specific depending on the level of real income and financial development. The level of real interest appears to support the 'complementarity' hypothesis in developing countries because the coefficient of real interest rate is significantly positive. However, when these countries acquire higher levels of income and higher financial development the neoclassical effect becomes significant and the real interest rate resumes significantly negative coefficient. The study also shows that, public investment significantly reduces private investment and the extent of crowding out effect appears directly related with the country specific level of real income; countries with higher real per capita income experience more crowding out and vice versa.

Empirical studies on OECD economies frequently report that public investment in infrastructure tends to crowd in private investment by enhancing capital productivity (Pereira & Roca-Sagales, 2001). In contrast, evidence from developing economies, including Bangladesh, highlights the importance of financing modalities: public projects funded through external concessional loans often exert neutral or positive effects on private investment, whereas those financed via domestic borrowing

commonly induce crowding-out pressures by driving up real interest rates (Haque & Montiel, 1993). The dynamics become more intricate in open economies due to capital mobility. Within the Mundell–Fleming framework, under a flexible exchange rate regime, increased public investment can attract capital inflows that offset upward pressures on domestic real interest rates (Fleming, 1962). Moreover, global factors—such as shifts in U.S. Federal Reserve policy or fluctuations in international commodity prices—transmit to domestic real interest rates, shaping the interaction between public and private investment in small open economies like Bangladesh (Obstfeld & Rogoff, 1996). To maximize the growth benefits of public investment, governments must ensure fiscal sustainability, prioritize high-quality projects, and coordinate with monetary authorities to maintain stable real interest rates. Medium-term fiscal frameworks that credibly signal debt sustainability help contain risk premiums and prevent excessive rises in real interest rates (International Monetary Fund, 2014). Additionally, structural reforms to deepen domestic capital markets can enhance the absorptive capacity of private investors, reducing the likelihood of crowding out. For developing countries, channeling public investment toward sectors with high multiplier effects—such as transport, energy, and digital infrastructure—offers the best prospects for crowding in private capital and accelerating inclusive growth (World Bank, 2020).

The determinants of private investment have been explored extensively in both theoretical and empirical literature. Keynes (1936) posited that investment depends on interest rates and expectations about future returns. Neoclassical theories emphasize marginal productivity and cost of capital, where the real interest rate plays a critical role. Barro (1990) and Aschauer (1989b) introduced the concept of productive government expenditure, arguing that public investment in infrastructure can raise the productivity of private capital and thereby crowd in private investment. Conversely, it is cautioned that excessive government spending, particularly when financed through deficits, can lead to crowding out (Easterly & Rebelo, 1993).

In the context of Bangladesh, limited empirical research exists. Ahmed and Miller (2000) found evidence of complementarity between public and private investment in South Asia. The impact of interest rates and

infrastructure on private investment in Bangladesh is analyzed with mixed findings (Islam, 2017 and Hossain and Islam 2013). Kamrul Hassan and Salim (2011) examined the determinants of private investment growth in Bangladesh. The study considered Terms of Trade (ToT), Public Investment, GDP acceleration, External Debt Level, and Real Interest Rate as variables to examine their impacts on private investment growth. The empirical results show that national output and external debt affect private investment positively while government expenditure, real interest rate and terms of trade affect negatively, though the coefficients of real interest rate and terms of trade are not statistically significant. Islam (2017) found that GDP growth rate, FDI, real export and domestic credit have the positive impact on the domestic investment in Bangladesh of which real export affects it significantly. On the other hand, financial intermediation and human capital have negative impact on domestic investment but they are insignificant. However, an integrated macroeconometric study covering the influence of both public investment and real interest rate in a dynamic setting for Bangladesh is largely absent. This study fills this gap by applying both OLS and VAR techniques on updated data, offering a comprehensive analysis.

3. Methodology

3.1 Variables and Data Sources

The study employs four key macroeconomic variables to investigate the dynamics of investment behavior in Bangladesh: Private Investment Growth (PVTINV_GR), GDP Growth (GDP_GR), Public Investment Growth (PUBINV_GR), and the Real Interest Rate (REALINT) to primarily assess the impact on the Private Investment Growth based on the movement of three others. Here GDP Growth serves as an indicator of overall economic performance, capturing the broader macroeconomic environment that influences investment decisions. Public Investment Growth measures changes in government-led capital expenditures, particularly in infrastructure and development projects, which can either crowd in or crowd out private investment. Finally, the Real Interest Rate reflects the cost of borrowing adjusted for inflation, directly affecting investment incentives and capital allocation.

Private Investment Growth Rate (PVTINV_GR)

The private investment growth rate measures the annual percentage change in real private gross fixed capital formation in Bangladesh. It reflects the expansion or contraction of private sector expenditures on productive assets such as machinery, equipment, and infrastructure. The data, expressed in constant prices with fiscal year 2015–16 as the base year, are sourced from the Bangladesh Bureau of Statistics (BBS) national accounts and investment series. Growth rates were computed from these constant-price figures to capture real changes in private investment, excluding the effects of inflation. This variable serves as the focal point of the analysis, enabling assessment of how private sector investment dynamics respond to changes in public investment, overall economic activity, and interest rate conditions.

Public Investment Growth Rate (PUBINV_GR)

The public investment growth rate represents the year-on-year percentage change in real public gross fixed capital formation, which includes government-led capital outlays in infrastructure, utilities, and other development projects. These investments, reported in constant 2015–16 prices, are critical for expanding productive capacity and providing the foundation for private sector activity. Data for public investment were collected from BBS national accounts and fiscal statistics publications. By converting these data into growth rates, the study evaluates the dynamic relationship between government investment and private sector responses, particularly in terms of potential crowding-in or crowding-out effects in the Bangladeshi context.

GDP Growth Rate (GDP_GR)

The GDP growth rate denotes the annual percentage change in real gross domestic product, serving as an indicator of the overall pace of economic activity and aggregate demand. The figures are reported at constant prices with the fiscal year 2015–16 as the base year, ensuring that the measure reflects real output changes rather than price fluctuations. GDP data were sourced from BBS's national accounts, which provide consistent long-run series on real output. Incorporating GDP growth into the analysis allows for evaluating the accelerator effect, where increases

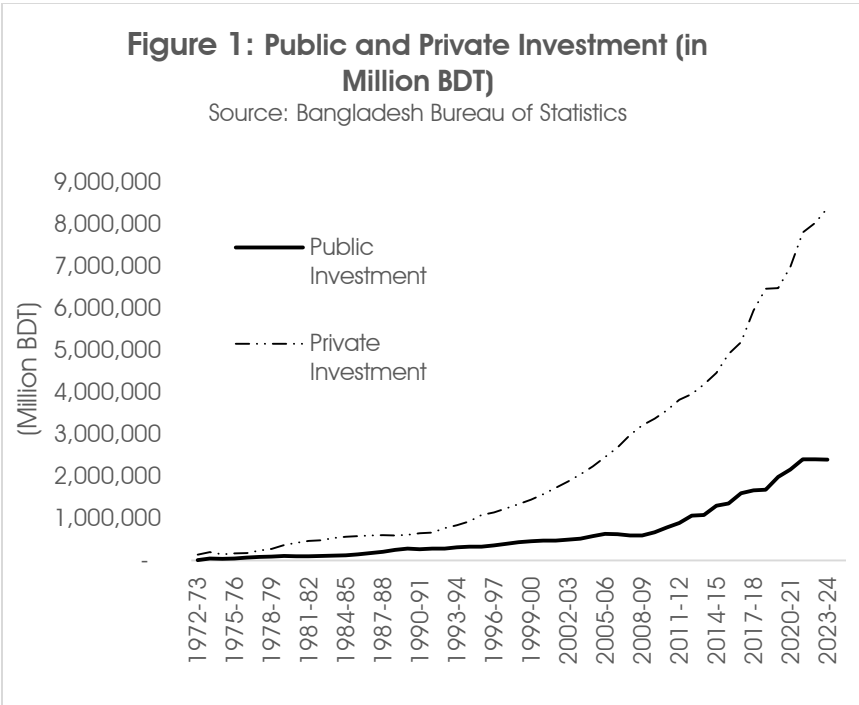
in output growth may incentivize higher private investment through improved expectations of profitability and market expansion.

Real Interest Rate

The real interest rate is defined as the nominal lending rate adjusted for inflation, capturing the real cost of borrowing faced by private investors. Data on real interest rates are obtained from the World Bank's World Development Indicators (WDI) database ensuring a consistent historical series. This variable provides insight into the monetary policy stance and credit conditions prevailing in Bangladesh, which are essential for understanding how borrowing costs influence private investment decisions. The inclusion of real interest rates complements the fiscal and real-sector variables by incorporating the monetary dimension into the analysis.

3.2 Data Overview

Figure 1 illustrates the long-term trends in public and private investment in Bangladesh from fiscal year 1972–73 to 2023-24. Both investment categories exhibit sustained growth, but private investment has expanded at a notably faster rate, especially since the early 1990s—coinciding with Bangladesh's trade liberalization, financial sector reforms, and increasing openness to private enterprise. The gap between private and public investment widened further after 2000, with private investment sharply rising during periods of strong GDP growth, particularly between 2010 and 2019, before showing a temporary slowdown during the COVID-19 pandemic in 2020–21. Public investment, while increasing steadily, has remained comparatively moderate, reflecting its role in infrastructure and enabling sectors. These trends highlight the evolving composition of capital formation in the economy and are central to this study, which investigates how public investment and real interest rates influence private investment growth. The acceleration of private investment alongside GDP growth and its sensitivity to macroeconomic shocks and financing conditions underscore the importance of understanding the dynamic interactions among these variables in the context of Bangladesh's development strategy.



On the other hand, Figure 2 illustrates the trends in public and private investment as a percentage of GDP in Bangladesh from 1972-73 to 2023-24, clearly demonstrating that private investment consistently dominates, starting below 5% and steadily rising to nearly 25% by the end of the period, while public investment, although showing some modest increases, remains considerably lower, fluctuating between approximately 1% and 7.5% of GDP, thereby highlighting the private sector's progressively central role in the nation's economic development over the past five decades.

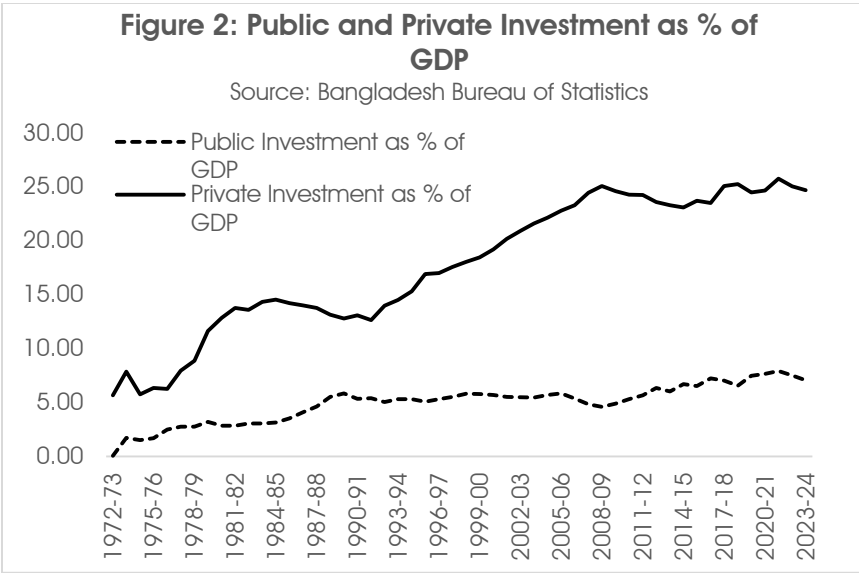
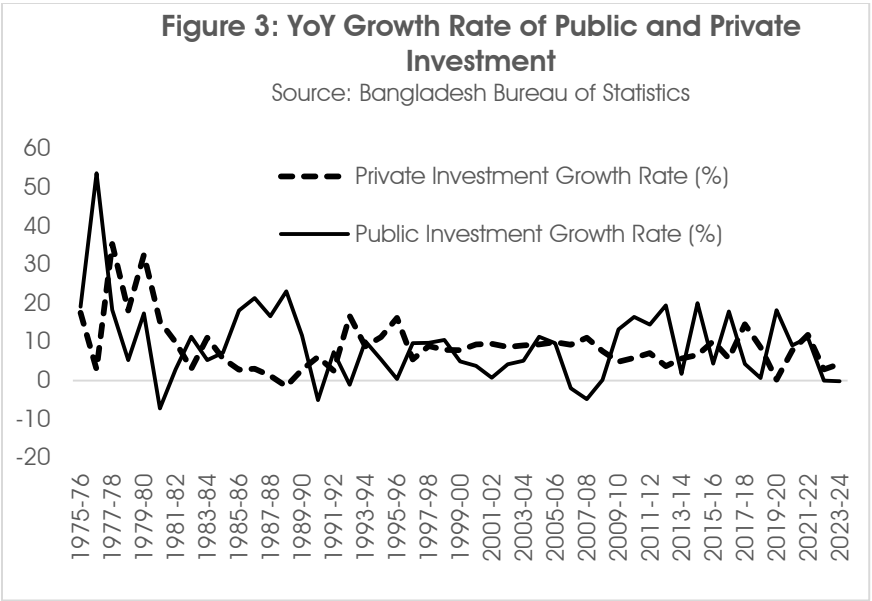
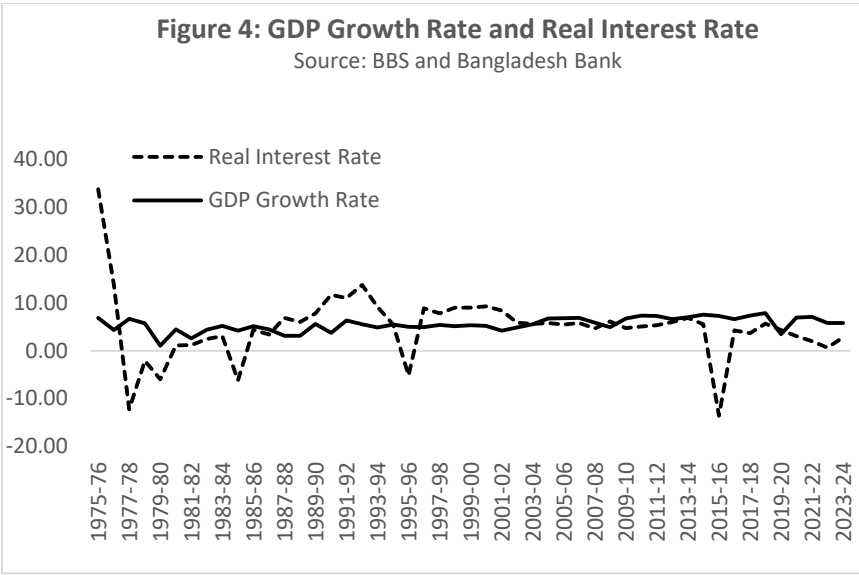


Figure 3 portrays the year-on-year growth rates of public and private investment in Bangladesh from 1975-76 to 2023-24. The early period (mid-1970s to late 1980s) is characterized by extreme volatility, especially in private investment which saw a peak over 50% in 1976-77 amidst post-independence political transitions and initial economic restructuring, contrasting with public investment's sharp but smaller swings influenced by government development priorities. The 1990s marked a period of relative stabilization and gradual growth in both investment types, aligning with Bangladesh's broad economic liberalization and privatization reforms, which fostered a more predictable investment climate. From the early 2000s, private investment growth generally settled into a 5-15% range, reflecting sustained economic progress, while public investment, though still more volatile, often demonstrated counter-cyclical responses; notably, a dip around the 2008-09 global financial crisis was followed by a surge, indicating governmental efforts to stimulate the economy, with a subsequent moderation in both investment types towards 2023-24 reflecting the impacts of the COVID-19 pandemic, Russia-Ukraine war and associated global economic disruptions.



Finally, Figure 4 illustrates the evolution of Bangladesh's GDP growth rate and real interest rate from 1975-76 to 2023-24. Early in the period, the real interest rate shows extreme volatility, with a peak above 30% in 1976-77 and sharp drops below -10% in the late 1970s, reflecting the nascent stage of the economy post-independence and significant macroeconomic instability, while GDP growth also experienced fluctuations. By the 1990s, as Bangladesh underwent economic reforms and liberalization, both indicators demonstrate greater stability, with GDP growth generally maintaining a positive trend around 5% to 7%, and the real interest rate mostly fluctuating between 0% and 10%. Notable divergences occur periodically; for instance, the significant dip in the real interest rate below -10% around 2015-16, potentially reflecting aggressive monetary easing, contrasts with a relatively stable GDP growth, suggesting that other factors might have sustained economic expansion. The overall trend, particularly from the 2000s onwards, indicates a more mature economy where GDP growth exhibits consistent positive performance, while real interest rates, despite occasional significant deviations, generally remain within a more contained range compared to the volatile early decades, reflecting improved macroeconomic management and integration into the global economy.



3.3 Descriptive Statistics

The descriptive statistics reveal notable contrasts in the behavior of private investment growth (PVTINV_GR), GDP growth (GDP_GR), public investment growth (PUBINV_GR), and the real interest rate (REALINT) over the study period. Private investment growth averages 8.88 percent, with considerable volatility (standard deviation = 6.87) and pronounced positive skewness (1.97), indicating frequent high-growth episodes. Public investment growth shows a similar pattern, with a higher mean (9.29 percent) and even greater variability (standard deviation = 10.07), alongside strong positive skewness (1.66) and leptokurtosis (8.80), suggesting sporadic but significant public spending surges. In contrast, GDP growth remains comparatively stable, averaging 5.51 percent with mild negative skewness and lower dispersion, and it is the only variable not rejecting normality under the Jarque–Bera test ($p = 0.11$). The real interest rate displays moderate volatility (standard deviation = 6.95) and positive skewness, with extreme values ranging from –13.64 to 33.79 percent, reflecting episodes of sharp monetary fluctuations.

Table 1: Summary Statistics of the Variables

	PVTINV_GR	GDP_GR	PUBINV_GR	REALINT
Mean	8.879080	5.512659	9.285587	4.917946
Median	7.958584	5.494611	9.080771	5.466994
Maximum	35.36044	7.881902	53.70865	33.79506
Minimum	-1.494186	1.008764	-7.218824	-13.64214
Std. Dev.	6.872165	1.450672	10.07036	6.948658
Skewness	1.966481	-0.692858	1.664117	0.672551
Kurtosis	8.177434	3.456877	8.797465	8.777952
Jarque-Bera	86.30945	4.346602	91.23747	71.85448
Probability	0.000000	0.113801	0.000000	0.000000
Sum	435.0749	270.1203	454.9938	240.9793
Sum Sq. Dev.	2266.879	101.0136	4867.783	2317.625
Observations	49	49	49	49

3.4 Model selection and Application of Econometric Techniques

The distributional features put above inform subsequent econometric choices. The presence of heavy tails and significant departures from normality in three of the four variables justifies the use of vector autoregression (VAR), which is robust to such non-normal distributions. The moderate volatility of GDP growth and the higher variability of investment and interest rate series further underscore the importance of incorporating multiple lags; indeed, lag length selection criteria (AIC, LR, FPE) collectively support a four-lag specification to adequately capture the dynamics among these variables without residual autocorrelation. Again, the choice of the Vector Autoregression (VAR) framework is guided by both the theoretical nature of the variables under study and the statistical properties of the data. Private investment growth, public investment growth, GDP growth, and the real interest rate are all macroeconomic indicators that interact dynamically, with causality potentially running in multiple directions rather than strictly from one variable to another. Unlike single-equation models, which impose a priori assumptions about which variables are exogenous and which are endogenous, the VAR model treats all variables as jointly endogenous,

allowing for a more flexible examination of feedback effects. This is particularly appropriate in the context of this study, where private investment decisions are influenced simultaneously by fiscal conditions, monetary policy, and output fluctuations, and where these same factors, in turn, may respond to changes in private investment.

Table 2: Stationarity of All of the Variables Confirmed by Augmented Dickey-Fuller Test:

		T-statistics	P value
GDP Growth Rate		-4.554384	0.0006
Private Investment Growth Rate		-5.094153	0.0001
Public Investment Growth Rate		-5.133216	0.0001
Real Interest Rate		-6.615937	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

From an empirical standpoint, the VAR model is further justified by the time-series properties of the data. Stationarity tests (ADF and PP) confirm that all four variables are integrated of order zero, enabling level-based estimation without differencing and preserving long-run dynamics. Moreover, descriptive statistics highlight significant variability and non-normal distributions in investment and interest rate series, features that the VAR framework can accommodate while still producing reliable impulse response and variance decomposition analyses. The selection of a four-lag specification—supported by information criteria—ensures that the model captures medium-term dynamics and mitigates residual autocorrelation. Overall, the VAR approach provides a coherent structure to analyze how shocks to GDP, public investment, and the real interest rate propagate through the system and affect private investment growth, while simultaneously accounting for reverse effects and interdependencies among the variables.

To examine the dynamic interrelationships among private investment growth, public investment growth, GDP growth, and the real interest rate, this study employs the Vector Autoregression (VAR) framework pioneered by Sims (1980). The VAR model treats all variables as jointly

endogenous, thereby allowing feedback effects and avoiding restrictive exogeneity assumptions typical of structural models (Lütkepohl, 2005). Prior to estimation, Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests were conducted to assess stationarity, and results indicated that all variables were stationary at levels, justifying the use of an unrestricted VAR rather than a cointegrated VAR or VECM (Enders, 2015). The optimal lag length was selected using multiple information criteria, ensuring that the model captures dynamic interactions while avoiding overparameterization.

The general form of the VAR(n) model with four endogenous variables is expressed as:

$$Y_t = c + A_1Y_{t-1} + A_2Y_{t-2} + \cdots\cdots\cdots + A_nY_{t-n} + \varepsilon_t$$

Where, Yt=[PIG_t, PUG_t, $GDPG_t$, RIR_t] represents private investment growth (PIG), public investment growth (PUG), GDP growth (GDPG), and real interest rate (RIR); c is a vector of constants; A_i are coefficient matrices; and ε_t is a vector of white-noise error terms.

Focusing on private investment growth, the equation can be written as:

$$PIG_t = \alpha + \sum_{i=1}^{n} \beta_{1i} PIG_{t-i} + \sum_{i=1}^{n} \beta_{2i} PUG_{t-i} + \sum_{i=1}^{n} \beta_{3i} GDPG_{t-i} + \sum_{i=1}^{n} \beta_{4i} RIR_{t-i} + \varepsilon_{1t}$$

This specification allows past values of public investment growth, GDP growth, and real interest rates to influence private investment growth while incorporating its own autoregressive dynamics. Post-estimation, impulse response functions (IRFs) are used to trace the temporal effects of structural shocks—particularly from public investment and real interest rate—on private investment growth, and forecast error variance decomposition (FEVD) is employed to quantify each variable's contribution to fluctuations in private investment growth over time. This methodological framework enables robust insights into both short-run and medium-run policy dynamics in the Bangladeshi context.

4. Results and Analysis

4.1 Lag Order Selection

The optimal lag length for the VAR model was determined using several statistical criteria, namely the Likelihood Ratio (LR) test, Final

Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan–Quinn Criterion (HQ). As indicated in the results, the LR statistic, FPE, and AIC unanimously identify four lags as optimal, whereas SC and HQ suggest shorter lag lengths. In this study, AIC and FPE are prioritized over SC and HQ because the data are annual fiscal series with approximately 50 observations, and AIC/FPE are generally more suitable for smaller samples and for models where capturing dynamic interactions is important (Lütkepohl, 2005). Selecting four lags ensures that the model adequately incorporates the relevant dynamics without underfitting, a decision further validated by the absence of residual autocorrelation at the fourth lag in subsequent diagnostic tests.

Table 3: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-505.3100	NA	79580.40	22.63600	22.79659*	22.69587*
1	-485.3335	35.51395	66932.61	22.45926	23.26223	22.75860
2	-467.9521	27.81010	64101.63	22.39787	23.84320	22.93668
3	-451.7717	23.01220	66573.49	22.38985	24.47755	23.16813
4	-427.0339	30.78474*	49389.73*	22.00151*	24.73158	23.01925

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

4.2 Model Stability and Diagnostic Tests

Unit Root Test

The stability of the estimated Vector Autoregressive (VAR) model was assessed through the unit root test, which examines whether the characteristic roots of the system lie inside the unit circle. The results reveal that all characteristic roots have moduli less than one, with the

highest modulus recorded at 0.889562, indicating that no root lies outside the unit circle. This confirms that the VAR model satisfies the stability condition, ensuring that the system's impulse responses and forecasts are reliable and will converge over time rather than diverge. Consequently, the dynamic relationships among Private Investment Growth (PVTINV_GR), GDP Growth (GDP_GR), Public Investment Growth (PUBINV_GR), and Real Interest Rate (REALINT) can be interpreted with confidence, and the model is suitable for policy analysis and simulation exercises.

Figure 5: Stability of VAR Model

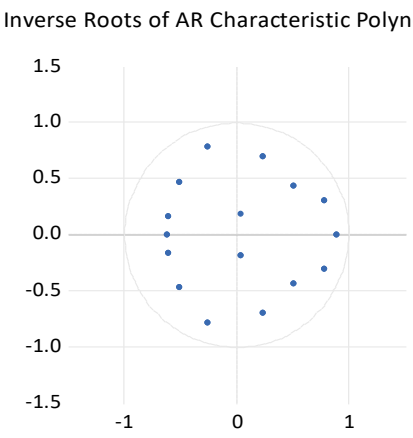


Table 4: Unit Roots Statistics

Root	Modulus
0.889562	0.889562
0.781468 - 0.306799i	0.839534
0.781468 + 0.306799i	0.839534
-0.261392 - 0.789805i	0.831936
-0.261392 + 0.789805i	0.831936
0.240042 - 0.692969i	0.733366
0.240042 + 0.692969i	0.733366
-0.508075 - 0.464697i	0.688537
-0.508075 + 0.464697i	0.688537
0.510246 - 0.438999i	0.673105
0.510246 + 0.438999i	0.673105
-0.612476 - 0.167982i	0.635094
-0.612476 + 0.167982i	0.635094
-0.623244	0.623244
0.033501 - 0.189543i	0.192480
0.033501 + 0.189543i	0.192480

No root lies outside the unit circle.
VAR satisfies the stability condition.

Residual Diagnostics

The stability of the estimated VAR model was assessed using the residual serial correlation LM test, which evaluates whether the residuals from the system are autocorrelated. The null hypothesis of this test posits no serial correlation at a given lag. As reported, the test statistics indicate significant autocorrelation at lags 1 to 3, with p-values below the 5%

threshold (0.0067, 0.0064, and 0.0129, respectively). However, at lag 4—the maximum lag length employed in the model—the p-value rises to 0.1388, exceeding the 5% level and thus failing to reject the null hypothesis of no serial correlation. This outcome implies that the inclusion of four lags is sufficient to eliminate residual autocorrelation and ensures that the disturbances behave as white noise beyond the chosen lag structure. Consequently, the model satisfies one of the key stability conditions required for reliable dynamic analysis, supporting the validity of subsequent impulse response and forecast error variance decomposition results derived from the VAR framework.

Table 5: Results of the Residual Serial Correlation LM Test

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	33.32120	16	0.0067	2.391781	(16, 64.8)	0.0071
2	33.44601	16	0.0064	2.402989	(16, 64.8)	0.0068
3	31.15462	16	0.0129	2.200297	(16, 64.8)	0.0135
4	22.13629	16	0.1388	1.462526	(16, 64.8)	0.1420

4.3 Granger Causality Test:

The Granger causality or block exogeneity Wald tests were conducted to assess the direction of predictive relationships among private investment growth (PVTINV_GR), GDP growth (GDP_GR), public investment growth (PUBINV_GR), and the real interest rate (REALINT) within the estimated VAR framework. Results indicate that GDP growth, public investment growth, and real interest rates all jointly Granger-cause private investment growth, as evidenced by statistically significant chi-square statistics (p-values of 0.0054, 0.0348, and 0.0000, respectively). This finding implies that past movements in macroeconomic output, fiscal investment, and monetary conditions are collectively important predictors of private investment dynamics. In contrast, none of the variables individually Granger-cause GDP growth, although the joint test for all variables is significant at the 5 percent level ($p = 0.0141$), suggesting limited but collective predictive power. For public investment

growth and real interest rate equations, no variable demonstrates significant Granger causality, either individually or jointly, indicating that these series are largely exogenous within the system. These causality patterns align with the impulse response and variance decomposition analyses, which also highlight the dominant role of GDP growth and real interest rate shocks in influencing private investment, while public investment plays only a secondary role.

Table 6: Results of Granger Causality Tests

Dependent variable: PVTINV_GR

Excluded	Chi-sq	df	Prob.
GDP_GR	14.69969	4	0.0054
PUBINV_GR	10.36040	4	0.0348
REALINT	51.36950	4	0.0000
All	74.70614	12	0.0000

Dependent variable: GDP_GR

Excluded	Chi-sq	df	Prob.
PVTINV_GR	7.134136	4	0.1290
PUBINV_GR	4.056253	4	0.3984
REALINT	2.549335	4	0.6358
All	25.14693	12	0.0141

Dependent variable: PUBINV_GR

Excluded	Chi-sq	df	Prob.
PVTINV_GR	2.620746	4	0.6232
GDP_GR	1.841131	4	0.7649
REALINT	2.617602	4	0.6237
All	6.400143	12	0.8946

Dependent variable: REALINT

Excluded	Chi-sq	df	Prob.
PVTINV_GR	2.689594	4	0.6110
GDP_GR	3.051353	4	0.5493
PUBINV_GR	2.445645	4	0.6544
All	7.257704	12	0.8401

4.4 VAR Estimation for Private Investment Growth

The estimated VAR equation for Private Investment Growth Rate as dependent variable is as follows:

PVTINV_GR = C(1,1)*PVTINV_GR(-1) + C(1,2)*PVTINV_GR(-2) + C(1,3)*PVTINV_GR(-3) + C(1,4)*PVTINV_GR(-4) + C(1,5)*GDP_GR(-1) + C(1,6)*GDP_GR(-2) + C(1,7)*GDP_GR(-3) + C(1,8)*GDP_GR(-4) + C(1,9)*PUBINV_GR(-1) + C(1,10)*PUBINV_GR(-2) + C(1,11)*PUBINV_GR(-

3) + C(1,12)*PUBINV_GR(-4) + C(1,13)*REALINT(-1) + C(1,14)*REALINT(-2) + C(1,15)*REALINT(-3) + C(1,16)*REALINT(-4) + C(1,17)

With substituted coefficients the model estimates the growth rate of private investment in the following way:

PVTINV_GR = 0.130116381814*PVTINV_GR(-1) + 0.123692805957*PVTINV_GR(-2) + 0.210125069426*PVTINV_GR(-3) + 0.223268668266*PVTINV_GR(-4) + 1.50245609249*GDP_GR(-1) - 0.770422931769*GDP_GR(-2) + 0.573146407811*GDP_GR(-3) - 0.521469949046*GDP_GR(-4) + 0.0932959126491*PUBINV_GR(-1) - 0.0230465357758*PUBINV_GR(-2) + 0.0710841977777*PUBINV_GR(-3) + 0.151428324852*PUBINV_GR(-4) + 0.236501024339*REALINT(-1) - 0.0563036220885*REALINT(-2) + 0.265134947234*REALINT(-3) + 0.446546821324*REALINT(-4) - 9.3574049737=

Table 7: Model Summary Statistics

	PVTINV_GR	GDP_GR	PUBINV_GR	REALINT
R-squared	0.822479	0.639941	0.328393	0.364361
Adj. R-squared	0.721039	0.434193	-0.055382	0.001138
Sum sq. resids	237.3485	34.67142	1761.746	670.6297
S.E. equation	2.911483	1.112774	7.932180	4.893982
F-statistic	8.108011	3.110312	0.855690	1.003134
Log likelihood	-101.2667	-57.98543	-146.3687	-124.6372
Akaike AIC	5.256300	3.332686	7.260831	6.294987
Schwarz SC	5.938817	4.015203	7.943347	6.977504
Mean dependent	8.025753	5.477276	7.969087	4.615262
S.D. dependent	5.512423	1.479355	7.721250	4.896770

The R^2 value for private investment growth as the dependant variable stands at 82.2 which implies that the model explains 82% of variation in private investment growth rate. The equation for private investment growth reveals several statistically significant determinants. Lagged GDP growth emerges as a key driver: the coefficient on GDP_GR(-1) is 1.50 with a t-statistic of 3.15, indicating that higher economic growth in the previous year strongly stimulates private investment expansion. Public

investment growth exhibits a delayed positive effect, with PUBINV_GR(-4) significant at the 5 percent level (0.15; t = 2.27). Notably, the real interest rate also displays significant positive coefficients at multiple lags—REALINT(-1), REALINT(-3), and particularly REALINT(-4) (0.45; t = 5.07)—suggesting that periods of elevated real interest rates are associated with subsequent increases in private investment growth. This counterintuitive relationship may reflect signaling effects whereby higher rates coincide with robust economic activity or expectations of higher returns, rather than conventional credit-cost dynamics.

4.5 Dynamic Analysis: Impulse Response and Variance Decomposition

The dynamic properties of the estimated vector autoregression (VAR) model were further investigated using impulse response functions (IRFs) and forecast error variance decomposition (FEVD). These tools provide complementary perspectives on the interrelationships among private investment growth (PVTINV_GR), GDP growth (GDP_GR), public investment growth (PUBINV_GR), and the real interest rate (REALINT). While the IRFs trace the time path of each variable's response to a one-standard-deviation shock in the others, the variance decomposition quantifies the relative importance of these shocks in explaining forecast error variance over the medium term.

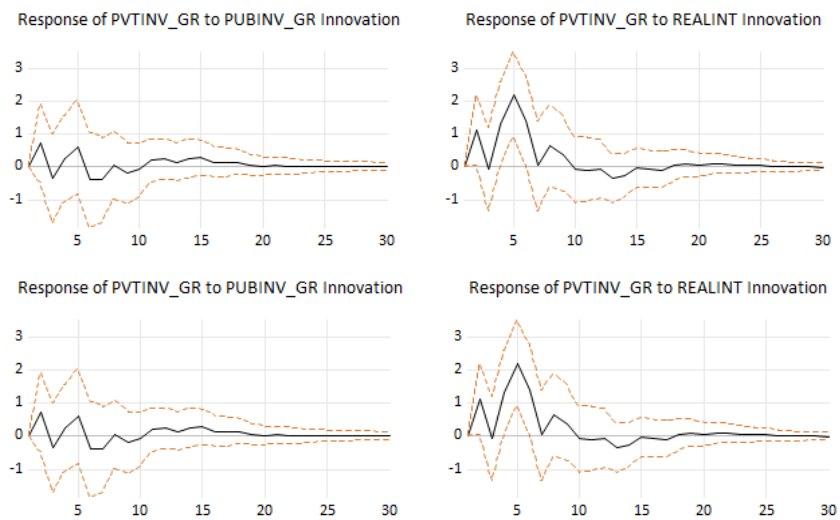
Impulse Response Function

The impulse response functions (IRFs) provide insights into the dynamic reaction of private investment growth to shocks in itself, GDP growth, public investment growth, and the real interest rate over a 30-period horizon. The IRFs indicate that private investment growth responds positively to shocks in its own past values, suggesting short-term momentum effects. A one-standard-deviation innovation in private investment growth generates an immediate surge of roughly 3 percentage points, which rapidly declines and converges toward zero within approximately eight periods. This pattern is consistent with investment cycles that are self-reinforcing in the short run but lack prolonged persistence. In response to GDP growth shocks, private investment growth also rises sharply initially, though the impact diminishes steadily and becomes negligible after approximately 10 periods. A positive GDP

shock raises private investment growth by more than 2 percentage points in the first few periods, with the effect gradually diminishing thereafter. This finding supports the accelerator hypothesis, whereby higher output levels stimulate private investment through increased demand expectations and profitability prospects. The persistence of this effect—though moderate—underscores the role of macroeconomic growth in catalyzing private sector expansion.

Public investment growth shocks elicit a modest positive response in private investment growth, albeit smaller in magnitude and shorter in duration than the GDP shock. This outcome points to a weak but present crowding-in effect, suggesting that infrastructure and capital outlays by the government do facilitate private sector activity, though the channel may be constrained by efficiency and financing considerations. Meanwhile, the response of private investment growth to real interest rate shocks is positive but more volatile. Initial increases of around 2 to 3 percentage points are observed, followed by oscillations that dissipate over 8 to 10 periods. This counterintuitive result—where higher real interest rates coincide with higher private investment—may reflect structural characteristics of Bangladesh's financial markets, such as procyclical credit expansion or interest rate movements that mirror broader economic booms rather than exerting purely restrictive effects.

Figure 6: Impulse Responses of Private Investment Growth



Variance Decomposition

The variance decomposition results reveal that innovations in private investment growth itself dominate the short-run forecast error variance but decline markedly over the projection horizon. In the first period, 100 percent of the forecast error variance in private investment growth is explained by its own shocks, reflecting the absence of lagged effects at this horizon. However, by the fifth period, this share falls to approximately 41 percent, indicating that external variables increasingly contribute to explaining fluctuations in private investment growth. Among these, shocks to the real interest rate emerge as the most influential external factor, accounting for nearly 38 percent of the forecast variance at period five and stabilizing around 41 percent in the long run. This substantial and persistent influence underscores the importance of monetary conditions in shaping private investment dynamics in Bangladesh.

GDP growth shocks also play a notable, though comparatively smaller, role in explaining private investment fluctuations. Their contribution rises steadily from about 19 percent in period two to nearly 18 percent in the long run, suggesting that output conditions exert a sustained impact on investment behavior consistent with accelerator-type dynamics. In contrast, public investment growth contributes only marginally to the variance of private investment, with its share peaking around 6–7 percent over the horizon. The relatively minor role of public investment shocks corroborates the weak crowding-in effect observed in the impulse response analysis. Overall, the variance decomposition highlights a dual dominance of real interest rate and GDP growth shocks in driving private investment fluctuations, pointing to the joint significance of monetary and real-sector dynamics in explaining investment variability in Bangladesh.

The variance decomposition of private investment growth complements the IRF findings by identifying the relative contributions of each variable's shocks to forecast error variance over time. In the first period, fluctuations in private investment growth are entirely self-driven, with 100 percent of its forecast error variance attributable to its own innovations. However, this share declines rapidly as external influences become more prominent: by the fifth period, private investment's own

shocks account for only about 41 percent of the variance, while real interest rate shocks explain nearly 38 percent, GDP growth shocks around 16 percent, and public investment growth roughly 5 percent.

Over the longer horizon (20 to 30 periods), the relative importance of these shocks stabilizes. Private investment's own shocks continue to explain about one-third of the forecast variance, while real interest rate shocks remain the single largest external contributor, accounting for approximately 41 percent. GDP growth shocks retain a significant though secondary role, explaining nearly 18 percent of the variance, whereas public investment shocks persist as a minor factor, contributing only about 6 to 7 percent. These results reinforce the centrality of monetary conditions—proxied by real interest rate movements—in driving private investment volatility, alongside a meaningful but smaller influence of aggregate output dynamics.

Table 8: Variance Decomposition of Private Investment Growth

Period	S.E.	PVTINV_GR	GDP_GR	PUBINV_GR	REALINT
1	2.911483	100.0000	0.000000	0.000000	0.000000
2	3.576136	66.51720	19.47251	4.105514	9.904781
3	3.629330	64.74210	20.67963	4.925561	9.652703
4	3.961903	54.34230	21.58011	4.594890	19.48270
5	4.580792	40.67099	16.14996	5.225883	37.95316
6	4.838281	37.33519	14.65249	5.363994	42.64833
7	4.856741	37.10370	14.56228	6.003031	42.33099
8	4.899672	36.53900	14.30904	5.903930	43.24803
9	4.951248	35.99936	15.11644	5.943001	42.94120
10	4.980417	35.58463	16.05854	5.892974	42.46386
11	4.994647	35.42463	16.30665	6.010463	42.25827
12	5.018273	35.09380	16.85679	6.168702	41.88070
13	5.053116	34.61322	17.46756	6.173871	41.74535
14	5.074106	34.38238	17.60649	6.361693	41.64944

15	5.086917	34.22418	17.71034	6.622983	41.44250
16	5.095151	34.11848	17.86961	6.685261	41.32665
17	5.099382	34.08913	17.88944	6.732461	41.28897
18	5.102052	34.06392	17.87863	6.799046	41.25840
19	5.103864	34.03979	17.88869	6.809905	41.26162
20	5.104459	34.03348	17.89421	6.810568	41.26175
21	5.105490	34.02135	17.88725	6.814054	41.27735
22	5.106717	34.00535	17.88286	6.812139	41.29965
23	5.107209	33.99898	17.88825	6.810947	41.30182
24	5.107471	33.99558	17.88997	6.810649	41.30380
25	5.107896	33.99003	17.89303	6.810753	41.30618
26	5.108236	33.98566	17.90236	6.810075	41.30191
27	5.108460	33.98279	17.90853	6.810343	41.29834
28	5.108679	33.97996	17.91288	6.812303	41.29486
29	5.108918	33.97677	17.91890	6.813319	41.29100
30	5.109112	33.97435	17.92304	6.814192	41.28841

Taken together, the IRF and VDC analyses suggest that private investment growth in Bangladesh is predominantly shaped by its own past behavior and by shocks to real interest rates, with GDP growth playing a supportive role and public investment exerting only marginal influence. The dominance of real interest rate shocks, both in magnitude and persistence, highlights the sensitivity of private investment to financial conditions and underscores the importance of effective monetary management. Meanwhile, the limited contribution of public investment shocks suggests that government spending alone may be insufficient to catalyze private investment unless complemented by broader macroeconomic stability and growth. These dynamic insights provide valuable guidance for policy, emphasizing the need for coordinated fiscal and monetary strategies to foster private sector–led growth.

5. Findings and Policy Implications

This study examined the dynamic relationship between private investment growth, public investment growth, GDP growth, and the real interest rate in Bangladesh using a vector autoregression (VAR)

framework. The model selection process, guided by AIC, FPE, and LR criteria, established a four-lag specification that satisfies stability conditions as confirmed by AR root tests and residual diagnostics. Granger causality tests reveal that GDP growth, public investment growth, and real interest rates jointly predict private investment growth, underscoring the interconnectedness of real and financial sectors. Dynamic analysis through impulse response functions (IRFs) and forecast error variance decomposition (FEVD) further demonstrates that shocks to real interest rates and GDP growth are the dominant drivers of private investment fluctuations, while the impact of public investment remains comparatively modest.

The VAR results highlight an strong accelerator effect: past GDP growth significantly boosts private investment growth. This implies that when the economy expands, firms respond by increasing capital expenditure to meet higher expected demand and profitability. For Bangladesh, this finding underscores that policies which stimulate broad-based economic growth indirectly foster private investment, even more effectively than direct fiscal incentives in some cases. To achieve this, the government should focus on enhancing productivity and diversification by investing in sectors with high value addition, improving infrastructure and logistics to reduce costs and facilitate business operations, and maintaining macroeconomic stability to build investor confidence. Integrating investment promotion within a comprehensive growth strategy—rather than relying solely on isolated incentives—will create a conducive environment where private investment can flourish organically alongside economic expansion.

While public investment exerts only a modest crowding-in effect, its role could be strengthened by prioritizing quality over quantity. Redirecting expenditures toward high-return infrastructure projects—such as transportation, renewable energy, and industrial zones—can enhance complementarities with private capital. Moreover, improving project governance and financing transparency would reduce inefficiencies and bolster investor confidence. This requires not only efficient project selection and implementation but also transparent financing mechanisms that minimize adverse effects on domestic borrowing costs. In parallel, strengthening financial intermediation and deepening capital markets can

enhance the responsiveness of private investment to both fiscal and monetary signals.

The procyclical relationship between real interest rates and private investment underscores structural gaps in Bangladesh's financial intermediation. Expanding capital market depth, broadening access to term financing, and strengthening credit risk management would improve the responsiveness of private investment to macroeconomic signals. Integrating financial reforms with fiscal discipline and growth strategies would create a virtuous cycle of investment and development.

Overall, the results underscore that private investment dynamics in Bangladesh are shaped by a combination of macroeconomic growth conditions and financial factors, with fiscal influences playing a secondary role. A policy mix that simultaneously fosters stable financial conditions, sustains economic growth momentum, and improves the efficiency of public spending is likely to yield the greatest dividends for private sector development. Future research could extend this analysis by incorporating structural breaks, sectoral investment data, or non-linear dynamics to further refine policy prescriptions in light of evolving macroeconomic conditions.

References

Acosta, P. and Loza, A. (2005). Short and long run determinants of private investment in Argentina. *Applied Economics*, 8, 389-406.

Aghion, Philippe. 2005. "Growth and Institutions." *Empirica* 32(1):3–18.

Ahmed, Shamim, and Md. Ezazul Islam. 2004. "Http://Www.Jstor.Org Interest Rate Responsiveness of Investment Spending in Bangladesh." *The Bangladesh Development Studies* 30(1/2):65–109.

Ahmed, S., & Miller, S.M. (2000). "Crowding-Out and Crowding-In Effects of the Components of Government Expenditure." *Contemporary Economic Policy*, 18(1), 124–133.

Anderson, D. (1990), Investment and economic growth. *Journal of World Development*, 18(8), 1057-1079.

Ari, Ibrahim, and Muammer Koc. 2020. "Economic Growth, Public and Private Investment: A Comparative Study of China and the United States." *Sustainability* 12(6): 2243.

Aschauer, D.A. (1989a). "Is Public Expenditure Productive?" *Journal of Monetary Economics*, 23(2), 177–200.

Aschauer, D.A. (1989b). Does pubic capital crowd out private capital? *Journal of Monetary Economics,* 24, 171-88.

Auerbach, A. J., & Gorodnichenko, Y. (2012). Measuring the output responses to fiscal policy. *American Economic Journal: Economic Policy*, 4(2), 1–27.

Aye, G.C., Miller, S.M., Gupta, R. et al. Forecasting US real private residential fixed investment using a large number of predictors. *Empir Econ* 51, 1557–1580 (2016).

Baldacci, E., & Kumar, M. S. (2010). Fiscal deficits, public debt, and sovereign bond yields. *IMF Working Paper*.

Bano, Shabnam Sazma. 2018. "The Dynamic Relationship between Real Interest Rate and Investment: An Empirical Analysis for Selected Pacific Island Countries." *International Journal of Economics and Financial Issues*, 2018, 8(5), 131-141

Barro, R.J. (1990). "Government Spending in a Simple Model of Endogenous Growth." *Journal of Political Economy*, 98(5), S103–S125.

Blanchard, O., & Johnson, D. R. (2013). *Macroeconomics* (6th ed.). Pearson.

Blejer, M. I., & Khan, M. S. (1984). Government policy and private investment in developing countries. *IMF Staff Papers*, 31(2), 379–403.

Calderón, C., & Servén, L. (2010). Infrastructure and economic development in Sub-Saharan Africa. *Journal of African Economies*, 19(suppl_1), i13–i87.

Checchi, D., Galeotti, M. (1993), The relationship between employment and investment: Theoretical aspects and empirical evidence for Italy. *Journal of Applied Economics*, 25(1), 13-24.

Easterly, W., & Rebelo, S. (1993). Fiscal policy and economic growth. *Journal of Monetary Economics*, 32(3), 417–458.

Elmendorf, D. W., & Mankiw, N. G. (1999). Government debt. In *Handbook of Macroeconomics* (Vol. 1, pp. 1615–1669).

Enders, W. (2015). *Applied econometric time series (4th ed.).* Wiley.

Erden, Lutfi and Randall Holcombe (2006) The linkage between public and private capital: A co-integration analysis of a panel of developing countries. *Eastern Economic Journal*, 32, 479-492.

Evans, P. and Karras, G. (1994) 'Are government activities productive? Evidence from a panel of U.S. states', *Review of Economics and Statistics*, Vol. 76, No. 1, pp. 1–11.

Fleming, J. M. (1962). Domestic financial policies under fixed and floating exchange rates. *IMF Staff Papers*, 9(3), 369–380.

Ghura, D., & Goodwin, B. (2000). Determinants of private investment: A cross-regional empirical investigation. *Applied Economics*, 32(14), 1819–1829.

Greene, J. and Villanueva, D. (1991) Private investment in developing countries: an empirical analysis, *IMF Staff Papers*, 38, International Monetary Fund, Washington D.C.

Haque, N. U., & Montiel, P. J. (1993). Fiscal policy in open developing economies. *IMF Staff Papers*, 40(2), 270–302.

Holtz-Eakin, D. (1994) 'Public-sector capital and productivity puzzle', *Review of Economics and Statistics*, Vol. 76, No. 1, pp. 12–21.

Hossain, M., & Islam, M.S. (2013). "Investment and Economic Growth in Bangladesh: An Empirical Analysis." *World Review of Business Research*, 3(1), 129–139.

International Monetary Fund. (2014). *Fiscal* policy and income inequality. IMF Policy Paper.

Islam, Md. R. (2017). A Disaggregated Econometric Analysis of Domestic Investment in Bangladesh: Issues and Challenges. *IOSR Journal of Economics and Finance*, 08(03), 58–74.

Jorgenson, D. W. (1963). Capital theory and investment behavior. *American Economic Review*, 53(2), 247–259.

Jorgenson, D. W. (1971). Econometric studies of investment behavior: A survey. *Journal of Economic Literature*, 9(4), 1111–1147.

Kamrul Hassan, A. F. M., & Salim, R. A. (2011). Determinants of private investment: Time series evidence from Bangladesh. *Journal of Developing Areas*, 45(1), 229–249.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. Macmillan.

Luintel, B. K. and Mavrotas, G. (2005) Examining private investment heterogeneity: evidence from a dynamic panel, *UNU-WIDER Discussion Paper* No. 2005/11.

Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Springer-Verlag.

Munnell, A.H. (1990) 'Why has productivity declined? Productivity and public investment', *New England Economic Review*, Vol. 30, pp. 3–22.

Nazmi, N. and Ramirez, M.D. (1997) 'Public and private investment and economic growth in Mexico', *Contemporary Economics Policy*, Vol. 15, No. 1, pp. 65–75.

Ngouhouo, I., Mouchili, E. (2014), Savings, investment and economic growth in Cameroun: A multivariate approach. *International Journal of Economics and Finance*, 6(9), 244-252.

Obstfeld, M., & Rogoff, K. (1996). *Foundations of International Macroeconomics*. MIT Press.

Pereira, A. M., & Roca-Sagales, O. (2001). Infrastructures and private sector performance in Spain. *Journal of Policy Modeling*, 23(4), 371–384.

Raihan, S. (2010). "Infrastructure and Investment: A Panel Study in South Asia." *South Asian Economic Journal*, 11(2), 257–273.

Servén, L. (2003). Real-exchange-rate uncertainty and private investment in LDCs. *Review of Economics and Statistics*, 85(1), 212–218.

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica*, 48(1), 1–48.

Tatom, J.A. (1991) 'Public capital and private sector performance', *Federal Reserve Bank of St. Louis Review*, Vol. 73, No. 3, pp. 3–15.

Wai, U.T. and Wong, C. (1982) 'Determinants of private investment in developing countries', *Journal of Development Studies*, Vol. 19, pp. 19–36.

World Bank. (2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chains*. World Bank.