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Abstract

This paper analyses the impact of monetary policy shocks on investment, foreign direct investment (FDI), and exchange rates in Bangladesh, alongside other key macroeconomic variables such as real GDP, consumption, exports, and inflation. Using a Structural Vector Autoregression (SVAR) model, the study investigates how changes in monetary policy instruments—specifically the bank lending rate and money supply—affect the economy. The findings reveal that while capping interest rates can stimulate investment, it negatively affects inflation and exchange rates. Expansionary monetary policy, aimed at stimulating investment by capping interest rates, has led to higher inflation and depreciation pressures. The study recommends a more comprehensive policy approach, combining fiscal incentives like tax breaks with flexible interest rate policies to promote sustainable investment and macroeconomic stability. These insights can assist policymakers in Bangladesh and other developing countries in crafting effective monetary strategies to achieve long-term growth and stability.

Keywords: Interest rate cap, Monetary policy, Private investment, Foreign Direct Investment (FDI), Inflation.

JEL codes: E44, E52, F21, F31, C32

1. Introduction

Monetary policy in Bangladesh is structured around a monetary targeting framework, with the primary goals of maintaining price stability and ensuring the robustness of the financial system. The Bangladesh Bank, the country's central bank, is responsible for the formulation and implementation of this policy. In recent years, Bangladesh Bank has adopted a policy of maintaining low interest rates to stimulate investment, operating on the premise that reduced borrowing costs can boost economic activity by encouraging both private and public sector investment. However, while such a policy might stimulate investment in the short term, it can also have significant implications for the broader macroeconomic environment.

Lower interest rates often lead to a depreciation of the national currency, which is a concern for both domestic and foreign investors, as it creates volatility in the foreign exchange market. Prolonged periods of low interest rates can generate expectations of further currency depreciation, leading investors to delay investments, waiting for more favourable exchange rates to maximise returns (Brada, Kutan, & Yigit, 2006). If the central bank allows the exchange rate to adjust freely to market conditions, inflationary pressures may arise in the domestic market (Dornbusch, 1976). On the other hand, if the bank intervenes to stabilise the currency, there will still be expectations of future depreciation, which can undermine investor confidence. This instability can particularly affect foreign direct investment (FDI), as fluctuations in the exchange rate diminish the value and returns of such investments (Cavallo, 2005).

Uncertainty in the economic environment significantly influences future growth prospects, dampening consumer confidence and reducing economic activity. Monetary policies that alter interest rates impact domestic investment by affecting borrowing costs, and a stable and competitive exchange rate provides certainty for economic agents engaged in international trade and investment. Such stability is essential for attracting FDI, which plays a critical role in promoting economic growth and development (Rodrik, 2008). Central banks can moderate short-term economic fluctuations by adjusting monetary tools, but much of the existing research in this field focuses on developed economies. There is a relative scarcity of studies examining the impact of monetary policy shocks in developing economies such as Bangladesh (e.g., Ahmed & Islam, 2004; Yunus, 2004; Rahman & Ahmed, 2014; Hossain & Chowdhury, 2020).

This study utilises two key monetary policy variables – the bank lending rate and the money supply – to capture the effects of monetary policy shocks. A Structural Vector Autoregression (SVAR) model is employed to identify these exogenous shocks and analyse their effects on exchange rates, investment (including FDI), and other macroeconomic variables in Bangladesh by imposing theoretically motivated restrictions. Following the pioneering work of Sims (1980), the VAR model has become one of the most popular and widely used empirical methodologies for evaluating monetary policy (Bernoit & Peersman, 2001). This paper also aims to determine which monetary transmission channels are most effective in stabilising the economy by observing the response of key

macroeconomic variables. Impulse response functions (IRFs) and forecast error variance decompositions (FEVDs) are calculated to assess the dynamic reactions of these variables to policy shocks.

Our study contributes to the empirical literature by thoroughly examining the effects of monetary policy shocks on the volatility of exchange rates, investment (including FDI), and other key macroeconomic variables within the Bangladeshi economy. While most existing studies have focused on the response of price levels and output to government spending, this research provides a comprehensive analysis of the response of multiple macroeconomic indicators to monetary policy shocks. The findings reveal that such shocks have an immediate short-run impact on several macroeconomic variables. For example, a positive interest rate shock has a negative effect on both the exchange rate and domestic investment, while an increase in the money supply positively influences both the exchange rate and domestic investment. Nevertheless, alongside monetary policy, other measures proven effective in promoting macroeconomic stability should also be considered.

The structure of the paper is as follows: Section 2 presents a literature review. Section 3 introduces the data and methodology used in the SVAR model and describes the identification scheme. Section 4 provides a detailed empirical analysis, while Section 5 concludes the paper.

2 Literature Review

2.1 The Effectiveness of monetary policy in the context of developing countries

Monetary policy has been the fundamental instrument over the years in attaining macroeconomic stability and as a prerequisite to attaining sustainable output growth (Okotori, 2019). Mathai (2012) viewed monetary policy as the regulating amount of the supply of money in a country’s economy in order to attain an optimal mix of output and inflation goal realisation.

While Chowdhury (2016) found weak effects, our estimations show that the monetary policy could significantly impact several macroeconomic variables, including GDP growth, consumption, investment, and other financial variables. Forhad, Homaifar, and Salimullah (2017) investigated the effectiveness of the monetary transmission procedure in the context of Bangladesh's economy. The findings of the paper support monetary non-neutrality. Both nominal and real macroeconomic variables respond to a monetary policy shock of increasing interest rates. Researchers and decision-makers consider the parameters of monetary policies to be the only feasible outcome to mitigate short-run economic fluctuations.

The effectiveness of monetary policy has been explored both theoretically and empirically showing mixed results in developing countries (Mishra, Montiel, & Sengupta, 2016) with some studies suggesting that monetary policy has minimal or no impact on economic growth, while others argue

that it plays a crucial role (Daoui, 2023). However, researchers and decision-makers have remained sceptical regarding which variables to consider. Cevik and Reksoz (2013) critically discuss the efficacy of monetary channels in the Gulf Cooperation Council (GCC). Using recursive structural vector autoregressive procedure and impulse response functions, they find out that bank policy rates have a significant impact on consumer prices and hydro-carbon output. Because of the pegged exchange rate system, exchange rate channels turn out to be an ineffective monetary management procedure.

A critical analysis by Shokr, Karim, and Zaidi (2019) uses a non-recursive SVAR model to estimate the effects of monetary and foreign policy shock on the economy of Egypt, specifically focusing on GDP, inflation, and exchange rates. They found that changes in lending rate or reserve money significantly affect output, inflation, and exchange rate. Moreover, foreign output and world oil prices significantly affect these domestic macroeconomic variables. The analysis suggests that the bank should modify the interest rate to maintain a constant level of price and output. Karim and Karim (2014) employed an open economy structural vector autoregression model (SVAR) to examine the effect of monetary policy during the period of interest rate targeting in Malaysia. The study collected monthly data to test the impact of foreign shock and the effectiveness of monetary policy on domestic macroeconomic aggregates. The results demonstrated that monetary policy has major effects on macroeconomic indicators during the framework under interest rate targeting.

This study adds to this branch of literature by providing new evidence of monetary policy effectiveness in Bangladesh. There has been a huge literature on the effectiveness of monetary policies in the context of developed countries compared to developing countries. The USA, UK, France, Germany, Australia, and other highly developed countries, have indeed been successful in establishing monetary policy instruments in stabilising their economy. Moreover, the strategy behind the monetary transmission mechanism has gained greater concern among policymakers.

2.2 Exchange rate volatility and monetary policy shock

Ozturk (2006) defined exchange rate volatility as being associated with exchange rate movements that are unexpected. Exchange rate volatility has inflationary tendencies, prompting central banks to closely monitor and manage it (Eze & Okotori, 2022). Ndung'u (1999) assessed if the rate of exchange of Kenyan currency is influenced by the monetary authority's policy actions and whether the observed impact is temporary or consistent. The study's findings reveal that from 1970 to 1994, the nominal exchange rate was influenced by real income growth, inflation rate, money supply expansion, cyclical movements in real exchange rate volatility, cointegrating vectors, and shocks.

The effects of unexpected changes in monetary policy on the exchange rate remain a controversial issue, as previous studies revealed intriguing results of empirical tendency such as the "delayed overshooting puzzle". According to Dornbusch's (1976) simple overshooting model, the nominal exchange rate appreciates immediately in response to a positive shock to the interest rate and gradually depreciates following uncovered interest parity (UIP). Kim and Lim (2018) reported quite a short delay in overshooting of the exchange rate followed by a contractionary monetary policy shock in the economies of the UK, Canada, Sweden, and Australia. The paper outlined that the length of the

delay in overshooting lasted not more than six months at best. However, more severe puzzles such as the exchange rate puzzle, delayed overshooting puzzle, and forward bias puzzle were discovered by them in an experimental study with a similar focus on six emerging countries including Korea, Thailand, Philippines, Mexico, Brazil, and Colombia in 2022 featuring small open economies.

Eichenbaum and Evans (1995) hypothesised that both nominal and real exchange rates exhibit significant and prolonged depreciation due to a positive monetary policy shock in the US economy. The recursive VAR followed by Sims (1980), along with impulse responses, revealed that the delay persists for two to four years. They discovered less volatility in monetary policy during the fixed exchange rate regime compared to the flexible exchange rate period. The response of relative prices to real changes is crucial in understanding the determinants of exchange rates. Some other studies suggested by Scholl and Uhlig (2008), Bouakez and Normandin (2010), and Heinlein and Krolzig (2012) highlighted that the duration of the delay in overshooting persists for a long time accompanied by a significant deviation from the uncovered interest rate parity (UIP). Grilli and Roubini (1995) constructed an empirical model of recursive VAR for G-7 countries excluding the US. The findings support the exchange rate puzzle phenomenon, contractionary monetary policy shock leads to exchange rate depreciation instead of appreciation.

Exchange rate volatility has been a serious issue of concern for academia, policymakers, and participants in financial markets across all economies worldwide (Rigobon, 2016). The research by Adeoye and Saibu (2014) conducted an analysis uncovering the relationship between fluctuations in the exchange rate and monetary policy shocks in the context of the Nigerian economy. The short-run dynamics indicate that changes in monetary policy instruments correlate to the variations in the rate of exchange through a self-correcting process without the involvement of the CBN (the Central Bank of Niger). Moreover, the study found a causal link between these two suggesting that the past values of monetary policy variables cause volatility in the exchange rate. However, this analysis emphasizes combining monetary policy with exchange rate policy to achieve macroeconomic stability through mitigating exchange rate volatility.

The monetary policy transmission mechanism through which the central bank ensures macroeconomic stability has undergone substantial changes due to the dynamic nature of economic conditions. Countries adopt different frameworks such as inflation-targeting regimes and floating exchange rate regimes within the economy to control inflation and exchange rate volatility. Fluctuations in exchange rate influence trade competitiveness affecting the profit margin of export and import firms.

This study contributes to this stream of literature by providing new findings of the effectiveness of contractionary or expansionary monetary policy on the exchange rate volatility, especially in the short term. These findings will help policymakers to identify the trade-off of a certain monetary policy regime more precisely and help them take decisions more efficiently.

2.3 Monetary policy shocks on domestic and foreign investment

Foreign direct investment contributes to fostering the growth and prosperity of the nation's economy in several ways. It has been considered a significant source of capital inflow from foreign investors to the host country facilitating technology spillovers, employment creation, development of managerial skills, and productivity enhancement (Blomstrom & Kokko, 1997; Jensen, 2003). On this note, Karahan and Bayır (2022) argued that monetary policy has an effect on attracting foreign direct investment, with expansionary or contractionary monetary policy having a negative or positive impact on FDI inflows. Albulescu and Ionescu (2018) also argued that uncertainty in monetary policy negatively impacts FDI inflows. Additionally, other research suggests that the financial environment of the host country can influence the investment decisions of FDI enterprises (Kellard et al., 2022).

Senibi et al. (2017) evaluated the behaviour of non-policy variables including domestic investment, FDI, and public debt to real exchange rate shock and lending rate shock by constructing the SVAR framework on the economy of Nigeria. While domestic investment responds positively to a positive shock from the lending rate associated with a high rate of inflation, the response of FDI is insignificant. They highlighted that the reason behind this lower expectation of foreign investors is the high interest rate along with high inflation. Min, Wen, and Wang (2022) experimented with a study on the Chinese economy and found an insignificant response of aggregate investment to lending rate shock but significant to money supply shock. Moreover, an insignificant effect is evident in private and foreign investment following a positive interest rate shock. Both fiscal and monetary policies contribute to enhancing domestic investment in China. There is no need for the Chinese government to enact comprehensive economic stimulus packages to bring domestic investment growth.

FDI decisions are often influenced by exchange rates. Companies and investors involved in cross-border investments and international trade prefer a stable and predictable exchange rate to ensure their profitability in investments. Volatility in currency exchange rates could result in macroeconomic instability which deter FDI inflows. (Eregha (2017) found that exchange rate uncertainty negatively affects FDI flow in the West African Monetary Zone (WAMZ). Maintaining stable exchange rates reduces the perceived risk of investing in the country which is essential for attracting FDI inflows. Central banks, through their monetary policy instruments, can significantly affect foreign direct investment and exchange rates. Fratzscher, Saborowski, and Straub (2009) empirically analysed the impact of exogenous monetary policy shocks on the composition of capital flows and trade balance on the economy of the U.S. This study estimated the structural vector autoregression model and observed the dynamic behaviour of some macroeconomic variables through impulse responses. A persistent and significant positive response is found in the net inflow of FDI which lasts for almost two years. The results also provide the existence of portfolio rebalancing motive behind investment decisions in equity. However, it does not give any insights into how investors could adjust their portfolios in response to monetary policy shocks.

The study expands the literature by providing evidence on the nexus or link between changes in monetary policies and investment decisions of the firm. Factors related to the underlying nature and

characteristics of domestic investment and FDI are the reasons behind the differential responses of these two categories of investments to changes in monetary policy. Domestic investment may have a relatively greater immediate impact, especially those financed by domestic borrowings, due to changes in monetary policies. On the other hand, FDI is sensitive to a lot of factors such as domestic market conditions, infrastructural development, technological advancement, stable political regulatory bodies, law and order, bureaucratic circumstances, etc.

3. Data and Methodology

The primary goal of monetary policy in Bangladesh, as in other countries, is to achieve price stability, keep inflation within a target range, and foster robust economic growth. Understanding the effects of monetary policies is crucial for ensuring broad-based, inclusive economic growth. This has led monetary authorities in developing countries to take responsibility for maintaining balanced and stable growth.

The main purpose of this study is to investigate the sensitivity of major macroeconomic aggregates—especially domestic investment, foreign direct investment, and exchange rates—to monetary policy shocks. Central banks generally target the money supply or interest rate channels to influence economic activity. It is important to examine how effective these monetary policy transmission processes are in stabilising economic conditions.

To keep our model simple and concise, we incorporated major macroeconomic variables along with FDI and exchange rates. This paper examines the effects of orthogonalised shocks on the lending rate and the ratio of the money supply to GDP (broad money) on selected macroeconomic indicators over the sample period. Multiple factors in the economy respond to changes in interest rates, either directly or indirectly.

3.1 Data source

Annual time series data were collected for the period spanning from 1986 to 2022. The data were sourced from the World Development Indicators, a comprehensive database published by the World Bank. This source is widely recognised for its reliability and extensive coverage of economic and social indicators. To facilitate analysis, the actual data were converted into logarithmic units. This transformation helps in stabilising the variance and normalising the distribution of the data, making it more suitable for econometric modelling and interpretation. Additionally, the logarithmic transformation aids in understanding the percentage changes rather than absolute changes, which is particularly useful in economic analysis.

Data for the years 1973 to 1985 were excluded from the study to avoid issues related to missing and negative values. Including these years could introduce bias and inaccuracies into the analysis, as

dealing with incomplete or problematic data can complicate the modelling process and lead to unreliable results. By focusing on the period from 1986 onwards, the study ensures a more consistent and robust dataset, enhancing the validity of the findings. This approach allows for a clearer investigation of the relationships between the selected macroeconomic variables and monetary policy shocks, providing a solid foundation for empirical analysis and contributing valuable insights into the dynamics of Bangladesh's economy.

3.2 Data description

The sample data sourced from the aforementioned secondary site are compiled in an orderly manner so that they can be easily applied to our econometric modelling. The estimation work is done using yearly data because some of the real sector data (GDP, consumption, investment) are not well structured in terms of time-frequency for the studied period. A total of 37 observations have been arranged for the relevant variables. In VAR we regress each variable on the other variables. Therefore, we do not need to specify dependent and independent variables.

Data on GDP, consumption, domestic investment, FDI, and exports are measured in real terms. Consumer price index data is collected to get some insights about inflation. Lending rate and broad money are used as proxies for monetary policy variables to measure interest rate and money supply respectively. Actual data for the variables except for lending rate and broad money are transformed into a natural logarithmic scale for estimation purposes. In existing literature, these variables are regarded as standard variables providing a deeper insight in understanding the effectiveness of monetary policy in the context of Bangladesh. The descriptions of the variables used in this analysis are presented in Table 1.

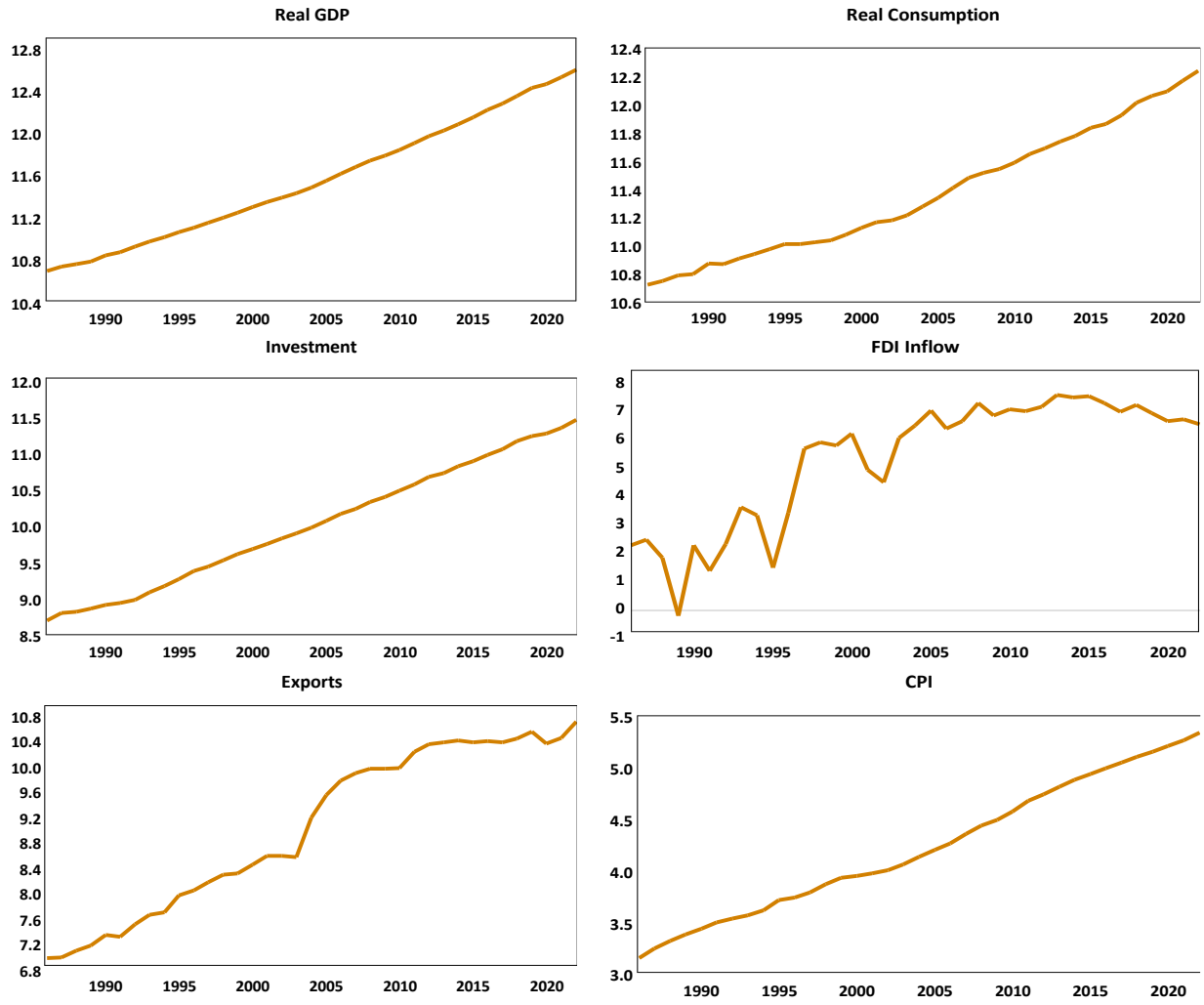
Table 1: Description of variables

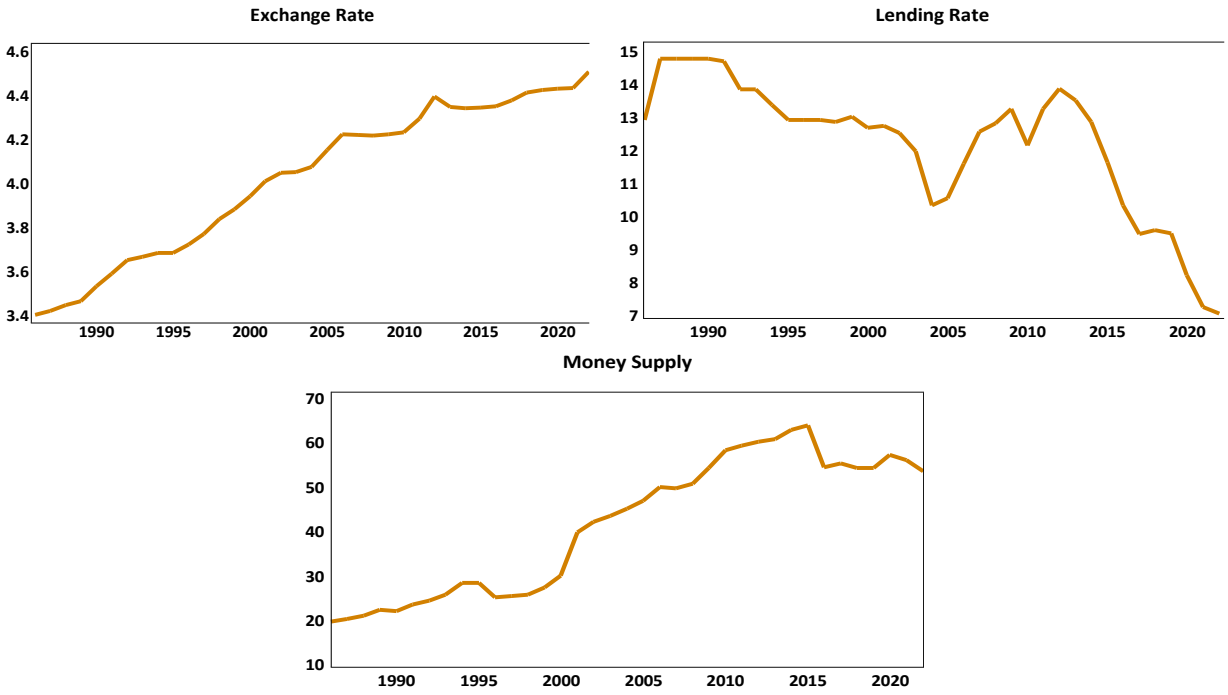
Variable	*Description*
Export Earnings	Exports of goods and services (constant 2015 USD)
Exchange Rate	Official exchange rate (LCU per USD, period average)
Gross Domestic Product (GDP)	Gross Domestic Product (constant 2015 USD)
Consumption	Households and NPISHs Final Consumption Expenditure (constant 2015 USD)
Interest Rate	Lending Interest Rate (%)
Investment	Gross Capital Formation (constant 2015 USD)/ Domestic Investment
Foreign Direct Investment (FDI)	Foreign Direct Investment, net inflows (FDI, net inflow, bop, constant USD)
Money Supply	Broad Money (%)
Inflation	Consumer Price Index (2010=100)

Source: World Development Indicators (World Bank)

Before analysing the statistical measurement of data for the estimation procedure, it is important to view the historical patterns or behaviour of the data over the sample period. Figure 1 helps provide some fundamental insights into the performance of macroeconomic aggregates over the sample period. Real GDP, real consumption, domestic investment, and exports maintained a consistent upward trend throughout the sample period. Along with the increase in these major macroeconomic indicators, the country experienced an overall steady increase in the price index, contributing to inflation. The FDI inflow is inconsistent and fluctuates more or less over the sample period. Weak infrastructure, political unrest, geopolitical events, lack of innovations, and technology transfer serve as barriers to attracting FDI inflow. The local currency of Bangladesh (taka) is losing its value against the US dollar and is expected to depreciate further due to huge financial outflows.

Figure 1: Behaviour of macroeconomic indicators over the sample period (1986-2022)





Source: Authors' estimation using WDI data.

3.3 Summary statistics

Table 2 provides descriptive statistics of the variables in the studied period. It helps demonstrate a brief fundamental idea about the various measures of central tendency, variability, distribution, etc. For example, the mean values of the log of GDP and the log of consumption are 11.588 and 11.393 respectively. The mean values for the other respective variables are reported in Table 2. These statistics allow data to be presented more comprehensively. There is a mix of smaller and larger values of standard deviations. However, if we observe the range of values, considerable variations among the variables can be witnessed.

Table 2: Summary statistics

Variable	*Obs.*	*Mean*	*Std. Dev*	*Min*	*Max*
LN_GDP	37	11.588	.58088	10.7313	12.6298
LN_Real Consumption	37	11.39296	.4552889	10.746	12.2652
LN_Domestic Investment	37	10.06399	.8570146	8.75013	11.5128
LN_FDI Inflows	37	5.3355	2.2287	-.20355	7.62357
LN Export Earnings	37	9.08165	1.28588	7.02783	10.7529
LN_CPI	37	4.26235	.65360	3.18965	5.3746
LN_Exchange Rate	37	4.032952	.349224	3.4146	4.5190
Interest Rate	37	12.292	2.042	7.121	14.846
Money Supply	37	42.199	15.306	20.198	64.507

Source: Authors' estimation using WDI data

Since multiple linear regression models are introduced in the estimation work, there is a high chance of correlation between variables. The correlation of GDP with consumption and investment is much higher. These macroeconomic variables tend to move along with the expansion of GDP, at least in the short run. Our data also supports their positive association which is evident from Figure 1. Therefore, variables might be highly correlated with each other because of the high value of the coefficient of correlation. The correlation coefficient indicates the degree of strength and direction of the relationship between the independent and dependent variables. Multicollinearity is detected if the value of the correlation coefficient equals 0.8 or more (Gujarati & Porter, 2009). It is evident from Table 3 that all these macroeconomic variables share quite a high correlation between themselves.

Table 3: Correlation matrix

Variable	y	c	i	f	x	p	ex	r	ms
y	1.000								
c	0.9975	1.000							
i	0.9980	0.9923	1.000						
f	0.8262	0.7968	0.8514	1.000					
x	0.9646	0.9559	0.9753	0.8970	1.000				
p	0.9983	0.9950	0.9974	0.8327	0.9697	1.000			
ex	0.9653	0.9513	0.9768	0.9050	0.9873	0.9684	1.000		
r	-0.7934	-0.7920	-0.7800	-0.5777	-0.6814	-0.7684	-0.7129	1.000	
ms	0.8951	0.9063	0.9289	0.8539	0.9659	0.9214	0.9554	-0.5768	1.000

Source: Authors' estimation using WDI data

Note: y = GDP, c = consumption, i = investment, f= FDI, ex = export, r= lending rate, p= CPI, ex= exchange rate, ms= money supply

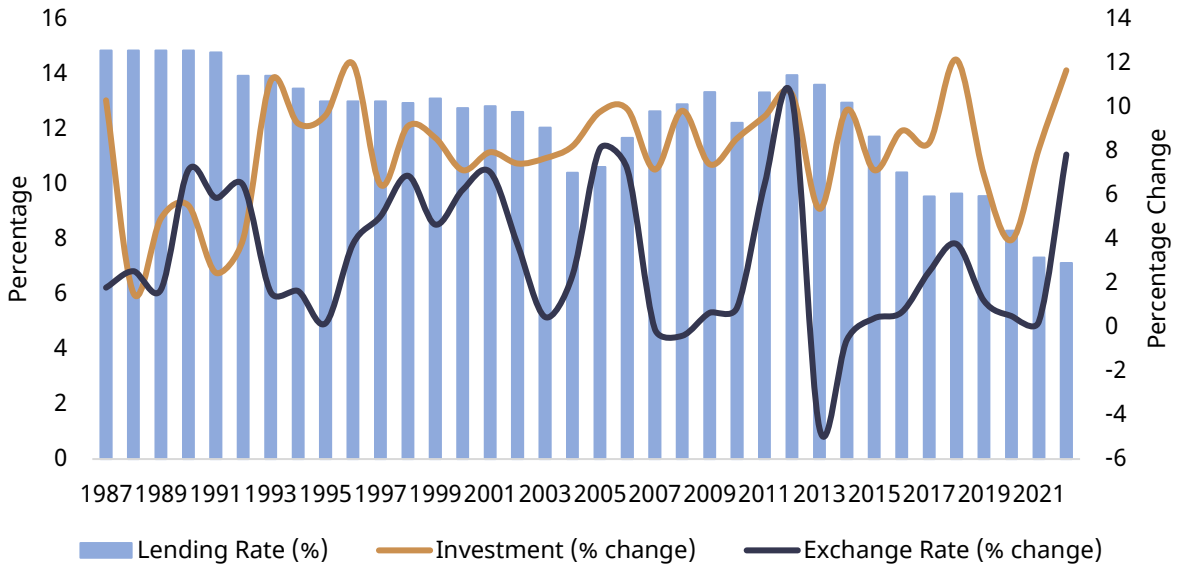
After the post-independence period, Bangladesh has undergone significant structural changes in its formation of economic status. Bangladesh initiated various structural economic reform programmes to balance the economy. Following this, in the mid-1980s, the country introduced structural adjustment programmes supported by the IMF international body to diversify the economy and stimulate macroeconomic performance. The democratic transition from semi-autocratic rule in 1990 marked a notable period in the political history of Bangladesh, helping to address structural imbalances in the economy. Moreover, trade liberalisation measures aimed at promoting export-based growth strategies integrated Bangladesh into the global market. At the beginning of 1990, Bangladesh experienced quite satisfactory robust growth in various macroeconomic indicators. The country observed a consistent economic growth of 5.44 percent in the first half of the 2000s which was remarkably much higher than its previous years.

Although FDI inflows were relatively low during the early stage of development, the growth phase started after the 2000s. According to the World Investment Report (2023) published by UNCTAD, Bangladesh received the highest FDI of $3.61 billion in 2018 reflecting an improved investment

climate for foreign investors.[1] However, the trend in FDI inflow was not regular. With the aim of ensuring the financial stability of the country, Bangladesh Bank started functioning in 1971. In 2003, the country changed its exchange rate policy by moving away from the fixed exchange rate regime to the flexible exchange rate regime with less intervention from the Bangladesh Bank. At the beginning period of the floating exchange rate regime, the exchange rate maintained less volatility. However, over the period the value of the taka has been depreciating against the US dollar. The exchange rate keeps fluctuating and a sharp depreciation has been noticed over the periods.

The monetary authority is responsible for conducting monetary policy orientations in Bangladesh through various cash and derivative banking instruments. The monetary transmission mechanism through which money supply affects the overall economy's output and price level remains a mystery due to the integration of the financial market and monetary innovations (Bernanke and Gertler 1995). From ANDRIEŞ's (2012) point of view, the monetary channelling process can be beneficial for the economy as long as decision-makers are aware of how it affects the economy and can use that knowledge to calibrate monetary policy and select the right tools for managing different short-term crises. Figures 2, 3, 4, and 5 illustrate the movement or fluctuations in the growth of investment, FDI and exchange rate in response to changes in monetary policy instruments.

Figure 2: Investment and exchange rate fluctuations to lending rate



[1] https://www.tbsnews.net/economy/348b-2022s-foreign-direct-investments-quadruple-next-year-bida-executive-chairman-663810

Figure 3: Investment and exchange rate fluctuations to money supply

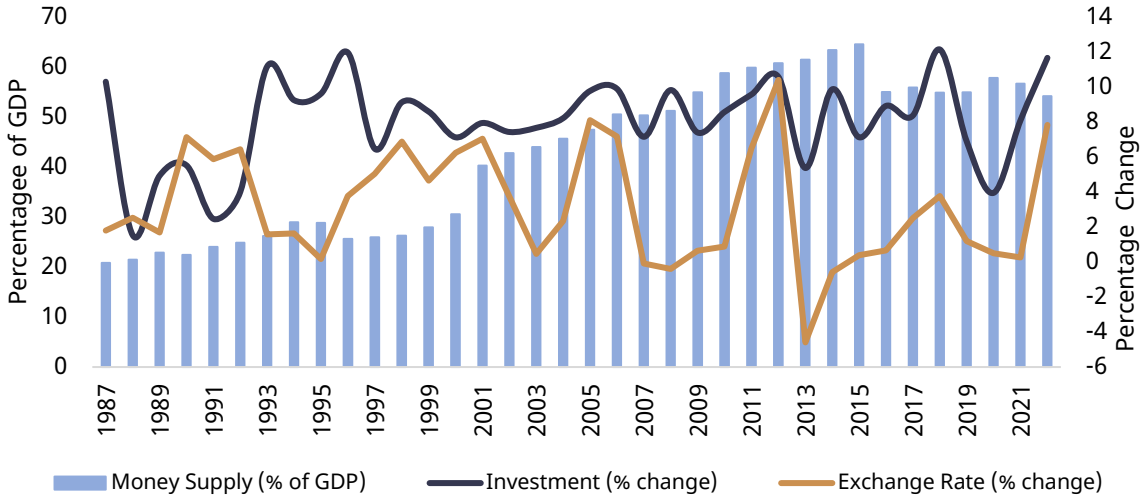


Figure 4: Fluctuations of FDI to lending rate

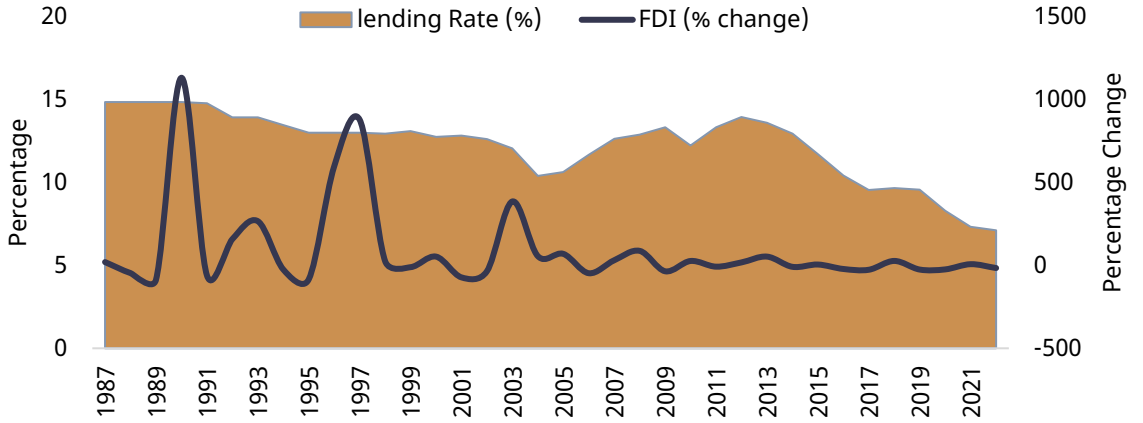
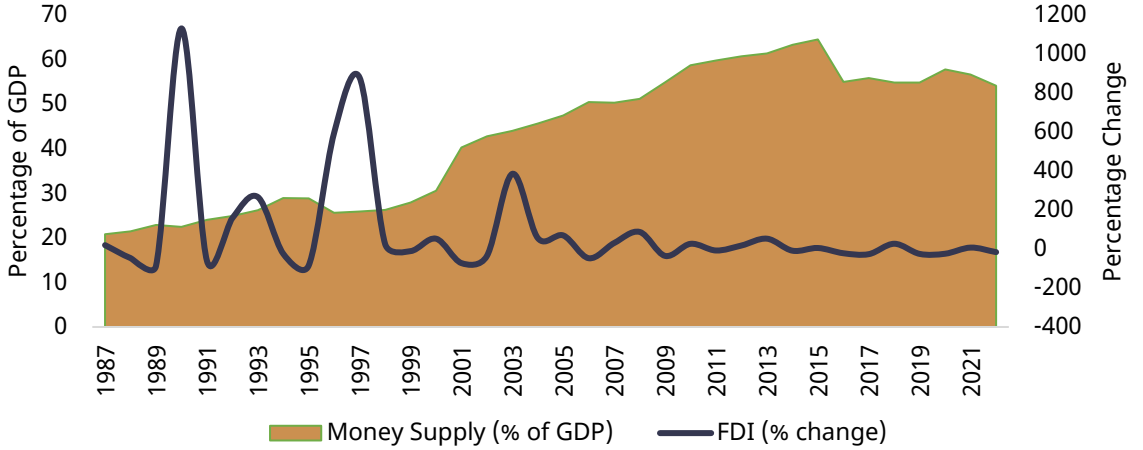


Figure 5: FDI fluctuations to money supply



Source: Authors' illustration using WDI data.

3.4 Data stationarity

The time series data gathered for the estimation of SVAR purposes must satisfy stationary conditions. The necessary property of conducting SVAR is that all of the specified series have to be stationary and integrated in the same order. A time series $\{x_t\}$ is stationary if the mean, variance, and autocorrelation can be well approximated by sufficiently long-time averages. Non-stationary series led autocorrelation problem, making Ordinary Least Squares (OLS) unsuitable for application. This paper will conduct the Augmented Dickey-Fuller (ADF) unit root test for data stationarity whether to see the data follows a regular pattern (convergence of mean, variance, and covariance) or not. As mentioned previously, the data are converted into natural logarithmic scale except for some variables for estimation purposes.

3.5 Methodology

This paper will try to estimate how responsive major macroeconomic variables are to a positive shock of monetary policy by applying the vector autoregressive (VAR) model. An autoregression implies a regression of a time series that relies on lagged values of itself as input variable. A vector autoregression or VAR is a macroeconomic representation of multivariate time series where each of the dependent variables depends on its past observations, and past observations of the other variables. The structure of VAR is quite different compared to other conventional univariate autoregression models because they permit synchronous interactions to occur between the variables.

VAR is applied to study the effects of monetary policy shocks. In this study, the structure of VAR modelling is built up following the existing literature. Suppose, the VAR model is given where N number of variables are represented by a linear function of p of their past values, p lag of the other $N-1$ variables. Algebraically, a p-order VAR model, written as VAR (p), is given by:

$$\boldsymbol{x_t = \beta_0 + \beta_1 x_{t-1} + \cdots + \beta_p x_{t-p} + e_t} \qquad \textbf{(1)}$$

Here $x_t = (x_{1t,} \dots, x_{kt})'$ is a $N \times 1$ column vector, β_1 through β_p represents $N \times N$ parameters matrices, β_0 is $N \times 1$ column vector of intercepts, and e_t representing $N \times 1$ vector of white noise errors, where $E(e_t) = 0, E(e_t e_t') = \zeta$ and $E(e_t e_s') = 0 \; for \; t \neq s$. Therefore, $N + pN^2$ number of coefficients and $N(N+1)/2$ number parameters in the variance-covariance matrix ζ. Predetermined variables of a stationary process are included in the right-hand side where the error term is assumed to be serially uncorrelated with homoscedastic variance. Therefore, we can estimate all the equations by applying OLS. This paper provides a technical construction of the SVAR framework from existing works of literature. The

Now, let's decompose the vector z_t into two parts, including monetary and non-monetary policy variables respectively:

$$\boldsymbol{z_t = [z_{1t}, z_{2t}]}$$

In this case, the vector z_{1t} represented a seven-dimensional macroeconomic time series, incorporating, real GDP (y), real consumption (c), domestic investment (i), foreign direct investment

(f), real exports (x), inflation (p), exchange rate (ex), lending rate (r), money supply (ms). The vector z_{2t} contained the shock parameters or monetary policy variables, interest rate and money supply, $z_{2t} = [r, ms]$. Macroeconomic aggregates are likely to be affected by unexpected changes in monetary policy. However, this reduced VAR does not allow simultaneous causality which makes VAR less useful in forecasting the impacts of shock on macroeconomic factors. SVAR technique imposes constraints or restrictions based on economically motivated theory leading to the main distinction between VAR and SVAR. These limitations of the VAR model motivated us to estimate the SVAR model. The SVAR model has brought methodological advancement in the field of large-scale macroeconomic time series. The main task in the SVAR model is to identify structural parameters. The short-run structural vector autoregressive (SVAR) model is expressed as,

$$\boldsymbol{A\left(I_K - A_1 L - A_2 L^2 - \cdots - A_p L^p\right) x_t = A\varepsilon_t = B u_t} \qquad \textbf{(2)}$$

where L denotes the lag operator, A, B, and $A_1, \ldots, A_p$ are $K \times K$ matrices of parameters, ε_t is a $K \times 1$ vector of structural shocks or innovations which is assumed to be serially uncorrelated with homoscedastic variance that is $\varepsilon_t \sim N(0, \zeta)$ and $E[\varepsilon_t \varepsilon_s{}'] = 0$ for all $s \neq t$. This vector is elaborated as $\varepsilon_t = \left[{\varepsilon_t}^y, {\varepsilon_t}^c, {\varepsilon_t}^i, {\varepsilon_t}^f, {\varepsilon_t}^x, {\varepsilon_t}^p, {\varepsilon_t}^{ex}, {\varepsilon_t}^r, {\varepsilon_t}^{ms}\right]$ which includes shocks of GDP, shocks of consumption, shocks of lending rate, shocks of investment, shocks of exchange rate, shocks of money supply, and inflation shocks respectively. u_t is a $K \times 1$ vector of orthogonal disturbances, that is, $u_t \sim N(0, I_K)$ and $E[u_t {u_s}'] = 0_k$ for all $s \neq t$. The solution of the SVAR system is derived by recovering the relationship between structural innovations (ε_t) and residuals of reduced form (u_t). These modifications of the innovations lead us to examine the dynamics of the system in terms of a change to an element of u_t. In a short-run structural VAR model, we obtain identification scheme by imposing restrictions on the nonsingular matrix of A and B.

The above equation shows that $P_{sr} = A^{-1}B$, where P_{sr} is the orthogonal matrix identified by a particular short-run structural VAR, which implies that $A\varepsilon_t \varepsilon A' = B u_t {u_t}' B'$. Both side's expectations give: $P_{sr} P_{sr}' = \zeta$. By inverting the equation (2) to an infinite-order, moving-average representation of the form gives:

$$\boldsymbol{x_t = \mu + \sum_{s=0}^{\infty} \Theta_s^{sr} u_{t-s}} \qquad \textbf{(3)}$$

whereby x_t is expressed in terms of the mutually orthogonal, unit-variance structural innovations u_t.The Θ_s^{sr} contains the structural IRFs at horizons.

In a short-run SVAR model, the A and B matrices contain all the information about simultaneous correlations. Additionally, innovations u_t are scaled by the B matrix to have unit variance. As a result, we can construct the structural IRFs from (3) which is stated as the effect on variable *i* of a one-unit increase in the structural innovation to variable j after s periods.

P_{sr} defines the structural IRFs by identifying a transformation of ζ, and P_{sr} is identified by the constraints imposed on the parameters in A and B. Since there are $N(N+1)/2$ free parameters in ζ, only $N(N+1)/2$ parameters may be estimated in an identified P_{sr}. Because there are $2N^2$ total parameters in A and B, exact identification requires at least $2N - N(N+1)/2$ constraints to be

imposed on those parameters. Amisano and Giannini (1997) performed a procedure to check that a structural VAR model is locally identified near some specified values for A and B.

3.5.1 Restriction and identification scheme of SVAR model

The existing literature proposes two types of identification strategies to impose restrictions on the contemporaneous matrix: recursive and non-recursive. This study adopts recursive SVAR strategy which shows a successive relationship between variables to identify monetary policy shocks. This strategy is one of the most commonly used identification schemes for VAR. This technique requires Cholesky factorisation to identify structural innovations from the reduced form VAR. Lower (upper) triangular assumption on the structural residuals is called a Cholesky decomposition. The absence of reverse causality and omitted variables are uncorrelated with the lower-ordered variables and the higher-ordered variables making it a strong assumption.

This paper imposes short-run restrictions (Sims 1980) in conducting the SVAR model. Exact identification for the model requires 36 restrictions to be imposed on the contemporaneous matrix. Short-run restrictions have been proven to perform remarkably well (Christiano et al., 2006). Timing constraints are essentially exclusionary constraints that indicate that some of the structural innovations or shocks do not immediately influence particular X variables. For instance, the monetary policy shock does not have any effect on output throughout the month (Stock & Watson, 2005).

Ordering of the relevant variables is an important factor to consider. Variables are ordered logically by placing the most exogenous variable in higher order. Variables placed in top order are said to have contemporaneous effects on the other lower-ordered variables. The first variable is affected only by its own shocks and does not have any contemporaneous effects from shocks of the other variables. Ordering might sound innocuous but it is not. If there are n number of variables then it is possible to construct $n!$ orderings. In our analysis, the recursive system introduces successive linkage between the central bank's monetary policy instruments and non-monetary policy instruments.

The rationale behind the ordering in this paper is based on existing literature that is consistent with the country's perspective. Our identification scheme is closely related to the work of Forhad, Homaifar and Salimullah (2017) which is built on a block recursive procedure where non-monetary policy instruments are stated, followed by monetary policy instruments. Christiano, Eichenbaum, and Evans (2005) also ordered policy variables at the end. The restrictions on contemporaneous matrix B^{-1} or B for Bangladesh SVAR model are summarised in the following equation:

$$\begin{bmatrix} \varepsilon_t^{\,y} \\ \varepsilon_t^{\,c} \\ \varepsilon_t^{\,i} \\ \varepsilon_t^{\,f} \\ \varepsilon_t^{\,x} \\ \varepsilon_t^{\,p} \\ \varepsilon_t^{\,ex} \\ \varepsilon_t^{\,r} \\ \varepsilon_t^{\,ms} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 & 0 & 0 & 0 & 0 \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & 1 & 0 & 0 & 0 \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & 1 & 0 & 0 \\ b_{81} & b_{82} & b_{83} & b_{84} & b_{85} & b_{86} & b_{87} & 1 & 0 \\ b_{91} & b_{92} & b_{93} & b_{94} & b_{95} & b_{96} & b_{97} & b_{98} & 1 \end{bmatrix} \begin{bmatrix} u_t^{\,y} \\ u_t^{\,c} \\ u_t^{\,i} \\ u_t^{\,f} \\ u_t^{\,x} \\ u_t^{\,p} \\ u^{ex} \\ u_t^{\,r} \\ u^{ms} \end{bmatrix} \quad (4)$$

The right-hand side of equation 4 presents a vector of structural shocks. The vector on the left-hand side is showing shocks from the reduced form which are responsible for an unexpected movement of each macro variables. The variables in the vector are divided into two blocks, a monetary block and a non-monetary block. The non-monetary policy variables are set ahead of monetary policy variables, and it is assumed that monetary policy variables react simultaneously to the non-monetary policy variables.

A nation's economic performance is monitored by the GDP growth. The recursive structure followed by the above equation include real GDP at the top order assuming it to be relatively the most exogenous variable which has contemporaneous effect on all the variables in considerations. Being a major component of GDP, real consumption and domestic investment is assumed to respond contemporaneously with the change in real GDP. Steady growth in a country's GDP contributes in boosting exports and attracting foreign direct investment. Therefore, a positive shock to GDP is expected to have an immediate impact on the country's exports and FDI. CPI is represented as the measure of inflation. Sustained growth in GDP could lead to Inflationary pressures. If the country's economic growth (measured by the level of GDP) declines then risk aversion among foreign investors is likely to arise reducing the demand for local currency which further creates downward pressure on the exchange rate.

The inclusion of bank lending rate and money supply to GDP equations at the bottom order is to represent that, these monetary policy instruments have been considered to be the most endogenous in the model. Christiano, Eichenbaum, and Evans (2005) mentioned that economic conditions can affect monetary policy, but monetary policy only affects economic conditions with a lag.

3.5.2 impulse response function and variance decomposition

The SVAR approach allows us to predict or forecast variables in response to a sudden economic shock. Shocks are generally disturbances to the system allowing researchers to capture the behaviour of endogenous variables in the model. Impulse Response functions or IRFs allow us to graphically observe how macroeconomic variables respond over the period to one unit or one standard deviation shock of the exogenous variables. In general, IRF explains the reaction of an endogenous variable to one of the innovations. It is considered an essential tool in empirical analysis.

If there are N number of endogenous variables then how those variables will respond to a one-time shock of the N disturbances are shown by the IRFs. Because the disturbances may be contemporaneously correlated, these functions do not explain how variable *i* reacts to a one-time increase in the innovation to variable j after s periods, holding everything else constant. To explain this, we must start with orthogonalised innovations so that the assumption to hold everything else constant is reasonable. Recursive VAR uses a Cholesky decomposition to orthogonalise the disturbances and thereby obtain structurally interpretable IRFs. Structural VAR incorporates theory to impose sufficient restrictions, which need not be recursive, to decompose the contemporaneous correlations into orthogonal components. By estimating IRFs, the paper attempts to see how sensitive major macroeconomic variables considered in this study are to positive monetary policy shock.

Forecast Error Variance Decomposition (FEVD) is a diagnostic instrument. It describes to us what percentage of the error is made while predicting a variable over the period because of a particular shock. More precisely, how much of the variability in the dependent variable is attributed to its own shocks as well as the shocks in the other variables in the system? The variance decomposition also follows the Cholesky decomposition procedure. Structural shocks in impulse response functions are not related to each other and they contain economic interpretations. In the latter case, they are all only shocks to specific models. FEDV also indicates the relative impact that a variable has on another. Lütkepohl (1993) and Hamilton (1994) have given a detailed formal explanation of the structure of the forecast error variance decomposition.

4. Empirical Results

Bangladesh Bank is responsible for implementing monetary policy in the country with the goal of achieving long-term economic growth. Monetary authorities take the initiative to change monetary policy by considering current economic issues. The main objective of this paper is to observe the effects of monetary policy shock on FDI inflow and exchange rate. Although inflation has been relatively low in the last few decades, recent spikes in inflation are leading to a greater concern for investors and businesses. Preventing excessive fluctuations in the value of the national currency and keeping inflation at a moderate level are two of the principal goals of the central bank. Since a high level of inflation lowers the value of assets linked to the local currency in relation to foreign currencies, it could result in declining foreign investments. In Bangladesh, the main tools for monetary policy are interest rates and reserve money. To achieve this, the central bank sets an inflation objective and adjusts its toolkit for monetary policy. The foundation for the monetary policy of the nation is based on this adaptable inflation targeting approach. Selecting the right policy tools is crucial for the bank to sustain steady economic growth.

4.1 Results of data stationarity

Table 4 in the appendix section provides the preliminary results of the unit root test. The optimal leg length requirement for the ADF test has been determined based on Akaike Information Criteria. The null hypothesis for conducting the ADF test involves the presence of unit root or non-stationarity of the time series variables. The results reveal that the series are non-stationary when testing the data at level. However, data at first difference shows stationary results and all the series are integrated in the same order, I (1), fulfilling the necessary condition of applying VAR. To maintain a consistent estimation of the regression result, the paper will perform regression using data at log level. Graphical representations of the stationarity of time series data for the sample period are presented in Figure 6 in the appendix section.

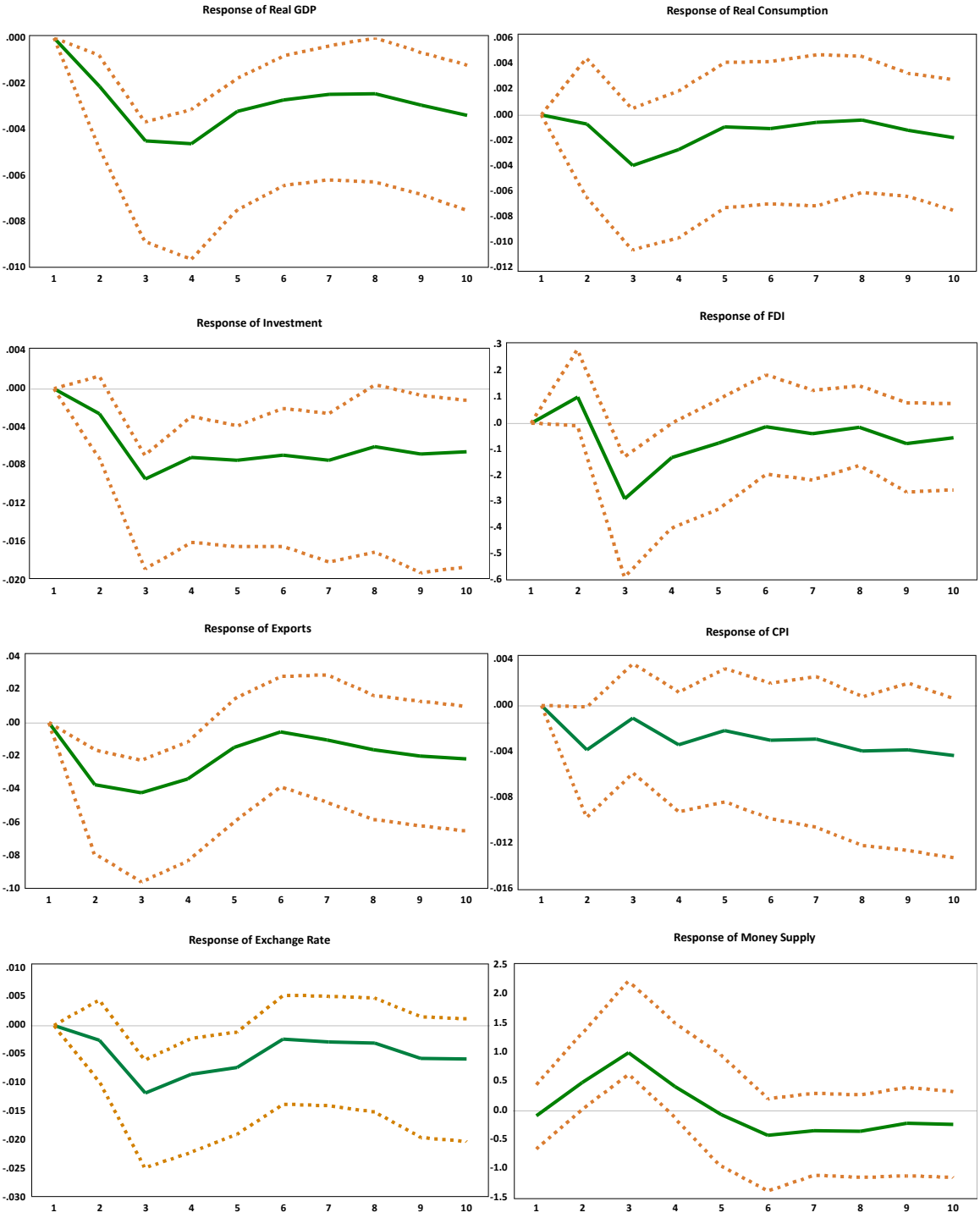
4.2 Results of recursive VAR

Table 5 in the appendix section shows the estimated contemporaneous coefficients which are consistent with their respective equation. In the Structural VAR model, coefficients attached to the contemporaneous variables may be treated as dependent or exogenous variables. While interpreting the results of contemporaneous coefficients, the sign of the coefficients shall be read as reversed. Most of the coefficients contain correct signs. For instance, the coefficient attached to the GDP in consumption equation (b_{21}) enters positively which is statistically significant. Correspondingly, the real GDP shock in the consumer price index equation (b_{61}) reports expected positive signs revealing a positive association between inflation represented by CPI and real output. The primary objective of SVAR analysis focuses on understanding the dynamic reactions of variables over time rather than precise estimation of parameters. Since, these coefficients indicate limited statistical significance (Nizamani et al., 2016).

4.3 Analysis of impulse response functions (IRFs)

Before analysing the impulse response functions, it is important to focus on the monetary transmission mechanism of the economy. A lot of available literature on the ground of monetary management policy argues that empirical research on monetary management should identify intermediate targets aligned with central bank goals (Chari, Kehoe, & McGrattan, 2002; Galí & Monacelli, 2005; Mishra & Montiel, 2013). For example, an increase in interest rates, often a result of contractionary monetary policy, attracts foreign capital to the domestic economy. This results in an appreciation of domestic currency due to the rising demand for domestic currency. Domestic goods become expensive relative to foreign goods leading to a fall in exports negatively affecting aggregate output. This fall in demand will have a further impact on the labour market reducing price and wages.

Figure 7: Response of macroeconomic aggregates to interest rate shock



Source: Authors' estimation using WDI data.

The impulse response functions (IRFs) for the selected variables to interest rate (lending rate) shock are plotted in Figure 7. IRF graphically provides us with the dynamic response of different variables to an exogenous shock. The horizontal axis represents the periods and the vertical axis represents the percentage deviation from the steady state. Here, the impulse response functions show the extent of the changes in the endogenous macroeconomic variables following a positive interest rate shock of one standard deviation. The IRFs are constructed using the bootstrapping method. Sims and Zha (1999) suggested using the likelihood-based band as opposed to the approximate confidence band of asymptotic theory because of the computational and conceptual complexities involved in the classical confidence region which makes it less reliable in multivariate time series models. Bootstrapping impulse responses are frequently used in the construction of confidence intervals to make statistical inferences. In comparison with asymptotic theory, this bootstrap method allows to work with small sample inferences more reliably (Kilian, 1998). Moreover, it helps in reducing biases giving more accurate estimation.

It is observable from the above panel that a positive shock in lending interest rates has an immediate short-run impact on most of the macroeconomic series. The reactions of real GDP, real consumption, and real investment are depicted by the first three graphs in the above panel. All these three variables respond negatively to a positive lending rate shock. Here, this positive shock causes the real GDP to be below its balanced growth path, reaching at its lowest peak in the third period, then gradually increases in a hump-shaped fashion. It is evident from the graph that real GDP falls roughly for three years at a stretch. This finding is consistent with Christiano, Eichenbaum, and Evans (1996), where a contractionary monetary policy shocks lead to persistent declines in real GNP. Therefore, a notable and significant decline in real GDP is observed following an unexpected rise in the bank lending rate, suggesting monetary policy instruments' effectiveness in the short run.

Lending rate shock has led to a slow downward movement in the level of consumption initially, creating a series of waves that fluctuate up to the fourth period and take a hump-shaped path. The inverse relationship between investment and interest rate is quite evident from the impulse responses. Domestic Investment forms a V-shaped response by declining gradually after the first period, bottoming out at the fifth period, and then tending to rise. The lending rate shock has a stimulating effect on foreign direct investment by reaching its peak after the first period, attracting more investment. FDI decisions often depends on a variety of factors including current economic circumstances, political steadiness, strong bureaucratic management, currency exchange rates, etc. One might argue that the initial positive response might be because of other factors which are influencing FDI decisions rather than just the interest rate channel. Our results are consistent with Auer (2019), who found that a positive surprise increase in the policy rate reduces real consumption, investment, and GDP. He also found an increase in foreign investment income receipts due to this shock. However, over time, the positive impact of the lending rate shock on FDI diminishes, possibly due to various factors such as adaptation, market saturation, or other changes in economic conditions. Although a gradual increase is observed at the end of the third period, the values remain negative.

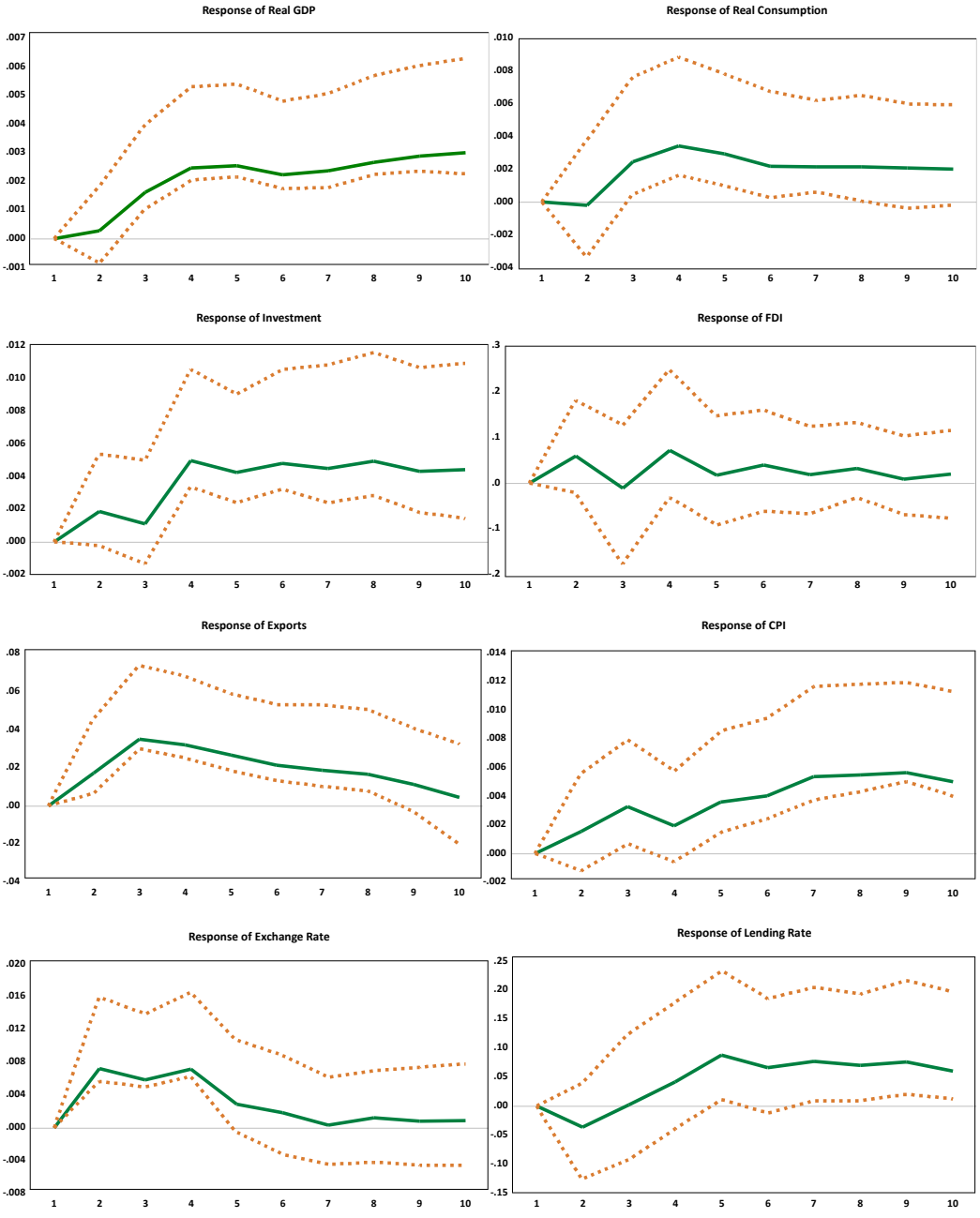
Both the price level and exports drop due to the shock, but the decline in exports is quite sharp after the second period. The fall in the price index (CPI) resulting from an increase in bank lending rate prevented the situation of falling under the price puzzle controversy of monetary economists that is often implied by recursive identification strategies (Scholl & Uhlig, 2008). This finding is similar to Ogaki et al. (2003), who found the absence of price puzzle. The price puzzle phenomenon describes a scenario of an unexpected response of interest rate to monetary policy actions which contradict the assumptions of mainstream economic theory. One standard deviation increase in lending rate causes the exchange rate to fall (appreciation of domestic currency) which reaches the lowest point in the third period, and then rises with an inverse V-shaped fashion. Sims (1992), Eichenbaum and Evans (1995), and Kim and Roubini (2000) for G7 countries; Peersman and Smets (2003) and Favero and Marcellino (2004) for the aggregate Euro area; Mojon and Peersman (2003) for individual Euro area countries; and Lindé (2003) for Sweden have also found that following a contractionary monetary policy shock, the real exchange rate depreciates which is inconsistent with Dornbusch's (1976) well known overshooting hypothesis. Recursive identification strategies followed by Grilli and Roubini (1995, 1996) and Eichenbaum and Evans (1995) found a persistent appreciation of the domestic currency for periods of up to 3 years, a phenomenon known as the 'delayed overshooting puzzle'. Appreciation of domestic currency has a significant impact on a country’s trade balance. Domestic consumers prefer imported goods over domestically produced goods due to the price advantage. However, export firms become less competitive in the international market due to the decreased demand for exports. The money supply responds negatively taking a hump-shaped fashion. All these results align with economic theories and economic anomalies such as output or price puzzles do not arise. Table 6 in the appendix provides us with these impulses' estimated results.

Turning to the second panel, which gives the dynamic response of macroeconomic indicators to a one standard deviation positive shock on the money supply measured by the broad money. Real GDP respond positively, gradually increasing within the first four periods, slightly slowing down and again starting to grow forming a hump-shaped pattern. Our results are in line with Ansari and Ahmed (2009), who also noticed a positive response of GDP to a positive shock to broad money supply. This positive outcome between the changes in money supply and real output is associated with the quantity theory of money. This classical economic theory suggests a direct proportional linkage between the change in the money supply and real output holding the velocity of money and price level constant. The slight fall in consumption is insignificant, tends to rise peaking in the third period with a hump-shaped pattern and remains stable.

Although domestic investment falls within the second year of shock, the effect is positive for the rest of the periods. An excessive supply of money can lead to inflationary expectations, which in turn reduces the purchasing power of borrowers. This in turn discourages investors, thereby reducing their willingness to invest. Initially, FDI increases and fluctuates over time following a one standard deviation positive shock to the money supply. Such a positive shock may lead to an initial rise in FDI due to improved liquidity which attracts foreign investors. However, changes in underlying economic conditions such as short-term market dynamics, expectations and uncertainty among investors, interest rate dynamics, and policy environment are responsible for this cyclical behaviour of FDI. This

suggests that factors influencing FDI are dynamic and may be subject to changing domestic and global economic conditions. An expansionary monetary policy is often associated with stimulating economic activity creating a more favourable business climate for profitable investment opportunities.

Figure 8: Response of macroeconomic aggregates to money supply shock



Source: Authors' estimation using WDI data.

The impulse response function reveals that exports tends to rise, maintaining a positive trend up to eighth period and gradually declines. Price level (CPI) respond positively in a hump-shaped fashion. This behaviour of price index (measure of inflation) due to money supply innovations is consistent with the prediction of quantity theory of money, assuming a constant velocity of money and real output. However, this might not always hold in real life since the short-term economic dynamics could lead different perspectives on the relationship between them. Additionally, some other economic theories, such as Keynesian theory, offer differing viewpoints regarding this proposition.

The exchange rate experiences a quick and significant increase (depreciation of local currency) within the first two periods of shocks and then declines afterwards resembling a hump-shaped pattern. It takes another hump-shaped pattern after six period which remains below the steady state. Several studies found appreciations of exchange rate in response to a positive shock to money supply confirming Dornbusch's (1976) hypothesis and providing no evidence of exchange rate puzzle (Rashid & Jehan, 2014; Bjørnland, 2008; Forni & Gambetti, 2010).

Such a depreciation of local currency affects import firms negatively by increasing costs, reducing their profit margins, and facing challenges in maintaining competitiveness. However, export revenue increases benefitting exporters. The delay in overshooting lasts for two years.

The response of interest rate is positive and significant which remains above the steady state for the rest of the periods. Such a response could be a signal about inflationary pressures in the economy. The central bank may increase interest rates to mitigate excess demand and prevent inflation from getting out of control.

4.4 Is monetary policy sufficient enough to boost Investment in Bangladesh's economy?

Private investment along with FDI has been playing a pivotal role in inducing economic growth in Bangladesh. From the macro perspective, in a regular business cycle, they account for the majority of the volatility in the Gross Domestic Product (GDP) dynamics, and their magnitude serves as a significant leading indicator of economic performance (Zarnowitz, 1992).

The results of this study implied that a monetary tightening (easing) through increasing (reduction) in interest rates led investment to fall (rise). In Bangladesh, investment has been facilitated by a series of policy approaches and reforms that have laid a robust foundation for the expansion of the private sector within the country's economy. In recent times, Bangladesh Bank has maintained a low level of interest rate by setting a single-digit on loans to make funds cheaper for stimulating investment.[2] However, private investment did not increase to a large extent in response to this policy,

[2] The central bank of Bangladesh has implemented several monetary policies. Following that, Bangladesh Bank adopted a monetary policy by setting a 9% interest rate cap on loans in April 2020. This policy was taken to maintain adequate credit flows to mitigate the financial sector risks. Such a constraint has created different response in the society.

which contradicts our findings. Therefore, only monetary policy mechanism through using `the interest rate channel alone is not sufficient enough to boost the level of investment in Bangladesh.

Investment decisions require consideration of several key factors. Weak infrastructure, unfavourable regulatory environment, bureaucratic issues, corruption, red tape, and political uncertainty have resulted in a lack of dynamism in private sector investment and the ease of doing business operations in Bangladesh. Both private investment and FDI are facing significant challenges in accessing finances and adequate logistic infrastructure in Bangladesh. The absolute amount received from these investments is relatively small to bring significant transformation across the economy. Foreign investment is anticipated to decline further in near future due to the COVID-19 pandemic and its aftermath. The growth in private investment has remained almost stagnant over the last decade. According to Bangladesh Business Climate Index (BBX) 2021, private sector investment as a percentage of GDP has been hovering between 21 to 23 per cent over the past decade, with the ratio of private investment to GDP rising only by 0.3 percentage points between FY2017-18 and FY2018-19.

There are several measurements of business environment on various parameters or indicators which are necessary to ensure a favourable and conducive investment climate. The country's performance on the Global Entrepreneurship Index (GEI), the Business Confidence Index (BCI) and the Logistics Performance Index (LPI), which are a comprehensive set of national-level performance indicators, is not satisfactory. Bangladesh has shown minimal improvement in these indicators, leading to low rankings in most areas. However, it is critical to focus on these indexes for a better business environment as well as for the next phase of the Growth Story. Moreover, after the stock market crashes in Bangladesh in the years 1996 and 2010, investors encountered much frustration due to gambling, syndication, insider trading, enactment of many laws and their short-term and sudden but adverse effects, fluctuating and volatile market conditions, rumour, etc., in freely investing their hard money in this market (Sarbabidya & Saha, 2018).

4.5 Implication from a global perspective

Several studies have found that a contractionary (expansionary) monetary policy shock through rising interest rate (rising money supply) leads to a fall (rise) in real economic activities and depreciation (appreciation) of the exchange rate which is consistent with our estimation. However, there is global evidence which has failed to provide a reliable effect of monetary policies on investments and stabilisation of domestic currency. An analysis by Walsh (2009) asserted that while monetary policy should stabilise the level of inflation, monetary policy should not be used to stabilise the level of real economic activity.

It is obvious that the role of interest is significant in explaining fluctuations of investments. However, concentrating solely on interest rates might lead to underestimating the significance of monetary policy for investment. However, there are evidence which have failed to provide a reliable effect of monetary policies on investments. Fazzari (2016) mentioned finance effects (the availability of finance, either through firms' internal cash flow or from external debt) on investment are more potent than the traditional interest-rate/cost-of-capital channel. He also argued that one outcome

of employing tight monetary policy to combat inflation could be weak investment which results not necessary because of higher interest rates but also from its broader macroeconomic effects on firms' profits, cash flow, and access to credit.

An empirical study conducted by Obamuyi's study (2013), socio-economic characteristics of investors such as age, gender, marital status, and educational qualifications were found to influence investment decisions among investors in Nigeria. On the other hand, Shiundu (2009) identified reputation of the firm, firm's status in industry, expected corporate earnings, profit and condition of statement, past performance firms stock, price per share, feeling on the economy and expected divided by investors affecting investment decisions at the Nairobi Stock Exchange. Therefore, relying only on monetary policies to stimulate a faltering economy is not always a good choice.

Many economists argue that exchange rate risk can be effectively mitigated through forward markets, making international monetary reform unnecessary (McKinnon, 1988). Suhendra et al. (2022) suggested officials must maintain a constant and low central bank interest rate to ensure the stability of the Rupiah exchange rate. He recommended to employ a prudent monetary management along with utilizing alternative bilateral exchange rates. Another study by Min, Wen, and Wang (2022) found limited effects of monetary policy on increasing domestic investment in China, indicating that it is unnecessary for the Chinese government to implement a large-scale economic stimulus package to enhance domestic investment and output growth.

Problem of economic stabilisation is, even in principle, an extremely intricate one, and that a much more thorough investigation of both theoretical principles and empirical relationships would be needed before detailed policy recommendations could be justified (Phillips, 1957). Alshubiri (2022) argued that monetary policy should focus on developing a systematic exchange rate to promote political stability and the sustainability of foreign investment in developed and developing countries.

4.6 Forecast error variance decomposition

This is a standard VAR tool that shows how much (proportions) total variance of each variable is due to the shock of that particular variable as well as shock of the other variables in the system (Ravnik & Žilić, 2011). Forecast error variance decomposition basically provides us the variability in the dependent variable explained due to a shock on its own observations as well as the shock on the rest of the variables in the system. like the IRFs, the variance decomposition under consideration utilizes Cholesky factorization for identification purposes. This statistical technique is frequently employed in econometrics and financial analysis to determine the relative importance of various factors in accounting for the fluctuations of an economic or financial variable.

Tables 8, 9, and 10 in the appendix section provide us with the estimated results of forecast error variance decomposition (in terms of percentage) of investment, FDI and exchange rate constructed for ten periods. The system moves from its short-run equilibrium to its long-run equilibrium. It helps us to understand the contribution explained by its own shocks and shocks of the other variables over time. We need to identify the variable that is most effective in predicting the amount of variation in our outcome variables investment, FDI, and exchange rate.

Table 8 in the appendix shows that in the short run (first period), more than 91 per cent of the variation in investment is driven by the shocks to the investment itself in the system. However, the contribution becomes limited over time. The role of monetary policy instruments, lending rate contributes 11.66 per cent and money supply contributes only a 4.01 per cent variation in investment. The result reveals that consumer price index, interpreted as a measure of inflation, is the most influential factor in explaining variability (15.16%) in investment. The exchange rate became the second most effective variable in explaining 14.44 per cent variations in investment.

The variance decomposition of FDI reveals that shocks to investment became the most effective one to explain the amount of variations in FDI. The contribution is more than 26 per cent. Between the monetary policy instruments, the money supply exhibits no significant influence (only 0.64%) while the lending rate contributes 6.84 per cent. Table 10 represents the contribution to exchange rate fluctuations, with having a moderate endogenous impact by contributing 78.71 per cent variations on itself in the first period. Similar to FDI, Investment has the most contribution to exchange rate fluctuations (above 29%). The shock on the lending rate and money supply account for only 4.95 per cent and 2.09 per cent variations in the changes in the exchange rate. Certainly, these results also ensure that various other factors are responsible behind the changes in investment (also FDI) and exchange rate volatility.

The standard errors corresponding to each estimate are useful in understating the robustness of the results. These standard errors provide a measure of the degree of uncertainty to make informed interpretations regarding the precision and reliability of the estimated contributions of shocks to the variability of the variables in the system. Therefore, both the magnitude of the estimated effects and associated standard errors need to be considered. The standard errors reported in the following table are much lower compare to our estimated parameters. A lower standard error makes the confidence interval narrower improving the precision of the estimate. In some cases, this also helps to get rid of heteroscedasticity problem.

5. Conclusion

In a developing country like Bangladesh, growth in both domestic and foreign investment plays a crucial role in economic development. Monetary policy can significantly influence these investments by affecting interest rates. This paper examines how shocks to monetary policy instruments impact investment, FDI, and exchange rates, alongside other real and nominal macroeconomic variables such as real GDP, real consumption, real exports, and the consumer price index. The results reveal that while an increase in interest rates may effectively control high inflation, it has a negative impact on investment. Therefore, the central bank in Bangladesh faces a trade-off.

To encourage private investment, Bangladesh Bank has implemented an expansionary monetary policy by capping interest rates. However, this approach has had serious negative side effects, leading to higher inflation and depreciation pressures on the foreign exchange rate. Thus, maintaining interest rates below market equilibrium is not an advisable policy for Bangladesh.

Instead, the government could consider fiscal incentives, such as tax breaks or tax holidays, which would stimulate both domestic and foreign investment without adversely affecting inflation or the foreign exchange rate.

Furthermore, our findings suggest that monetary policy alone may be insufficient to restore macroeconomic stability and promote growth. Bangladesh Bank should consider targeted policy measures tailored to the specific characteristics of the economy. A comprehensive approach, integrating monetary policy with fiscal and exchange rate policies, is recommended to alleviate inflationary pressures in the domestic market. Additionally, the central bank should refrain from imposing limits on interest rates. Adopting a flexible or market-based interest rate could better combat high inflation.

The findings of this study provide valuable insights for policymakers, highlighting the limitations of monetary policy in Bangladesh and suggesting alternative policy tools to achieve economic objectives. These insights can assist decision-makers and analysts in developing effective monetary strategies that promote sustainable economic growth and stability. Lastly, the study offers a reference for economists and policymakers in other developing countries facing similar challenges. The research methodology and findings can be adapted to offer useful perspectives on the effectiveness of monetary policy in comparable contexts.

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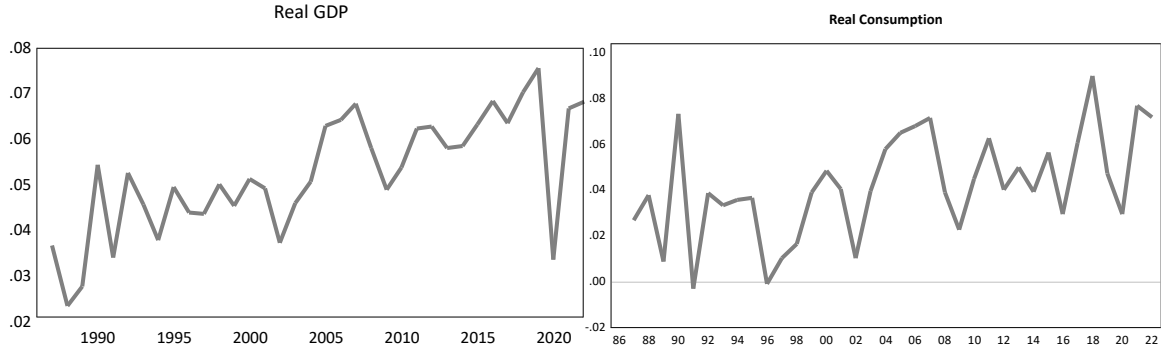
Appendix

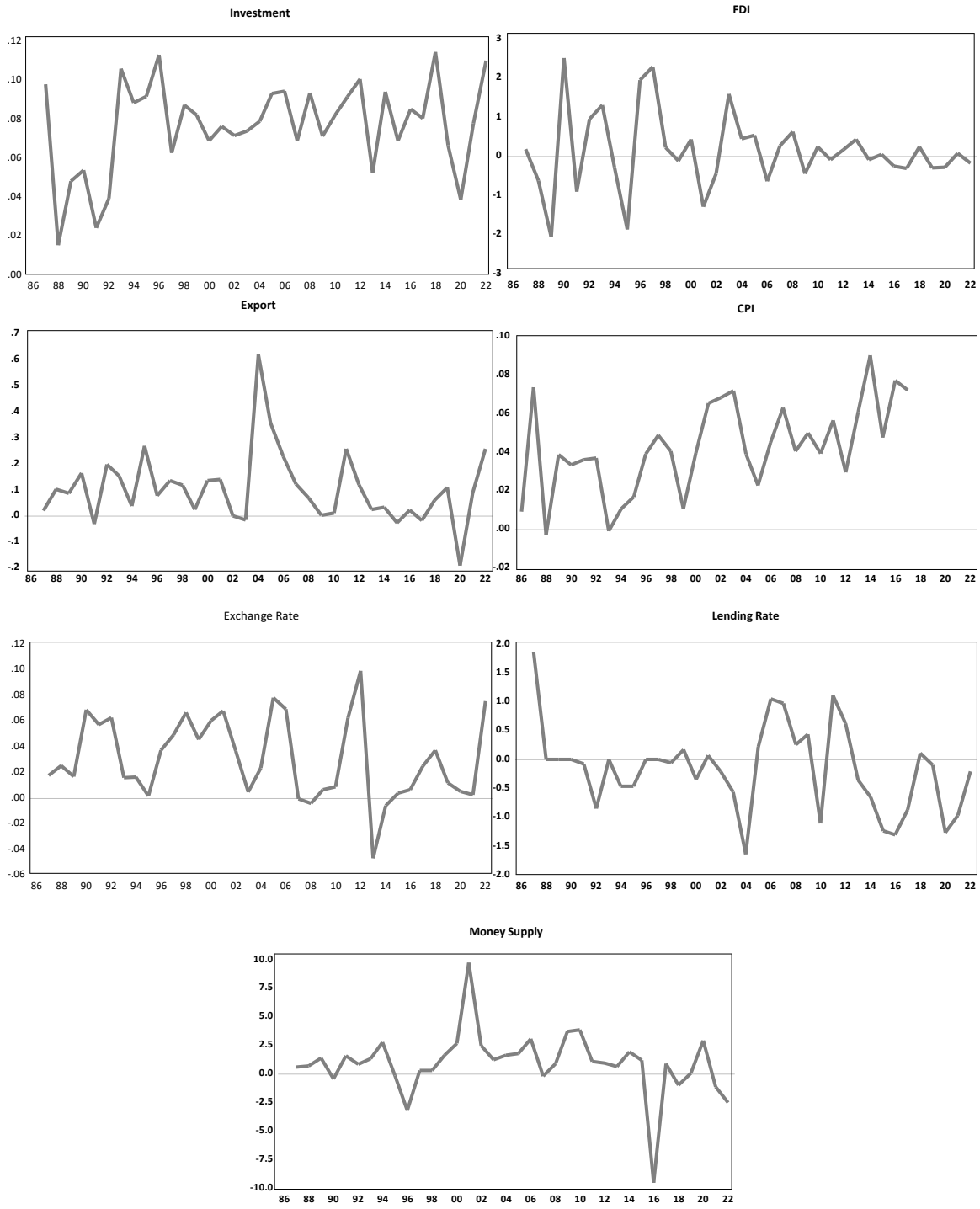
Table 4: ADF unit root test

Variables	Level/1st Difference	ADF Statistics	P Values	Status
LN_GDP	Level	5.782	1.0000	I (1)
	1st Difference	-3.408	0.0107	
LN_Consumption	Level	1.120	0.9954	I (1)
	1st Difference	-9.599	0.0000	
LN_Investment	Level	0.903	0.9931	I (1)
	1st Difference	-6.021	0.0000	
LN_FDI	Level	-1.620	0.4727	I (1)
	1st Difference	-6.785	0.0000	
LN_Exports	Level	-1.028	0.7429	I (1)
	1st Difference	-4.727	0.0001	
LN_CPI	Level	0.472	0.9840	I (1)
	1st Difference	-4.451	0.0002	
LN_Exchange.rate	Level	-1.461	0.5528	I (1)
	1st Difference	-4.371	0.0003	
Lending rate	Level	0.473	0.9840	I (1)
	1st Difference	-4.978	0.0000	
Money supply	Level	-1.239	0.6565	I (1)
	1st Difference	-4.697	0.0001	

Source: Authors' estimation using WDI data.

Figure 6: Stationary series of data (1st difference)





Source: Authors' illustration using WDI data.

Table 5: Estimated contemporaneous coefficients of SVAR: recursive model

Restrictions	*Coefficients*	*Standard Error*
b_{21}	-1.917226***	0.360779
b_{31}	-0.6339189	0.5010619
b_{32}	0.3104415*	0.1746443
b_{41}	-44.84099***	13.25095
b_{42}	0.9650138	4.715943
b_{43}	3.51339	4.371309
b_{51}	0.0283249	2.426734
b_{52}	-3.59844***	0.7501328
b_{53}	-3.148256***	0.7012823
b_{54}	-0.0419286	0.0268705
b_{61}	-0.8263484	0.5246815
b_{62}	-0.4405938**	0.2088023
b_{63}	-0.5221438***	0.1903351
b_{64}	0.008327	0.0060083
b_{65}	0.0315597	0.0365459
b_{71}	-0.6156959	0.9403564
b_{72}	-0.5949597	0.3839431
b_{73}	-0.621781*	0.3633611
b_{74}	0.011531	0.0106876
b_{75}	-0.0030408	0.0639654
b_{76}	0.5218481*	0.2927482
b_{81}	3.953133	14.39081
b_{82}	-6.597628	6.037056
b_{83}	-12.64993**	5.753532
b_{84}	-0.0580521	0.1652478
b_{85}	0.8800138	0.9729896
b_{86}	0.8814464	4.65065
b_{87}	-7.948568***	2.571077
b_{91}	39.41824	44.51274
b_{92}	-64.6569***	18.96894
b_{93}	7.634814	18.96527
b_{94}	2.567567***	0.5114834
b_{95}	-5.948591**	3.041281
b_{96}	51.82388***	14.37699
b_{97}	-41.23186***	8.963413
b_{98}	0.2398318	0.522273
b_{11}	0.0051181***	0.0006117
b_{22}	0.0109241***	0.0013057
b_{33}	0.0112869***	0.001349
b_{44}	0.2918912***	0.0348877
b_{55}	0.0464014***	0.005546
b_{66}	0.0100324***	0.0011991
b_{77}	0.0173753***	0.0020767

b_{88}	0.2642902***	0.0315887
b_{99}	0.8166061***	0.0976031
Log Likelihood	559.8306	

Source: Authors' estimation using WDI data.

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 6: Values of Estimated Impulse Response Function (shock to lending Rate)

Period	LNGDPMIL	LNCMIL	LNINVMIL	LNFDIMIL	LNEXPO...	LNCPI	LN_EX	INTERES...	BROADM...
1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.390890	-0.093748
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00329)	(0.04534)
2	-0.002117	-0.000740	-0.002607	0.099253	-0.037182	-0.003853	-0.002555	0.277774	0.480554
	(5.0E-07)	(3.4E-06)	(2.5E-06)	(0.00223)	(0.00015)	(3.1E-06)	(7.7E-06)	(0.00300)	(0.05145)
3	-0.004491	-0.003958	-0.009424	-0.290896	-0.041944	-0.001117	-0.011794	0.140448	0.990991
	(1.0E-06)	(3.5E-06)	(5.2E-06)	(0.00731)	(0.00020)	(3.1E-06)	(1.1E-05)	(0.00340)	(0.07742)
4	-0.004602	-0.002735	-0.007195	-0.133264	-0.033903	-0.003453	-0.008513	-0.034768	0.412463
	(1.3E-06)	(4.5E-06)	(5.5E-06)	(0.00487)	(0.00019)	(3.8E-06)	(1.1E-05)	(0.00317)	(0.06433)
5	-0.003196	-0.000962	-0.007485	-0.076546	-0.014800	-0.002217	-0.007310	-0.030130	-0.073386
	(1.1E-06)	(4.4E-06)	(5.1E-06)	(0.00466)	(0.00015)	(3.8E-06)	(1.1E-05)	(0.00329)	(0.07072)
6	-0.002702	-0.001110	-0.006932	-0.013450	-0.005610	-0.003028	-0.002426	-0.049341	-0.431937
	(1.0E-06)	(3.8E-06)	(6.1E-06)	(0.00410)	(0.00016)	(4.1E-06)	(1.1E-05)	(0.00297)	(0.06493)
7	-0.002461	-0.000611	-0.007449	-0.040187	-0.010453	-0.002945	-0.002926	0.000874	-0.349793
	(1.0E-06)	(3.2E-06)	(6.5E-06)	(0.00360)	(0.00016)	(4.6E-06)	(1.1E-05)	(0.00263)	(0.06462)
8	-0.002441	-0.000425	-0.006031	-0.016465	-0.016295	-0.003996	-0.003107	0.007887	-0.361476
	(1.2E-06)	(2.7E-06)	(6.7E-06)	(0.00305)	(0.00016)	(4.8E-06)	(1.0E-05)	(0.00277)	(0.06781)
9	-0.002931	-0.001227	-0.006806	-0.078417	-0.020114	-0.003864	-0.005777	0.004532	-0.222056
	(1.3E-06)	(2.4E-06)	(7.4E-06)	(0.00255)	(0.00017)	(4.8E-06)	(1.1E-05)	(0.00305)	(0.06794)
10	-0.003363	-0.001809	-0.006599	-0.056235	-0.021676	-0.004370	-0.005823	-0.027160	-0.245485
	(1.5E-06)	(2.3E-06)	(7.7E-06)	(0.00226)	(0.00020)	(4.6E-06)	(1.0E-05)	(0.00272)	(0.07054)

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDPMIL LNCMIL LNINVMIL LNFDIMIL LNEXPORTMIL LNCPI LN_EX INTERESTRATE BROADMONEY

Source: Authors' estimation using WDI data.

Table 7: Values of estimated Impulse Response Function (shock to money supply)

Period	LNGDPMIL	LNCMIL	LNINVMIL	LNFDIMIL	LNEXPO...	LNCPI	LN_EX	INTERES...	BROADM...
1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.207777
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.02128)
2	0.000281	-0.000217	0.001850	0.058236	0.017066	0.001541	0.007259	-0.036893	0.462525
	(1.8E-07)	(1.6E-06)	(1.0E-06)	(0.00099)	(5.0E-05)	(1.2E-06)	(3.4E-06)	(0.00085)	(0.02259)
3	0.001625	0.002454	0.001089	-0.012059	0.034686	0.003262	0.005892	0.001502	0.381258
	(2.6E-07)	(1.5E-06)	(1.4E-06)	(0.00242)	(7.0E-05)	(1.5E-06)	(2.9E-06)	(0.00143)	(0.02793)
4	0.002468	0.003419	0.004956	0.071480	0.031943	0.001912	0.007179	0.041346	0.284000
	(3.3E-07)	(1.6E-06)	(1.7E-06)	(0.00228)	(6.2E-05)	(1.3E-06)	(3.5E-06)	(0.00143)	(0.02417)
5	0.002550	0.002921	0.004246	0.016732	0.026417	0.003577	0.002910	0.087795	0.413386
	(3.5E-07)	(1.6E-06)	(1.5E-06)	(0.00198)	(5.1E-05)	(1.3E-06)	(3.8E-06)	(0.00137)	(0.02140)
6	0.002239	0.002159	0.004782	0.039347	0.021217	0.004036	0.001838	0.065311	0.392732
	(2.9E-07)	(1.1E-06)	(1.8E-06)	(0.00154)	(5.0E-05)	(1.4E-06)	(4.0E-06)	(0.00108)	(0.01927)
7	0.002360	0.002137	0.004484	0.017661	0.018527	0.005363	0.000322	0.076217	0.373813
	(3.0E-07)	(9.5E-07)	(1.9E-06)	(0.00113)	(5.2E-05)	(1.8E-06)	(3.3E-06)	(0.00091)	(0.02061)
8	0.002669	0.002139	0.004937	0.030946	0.016467	0.005488	0.001262	0.069413	0.217980
	(3.8E-07)	(9.0E-07)	(2.2E-06)	(0.00109)	(4.6E-05)	(1.7E-06)	(3.1E-06)	(0.00105)	(0.02107)
9	0.002891	0.002061	0.004324	0.007851	0.011078	0.005643	0.000843	0.075849	0.184031
	(4.1E-07)	(8.2E-07)	(2.2E-06)	(0.00090)	(5.0E-05)	(1.5E-06)	(3.0E-06)	(0.00117)	(0.01924)
10	0.002994	0.002005	0.004414	0.018792	0.004317	0.005016	0.000865	0.059863	0.127395
	(4.1E-07)	(8.1E-07)	(2.4E-06)	(0.00094)	(6.3E-05)	(1.4E-06)	(3.5E-06)	(0.00094)	(0.02012)

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDPMIL LNCMIL LNINVMIL LNFDIMIL LNEXPORTMIL LNCPI LN_EX INTERESTRATE BROADMONEY

Source: Authors' estimation using WDI data.

Table 8: Variance decomposition of investment

Period	S.E.	LNGDP	LNC	LNINV	LNFDI	LNEXPORT	LNCPI	LNEXRATE	LENDING	MS
1	0.007565	0.037444	8.300474	91.66208	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.010259	0.051162	4.405409	73.05819	1.283608	4.118393	8.425096	6.958797	1.135349	0.563996
3	0.013394	0.183514	9.637167	55.87973	0.919463	3.383059	12.27162	5.967937	11.21467	0.542844
4	0.015722	0.319009	11.28378	48.25336	0.821621	2.870006	13.88337	5.105292	14.58054	2.883034
5	0.016913	0.264251	9.356940	45.45295	2.255944	2.162957	14.44672	7.384446	15.16348	3.512310
6	0.018429	0.199755	7.063059	43.52755	4.645419	1.664994	14.72052	10.18654	14.07515	3.917007
7	0.020630	0.166081	5.625077	42.61498	5.480415	1.451794	14.48526	12.81267	13.42643	3.937296
8	0.022809	0.140855	4.669502	42.77938	6.006770	1.219462	14.63275	13.93413	12.46757	4.149577
9	0.024513	0.122896	4.181395	42.99226	6.243589	1.057012	14.81142	14.43364	12.04891	4.108880
10	0.025969	0.133840	3.888731	43.16373	6.460034	0.970944	15.18537	14.43735	11.66047	4.099529

Source: Authors' estimation using WDI data.

Table 9: Variance Decomposition of FDI

Period	S.E.	LNGDP	LNC	LNINV	LNFDI	LNEXPORT	LNCPI	LNEXRATE	LENDING	MS
1	0.007565	35.55607	0.002656	1.209897	63.23138	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.010259	17.69152	29.19101	9.265910	26.86637	5.269898	9.265784	0.556263	1.409499	0.483746
3	0.013394	13.78531	26.31042	15.23228	19.26651	3.512932	12.28899	0.604155	8.675204	0.324195
4	0.015722	13.75995	23.80761	17.71038	16.77409	4.390782	13.70654	0.511632	8.671525	0.667492
5	0.016913	13.03057	21.04507	23.30775	15.27987	3.870067	13.42827	1.398695	8.033812	0.605891
6	0.018429	12.76515	21.41557	23.49627	14.87679	3.738416	12.98526	2.311660	7.728457	0.682433
7	0.020630	12.52053	20.99215	23.73335	14.29682	3.707322	12.45723	4.120675	7.499327	0.672594
8	0.022809	12.43279	20.15387	24.97948	13.90063	3.527768	12.30936	4.891099	7.111510	0.693488
9	0.024513	12.38514	19.59525	26.05185	13.30052	3.391009	12.58610	5.010965	7.024258	0.654905
10	0.025969	12.61773	19.60954	26.42538	12.73112	3.361585	12.98113	4.793562	6.839212	0.640739

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDP LNC LNINV LNFDI LNEXPORT LNCPI LNEXRATE LENDING MS

Source: Authors' estimation using WDI data.

Table 10: Variance decomposition of exchange rate

Period	S.E.	LNGDP	LNC	LNINV	LNFDI	LNEXPORT	LNCPI	LNEXRATE	LENDING	MS
1	0.007565	3.974011	2.950419	6.186833	0.882234	0.183682	7.113692	78.70913	0.000000	0.000000
2	0.010259	4.924629	8.460436	7.054853	2.601577	1.676204	3.699126	67.91000	0.408165	3.265007
3	0.013394	3.863608	6.458112	13.79737	2.435858	1.356370	4.997836	56.67517	6.512532	3.903147
4	0.015722	6.719417	6.593159	19.37172	2.786246	1.044461	6.734538	44.46549	7.512464	4.772503
5	0.016913	9.904961	8.220864	24.56855	3.282939	1.040706	6.516393	35.45310	7.146346	3.866143
6	0.018429	10.89375	8.894694	26.95429	4.101673	1.303946	6.215223	32.15595	6.149973	3.330496
7	0.020630	10.54639	9.035951	28.49485	4.347811	1.594501	6.361726	31.12359	5.568426	2.926758
8	0.022809	10.18367	9.961232	29.21983	4.322427	1.695173	7.585271	29.17529	5.190554	2.666554
9	0.024513	9.978170	11.61828	29.52772	4.044745	1.764132	9.623912	25.97097	5.104669	2.367403
10	0.025969	10.06770	13.07491	29.59553	3.804019	1.842573	11.73482	22.83819	4.950319	2.091935

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDP LNC LNINV LNFDI LNEXPORT LNCPI LNEXRATE LENDING MS

Source: Authors' estimation using WDI data.

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