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Relative Effectiveness of Monetary and Fiscal Policies on Output Growth in Bangladesh: A VAR Approach

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October 2005

Abstract

This paper investigates the relative importance of monetary and fiscal policies in altering real output of Bangladesh. An unrestricted vector autoregressions (VARs) framework, based on the St. Louis equation, is used to compute variance decompositions (VDCs) and impulse response functions (IRFs) through 1000 Monte Carlo simulations. A '*Monetary—Fiscal Game*' under oligopolistic framework is also used to justify the co-ordination and co-operation between the monetary and fiscal authorities. The results derived from the VDCs and IRFs imply that monetary policy alone has a significantly positive impact on real output growth in Bangladesh. However, the impact of fiscal policy on real output growth remains broadly insignificant. The outcome of this study, thus, supports the views of the proponents of the St. Louis Model that monetary policy is relatively more effective than fiscal policy in stimulating real economic activity. The results also confirm the presence of interactions between monetary and fiscal policies. The outcome of the *'Monetary—Fiscal Game'* substantiates the necessity for cooperation between the monetary and fiscal authorities.

Keywords: Monetary policy, Fiscal policy, and Vector autoregressions (VARs).

JEL Classification: E61, E63, O23.

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Relative Effectiveness of Monetary and Fiscal Policies on Output Growth in Bangladesh: A VAR Approach

-Md. Habibur Rahman

1. Introduction

Sustainable output growth with relatively stable inflation & exchange rates is one of the important components of any macroeconomic stabilization policy. In order to accomplish this policy objective, there are two main alternative policy options — monetary and fiscal policy actions. The intention of this paper is to examine the relative effectiveness of these two policy actions in altering output using time series econometric technique based on St. Louis equation developed by the Federal Reserve Bank of St. Louis of the USA[2].

Economists are divided mainly into two groups regarding the effectiveness of macroeconomic stabilization policy. The group that believes in monetary actions argues that monetary policy is more powerful than fiscal policy in achieving various economic goals. In many cases, they (e.g., Milton Friedman and Meiselman, 1963; Anderson and Jordan, 1968; Carlson, 1978) use the St. Louis equation to provide empirical evidence in favor of their stand. The other group led by Keynes (1964), however, inclines to believe in fiscal actions.

Some economists, such as Stein (1980) and Ahmed et al. (1984), criticize the validity of using the St. Louis equation in various grounds. Stein (1980) and Ahmed et al. (1984) list some of the commonly used criticisms against the St. Louis equation. Among them the following are important: (i) the St. Louis equation is a reduced form equation. The policy variables (such as, money and government expenditure) included in this equation are not statistically exogenous; (ii) the St. Louis equation suffers from specification error because it omits some other relevant regressors (e.g., interest rates); (iii) the St. Louis equation is based on constrained Almon lag procedure. They argue that because of the above limitations, the results obtained by the St. Louis equation could be biased and inconsistent; and finally (iv) the use of the model in the developing economies with low degree of monetization remains somewhat less relevant. Nonetheless, the current paper makes an attempt to use the idea of St. Louis equation in Bangladesh to extract some indication of relative policy effectiveness from the monetary as well as fiscal point of view.

The current study uses Sims's (1980) vector autoregressions (VARs) approach to address the above criticisms associated with the St. Louis equation. The VAR model addresses the problem of endogeneity because it assumes all the variables in the system are endogenous. Inclusion of interest rate addresses, to some extent, the problem of omitted variables. Besides, the VAR model takes care of constrained Almon lag problem in that it allows selecting lag length optimally such that estimated residuals are white noise.

[2] St. Louis equation first appeared in Anderson, L. and J. Jordan (1968), "*Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization*," Federal Reserve Bank of St. Louis Review, pp. 11-24.

The objective of this study is to investigate the relative impact of monetary and fiscal policy actions on output growth in Bangladesh from the St. Louis equation stand point. The hypothesis of this paper, therefore, is that monetary policy is relatively more effective than fiscal policy in altering real output in Bangladesh. Variance decompositions (VDCs) and impulse response functions (IRFs) derived from the unrestricted VARs are used to evaluate the hypothesis. The rest of the paper is organized as follows: Section 2 discusses the stances of monetary as well as fiscal policies including a historical overview of monetary and fiscal policy stances in Bangladesh. This section also contains a game theoretic approach to analyze the relevance of co-ordination and co-operation between the two policy options. Section 3 contains literature review and Section 4 discusses the methodology of the study. Section 5 contains the description of data, preliminary data analysis and the analysis of the empirical results. And finally Section 6 contains summary and conclusion of the paper.

2. Policy Stances: Monetary vs. Fiscal

As an integral part of the national macroeconomic stabilization policy, monetary and fiscal policies are designed to fine-tune the fluctuations of the economy—in particular, fluctuations in the economic growth, inflation and unemployment rates. In line with the national goals of Medium Term Macroeconomic Framework (MTMF), the monetary policy is conducted with a view to achieving multiple objectives, such as maintaining price stability with a low inflation rate and fostering higher economic growth. Monetary policy is seen as a fundamental government policy with respect to the quantity of money, interest and exchange rates which is believed to have a predominant role on aggregate demand, inflation and output. This owes much to the "rise" of the doctrine of monetarism and to the "defeat" of the popular interpretation of Keynesian fiscal policy.

The fiscal policy, on the other hand, deals with the revenue and expenditure of the government. The government is responsible for providing all the major public goods and services through its administrative, development and welfare oriented programs which is not feasible for the private sector to supply. An excess expenditure over revenue creates fiscal deficit while excess revenue over expenditure creates fiscal surplus. The equality between expenditure and revenue produces a balanced budget situation. The income—expenditure management of the government is very crucial in that it has far reaching impact on various macroeconomic activities.

To achieve a certain policy objective, such as stable and low inflation or higher output growth, do we need to depend heavily on monetary policy or on fiscal policy or on a coordinated combination of both, is a compelling question to ask. Answer to this question definitely requires an in-depth investigation on relative effectiveness of monetary and fiscal policies. Accordingly, this paper makes an attempt to investigate the issue of relative effectiveness of monetary and fiscal policies on output growth in Bangladesh.

2.1 A Historical Overview of Monetary and Fiscal Policy Stances in Bangladesh

(a) Monetary Policy Stance in Bangladesh

The Bangladesh Bank is responsible for formulation and implementation of monetary policy. According to the Bangladesh Bank Order of 1972, the main functions of monetary policy in Bangladesh are: (1) to maintain reasonable price stability, (2) to ensure a stable balance of payment position and maintained an external competitiveness of the Bangladesh Taka, and (3) obtain sustained economic growth through increased production and employment. Although in a broad sense these objectives are complimentary, lack of coordination between monetary and fiscal authorities may create a conflicting situation. The necessity for smooth coordination between monetary and fiscal authorities is, therefore, very crucial in achieving optimal benefit from various policy actions. Accordingly, the Bangladesh Bank Order, 1972 (Amendment 2003, Section 9A) provides legal ground to establish a Co-ordination Council for the co-ordination of fiscal, monetary and exchange rate policies. The main responsibilities of the Co-ordination Council among others are: (i) to co-ordinate the macroeconomic framework including fiscal, monetary and exchange rate strategies and policies; and (ii) to ensure consistency among macroeconomic targets of growth, inflation and fiscal, monetary and external accounts.

Monetary policy in Bangladesh aims at achieving a multitude of objectives, such as economic growth, price and exchange rate stability, equilibria in the balance of payments, and the development of money and capital markets. With ongoing economic reforms in Bangladesh since the early-1990s, monetary policy has gained some independence in achieving and maintaining price stability. The Bangladesh Bank conducts its monetary policy by targeting the growth rate of the broad money (M2) based on projected inflation and output growth for given rate of changes in the income velocity of money. The monetary authority of Bangladesh Bank closely monitors the overall liquidity situation including domestic credit expansion to the public as well as private sectors while conducting monetary policy. The Bangladesh Bank uses various indirect policy instruments, such as T-bill auctions, repo and reverse repo operations under its open market operation activities along with moral suasion to contain the growth rate of the money supply within a predetermined target level.

It is noteworthy to mention that Bangladesh is presently under the IMF program of PRGF where maintaining a low-level inflation is required for macroeconomic stability. Recently the monetary authority of Bangladesh has pursued a series of legal, policy and institutional reforms to improve the process of financial intermediation and ensure efficient allocation of financial resources and in the ultimate analysis improve the competitiveness of the private sector and thereby promote investment and growth in the real sector. The thrust of the reform program is to improve the environment for, and the ability of bank owners, bank management, bank regulators and the markets to provide for better governance and regulation. The reform program focuses on: (i) greater autonomy to the Bangladesh Bank; (ii) strengthening of the Bangladesh Bank's capabilities and technical skills to perform its enhanced responsibilities; (iii) strengthening prudential regulations and supervision; (iv) restructuring the management and internal processes of Nationalized Commercial Banks (NCBs) and ultimately privatization of selected NCBs

and Development Financial Institutions (DFIs), (v) strengthening the legal and judicial processes and (vi) improving the money and debt markets.

In line with structural adjustment program, the financial sector underwent a pragmatic reform program with a view to developing a sound and well-functioning financial system. Since the inception of the Financial Sector Reforms Program (FSRP) in the early 1990s, Bangladesh has achieved considerable success in several spheres of financial as well as the real sector. The flotation of exchange rate in May 2003, the introduction of Repo and reverse Repo in July 2002 and in April 2003, respectively, and the initiation of secondary market for government bonds/bills in 2003 are some of them.

(b) Fiscal Policy Stance in Bangladesh

In pursuance of reconstructing the war-ravaged economy, Bangladesh followed an expansionary fiscal policy during the decade of 1970s producing a substantial amount of fiscal deficits. Besides, the centrally planned economic framework of the early 1970s also contributed significantly in accumulating large amount of fiscal deficits overtime. Consequently, Bangladesh economy started with a relatively larger size of public sector where most of the enterprises were nationalized. Financial losses in these state owned enterprises (SOEs) have often been the root cause of consolidated fiscal debt, which still haunts us today. The structural adjustment program of the early 1980s was the first initiative in the right direction of reducing the size of the public sector. It is argued that the share of public sector enterprises in Bangladesh is still high, and in all the public sector enterprises, nationalized banks and autonomous bodies, there has been a persistent waste of resources and unscrupulous expenditure (Habibullah, 1991).

In line with the objectives of the IMF Poverty Reduction and Growth Facility (PRGF) program, recently the government of Bangladesh has undertaken substantial policy measures to maintain fiscal discipline. To consolidate the fiscal sector, the government has initiated a four-year program to phase-out the loss making SOEs. In addition to the Adamjee Jute Mills, another 24 SOEs were closed in 2003 (Hossain, 2004).

It is observed from Table-1 that the government of Bangladesh witnessed a relatively high fiscal deficit of 7.6 percent of GDP during 1973-1980 and 6.9 percent of GDP during 1981-1990 reflecting expansionary fiscal policy stance during the period. The fiscal deficit was maintained well below 5.0 percent of GDP during the entire decade of 1990s (4.6 percent of GDP). Recent data, as reported in Table-1, also show that the central government deficit reduced from 5.1 percent of GDP in FY01 to 4.2 percent of GDP in FY03, on account of both revenue measures and expenditure discipline. The deficit further declined to 3.8 percent of GDP in FY04. The average fiscal deficits, however, stood at 4.4 percent of GDP during the period 2001-2005.

Table-1
Government Revenue, Expenditure and Fiscal Deficit in Bangladesh
(As percent of GDP)

Year (End June)	Revenue	Expenditure	Fiscal Deficit
1973-1980	7.2	14.8	-7.6
1981-1990	8.5	15.5	-6.9
1991-2000	9.1	13.7	-4.6
2001	9.6	14.8	-5.1
2002	10.2	14.9	-4.7
2003	10.3	14.5	-4.2
2004	10.6	14.4	-3.8
2005	10.5	14.7	-4.2
2001-2005	10.24	14.66	-4.4

Sources:
1. Hossain (1996).
2. GOB (2003 and 2005).
3. Bangladesh Bank, *Annual Report* (various issues) and author's own calculation.

2.2 A Monetary—Fiscal Game: Prisoners' Dilemma

The debate concerning the relationship between the monetary and fiscal policies is centered on the inflationary consequences of the deficit financing by the fiscal authority. In order avoid the inflationary consequences, the main policy recommendation has been to institute an independent monetary authority whose main mandate would be the control of inflation. The harmful consequences of high inflation could also be addressed by the fiscal authority by rationalizing fiscal expenditure and by raising tax revenue (Bennett and Loayza, 2002).

The Bangladesh Bank Order, 1972 is the basis of the conduct of monetary policy in Bangladesh. It provides the Bangladesh Bank with the responsibility of achieving both monetary stability with the special emphasis on domestic price stability and economic growth. Although in a way these broad objectives are complimentary, they could be in conflict if growth objectives get priority over price stability creating a situation where the co-ordination and co-operation between the fiscal and monetary authorities become highly important. For example, the program of monetary targeting of monetary authority could be jeopardized by fiscal dominance created by the fiscal authority with control of different policy instruments and objectives. The necessity for smooth coordination between monetary and fiscal authorities is, therefore, very crucial in achieving optimal real benefit from various policy actions. Following Bennett and Loayza (2002), a game theoretic approach after the well-known prisoners' dilemma is used to justify coordination between monetary and fiscal authorities. It can be shown that co-ordination and co-operation between the monetary and fiscal authorities are required for broader national interest.

Assume that monetary and fiscal authorities are the two players in the market under duopoly framework. Both of them want to maximize their pay-offs in terms of low inflation and high output given that they have different preferences for both inflation and output. The monetary authority places greater value on achieving low inflation than on achieving high output. The fiscal authority, on the other hand, puts more value on achieving high output than on achieving low inflation. Both of the authorities have two options: they can either cooperate with each other or may decide not to cooperate at all. The possible outcome and payoffs of their joint moves are given in Box-1.

Box-1

A Monetary—Fiscal Game[3]: Prisoners' Dilemma

		Central Bank (CB)	
		Cooperation	**Non-cooperation**
Fiscal Authority (FA)	**Cooperation**	Low Inflation High Output CB=50, FA=50 Total=100	Low Inflation Low Output CB=60, FA=20 Total=80
	Non-cooperation	High Inflation High Output CB=20, FA=60 Total=80	High Inflation Low Output CB=25, FA=25 Total=50

Given the possible outcome and payoffs of the game (Box-1) between the monetary and fiscal authorities, the only Nash equilibrium is non-cooperation from the both sides with the outcome of high inflation and low output. All of the other alternatives provide opportunities for one of the players to benefit by unilaterally deviating from it. Note that the Nash equilibrium is the worst among all the alternatives in terms of the outcome and payoffs. The best outcome with low inflation and high output of this game, however, can only be achieved by co-operation from both players, which is obviously superior to Nash equilibrium. Therefore, co-ordination and co-operation between the monetary and fiscal authorities are required for low inflation and high output.

[3] Both the Central Bank (CB) and Fiscal Authority (FA) are free to follow one of the two options, cooperation or non-cooperation, depending on their individual payoffs. Summation of individual payoffs makes the value of total payoff. For example, if both CB and FA cooperate, the individual payoff for CB and FA would be 50 making total payoff value equal to 100 and so on.

3. Literature Review

The debate on the comparative effectiveness of monetary and fiscal actions as discretionary stabilization tools is very old and extensive. Right after the end of Great Depression, there was a widespread credence that fiscal policy is more effective on economic activity. Keynes's '*General Theory*' followed by some noteworthy works, such as Leeuw et al. (1969), Schmidt and Waud (1973), Blinder and Solow (1974) provide basic theoretical and practical ground for active fiscal policy. Starting from the late sixties, as noted by Gramlich (1971), the failure of 1968-surtax policy introduced a new ground for monetarist attack claiming that fiscal policy has a very little effect on aggregate demand and monetary policy is more important than most people had thought to be. New classical economists, such as Robert Lucas, Thomas J. Sargent, and Robert J. Barro called into question many of the precepts of the Keynesian revolution in the seventies. New classical economists build their macroeconomic theories on the assumption that wages and prices are flexible. They believe that as prices adjust quickly markets clear by balancing supply and demand instantly. New Keynesian economists, however, believe that market-clearing models cannot explain short-run economic fluctuations. They argue that the wages and prices are "sticky" resulting in the existence of disequilibrium and involuntary unemployment explaining why monetary policy has such a strong influence on economic activity (Mankiw and Romer, 1991).

In respect of the relationship between money and output, a classic study by Milton Friedman and Schwartz (1963) is still very important and influential. Their study, as mentioned by Walsh (1998), indicates that variation in the rate of money growth cause variations in real economic activity. However, some economists e.g., Benjamin Friedman and Kuttner (1992), and Tobin (1970) have challenged the prediction of Milton Friedman and Schwartz (1963). They argue that the causation from money to output, as claimed by Milton Friedman and Schwartz, might not be the case.

Benjamin Friedman and Kuttner (1992) re-examine the postwar evidence of significant relationship between money and income using time-series approach on extended data through the 1980s for the U.S. economy. The empirical findings do not indicate a close or credible relationship between money and income. Their paper, however, has one strong finding that the spread between the commercial paper and Treasury bill rate has very significant information about the movements in real income. In the concluding section of their paper, they express their concern about the difficulty of using this spread as an intermediate policy target of the Federal Reserve System because of the continuously changing relationship between policy target and its outcome.

Gramlich (1971) summarizes some of the important papers on monetary-fiscal debate. He points out that a paper by Friedman and Meiselman (1963) predicts more stable and statistically significant relationship between output and money than that of output and autonomous spending. The paper by Anderson and Jordan (1968) uses various measures of monetary and fiscal policy actions and shows that monetary policy has greater, faster and more predictable impact on economic activities. Gramlich (1971) also reports the findings of some other papers from the antagonist side, such as, Ando and Modigliani (1965), DePrano and Mayer (1965) against the monetarist claim. His own study,

however, indicates that both monetary and fiscal policy have impact on real economic activity with the indication that money matters greatly.

Benjamin Friedman (1977) uses the St. Louis equation in his paper and claims that the St. Louis equation now '*believes in*' fiscal policy. In response of Benjamin Friedman's (1977) claim, Carlson (1978) re-estimates the St. Louis equation and argues that Benjamin Friedman's equation was suffering from the heteroscedasticity problem. The evidence from new and corrected estimation does not support Benjamin Friedman's claim that fiscal policy is more important than monetary policy. His findings suggest that only monetary policy has significant impact on economic activity and fiscal policy does not have any impact on real output.

Likewise, the outcome of developed countries, the empirical evidence for developing countries regarding the relative effectiveness of monetary and fiscal policies on economic activities is also mixed. Studies of Jayaraman (2002) for the South Pacific Island Countries, Masood and Ahmed (1980) for Pakistan, Saqib and Yesmin (1987) for Pakistan and Upadhyaya (1991) for developing countries support the monetarists' view that monetary policy is important for economic activity. Some other studies on developing countries, such as Hussain (1982) for Pakistan, and Darrat (1984) for five Latin American countries find that fiscal policy is more effective than monetary policy in altering real output.

Using modified version of St. Louis equation, study by Latif and Chowdhury (1998) for Bangladesh finds that fiscal policy is more effective over monetary policy in Bangladesh. This study is based on the OLS technique using the nominal data during 1974-1993 that suffers from all of the limitations indicated by Stein (1980) and Ahmed et al. (1984). They estimate six different equations of which four have only a single explanatory variable. One recent study on Bangladesh by Hasan (2001) based on the modified version of St. Louis equation predicts that both monetary as well as fiscal policies are important for economic growth. This study uses various econometric techniques based on nominal data during 1974-1996. The prediction of this paper, however, alters if real variable for income is used instead.

In contrast to other studies, the approach in this paper is methodologically and significantly different from previous studies on Bangladesh economy. Firstly, the data used in this paper are more recent and cover wider span of time producing more degrees of freedom and power that helps to get more efficient parameter estimates. Secondly, the data used in this paper are real enabling us to investigate real effect of the policy actions. Thirdly, this paper uses sophisticated econometric techniques, such as cointegration and vector autoregressions with simulated standard errors and confidence bands that address most of the criticisms associated with the St. Louis equation[4].

[4] See Enders, W. (1995) for more details.

4. Methodology and Cholesky Ordering

Structural macroeconometric models, such as the Klein interwar model, the Brooking model, the BEA model, the St. Louis macroeconomic model and the Taylor model are based on hundreds of equations and variables. In addition to the estimation difficulties, the problems of identification and endogeneity are commonly associated with these giant structural macroeconomic models. Sims's (1980) seminal work introduces unrestricted vector autoregressions (VARs) that allows feedback and dynamic interrelationship across all the variables in the system and appears to be highly competitive with the large-scale macro-econometric models in forecasting and policy analysis. The unrestricted VARs model assumes that each and every variable in the system is endogenous and does not impose any a priori restrictions.

The VARs approach solves the endogeneity problem associated with the St. Louis equation by assuming that all the variables in the system are endogenous. To address the problem of omitted variable, interest rate is added along with the three existing variables in the St. Louis equation, namely, real government expenditure as proxy for fiscal policy, real money supply (m2) as proxy for monetary policy and real output. The vector of the VAR model, therefore, contains the following variables:

1. Real Government Expenditure (g),
2. Real Money (m),
3. Real Interest Rate (r) and
4. Real GDP (y).

Variance decompositions (VDCs) and impulse response functions (IRFs) derived from vector autoregressions (VARs) approach are used to examine the relative impact of monetary and fiscal policy on real output growth. The VDCs show the portion of the variance in the forecast error for each variable due to innovations to all variables in the system. The IRFs show the response of each variable in the system to shock from system variables. By analyzing respective orthogonalized variance decompositions (VDCs) and impulse response functions (IRFs), the relative strength of monetary and fiscal policies could easily be determined. For example, if the response of real output growth due to monetary innovations is relatively higher and dissipate at a relatively slower rate than that of fiscal innovations, we could conclude that monetary policy is more effective than fiscal policy.

A Cholesky decomposition requires the variables to be ordered in a particular fashion, where variables placed higher in the ordering have contemporaneous impact on the variables which are lower in the ordering, but the variables lower in the ordering do not have contemporaneous impact on the variables those are higher in the ordering. As the objective of this study of to examine the relative impact of monetary and fiscal policies on output growth, this variable has been put in the last position. Since interest rate is influenced by the monetary and fiscal policy actions, the interest rate variable has been put in the third position in the ordering of the 4-variable VAR model. And finally, two policy variables have been put in the first two places. To check the robustness of the outcome, first two places are being interchanged between the two policy variables. Two models of VARs using log-differenced as well as log-levels are also attempted.

5. Description of Data

Annual data on real government consumption, real money supply, real interest rate and real output during 1975-2003 are used in the investigation. All of the series are in growth form except the real interest rate. The sources of the data are the World Bank 2003 CD-ROM and Annual Report (various issues) of Bangladesh Bank. The definitions of all of the variables are given below:

Consumer Price Index (1995 = 100): Consumer price index reflects changes in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly.

Real Government Expenditure (g): Real government expenditure is CPI adjusted general government final consumption expenditure that includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defense and security, but excludes government military expenditures that are part of government capital formation.

Real Money (m): Real money is CPI adjusted broad money that comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government.

Real Interest Rate (r): Real interest rate is calculated from the average of lending and deposit rates minus expected inflation. Lending interest rate is the rate charged by banks on loans to prime customers. Deposit interest rate is the rate paid by commercial or similar banks for demand, time, or savings deposits. Expected inflation is proxied by lagged (by a year) inflation.

Real Output (y): Real output is price (CPI based) adjusted GDP that includes gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

5.1 Preliminary Data Analysis

Before using the data in the estimation of VAR, we need to know time series properties of all the variables. Accordingly, a series of unit root tests[5], such as Augmented Dickey-Fuller (ADF, 1981), Phillips-Perron (PP, 1988), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) are used to determine the order of integration for each series. The results of unit root tests as reported in Table-2 indicate that only the real interest rate is stationary while rest of the variables, i.e., natural log of real government consumption, real money and real output are non-stationary and contain unit-roots I(1).

[5] Note that ADF and PP tests are based on the null of unit-roots while KPSS test assumes the null of stationarity.

Table-2
Results of Unit-Root Tests

Variables (in log levels)	Without Trend			With Trend			Decision
	ADF	PP	KPSS	ADF	PP	KPSS	
Real Interest Rate $^{\varphi}$ (r)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)
Real Government Consumption (g)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Real Money (m)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Real Output (y)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Notes:
1. Lag length for ADF tests are decided based on Akaike's information criterion (AIC).
2. Maximum Bandwidth for PP and KPSS test are decided based on Newey-West (1994).
3. All the tests are performed on the basis of 5 percent significance level.
4. φ = without log

As Engle and Granger (1987) point out that a VAR model would be misspecified if the all non-stationary I(1) variables of the model are cointegrated, Johansen's (1988) cointegration test is used to identify the presence of any co-integrating vectors among the all I(1) variables in the system. The results indicate that natural log of real government consumption, real money supply and real output are not cointegrated[6]. Therefore, a VAR model with variables in their growth form is appropriate. As a result, a VAR estimation technique is applied to the system of all variables in growth form except the real interest rate. The estimated results of VARs in terms of VDCs and IRFs are presented in the following section.

5.2 Empirical Results

To estimate VDCs and IRFs, orthogonalization of the residuals is required. A Cholesky decomposition is used to orthogonalize the residuals. To examine the relative impact of monetary and fiscal policies on output growth, the VDCs and IRFs are generated through 1000 Monte Carlo simulations from the orthogonalized residuals.[7] Computed VDCs are reported in Tables 3-5 and IRFs are reported in Figures 1-3. Table-3 contains VDCs of output growth while Table-4 and 5 contain VDCs of money and government consumption growth respectively. The IRFs of output growth due to policy shocks are reported at Figure-1. The IRFs of monetary policy due to fiscal policy shocks and the IRFs of fiscal policy due to monetary policy shocks are reported at Figures-2 and 3 respectively.

The variance decompositions of output growth, as reported in Table-3, indicate that most of the forecast error variance of output growth is explained by the monetary policy

[6] The results (not reported here but available from the author on request) are based on the assumptions of a constant and a linear trend in the data with optimal lag length 3. Akaike's Information Criteria (AIC), and Likelihood Ratio (LR) test are used to decide the optimal lag length that makes all the residuals white noise.

[7] The standard errors of VDCs and the confidence bands of IRFs are generated through 1000 Monte Carlo simulations.

shocks. The growth rate in money supply alone explains more than 50 percent of the forecast error variances of output growth during all time horizons with the exception of year-4 where it explains about 49.0 percent of the forecast error variances of output growth. None of the other variables, such as fiscal policy and interest rate has any significant influence in predicting the movement of output growth. The output growth itself explains only about 28.0 percent of its own forecast error variance at the very first year. In rest of the period it does not have any statistically significant explanatory power of dictating its own future path. Therefore, monetary policy alone is the most important factor for the prediction of future output growth of Bangladesh.

Table-3
Variance Decompositions of Output Growth

Time Horizon (Years Ahead)	Explained by Shocks in the Growth of			
	Fiscal Policy	Monetary Policy	Interest Rate	Output
1	2.47	66.51**	3.29	27.73**
	(8.78)	(12.50)	(4.86)	(9.60)
4	28.29	48.70**	3.83	19.18
	(19.18)	(19.26)	(5.50)	(10.93)
8	20.22	56.08**	5.60	18.09
	(19.64)	(21.64)	(7.39)	(11.49)
12	17.11	51.00**	11.77	20.12
	(20.40)	(22.48)	(7.99)	(12.20)

Notes:
1. First entry in each cell is the point estimates of the percentage of forecast error variance of variable *i* as explained by shocks to variable *j*. Monte Carlo (1000) simulated standard errors are reported in the parenthesis.
2. ** Indicate point estimates are statistically significant at 5 percent level assuming that the estimates are asymptotically normally distributed.

The VDCs of money growth as reported at Table-4 indicate that most of the variations in the money growth are explained by money growth itself indicating that money is growing independent and exogenously. The fiscal policy variable does not contain any information about money growth as the portions of forecast error variance of money growth at various time horizons explained by fiscal policy variable are not statistically significant. Likewise, the forecast error variances of money growth during 1-8 time horizons explained by real interest rate and output growth are not statistically significant. At time horizon 12, however, the real interest rate and output growth explain respectively 17.54 percent and 28.18 percent of the forecast error variance of money growth.

Table-4
Variance Decompositions of Money Growth

Time Horizon (Years Ahead)	Explained by Shocks in the Growth of			
	Fiscal Policy	Monetary Policy	Interest Rate	Output
1	2.00 (8.70)	98.00** (8.70)	0.00 (0.00)	0.00 (0.00)
4	29.74 (17.54)	58.59** (19.13)	4.65 (5.64)	7.01 (7.97)
8	32.52 (18.03)	47.59** (21.38)	7.63 (7.56)	12.25 (10.65)
12	23.92 (19.32)	30.36 (22.90)	17.54** (8.23)	28.18** (11.56)

Notes:
1. First entry in each cell is the point estimates of the percentage of forecast error variance of variable *i* as explained by shocks to variable *j*. Monte Carlo (1000) simulated standard errors are reported in the parenthesis.
2. ** Indicate point estimates are statistically significant at 5 percent level assuming that the estimates are asymptotically normally distributed.

The VDCs of fiscal policy variable as reported at Table-5 indicate that at the very first time horizon, 100 percent of its own forecast error variance is explained by itself. The fiscal policy variable becomes totally irrelevant in explaining its own future path as the portions of forecast error variance of this variable explained by itself after the initial time horizon are not statistically significant. During the time horizons 2-12, the forecast error variances of the fiscal policy variable are mostly explained by money growth indicating that money growth is important in forecasting future path of fiscal policy variable. Movement in the real interest rate, however, does not contain any information about the movement of the fiscal policy variable as none of portions explained by the real interest rate is statistically significant at any time horizon. The output growth, on the other hand, significantly explains 22.08 percent and 24.18 percent of forecast error variance of the fiscal policy variable at time horizons 4 and 12 respectively.

Table-5
Variance Decompositions of Government Expenditure Growth

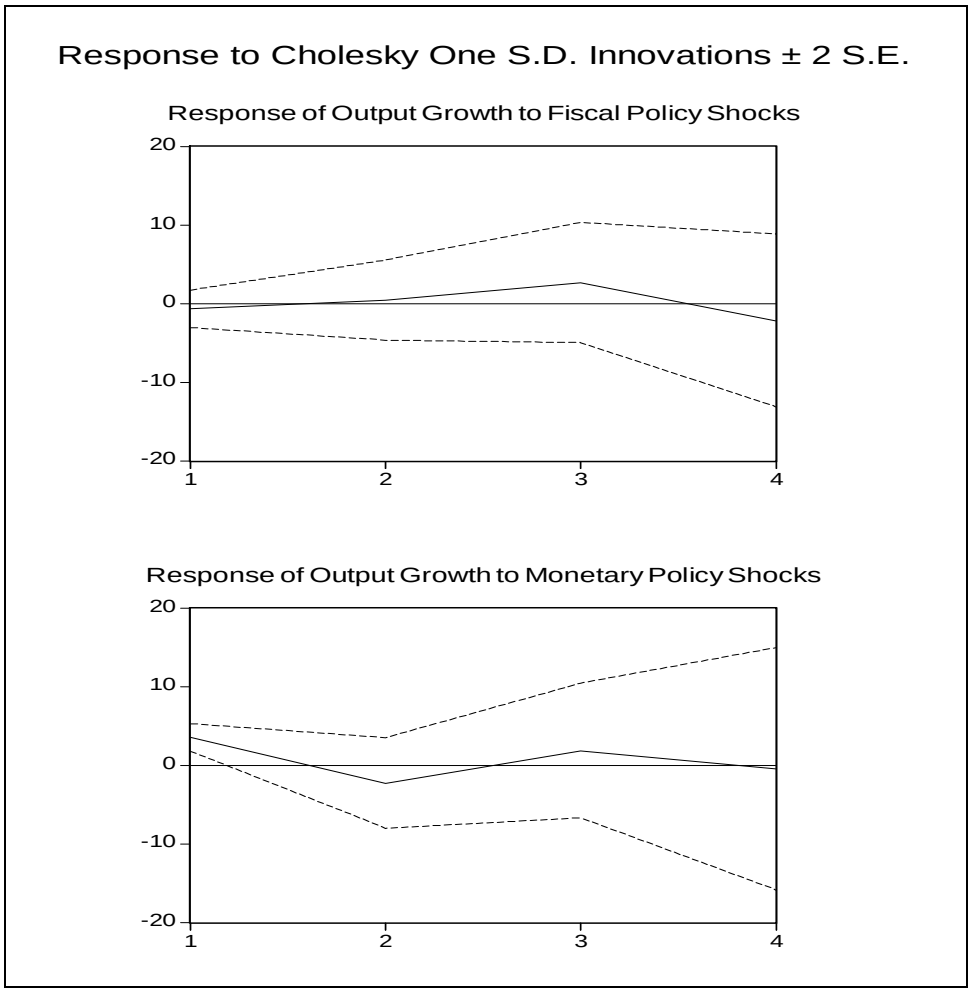
Time Horizon (Years Ahead)	Explained by Shocks in the Growth of			
	Fiscal Policy	Monetary Policy	Interest Rate	Output
1	100.00**	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
4	23.75	50.03**	4.14	22.08**
	(16.67)	(19.10)	(5.57)	(10.70)
8	9.67	64.86**	9.63	15.84
	(18.50)	(21.27)	(7.45)	(10.79)
12	7.28	52.86**	15.68	24.18**
	(19.93)	(22.44)	(8.38)	(11.90)

Notes:
1. First entry in each cell is the point estimates of the percentage of forecast error variance of variable *i* as explained by shocks to variable *j*. Monte Carlo (1000) simulated standard errors are reported in the parenthesis.
2. ** Indicate point estimates are statistically significant at 5 percent level assuming that the estimates are asymptotically normally distributed.

The estimated IRFs along with 95 percent confidence interval of output growth due to fiscal as well as monetary policy shocks are reported in Figure-1[8]. The top part of this figure represents the IRFs of output growth due to fiscal policy shocks and the bottom part represents the response of output growth due to monetary shocks. Figure-1 indicates that only monetary policy shocks have significant and positive impact on output growth, which is very much in line with the outcome of VDCs. Real output growth responds positively to the monetary policy shocks at the initial period and becomes insignificant for rest of the period indicating a short-run positive impact of monetary policy on real output growth. The response of output growth to the fiscal policy shocks, however, is always insignificant indicating no real impact of fiscal policy on real output growth.

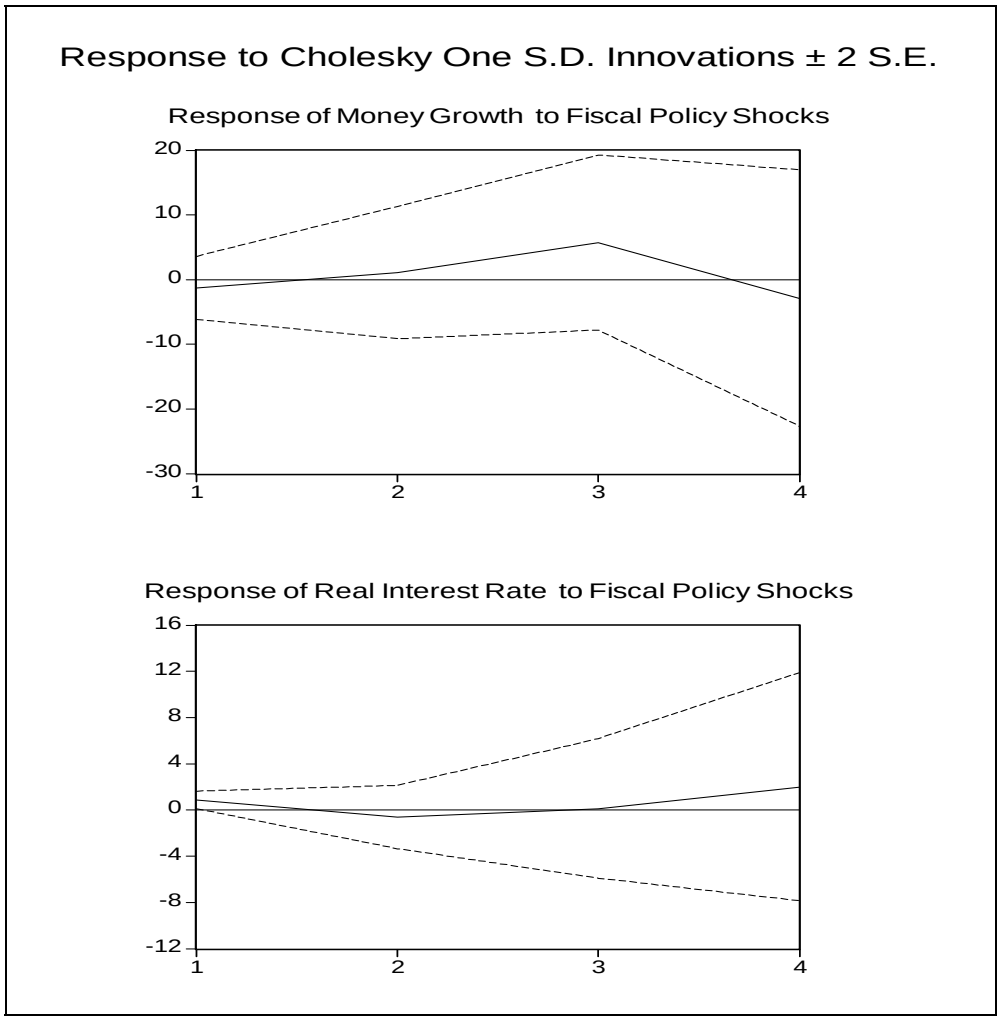
[8] A response is considered as significant if it does not contain the zero line within its confidence bands. Confidence bands (+ 2 s.d.) are generated through 1000 Monte Carlo simulations.

Figure-1
Impulse Response of Output Growth to Fiscal and Monetary Policy Shocks



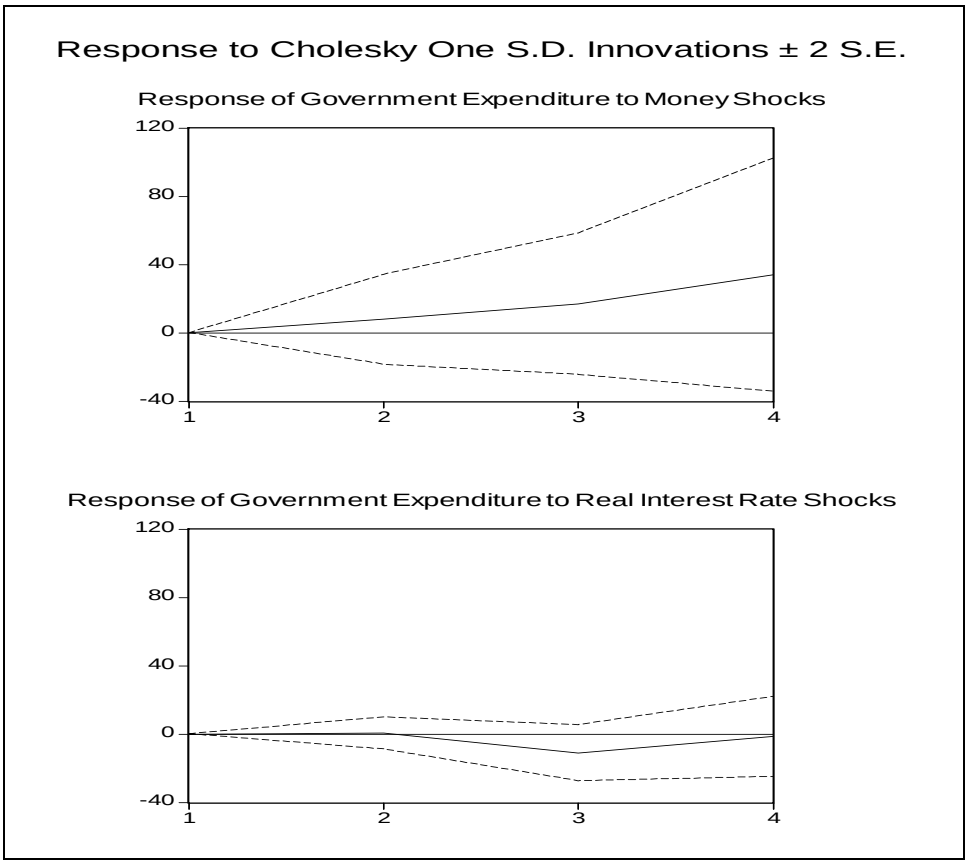
The IRFs of monetary policy due to fiscal policy shocks as shown at Figure-2 indicate that money growth does not respond to any fiscal policy shocks but the real interest rate responds positively at the initial period. That is, an increase in the government expenditure will lead to an increase in the real interest rate. The IRFs as depicted at Figures-3 indicate that government expenditure, the proxy for fiscal policy, does not respond at all to any positive shock to money growth or real interest rate.

Figure-2
Impulse Response of Monetary Policy to Fiscal Policy Shocks



Concerning the inter-relationship between monetary and fiscal policy actions, the findings of this paper imply that there is some degree of relationship between them. Therefore, coordinated policy actions are required to extract expected outcome in terms of low inflation and high output growth from the long-run macroeconomic policy in Bangladesh.

Figure-3
Impulse Response of Fiscal Policy to Monetary Policy Shocks



The absence of cointegration among the natural log of real government consumption, real money supply and real output supports the finding that none of the policy variables has long run impact on real output and there is no long-run equilibrium relationship among them. In order to check the robustness of this finding, a VAR model is estimated by interchanging the ordering of two policy variables and another VAR model is estimated in natural log levels of all variables[9]. The outcome regarding the relative impact of fiscal and monetary policies on real output growth remains the same regardless the ordering of the two policy variables and a VAR model in log levels.

6. Summary and Conclusion

This study investigates whether the monetary policy or fiscal policy has greater impact on real output growth using unrestricted VARs based on St. Louis equation. The result from the VDCs implies that monetary policy variable explains most of the forecast error variance of real output growth where fiscal policy remains broadly ineffective in explaining the forecast error variance of output growth. In line with the prediction of VDCs, the outcome of IRFs also suggests that monetary policy alone has significant

[9] The results are not reported here but available from the author on request.

impact on real output growth in Bangladesh. However, the existence of inter-relationship between the fiscal and monetary authorities remains somewhat subdued in the outcome of VDCs and IRFs. The result of cointegration test, on the other hand, does not provide any evidence of long-run equilibrium relationship among the two policy variables and real output. A '*Monetary—Fiscal Game*' under oligopolistic framework is used to justify the co-ordination and co-operation between the monetary and fiscal authorities. The prediction of the duopoly game warrants proper co-ordination and co-operation between the monetary and fiscal authorities.

The results as evident from Tables 4-5 and Figures 2-3 indicate that there is some degree of inter-relationships between the two policy actions that support the prediction of the duopoly game shown in Box-1. The outcome of VDCs (Tables 4-5) indicates that money growth is an important variable for the prediction of future government spending. The outcome of IRFs (Figures 2-3), on the other hand, implies that an increase in the government expenditure will lead to an immediate increase in the real interest rate that could be detrimental for the private investment and hence for economic growth. Although the interaction between the fiscal and monetary authorities is not strong enough to have any significant effect of fiscal action on GDP growth, some sort of co-operation between monetary and fiscal authorities is required to achieve long-run macroeconomic policy objectives.

The prediction of this study in terms of the relative impact of monetary and fiscal policies on real output growth sharply contrasts to the findings of Latif and Chowdhury (1998). Their study finds that fiscal policy is more effective than monetary policy in Bangladesh. This is mainly because their study is based on the OLS technique, which suffers from the problems of endogeneity and omitted variables associated with the St. Louis equation as indicated by Stein (1980) and Ahmed et al. (1984). Latif and Chowdhury (1998) estimate six different equations of which 4 have only a single explanatory variable. Their study uses nominal variables during 1974-1993 that mostly limited to the pre-reform era. Some or all of these limitations associated with their study may be responsible for the contrasting results. The current study, on the other hand, uses sophisticated econometric technique based on real variables with extended data covering a longer horizon, 1975-2003 that includes a substantial time period since the initiation of financial sector reform program in the early 1990s.

The outcome of the current study is very much in line with the predictions of the classic study by Milton Friedman and Schwartz (1963) and other advocates of the St. Louis equation where variation in the rate of money growth causes variation in real economic activity. The findings of this paper, thus, suggest that only monetary policy is effective in altering real output of Bangladesh where fiscal policy remains broadly ineffective. In order to achieve higher output growth, we should rely heavily on monetary policy rather than fiscal policy. An independent monetary authority and continuous effort to bring discipline in the financial as well as public sector is recommended. Any policy recommendation based on the outcome of a single study, however, may not be appropriate. Further studies on this issue are therefore required for making appropriate policy recommendations.

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