**Relative Effectiveness of Monetary and Fiscal Policies on Output Growth in Bangladesh: A Co integration and Vector Error Correction Approach**

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## Abstract

This paper investigates the relative importance of monetary and fiscal policies in altering real output growth in Bangladesh. Broad money supply (M2) and government consumption expenditure have been used as a proxy for monetary and fiscal policies while GDP growth at constant prices is used as proxy for real output growth. Anderson and Jordan (1968) St. Louis equation is used to estimate the relative effectiveness of monetary and fiscal policies. Various charts, graphs, correlation, granger causality test, co-integration and vector error correction approach are used to examine the validity of St. Louis equation in measuring relative effectiveness of monetary and fiscal policies in Bangladesh. The empirical results show that both the monetary and fiscal policies have significant and positive impact on real output growth in Bangladesh with varying degree. The outcomes of the study demonstrate that monetary policy has relatively stronger impact than that of fiscal policy in altering output growth in Bangladesh. This support the view of the proponent of St. Louis Model that avowed monetary policy is relatively more effective than fiscal policy in stimulating real economic activity.

## 1.    Introduction

The objective of this paper is to examine the relative effectiveness of monetary and fiscal policies in altering real output in Bangladesh using annual data from 1980 to 2011. Sophisticated time series econometric techniques based on St. Louis equation[2] developed by the Federal Reserve Bank of St. Louis of USA are used in the study. As per policy framework of the central bank of Bangladesh, the main goals of monetary policy are to maintain price stability with low inflation to support the highest sustainable output growth. The fiscal authority, on the other hand, has also their objective to reach highest attainable growth path by using fiscal policy. In the literature, there are two groups arguing over the relative effectiveness of the two policies in macroeconomic stabilization of a country. The group that believes in monetary actions argued that monetary policy is more powerful than fiscal policy in achieving various economic goals. For example, Milton Friedman and Meiselman, (1963), Anderson and Jordan (1968), Carlson (1978) used the St. Louis equation to provide empirical evidence in favor of their stand. The other group led by Keynes (1964), however, tends to believe in fiscal actions.

The hypothesis of this paper is, therefore, to investigate whether the monetary policy is relatively more effective than fiscal policy in altering real output of Bangladesh. 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 view of avoiding the inflationary consequences, the main policy recommendation has been to institute an independent monetary authority whose main mandate is 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 current study makes an attempt to overcome the criticism associated with the St. Louis equation. Co-integration, Vector Error Correction (VEC) approach and Granger

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[2] Some economists, such as Stein (1980) and Ahmed and Johannes (1984) criticize the validity of using the St. Louis equation in various grounds. Stein (1980) and Ahmed and Johannes (1984) list some of the commonly used criticisms against the St. Louis equation. Among them the following are important: (i) the St. Louis equation was 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); and (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.

Causality tests have been used. The VEC 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.

The plan of the study is as follows: after the introduction in section-I, a review of the related literature is provided in section-II. While section-III analyzes the relationship between monetary and fiscal policies, section–IV outlines the model specification, methodology and the empirical estimation. Finally, the conclusions and recommendations are given in section-V.

## II.     Literature Review

The debate on the comparative effectiveness of monetary and fiscal policy actions as discretionary stabilization tools is very old and extensive topic. During the era 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 thought to be.

In respect of the relationship between money and output, a seminal paper by Milton Friedman and Schwartz (1963) is 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), Tobin (1970) have challenged the prediction of Milton Friedman and Schwartz (1963). They argued 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 concerned 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. Paper of 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 of Latif and Chowdhury (1998) for Bangladesh found that fiscal policy is more effective over monetary policy in Bangladesh. This study uses the OLS technique based on 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 4 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 co-integration and vector error correction that address most of the criticisms associated with the St. Louis equation.

Although in a broad sense these broad objectives are complimentary, they could be in conflict if developmental objectives get priority over price stability. Lack of coordination between monetary and fiscal authorities is one of the very common cases that create a situation where other issues get priority over the price stability. 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. Bennett and Loayza (2002) using a game theoretic approach known as prisoners' dilemma justified the coordination between monetary and fiscal authorities for broader national interest.

## III.    An analyses of fiscal policy and monetary policy stance in Bangladesh

### Fiscal policy stance

In pursuance of reconstructing the war-ravaged economy, Bangladesh had been following an expansionary fiscal policy during the decade of 1970s producing a substantial amount of fiscal deficits since then. Besides, centrally planned economic framework of the early 1970s also contributed significantly in accumulating large amount of fiscal deficits overtime. Because of the Bangladesh economy started with a relative huge 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 deficits.

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 has been well cited in the literature (Habibullah, 1991) 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.

Table-1 reports the data for government revenue, expenditure and fiscal deficit during 1973-2012. 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. During the period of 1981-1990, the practice of expansionary fiscal policy was still in place. Despite of the expansionary fiscal policy stance, the fiscal deficit was slightly moderated at 6.9 percent of GDP during 1981-1990. The fiscal deficit was maintained well below 5.0 percent of GDP during the late 1990s. The amount of fiscal deficits as a percent of GDP stood at 4.6 during the period 1991-2000. The average fiscal deficits, however, stood at 3.7 percent of GDP during the period from 2001 to 2012.

**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 |
| 2001-2003 | 10.0 | 14.7 | -4.7 |
| 2004-2012 | 9.9 | 13.2 | -3.2 |
| 2001-2012 | 9.9 | 13.7 | -3.7 |

Sources:

1. The data from 1973 to 1989 has been taken from Hossain (1996).
2. Ministry of Finance, Government of Bangladesh: The Economic Review, 2012.
3. Bangladesh Bank, Annual Report (various issues) and author's own calculation.

Most recent data, as reported in Table-1, show that the government deficit reduced from 5.1 percent of GDP in FY2001 to 4.7 percent of GDP in FY2002, on account of both revenue measures and expenditure discipline. The deficit further declined to 4.2 percent of GDP in FY2003. The average fiscal deficits, however, stood at 4.7 percent of GDP during the period 2001-2003. The govt. budget deficits stood lower at 3.2 percent during the period from 2004 to 2012.

*Monetary policy stance*

Monetary policy in Bangladesh aims at achieving a multitude of objectives, such as economic growth, price and exchange rate stability. 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 monetary policy by targeting the growth rate of the broad money supply (M2) and uses credit control and supports measures to contain the growth rate of the money supply within a predetermined target level.

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. Recently, some changes have been brought about in the objectives of monetary policy through the Bangladesh Bank (Amendment) Act, 2003. The objectives as stated in the Act are, *"----- to manage the monetary and credit system of Bangladesh with a view to stabilizing domestic currency value and maintaining a competitive external par value of the Bangladesh Take towards fostering growth and development of country's productive resources in the best national interest."* It is noteworthy to mention that Bangladesh is presently under the IMF program of PRGF where maintaining a low-level of inflation is required for macroeconomic stability. In view of establishing dynamically evolving and well functioning financial system, recently the monetary authority of Bangladesh has taken a series of major policy actions.

The Bangladesh Bank 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 State Owned Commercial Banks (SCBs) and ultimately privatization of selected SCBs 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 through a pragmatic reform program in view of 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 a considerable success in several spheres of financial as well as real sector. The floatation 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 are some of them. Poverty reduction and the growth performance are also showing the sign of improvement since then.

## IV. Model specification, methodology and empirical estimation

St. Louis has received much attention from the policy maker's researchers and academicians despite its criticism regarding methodology and variables. The equation could be reproduced here as follows:

$$\Delta y_t = c_0 + \sum_{i=0}^{4} m_t \, \Delta M_{t-i} + \sum_{i=0}^{4} g_t \, \Delta G_{t-i} + e_t \dots \dots \dots (1)$$

Where,

$\Delta y$ = the growth rate of nominal GNP;

$\Delta M$ = the growth rate of money;

$\Delta G$ = the growth rate of full-employment government expenditures;

m and g are regression coefficients of money and government expenditure that are constrained to lie on a fourth-degree polynomial with endpoint constraints.

This study addresses some of the criticism of St Louis equation such as omitted variable, methodology and finally, criticism by Schmidt and Waud (1973) who argued that the constrained Almon lag procedure imposed on (1) for estimation purposes may "lead to biased and inconsistent estimates and to invalid tests". In this paper 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 GDP as proxy for real output growth to take care of the omitted variable bias. Unlike St. Louis equation this study uses VAR based co-integration technique and vector error correction

model to see the short run dynamics of the model and also to solve the problem of endogeneity. The vector of the VEC 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).

The model can be specified as follows:

$$Log\ (y) = f\ (log\ m,\ log\ g,\ log\ r)\quad ………………(1)$$

**Data**

Annual data for real government consumption (g), real money supply (m), real interest rate (r) and real GDP growth (y) during 1980-2011 are used in the investigation. All of the series are in log level and in real from except the real interest rate. The sources of the data are the IFS CD-ROM and annual report (various issues) of Bangladesh Bank. The definitions of all of the variables are given below:

**GDP deflator (2005=100):** GDP deflator has been used as measure of inflation.

**Real Government Expenditure (g)**: Real government expenditure is GDP deflator 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 GDP deflator 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 weighted average lending minus expected inflation based on GDP deflator. Lending interest rate is the rate charged by banks on loans to prime customers. Expected inflation is proxied by lagged inflation.

**Real Output (y):** Real output is price (GDP deflator) 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.

**Preliminary Data Analysis**

Before using the data in the estimation, we need to know time series properties of all the variables. Accordingly, a series of unit root tests[3], 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 all the variables are I (1) i.e., natural log of real government consumption, real money and real output and the real interest rate are non-stationary and contain unit-roots I (1).

**Table-2**

**Results of Unit-Root Tests**

| Variables (in log levels) | Without Trend | | | With Trend | | | Decision |
|---|---|---|---|---|---|---|---|
| | DF | PP | KPSS | DF | PP | KPSS | |
| log of real interest rate$^\varphi$ (r) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) |
| log of real government consumption (g) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) |
| log of real money (m) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) | I(1) |
| log of 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. $\varphi$ = without log

Before estimate the model a correlation matrix has been calculated to see whether variables of interest are correlated. Besides, since correlation does not ensure causality, a pair wise Granger Causality test is also performed to see the direction of the causality using different lags. Table 3 and 4 show the results of correlation matrix and Granger Causality test. From the correlation matrix and Granger Causality test it has been seen that in the log level real output, real government consumption expenditure and real money supply and real interest rate are correlated. Granger Causality test also shows that causality runs both ways at different lags. The Correlation and Granger Causality test form the basis for examine the precise relationship of output, monetary and fiscal policies and the interest rate.

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

**Pearson Correlation Coefficients**
**Prob > |r| under H0: Rho=0**

| Variables | g | y | r | m |
|-----------|---|---|---|---|
| g | 1 | | | |
| y | 0.94 (0.001) | 1 | | |
| r | 0.44 (0.01) | 0.43 (0.01) | 1 | |
| m | 0.94 (0.01) | 0.99 (0.001) | 0.44 (0.012) | 1 |

**Pair wise Granger Causality Tests**
**Lags: 2**

| Null Hypothesis: | Obs | F-Statistic | Probability |
|------------------|-----|-------------|-------------|
| y does not Granger Cause m | 30 | 18.12 | 0.001 |
| m does not Granger Cause y | | 3.28 | 0.05 |

**Pair wise Granger Causality Tests**
**Lags: 9**

| Null Hypothesis: | Obs | F-Statistic | Probability |
|------------------|-----|-------------|-------------|
| y does not Granger Cause g | 23 | 21.34 | 0.004 |
| g does not Granger Cause y | | 9.36 | 0.02 |

**Pairwise Granger Causality Tests**
**Lags: 5**

| Null Hypothesis: | Obs | F-Statistic | Probability |
|------------------|-----|-------------|-------------|
| r does not Granger Cause y | 26 | 4.63 | 0.009 |
| y does not Granger Cause r | | 0.67 | 0.65 |

**Pairwise Granger Causality Tests**
**Lags: 3**

| Null Hypothesis: | Obs | F-Statistic | Probability |
|------------------|-----|-------------|-------------|
| r does not Granger Cause y | 28 | 0.31 | 0.82 |
| y does not Granger Cause r | | 3.17 | 0.05 |

Engle and Granger (1987) pointed out that a VAR model would be mis-specified if the all non-stationary variables of the model are co-integrated. Therefore, estimating a VAR model with I (1) series are not appropriate if they are co-integrated. Accordingly, Johansen's (1988) co-integration test is used to identify the presence of co-integration among the integrated

variables. The results[4] indicate that natural log of real government consumption, real money supply and real output and real interest rate are co-integrated. The purpose of the co-integration test is to determine whether a group of non-stationary series is co-integrated or not. If a series of non stationary variables are co-integrated they form the basis for estimating the model using Vector Error Correction approach (VEC).

## Empirical Results

## Estimation Results of Co-integration

In our empirical estimation we have applied the Johansen (1991 and 1995) and Johansen and Juselius (1990, 992) multivariate co-integrating methodology which jointly determine empirically the number of *r* (maximum *k-1*) co-integrating vectors from a vector of *k* endogenous variables in the model along with coefficients of the variables and the adjustment parameters to a third order VAR (with maximum lag three) to test for co-integration. In our deterministic trend component specification in co-integrating equations we choose case-4 (linear trend assumption) that is, we assumed that the level series of endogenous variables have linear deterministic trends but the co-integrating equations have only intercepts (constants). The results are presented in Tables-3 to 4.

**Table 3: Co-integration Analysis of real GDP(y), broad money(m), real government consumption(g) and real interest rate(r)**

| Eigen values | 0.89 | 0.85 | 0.49 | 0.19 |
|---|---|---|---|---|
| Hypotheses | r = 0 | r ≤ 1 | r ≤ 2 | r ≤3 |
| Trace Statistics | 133.12** | 74.41** | 23.68 | 5.72 |
| 95% Critical Values | 62.99 | 42.44 | 25.32 | 12.25 |

Trace test indicates 2 co integrating equation(s) at both 5% and 1% levels

| Eigen values | 0.89 | 0.85 | 0.49 | 0.19 |
|---|---|---|---|---|
| Hypotheses | r=0 | r ≤ 1 | r ≤ 2 | r ≤3 |
| Maximum Eigen-Statistic | 58.71 | 50.73 | 17.96 | 5.71 |
| 95% Critical Values | 31.46 | 25.64 | 18.96 | 12.25 |

Max-eigenvalue test indicates 2 cointegrating equation(s) at both the 5% and 1% levels

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[4] 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.

**Table-4: Normalized Co-integrating Coefficients (or Eigenvectors) 1 Co-integrating Equation(s)**

| Log y | log m | log g | log r | c | @trend |
|:---:|:---:|:---:|:---:|:---:|:---:|
| **1.00** | -0.19 | -0.03 | 0.01 | -5.89 | -0.03 |
| | (-7.44) | (-2.89) | (16.67) | | (-16.7) |

(t-value in parentheses)

Or in equation form: $\log y = 5.89 + 0.19\, m + 0.03\, g - 0.01\, r + 0.03\, trend$

$$(7.44) \quad (2.89) \quad (-16.67) \quad (16.7)$$

According to the St. Louis equation there exists at least one co-integrating (or long-run) relationship between real money supply, real government consumption expenditure and the level of real output and the interest rate. In all the bi-variate co-integrating relationships, the critical values of the maximal eigen-value statistics and trace statistics strongly reject the null hypothesis of no (zero) co-integrating vector in favor of two co-integrating vector both at the 1% and 5 % levels. The existence of bi-variate co-integrating relations implies that there were long run equilibrium relationships between real GDP and each of the variables in interest separately such as *log m, log g, real interest rate.*

Several important remarks could be developed from the results of co-integrating relations.

✓ The elasticity between *real m, real g, and the interest rate are 0.19, 0.03 and -0.01* respectively.

✓ Like earlier study, this study finds strong and positive relation between money and the real GDP implying that monetary policy is more effective in altering real output in Bangladesh.

✓ While the relationship between real GDP and government consumption expenditure is significant and positive implying that fiscal policy is also effective in altering output in Bangladesh

✓ However, in terms of significant level and relative magnitude it appears that monetary policy is more effective than fiscal policy.

**Vector Error Correction (VEC) Models**

A vector error correction (VEC) model is used to see the short run dynamics since the variable are co-integrated. VEC is a restricted VAR representation. The co-integrating

relationships reveal the presence of long-run equilibrium relationships among the variables of the model. However, in the short run, deviations from these relations could occur as a result of shocks to any of the relevant endogenous variables. Thus, after testing for co-integration, a VECM is estimated. The VECM is conditional on co-integrating vectors and thus, specified as to regress the first (time) difference of each non-stationary endogenous variable at time-t on one period lag (at time -1) of the co-integrating equation/vector (s) and the lagged (at time-t-i) first (time) differences of all of the endogenous variables in the system. In fact, when we impose number of co-integrating vectors as restrictions among the endogenous variables in the VAR, we move to VEC model whose general form is:

$$\Delta x_{t=}c_o + \sum_{i=0}^{p-1} \gamma_i\, \Delta x_{t-i} + \delta_i ECT_{t-i} + \omega_t$$

In our case the form of VECs will be as follows:

$$\text{Model:}\Delta y_t = c_0 + \sum_{i=0}^{p-1}\gamma 1_i\, \Delta m_{t-i} + \sum_{i=0}^{p-1}\gamma 2_i\, \Delta g + \sum_{i=0}^{p-1}\gamma 3_i\, r_{t-i} ++\delta_i EC y_{t-i}+\omega 1_t$$

Where, EC is the error correction term (generated from the co-integrating equation) capturing the disequilibrium or deviation that arise between the level of real output, monetary and fiscal policies and the interest rates. The parameter $\delta$ is the speed of adjustment (in case of short run imbalances) in bringing about the equilibrium that is, removing the deviation. In the VEC all the variables in the model are endogenously determined and the parameter $\delta$ is the speed of adjustment or the parameter of error correction. From our VEC model estimation results, we can draw several important conclusions; first, the error correction term is significant (at the 1-percent error level) in our specification as implied by the Granger representation theorem. The optimal lags of VECM stands at three as confirmed by the Log likelihood test, Akaike Information Criteria and also by Final Prediction Error. The error correction term found negative and significant for D(y).

In more general terms, the significance of EC term implies that the error-correction mechanism work effectively to reduce the disequilibrium between the real GDP, monetary and fiscal policies so that the real GDP adjust to the new equilibrium. However, there are several features to be analyzed. Some of the adjustment coefficients of lagged values of explanatory variables were not significant. The value of ajdusted $R^2$ is reasonably good which is 0.82

A negative sign of EC term (coefficient of co-integrating vector) means that if the level of real output is distorted away from money supply and government consumption (from long run goods market equilibrium point of view) then the distortion was automatically removed by appropriate change of monetary and fiscal policies or adjustment of *m, g and r* brings equilibrium. The statistically significant error-correction terms implied that lagged values of the m, *g, r* can be used as a guideline for present or future policy direction of real sector equilibrium adjustment. The coefficient on the error correction term is high indicating that prices adjust rapidly to its long-run equilibrium. In VEC specification the estimated coefficient of the EC term is 0.45 implies a more rapid adjustment mechanism at work in correcting real output disequilibrium.

## V.     Summary and Concluding Remarks

The prediction of this study in terms of the relative impact of monetary and fiscal policies on real output growth is sharply contrasting to the findings of Latif and Chowdhury (1998). Their study finds that fiscal policy is more effective over 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 and Johannes (1984). They 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 during 1980-2011 that includes a substantial time period including 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 money supply causes variation in real economic activity. The findings of this paper, thus, suggest that monetary policy is more effective in altering real output of Bangladesh where fiscal policy remains relatively less effective. In order to achieve higher output growth, we should rely more on monetary policy as compared with fiscal policy. An independent monetary authority and continuous effort to bring discipline in the financial as well as public sector is therefore, recommended.

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