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**Policy Analysis Unit (PAU)**

**Working Paper Series: WP 0605**

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## **An Examination of Revenue and Expenditure Causality in Bangladesh: 1974-2004**

**Shubhasish Barua\***

December 2005

### **Abstract**

This paper examines causal relationships between government revenue and expenditure for Bangladesh using annual data over the period 1974-2004. A three variable model is formulated comprising the fiscal variables and GDP. The Johansen Cointegration and Granger Causality tests are used to detect causal relationships between the variables. The Johansen test results suggest that there is a long-run relationship between government expenditure, revenue and GDP. Any deviation from the long-run equilibrium is corrected by short-run adjustments of expenditure and GDP. The Granger Causality test on the corresponding Vector Error Correction (VEC) model suggests that there is no causal relationship between revenue and expenditure in the short run. It is also observed that the short-run relation extends from both the fiscal variables to GDP, and not the other way around.

*Keywords:* Revenue, Expenditure, Granger Causality, Johansen Cointegration test

*JEL Classification:* H20, H50

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## **1. Introduction**

Developing countries are facing dual challenges while undertaking fiscal adjustment policies. One arises from the increasing demand for public expenditures for infrastructure and social sector investment, and the other arises from the lack of capacity to raise revenue from domestic sources to finance the increased expenditure, primarily due to narrow tax base. To boost competitive capacity of the country in a rapidly globalizing world, the governments of developing countries have to invest a large portion of their revenue in building physical infrastructures. In addition, the low income developing countries also need to spend a major portion of their development expenditures in providing social services to the poor such as health, education etc. On the other hand, as Khattry (2003: 402) pointed out, “the structural characteristics of low income countries, combined with prevalence of unsophisticated tax administration limit their ability to raise taxes from domestic sources, namely income and domestic indirect taxes”. Also, the existence of a large informal sector and the underground economy constrains the government’s capacity for revenue growth.

Another source of fiscal problem arises with the process of trade liberalization that requires reduction of taxes on international trade together with the elimination of quantitative restrictions and other forms of trade barriers. Therefore countries have to resort to domestic sources to compensate the revenue loss emanating from trade liberalization. As the scope of domestic sources of revenue is limited due to the narrow tax base and structural constraints in the low income countries, this may lead to a vulnerable fiscal position. In principle, a well functioning VAT system on import (combined with broad based low tariffs) can recoup some of the revenue loss due to the greater inflow of imports that eventually follows trade liberalization. National Strategy for Accelerated Poverty Reduction (NSAPR) of Bangladesh (2005) recognizes that, as government revenue is heavily dependent on trade taxes, and tariff liberalization typically results in tariff revenue loss, alternative sources of revenue must be ensured in order to prevent a sudden rise in budget deficit (which is already high). In order to recoup revenue losses due to tariff liberalization government is trying to increase revenue from direct taxes. It is also envisaged that “if indirect taxes such as VAT and supplementary duty are applied uniformly on both domestic production and imports, it would both reduce anti-export bias and increase government revenue by widening the tax-net” (NSAPR, 2005, p.86).

Trade liberalization may thus lead to a ‘fiscal squeeze’ as a result of reduced revenue and simultaneous increase in expenditure. According to Khattry (2003) fiscal squeeze led some countries to reduce expenditure on physical capital, while that on social services (e.g. health and education) has been financed by acquiring additional debt. However, it has been empirically substantiated that government capital expenditure plays an important role in enhancing economic growth. Bose et al (2003) investigated a panel of thirty developing countries over the decades of 1970s and 1980s, and found that, the share of government capital expenditure in GDP is positively and significantly correlated with economic growth though current expenditure is insignificant.

The purpose of this paper is to evaluate the relationship between revenue and expenditure and its implication for managing the budget deficit. In order to do this a three variable model is formulated comprising government expenditure, revenue and GDP. Firstly, existence of a long-run relationship among these three variables is tested by using Johansen (1991, 1995) cointegration approach. Granger causality test is applied on the corresponding vector error correction model to examine short-run causal relationship between the variables.

The goal of fiscal policy is to enhance economic growth and employment and to bring stability in economic outcome variables such as the real GDP growth rate. Under the above circumstances, the nature and objectives of fiscal policy may differ with the level of development of the countries. Long run outcome of expansionary fiscal policy depends on the nature of distribution of public resources as the same amount of public money can generate different growth pay-offs in different sectors, and the overall growth of the economy depends on the combined growth of these sectors.

When the government takes expansionary fiscal policy (expenditure surpassing revenue) either through increasing expenditure or reducing taxes or both, it has to borrow from internal and external sources to finance the deficit. The concept of deficit budget was popularized by Keynes and his followers –the principal argument is that government can boost up economic growth by increasing government expenditures in the short run. Again the government has to shrink its expenditures during the time of growth as excessive aggregate demand can generate inflation. In contrary to the above theory some economists argue that budget deficit negatively affects economic growth.

According to the advocates of the latter view, lowering budget deficit reduces interest rate thereby increasing investment, which in turn enhances economic growth<sup>1</sup>.

The risk of expansionary fiscal policy is that, it leads to public debt growth, where it is envisaged that the growth of the economy will be significant enough in the subsequent periods so that the government will have a larger revenue base to finance its enhanced debt obligations. However, failure to generate enough economic growth may force the government into a deficit trap. Therefore the government has to borrow again to finance its deficit -this time may be in greater volume due to increase in the expenditure for repaying principal and interest of previous period's debt even if the magnitude of public sector activities remains unaltered.

There is also a risk that, government borrowing from domestic sources may crowd out private investment by raising the rate of interest. Constraining private investment in this fashion and expending the same amount of money in less productive sectors of the economy can negatively affect overall growth of the economy. As mentioned by Carneiro et al (2004, p.9), "if economic agents are non Ricardian<sup>2</sup> due to credit constraints and overlapping generation, public deficit can have a negative impact on growth as public deficits can hamper growth by competing with private physical capital for individual savings". Conversely, in developing countries public investment can be influential to crowd in private investment as shown by Binswanger et al (1993); infrastructure accessibility and the rural banks are crucial factors for increasing private investment in agriculture, which requires substantial government intervention in facilitating private investment. Given excess liquidity in the system (as it is the case in Bangladesh), in spite of significant public borrowing from the banking system over the last 4-6 months, private credit actually proceeded at its usual pace. This however need not be true all the time.

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<sup>1</sup> Mitchell. D. J (2005) discussed the debate in more detail.

<sup>2</sup> The well known Barro-Ricardo equivalence proposition, or Ricardian equivalence theorem, argues that government bonds are not net wealth because the agents recognizes that there will be a rise in future taxes for government borrowing now in order to repay its debt. Given that the present value remains the same, approaches of the agents toward current taxes and expected future taxation will not differ. Therefore reduction in government saving due to present deficit will be matched by equal amount of increase in private savings (See Barro, 1974).

Following the introduction in section 1, this paper is organized as follows. Section 2 provides a brief discussion on fiscal reforms in Bangladesh and section 3 discusses the dynamics of revenue and expenditure relationships. Section 4 and 5 respectively provide a review of empirical findings of existing literature and data and methodology of the study. Section 6 provides the results and policy implications and finally Section 7 concludes the paper.

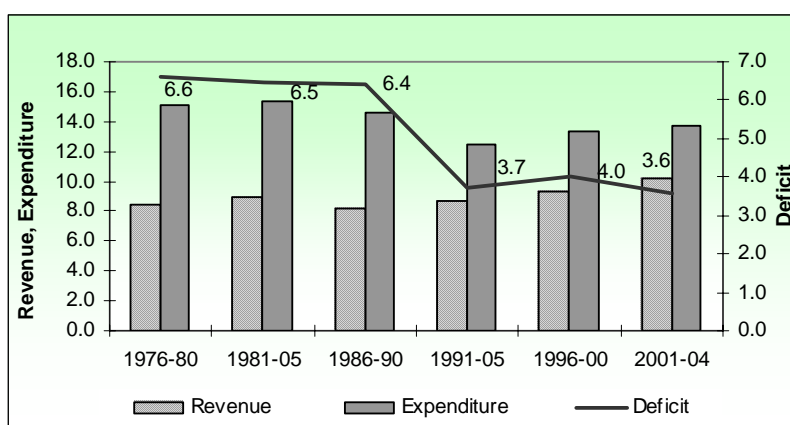
## **2. A brief discussion on fiscal reforms in Bangladesh**

Bangladesh initiated a major macroeconomic reform program under the guidelines of World Bank and IMF during mid 80's. One of the core objectives of SAF (Structural Adjustment Facility) and ESAF (Enhanced Structural Adjustment Facility) arrangements was - to readjust government spending and to improve revenue collection. The fiscal consolidation program (under SAF and ESAF) aimed to reduce the budget deficit by about 3 percent of GDP, over a three-year period. Enhancing capital expenditure and selective reduction in current expenditure (as percent of GDP) was a common strategy for most of the countries for expenditure management. On the other hand, shift from direct to indirect taxation, non-tax to tax revenue along with administrative capacity building were among the major focus of the revenue side reforms<sup>3</sup>. The country also introduced important reform measures toward liberalization through reducing public expenditures in loss-making sectors e.g., rapid privatization of unprofitable State Own Enterprises (SOEs) to reduce its fiscal burden. In 1991, Bangladesh initiated Value Added Tax (VAT) as a broad based consumption taxation system which is more effective than the earlier system of indirect taxation. The country also introduced some reforms measures with a view to financing increasing public investment through domestic resource mobilization.

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<sup>3</sup> (Finance and Development/ September 1997)

**Figure 1: Revenue and Expenditure (as percent of GDP) from FY76 to FY04**



During FY1976-80 budget deficit was as high as 6.6 percent of GDP (on the basis of BBS statistical year book various issues) which has been reduced to around 3.7 percent of GDP during FY1991-05 period. This happened mainly due to a significant fall in total expenditure along with modest increase in revenue. It is worth mentioning that, over the last decade government expenditure in terms of interest payment has increased substantially as Chowdhury (2005) showed; share of interest payment in revenue expenditure of Bangladesh has increased from 14 percent in FY91 to around 20 percent in FY01 and share of interest on domestic borrowing also increased from around 55 percent of total interest payment in FY91 to around 75 percent in FY01.

Medium-Term Macroeconomic Framework of NSAPR (2005) projected that the revenue/ GDP ratio should rise to 12.0 percent and the expenditure/ GDP ratio would reach 16.4 percent in FY 09 and overall budget deficit will stabilize at 4.4 percent of GDP during the FY06-FY09 period. The MTMF projected increase in the revenue/ GDP ratio from 10.4 percent in FY05 to 12.0 percent in FY09 based on the assumption that there will be continued tax reform in the country over the next few years. It is projected that net foreign financing would contribute 2.6 percent of GDP to finance the budget deficit in FY08-FY09 period, while domestic financing would be 1.8 percent of GDP for the same period.

In order to strengthen tax administration, recently the government has undertaken some reforms. Creation of Large Taxpayers Unit (LTU) and Central Intelligence Unit (CIU) within the National Board of Revenue (NBR) to monitor tax compliance of largest tax payers are among the important measures initiated by the government. Efforts are also



underway to strengthen custom administration and develop professional skill of NBR officials. Government is also trying to increase income tax and the VAT net and rationalize non-tax revenue rates (NSAPR, 2005). The MTMF framework also projected that expenditure in core social and economic sectors of the economy, such as education, health and infrastructure would substantially rise in real terms during FY06-FY09 in order to attain pro-poor growth.

### **3. Dynamics of Revenue-Expenditure Relationships**

There are four possible hypotheses regarding the relationship between revenue and expenditure. Firstly, revenue-expenditure hypothesis can arise in two distinct forms<sup>4</sup>. The first relationship is advocated by Friedman and his followers. According to Friedman (1978) raising taxes in an attempt to reduce deficit will also cause expenditure to rise. Therefore it will not be possible to reduce deficit by increasing taxes. The alternative version of revenue-expenditure hypothesis is popularized by Wagner (1976) and Buchanan and Wagner (1977). According to them, reducing taxes will cause expenditure to rise because of fiscal illusion of the population.

In contrast, Barro (1974), on the basis of the Ricardian equivalence theory suggests that spending causes revenue to rise. The expenditure-revenue relationship can arise when the government takes its expenditure decision first and increases its taxes to finance deficit. There are various interest groups within the government, who prefer to borrow initially to finance increased expenditure and gradually raise taxes to compensate for the incurred debt burden and rising deficit.

The third kind of relationship that may appear between these two variables defined as fiscal synchronization hypothesis which suggests that revenue and expenditure are determined simultaneously. This argument is mainly developed by Musgrave (1966) and Meltzer and Richard (1981). According to them, government expenditure and revenue are determined in the process of equalizing marginal benefit and marginal cost of government services by the population of the country.

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<sup>4</sup> Payne, (May 2003) and Martin et al (December 2004), discussed both the forms of the revenue-expenditure hypotheses. However, the latter one is less likely scenario due to budget constraints.

Finally, there is the view that there can be no relationships between revenue and expenditure i.e. these variables are determined independent of each other. Darrat (1998), Widavsky (1988), Baghestani and McNown (1994) support this argument. This is a possible scenario when the government determines expenditure on the basis of requirements of the citizen and imposes taxes up to a tolerable limit to the citizen (Martin et al, 2004).

#### **4. Review of empirical findings in the existing literature**

Direction of causal relationship between revenue and expenditure and its implication for budget deficit has not been empirically resolved. Though over the last three decades a number of studies have been carried out in different countries to explore the issue, findings vary from country to country and also within the country.

Legrenzi & Milas (2002) found evidence in favor of a long-run relationship between general government expenditures and revenues in Italy. Besides, short-run increase in government expenditures causes increase in taxes -providing support for the spend-and-tax hypothesis. After allowing for non-linear effects in the short-run adjustment process they found evidence of asymmetric adjustment around a unique (at zero) equilibrium rather than multiple ones. Martin et al (2004) studied revenue expenditure relationship for Swiss cantons based on vector error correction models and found that long term relationship can extend from revenue to expenditure, expenditure to revenue, can be mutual or non existent between these two variables. Aka and Decaluwe (1999); examined long-run relationship between the tax rate and budget deficits for four developing countries (Benin, Cote d'Ivoire, Niger and Togo) and could not find any long-run relationship between these two variables. However, the Granger causality test suggests that there is strong bidirectional causation between the tax rate and budget deficits. Hussain (2005) tested revenue expenditure relationship for Pakistan using revised estimates of expenditure and revenue in real terms from 1973 to 2003. The author applied Granger causality test for series of revenue and expenditure and found evidence of unidirectional causality from expenditure to revenue in Pakistan.

Maghyereh et al (2004) tested tax-spend, spend-tax and fiscal synchronization hypothesis for Jordan using annual time series data from 1969 to 2002. The authors used real GDP as control variable along with real government expenditures and real government revenues. The Granger causality test based on Multivariate ECM found

evidence in favor of bi-directional causality between revenue and expenditure. The result also suggests that there is long-run interdependence between output and fiscal variables indicating effectiveness of fiscal policy in Jordan. Chang and Ho (2002) tested causal relationship between tax and spend for Taiwan and found unidirectional causality from revenues to expenditure. They also found that there is a cointegrating relationship between GDP, Govt. revenues and expenditures in real terms for annual data from 1967 to 1999 and that only government expenditure adjusts for any deviations from long-run equilibrium.

## **5. Data and Methodology**

### **5.1 Data:**

Government revenue and expenditure data are collected from various issues of *Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics and *Bangladesh Economic Review*, Ministry of Finance, Government of the People's Republic of Bangladesh. GDP at current market price and GDP deflator (2000=100) data are collected from *International Financial Statistics (IFS)* online databases, International Monetary Fund (IMF). Annual data from 1974 to 2004 are taken. Real series (2000=100) of revenue, expenditure and GDP data are transformed into their logarithmic form to test causal relationships among the variables. However there is a debate whether nominal and real form of revenue and expenditure would be appropriate to test the causality between the variables. Martin et al (2004), in their study used revenue and expenditure data in real terms assuming that government takes budgetary decision by taking account of the expected level of inflation and because inflation affects actual level of expenditure and revenue. Legrenzi et al (2002) used nominal values in order to avoid the difficulty of identifying an appropriate deflator for the revenue expenditure series and contamination of data that may arise from the use of an inappropriate deflator. Here we used real values of revenue and expenditure in order to eliminate the inflationary effect from revenue and expenditure because the country has suffered from high and volatile inflation during the early 70s and late 80s and moderate to low inflation during early 90s to date.

Definitions of the variables are as follows:

LRTEX = Log of Real Government Expenditure

LRTR = Log of Real Government Revenue

LRGDP= Log of Real GDP

## 5.2 Methodology

### Granger Causality

Revenue (RTR) Granger causes expenditure (RTEX) if in a regression of expenditure on its own lagged values ( $RTEX_{t-i}$ ), the inclusion of lagged values of revenue ( $RTR_{t-j}$ ) significantly improves the prediction of expenditure. However, existence of Granger causality from revenue to expenditure does not imply that expenditure is the result of revenue. Rather it implies that changes in revenue precede expenditure, and past and present values of revenue provide important information to forecast future values of expenditure, that are not incorporated in the past values of RTEX.

Granger causality form with two variables, expenditure (RTEX) and (Revenue) can be expressed in following way,

$$RTEX_t = \sum_{i=1}^n \alpha_i RTEX_{t-i} + \sum_{j=1}^n \beta_j RTR_{t-j} + \varepsilon_t \quad 1$$

$$RTR_t = \sum_{j=1}^n \chi_j RTR_{t-j} + \sum_{i=1}^n \delta_i RTEX_{t-i} + \xi_t \quad 2$$

An unidirectional causality from revenue to expenditure will be found if  $\sum \beta_i \neq 0$  and  $\sum \delta_i = 0$ , that is the set of estimated coefficients of lagged  $RTR$  are significantly different from zero in  $RTEX$  equation and cluster of estimated coefficients of lagged  $RTEX$  are not significantly different from zero in  $RTR$  equation.

Conversely, an unidirectional causality from expenditure to revenue will be found if  $\sum \delta_i \neq 0$  and  $\sum \beta_i = 0$ , that is the set of estimated coefficients of lagged  $RTEX$  are significantly different from zero in  $RTR$  equation and cluster of estimated coefficients of lagged  $RTR$  are not significantly different from zero in  $RTEX$  equation.

There will be bidirectional causality or feedback between revenue and expenditure if both the conditions  $\sum \beta_i \neq 0$  and  $\sum \delta_i \neq 0$  simultaneously hold, that is the set of estimated coefficients of lagged  $RTR$  and lagged  $RTEX$  are significantly different from zero in both  $RTEX$  and  $RTR$  equation. Revenue and expenditure will be determined independently if  $\sum \beta_i = 0$  and  $\sum \delta_i = 0$ , that is there is no causal link between these two variables.

Modern time series econometrics allows us to test joint significance of the coefficients of lagged terms. However, validity of the test results depends on the stationary

properties of data i.e., if both revenue and expenditure series are stationary in level forms we can use Granger Causality test described above. When both the series are non stationary in level forms but stationary after first differencing, that is both are integrated of order one or I(1), we can use the differenced series to test causality between the two variables. But if both the series are stationary after first differencing and cointegrated, we cannot use the VAR in first differences to test the causality between the two series. If the variables are integrated of same order we can use cointegration test to check whether the variables are cointegrated or not. If the series of revenue and expenditure are cointegrated, error correction representation of cointegrated series can be estimated to examine causality between the variables.

We applied Johansen (1991, 1995) cointegration test to examine cointegration between revenue and expenditure. Johansen developed a multivariate technique to evaluate the cointegration relationship among a group of variables. Suppose  $Y_t$  is a n-vector of non stationary or I(1) variables, forms a VAR of order p

$$Y_t = A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \mu + \varepsilon_t \quad 3$$

Where  $\mu$  is a constant term which can be divided into two parts, the intercept in the cointegrating relation and the trend term, and  $\varepsilon_t$  is n-dimensional vector of innovations and independently and identically distributed with zero mean and variance  $\Lambda$ . We can rewrite this model into a vector error correction form,

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_t + \mu + \varepsilon_t \quad 4$$

Here,  $\Pi$  is the coefficient matrix and if rank of  $\Pi$  denoted as 'r' is less than 'n', then  $\Pi$  equals  $\alpha\beta'$ , where  $\beta$  and  $\alpha$  are  $n \times r$  matrices of full rank and columns of  $\beta$  are cointegrating vectors and elements of  $\alpha$  are known as adjustment coefficients. If rank of  $\Pi$  equals 'n' then the vector  $Y_t$  is stationary. In the other extreme, when rank of  $\Pi$  equals zero then the matrix is null and  $Y_t$  vector is a non stationary process. If rank of  $\Pi$  is one, there is a single cointegrating or stationary vector. When rank of  $\Pi$  is within the range,  $0 < r < n$ , there are r cointegrating vectors.

Johansen developed two test statistics for cointegration test, namely trace statistic

$$\lambda_{trace} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \text{ and maximal eigenvalue statistics } \lambda_{max} = -T \ln(1 - \hat{\lambda}_{r+1}), \text{ where}$$

$\hat{\lambda}_i$  is defined as the estimated values of characteristics roots obtained from the estimated  $\Pi$  matrix and  $T$  is the number of included observations. Following Reimer's (1992) suggestion both the test statistics are corrected for small sample size, where the number of included observations in the cointegration test,  $T$  are replaced by  $T-np$ . These statistics will allow us to determine whether there is any cointegration between the series. If the revenue and expenditure series are cointegrated we can use error correction representation to test causality between the two series.

After including real GDP as an additional variable, VAR in first differences with one lag of error correction terms can be represented as follows:

$$\Delta RTEX_t = \mu_1 + \sum_{i=1}^n \alpha_i \Delta RTEX_{t-i} + \sum_{j=1}^n \beta_j \Delta RTR_{t-j} + \sum_{l=1}^n \sigma_l \Delta RGDP_{t-l} + \theta_1 R_{t-1} + \varepsilon_t \quad 5$$

$$\Delta RTR_t = \mu_2 + \sum_{j=1}^n \chi_j \Delta RTR_{t-j} + \sum_{i=1}^n \delta_i \Delta RTEX_{t-i} + \sum_{l=1}^n \phi_l \Delta RGDP_{t-l} + \theta_2 R_{t-1} + \zeta_t \quad 6$$

$$\Delta RGDP_t = \mu_3 + \sum_{l=1}^n \gamma_l \Delta RGDP_{t-l} + \sum_{j=1}^n \varphi_j \Delta RTR_{t-j} + \sum_{i=1}^n \eta_i \Delta RTEX_{t-i} + \theta_3 R_{t-1} + \omega_t \quad 7$$

Here  $R_{t-1}$  is the lagged residual from the cointegrating regression, the coefficient of which represents speed of adjustment to the long-run equilibrium.

The above formulation is very useful to identify the sources of causation—we can evaluate short-run causal relationship between the variables by testing joint significance of lagged dynamic terms in each of the above equations and we can also derive information on long-run causality by testing significance of error correction terms.

In a multivariate framework Granger causality test is also called block-causality or block exogeneity test where cross equation restrictions are imposed to test causality between the variables. In this paper, we applied Granger causality test or block-exogeneity test to evaluate short-run causality between the variables. Weak exogeneity test is also conducted to evaluate whether a variable can be treated as exogenous or not, that is whether the variable adjusted towards long-run equilibrium or not.

## 6. Econometric Results

At the outset of the cointegration test we have to check the stationarity property of the variables. Augmented Dickey Fuller test (ADF) and Phillips–Perron (PP) tests are used to test the null hypothesis of unit root. To check the robustness of the above two tests, Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test is also applied, which has a null hypothesis of stationarity.

**Table1 Unit root test Result**

Tests	Trend Assumption	Variables	LRTR	LRGDP	LRTEX
0ADF	Constant	Level	0.97	4.23	-2.00
		First Difference	-6.45*	-7.58*	-6.13*
	Constant and Linear Trend	Level	-1.64	0.31	-3.07
		First Difference	-4.29**	-5.76*	-5.78*
PP	Constant	Level	-1.51	1.10	-2.00
		First Difference	-6.46*	-7.26*	-4.96*
	Constant and Linear Trend	Level	-3.98**	-1.04	-3.07**
		First Difference	-6.42*	-7.36*	-5.09*
KPSS	Constant	Level	0.74*	0.74**	0.71**
		First Difference	0.10	0.26	0.18
	Constant and Linear Trend	Level	0.10	0.16**	0.10
		First Difference	0.06	0.14	0.12

Note: ‘\*’ and ‘\*\*’ indicate rejection of null hypothesis at 1 percent and 5 percent level consecutively. Lag length of ADF tests are chosen based on AIC criterion,

Unit root test results on the basis of Augmented Dickey Fuller test (ADF) indicate that all the series are integrated of order one or I(1). The null hypothesis of unit root could not be rejected for all the three series in the log level form and clearly rejected in their first differences for both the models (constant and constant with linear trend). However, Phillips–Perron test rejects the null hypothesis of unit root (for the model with constant and linear trend) only at the 5 percent level of significance for LRTR and LRTEX series in the log level form and rejects the null hypothesis at the 1 percent level of significance in the first difference form of the series for both the cases. Again KPSS test could not reject the null hypothesis of stationarity for LRTR and LRTEX series for the second model with constant and linear trend but clearly reject the hypothesis in the first difference form of the variables. Though for the model with a constant and linear trend

there is some doubt about the unit root property of the data in log level form, all the variables are nonetheless stationary in their first difference form. So we can use Johansen (1991, 1995) cointegration test to determine the underlying relationships between the variables.

At the start of Johansen (1991, 1995) test we have to determine the appropriate lag length for the VAR system as the test results can be sensitive to the choice of the lag length. We estimated an unrestricted VAR model in level form of the series and used Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) to choose appropriate lag length  $p$ . It is observed that it takes 3 lags to get uncorrelated and homoscedastic residual for the VAR system. The cointegration test is carried out assuming linear trend in data, and both an intercept and a trend in the cointegrating equation. Because some of the series seem to be trend stationary and a linear trend term in cointegrating space minimizes the value of AIC.

**Table 2 Johansen Cointegration Test Result**

Hypothesized No. of Coint. Eq.	Trace Statistic	Trace Statistic (adjusted)	95% Critical Value	Hypothesized No. of Coint. Eq.	Max- Eigen Statistic	Max- Eigen Statistic (adjusted)	95% Critical Value
None	70.43	47.79	42.92	None	44.75	30.37	25.82
At most 1	25.67	17.42	25.87	At most 1	17.30	11.74	19.39
At most 2	8.37	5.68	12.52	At most 2	8.37	5.68	12.52

Note: Trace and Max-eigenvalue test indicates one cointegrating equation at the 0.05 level.

Both trace statistic ( $\lambda_{\text{trace}}$ ) and maximal eigenvalue ( $\lambda_{\text{max}}$ ) statistics indicate that there is at least one cointegrating vector between LRTR, LRTEX and LRGDP, we can reject the null hypothesis of no cointegrating vector in favour of one cointegrating vector in both the cases at 5 percent level of significance. We cannot reject the null hypothesis of at most one cointegrating vector against the alternative hypothesis of two cointegrating vectors, for both the Trace and Max-eigen test statistics. Therefore there is a long-run equilibrium relationship between real government expenditure, real government revenue and real GDP. Long-run relationship between these three variables is derived by normalizing on LRTEX, reported in Table 3. The estimates of adjustment coefficients on LRTEX, LRTR and LRGDP, are also given in the same table with their respective standard errors. All the adjustment coefficients have negative sign and significant in both LRTEX and LRGDP equation but insignificant in LRTR equation. We can test



weak exogeneity with the help of likelihood ratio test that follows chi-square distribution, by imposing zero restriction on the adjustment coefficients of each equation. We can reject weak exogeneity of LRTEX and LRGDP at 1 percent level of significance and cannot reject weak exogeneity of LRTR at any conventional level of significance; results of the tests are also reported in table 3. Any deviation from long-run equilibrium will be corrected by changes in government expenditure or GDP because adjustment coefficients of these two equations are significant, where adjustment coefficient of the revenue equation is insignificant.

**Table 3 Cointegration Equation**

Normalized cointegrating coefficients				Adjustment coefficients		
LRTEX	LRTR	LRGDP	Trend	$\Delta$ LRTEX	$\Delta$ LRTR	$\Delta$ LRGDP
1	-0.27	-2.96	0.096	-0.76	-0.49	-0.16
	(-0.10)	(-0.36)	(-0.01)	(-0.27)	(-0.37)	(-0.05)
Weak Exogeneity test						
Chi-square(1)				7.89	2.04	11.29
Probability				0.00	0.15	0.00

Note: Figures in parentheses indicate standard error.

Existence of a single cointegrating vector indicates that government expenditure, government revenue and GDP display long-run comovement, i.e. there is a long-run equilibrium relationship between the variables. Whenever the gap between these three variables widens above the long-run equilibrium, expenditure and GDP will adjust to restore the equilibrium. That is short-run adjustments are done by changes in government expenditure and GDP to restore the long-run equilibrium. However, the existence of long-run equilibrium relationship between these three variables does not assure a balanced budget, rather the result indicates that the gap between government expenditure and government revenue will persist at a long run sustainable level. When budget deficit rises above the long run sustainable level, expenditure is reduced to maintain the deficit at a tolerable limit. It is worth mentioning that, government expenditure adjusts at a reasonable speed to the long-run equilibrium, where almost three-fourth of the disequilibrium is corrected in the first period. GDP also converges to its long-run equilibrium level thorough a series of partial short-run adjustments. On the other hand, weak exogeneity of revenue indicate that this variable does not adjust towards long-run equilibrium. Therefore government expenditure must be reduced to maintain budget deficit at a long run sustainable limit.

The above finding appears plausible. Because it is not easy to raise revenue by increasing the taxes on domestic consumption and income due to various structural constraints and lack of administrative capacity to collect potential revenue in a developing country like Bangladesh, and the condition is further exacerbated by rapid tariff liberalization. On the other hand, expenditure growth is constrained by revenue shortfall and increasing cost of deficit financing. Therefore, whenever there is a tendency of rising deficit beyond its long run limit, expenditure adjusts to restore the equilibrium.

**Table 4 VEC Granger Causality Tests**

$\Delta$ LRTEX)			$\Delta$ LRTR			$\Delta$ LRGDP		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
$\Delta$ LRTR	1.59	0.44	$\Delta$ LRTEX	2.18	0.34	$\Delta$ LRTEX	8.88	0.01
$\Delta$ LRGDP	1.84	0.39	$\Delta$ LRGDP	0.46	0.80	$\Delta$ LRTR	9.95	0.01
All	3.37	0.49	All	3.00	0.56	All	15.76	0.00

Granger causality test is applied on estimated VEC, where cross equation restrictions are imposed on the lag differences in each of the equations of VEC. If lagged values of  $\Delta$ LRTEX are statistically significant in both the  $\Delta$ LRTR and  $\Delta$ LRGDP equations, we can say that LRTEX granger causes LRTR and LRGDP. The Granger causality tests or the block exogeneity test restricts all the lag differences of LRTEX or  $\Delta$ LRTEXs to be equal to zero in both the  $\Delta$ LRTR and  $\Delta$ LRGDP equations. We can test these restrictions with the help of likelihood ratio test, which follows chi-square distribution. Results of the Granger causality test are reported in Table 4. Here it is clear that we cannot reject the null hypothesis that LRTR does not Granger cause LRTEX which have a chi-square value of 1.59 with a probability of 0.44 in the  $\Delta$ LRTEX equation, reported in column one of Table 4. Again the null hypothesis that LRTEX does not Granger cause LRTR, cannot be rejected in the  $\Delta$ LRTR equation which have chi-square value of 2.18 with a probability of 0.34. In both the equations,  $\Delta$ LRTEX and  $\Delta$ LRTR, null hypothesis of no causal relationship from LRGDP to LRTEX and LRGDP to LRTR cannot be rejected. However null hypothesis of no causal relationship from LRTEX to LRGDP and LRTR to LRGDP are clearly rejected in  $\Delta$ LRGDP equation. The above findings indicate that there is no causal relationship between government expenditure and revenue in the short run. Granger causality test is also applied on the estimated error correction model for each pair of the above three variables. The calculated F-statistics for both the revenue

and expenditure equations also suggest that there is no causal relationship between revenue and expenditure in the short run<sup>5</sup>. Therefore, we can say that government expenditure and revenue are independently determined in the short run. Budget deficit can be reduced either by reducing government expenditure or by raising revenues in the short run. When both government expenditure and taxes are raised together, rise in expenditure should be less than the rise in taxes to reduce the budget deficit.

On the other hand, government expenditure and revenue Granger cause GDP. Short run causality between the fiscal variables and GDP implies that changes in fiscal policies may affect real GDP growth (in the sense that changes in government expenditure and revenue precede changes in GDP) in the short run. Net affect of adjustment in the fiscal policy variables on real GDP growth depend on the positive effect of expenditure and negative effect of taxes. But as raising government revenue by increasing taxes is not easy for a developing country like Bangladesh with various structural constraints, major adjustment should be done by expenditure reduction in unproductive sectors and by reforming development expenditures. When growth will be ensured by effective utilization of existing resources it will be possible to raise taxes from domestic sources and thereby reducing budget deficit. Fiscal policy should be designed and implemented in such a way that it can ensure growth; the government will then be able to raise taxes from the increased income growth.

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<sup>5</sup> The results are not reported here but available from the author on request.

## **7. Conclusion**

The paper examines causal relationship between real government expenditure and revenue by using annual data from 1974 to 2004 period. Real GDP is also included in the model along with these two fiscal variables. Johansen (1991, 1995) cointegration test suggests that there is a long-run equilibrium relationship between government expenditure, government revenue and GDP. Granger causality test based on the estimated VEC suggests that there is no causal relationship between government expenditure and revenue in the short run. It is felt that expenditure is the key variable to reduce budget deficit because of structural constraints of the economy in raising revenue. So budget deficit should be reduced by reducing public expenditure in unproductive sectors and at the same time ensuring effective utilization of available resources such as to engender the productivity of labor and capital in the economy. If the economy achieves enhanced economic growth it will be possible to raise revenue from domestic sources.

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