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BUDGET DEFICITS AND INTEREST RATES: AN EMPIRICAL ANALYSIS FOR PAKISTAN

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"Economists like to think of economics as a science. In a science, however, repeated contradictions of a paradigm lead to its abandonment if there is a sensible alternative. One paradigm in economics implies that large deficits produce high interest rates. This paradigm is not supported by the facts."

Paul Evans (1985)

This paper empirically examines long run relationship between nominal interest rates and budget deficits for Pakistan using quarterly time-series data for the period 1960 to 2005. We test the conventional *crowding-out* view against the *Ricardian deficit neutrality* alternative. Regression results show that budget deficits do not have significant effect on nominal interest rates. These results reveal the existence of the Ricardian deficit neutrality in Pakistan. While budget deficit-GDP ratio has significant positive impact on nominal interest rates. These findings support the conventional wisdom of crowding-out. The results are also validated by the Granger causality tests.

1. INTRODUCTION

Since the appearance of large government budget deficits in the late 1970s, there has been a continued concern that these deficits use higher interest rates. Standard Keynesian and Neoclassical models provide justification for this belief. This conventional view regards such causal relationship between budget deficits and interest rates as "crowding out". During 1980s, the Ricardian neutrality (or equivalence) hypothesis has received increasing attention. The hypothesis has been most forcefully advocated by Barro (1989). One implication of this theory is

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that budget deficits do not have any relationship with interest rates. Accordingly, empirical work has been conducted in order to quantify the link between budget deficits and interest rates. A critical review of this empirical evidence shows that there exists no true consensus in the literature on the budget deficits and interest rates. For example, Hoelscher (1983), Aschauer (1985), Evans (1985), Darrat (1989,1990), Findlay (1990) and Kormendi and Protopapadakis (2004) have found an insignificant relationship between government deficits and interest rates. While Makin (1983), Barth *et al.* (1985), Tanzi (1985), Cebula (1988), Zahid (1988), Vamvoukas (1997), Baer (2003) and Dai and Philippon (2004) find a significant positive linkage between budget deficits and interest rates.

In empirical literature, most of the studies on budget deficit and interest rate are confined mainly to the developed countries. While for the developing and transition economies, there is still scarcity of empirical work on the subject. In context of Pakistan, Burney and Yasmeen (1989) and Ahmad (1994) found no link between nominal interest rates and budget deficits. To test the conventional view that large government deficits use higher interest rates, these studies regress interest rates against contemporaneous values of a number of variables, including budget deficits. The insignificance of the coefficient on the budget deficit measure provides basis for conclusions relating to interest rates and budget deficits. We believe that correlation-based regressions, which these studies have applied, are inadequate methods to test the conventional view regarding the causal relationship between budget deficits and interest rates. Indeed the hypothesis being tested does not merely contend that budget deficits and interest rates are positively correlated, but also that the former causes the latter without significant feedback. A high correlation between budget deficits and interest rates cannot discriminate among four alternatives, yet equally plausible, hypotheses. These are: (a) budget deficits cause interest rates (the conventional view), (b) interest rates cause budget deficits (the alternative viewpoint), (c) both hypothesis are valid, implying bi-directional causality, and (d) neither hypothesis is valid, implying causal independence (the Ricardian neutrality Proposition).

An insignificant coefficient on the budget deficit variable in an interest rate equation is, therefore, not a reliable evidence to reject the conventional hypothesis. A more appropriate test to this and other alternative hypotheses is to focus on the direction of causality between two variables and not on the correlation between them (Darrat, 1990). Therefore, the objective of this study is to examine the issue of causality

between budget deficits and interest rates along with cointegration and Error Correction Methodology (ECM) for Pakistan.[1] The results of the causality test will be useful to draw inference about the degree of belief in the conventional wisdom for Pakistan that is increase in government deficits causes increase in interest rates.

The rest of the paper is organized as follows. Section 2 describes the analytical framework. Data description and empirical findings are given in section 3. Finally, section 4 concludes the study.

2. ANALYTICAL FRAMEWORK

2.1. Cointegration Test

The concept of cointegration was first introduced by Granger (1981) and elaborated further by Engle and Granger (1987), Phillips and Ouliaris (1990) and Johansen (1991), among others. Engle and Granger cointegration (i.e. long - run relationship) test requires that

- Time series, say Y_t and X_t, are non-stationary in levels but stationary in first differences i.e. $Y_t \sim I(1)$ and $X_t \sim I(1)$.
- There exists a linear combination between these two series that is stationary at levels i.e. $\upsilon_{it} (= Y_t - \hat{\alpha} - \hat{\beta} X_t) \sim I(0)$.

Thus, the first step for cointegration is to test whether each of the univariate series is stationary or not. If they both are stationary say at first difference i.e. they are $I(1)$, then we may go to the second step to verify the long - run relationship between them.

Augmented Dickey Fuller (ADF) test is usually applied to test stationarity. It tests the null hypothesis that a series (Y_t) is non-stationary by calculating a *t*-statistics for $\beta = 0$ in the following equation:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \gamma_t + \sum_{k=2}^{n} \delta_k \Delta Y_{t-k} + \varepsilon_t \qquad (1)$$

[1] The causal relation between budget deficits and interest rates tested in this study does not include other variables, often included in regression-based analysis of crowding-out, like money stock, expected rate of inflation etc. This is based on an understanding of institutional realties of interest rate determination. For more details see Sood (1998).

where $\Delta Y_t = Y_t - Y_{t-1}$, $\Delta Y_{t-k} = Y_{t-k} - Y_{t-k-1}$ and $k = 2,3,.....,n$. While α, β, γ and δ are the parameters to be estimated and ε_t is white noise error term.

If the value of the ADF statistic is less than the critical value at the conventional significance level (usually the five per cent significant level) then the series (Y_t) is said to stationary and *vice versa*. If Y_t is found to be non-stationary then it should be determined whether Y_t is stationary at first differences i.e. $\Delta Y_t (= Y_t - Y_{t-1}) \sim I(0)$ by repeating the above procedure. If the first difference of the series (ΔY_t) is stationary then the series (Y_t) may be concluded as integrated of order one i.e. $Y_t \sim I(1)$. Now we can move to the second step to check cointegration.

In order to test cointegration, we will apply two-step residual based test of Engle and Granger (1987). In the first step we apply OLS to the following regression equation in which all variables are found to be integrated of the same order [e.g. $I(1)$].

$$Y_t = a + bX_t + \upsilon_t \qquad (2)$$

The second step involves testing whether the residual term υ_t from the cointegrating regression equation (2) is stationary [i.e. $\upsilon_t \sim I(0)$] using a modified ADF test

$$\Delta\upsilon_t = \vartheta\upsilon_{t-1} + \sum_{k=2}^{n} \theta_k \Delta\upsilon_{t-k} + \mu_t \qquad (3)$$

where υ_t, υ_{t-1}, υ_{t-k} and υ_{t-k-1} are, respectively, residuals at time t, $t-1$, $t-k$ and $t-k-1$.While ϑ and θ are parameters to be estimated and u_t is the residual term.

The constant and the time trend are omitted from the ADF test because the residual from the cointegrating regression will have a zero mean and be de-trended. The null hypothesis of $\vartheta = 0$ is tested to check the stationarity of the residual. If the value of *t*- statistic of the ϑ coefficient is less than the critical value then the null hypothesis of non-stationarity is rejected and the residual is found to be stationary at levels. This, in turn, leads to the conclusion that long-run cointegration holds between two time-series.

2.2. Error Correction Model (ECM)

If time series are *I* (1), then one could run regressions in their first differences. However, by taking first differences, we lose the long-run relationship that is stored in the data. This implies that one needs to use variables in levels as well. Advantage of the Error Correction Model (ECM) is that it incorporates variables both in their levels and first differences. By doing this, ECM captures the short-run disequilibrium situations as well as the long-run equilibrium adjustments between variables. An ECM formulation, which describes the relationship between Y_t and X_t , can be presented as

$$\Delta Y_t = \gamma_1 + \gamma_2 \Delta X_t - \omega \hat{\upsilon}_{it-1} + \nu_{it} \qquad (4)$$

In this model, γ_2 is the impact multiplier (the short-run effect) that measures the immediate impact that a change in X_t will have on a change in Y_t. On the other hand, ω is the feedback effect or the adjustment effect that shows how much of the disequilibrium is being corrected, that is the extent to which any disequilibrium in the previous period effects any adjustment in the Y_t period.

2.3. Granger Causality Test

If a pair of series is cointegrated, then there must be Granger-causality in at least one direction, which reflects the direction of influence between series. Theoretically, if the current or lagged terms of a time-series variable, say X_t, determine another time-series variable, say Y_t, then there exists a Granger-causality relationship between X_t and Y_t, in which Y_t is Granger caused by X_t. From the above analysis, the model is specified as follows:

$$\Delta Y_t = \theta_{11}\Delta Y_{t-1} + ... + \theta_{1n}\Delta Y_{t-n} + \theta_{21}\Delta X_{t-1} + ... + \theta_{2n}\Delta X_{t-n} - \gamma_1(Y_{t-1} - \alpha X_{t-1} - \delta) + \varepsilon_{1t} \qquad (5)$$

$$\Delta X_t = \theta_{31}\Delta X_{t-1} + ... + \theta_{3n}\Delta X_{t-n} + \theta_{41}\Delta Y_{t-1} + ... + \theta_{4n}\Delta Y_{t-n} - \gamma_2(Y_{t-1} - \alpha X_{t-1} - \delta) + \varepsilon_{2t} \qquad (6)$$

The following two assumptions are tested using the above two models to determine the Granger causality relationship between prices:

$\theta_{21} = \cdots = \theta_{2n} = \cdots = \gamma_1 = 0$ (no causality from X_t to Y_t)

$\theta_{41} = \cdots = \theta_{4n} = \cdots = \gamma_2 = 0$ (no causality from Y_t to X_t)

3. DATA, ESTIMATION AND INTERPRETATION OF RESULTS

We conduct our analysis for Pakistan using quarterly data for the period 1960 to 2005. The crude data have been taken from various issues of *International Financial Statistics* (International Financial Corporation) and *Economic Survey* (Government of Pakistan).

The methodology has been employed to investigate the relationship between budget deficits and interest rates follows three steps. The first step is to test the order of integration of the levels of budget deficit (BD), budget deficit-GDP ratio (BDGDP) and nominal interest rate (R) Table 1 gives the results of ADF tests. Based on the ADF test, budget deficit (BD), budget deficit-GDP ratio (BDGDP) and nominal interest rate (R) appear to be non-stationary at levels but stationary at first difference. Thus, these variables are found to be integrated of order one i.e. *I*(1).

Table 1. Augmented Dickey-Fuller (ADF) Test on the Levels and on the First Difference of the Variables (1960Q1 – 2005Q4)

Variables	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
			1 %	5 %	10 %		
Budget deficit (BD)	0.1360	-13.1953	-2.5769	-1.9415	-1.6166	Nonstationary at level but stationary at first difference	*I* (1)
Nominal Interest Rate (R)	-1.3640	-17.5233	-2.5769	-1.9415	-1.6166	Nonstationary at level but stationary at first difference	*I* (1)
Budget deficit-GDP ratio (BDGDP)	-0.9667	-9.6820	-2.5769	-1.9415	-1.6166	Nonstationary at level but stationary at first difference	*I* (1)

Given the results of the unit root tests, the second step is to test for cointegration between nominal interest rate and budget deficit, and nominal interest rate and budget deficit- GDP ratio in Pakistan. This would help us identify, if there exists, an equilibrium relationship between nominal interest rate and budget deficit, and between nominal interest rate and budget deficit-GDP ratio.

Table 2 represents the results of regression analysis. The underlying results reveal that the budget deficit (BD) does not have any significant impact on the nominal interest rate (R). This finding is in accordance with those of Burney and Yasmeen (1989) and Ahmad (1994) and invalidates the conventional view of crowding-out in Pakistan. However, the budget deficit-GDP ratio (BDGDP) affects nominal interest rate both significantly and positively in Pakistan. Burney (1988) has shown that in Pakistan there exists an inverse relationship between investment and nominal interest rates.Thus suggesting that an increase in the budget deficit-GDP ratio is likely to crowd-out private investment expenditure in Pakistan.

Table 2. Empirical Findings of the Model

Independent Variables	Dependent Variable Nominal Interest Rates (R)	
	(1)	(2)
Constant	6.7375	6.1430
	(8.3302)*	(6.3611)*
Budget deficit (BD)	0.0040	
	(1.3397)	
Budget deficit-GDP ratio (BDGDP)		1.2152
		(3.5999)*
AR (1)	0.8172	0.7928
	(19.0967)*	(17.3533)*
R^2	0.6852	0.6858
Adjusted R^2	0.6817	0.6823
DW	2.1993	2.0816
F-Stat	195.9012	196.4317
Prob (F-Stat)	0.0000	0.0000
Number of Observations	183	183

Note: Values in parentheses show t-statistics. The t-statistics significant at 5 % levels of significance are indicated by *.

In order to verify the long-run relationship, we now check the order of integration of the residuals. If the estimated regressions' residuals are integrated of order zero i.e. *I* (0); then there exists a long-run relationship between the nominal interest rate and the budget deficit or the budget deficit-GDP ratio. The results are reported in Table 3. The linear combinations of the nominal interest rate and the budget deficit, and the nominal interest rate and

the budget deficit-GDP ratio give the residuals which are stationary at a level that they are integrated of order zero [i.e. *I*(0)]. This validates our proposition that the nominal interest rate and the budget deficit and the nominal interest rate and the budget deficit-GDP ratio are cointegrated, that is a long-run relationship holds between these variables.

Table 3. Augmented Dickey-Fuller Test on the Levels of the Residuals

		Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root				
Estimated Residuals	Level	1 %	5 %	10 %	Decision	Order of Integration
υ_{1t} (R on BD)	-15.6833	-2.5769	-1.9415	-1.6166	Stationary at level	*I* (0)
υ_{2t} (R on BDGDP)	-15.5505	-2.5769	-1.9415	-1.6166	Stationary at level	*I* (0)

In order to check stability of long-run relationship between the nominal interest rate and the budget deficit and between the nominal interest rate and the budget deficit-GDP ratio we estimate Error-Correction Models. The results are presented in Table 4. The results indicate that there is an insignificant short run impact of the budget deficit on the nominal interest rate while the budget deficit-GDP ratio has a significant short run effect on nominal interest rates. In both equation specifications the adjustment parameters (ω) appear with negative values indicating the long-run convergence. In the first case it takes almost three quarters for the nominal interest rate to get adjusted due to a particular change in the budget deficit. While in the second case it takes almost two quarters for the nominal interest rate to get adjusted due to a particular change in the budget deficit-GDP ratio. Thus, there is a stable long-run relationship between the nominal interest rate and each measure of the budget deficit.

Table 4. Empirical Findings of Error Correction Model

Variables	D(R)	
	(1)	(2)
Constant	0.0015	0.0146
	(0.0131)	(0.1251)
D(BD)	0.0020	
	(1.4102)	
D(BDGDP)		2.7469
		(2.2121)*
ω_1	-0.3236	
	(-4.4916)*	
ω_2		-0.5152
		(-4.7808)*
R^2	0.4103	0.4342
Adjusted R^2	0.4002	0.4123
DW	2.0828	2.0701
F-Stat	11.0929	11.5405
Prob(F-Stat)	0.0000	0.0000
Number of Observations	182	182

Note: Values in parentheses show t-statistics. The t-statistics significant at 5 % levels of significance are indicated by *.

To check the causal relationship between the variables we have applied Granger-causality test using lag length up to four periods. The results are filed in table 5. The results show that the nominal interest rate and the budget deficit do not Granger cause each other at any lag length. It supports our previous findings that the budget deficit does not have any significant impact on the nominal interest rate. Therefore, it suggests that the evidence from Pakistan does not support the conventional notion of crowding-out of the private investment expenditures due to the increase in the interest rates; whereas the existence of Ricardian neutrality hypothesis is confirmed in Pakistan by these results. On the other hand, at the all four-lag lengths the budget deficit -GDP ratio does Granger cause the nominal interest rate while the nominal interest rate does not Granger cause the budget deficit -GDP ratio at any lag length. These results are in accordance with our expectations as our earlier findings in regression analysis also show that the budget deficit -GDP ratio significantly affect the nominal interest rate, both in the short - run and in the long - run. Here the role of the behavior of GDP seems a crucial one. As Pakistan is a

growing economy and increase in GDP may reinforce the long-run relationship between non-stationary variables. Thus, we may conclude that a uni-directional causality exists between the nominal interest rate and the budget deficit -GDP ratio, running from the latter to the former. It validates the presence of the conventional wisdom of crowding-out in Pakistan.

Table 5: Pair-wise Granger Causality Tests up to Four Quarter Lag Length

Lag Lengths Null Hypotheses	1 F-Stat	2 F-Stat	3 F-Stat	4 F-Stat
Causality Between Budget deficit (BD) and Nominal Interest Rate (R)				
Budget deficit (BD) does not Granger Cause Nominal Interest Rate (R)	0.0948	0.2552	0.1778	0.4277
	(0.7586)	(0.7750)	(0.9114)	(0.7885)
Nominal Interest Rate (R) does not Granger Cause Budget deficit (BD)	2.5419	1.9364	0.8559	1.2250
	(0.1126)	(0.1473)	(0.4652)	(0.3021)
Causality Between Budget deficit-GDP ratio (BDGDP) and Nominal Interest Rate (R)				
Budget deficit-GDP ratio (BDGDP) does not Granger Cause Nominal Interest Rate (IR)	8.5173	6.4453	5.1338	3.9832
	(0.0040)*	(0.0141)*	(0.0211)*	(0.0408)*
Nominal Interest Rate (IR) does not Granger Cause Budget deficit-GDP ratio (BDGDP)	0.4262	0.9272	1.0510	1.5426
	(0.5147)	(0.3639)	(0.2788)	(0.1186)

Note: Values in parentheses show probability of F-Statistics. The F-Statistics significant at 5 % levels of significance are indicated by *.

4. CONCLUSIONS

In this study an attempt has been made to investigate the nature of the causal relationship that exists between the government budget deficit and the nominal interest rate in Pakistan. Previous studies on Pakistan have used regression techniques to investigate whether the government budget deficit has

acted to raise the interest rate. The present paper provides compelling evidence from cointegration analysis for the 1960:1-2005:4 period that there does not exist any significant positive relationship between the nominal interest rate and the budget deficit in Pakistan. It reveals the existence of the Ricardian neutrality hypothesis in Pakistan. However, the nominal interest rate and the budget deficit-GDP ratio are not only found cointegrated but also there exists a uni-directional causality between them, running from the latter to the former. It confirms the presence of the conventional hypothesis of crowding-out in Pakistan.

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