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The Relationship between Government Expenditure and Revenues in the Kingdom of Saudi Arabia: Testing for Cointegration and Causality

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ABSTRACT**.** This study examines the long run equilibrium relationship between government expenditure and revenues in the Kingdom of Saudi Arabia using Cointegration technique and the direction of causality relationship in the long and short runs between the variables through integrating the Error Correction Model (ECM) into the traditional Granger causality test. The unit root test shows that the series under investigation are non stationary at their levels, where they are stationary at their first differences. The Cointegration test indicates the existence of long run equilibrium between government expenditure and revenues. The causality tests indicate that there is a bi-directional causal relationship between government expenditure and revenues in both the long and the short run.

I. Introduction

One of the controversial issues in macroeconomics and pubic finance is the nature of the relationship between government expenditure and government revenues. The debate has been strengthened; recently, with increasing government budget deficits that has been experienced in developed as well as developing countries. This issue is more important in developing countries in which the government expenditure plays a major role in the economy. Government expenditure in the Kingdom of Saudi Arabia (KSA) is a major component of GDP averaging (35%) in the last decade. Moreover, government expenditure has been increasing substantially over years. It is seen as the engine of

economic growth and considered the leading sector in the economy. The successive economic development plans with massive government expenditure on defense, education, health, social insurances and welfare services, housing and society development, economic services, and others contributed; largely, to increasing the economic growth rate and improving the life quality of the people. Government expenditure is financed; mostly, through oil exports revenues that accounted for about (80%) of total government revenues. Nevertheless, the growing government expenditure associated with sharp drop in government revenues that caused by the persistence fluctuations in oil prices in recent years, have contributed largely to accumulating national debt that is estimated to be 170 billion dollars in 2002. Furthermore, the major components of government expenditure are wages and salaries to the government employees that are difficult to cut in the time of declining revenues. This represents a dilemma to the policy makers who are trying to keep up the momentum into the economy by injecting more government expenditure into domestic economy while at the same time are faced with declining oil revenues. Moreover, the continuous government deficit has raised the question of the ability of the national economy to grow over time.

Therefore, the causal relationship between government expenditure and government revenues comes to be an empirical one. The purpose of this paper is to investigate the causal relationship between government expenditure and revenues over the period 1964 to 2001 in KSA. The evidence in either direction has significant policy implications. This paper organized as follows. Section II presents review of the relevant theoretical and empirical works. Section III provides an overview of the methodology used to test the relationship between government expenditure and revenues, while Section IV describes the data and discusses the empirical findings. Finally, Section V concludes.

II. Theoretical Background and Previous Empirical Works

The role of government sector in the economic activities has been increasing since (Keynes, 1936) published the General Theory of Money, Interest, and Unemployment in 1936. In order to boost the effective demand, governments, based on Keynesian income policies, have increased their expenditure substantially. Furthermore, the discovery of the negative relationship between inflation rate and unemployment rate has contributed largely to more government's involvement in social and economic programs. However, the deficit spending that was proposed by the Keynesian could not overcome the unemployment problem, but contributed along with easy monetary policies to higher inflation rate. Therefore, the role of government expenditure was questionable and; hence, the stimulant deficit spending view was challenged. (Fischer, 1993) and (Haan and Sturm, 1995) among others found that government budget deficit has a negative effect on real economic growth.

There are different hypotheses regarding the relationship between government revenue and expenditure. First hypothesis was proposed by (Buchanan and Wagner, 1977) and (Friedman, 1978) maintains that government revenues solely determined its expenditure which indicates a unidirectional causality runs from revenues to expenditure. A according to Friedman, high taxes imply more spending leading at the end to a larger budget deficit. In the case of the Kingdom of Saudi Arabia, government

expenditure is financed mostly through oil exports revenues that accounted for about 80% of total government revenues. Second hypothesis was proposed by (Barro, 1974), (Peacock and Wiseman, 1979) holds that government determines its expenditure prior to its revenues which is known as spend and tax hypothesis. Peacock and Wiseman argues that during crises, government increases its expenditure which; eventually, lead to higher taxes. Hence, there is a unidirectional causality runs from government expenditure to revenues. In the case of the Kingdom of Saudi Arabia, the policy makers take into account the expected government expenditure when they determine the optimal level of government revenues (Al-Hakami, 2002). Third view presented by (Musgrave, 1966) and (Meltzer and Richard, 1981) who argue that government makes simultaneously its revenues and expenditure which means that there is a bi-directional relationship between government revenues and expenditure. Finally, (Baghestani and McNown, 1994) believe that non of the above hypotheses describes the relationship between government revenues and expenditure. Government expenditure and revenues are each determined by the long run economic growth reflecting the institutional separation between government revenues and expenditure.

The different views regarding the direction of the causality between government revenues and expenditure have different policy implications with respect to the role of government expenditure in the economy and controllability of the budget deficit.

Considerable empirical works have been done with respect to the above mentioned hypotheses. Using different econometric methods, studies have reached to different results. (Friedman, 1972), (Buchanan and Wagner, 1978), (Blackley, 1986), (Manage and Marlow, 1986), (Ram, 1988), (Joulfaian and Mookerjee, 1990), (Owoye, 1995) for Japan and Italy, (Darrat, 1998), (Kollias and Makrydakis, 2000), (Chang and Ho, 2002), and (Chang *et al*., 2002) for Japan, South Korea, Tiawan, UK, and the USA; gave support to a unidirectional causality that runs from government revenues to expenditure. On the other hand, the spend-and-tax hypothesis is supported by studies done by (Peacock and Wiseman, 1961), (Anderson *et al.*, 1986), (von Furstenberg *et al.*, 1986), (Provopoulos and Zambaras, 1991), (Jones and Joulfaian, 1991), (Dahlberg and Johansson, 1998), (Dhanasekaran, K., 2001), and (Chang *et al*., 2002) for Australia and South Africa. The bi-directional causality hypothesis between government revenues and expenditure are supported by the studies of (Miller and Russek, 1990), (Bohn, 1991), (Owoye, 1995), (Hasan and Lincolin, 1997), (Xiaoming, 2001), and (Chang *et al.*, 2002) for Canada. In the context of the Kingdom of Saudi Arabia (KSA), (Al-Hakami, 2002) who used two steps procedure to test for Cointegration and Wald test to test the causality found a unidirectional causality that runs from government revenues to government expenditure in a bivariate model and a bi-directional causality in a trivariate model when the gross domestic product was added to the model. Also, (Albatel, 2002) found that there is a unidirectional causality that runs from government revenue to expenditure in the Kingdom of Saudi Arabia.

III. Methodology

The causal relationship between government expenditure and revenues known as Granger causality is concerned with the relevance of past information of a variable in predicting the value of the other (Granger, 1969, 1988).

The causality test relationship between government expenditure and revenues requires three steps. First, the time series would be analyzed in order to determine the order of integration. Second, investigating the long run equilibrium relationship between government expenditure and revenues. Finally, the short run as well as the long run causality relationship between government expenditure and revenues would be investigated.

Unit Root Test

Most of time series have unit root as many studies indicated including (Nelson and Polsser, 1982), and as proved by (Stock and Watson, 1988) and (Campbell and Perron, 1991) among others that most of the time series are non-stationary. The presence of a unit root in any time series means that the mean and variance are not independent of time. Conventional regression techniques based on non-stationary time series produce spurious regression and statistics may simply indicate only correlated trends rather than a true relationship (Granger and Newbold, 1974). Spurious regression can be detected in regression model by low Durbin-Watson statistics and relatively moderate $R^{2.}$

One of the most widely used unit root test is the Augmented Dickey-Fuller (ADF) unit root test (Dickey and Fuller, 1979, 1981). Alternatively, (Phillips, 1987) and (Phillips and Perron, 1988) (PP) have proposed a nonparametric method to correct a wide variety of serial correlation and heteroskedasticity. (Perron, 1989, 1990) demonstrates that if a time series exhibits stationary fluctuations around a trend or a level containing a structural break, then unit root tests will erroneously conclude that there is a unit root. Phillips-Perron and Dickey-Fuller tests have the same asymptotic distributions.

The unit root test and the order of the integration would be preformed on both the original series and the differences of the series using the PP test.

Cointegration Test

The non-stationary series with the same order of integration may be cointegrated if there exist some linear combination of the series that can be tested for stationarity. Cointegration is a test of long run equilibrium of non-stationary series that do not have equilibrium relationship in the short run (Granger and Newbold, 1974, 1977). (Engle and Granger, 1987) propose a two steps procedure to test cointegration between two time series, First, cointegration regression:

$$X_t = a + bY_t + U_t \qquad (1)$$

is estimated by OLS, then the residuals from the regression are tested for stationarity. If the test indicates that the residuals are stationary, i.e. I(0), then there is a Cointegration between X_t and Y_t, *i.e.* they have a long run equilibrium relationship. Moreover, the existence of Cointegration between two time series indicates the existence of a causality relationship at least in one direction (Granger, 1988). However, Engle-Granger procedure is considered appropriate for two time series with large sample sizes.

Alternatively, the Johansen and Juselius procedure (Johansen, 1988), (Johansen and Juselius, 1990) is preferable to test for Cointegration for more than two series. Moreover, Johansen and Juselius procedure is considered better than Engle-Granger

even in two time series case and has better small sample properties since it allows feedback effects among the variables under investigation where it is assumed in the Engle-Granger procedure that there are no feedback effects between the variables. The procedure is based on likelihood ratio (LR) test to determine the number of Cointegration vectors in the regression. Johansen technique enables to test for the existence of non-unique Cointegration relationships.

Two tests statistics are suggested to determine the number of Cointegration vectors based on likelihood ratio test (LR): the trace test and maximum eigenvalues test statistics.

The trace test (l_{trace}) is defined as:

$$\text{Trace} = -T\sum_{i=r+1}^{n} \log(1\hat{l}_i) \qquad (2)$$

The null hypothesis is that the number of Cointegration vectors is $\leq r$ where r = 0, 1, or 2 against the alternative hypothesis that the number of Cointegration vectors = r. The maximum eignvalues test $(l_{\max})$ is defined as:

$$l_{\max} = -T\log(1-\hat{l}_i) \qquad (3)$$

Which test the null hypothesis that the number of Cointegration vectors = r against the alternative that there are r+1 cointegrating vectors, the null hypothesis, r = 0 is tested against the alternative that r = 1, and r = 0 is tested against the alternative r = 2, when the two tests Produced conflicting results, the maximum eignvalues test is considered since the alternative hypothesis is an equality.

Error Correction Model and Causality Tests

Having established the long run equilibrium relationship between government expenditure and revenues, the short run adjustments are estimated using the error correction model (ECM). The error correction model is based on the two following equations:

$$\Delta X_t = a_0 + a_1 e_{t-1} + \sum_{i=1}^{m} a_i \Delta X_{t-i} + \sum_{j=1}^{n} a_j \Delta \mathrm{Y}_{t-j} + e_t \qquad (4)$$

$$\Delta \mathrm{Y}_t = b_0 + b_1 u_{t-1} + \sum_{i=1}^{m} b_i \Delta \mathrm{Y}_{t-i} + \sum_{j=1}^{n} b_j \Delta X_{t-j} + h_t \qquad (5)$$

Where e_{t-1} and m_{t-1} represent the error-correction terms which are the lagged residuals from the Cointegration relations. The error correction terms (e_{t-1}, m_{e-1}) will capture the speed of the short run adjustments toward the long run equilibrium. Furthermore, the error correction model equations (4) and (5) allow to test for short run as well the long run causality between government expenditure and revenues.

The short run causality is based on a standard F-test statistics to test jointly the significance of the coefficients of the explanatory variable in their first differences. The long run causality is based on a standard t-test. Negative and statistically significant values of the coefficients of the error correction terms indicate the existence of long run causality.

IV. The Empirical Findings

The variables of the model are real government expenditure (RGOV) and real revenues (RREV) and real gross domestic product (RGDP) in natural log forms for the Kingdom of Saudi Arabia. The annual data employed in this study covers the period from 1964-2001 obtained from the different annual reports of Saudi Arabian Monetary Agency.

Properties of the Time Series

The first step in constructing the cointegration model and testing the Granger causality relationship is to test the stationarity of the series over time and to determine the degree of integration based on the Phillips and Perron unit root test (PP). The analysis of time series showed that the time series of real government expenditure and real revenues and real gross domestic product are not stationary at their levels at the (5%) level of significance. However, the series are stationary at their first differences, which indicates that the series are integrated of degree one (I (1)).

TABLE 1. PP Unit Root Test.

First difference with no intercept and trend	First difference with intercept and Trend	First difference with intercept	Level with no intercept trend and	Level with intercept and trend	Level with intercept	Variable
-3.59	-4.40	-4.05	-1.35	-1.43	-2.39	RGOV
-4.53	-4.83	-4.70	0.86	-1.85	-2.27	RREV
-3.27	-4.07	-3.80	1.65	-1.76	-2.12	RGDP

Critical values:	Intercept	Intercept and Trend	No Intercept and Trend
At (1%) level of Significance	-3.62	-4.22	-2.63
At (5%) level of significance	-2.94	-3.53	-1.95
At (10%) level of significance	-2.61	-3.20	-1.62

Cointegration Test

Since the series are non-stationary with the same order of integration, they may be cointegrated if there exist some linear combination of the series that can be tested for stationarity, *i.e.* (I(0)).

Cointegration relationship between government expenditure and revenues is tested using the (Engle and Granger, 1987) two steps procedure. The following equations are first estimated by OLS:

$$RGOV_t = \alpha_0 + \alpha_1 RREV_t + RGDP_t + \varepsilon_t \quad (6)$$

$$RREV_t = \beta_0 + \beta_1 RGOV_t + \mu_t \quad (7)$$

Then the residuals from the regression are tested for stationarity using PP unit root test. If the tests indicate that the residuals are stationary, i.e. I(0), then there is a Cointegration between government expenditure and revenues.

TABLE 2. Engle and Granger two-step cointegration test.

Variables / Regression Equations	constant	RREV	RGDP	RGOV	DW	SE	PP unit Root Tests on Residuals
RGOV	-1.05 (-3.81)	0.32 (2.48)	0.77 (5.85)		0.80	0.25	-2.99
RREV	0.61 (2.35)			0.86 (15.75)	0.56	0.32	-2.588

critical value at 5% level of significance equals –1.95.
Values in the parentheses are t values

Table 2 presents the estimation of equations (6) and (7) in order to identify the existence of the long run relation (cointegration model) between government expenditure and revenues. The unit root tests of the estimated residuals of equations (6) and (7), indicate that the residuals are stationary at (5%) level of significance (*i.e.,* I(0)). Therefore, government expenditure and revenues are cointegrated.

Johansen Cointegration Result

Having established the long run relationship by the Engle-Granger two-steps cointegration test, Johansen-Juselius[51] procedure is used to further test for Cointegration between government expenditure and revenues. Table 3 presents the result of the vector autoregression model (VAR) model which includes the results of trace test (l_{trace}) and maximum eigenvalues test $(l_{\max})$ statistics for the existence of long run equilibrium between the government expenditure and revenues .

TABLE 3. Cointegration (bivariate model) with restricted intercept and no trend in the VAR.

Null Hypothesis	$(l_{\max})$	(l_{trace})	95% critical value for maximum eignvalue test	95% critical value for trace test
r = 0	27.89	34.28	15.87	20.18
$r \leq 1$	6.39	6.39	9.16	9.16

The null hypothesis of no Cointegration based on both the maximum eignvalues test and the trace test between government expenditure and revenues (*i.e.,* r=0) is rejected at (5%) level of significance. However, the null hypothesis that $(r \leq 1)$ could not be rejected. The estimated two tests indicate that there is only one Cointegration vector.

Real gross domestic product was, then, added to the VAR model to test for cointegration given the fact that gross domestic product has an effect on government expenditure in the Kingdom of Saudi Arabia. Table 4 presents VAR model result which includes the results of trace test (l_{trace}) statistics and maximum eigenvalues test $(l_{\max})$ statistics for the existence of long run equilibrium between government expenditure and revenues and gross domestic product in real terms.

TABLE 4. Cointegration (trivariate model) with restricted intercept and no trend in the VAR.

Null Hypothesis	$(l_{\max})$	(l_{trace})	95% critical value for maximum eignvalue test	95% critical value for trace test
r = 0	41.67	76.12	22.04	34.87
$r \leq 1$	28.04	34.45	15.87	20.18
$r \leq 2$	6.40	6.40	9.16	9.16

The Cointegration tests based on both the maximum eignvalues test and the trace test indicate the existence of at least one cointegrating vector between real government expenditure and real revenues and real gross domestic product.

Granger Causality and the Error Correction Model (ECM)

Since the cointegration tests reveal that there exist a long run relationship between government expenditure and revenues, following (Engle-Granger, 1987), (Granger, 1988) an error correction model (ECM) can be integrated into the traditional Granger causality test in order to assess the short run adjustments towards the long run equilibrium relationship and determine the direction of the causality in short run as well as the long run. Cointegration tests provide the existence of Granger causality at least in one direction as (Granger, 1988) indicated. The inclusion of the error terms in the Granger causality test equations (5) and (6) will enable us to distinguish between short run and long run causality between $RREV_t$ and $RGOV_t$. Since Granger test is sensitive to the number of lags of the explanatory variables included in the causality equations, (Akaike, 1969) Information Criterion (AIC) is used to choose the optimal lags.

Short Run Causality

Table 5 presents the results of the short run Granger causality test based on a standard F-test statistics that tests jointly the significance of the coefficients of the explanatory variables in their first differences as well as the long run Granger causality test based on a standard t test statistics that test the significance of the error terms lagged one period .

TABLE 5. Short and long run causality tests.

Regression	**Lags**	**F - test**	**t- test on error terms**	**Direction of long causality in the run**	**Direction of causality in the short run**
RGOV on RREV and RGDP	(١ ،2)	14.87	- 2.97 (0.006)	RGOV → RREV	RGOV → RREV
RREV on RGOV	(2 ،1)	11.47	- 2.79 (0.009)	RREV → RGOV	RREV → RGOV

The coefficients of the explanatory variables in their first differences are jointly statistically significant in both equations at more than (1%) level of significance based on F- test statistics. The results indicate that there is a bi-directional causality between government expenditure and revenues in the long run.

The error terms in both equations are statistically significant and negative at more than (1%) level of significance based on t test statistics which indicate that there is a bi-directional causality between government expenditure and revenues in the short run. Therefore, there is bi-directional causality between government expenditure and revenues in the long as well as in the short run. The results coincide with (Miller and Russek, 1990), (Bohn, 1991), (Owoye, 1995), (Hasan and Lincolin, 1997), (Xiaoming, 2001), and (Chang *et al.*, 2002) for Canada and (Al-Hakami, 2002) in the case of the Kingdom of Saudi Arabia in the bivarite model, that government makes simultaneously its revenue and expenditure . However, the results are in contrast with (Al-Hakami, 2002) and (Albatel, 2002) in the case of the Kingdom of Saudi Arabia in the trivariate model who found that there is a unidirectional causality that runs from government revenues to government expenditure.

V. Conclusion and Policy Implication

The goal of this paper is to investigate the long run relationship between the real government expenditure and real revenues in the Kingdom of Saudi Arabia using cointegration technique and the direction of causality in both long and short run through integrating the Error Correction Model into the traditional Granger causality test. Data properties were analyzed to determine their stationarity using the PP unit root tests which indicated that the series are I(1). The results of the cointegration based on Granger two steps and Johansen technique indicate that there is a long run equilibrium relationship between the real government expenditure, real revenues, and real gross domestic product; although, they may be in disequilibrium in the short run.

The long run causality tests based on F test statistics reveals that the coefficients of the explanatory variables in their first differences are jointly statically significant at more than (1%) level of significance in both real government expenditure and revenues equations which indicate that there is a bi-directional causality between government expenditure and revenues in the long run.

The short run causality tests based on t test statistics indicates that the error terms in both equations are statically significant and negative at more than 1% level of significance which means that there is a bi-directional causality between government expenditure and revenues in the short run too.

Therefore, there is bi-directional causality between real government expenditure and real revenues in both the long run and the short run. This results coincide with the findings of (Miller and Russek, 1990), (Bohn, 1991), (Owoye, 1995), (Hasan and Lincolin, 1997), (Xiaoming, 2001), and (Chang *et al.*, 2002) for Canada that government makes simultaneously its revenue and expenditure. Furthermore, this result confirms the finding of (Al-Hakami, 2002) in a trivariate model when the gross domestic product was added to the model. However, the results are in contrast with (Al-Hakami, 2002) and (Albatel, 2002) in the case of the Kingdom of Saudi Arabia in the trivariate model who found that there is a unidirectional causality that runs from government revenues to government expenditure.

The policy implication of the results suggests that there is interdependence between government expenditure and revenues. The government makes its expenditure and revenues decision simultaneously. That may be attributed to the fact that government depends on its oil revenues that fluctuate over time which in turn affect the government expenditure and the growth of the economy. On the other hand, increasing government expenditure stimulates economic activities which in turn increase government non-oil revenues. In addition, the bi-directional causality between government expenditure and revenues might complicate the government's efforts to control the budget deficit and may contribute in explaining the high national debt figure.

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العلاقة بين الإنفاق والإيرادات الحكومية في المملكة العربية السعودية: دراسة تطبيقية باستخدام التكامل المشترك والعلاقة السببية

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المستخلص : يهدف البحث إلى دراسة وجود علاقة توازنية طويلة الأجل بين الإنفاق والإيرادات الحكومية في المملكة العربية السعودية باستخدام نموذج التكامل المشترك، وتحديد اتجاه العلاقة السببية بين المتغيرين في الأجل الطويل والقصير، من خلال إدخال نموذج تصحيح الخطأ في نموذج سببية قرينجر التقليدي. وقد دل اختبار استقرار السلاسل الزمنية على أن المتغيرات المستخدمة في الدراسة غير مستقرة في مستوياتها، ولكنها مستقرة في فروقها الأولى. كما أشار اختبار التكامل المشترك إلى وجود علاقة توازنية طويلة الأجل بين الإنفاق والإيرادات الحكومية. كما وضح اختبار السببية أن هناك علاقة سببية ثنائية بين الإنفاق والإيرادات الحكومية في الأجلين القصير والطويل.