Analyzing the Fiscal Process Under a Stochastic Environment: Evidence From Egypt

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Abstract

This paper investigates the sustainability of the fiscal budgeting process for Egypt, for both stochastic and non-stochastic environments. Both cointegration and multicointegration methodologies were used to evaluate these processes. It was found that the fiscal budgeting process in Egypt is not sustainable in either environment.

Keywords: fiscal sustainability and multicointegration

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I. Introduction

The intertemporal budget of a government is sustainable if the present discounted value of all current and expected future tax revenues is equal to the present discounted value of all current and expected future spending, plus current outstanding debt, including interest payments on the debt. Such a condition is known as the ''no Ponzi" condition. This means that the government must plan to raise sufficient revenue, in present-value terms, to repay its existing debt and finance its planned expenditures. The alternative "Ponzi" scheme is when the government employs a strategy of rolling over an initial debt with interest forever. In that situation, the budget would not be sustainable and the government could be expected to impose high tax rates and to resort to the monetization of debt. This would lead to future inflation and perhaps hyperinflation. In other words, a long sequence of primary deficits has implications for future seigniorage, which will be used to generate the necessary future surpluses. In developing as well as emerging countries, where debt markets are not fully developed, there is a high possibility of monetization of debt. In general, solvency requires that the government asymptotically cannot have a debt with a positive expected value.

Most existing studies [e.g, Trehan and Walsh (1991), Martin (2000), Cunado *et al*. (2004), Hamilton and Flavin (1986), Wilcox (1989), Hakkio and Rush (1991), Hansen *et al.* (1991), and Gali (1991)], have assumed the discount rate remains positive and constant. The results of these studies vary depending on the sample period and the

methodology used. The cointegration methodology is also used to investigate fiscal sustainability, e.g., Wu (1998), Green *et al.* (2001), Bravo and Silvestre (2002), Hatemi-J (2002), Goyal *et al.* (2004) and Ehrhart and Llorea (2008). However, Luporini (2002) argues that the efficiency of the cointegration analysis is constrained by its assumptions regarding the real interest rate and the stochastic process that drives deficits. Consequently Luporini, as well as Telatar *et al.* (2004), apply Bohn's (1998) approach in their sustainability studies, using data from Brazil and Turkey, respectively.

As mentioned by Bohn (1995, 1998) and Ball *et al.* (1998), persistent deficits and the accumulation of debt do not necessarily imply that the debt is unmanageable, and hence, that fiscal processes are unsustainable. It is possible for a government to change the historical pattern it has been following so that it will not continue to borrow and run a "Ponzi" scheme in the future. This implies that the standard approach (cointegration analysis) to testing whether a government adheres to its intertemporal budget constraint, does not provide sufficient criteria for determining whether the fiscal process is truly sustainable.

Leachman (1996), consequently, uses a more encompassing set of criteria under more realistic assumptions for determining whether a country exhibits a sustainable budgeting process. His criteria for sustainability are based on the multicointegration approach first presented by Granger and Lee (1989, 1990). Leachman *et al.* (2005) use the one-step multicointegration approach which was developed by Engsted *et al.* (1997). Multicointegration can ensure that a country's budgeting strategy is also sustainable in 'bad' states of nature, that is, when the rate of economic growth falls short of the real

interest rate on sovereign debt. To the best knowledge of the authors, no such study for Egypt, a MENA (Middle East and North African) country, exists.

For example, Alba, *et al.* (2004) conclude that Egypt has a high debt-output relative to what is considered desirable for macroeconomic stability. They compare Egypt's debt-output ratio with middle and lower middle income countries as a group, and also with selected countries, including Argentina, Brazil, Malaysia, Philippines, Thailand and Turkey for the year 2000 and find Egypt has an unsustainable debt-GDP ratio. Abdel-Khalek (2007) also studies domestic and external debt in Egypt and concludes that Egypt's domestic debt as opposed to its external debt is a serious problem. Therefore, he claims that the domestic debt (a record high in 2006) raises serious concerns regarding sustainability.

However, it should be noted that a high debt-GDP ratio or a rising debt per GDP is not necessarily consistent with an unsustainable fiscal process in a stochastic environment. In a stochastic setting the government might issue a portfolio of securities that promises a total payoff conditional on the state of the economy at the time of maturity. Then the new level of government debt would change according to the state of the economy. In such an environment, the sustainability of fiscal processes requires revenues and expenditures, including interest payment on public debt, not to depart from each other over the long run, and at the same time the government debt should be cointegrated with its revenues/expenditures. To the best knowledge of the authors, no study so far has investigated formally the sustainability of the fiscal process in Egypt.

The objective of this paper is to develop and test such criteria for Egypt. With more than 90% of its country being desert land, Egypt relies mostly on tourism**.** During

the late 1940's Egypt experienced a surplus in the government budget, which peaked at 4.2% of GDP in 1947. During most of the 1950's the country's budget was in deficit which peaked at 7.4% of GDP in 1957. With the exception of 1981, Egypt experienced deficits from 1961 through 1991. These deficits peaked at 23.39% of GDP in 1976. Following these extended period of deficits Egypt experienced surpluses from 1992 through 1995 and again in 1999. These surpluses earned the praise of several international organizations. Egypt's debt-GDP ratio, consequently, fell from 99% in 1991 to 71% in 1999.[1] In the year 2000, the budget was in surplus (0.8% of GDP). Since then, however, Egypt has experienced increasing deficits resulting in a debt-GDP ratio of 92% in 2004. The main factors leading to budget deficits since 2000 include the South East Asian financial crisis, the second *Intifada*, the September 11 crisis of 2001 and the war in Iraq. The cumulative effect has lead to a sharp decline in tourism and investment and, consequently, in hard currency. These fluctuations in deficit-GDP and debt-GDP ratios in Egypt present a good opportunity for testing sustainability of fiscal policy in both a stochastic and non-stochastic environment.

The methodology used in this study is purely for a stochastic environment, which is more relevant for Egypt than for developed countries. Finally, contrary to the existing literature, this study incorporates policy regime changes that influence the short-run dynamics of the system. The rest of the paper is organized as follows: Section II formulates the models and explains the methodology. Section III focuses on the data, and on the empirical results and Section IV analyzes the policy regime changes and deficits per GDP. The final section provides some concluding remarks.

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[1] Data on debt was taken from Abdel-Khalek (2007). See Section III for the sources on the data of other variables.

It was found in this study that the fiscal budgeting process in Egypt is not sustainable in either a stochastic or a non-stochastic environment. We also found that the nationalization of all foreign trade in 1961-73 and 1984-2004 resulted in an increase in deficit-GDP ratio. The deficit per GDP fell in Egypt with the adoption of an austerity budget in 1967 and paying an additional cost of living allowance to government employees since 1975.

II. The Model and the Methodology

Under a stochastic environment, uncertainty exists and the discount rate is subjective and time variant. In such a situation, the discount rate is not necessarily always positive. Specifically, the safe real rate of return could be less than the economy's real growth rate. In that case, even if the intertemporal budget balance holds, i.e., deficits and outstanding debt are cointegrated, the deficit processes would not necessarily be sustainable. Furthermore, as Bohn (1995) shows, in a stochastic environment, if the growth rate of real income is a unit root process that can take on negative values, and there are no lump-sum taxes, running a balanced budget may be unsustainable. This is because there is a positive probability of large income declines that can make the debt-to-income ratio large enough to threaten sustainability, see Walsh (2000).

In a stochastic economy, if investors become sufficiently risk averse, the risk-free rate will fall below the expected growth rate of the economy. This is so because the more risk averse investors become, the higher will be the demand (price) for risk-free assets, which leads to a lower safe-interest rate. Thus, the risk-free rate may fall below the expected growth rate of the economy. In a deterministic steady state, this condition is also associated with dynamic inefficiency, but not necessarily in a stochastic economy,

Ljungqvist and Sargent (2000). But in such a case, the transversality ("no-Ponzi")

condition cannot be satisfied and the fiscal process cannot be sustained. This means that,

unless investors are risk neutral, the discount rate in a stochastic situation would be

subjective and time variant.

Under a constant real safe-rate when the discount rate is subjective (a stochastic

environment), utility is time separable, the marginal utility of consumption follows a

random walk, and the covariance between the marginal substitution between current and

future consumption and fiscal variables [i.e., real government expenditure on goods and

services as well as transfer payments, (G), and real government revenues, (R)], is

constant. Ahmed and Rogers (1995) prove the existence of a long-run cointegrating

relationship between G'_t (= $G_t + r_{t-1}D_{t-1}$) and R_t with the cointegrating vector of (1, -1)

guarantees $\lim_{n \to \infty} E_t[(1 + r_{t+n})^{-1} D_{t-n} | I_t] = 0$, i.e., a sustainable fiscal process. The variables r

and D are the real interest rate and the outstanding debt at time t, respectively. I_t is the

current available information. Ahmed and Rogers stressed that the existence of a

cointegration relationship between expenditures and revenues is both a necessary and a

sufficient condition for the present value "no-Ponzi" condition to hold, even under a

stochastic environment. However, this does not mean that the national debt must

eventually be paid off.

Specifically, even if government spending, including interest payments, and

revenues are cointegrated, the "Ponzi" scheme (i.e., the possibility of issuing new debt to

pay interest on the outstanding debt) is still possible. Furthermore, as Bohn (1995)

mentions, in a stochastic setting the government might issue a portfolio of securities that

promises a total payoff conditional on the state of the economy at the time of maturity.

The new level of government debt, therefore, would change according to the state of the economy. This means that besides the cointegration condition between government expenditures (including interest payments) and revenues, we need to impose an additional condition for the sustainability of fiscal processes. This extra condition would be that the government debt should also be cointegrated with its revenues/expenditures.

Specifically, a fiscal process is sustainable if expenditures and revenues do not drift apart over the long run, and in the meantime the outstanding debt and revenues/expenditures do not drift apart either over the long run, i.e., revenues and spending should be multicointegrated in the sense of Granger and Lee (1989, 1990). This multicointegration condition guarantees the sustainability of fiscal processes in a stochastic environment.

In general, for G'_t and R_t to be multicointegrated, we need first $G'_t - R_t = z_t \sim I(0)$, and then R_t (or $G'_t) - CD_t = Z_t \sim I(0)$, where C is a constant coefficient. Since G'_t, R_t and D_t are generated based on the same information, it is possible to show that the error correction models (ECMs) associated with each of these systems include both Z_t and z_t, see Granger and Lee (1990). Otherwise, the error correction equations will be misspecified. Thus, if G' and R are multicointegrated, they may be considered to be generated by an ECM of the form:

$$\Delta G'_t = \rho_1 z_{t-1} + \rho_2 Z_{t-1} + \text{lagged}(\Delta G'_t, \Delta R_t) + \text{white noise residual}, \qquad (1)$$

$$\Delta R_t = \eta_1 z_{t-1} + \eta_2 Z_{t-1} + \text{lagged}(\Delta G'_t, \Delta R_t) + \text{white noise residual}, \qquad (2)$$

which is estimated by OLS and the significance of ρ's and η's can be tested using standard *t*-tests.

As an alternative test for multicointegration, one can follow the one-step process of Engsted *et al.* (1997), Haldrup (1998), and Engsted and Haldrup (1999). Specifically, assume G' and R have a unit root. Then $Y_t = \sum_{i=0}^{t} G'_{t-i} \sim I(2)$, and $X_t = \sum_{i=0}^{t} R_{t-i} \sim I(2)$.

Under this assumption, the one-step test for sustainability of fiscal processes in a stochastic environment requires that OLS be run on the following equation:

$$Y_t = C_0 + C_1 X_t + C_2 \Delta X_t \text{ (or } C'_2 \Delta Y_t) + C_3 \text{ trend} + C_4 \text{ trend}^2 + e_t \qquad (3)$$

We need to test if in the integral regression (3) e_t follows an I(0) process (the case of multicointegration), an I(1) process (the case of first level cointegration, but no multicointegration) and finally the case of an I(2) process where there is no cointegration amongst variables. Note that in the case of multicointegration, the least squares estimated coefficient, of our I(1) variable (i.e., $G'_t = \Delta Y_t$ or $R_t = \Delta X_t$) is super consistent, and of

I(2) variable (i.e., $X_t = \sum_{i=0}^{t} R_{t-i}$) is super-super consistent, see Haldrup (1994),

Theorem 1 and Engsted *et al.* (1997).[2]

The interpretation of Equation (3) is as follows: if $C_1 > 1$ spending, on average, outpaces revenues. Sustainability requires $C_2 > 1$ (or $C'_2 < 1$) so that revenues rise (or expenditure falls) to accommodate the rising level of debt. If $C_1 < 1$, revenues, on average, outpace spending. Sustainability requires $C_2 < 1$ (or $C'_2 > 1$) so that revenues fall (or expenditure rises) to accommodate the rising level of savings. These conditions ensure neither government nor private agents are involved in a "Ponzi" scheme or gamble. For example, if $C_1 > 1$ and $C_2 < 1$, then the government may be engaged in a "Ponzi" gamble

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[2] The critical values for the cointegration ADF-test with intercept are given in Haldrup (1998) and with intercept and trends, in Engsted *et al.* (1997).

requiring tax increases (or spending cuts) in bad states of nature, see also Leachman *et al.* (2005). If $C_1=1$ the budget, on average, is balanced. Then the magnitude of C_2 (or C'_2) is no longer important for sustainability.

III. Data and Sustainability Test Results

The model is tested on annual data for Egypt from 1947 through 2004, since fiscal variables for Egypt are available only on an annual basis. The sample period was chosen because of the availability of the data. The fiscal data from 1947 through 1974 was taken from Scobie (1983). The source of the fiscal data for the period 1975 through 2003 is the *International Financial Statistics* (IFS) online. The data for 2004 was taken from the Ministry of Foreign Trade and Industry in Egypt. The CPI was used to convert the variables to real terms as a GDP deflator was not available for the entire period. The source of the data on GNP/GDP from 1947 through 1951 is Scobie (1983) and for the remaining of the sample period is IFS online. The data for CPI, for the period 1948-2004, was taken from IFS, and for 1947, was taken from Scobie (1983). The 1947 data was adjusted for the base year 2000 to be 100 so as to be consistent with the IFS data. We will investigate later in the paper if the empirical result is sensitive to the data being from two different sources.

Table 1 reports ADF and PP test results as well as multicointegration test results for both a linear and a quadratic time trend. The ADF statistics for the presence of a unit root allow a drift and trend in each series. According to these results, both G′ and R are homogenous of degree one. We also used Zivot and Andrews' (1992) unit-root test, which allows for unknown breaks in the intercept and slopes. These test results were consistent with the ADF and PP results, but for the sake of brevity these results are not

reported here, though they are available upon request. As for the multicointegration test, according to the ADF test result, reported in Column 9 of the table, government spending and revenues are not multicointegrated in Egypt. To ensure that the result is not sensitive to the data being from different sources we also reported in Table 1 the multicointegration test result on data taken from the IFS source. According to ADF statistics we cannot reject the null hypothesis of no multicointegration between government spending and revenues, indicating that the result is not sensitive to the data being from different sources. Having rejected this null hypothesis for Egypt, the conventional cointegration test between spending and revenues implied by Equation (4) should be sufficient for checking the sustainability of fiscal processes in this country.

$$G'_t = \beta_0 + \beta_1 R_t + z_t, \tag{4}$$

where β's are coefficients and z_t is, as before, the error term.

The bottom of Table 1 reports the results of these tests. However, it should be noted that, as it was shown by Gregory and Hansen (1996), the power of the ADF test in rejecting the null hypothesis of no cointegration will fall sharply in the presence of a regime shift. Of course the government could change its fiscal policy based on wars, recessions, etc. Consequently, we report in Table 1 Gregory and Hansen's Augmented Dickey-Fuller test (ADF*) when there is a possibility of an unknown break point. ADF* is the Dickey-Fuller statistics at its lowest value where there is a possibility of a break. If this statistics rejects the null hypothesis of no cointegration even with a regime shift, then we will conclude that a long-run relationship between government spending and revenues exists and, therefore, that the fiscal process of the country may be sustainable in a non-stochastic environment. To ensure again that the result is not sensitive to the data being

from different sources we also reported in the bottom of Table 1 the cointegration test result on data taken from the IFS source.

Table 1 about here

According to the ADF* test results reported in Table 1, government spending and revenues in Egypt are not cointegrated. The estimated coefficient for the whole period is one which indicates that the relationship is characterized by persistently balanced spending relative to revenues, but, according to the ADF* statistics, spending and revenues do not share a long-run equilibrium relationship, and there might be a break in both slope and intercept in 1979. Consequently, the fiscal budgeting process in Egypt is not sustainable in a non-stochastic environment. The result for the period 1975-2004 also confirms the lack of sustainable fiscal process in Egypt and consistency of the data. It should be mentioned that we also used the Maximum Likelihood Estimation technique (Trace test), developed by Johansen and Juselius (1991), to test for the existence of a cointegration relationship between spending and revenues in Egypt. The estimation result, not reported, but available upon request, confirms the residual based test reported in Table 1. Since there is no long-run relationship between revenues and spending we cannot estimate error-correction equations.

IV. Policy Regime Changes and Deficits in Egypt

Having established that the fiscal process in Egypt is not sustainable, it would be interesting to investigate whether the policy regime changes, which have been implemented during our sample period, could have any impact on the deficits (spending minus revenues). In fact, during our sample period, there are some policy regime changes which clearly could influence the fiscal process in Egypt. Figure 1 depicts government

expenditure and revenues during our sample period. As we can see, there are some changes in government revenue and expenditure which could be due to these policy regime changes.

Figure 1 about here

These policy shocks include (see *The Middle East and North Africa*, various editions):

(i) All foreign trade was nationalized in 1961. However, during the *infitah* (open door) period from 1974 to 1983, the nationalization of foreign trade was mostly undone. To account for this policy regime change, the dummy variable "national" = 1 for 1961-73 and 1984-2004, and zero, otherwise, was created.

(ii) The Egyptian government devaluated the currency in 1962. The dummy variable "dev" = 1 for 1962 and zero, otherwise, was created to account for this policy regime change.

(iii) In June 1967, after the war with Israel, the loss of revenues from the Suez Canal, tourism, and oil produced in Sinai, amounted to 12.5 million Egyptian pounds per month; about half the Egyptian foreign currency. In July of the same year, an austerity budget was adopted. The dummy variable "bud" = 1 for 1967 and zero, otherwise, was constructed to account for this policy regime change, caused by an external shock.

(iv) On May 1, 1975, Anwar Sadat announced that all lower paid public sector employees would receive an additional cost of living allowance equal to 30% of their pay. The dummy variable "costlive" = 1 for 1975 and after, and zero, otherwise, was constructed to account for the cost of living adjustment policy regime change in this year.

(v) A new sales tax of between 5% and 30% was introduced on most goods and services in May 1991. The dummy variable "tax" = 1 for 1991 and later years and zero, otherwise, accounts for a jump in prices for this fiscal policy change.

(vi) In late 1994, price subsidies were eliminated or substantially reduced throughout the public sector, and schedules existed for the removal of the remaining subsidies. This fiscal policy resulted in a hike in the price level in late 1994 and early 1995. The dummy variable "pricesub" = 1 for the period 1994-1995, and zero, otherwise, accounts for this policy regime change.

(vii) In early 1993, the maximum import tariff of 100% was reduced to 80%. In July of that year, the government declared its intent to further reduce the maximum tariff from 80% to 50% over a four-year period. In February 1994, the maximum import tariff was actually lowered from 80% to 70%. In January 1996, as part of its drive to stimulate industrial investment, the government cut import tariffs on capital goods, which had ranged from 20%-40%, to 10%. Thirteen free-trade zones were also approved. In 1998 clothing and some poultry products were the only products still subject to import bans. Continued tariff reform resulted in a significant reduction in most-favorite-nation (MFN) tariff rates. The simple average MFN tariff fell to 26.8% in 1998, from 42.2% in 1991. This reform has also reduced the maximum MFN tariff from 100% in 1991 to 40% in 1998 in most sectors.[3] To account for this policy regime change, the dummy variable "tariff" was constructed. It is zero prior to 1993, and is equal to 0.166667 for 1993. It then increases linearly to 1 for 1998, and remains 1 for the rest of the sample period.

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[3] Note that in September 2004, the Government of Egypt announced a new tariff structure, which removed services fee and import surcharges. This policy change was in effect only in the last four months of the sample period and so we ignored it.

(viii) The Egyptian pound was allowed to float in January 2003.[4] The dummy

variable "flex" = 1 for 2003 and later years, and zero, otherwise, was constructed to

account for this policy change.

To investigate the impact of the above policy regime changes on deficit per GDP

(defgdp) we estimate: $\text{defgdp}_t = \text{constant} + \sum_{i=1}^{k} \alpha_i \text{defgdp}_{t-i} + \delta \text{DUM}_t + u_t$, where α_i, for

i = 1 to k, is a constant coefficient, δ is a row vector of constant coefficients, the vector

DUM is defined as: $\text{DUM'}_t = (\text{national}_t, \text{dev}_t, \text{bud}_t, \text{costlive}_t, \text{pricesub}_t, \text{tariff}_t, \text{tax}_t, \text{flex}_t)$

and u is a disturbance term. According to the Augmented Dickey-Fuller (ADF) and

Phillips-Perron non-parametric (PP) test results, defgdp is stationary, but according to

Zivot and Andrews' (1992) unit-root test result, it has a unit root. Note that Zivot and

Andrews' unit-root test allows for unknown breaks in the intercept and slopes. Since

there are definitely structural breaks in the system we accept Zivot and Andrews' test

result. However, according to all above test results the first differences of defgdp is

stationary.[5] We, consequently, estimate: $\Delta\text{defgdp}_t = \text{Constant} + \sum_{i=1}^{k} \alpha_i \Delta\text{defgdp}_{t-i} +$

$\delta \text{DUM}_t + u$, where Δ means the first difference.

Table 2 about here

To avoid biased results, we allow for a lag profile of five years for the lagged

dependent variable. Furthermore, having too many coefficients can also lead to

inefficient estimates. To guard against this problem and ensure parsimonious estimation,

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[4] However, while allowing the pound to float, the government has stepped in to limit the decline of the currency. Despite this effort, however, the Egyptian pound has depreciated by about 17% between January 2003 and March 2007.
[5] For the sake of brevity these stationarity test results are not reported, but are available upon request.

we selected the final estimation result on the basis of Hendry's General-to-Specific approach. Table 2 reports the parsimonious estimation result. The specification test results reported in Table 2 in the bottom panel, suggest that the estimated equations are statistically adequate. According to Hansen's stability L test, all of the coefficients are stable. The joint Hansen stability L_c test result is statistically significant at the 66% level of significance indicating all coefficients and variance are jointly stable.

The estimation technique is Ordinary Least Squared. It seems only dummy variables national, bud and costlive are statistically significant. The estimated coefficient of dummy variable national is positive implying that nationalization of all foreign trade in 1961-73 and 1984-2004 resulted in an increase in deficit-GDP ratio. The estimated coefficient of the dummy variables bud and costlive is negative indicating that both policy regime changes of adopting an austerity budget in 1967 and paying an additional cost of living allowance to government employees since 1975 resulted in a reduction of deficit-GDP ratio.

V. Implications and Conclusions

In this article, a richer set of criteria is used to assess the sustainability of fiscal budgeting processes, which is based on the more realistic assumption that the discount factor is variable through time. The multicointegration of government spending and revenues is used to test for the sustainability of the fiscal process in a stochastic environment. It has been shown in the literature [see Leachman *et al.* (2005)] that the multicointegration condition is more appropriate for the sustainability test of the fiscal policy, since it implies that both the levels and rates of change of the series are tied together over the long run.

The data for Egypt does not exhibit multicointegration of its system of fiscal variables. Since a long-run cointegrating relationship between spending and revenues does not exist the fiscal budgeting process is not sustainable even in a non-stochastic environment. Furthermore, the earlier and recent nationalization of foreign trade resulted in an increase in deficits-GDP ratio. Adopting an austerity budget in 1967 and paying an additional cost of living allowance to government employees since 1975were the only two policy regime changes which reduced the deficit per GDP. No other policy change in our sample period could have any impact on this variable.

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Table 1: Unit Root Tests: Multicointegration Tests

Variables[1]	ADF τ-Stat(k)[2]	PP Z-Stat(k)	Multicointegration-Coefficients[3]					
	Stationarity Tests		C_0	C_1	C_2	C_3	C_4	ADF(k)[4]
	1947-2004		1947-2004					
G'	-2.82 (0)	-0.27 (4)	-357.51	0.84	1.18	27.86	1.52	-2.73 (4)
R	-0.86 (0)	-0.93 (4)	-490.04	0.98	1.16	50.00	-	-2.74 (4)
ΔG'	-8.23[a] (0)	-8.37[a] (4)	1975-2004					
ΔR	-6.19[a] (0)	-6.31[a] (4)	-1568.66	1.04	-0.34	158.70	-1.70	-1.25 (4)
			-3350.70	0.78	-0.21	209.84	-	-1.44 (4)

Residual Based Tests[5]			
Sample Period	β_0	β_1	ADF*[6](k)-Break
1947-2004	49.48	1.00	-3.24 (1) - 1979
1975-2004	253	0.75	-5.39 (0) - 2000

1. G' and R are real government spending, including interest payments, and real revenues, respectively. Δ before a variable means its first differences.

2. All tests include constant and trend, and k is the optimal lag length, which was determined by the minimum of AIC and SC. The critical values for Augmented Dickey-Fuller (ADF) τ test [for N=58, is -2.88 at 5% and -3.46 at 1%], and for Phillips-Perron non-parametric (PP) Z test (window size = 4) [for N=58, is -2.91 at 5% and -3.55 at 1%].

3. $Y_t = C_0 + C_1 X_t + C_2 \Delta X_t + C_3 \text{ trend} + C_3 (\text{trend})^2 + e_t$, where $Y_t = \sum_{i=0}^{t} G'_{t-i} \sim I(2)$, and $X_t = \sum_{i=0}^{t} R_{t-i} \sim$

I(2). The *t*-values are not shown as the e's are far from being white noise.

4. The null hypothesis: Residuals are I(1), i.e., all I(2) variables in the model cointegrate into an I(1) relation. The alternative hypothesis: Residuals are I(0) indicating multicointegration. The critical values are from Engsted *et al.* (1997), Table 1, where for N$\geq$50 these values are: -4.42 for 5% and -5.11 for 1% And for N$\geq$25 the critical values are: -4.71 for 5% and -5.60 for 1%.

5. $G'_t = \beta_0 + \beta_1 R_t + z_t$, where G' is real government spending, including interest payments, R is real revenues and z is the error term.

6. ADF* is Gregory and Hansen's (1996) smallest value of *t*-statistics of ADF. The critical value, when break is on the intercept and slope is -5.5 at 5% and -5.97 at 1%.

a=Significant at 1%.

b=Significant at 5%.

Table 2: Deficits per GDP and Policy Regime Shifts[1]

Dependent Variable	Δdefgdp	
Variables	**Coef. (SE)[2]**	L_i (*p*)
national$_t$	0.02 (0.01)	0.65
bud$_t$	-0.10 (0.04)	To avoid non-invertible matrix dependent variable was adjusted for this dummy variable.
costlive$_t$	-0.02 (0.01)	0.97
Δdefgdp$_{t-1}$	-0.36 (0.12)	1.00
Δdefgdp$_{t-5}$	-0.27 (0.12)	0.47
variance	-	0.06
joint-test L_c	-	0.66
Specification		***p*-value**
$\overline{R}^2$	0.23	-
DW	2.15	-
Godfrey(5)	1.43	0.23
White	11.60	0.92
ARCH(5)	9.38	0.09
RESET	0.39	0.76

1. The sample period is 1947-2004. Δ means the first difference and defgdp is the government deficits per GDP. Dummy variables are: national is equal to 1 for 1961-73 and 1984-2004, and zero, otherwise, bud is equal to 1 for 1967 and zero, otherwise, costlive is equal to 1 in 1975 and zero, otherwise. Godfrey is five-order Godfrey's (1978) test, White is White's (1980) general test for heteroskedasticity, ARCH is five-order Engle's (1982) test, REST is Ramsey's (1969) misspecification test, L_i is Hansen's (1992) stability test for the null hypothesis that the estimated coefficient or variance of the error term is constant and L_c is Hansen's (1992) stability test for the null hypothesis that the estimated coefficients as well as the error variance are jointly constant.
2. The estimation method is Least Squared.

Figure 1

Real Government Spending and Revenues