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FINDING THE OPTIMUM LEVEL OF TAXES IN SOUTH AFRICA: A BALANCED BUDGET APPROACH

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Abstract

The optimum level of government intervention in the economy has been researched extensively internationally but not in South Africa. This paper is primarily concerned with assessing the optimum size of government in terms of revenue and expenditure for South Africa, in order to maximize economic growth, using time series data for the period 1960 to 2006. The results indicate that the actual average tax burden far exceeds its optimum level and that the authorities will have to adjust tax policy accordingly in order to improve on the level of economic growth. The optimum level of taxation is estimated within a balanced budget scenario.

1. INTRODUCTION

As in many other countries the growth rates of taxes and government expenditure in South Africa tend to exceed economic growth and the country is featured by relatively high levels of taxation. However, in a developing country such as South Africa, the merit of this phenomenon should be weighted against the growing needs on the expenditure side, (Koch *et al,* 2005).

In this study an attempt is made to determine the optimum average tax rate in South Africa by using a balanced budget approach. A Cobb-Douglas type production function is used with two sectors namely a Government sector and a Private sector. The public sector provides goods produced with capital and labour (RG_{t-1}), and financed from tax revenue i.e. $RG_{t-1} = \tau Y_{t-1}$ (i.e. balanced budget). The amount spent by the private sector is determined by the rate of taxation and that period's national output $(1-\tau)Y_{t-1}$. Both public and private goods contribute to output in time t. Casual analysis shows that similar what was found in other studies, a positive/negative relationship exist between the ratio of government expenditure/taxation to GDP and the economic growth rate, (Black *et al,* 2006).

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Government expenditure comprises of public goods such as education, social services, security and health and in a balanced budget context sufficient funding is required to provide these services to the public. The secret is obviously to find the optimum level of taxes in order to optimise economic growth, without distorting the moral of the general public, (Rosen, 2005).

At this optimum tax level economic growth is maximised, employment is growing and tax evasion is minimised. However, a tax rate beyond this optimum level has a negative effect on economic growth and impacts negatively on economic behaviour of the tax paying public. For example, too high tax rates result in lower productivity and savings, (Black, 2006). Such a change in behaviour is often caused by a double tax effect since firstly, tax payers have to pay their taxes, but secondly they also experience a decrease in their standard of living because of the lower growth rates (Scully, 1994). Disposable income declines and with that consumption and investment which causes substitution of leisure for labour resulting in not only a loss in hours worked, but probably also labour productivity (Feldstein, 2006). The decline in savings (especially household savings) in South Africa over the past decade is often mentioned as the result of too high tax rates.

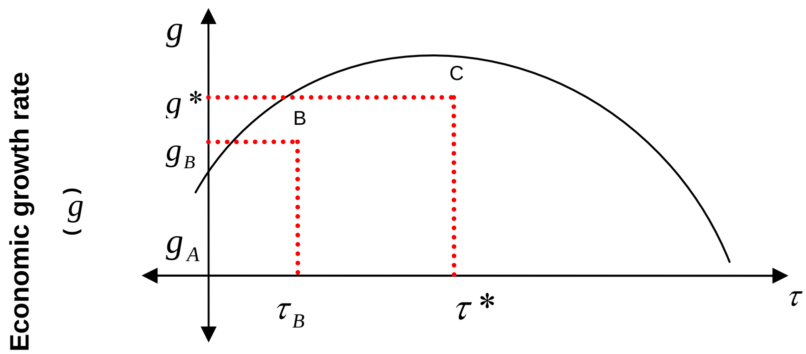
To obtain an optimum tax rate, government expenditure should be optimised as well by improving on the efficiency of government expenditure. For example, appointing more teachers would be a quantity solution to improve education, but spending more on the current teachers' skills would probably contribute more to improving education and the budget would be spent more effectively (Hood *et al*, 2002).

The layout of the rest of the paper is as follows: Section 2 contains a review of the relevant literature. Section 3 analyses government expenditure and tax ratios in South Africa while the analytical framework is discussed in Section 4 and the data used in Section 5. The empirical results of the analysis are presented in Section 6 and Section 7 concludes with some policy recommendations.

2. LITERATURE REVIEW

In a paper by Chao *et al* (1998), the relationship between economic growth and the level of government expenditure in Canada is investigated with the findings illustrated in Figure 1. The GDP growth rate is depicted on the vertical axis and government expenditure/total taxes as a percentage of GDP on the horizontal axis. At a zero level of government expenditure (government is absent) the growth rate is g_A (no rule of law exists i.e. a state of chaos). At this zero rate of government expenditure output is at a low level with little incentive to save and invest. With increasing expenditures on for example, national defence, a legal system and education, economies of scale become evident. The BC line in the curve shows that the proportional increase in government expenditure is less than the proportional increase in economic growth. Eventually, the marginal rate of return on such additional government expenditure on reaches level zero at point C. Thus the optimum level of government expenditure as a percentage of GDP is reached at $\tau *$ after which the marginal return on such expenditures in terms of value added becomes negative.

Figure 1: The relationship between economic growth and public expenditure/taxes



Government expenditure/Total taxes as a percentage of GDP (τ)

Source: Chao *et al.*

The Ricardian equivalence theory suggests that the current generation might be under-taxed if government borrows (debt financing) instead of only levying taxes to finance government expenditure. Rising public debt will result in higher future taxes. Therefore, debt financing only postpones the tax burden over more than one generation. Should taxes be used to finance expenditures instead, the current generation would rather bear the burden. Thus, the Ricardian equivalence theorem holds that it is indifferent whether tax or debt financing is used since the current generation would increase their private savings by reducing their private consumption, realising that such loans would have to be repaid in future from tax revenue (Black, 2006). The impact thereof is that the multiplier affects are neutralised and the stimulation of the economy by public intervention, largely constrained.

Schoeman (1995) refer to Barro's provocative hypothesis that government finding by means of taxes or new debt might be irrelevant, because the private individual can loosen the intergenerational effects of government debt policy. The Barro hypothesis is further extended in a study where the public sector is incorporated into a simple, constant-returns endogenous-growth model. (Barro, 1990) points out that there is a potentially positive linkage exists between government expenditure and economic growth but that the size of government does matter. When government is relative small a positive relationship exist between government expenditure as a percentage of GDP and the growth rate but when government is relative larger this relationship turns negative.

Mitchell (2001) finds evidence that economic performance is sensitive to the level of taxation, therefore a lower tax rate enhances the level of compliance with more people paying their taxes. Mitchell concludes that lowering tax rates improves investment, savings, and incentives to work and also enhances the immediate and long term development of small business and entrepreneurship. However, higher tax rates lower the price of leisure and thereby reduce the levels of saving, investment, and labour productivity probably resulting in lower levels of production. Mitchell states that capital supply mainly originates from higher income tax payers and they are the ones more sensitive to the level of tax rates. By implication, a lowering of marginal tax rates would induce higher savings, thereby broadening the capital base and thus increase the growth potential of the economy. The general notion seems to be that government expenditure on public goods (infrastructure, education, health, defence) improves the productivity of human and fixed capital which in turn would increase economic growth and thereby raise individual living standards (Scully, 1994). Such expenditures have to be financed and the effect of taxation on economic growth depends on the magnitude of these government expenditures.

In a paper on the size of Government, Clemens *et al*. (2002) support the Grossman hypothesis (1988), namely, that a negative relationship exists between government expenditure and economic growth. They also cite a study by Vedder and Gallaway, who find that a decrease in government expenditure would be growth-enhancing, and estimate that the growth of the US economy would be optimised if government expenditure as a percentage of GDP is fixed at around 17.5% of GDP. Clemens (Ibid) also cites a study by Peden and Bradle who set the estimated optimal level of government expenditure as a percentage of GDP to 17 % for the US, warning that any increase beyond this optimal point will dampen economic growth. The studies referred to seem to concur that an inverse relationship exists between the level of government expenditure and economic growth, at least when government expenditure has exceeded a certain critical level.

This inverse relationship between government expenditure and economic growth is also confirmed by Pevcin (2004) who does a panel regression on 12 European countries (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Sweden and United Kingdom) for the time period 1951-1995. In this study the average optimum size of government ranges between 36.6 and 42.12 per cent. Pevcin concludes that countries with a higher level of government expenditure, experiences lower rates of economic growth.

Scully (1994) also elaborates on the relationship between the level of government expenditure /taxes and economic growth. He states that government expenditure grows until a certain optimum point, after which productivity and economic growth are reduced. He finds that tax rates affect not only government revenue, but also economic efficiency. High tax rates divert resources from the private sector, encourage tax avoidance and evasion and channel resources into a less productive "shadow" (or informal) economy in order to escape the high taxes. According to Scully countries that increase government revenue at the expense of economic growth, expose their taxpayers to a form of double taxation. The first tax would be taxes paid according to the tax jurisdiction and the second tax the lowering in their standard of living, caused by the lower economic growth. The study concludes that after a 40 year period of optimum levels of taxation, a country would enjoy more than three times as much economic growth.

Scully (ibid) estimates that, for the United States, the optimal level of government expenditure/taxation is in the range of 19 to 23 per cent. The Scully model estimates a growth-maximising tax rate for the years 1927-1994 at an average 19.7 per cent of GDP for New Zealand (Caragata, 1998). Mackness (1999) estimates the optimum size of the tax rate for Canada at about 20 to 30 per cent of Gross Domestic Product (GDP). Mavrov (2007) finds the optimum ratio for government expenditure as percentage of GDP in Bulgaria to equal 21.42 per cent. All of these studies find that the optimum tax rate is much smaller than the actual tax rate in these countries. Mirrlees (1971) suggests that government expenditure could be growth enhancing or retarding pending on its end use. The outcome is determined by the nature of expenditures as well as the way in which it is financed.

In the next section government expenditure and revenue ratios in South Africa are analysed in order to test fir the relevance of the theories discussed.

3. GOVERNMENT EXPENDITURE AND TAX RATIOS IN SOUTH AFRICA

Since 1960, the South African government has appointed the Franzsen Commission (1968), Margo Commission (1987) and the Katz Commission (1994) to investigate the impact of tax jurisdictions on economic growth. Thus, during this period South Africa's tax system went through a number of reforms. During the 1980s, the economy endured international sanctions that lead to a loss of international investment and the debt standstill. The Katz Commission was appointed at the time of a new political dispensation for South Africa with international trade sanctions gradually lifted. The challenge was to find the ideal level and size of government intervention given the poverty and socioeconomic problems in general (First Interim Report, 1994). In his 2002 speech on Tax Reform experience in South Africa since 1994, the Minister of Finance stated that the fiscal achievements were: "…stabilisation of the tax burden at approximately 25 per cent of GDP…" and "… a decline in government consumption expenditure as a percentage of GDP, from 20 per cent in the mid-1990s to 18 per cent in 2001…", Budget Speech (2002).

In June 1996, the government adopted a five year macro economic program (GEAR). This program's goal was to achieve sustained annual real GDP growth of 6 per cent or more by the year 2000 with increased job opportunities and investment. The latter was not achieved but the growth rate increased from its negative base in 1990, to more than 5 per cent in 2007 as seen in Table 1.

Table 1: Tax revenue, Government expenditure and Economic growth rates

Series	***Code***	***1981***	***1984***	***1990***	***1995***	***2000***	***2004***	***2007***
Tax on individuals/Total revenue	KBP4429J	20.7	31.7	32.2	40.6	42.1	33.1	30.1
Tax on companies/Total revenue	KBP4430J	34.5	22.9	22.6	13.1	16.0	23.2	29.4
VAT/Total revenue	KBP4431J	13.6	23.3	24.4	26.0	25.0	28.3	27.2
Tax revenue/GDP	KBP4433J	20.2	20.9	24.7	22.2	22.5	23.5	26.9
Expenditure/GDP	KBP4434J	22.1	24.3	25.5	27.1	24.4	25.5	26.1
GDP growth	KBP6006Z	5.4	5.1	-0.3	3.1	4.1	4.8	5.1

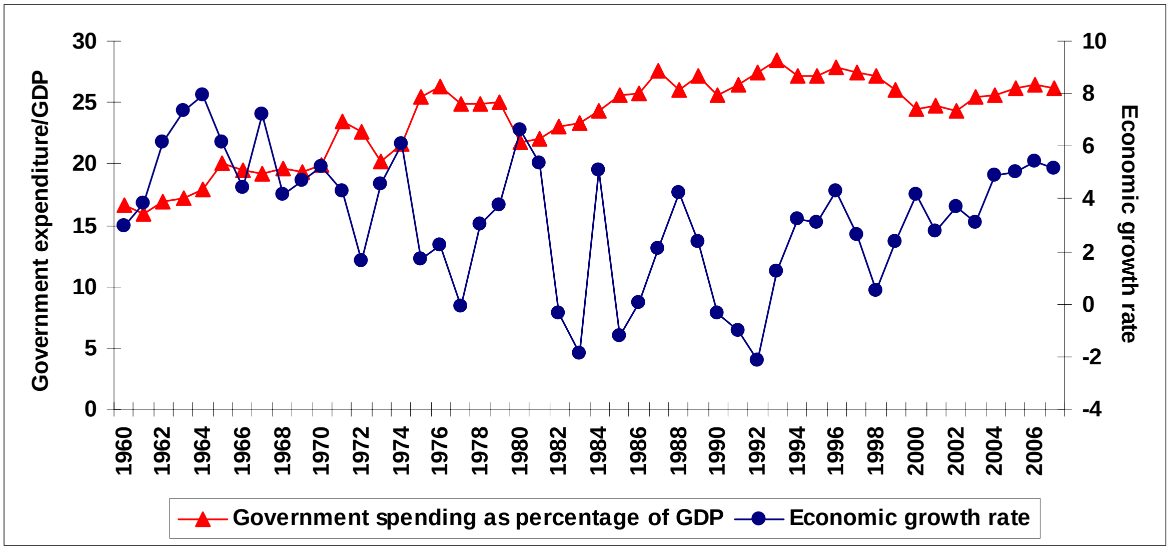
Source: SARB various sources

The table also gives an indication of the change in the tax burden between 1981 and 2007. Personal income tax comprised 42 per cent of total tax revenue in 2000 but its share declined to 30 per cent in 2007. Company tax was 16 per cent in 2000 but increased to 29.4 per cent as a percentage of total revenue. Corporate and individual rates were significantly reduced since 1994. The corporate tax rates decreased from 40 per cent to 28 per cent and the top marginal personal income tax rate from 45 per cent to 40 per cent (Budget review, 2008).

In Figure 2, the real economic growth rate and real government spending as a age of GDP are illustrated for the years from 1960 to 2007. The graph shows that during the period 1960 to 1965, the economic growth rate had been relatively high with relatively low levels of government spending. After about 1970, the level of government expenditure started to increase and fluctuated at an average of 26 per cent between 1985 and 2007. This tendency is similar to findings of

Devarajan *et al* (1996), according to which governments in developing countries on average spend 26 per cent of GDP.

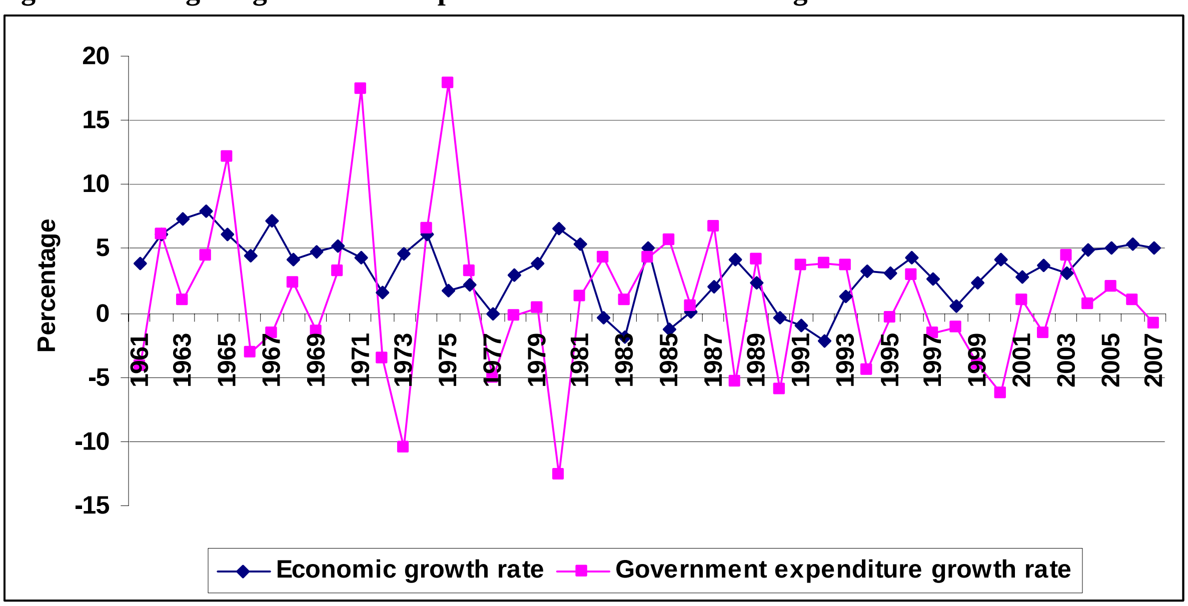
Figure 2: Government expenditure as percentage of GDP and the economic growth rate



Source: SARB various issues

In Figure 3, the real economic growth rate is compared with the real government expenditure growth rate for the years from 1961 to 2007. The graph shows an inverse relationship between the economic growth rate and the change in government expenditure. For example, in the years 1966 to 1970 and 1976 to 1982.

Figure 3: Change in government expenditure and the economic growth rate



Source: SARB various issues

In the next section an attempt will be made to quantify the optimal level of tax revenue for South Africa.

4. ANALYTIC FRAMEWORK

The model used is based on that of Scully (1994), using a simple, constant-returns endogenous non-linear Cobb-Douglas production function. The rate of real economic growth is related to the fraction of output that is a function of a two sector economy namely the public and private sectors. Economic growth rate is a function of real government expenditure as a share of GDP which is also the equivalent of the $\frac{RG_{t-1}}{Y_{t-1}}$ ratio and the fraction that is retained by consumers after tax $(1-\tau)Y_{t-1}$. It is structured to assume a balanced budget with government expenditure = government revenue $RG_{t-1} = \tau Y_{t-1}$. Furthermore, all the other drivers of economic growth are set at zero.

Non-linear Cobb-Douglas production function:

$$Y_t = \alpha (RG_{t-1})^{\beta} ((1-\tau)Y_{t-1})^{\delta} \qquad (1)$$

Growth rate:

$$1 + g = \frac{Y_t}{Y_{t-1}}$$

Substitute (1) in growth rate

$$1 + g = \frac{Y_t}{Y_{t-1}} = \alpha (RG_{t-1})^{\beta} (1-\tau)^{\delta} (Y_{t-1})^{\delta - 1} \qquad (2)$$

Where

α	= total factor productivity
Y_t	= Gross domestic product (GDP) current period
Y_{t-1}	= Gross domestic product (GDP) previous period
RG_{t-1}	= real government expenditure previous period
g	= economic growth rate
τ	= tax ratio

Cobb-Douglas production function in logarithm form:

$$\ln(1+g) = \ln(\frac{Y_t}{Y_{t-1}}) = \ln\alpha + \beta\ln(RG_{t-1}) + \delta\ln(1-\tau) + \delta\ln(Y_{t-1}) - \ln(Y_{t-1}) \qquad (3)$$

Differentiate growth rate w.r.t government expenditure

$$\frac{\partial\ln(1+g)}{\partial RG_{t-1}} = \beta(RG_{t-1})^{-1} \qquad > 0 \qquad (4)$$

$$\frac{\partial^2\ln(1+g)}{\partial RG_{t-1}{}^2} = -\beta(RG_{t-1})^{-2} \qquad < 0 \qquad (5)$$

thus a positive relationship between government expenditure and the growth rate but at a diminishing rate. From increasing government expenditure (holding productivity and employment constant) the growth rate will raise but less than when government expenditure was lower.

Differentiate growth rate w.r.t tax rate (τ)

$$\frac{\partial\ln(1+g)}{\partial\tau} = -\delta(1-\tau)^{-1} \qquad < 0 \qquad (6)$$

$$\frac{\partial^2\ln(1+g)}{\partial\tau^2} = -\delta(1-\tau)^{-2} \qquad < 0 \qquad (7)$$

thus a negative relationship between the tax rate and the growth rate but at an increasing rate

Calculation of the tax rate that maximizes growth

By definition $RG_{t-1} = \tau Y_{t-1}$ and substitute into (1) and (2)

$$Y_t = \alpha(\tau Y_{t-1})^{\beta}((1-\tau)Y_{t-1})^{\delta}$$

$$= \alpha(\tau)^{\beta}(1-\tau)^{\delta}(Y_{t-1})^{\beta+\delta} \qquad (8)$$

Growth rate:

$$1+g = \frac{Y_t}{Y_{t-1}} = \alpha(\tau)^{\beta}(1-\tau)^{\delta}(Y_{t-1})^{\beta+\delta-1} \qquad (9)$$

Constant returns to scale $\beta+\delta=1$

Thus (9): $$1+g=\frac{Y_t}{Y_{t-1}}=\alpha(\tau)^{\beta}(1-\tau)^{\delta}(Y_{t-1})^{1-1}$$

$$1+g=\frac{Y_t}{Y_{t-1}}=\alpha(\tau)^{\beta}(1-\tau)^{\delta} \qquad (10)$$

Calculation of the **optimum tax rate that maximizes growth**, by differentiating growth w.r.t tax rate and set equal to zero.

From (10) $\ln(1+g)=\ln(\frac{Y_t}{Y_{t-1}})=\ln\alpha+\beta\ln(\tau)+\delta\ln(1-\tau)$

$$\frac{\partial\ln(\frac{Y_t}{Y_{t-1}})}{\partial\tau}=\beta(\tau)^{-1}+[\delta(1-\tau)^{-1}(-1)]=0 \qquad (11)$$

$$\frac{\beta}{\tau}=\frac{\delta}{1-\tau}$$

$$\frac{1-\tau}{\tau}=\frac{\delta}{\beta}$$

$$\frac{1}{\tau}-1=\frac{\delta}{\beta}$$

$$\frac{1}{\tau}=\frac{\beta}{\beta}+\frac{\delta}{\beta}$$

Optimum tax rate that maximizes growth $$\tau^*=\frac{\beta}{\beta+\delta} \qquad (12)$$

5. THE DATA

Series	***Abbreviation***	***Description***	***Transformation used***
KBP6006J	**Y/GDP**	Gross domestic product at market prices	R millions Current prices
KBP6008J	**consG**	Final consumption expenditure by general government	R millions Current prices
KBP6100J	**capG**	Gross fixed capital formation: general government	R millions Current prices
KBP7032J	**CPI**	Consumer Price Index	Yearly index
Calculated	**G**	Government expenditure	consG + capG
Calculated	**RG**	Real government expenditure	G/CPI*100
Calculated	**RY**	Real gross domestic product	Y/CPI*100
Calculated	**TAX**	Tax percentage	RG/RY*100
Calculated	**YD**	Disposable income	100-TAX
Calculated	**DUM**	Political change	1:1994
Calculated	**GROWTH**	Growth rate of GDP	((ry/ry(-1))-1)*100
Calculated	**GRG**	Growth rate of RG	((grg/grg(-1))-1)*100
Calculated	**GRYD**	Growth rate of RYD	((gryd/gryd(-1))-1)*100

Source: SARB quarterly bulletin, various issues

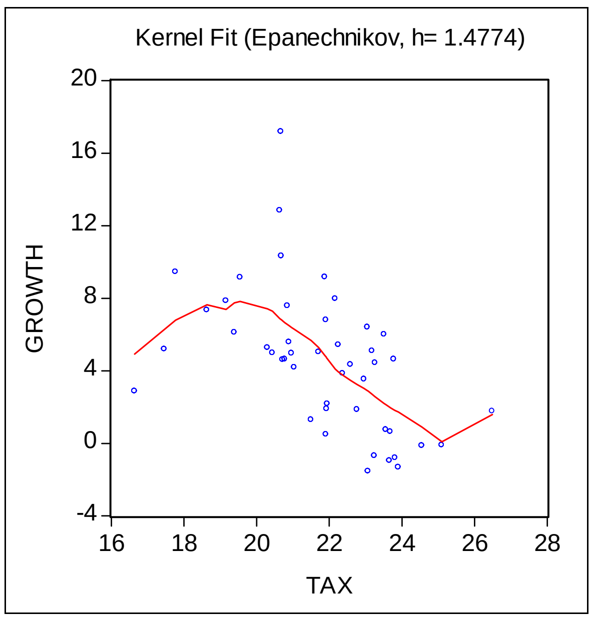
Ordinary Least Square Regression procedure is used for the modeling. All data retrieved and used in the model is at current (nominal) prices and transformed to real values by using the CPI index.

6. EMPIRICAL RESULTS

The parameters used in the model were estimated using yearly time series data for the period 1960 to 2006 from the South African Reserve Bank (www.resbank.co.za).

Empirical Analysis

Figure 4: Tax ratio and economic growth rate in South Africa: scatter of annual observations



In Figure 4 the rate of economic growth is on the y-axis and the $\tau = \frac{RG_{t-1}}{Y_{t-1}}$ ratio on the x-axis. The individual points represent annual observations of these two variables for the period 1960 to 2006. A Laffer curve can be visualized in the inverted U through the points in the graph. It is clear that most of the tax ratios over the period lie to the right hand side of the optimum turning point of the curve. Thus an increase in τ rate decreases growth at an increasing rate.

Informal tests suggest that all the data series used for estimating growth is non-stationary I(0). Differencing the series once, ADF unit root test confirmed stationarity of the series, therefore RG, TAX, RGDP,YD are all I(1). See Appendix A for the empirical analysis.

Cointegration model

Cointegration involves combing economic data series (although I(1)), through a linear combination, into a single series, which is itself stationarity. This process shows which variables affect GDP in the long run. According to this step it was found that:

$$GROWTH = f(G\overset{+}{R}G, G\overset{+}{Y}D)$$

Long-run estimation

Below is the outcome of the regression:

Table 2: Output coefficients for the long run cointegrated equation
Dependent variable: LNGROWTH

Variable	Coefficient
LNGRG	0.221163
LNGRYD	0.777612
C	-0.000172

Source: Eviews 5

The signs and magnitudes of the variables in the long-run equation do conform to a priori expectations. It is expected that an increase in government expenditure (LNGRG) on the economic growth rate is positive until it reaches a maximum optimum point. Beyond that point the growth rate is lowered at a diminishing rate. An increase in disposable income (LNGRYD) will have a positive impact on economic growth, because of increased expenditures. A 1 per cent increase in government expenditure would lead to a 0.22 per cent increase in economic growth. A 1 per cent increase in disposable income would lead to a 0.77 per cent increase in economic growth.

Test for cointegration

H_0 : no cointegration
H_1 : cointegration

Table 3: Testing stationarity of the cointegrating residuals

Series	Model	Lags	τ
RES_LR	Constant, no trend	0	-5.703701

Source: Eviews 5

The variables are cointegrated at a 1% level of significance, as -5.704 is smaller than the calculated MacKinnon[2] critical value of -4.612, thereby rejecting the null hypothesis at a 1 per cent level of significance, indicating cointegration.

Error correction model

A model incorporating the short-run effects on economic growth corrects the stochastic residuals from the long-run cointegrating regression. The results are shown in Table 4.

Table 4: Regression output of the Error Correction Model for Growth

Dependent variable ΔLRGROWTH				
Variable	*Coefficient*	*Standard Error*	*t-Statistic*	*p-Value*
RES_LRt-1	-0.807583	0.145423	-5.553345	0.0000
ΔLNGRG	0.222991	0.002906	76.72329	0.0000
ΔLNGRYD	0.779224	0.002979	261.5298	0.0000
ΔLRGROWTH(-1)	-0.007359	0.003848	-1.912191	0.0632
DUM	0.000220	0.000289	0.760124	0.4518
R squared= 0.999487 Adjusted R squared = 0.999435 S.E. of Regression = 0.001031				

Source: Eviews 5

All the variables included in the ECM were originally I(1). Differencing them once transformed them into I(0) series. The error correction coefficient is negative and statistically different from zero. The Adjusted R square value indicates that 99.94 per cent of the variation in growth is being explained by the ECM.

All the perfunctory tests were performed on the ECM, with the following results:

Table 5: Selected diagnostic results of the short-term model estimating GDP

Test	H_0	***Test Statistic***	***p-value***	***Conclusion***
Jarque-Bera	Residuals are normally distributed	JB = 8.58	0.0137	Can not reject H_0, and conclude that the residuals are normally distributed
Ljung-Box Q	No serial correlation in the residuals up to the 6th order	LB_Q = 12.29	0.0566	Can not reject H_0, and conclude that there is no serial correlation in the residuals up to the 6th order
Breusch-Godfrey	No serial correlation in the residuals up to the 2nd order	nR^2 = 8.66	0.0132	Can not reject H_0, and conclude that there is no serial correlation in the residuals up to the 2nd order
ARCH LM	No autoregressive conditional heteroskedasticity up to the 1st order	nR^2 = 11.26	0.0104	Can not reject H_0, and conclude that there is no autoregressive conditional heteroskedasticity up to the 1st order

[2] see Appendix D

White	No heteroskedasticity	$nR^2 = 30.53$	0.0454	Can not reject H_0, and conclude that there is no heteroskedasticity
Ramsey RESET	Model is stable with no specification error	LR = 1.34	0.2471	Can not reject H_0, and conclude that the model is stable with no specification error

Source: Eviews 5

Thus given the diagnostic results at a 1 percentage level of significance, it is reasonable to conclude that the residuals do satisfy the assumptions of the classical normal linear regression model.

Adjustment of the cointegration coefficient and t-values

In order to address the problem of non-stationarity of the time series in the cointegration equation the coefficients had to be adjusted using error correction (ECM). Thus the t-statistics are also not suitable for inference because of their inaccuracy and biasedness. The ECM is used via its residuals to adjust the long-run coefficients and their corresponding t-statistics.

Third step adjustment

The residuals from the ECM is then regressed on the variables included in the long-run equation multiplied by the negative coefficient of the residuals from the cointegrating equation retrieved from the ECM.

Table 6: Results of the Engle-Yoo regression

Dependent variable: RES_LRt-1				
Variable	*Coefficient*	*Standard Error*	*t-Statistic*	*p-Value*
0.807583*LNGRG	-0.002860	0.003231	-0.885021	0.3811
0.807583*LNGRYD	-0.000766	0.003889	-0.197011	0.8447

Source: Eviews 5

Adjusted long-run coefficients and t-statistics

Table 7: Calculated coefficients and adjusted t-statistics

Dependent variable: RES_LRt-1			
Variable	*Adjusted Coefficients*	*Standard Error*	*Adjusted t-Statistic*
LNTAX	0.221163+(-0.002860)= 0.218303	0.003231	0.218303/0.003231= 67.56515
LNYD	0.221163+(-0.000766)= 0.776846	0.003889	0.776846/0.003889=199.7547

Source: Eviews 5

In the long run, all the adjusted coefficients are highly statistically significant as their respective t-statistics are all larger than 1.96 in absolute value.

Growth maximizing tax rate

The coefficients of the model are now used to calculate the optimal growth maximising tax ratio by solving the equation:

From equation (12):

$$\tau^* = \frac{\beta}{\beta + \delta}$$

$$= \frac{0.218303}{(0.218303 + 0.776846)} * 100$$

$$= 21.94\ \%$$

According to the model the optimum tax rate is 21.94 per cent. The actual level of tax as a share of GDP for 2006, was 26 per cent and in 2007, it increased to close to 28 per cent. Thus, the tax ratio that maximizes growth is substantially lower than the realised rate. The optimum rate calculation is consistent with the findings of Scully (ibid) with rates between 19 and 23 per cent for the United States and New Zealand. It is also consistent with the findings of Mavrov (2007) with an optimum ratio for government expenditure as percentage of GDP of 21.42 per cent in Bulgaria.

6. CONCLUSIONS AND RECOMMENDATIONS

In view of the skewed distribution of wealth in South Africa and poverty in general, it is of crucial importance that government (inter alia) provides public goods, such as infrastructure, health, education and national security to the society. However, such expenditures reach an optimum level after which it becomes a drain on the economy's growth performance. The reason being that scarce resources are channelled away from more productive sectors with the result that economies of scale of government endeavours turn negative.

This paper finds that (in a balanced budget scenario) the optimum level of government intervention as represented by the ($\frac{RG_{t-1}}{Y_{t-1}} = \tau$) ratio is approximately 21.94 per cent. This is in line with similar benchmarks for other countries reported in the literature but much lower than the actual figures recorded over the past two decades. Thus, the finding indicates that the current average tax burden for South Africa might be on the downward-sloping portion of the Laffer curve. Therefore, the tax rburden has a negative impact on economic growth. As part of tax reform, policy makers should consider the adjustment of tax rates to return to its optimum level.

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APPENDIX A

Real Government expenditure (RG)

Figure 6a:

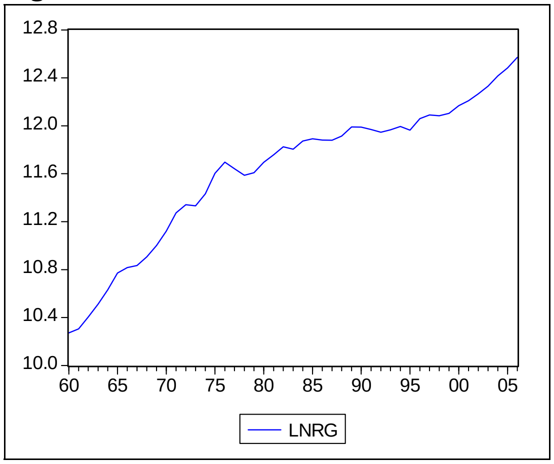
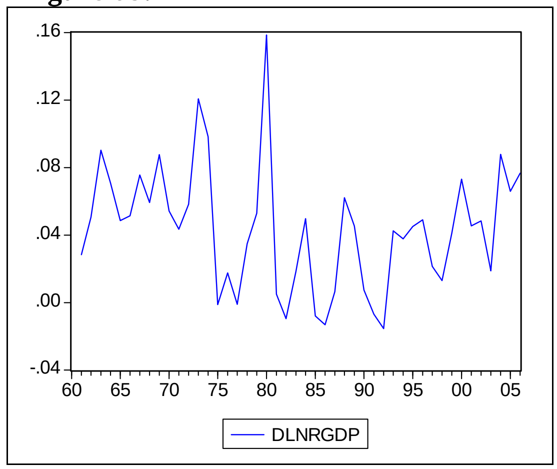


Figure 6b:



Source: Eviews 5

Figure 6(a), which graphs real government expenditure in natural logarithm levels indicates that the series does not have a constant mean and variance. The autocorrelations of the correlogram[3] take some time to taper off, thus perhaps indicating non-stationarity. The Augmented Dickey-Fuller unit root test[4] proves the non-stationarity of the series.

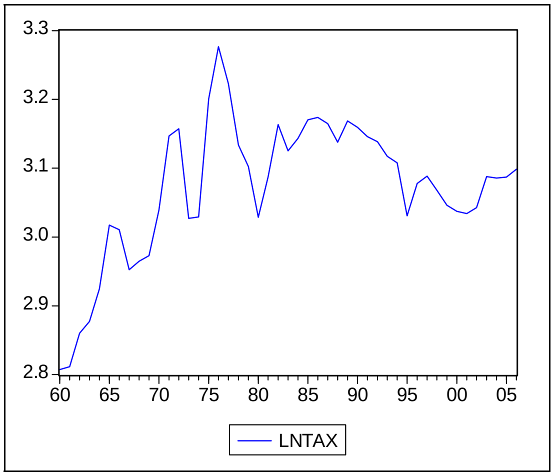
In Figure 6(b), real government expenditure in natural logarithm levels is differenced once, indicating that the series have a constant mean and variance about the trend – thus possibly stationary. The Augmented Dickey-Fuller unit root confirmed stationarity. Therefore **RG~I(1).**

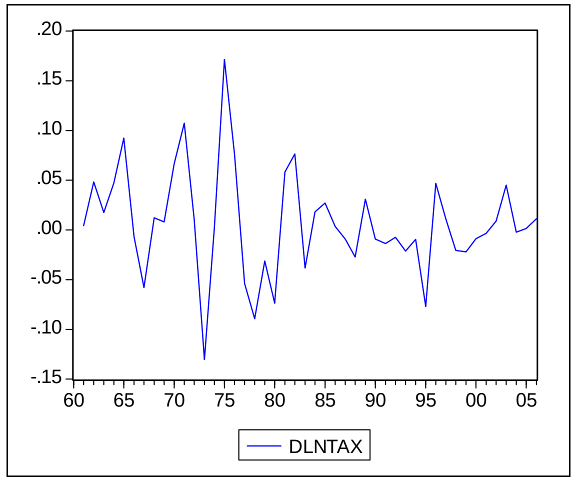
Tax rate (TAX)

Figure 7a:

Figure 7b:

[3] See Appendix B
[4] See Appendix C





Source: Eviews 5

Figure 7(a) shows the tax rate over time exhibiting the characteristics of a stationary time series. The autocorrelations of the correlogram[3] take some time to taper off, thus perhaps indicating non-stationarity. The Augmented Dickey-Fuller unit root test[4] proves the non-stationarity of the series.

In Figure 7(b) the series are differenced once, indicates a constant mean and variance around the trend – indicating possible trend stationarity. The Augmented Dickey-Fuller unit root test confirms stationarity. Therefore **TAX~I(1).**

Real Gross domestic product (RGDP)

Figure 8a:

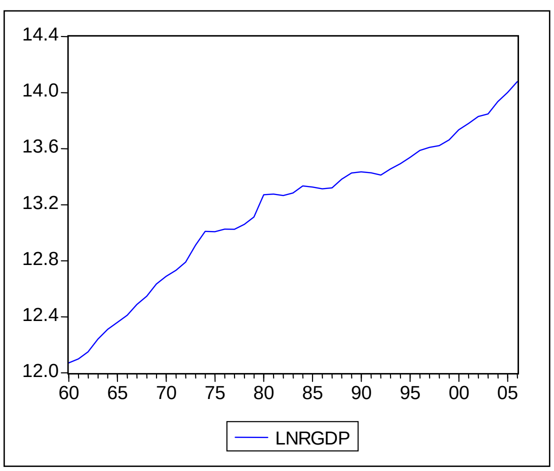
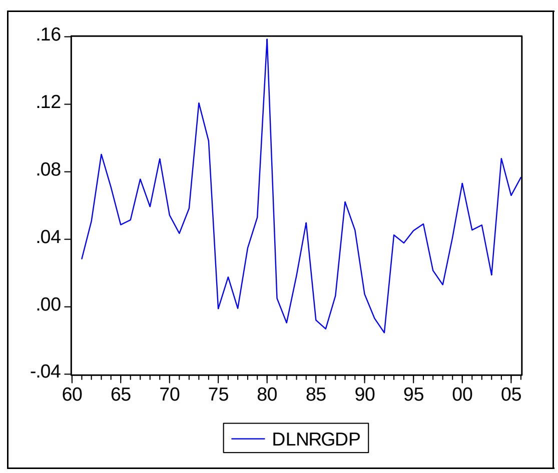


Figure 8b:



Source: Eviews 5

Figure 8(a), which shows GDP real growth appears to exhibit the normal visual characteristics of a stationary time series. However, the autocorrelations of the correlogram[3] take some time to taper off, thus perhaps indicating non-stationarity. The Augmented Dickey-Fuller unit root test[4] proves the suspicion of non-stationarity.

Figure 8(b), which is the graph of GDP real growth differenced once, indicates that the series have a constant mean and variance about the trend – indicating trend stationarity. The Augmented Dickey-Fuller unit root test confirmed stationarity. Therefore **RGDP~I(1).**

Figure 9(a), shows growth in real disposable income and appears to exhibit the normal characteristics of a stationary time series. The autocorrelations of the correlogram[3] take some time to taper off, thus perhaps indicating non-stationarity. The Augmented Dickey-Fuller unit root test[4] proves the suspicion of non-stationarity.

Disposable income (YD)

Figure 9a:

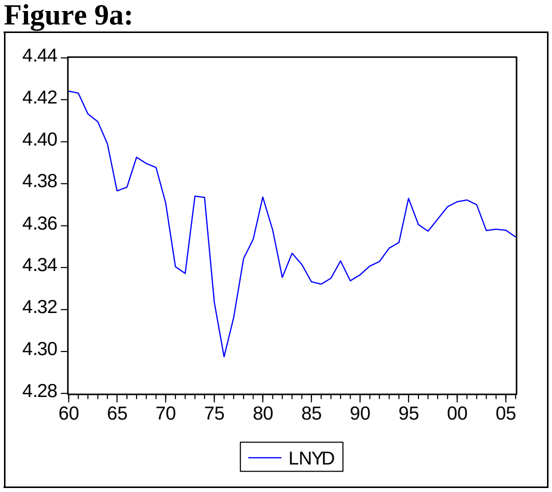
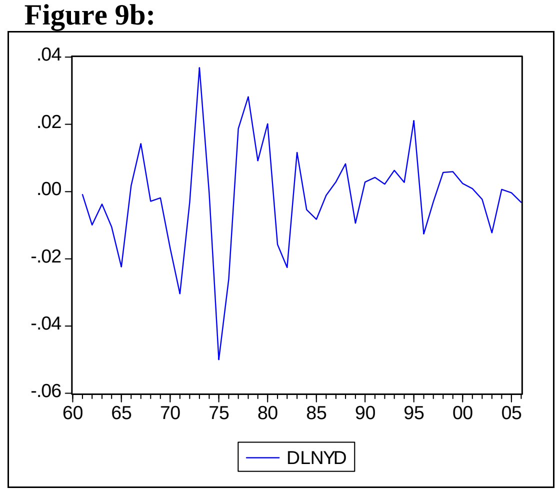


Figure 9b:



Source: Eviews 5

In Figure 9(b), real disposable income is differenced once, indicating that the series have a constant mean and variance about the trend – meaning it is stationary. The Augmented Dickey-Fuller unit root test confirmed stationarity. Therefore **YD~I(1)**

Dummy Variable (Dum)

A dummy variable was incorporated to account for the structural break caused by the political change in 1994 which distorted the available time series.

APPENDIX B

Correlogram of LNTAX

Date: 03/26/08 Time: 09:17
Sample: 1960 2006
Included observations: 47

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.786	0.786	30.891	0.000
. |**** |	**| . |	2	0.510	-0.279	44.215	0.000
. |*** |	. |** |	3	0.392	0.280	52.273	0.000
. |*** |	. | . |	4	0.365	0.018	59.396	0.000
. |*** |	. |*. |	5	0.354	0.092	66.267	0.000
. |** |	. | . |	6	0.327	0.009	72.282	0.000
. |** |	.*| . |	7	0.236	-0.139	75.477	0.000
. |*. |	.*| . |	8	0.082	-0.170	75.874	0.000
. | . |	. |*. |	9	0.018	0.131	75.893	0.000
. | . |	.*| . |	10	0.012	-0.119	75.902	0.000
. | . |	.*| . |	11	-0.025	-0.060	75.943	0.000
. | . |	. |*. |	12	-0.048	0.085	76.093	0.000
.*| . |	. | . |	13	-0.058	-0.049	76.321	0.000
.*| . |	.*| . |	14	-0.138	-0.177	77.642	0.000
**| . |	.*| . |	15	-0.264	-0.139	82.646	0.000
**| . |	. |*. |	16	-0.289	0.074	88.868	0.000
.*| . |	. |** |	17	-0.173	0.241	91.171	0.000
.*| . |	***| . |	18	-0.151	-0.335	92.973	0.000
.*| . |	. |*** |	19	-0.119	0.422	94.147	0.000
.*| . |	**| . |	20	-0.091	-0.259	94.850	0.000

Autocorrelations do not seem to converge very quickly, therefore the series appears to be non-stationarity.

Correlogram of LNRGDP

Date: 03/26/08 Time: 11:14
Sample: 1960 2006
Included observations: 47

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*******|	. |*******|	1	0.860	0.860	37.051	0.000
. |****** |	. | . |	2	0.739	-0.002	65.036	0.000
. |***** |	. | . |	3	0.632	-0.016	85.912	0.000
. |**** |	. | . |	4	0.542	0.010	101.64	0.000
. |**** |	. | . |	5	0.462	-0.011	113.35	0.000
. |*** |	. | . |	6	0.388	-0.025	121.79	0.000

. |** |	. | . |	7	0.321	-0.014	127.72	0.000
. |** |	. | . |	8	0.262	-0.013	131.78	0.000
. |** |	. | . |	9	0.204	-0.036	134.31	0.000
. |*. |	. | . |	10	0.155	-0.008	135.81	0.000
. |*. |	. | . |	11	0.109	-0.025	136.57	0.000
. | . |	. | . |	12	0.064	-0.034	136.84	0.000
. | . |	. | . |	13	0.025	-0.018	136.88	0.000
. | . |	. | . |	14	-0.003	0.008	136.88	0.000
. | . |	. | . |	15	-0.019	0.019	136.91	0.000
. | . |	. | . |	16	-0.036	-0.022	137.00	0.000
. | . |	. | . |	17	-0.051	-0.013	137.20	0.000
.*| . |	. | . |	18	-0.060	0.004	137.49	0.000
.*| . |	. | . |	19	-0.066	-0.001	137.84	0.000
.*| . |	. | . |	20	-0.066	0.007	138.22	0.000

Autocorrelations do not seem to converge very quickly; therefore the series appears to be non-stationarity.

Correlogram of LNYD

Date: 03/26/08 Time: 11:15
52405
Included observations: 47

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.784	0.784	30.744	0.000
. |**** |	**| . |	2	0.504	-0.285	43.750	0.000
. |*** |	. |** |	3	0.386	0.287	51.554	0.000
. |*** |	. | . |	4	0.362	0.018	58.572	0.000
. |*** |	. |*. |	5	0.353	0.091	65.414	0.000
. |** |	. | . |	6	0.324	0.002	71.310	0.000
. |** |	.*| . |	7	0.230	-0.135	74.366	0.000
. |*. |	.*| . |	8	0.078	-0.168	74.722	0.000
. | . |	. |*. |	9	0.015	0.134	74.736	0.000
. | . |	.*| . |	10	0.013	-0.120	74.747	0.000
. | . |	.*| . |	11	-0.024	-0.062	74.784	0.000
. | . |	. |*. |	12	-0.048	0.088	74.937	0.000
.*| . |	. | . |	13	-0.058	-0.047	75.167	0.000
.*| . |	.*| . |	14	-0.136	-0.181	76.466	0.000
**| . |	.*| . |	15	-0.263	-0.138	81.443	0.000
**| . |	. |*. |	16	-0.291	0.070	87.715	0.000
.*| . |	. |** |	17	-0.172	0.247	89.988	0.000
.*| . |	***| . |	18	-0.149	-0.350	91.755	0.000
.*| . |	. |*** |	19	-0.118	0.455	92.905	0.000
.*| . |	**| . |	20	-0.090	-0.317	93.589	0.000

Autocorrelations do not seem to converge very quickly; therefore the series appears to be non-stationarity.

Correlogram of the DLNTAX

Date: 03/26/08 Time: 11:12
Sample: 1960 2006
Included observations: 46

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.199	0.199	1.9449	0.163
***| . |	****| . |	2	-0.438	-0.498	11.582	0.003
**| . |	. | . |	3	-0.266	-0.051	15.227	0.002
. | . |	.*| . |	4	0.008	-0.167	15.230	0.004
. |*. |	. |*. |	5	0.174	0.075	16.861	0.005
. |** |	. |*. |	6	0.260	0.186	20.601	0.002
. |*. |	. |*. |	7	0.141	0.173	21.734	0.003
**| . |	**| . |	8	-0.307	-0.230	27.210	0.001
**| . |	. |*. |	9	-0.213	0.145	29.919	0.000
. |** |	. |*. |	10	0.209	0.069	32.601	0.000
. |*. |	.*| . |	11	0.152	-0.078	34.066	0.000
. | . |	. | . |	12	-0.045	-0.010	34.199	0.001
. | . |	. |*. |	13	0.031	0.146	34.262	0.001
. | . |	. | . |	14	0.027	0.005	34.311	0.002
.*| . |	. | . |	15	-0.128	-0.018	35.476	0.002
. | . |	.*| . |	16	-0.049	-0.060	35.655	0.003
. | . |	.*| . |	17	0.013	-0.171	35.667	0.005
. | . |	. | . |	18	-0.057	-0.051	35.923	0.007
. | . |	. | . |	19	0.017	-0.005	35.945	0.011
. | . |	.*| . |	20	0.037	-0.179	36.060	0.015

Autocorrelations seem to converge, therefore the series appears to be stationarity.

Correlogram of the DLNRGDP

Date: 03/26/08 Time: 11:17
Sample: 1960 2006
Included observations: 46

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.303	0.303	4.4993	0.034
.*| . |	.*| . |	2	-0.073	-0.182	4.7680	0.092
.*| . |	.*| . |	3	-0.136	-0.062	5.7181	0.126
. |*. |	. |** |	4	0.169	0.255	7.2110	0.125
. |*. |	. | . |	5	0.152	-0.017	8.4512	0.133

. |** |	. |** |	6	0.263	0.283	12.270	0.056
. |*. |	. |*. |	7	0.193	0.118	14.378	0.045
. | . |	. | . |	8	0.039	-0.055	14.465	0.070
. |*. |	. |** |	9	0.069	0.207	14.746	0.098
. |*. |	. | . |	10	0.138	0.002	15.913	0.102
. | . |	.*| . |	11	0.033	-0.123	15.982	0.142
**| . |	***| . |	12	-0.274	-0.343	20.853	0.053
.*| . |	.*| . |	13	-0.162	-0.142	22.602	0.047
. | . |	**| . |	14	-0.050	-0.217	22.778	0.064
. | . |	.*| . |	15	0.029	-0.179	22.837	0.088
. | . |	. | . |	16	-0.026	-0.044	22.887	0.117
. | . |	. | . |	17	0.009	0.049	22.893	0.153
.*| . |	. |*. |	18	-0.110	0.127	23.853	0.160
.*| . |	. |** |	19	-0.132	0.217	25.276	0.152
. | . |	. |*** |	20	-0.025	0.351	25.328	0.189

Correlogram of DLNYD

Date: 03/26/08 Time: 11:18
Sample: 1960 2006
Included observations: 46

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.204	0.204	2.0461	0.153
****| . |	****| . |	2	-0.466	-0.529	12.922	0.002
**| . |	. | . |	3	-0.289	-0.051	17.201	0.001
. | . |	**| . |	4	0.015	-0.190	17.213	0.002
. |*. |	. |*. |	5	0.188	0.071	19.109	0.002
. |** |	. |*. |	6	0.229	0.129	21.996	0.001
. |*. |	. |*. |	7	0.109	0.164	22.674	0.002
**| . |	**| . |	8	-0.294	-0.245	27.706	0.001
**| . |	. |*. |	9	-0.203	0.158	30.168	0.000
. |** |	. | . |	10	0.213	0.050	32.950	0.000
. |*. |	.*| . |	11	0.149	-0.076	34.353	0.000
.*| . |	. | . |	12	-0.067	-0.012	34.641	0.001
. | . |	. |*. |	13	0.019	0.171	34.665	0.001
. | . |	. | . |	14	0.043	-0.020	34.794	0.002
.*| . |	. | . |	15	-0.106	0.004	35.594	0.002
. | . |	. | . |	16	-0.045	-0.026	35.741	0.003
. | . |	.*| . |	17	0.010	-0.162	35.749	0.005
. | . |	. | . |	18	-0.048	-0.022	35.933	0.007
. | . |	. | . |	19	0.012	-0.008	35.945	0.011
. | . |	.*| . |	20	0.031	-0.187	36.025	0.015

APPENDIX C

Augmented Dickey Fuller unit root test on variables

H_0 : ρ= 0 (non-stationarity)
H_1 : ρ< 0 (stationarity)

Summary of Results

	Model	*Lags*	$\tau_\tau, \tau_\mu, \tau$	ϕ_3, ϕ_1	*Conclusion*
LNTAX	Trend & Intercept	2	--2.4099	6.8034***	Non-stationarity
	Intercept	2	-2.9002*	9.1946***	
	None	2	0.8672		
LNRGDP	Trend & Intercept	1	-2.3546	3.9285	Non-stationarity
	Intercept	0	-1.5394	2.3698	
	None	0	7.9213		
LNYD	Trend & Intercept	2	-2.2742	7.1207**	Non-stationarity
	Intercept	2	-2.6909*	9.6337***	
	None	2	-0.8495		
ΔLNTAX	Trend & Intercept	2	-7.3543***	18.376***	Stationarity
	Intercept	2	-7.0835***	25.559***	
	None	2	-7.0309***		
ΔLNRGDP	Trend & Intercept	0	-4.7335***	11.212***	Stationarity
	Intercept	0	-4.6622***	21.736***	
	None	0	-2.5173***		
ΔLNYD	Trend & Intercept	2	-7.5379***	19.152***	Stationarity
	Intercept	2	-7.3338***	27.183***	
	None	2	-7.3126***		

*(**)[***] Statistically significant at a 10(5)[1] % level

The results of the formal unit root tests ADF, clearly show that TAX, RGDP and YD test stationarity (null hypothesis is not rejected) after first differencing. Furthermore, from graphical representations and correlograms of the data, the assertion that these series are integrated of order one I(1) is credible.

APPENDIX D

Use the MacKinnon response surface calculation to determine the critical value for cointegration test.

$C(p) = \phi\infty + \phi 1 * T^{-1} + \phi 2 * T^{-2}$

10%: C(10) = -3.4518+(-6.241)(46^-1) + (-2.79)(46^-2)
= --3.5888
5%: C(5) = -3.7429+(-8.352)(46^-1) + (-13.41)(46^-2)
= -3.9308
1%: C(1) = -4.2981+(-13.79)(46^-1) + (-46.37)(46^-2)
= -4.6198

n=3