The Effect of Economic Policies on the Tax Ratio in Trinidad and Tobago

An Empirical Approach

George Saridakis
University of Essex
gsarid@essex.ac.uk

&

Sandra Sookram
The University of The West Indies
ssookram@fss.uwi.tt

March 2005

Presented at the 25th Annual Review Seminar, Research Department
Central Bank of Barbados
July 5 – 8, 2004

Abstract

We focus mainly on economic factors that may affect revenue available in Trinidad and Tobago and present cointegration test statistics for a second order VAR(2) based on Johansen's maximum likelihood approach. Our results suggest a positive relationship between level of income and the tax ratio and also that external debt and inflation impede the collection of taxes. Additionally, we found that the degree of openness exerts insignificant impact on the tax ratio. Our study recommends potential areas that may be targeted in order to raise tax revenues and which may also raise the consciousness that tax reform is a very integral subject matter.

Key Words: Tax ratio, economic policy, cointegration, weak exogeneity, impulse response

JEL Classification: H, O

* **Corresponding author**: Sandra Sookram, Department of Economics, The University of The West Indies, St. Augustine, Trinidad and Tobago.
Acknowledgments: We would like to thank Siong Hook Law, Rebeca Munoz-Torres and Lise Tole for helpful comments on earlier version of the paper. We are very grateful to two discussants and seminar participants at the Central Bank of Barbados for their constructive and insightful comments.

1. Introduction

The adoption of effective and efficient tax policy in developing counties is a formidable challenge and has been the subject of theoretical and empirical study worldwide (see Burgess and Stern, 1993). Tax shares in developing countries tend to be much lower than in developed countries, which makes this research a very important and timely policy issue. Studies increasingly highlight the importance of tax revenues as an instrument for economic growth and development. The amount of potential tax uncollected greatly hinders the ability of government to make productive investments. In light of this consideration most of the earlier empirical research have used the tax ratio model and focused especially on the cross-country relationship between the tax revenue-GDP ratio and economic-policy-related variables (e.g. Ghura, 1998; Stotsky and WoldeMariam, 1997; Tanzi, 1992; Tait *et al.*, 1979; Chelliah, 1971; Lotz and Morss, 1967). On the basis of existing empirical literature, time-series modelling has undoubtedly received less attention as an alternative to the estimation of the tax ratio model. Modern time-series econometric techniques allow the estimation of the tax ratio model by efficiently addressing possible mis-specification problems (see Bird, 1976; Bahl, 1971; Pryor, 1967) and at the same time dealing satisfactorily with the concept of causality and exogeneity. Fundamentally, tax revenues would appear to depend on both the revenues bases available to governments, and on government's capacity and efficiency to collect these revenues. We focus mainly on the economic factors that may affect available revenue.

The objective of this paper is to examine empirically the effect of economic factors on the tax ratio in Trinidad and Tobago data over the period 1960-2000. However, the analysis is limited to public finance (or political economic) variables that may proxy government capacity to maximise its taxable capacities. The analysis begins with an unrestricted fifth-equation system of tax ratio, income per capita, the inflation rate, trade ratio (or index of openness) and external debt ratio. Our primary concern is to extract long-run relationships between the economic policies related variables and tax revenue-GDP ratio and also the information associated with the short-run adjustment behaviour of economic variables. With respect to the econometric modelling adopted in this study, our analysis is based on Johansen's (1988, 1995) cointegration approach, which is used as an alternative to estimating the tax ratio model. We came to the following conclusions. First, we find a positive impact of per capita income on tax revenue. Second, inflation and external debt was found to impede the collection of taxes. Finally, we find that international trade is not a significant source of tax revenue in Trinidad and Tobago. The latter was subject to tax exemptions and other initiatives, which may explain its insignificant coefficient.

The rest of the paper is organized as follows: Section 2 reviews the existing literature on the fundamentals of the theory of tax revenue and tax effort. Section 3 presents the statistical model and data. Section 4 presents the results and the last section concludes the paper.

2. Background

2.1 Tax Revenue in Trinidad and Tobago

In an early cross-country empirical study by Lotz and Morss (1967), Trinidad and Tobago was categorised as a low tax effort country with a computed tax ratio of 16.7%. In their study nine out of eleven Central American and Caribbean countries were classed as low tax effort. Similarly, Chelliah (1971) observed that Central American and the Caribbean countries seem to have a history of low tax ratios. In the latest study by Tait *et al.* (1979) the estimates by Lotz and Morss (1967) were updated and a tax ratio of 21.9% was calculated for Trinidad and Tobago using 1972-76 data, which represented an increase of 31% from the previous period. In Table 1, which summarise the composition of government revenue in Trinidad and Tobago during the last six years, it is shown that taxes are derived from income (companies and individuals), property, goods and services (VAT, excise and motor vehicle taxes) and international trade. During the period 1995-2000, on average, income taxes accounted for 33.2% of recurrent revenue, international trade taxes for 6.3% and property taxes for 0.6%. Chelliah (1971) noted that direct taxes accounted for only approximately 30% of revenue in most developing countries and this applies to Trinidad and Tobago until today.

Table 1.
Composition of Central Government Revenue: 1995-2000

Recurrent Revenue	1995	1996	1997	1998	1999	2000
Oil Revenue	30.0	32.1	22.7	17.7	20.8	34.4
Non-Oil Revenue	70.0	67.9	77.3	82.3	79.2	65.6
Income Taxes	31.8	31.8	34.3	35.2	35.9	30.1
Property Taxes	0.7	0.6	0.6	0.6	0.6	0.5
Taxes on Goods and Services	23.4	22.0	26.5	31.9	26.5	22.3
International Trade Taxes	5.8	5.2	6.2	7.2	7.3	5.9
Non-Tax Revenue	8.3	8.2	9.6	7.3	9.0	6.8
Total Recurrent Revenue	100.0	100.0	100.0	100.0	100.0	100.0

Source: Central Bank of Trinidad and Tobago Annual Economic Survey, 1998 and 2001
Note: Figures may not add to 100.00 due to rounding.

2.2 What Determines Tax Revenue?

One of the most important factors to affect a country's tax revenue ratio is the level of economic development (see Lotz and Morss, 1967). Economists in estimating a country's developmental level have typically used per capita income and therefore a positive relationship between them is expected. Martin and Lewis (1956) was one of the first studies to observe that there was a certain relationship between per capita Gross National Product (GNP) and tax and also found that countries with a higher per capita GNP have higher shares of revenues and expenditures. Similarly, Williamson (1961), using data for 33 developed and developing countries found a significant positive relationship between per capita income and the tax revenue ratio. However, Hinrichs (1966) in a study of 40 developing and 20 developed countries found that while the relationship between the tax ratio and per capita income was significant for the whole sample, no relationship could be found between these two variables among the group of developing and developed countries when taken separately.

In studies by Hinrichs (1966) and Thorn (1967) the imports/GDP ratio as proxy of openness was found to be a significant determinant of tax revenue for developing countries. Lotz and Morss (1967) pointed out that there are certain features of international trade that make it more amenable to taxation than domestic activities, for instance, there are specific entry and exit points for these goods making it easier to administer taxes. Chelliah *et al.* (1975) used various combinations of explanatory variables and found that the best fit was obtained when they used the agricultural share, the mining share and the export ratio in GDP. Tait *et al.* (1979) found that openness, as measured by the export/GNP ratio, rather than an import/GNP ratio, the level of development and the sectoral composition of income produced were important variables affecting the tax ratios in developing countries. They found a positive relationship between the share of exports in income and the tax ratio. Leuthold (1997) estimated a model using panel data for 8 African countries during the time period 1973-1981. While the model had a weak performance generally, she found that only the trade share in GDP had the expected sign and was significantly different from zero. Stotsky and WoldeMariam (1997) used imports as a share of GDP and exports as a share of GDP to examine the effect of 'openness' on their study on sub-Saharan African Countries. They found that while the import share had a strong direct relationship with the tax revenue share, the share of export, while also directly related to the tax share, had a weaker relationship.

The inflation rate was incorporated to test for the likely negative impact of inflation on the tax ratio (see Weiss, 1969). A high inflation rate implies deteriorating economic circumstances and an increase in the real tax burden. Additionally, this may serve as a possible motive for holding an unofficial job, which can be concealed, from the authorities and therefore not subject to taxes. Further, if earnings in the official economy are not indexed or if the tax system is not indexed fully, as the cost of living falls, earnings in the underground economy appear relatively more attractive in comparison to real after-tax earnings in the official sector. Accordingly, due to collection lags and tax structure, high rates of inflation would translate to low rates of tax revenue. Ghura (1998) used the inflation rate to proxy the effect of macroeconomic policies, specifically expansionary monetary and fiscal policies. He mentioned that inflation influences tax revenue in three following ways. First, the Tanzi-Olivera[1] effect, second, excise duties that are not indexed to the inflation rate (Tanzi, 1989) and finally the reduction of the tax base due to the portfolio adjustment actions taken by economic agents to protect the real value of their wealth from high inflation rates. Ghura (1998) found that among the economic policy-related variables, inflation had the largest impact on the tax revenue ratio.[2]

[1] If there is an inflationary situation, since actual tax payments lag the transactions to be taxed then tax commitments are lower in real terms at the time of tax payments (Tanzi, 1977)
[2] These results are supported by the theoretical view provided by Tanzi (1989) and empirical evidence as found by Farhadian-Lirie and katz (1989) and Nashashibi and Bazzoni (1994).

However, Shin (1969) used the inflation rate in addition to per capita income, rate of growth of population, degree of industrialization measured by the agriculture/income ratio, and openness as measured by the foreign trade ratio. He expected and found a significant positive relationship between the inflation rate and the tax ratio and attributed that to his sample countries having progressive tax systems. Bahl (1971, pg. 578) suggested that Shin's reason for including the inflation variable was unconvincing, but noted however, that "inclusion of the price variable may suggest a simultaneous equation bias, since a low tax ratio may mean that public expenditures were financed relatively heavily by borrowing from the banking system". UNCTAD (1970) in their study pooled data for 36 countries and included inflation and the agriculture share. While they found significant results, the inflation variable was eventually dropped because of a lack of a priori reason to include the inflation variable.

Tanzi (1989) suggested that a high debt burden can create macroeconomic imbalances that may tend to reduce the tax level. Servicing of the foreign debt requires a trade account surplus, which in turn may require a reduction in imports and this would affect revenue given the high dependence of the tax system on the external sector. Ghura (1998) used the external debt ratio as one of the proxies of the external environment and found a negative relationship. He concluded that increases in external debt could also lower tax revenue in that it may suggest the substitution of external financing for domestic tax revenue mobilization. In a later study, Tanzi (1992) noted that even though a high debt service would have an immediate negative impact on tax revenue, at a subsequent time there might be the need to raise additional revenues to generate the primary surplus required to service the debt. In this study Tanzi found a positive relationship between the external debt ratio and tax revenue.

2.3 The Tax Revenue Model

A theoretical model of tax behaviour in Trinidad and Tobago can be developed using the normative approach to utility theory. To model this behaviour it can be assumed that the actions of politicians or government decision-makers would reflect their fiscal choices. It is further assumed that, subject to a budget constraint, they would maximise their utility using the different avenues of finance they have at their disposal both in the private and public sector. According to Heller (1975) and Leuthold (1991), the utility function of the public decision-maker is as follows:

$$U = U(Y - T, G, D_B) \tag{1}$$

U_{Y-T} and $U_G > 0$, and $U_{D_B} < 0$.

where $Y - T$ is equal to disposable income in the private sector (GDP*(Y)* minus Tax Revenue*(T)*), G is equal to total government expenditure (government investment expenditure plus government consumption expenditure) and D_B is domestic borrowing. All the variables are in real per capita terms. The decision-maker seeks to maximise the utility function with a balanced budget constraint given by

$$T + D_B = G \tag{2}$$

In Leuthold's (1991) tax model, it is assumed that the actual tax share in income, T/Y is a function of the desired tax share (T/Y)* and of the availability of the certain tax bases as well as of the status of macroeconomic policies. Therefore we can write the tax ratio function as follows:

$$\frac{T}{Y} = f\left[\left(\frac{T}{Y}\right)^*, i, d, r\right] \tag{3}$$

where

i = rate of inflation

d = debt service (external debt to GDP)

r = export plus imports to GDP.

The desired tax share can be determined by maximising the utility function *eq. (1)* subject to the balanced budget constraint *eq. (2)*. The utility function as suggested by Leuthold (1991) can take the following structure: [3]

$$U = a_1 \ln(Y - T - Y_S) - a_2 \ln D_B + a_3 \ln(G - G_S) \tag{4}$$

a_1, a_2 and $a_3 > 0$

where subsistence income (Y_S) and (G_S) subsistence public goods and services are assumed to be a linear function of income as given below:

[3] Heller (1975) assumed a quadratic utility function.

$$G_S = g_0 + g_1 Y \tag{5a}$$

and

$$Y_S = y_0 + y_1 Y \tag{5b}$$

Maximization of U with respect to T, D_B and G and subject to the constraints of *eq. (2)* yields the following reduced form for the desired equation for the tax revenue-GDP ratio:

$$\left(\frac{T}{Y}\right)^* = 1 - \frac{Y_S}{Y} - \frac{a_1}{a_1 - a_2 + a_3}\left(1 - \frac{Y_S}{Y} - \frac{G_S}{Y}\right) \tag{6a}$$

or if we let $a = \dfrac{a_1}{a_1 - a_2 + a_3}$, $a > 0$ where then:[4]

$$\left(\frac{T}{Y}\right)^* = (1-a) + a\left(\frac{G_S}{Y}\right) - (1-a)\left(\frac{Y_S}{Y}\right) \tag{6b}$$

Substituting *eq. (5a)* and *(5b)* into *eq. (6b)* we have:

$$\left(\frac{T}{Y}\right)^* = (1-a) + ag_1 - (1-a)y_1 + [ag_0 - (1-a)y_0]\left(\frac{1}{Y}\right) \tag{7}$$

The desired tax share has an indeterminate relationship with per capita income since the coefficient of the inverse of per capita income depends on the relative magnitudes of g_0 and y_0. Combining (3) and (7) yields to the following tax ratio function:

$$\frac{T}{Y} = f(1/Y, i, d, r) \tag{8}$$

3.Empirical Methodology and Data

3.1 Statistical Framework

We estimate the following model:

$$\ln\left(\frac{T}{Y}\right) = b_0 + b_1 \ln\left(\frac{1}{Y}\right)_t + b_2 \ln i_t + b_3 \ln d_t + b_4 \ln r_t + \varepsilon_t \tag{9}$$

[4] a can be negative if a_2 is sufficiently large, however, this possibility is remote.

The econometric framework adopted in this study based on cointegration techniques suggested by Johansen (1988, 1995). By applying vector autoregressive (VAR) techniques to time-series of tax revenue we are able to approximate a dynamic structure in which initially all the variables are treated as endogenous. Assuming that the lag length of the VAR is equal to two and has two deterministic variables (intercept and time trend) we can write the *eq.(9)* in the following VAR(2) form:

$$x_t = \mu + \sum_{i=1}^{p} \Phi_i x_{t-i} + \Psi D_t + \varepsilon_t \quad \text{for} \quad p \geq 2 \tag{10}$$

where $x_t = \left(\dfrac{1}{Y}, i, d, r\right)'$, and D_t is a column vector of the policy variables (a pulse dummy variable, *s*, which takes the value 1 when *t*=1982 and 0 otherwise).[5] Equation (10) can be reformulated into a Vector Error Correction Model as follows:

$$\Delta x_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \Psi D_t + \varepsilon_t \tag{11}$$

where Δ is the first difference operator, χ_t is the set of *I(1)* variables Γ is the short-run *n* x *n* response matrix, Π is the long-run (*n* x *n*) multiplier matrix of the form $\Pi = a\beta'$, where α and β are *n* x *r* matrices of rank r, μ is nx1 vector, the deterministic component D_t contains dummies and e_t is a vector of independent errors with mean 0 and constant covariance matrix Σ.

3.2 Data

The data used in this study was obtained from the International Financial Statistics and the Central Bank of Trinidad and Tobago Annual Economic Review. The dependent variable, i.e. the tax share, excludes oil revenue but includes profits from non-financial enterprises (for example, National Lottery), interest income and administrative charges.[6] Figure 1 illustrates the time-series behaviour of the dependent variable. All the independent variables that are ratios have GDP as the common

[5] The year 1982 marked the start of a recession in Trinidad and Tobago.

[6] Lotz and Morss (1967) stated that these profits could be seen as an alternative to taxes. Also Chelliah (1971, p. 288) stated "…..since 'non-tax revenues' particularly profits of public enterprises, are partly substitutable for tax revenue, one should work with total revenue".

denominator and all amounts are measured in Trinidad and Tobago dollars. [7] Table 2 presents summary statistics.

Figure 1.

The Tax-ratio in Trinidad and Tobago, 1960-2000

Table 2.
Summary Statistics

Variables(s)	Maximum	Minimum	Mean	Standard Deviation
T/Y	0.234	0.075	0.150	0.047
1/Y	0.005	0.002	0.004	0.001
i	21.93	0.820	8.089	5.303
d	0.386	0.021	0.154	0.098
r	1.343	0.609	0.894	0.192

4. Estimation Results

4.1 Unit Root Tests

The initial objective is to achieve a stationary representation of the VAR shown in *eq*. (11). The Augmented Dickey-Fuller (ADF) test was carried out. The null hypothesis is that the times-series are non-stationary (i.e. the series have a unit root or are integrated of order one, *I(1)*). Table 3 presents the results of the ADF and Phillips-Perron (PP) tests without and with trend. From Table 3 it is clear that the null of a unit root on the levels of the variables cannot be rejected. However, the evidence on whether the (inverse) per capita income is *I(1)* or *I(2)* is ambiguous. Given that ln(*1/Y*) is *I(1)* when no augmentation and trend are used in the regression it is assumed that it is *I(1)*. The implications of all the variables being *I(1)* may lead to surprising conclusions. For instance, if inflation is *I(1)* this implies that prices are *I(2)*.[8] However, this paper does not go further into this issue and for technical reasons we assume that all the variables are *I(1)*.

Table 3.
Unit Root Tests

Variable(s)	Levels		First Diff.	
	Without trend	With trend	Without trend	With trend
	Augmented Dickey Fuller (ADF) Test			
ln(*T/Y*)	-1.5842	-2.6487	-4.7995**	-4.7528**
ln(*1/Y*)	-1.8181	-1.8428	-1.9826	-1.8393
ln*i*	-2.1752	-1.9188	-6.5750**	-6.7671**
ln*d*	-1.5125	-2.0281	-4.3328**	-4.2731**
ln*r*	-2.8025	-2.4460	-4.7312**	-4.9633**
	Phillips-Perron (PP) Test			
ln(*T/Y*)	-1.7247	-2.4915	-5.9087**	-5.9611**
ln(*1/Y*)	-1.3451	-1.2989	-2.8756	-2.7871
ln*i*	-2.5449	-2.3724	-8.2302**	-8.4021**
ln*d*	-1.4845	-2.0380	-5.9171**	-5.8427**
ln*r*	-2.3780	-2.1768	-6.7990**	-6.9317**

Note: The equations include one lag of the dependent variable. Critical values at the 5% level are as follows: without trend –2.9378 and with trend –3.5279. The ** indicates rejection at the 95% critical value.

4.2 Cointegration

Before applying Johansen's procedure it is necessary to determine the lag length of the VAR. To ensure that the errors are white noise and given that we have five variables and only 41 observations, it is assumed that the lag length of the VAR is 2.[9] Table 4 presents the diagnostic tests for serial correlation, autoregressive conditional heteroscedasticity, and normality in the residuals for each of the five equations of a VAR(2) model. The results suggest that there is no evidence of serial correlation or ARCH effects in any of the single equation estimations. However, there is some evidence of

[7] GDP includes income accruing to foreign factors of production and excludes income received from abroad by residents.

[8] The non stationarity of inflation has received an empirical support (see Charemza *et al.*, 2004).

[9] For VAR(1) we found that the equation of income suffers from serial correlation.

nonnormality in the residuals only for the equations of inflation and trade. Since the VAR residuals are indeed uncorrelated, we specify the VAR system on the basis of it.

Table 4.
Residual Diagnostic Test

Variable(s)	N(2)	LMSC(2)	ARCH(1)
ln(*T/Y*)	0.13 [0.93]	1.12 [0.34]	0.65 [0.43]
ln(*I/Y*)	3.48 [0.17]	0.58 [0.57]	0.14 [0.71]
ln*i*	9.59* [0.00]	1.68[0.21]	0.29 [0.59]
ln*d*	2.27 [0.32]	0.41 [0.67]	1.95 [0.17]
ln*r*	5.67**[0.06]	0.44 [0.64]	0.03 [0.87]

*Significant at the 1% level **Significant at the 10% level

We proceed to conduct Johansen's (1988, 1995) unified ML-framework to test for the existence of cointegration relations. For this purpose, we estimate a VAR(2) model with an intercept and a linear trend (restricted to the cointegration space). The results of the cointegration analysis based on both the trace and maximum eigenvalue of the stochastic matrix support the rejection of the null hypothesis *r=0* and indicates that there is one cointegrating relationship (*r=1*). Table 5 presents the results of the cointegration test based on a trace of the stochastic matrix.

Table 5.
A Cointegration Analysis of Tax Revenue

Null	Alternative	Trace Statistics	95% quantile	Eigenvalues
r=0	r>=1	98.7*	87.2	0.72
r<=1	r>=2	48.5	63	0.41
r<=2	r>=3	28.1	42.3	0.28
r<=3	r>=4	15.2	25.77	0.24
r<=4	r>=5	4.4	12.4	0.11

Note: Critical values for the trace statistic are taken from Osterwald-Lenum (1992).
*Significant at the 5% level.

The estimated cointegrating relation normalizing the coefficient of *ln(*T/Y*)* to 1 is given in Table 6. Generally, the coefficients of the economic variables carry the right signs and are statistically significant. The ratio of exports and imports to GDP, however, was found to carry a negative sign and was statistically insignificant. This may have occurred due to tax exemptions and other initiatives which were used to boost exports and encourage foreign investment. Therefore, we re-estimate the cointegrating relation, imposing the over-identifying restriction on its coefficient. The log-likelihood ratio statistics for testing the restriction that the coefficient of ln*r* is equal to zero, is given by $\chi^2(1) = 1.5$, which is not statistically significant and hence suggest that the restriction on the coefficient of ln*r* cannot be rejected. We test for further identifying restrictions and particularly whether or not ρ=0 which is rejected in a $\chi^2(2)$ distribution.

Table 6.

Normalized Cointegrating Vectors (Full system analysis)*

Estimates in the full system with r=1						
	ln*(T/Y)*	ln*(I/Y)*	ln*i*	ln*d*	ln*r*	ρ
β_e'	1	0.24	0.23	0.12	0.18	-0.03
		(0.11)	(0.05)	(0.08)	(0.14)	(0.004)
Estimates for the full system by imposing a restriction on the coefficient of ln*r*						
β_e'	1	0.24	0.21	0.12	0	-0.03
		(0.12)	(0.05)	(0.09)		(0.004)

*Standard errors are in brackets.

4.3 Granger Causality Tests

If a common trend among a set of variables that move together in the long-run equilibrium exist, the Granger causality tests should be constructed within a vector error-correction model (VECM) to avoid misspecification. The causality test is implemented by calculating the F-statistic based on the null hypothesis that the set of coefficients on the lagged values of independent variables are not statistically different from zero. If the null hypothesis is not rejected, then it can be concluded that the independent variable does not cause the dependent variable. Table 7 reports the F-statistic short-run causality test among the variables. Although, individually, the explanatory variables did not significantly Granger-cause the tax ratio in the short-run, the short-run disequilibrium in the long-run cointegrating relationship did Granger-cause the tax ratio. The empirical results indicate that there are uni-

directional causal effects running from tax ratio and income to external debt. In addition, the error correction coefficient for the external debt is highly statistically significant.

Table 7

Granger Causality Results based on Vector Error Correction (VECM) Model
(Uniform lag-length, $p = 2$)

	Independent Variables					
Dependent Variable	$\Delta\ln(T/Y)$	$\Delta\ln(1/Y)$	$\Delta\ln i$	$\Delta\ln d$	$\Delta\ln r$	$ECT_{[e1,t-1]}$
	F-statistics (Significance Levels)					t-statistics
$\Delta\ln(T/Y)$	-	2.185 (0.134)	0.507 (0.608)	0.044 (0.957)	0.641 (0.535)	-0.772 [-2.346]**
$\Delta\ln(1/Y)$	0.190 (0.828)	-	1.542 (0.234)	0.251 (0.780)	0.603 (0.555)	0.277 [1.181]
$\Delta\ln i$	0.466 (0.633)	0.112 (0.895)	-	0.264 (0.770)	1.898 (0.171)	-1.271 [-0.754]
$\Delta\ln d$	8.943* (0.001)	4.903** (0.016)	2.396 (0.112)	-	0.181 (0.835)	-1.462** [-2.341]
$\Delta\ln r$	2.041 (0.151)	0.525 (0.598)	1.718 (0.200)	0.023 (0.977)	-	0.3142 [0.886]

Note: The F-statistic tests the joint significance of the lagged value of the independent variables, and t-statistic *1% tests the significance of the error correction term (ECT). The * indicate the following levels of significance: *1%. and **5%

4.3 Estimates of the Partial Model

For comparison, the cointegrating rank is determined by an analysis of the partial system of ln(*T/Y*) and ln*d* is conditional on ln(*1/Y*), ln*i* and ln*r*. Under the null of no cointegration, we have a system with $p - r = 5$ of which two ($p_1 - r = 2$) is the partial system. From Harbo *et al.* (1998) with $p_2 = 3$ and $p_1 - r = 2$ the 95% quantile is 39.9, where the likelihood ratio test for *r*=0 based on the partial model gives the value of 54.1 (see Table 8). Therefore, the hypothesis that *r=1* is rejected in favour of one cointegrating vector which is consistent with the analysis of the full model. Similarly as in the full model the trade ratio was found to carry a negative sign and be insignificant and therefore we re-estimate the cointegrating vector by imposing over-identifying restriction on the coefficient of ln*r* to be equal to zero (see Table 9). The log-likelihood ratio for testing that the restriction is given by $\chi^2(1) = 2.03$ which is not statistically significant and therefore the restriction that the coefficient of ln*r* is equal to zero cannot be rejected. The coefficients of the error correction term for equations of tax revenue and external debt have the right signs and are statistically significant. In Figure 2 we plot the cumulative sum of the recursive residuals (see Brown *et al*. 1975) together with the 5% critical lines, which suggests constancy for the conditional model.

Table 8.
A Cointegration Analysis of a Partial Model
of Tax Revenue

Null	Alternative	Trace Statistics	95% quantile	Eigenvalues
r=0	r>=1	54.1*	39.9	0.68
r<=1	r>=2	9.3	20.5	0.22

Note: Critical values for the trace statistic are taken from Harbo *et al.* (1998).
*Significant at the 5% level.

Table 9.

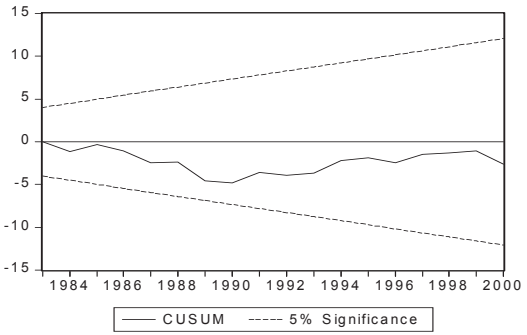
Normalized Cointegrating Vectors and the Error Correction Coefficients
(Partial System Analysis)*

Estimates in the partial system with r=1						
	$\ln(T/Y)$	$\ln(1/Y)$	$\ln i$	$\ln d$	$\ln r$	ρ
β_e'	1	0.21 (0.09)	0.20 (0.04)	0.10 (0.07)	0.18 (0.11)	-0.03 (0.003)
Estimates for the partial system by imposing a restriction on the coefficient of ln*r*						
β_e'	1	0.21 (0.11)	0.18 (0.04)	0.11 (0.09)	0	-0.03 (0.004)
α'	-0.79 (0.12)	0	0	-0.76 (0.37)	0	

*Standard errors are in brackets.

Figure 2.

Recursive statistics for a conditional system of tax revenue



5. Policy Recommendations and Conclusion

For developing countries, taxation is viewed as a powerful policy instrument which serves many objectives, primary of which is to mobilize resources to finance government expenditure. However, in these countries challenges come through the structure of the economy, which makes it difficult to impose and collect certain taxes, the limited capacity of the tax administration and also the political arrangement, which prevents developing countries from enforcing judicious tax policy. This study is consistent with previous studies which suggested that a higher per capita income reflects a higher level of development and is held to indicate a higher capacity to pay taxes as well as a greater ability to levy and collect them (see also Chelliah, 1971). Inflation emerged as a major factor in influencing the tax ratio and this demonstrates the necessity for economic policies that emphasize a prudent financial stance. Our findings also suggest that external debt is negatively related to the tax share ratio and also that the trade variable has no significant effect on the level of taxation.

References

Ansari, M.M. (1982). Determinants of Tax Ratio: A Cross-Country Analysis. *Economic and Political Weekly,* June, pp. 1035-1042.

Bahl, R.W. (1971). A Regression Approach to Tax Effort and Tax Ratio Analysis. *IMF Staff Papers,* International Monetary Fund, 18, pp. 570-612.

Bird, Richard M. (1976). Assessing Tax Performance in Developing Countries: A Critical Review of the Literature. *Fiannzarchiv*, 34(2), pp. 244-265.

Bird, Richard and Oliver Oldman (eds) (1990). Taxation in Developing Countries, Fourth Edition. Baltimore: The Johns Hopkins University Press, 1990.

Burgess, Robin and Nicholas Stern (1993). Taxation and Development. *Journal of Economic Literature*, 31(2), 762-826.

Charemza, W.W., Hristova, D. and P. Burridge (2004). Is inflation Stationary? *Applied Economics* (forthcoming)

Chelliah, R.J. (1971). Trends in Taxation in Developing Countries. *IMF Staff Papers*, 18, pp. 254-327.

Chelliah, R.J. H.J. Baas and M.T. Kelly (1975). Tax Ratios and Tax Effort in Developing Countries. *IMF Staff Papers*, International Monetary Fund, 2, pp. 187-205.

Fleming, M.H. J. Roman and G. Farrell (2000). The Shadow Economy. *Journal of International Affairs* 53(2) pp. 387-410.

Ghura, D. (1998). Tax Revenue in Sub-Saharan Africa: Effects of Economic Policies and Corruption. IMF Working Paper WP/98/135, International Monetary Fund.

Heller, Peter S. (1975). A Model of Public Fiscal Behavior in Developing Countries: Aid, Investment, and Taxation. *The American Economic Review*, 65, pp. 429-445.

Hinrichs, Harley H. (1966). A General Theory of Tax Structure change During Economic Development, Cambridge, MA: Harvard, pp. 7-31.

Hinrichs, Harley H. and Richard Bird (1963). Government Revenue Shares in Developed and Less Developed Countries. *Canadian Tax Journal*, September-October.

Johansen, S. (1988). Statistical Analysis of Cointegrating Vectors. *J. Econ. Dynam. Control* 12:231-254

Johansen, S. (1995). Likelihood Inference in Cointegrated Vector Autoregressive Models, Oxford University Press

Lachman D. and K. Bercuson (1992). Economic Policies for a New South Africa. *IMF Occasional Paper 91.* International Monetary Fund.

Leuthold, J.H. (1991). Tax Share in Developing Economies – A Panel Study. *Journal of Development Economics*, 33, pp. 173-185.

Lotz, J.R. and E.R. Morss (1967). Measuring 'Tax Effort' in Developing Countries. *IMF Staff Papers*, pp 478-497.

Lotz, J.R. and E.R. Morss (1970). A Theory of Tax Level Determinants for Developing Countries. *Economic Development and Cultural Change,* 18(3), 328-341.

Martin, A. and W.A. Lewis (1956). Patterns of Public Revenue and Expenditure. *The Manchester School of Economic and Social Studies*, pp. 203-244.

Musgrave, R.A. (1987). Tax Reform in Developing Countries. In: D. Newbery and N. Stern, eds., *The Theory of Taxation for Developing Countries*, New York: Oxford University Press, pp. 242-263.

Nagy Eltony, M. (2002). The Determinants of Tax Effort in Arab Countries. *Arab Planning Institute WPS 020,* Kuwait: Arab Planning Institute.

Newlyn, W.T. (1985). Measuring Tax Effort in Developing Countries. *Journal of Development Studies*, 21, pp. 391-44.

Oshima, H.T. (1957). Share of Government in Gross National Product for Various Countries. *American Economic Review*, pp. 381-390.

Osterwald-Lenum, M. (1992). A Note with Franctiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics: Four cases. *Oxford Bulletin of Economics and Statistics*, 54:461-472.

Pryor, F.L. (1967). Elements of a Positive Theory of Public Expenditures. *Finanzarchiv*, 26, pp. 425.

Shin, K. (1969). International Difference in Tax Ratio. *The Review of Economics and Statistics,* 51(2), pp. 213-220.

Stotsky, J.G. and A. WoldeMariam (1997). Tax Effort in Sub-Saharan Africa. *IMF Working Paper WP/97/107/.* International Monetary Fund.

Tait, Alan and Barry J. Eichengreen (1978). Two alternative Approaches to the International Comparison of Taxation. *IMF Departmental memorandum 78/73*, Washington: International Monetary Fund.

Tait, Alan., W. Gratz and Barry J. Eichengreen (1979). International Comparisons of Taxation for Selected Developing Countries, 1972-1976, *IMF Staff Papers*, International Monetary Fund, 26, pp. 123-56.

Tanzi, Vito (1992). Structural Factors and Tax Revenue in Developing Countries; A Decade of Evidence. In: I. Goldin and L.A. Winters eds., *Open Economies: Structural Adjustment and Agriculture*, Cambridge: Cambridge University Press, pp. 267-281.

Tanzi, Vito (1987). Quantitative Characteristics of the Tax Systems of Developing Countries. In: D. Newbery and N. Stern, eds., *The Theory of Taxation for Developing Countries*. New York: Oxford University Press, pp. 205-241.

Tanzi, Vito (1981). A Statistical Evaluation of Taxation in Sub-Sharan Africa. *In*: *Taxation in Sub-Saharan Africa*, Washington: International Monetary Fund, pp. 45-50.

Tanzi, Vito and Zee Howell, H. (2000). Tax Policy for Emerging Markets: Developing Countries. *National Tax Journal*, 53(2), pp. 299-322.

Teera, J.M. (2003). Determinants of Tax Revenue Share in Uganda. *Centre for Public Economics Working Paper 09b-03*, University of Bath.

Thorn, R.S. (1967). The Evolution of Public Finances during Economic Development. *The Manchester School of Economics and Social Studies*, 35, 19-53.

United Nations Conference on Trade and Development (1970). Objectives for the Mobilization of Domestic resources-Mobilization of Resources for Development (mimeo), TD/B/C, 3/75, Add. I.

Weiss, S.J. (1969). Factors Affecting the Government Revenue Share in Less Developed Countries. *Social and Economic Studies*, 18, 348-364.

Williamson, J.G. (1961). Public Expenditure and Revenue: An International Comparison. *The Manchester School of Economic and Social Studies*, pp. 43-56.