



**TAX BUOYANCIES IN EASTERN CARIBBEAN
CENTRAL BANK MEMBER COUNTRIES**

by

Wayne Mitchell
Economist
Financial Enterprise and Development Unit

&

Lennox Andrews
Research & Information Department
Eastern Caribbean Central Bank

Presented at the Annual Review Seminar, Research Department,
Central Bank of Barbados
July 27 - 30, 1999

TAX BUOYANCIES IN ECCB MEMBER COUNTRIES

BY

WAYNE MITHCELL AND LENNOX ANDREWS¹

1. The authors are economists in the Financial Enterprise and Development Unit and Research and Information Department respectively. The views expressed are those of the authors and may not reflect those of the ECCB, its Board of Directors, or Monetary Council. All errors and omissions are those of the authors.

TAX BOUYANCIES IN THE ECCB MEMBER COUNTRIES

Introduction

The fiscal systems of the member territories of the ECCB¹ have come under increasing scrutiny recently. This is partly due to the persistent fiscal deficits experienced by some of the countries namely Antigua, Grenada, Montserrat and Dominica. Additionally, declining access to investment capital and concessionary finance in favor of the emerging markets and former Soviet economies that are in transition, requires that the member territories make a greater effort at fiscal solvency.

There have been numerous partial tax adjustments and reforms implemented by the member countries over the last 20 years. As can be expected the reasons given for these reforms included economic as well as political considerations. However economic considerations normally dominate debates on the issue. In justifying the basis for the reforms governments have at one time or another indicated some or all of the following four objectives; to improve revenue yields; to encourage economic growth; to make the tax system more equitable; and to provide economic stabilization (with regard to the price level and balance of payments). Sometimes in the pursuit of these objectives governments seem oblivious to the fact that significant trade-offs occur between a number of those objectives, for e.g. between growth and revenue yields particularly where a large number of concessions are granted in pursuit of the former. Trade-offs also occur between growth and equity, and between stabilization and equity. Governments often claim that their policies are designed to achieve most or all of the above mentioned objectives. However their attempts at tax adjustments are geared mainly towards improving revenue yields in order to meet the growing demand for services, infrastructure and for stabilization.

The responsiveness of tax revenue to changes in income is considered to be critical to the design of a tax system. We use the term *tax elasticity*² where there is an automatic response of tax

¹ The Eastern Caribbean Central Bank (ECCB) is the Monetary Authority for the eight member countries of the Organization of Eastern Caribbean States (OECS). The countries consist of Anguilla, Antigua & Barbuda, Dominica, Grenada, Montserrat, St. Kitts & Nevis, St. Lucia and St. Vincent & The Grenadines. Anguilla and Montserrat are still British colonies.

² Tax elasticity also defined as the ratio of the marginal tax rate to the average tax rate measures the automatic response of revenue to income changes and excludes the effects of discretionary changes.

revenue to changes in income excluding the effects of discretionary changes³ and the term *tax buoyancy* to refer to the total automatic response of tax revenue to changes in income. High elasticities or buoyancies of and above unity indicate that revenue increases or decreases at rates equal or greater than income. This is a desirable feature of tax system design since it indicates that the rate structure can easily be adjusted to alter the purchasing power of the private sector as required with a high degree of certainty. Mansfield (1991) states that a high tax elasticity allows growth in expenditure (*preferably that related to development*) to be financed by rising tax revenue without the need for politically difficult decisions to raise taxes. This is echoed by Ehdaie (1990) who notes that structural adjustment programmes of developing countries use fiscal deficit reductions as a policy tool for achieving real economic growth with price stability and balance of payments viability. Consequently, knowledge of the elasticities of the different taxes allows one to project the additional revenues that can be mobilised by the existing tax system as national income grows and to determine the need for additional revenue through discretionary tax measures.

This paper attempts to empirically examine the changes in tax buoyancies in the member countries of the ECCB over the 1980 through 1997 period and provide explanations for some of the changes that occurred. In section 2 of the paper we provide different methods for estimating tax elasticity and explain why similar difficulties other researchers have experienced in its estimation lead us to the estimation of tax buoyancies instead. A methodology is proposed in section 3 to distinguish between the different functional forms used for estimating tax buoyancies and to select the ones most appropriate for use in the ECCB member territories. The empirical results and explanations for the estimated tax buoyancies are provided in sections 4 and 5. General conclusions are provided in section 5.

Section 2: Approaches to Estimation

Tax elasticities are usually presented in aggregate models as a single number representing the elasticity estimated over a specified period. It can be visualised as the weighted average of the sum of the elasticities of separate taxes that respond differently to changes in income. Isolating the total tax elasticity in this manner identifies the sources of fast or slow growth and identifies the part of the revenue growth in the control of the authorities. This simple assessment ignores the fact that tax elasticity is also composed of an element that relates the elasticity of the tax base to income⁴. The tax base lies outside the control of the authorities and it is largely determined by the way in which the structure of the economy changes with economic growth. It is a known fact that economic growth has a number of influences on tax elasticities. For instance, growth in income causes 'bracket creep', i.e., pushes taxpayers into higher tax brackets or may change consumption patterns in favor of highly taxed luxury goods. This should lead to tax progressivity and higher tax elasticities. In lesser-developed countries economic growth is sometimes the

³ Where discretionary changes refer to minor adjustments to taxes, tax rates, tax bases, concessions and licenses that affect the generation of tax revenue.

⁴ Mansfield shows that the elasticity of any tax can be decomposed into two elements the product of the elasticity of the tax to its base and the elasticity of the tax base to income. Thus the extent to which elasticity can accurately be used for making projections will also depend on changes in the tax base.

result of faster growth in the modern sector which may cause a relative faster growth of the tax base relative to GDP. If that is the case then higher tax elasticity should be the result. Additionally, economic growth and income may change preferences for good tax administration as well as increase the resources available for improving tax collection. However, increases in the tax base and improvements in administration are thought to decline in importance as the economy extends beyond a threshold level of development.

Two problems are encountered when estimating tax elasticities. The first concerns the specification or functional form of the estimation equation and the second relates to the difficulties in isolating the effects of discretionary changes, such as, legal changes in tax rates or in the tax base, the introduction of new taxes and/or changes in administrative effort, from other tax revenue growth.

Tax elasticities are normally estimated through the use of a linear or log-linear regressions which assume that the income elasticity is constant over the period considered. However, this assumption is valid if the period over which the estimation is undertaken is short. Osoro and Leuthold (1994) in a study done on tax elasticities in Tanzania, argue that the use of constant elasticities is inappropriate over long periods because tax elasticities may change over time due to deliberate changes in tax structures and administration or from economic and income growth. Consequently, the use of a constant elasticity may lead to inaccurate forecasts and the application of inappropriate policies.

With regard to the second problem two general procedures have been used to isolate discretionary tax revenue changes from time series data prior to measuring tax elasticity. In the first of these procedures which we discuss there are two techniques, the Proportional Adjustment and the Constant Rate Structure techniques that have been developed to eliminate discretionary tax revenue changes from time series data. The Proportional Adjustment (PA) technique proceeds in two steps⁵. First the tax data is first adjusted by subtracting from the actual yield for each year the estimated amount attributed to the discretionary change in that year. That is

$$T_{i,t} = T_t - D_t \quad (1)$$

where

- T_t = the actual tax revenue collected in the t^{th} year.
- D_t = the budget estimate of the revenue impact of the discretionary tax measures implemented in the t^{th} year.
- $T_{i,t}$ = the actual revenue in the t^{th} year adjusted to the structure of that year.

The adjusted series $T_{i,t}$ is then further refined to the first year base by multiplying for the i^{th} year $T_{i,t}$ the previous year's ratio of the adjusted tax revenue according to the first year's structure $T_{i,1}$ over the actual tax yield $T_{i,1}$. This new series represents what the tax revenue would have been if the tax structure had remained as in year 1 with all the discretionary changes removed from the years following year 1. That is

⁵ see Ehdaie (1991) and Mansfield (1990) for explanations

$$T'_1 = T_{i,1}$$

$$T'_2 = \left[\frac{(T')_1}{T_1} \right] T_{2,2}$$

$$T'_t = \left[\frac{(T')_{t-1}}{T_{t-1}} \right] T_{t,t}$$

After making successive substitutions, the following formula is derived for T'_t which is in terms of $T'_1 = D'_1$

$$(T')_t = (T_t - D_t) \prod_{j=1}^{t-1} \left[\frac{T_j - D_j}{T_j} \right] \quad (2)$$

According to this technique changes in an individual tax system directly results in an exogenous change in its tax revenue, i.e., a shift in equation (1). This technique is based on the strong assumption that these changes do not affect its own and other individual tax bases endogenously through substitution and income effects. It also ignores the impact of changes in the degree of evasion or of administrative efficiency on tax revenue. Lastly, it assumes that the budget estimates of discretionary tax changes are available and reliable. The latter point is mentioned in light of the tendency of budget estimates in member territories to differ substantially from actual discretionary outturns.

The Constant Rate Structure (CRS) technique requires sufficiently disaggregated data on the growth and distribution of reported legal tax bases and their corresponding tax rates (for example, by income brackets or commodity rates). The actual tax revenue time series is then divided by indices of base and rate changes which would yield a constant rate-base time series net of discretionary changes. Thus

$$(T')_t = \sum_{i=0}^n (r_i) \cdot (x_i)_t \quad (3)$$

where

- $(r_i)_0$ = the base year statutory tax rate on the i^{th} income bracket or commodity.
- $(x_i)_t$ = the reported tax base in the i^{th} income bracket or commodity in the t^{th} year.
- n = number of income brackets or commodities

This technique incorporates only those discretionary changes resulting from statutory tax rates and ignores the effects of changes in administrative efficiency, in tax bases, in tax credit and tax concessions. Like the PA technique it ignores the substitution and income effects of discretionary changes of the tax system in the process of adjustment. The technique is suitable where data on the legal tax bases are available and where the rate structures are not complex. However these are features that are atypical of developing countries.

The PA and CRS techniques may result in measurement errors which in turn may cause a specification bias (the first problem indicated above) in the estimation of tax elasticity.

The other procedure for estimating tax elasticities utilises dummy variables as proxies for discretionary tax changes during the period under review. No attempt is made to cleanse the data of the tax changes instead dummy variables are imposed in the year in which discretionary changes of significance were effected. This method is questionable because a serious multicollinearity problem arises as a result of the introduction of more than one dummy variable into the tax function. The degree of multicollinearity increases as the time interval between successive discretionary tax changes falls. In such situations the reliability and precision of the estimated coefficients are reduced.

In this paper we have been mindful of the difficulties of obtaining data and the limitations posed by the PA and CRS techniques for eliminating discretionary tax changes from tax revenue time series data. These difficulties also occur in varying degrees in the member territories which would make an exercise estimating tax elasticities of all them extremely difficult. To those who welcome the challenge of doing in depth studies of tax elasticity on one or all the territories we hope we have provided sufficient information of the estimation methods and potential difficulties. Such work is beyond the scope of this paper. Instead we have included the discretionary tax changes and estimate tax buoyancy. Our measurement of tax buoyancies is based on a technique employed by Osoro and Leuthold (1994) that uses a Box-Cox transformation procedure.

Section 3: Methodology

The Box-Cox transformation method is appealing because it allows the data to determine the functional form most appropriate for the estimation process.⁶ That is there is no pre-specification of the structural or functional form of the relationship between the dependable and explanatory variables. There are various applications of this method involving the transformation of either the dependent variable, the independent variable or both with fixed or varying values of the transformation parameter (λ).

We employ a combined Box-Cox and Box-Tidwell model in which the dependent variable T_i (revenue from the i^{th} tax) and the independent variable Y (GDP), are both transformed using a different λ . The functional form determined by the data is that functional form that has been defined by the estimated values of λ .

The model takes the general form:

$$T_{it}^{(\lambda_{1i})} = \alpha_{0i} + \alpha_{1i} Y_t^{(\lambda_{2i})} + e_{it} \quad (4)$$

where :

e_{it} is a random disturbance term.

$$T_{it}^{(\lambda_{1i})} = (T_{it}^{(\lambda_{1i})} - 1) / \lambda_{1i} \quad \text{for } \lambda_{1i} \neq 0$$

⁶ Judge, Hill, Griffiths, et al, Introduction to the Theory and Practice of Econometrics, 2nd Edition, pg. 556.

$$\text{and} \quad = \ln T_{it} \quad \text{for } \lambda_{1i} = 0$$

$$Y_t^{(\lambda_{2i})} = (Y_t^{(\lambda_{2i})} - 1) / \lambda_{2i} \quad \text{for } \lambda_{2i} \neq 0$$

$$= \ln Y_t \quad \text{for } \lambda_{2i} = 0$$

The tax buoyancy then depends on the estimated values of the transformation parameters, λ_1 and λ_2 and on the value of the coefficient on the income variable, Y_t . Tax buoyancy is defined in the following equation:

$$\varepsilon_{TY} = \alpha_{1i} T_{it}^{\lambda_{1i}} Y_t^{\lambda_{2i}}$$

When $\lambda_1 = \lambda_2 = 0$, the model takes on the double log-linear form in OLS and the tax buoyancy is determined by β_1 , the coefficient on Y .

$$\ln T_{it} = \beta_{0i} + \beta_{1i} \ln Y_t + e_{it} \quad (5)$$

When $\lambda_1 = \lambda_2 \neq 1$, the model takes on the linear form in OLS in which case the tax buoyancy ratio which must be computed is also constant over time⁷.

$$T_{it} = \beta_{0i} + \beta_{1i} Y_t + e_{it} \quad (6)$$

Differing values of λ_i yield a model with a non-linear functional form, which is estimated by a maximum likelihood process. That is when λ_1 and λ_2 are $\neq 0$ or 1, then the buoyancy varies over time with T_{it} and/or Y_t . The variation in these two variables is responsible for the intertemporal variation in the buoyancy.

Section 4: Data and Results

Tax revenue and GDP data on the 8 member countries of the ECCB for the period 1980 through 1997 is obtained from the Statistical Digests published by the Research & Information Department of the East Caribbean Central Bank.

Our focus in the model is simply to evaluate the impact of the various discretionary tax changes on the revenue generation process of the ECCB member territories and to provide a trend or forecast of government tax revenue and its three major components, direct taxes, domestic taxes and international trade taxes.

The unrestricted form⁸ of the model, equation (1), was first estimated for the four data sets for each country. There was no convergence in the iterations for the estimation of the equation for

⁷ Buoyancy in this case is given by $\beta_{1i} (\bar{Y}_i \div \bar{T}_i)$

total tax revenue for Anguilla and Grenada. This could be a consequence of the small sample size and the high variance in the parameters for the two countries. All the coefficients were significant at the 1% level by the normal t-test and the adjusted R^2 for each were above 90%.

Table 1: Box-Cox Estimates for the Unrestricted Model

COUNTRY	Coefficient t 0	Coefficient _1	Lambda λ_1	Lambda λ_2	LLF
Anguilla@	-4.5354 (-34.92)	2.4121 (52.32)	-0.26	-0.26	-54.8771
Antigua	-27.975 (-40.51)	15.086 (47.32)	0.020	-0.4333	-59.6029
Dominica	-9.5831 (-34.44)	5.759 (47.67)	-0.09	-0.38921	-46.4547
Grenada	391.19 (3.634)	0.032203 (34.42)	1.82	1.9834	-55.8639
Montserrat@	-30.687 (-26.88)	66.288 (27.37)	-1.63	-1.63	-34.8158
St.Kitts	41.041 (9.81)	0.003176 (24.18)	1.18	1.8297	-54.85
St.Lucia	-17.119 (-48.36)	6.3019 (67.87)	0.1	-0.18467	-57.22567
St.Vincent	-30.897 (-32.48)	29.055 (34.97)	-0.33	-0.86762	-55.8325

@ represents the results from the restricted model in which both parameters are equal to an unrestricted parameter, λ .

Equation (1) was also estimated with the following restrictions on the transformation parameters, (a) $\lambda_1 = \lambda_2 = 0$ (the log model) (b) $\lambda_1 = \lambda_2 = 1$ (the linear model) and (c) $\lambda_1 = \lambda_2 = \lambda$ for total tax revenue for the other countries. Log-likelihood ratios (shown in table 2) were computed from the respective log-likelihood functions (LLF) to compare the three hypothesis against a χ^2 distribution. This test statistic is computed as

$$2[LLF_U - LLF_R]$$

where

U and R indicate unrestricted and restricted estimates respectively

The critical χ^2 statistic for the first two restrictions was 5.991 at the 5% level and 3.841 for the third restriction. The results indicate that the unrestricted model is appropriate for the estimation

^a All estimations were done using SHAZAM

of total tax buoyancy in the case of Antigua, Dominica, St.Kitts, St.Lucia and St.Vincent since their test statistic exceeded the critical χ^2 statistic. In the case of Montserrat a comparison of the unrestricted form of the model with the restricted form where both parameters are equal to an unrestricted parameter indicates the the latter model is superior. Anguilla and Grenada the log-likelihood function from the third restriction was used to compare and test the hypotheses that $\lambda_1 = \lambda_2 = 0$ or $\lambda_1 = \lambda_2 = 1$. The results indicate that both hypotheses can be rejected for Anguilla. However in the case of Grenada, the log-likelihood ratio of 2.6188 indicates that we cannot reject the hypothesis that $\lambda_1 = \lambda_2 = 1$ and that the linear model is appropriate for estimating tax buoyancy. The results for Anguilla and Montserrat that are shown in table 1, represents the estimation of the model where both parameters are equal to the unrestricted parameter, -0.26 and -1.63, respectively. For Grenada the results of the linear regression of tax revenue on GDP are shown in table 3. The results show that the tax buoyancy for Grenada over the 1980 - 1997 period is estimated as 0.9192.

Table 2: Box-Cox Estimates for the Restricted Models

COUNTRY	Restriction	LLF	LLR
Anguilla	$\lambda=1$	-62.3266	71.1516
	$\lambda=0$	-90.4529	14.899
Antigua	$\lambda=1$	-65.2676	7.2846
	$\lambda=0$	-63.2452	11.3294
	$\lambda=\lambda$	-63.2379	7.27
Dominica	$\lambda=1$	-49.5951	13.3892
	$\lambda=0$	-53.1493	6.2808
	$\lambda=\lambda$	-49.3336	5.7578
Grenada	$\lambda=1$	-61.1253	3.3392
	$\lambda=0$	-57.5335	10.5228
	$\lambda=\lambda$	-56.2241	0.7204
Montserrat	$\lambda=1$	-43.628	8.1118
	$\lambda=0$	-38.895	16.968
	$\lambda=\lambda$	-34.8158	1.9024
St.Kitts	$\lambda=1$	-64.4953	7.7784
	$\lambda=0$	-58.7392	19.2906
	$\lambda=\lambda$	-58.6230	7.546
St.Lucia	$\lambda=1$	-62.6567	11.7816
	$\lambda=0$	-63.1165	10.862
	$\lambda=\lambda$	-62.2133	9.9752
St.Vincent	$\lambda=1$	-60.666	8.3034
	$\lambda=0$	-59.9842	9.667
	$\lambda=\lambda$	-59.7094	7.7538

Table 3: OLS Estimates on Grenada

COUNTRY	Coefficient 0	Coefficient 1	Mean Tax	Mean GDP	Adjusted R ²
Grenada	9.3049 (2.357)	0.25066 (28.89)*	115.08	422	0.9812

* significant at the 1% level.

The slope and transformation parameters shown in table 1 are used to calculate the intertemporal tax buoyancies for each year of data for all countries (except Grenada) and are given in table 4 below.

For the eight countries tested there was no convergence of the unrestricted form of the model on equation (1) for direct taxes, domestic taxes and international trade taxes. This problem is thought to be associated with high parameter variance which causes overflows. Equation (1) was re-estimated with the three restrictions on the transformation parameters. The results indicate that the Box-Cox approach using equal power transformation on the variables are superior to both the linear and double log forms in each of the estimates run for Dominica and in the case of St. Lucia for direct and domestic taxes. Although the coefficients for the estimates run are significant at the 10% level the adjusted R² were much lower, ranging from 20% to 30%. For the remaining countries tax buoyancies for the three major components of tax revenue were appropriately estimated using either the linear or double log form as indicated from the hypothesis testing. These buoyancies are shown in tables 5 through 7. Tables showing the log likelihood functions, log likelihood ratios and results of the hypothesis tests for the three major taxes are given in the appendix.

The results validate the use of the Box-Cox as a robust albeit arduous approach to the estimation of total tax buoyancies in the member territories. They also verify that intuitively, linear and double log forms of estimation of buoyancies of the three tax components may have been appropriate depending on the countries and taxes to which they applied.

Section 5: Factors accounting for the changes in tax buoyancy

The estimated time varying tax buoyancies reflect to a large extent the effects of the different adjustments to the tax systems of the member territories over the last 18 years. There is similarity in the tax buoyancy trends for Antigua, Dominica, St. Lucia and St. Vincent & The Grenadines. For these countries buoyancy remained high shortly before and after their attainment of Independence in the late 1970s and early 1980s. After that period buoyancy showed a secular falling trend, with levels falling fastest in St. Vincent & The Grenadines than the others. For the other two independent countries Grenada and St. Kitts, buoyancy levels were different. In the case of St. Kitts and Nevis, buoyancy levels were low in the decade of the 1980s and rose continuously thereafter. On the other hand, for the two nonindependent states buoyancy levels remained consistently high throughout the period of analysis. High buoyancies of and above unity indicate that revenue increases at rates equal to or greater than income. Thus as national income increases, public expenditure demands can be financed through rising tax revenue.

A number of factors accounted for the similarity in buoyancy in the first group of islands. These islands attained independence from Britain during the period 1978-1981. During that period there were no major changes to the tax structures. The islands were unable to immediately break with the colonial administration and therefore maintained high level of direct taxes albeit on a narrow base. High compliance levels were also reflective of the tight administrative controls implemented by the colonial administrators. The emphasis on direct taxes was also reflective of the economic relationship existing between the colonial power and the colonies in which the latter were mere suppliers of raw materials to the metropole industries.

Nevertheless, with the attainment of independence, the new leaders soon sought to improve living conditions of their people by changing the structure of the economy. For this purpose many turned to fiscal policy and in particular taxation policy to influence private sector decision makers. New taxation measures were therefore designed and enacted with particular emphasis on tax (fiscal) incentives to boost economic activities in areas like tourism, agricultural diversification and light manufacturing. These fiscal incentives meant a reduction in government revenues in the medium term, and in part, explain the fall in buoyancy after independence.

Table 4: Tax Buoyancies over 1980 - 1997

YEAR	Anguilla	Antigua & Barbuda	Dominic a	Montserra t	St. Kitts & Nevis	St. Lucia	St. Vincent & The Grenadines
1980	NA	1.471	1.175	1.048	0.209	2.094	1.365
1981	NA	1.402	1.147	1.051	0.283	2.027	1.196
1982	NA	1.352	1.131	1.048	0.449	1.996	1.185
1983	NA	1.287	1.089	1.150	0.526	1.968	1.105
1984	1.319	1.224	1.059	1.058	0.598	1.931	1.058
1985	1.371	1.151	1.029	1.041	0.686	1.886	1.036
1986	1.420	1.079	0.993	1.190	0.710	1.822	0.953
1987	1.432	1.009	0.959	1.180	0.661	1.796	0.898
1988	1.452	0.940	0.923	1.091	0.809	1.753	0.825
1989	1.432	0.898	0.914	1.254	0.810	1.711	0.758
1990	1.428	0.882	0.886	1.284	0.983	1.681	0.716
1991	1.473	0.862	0.857	1.842	1.128	1.658	0.681
1992	1.458	0.851	0.841	1.256	1.199	1.626	0.628
1993	1.586	0.826	0.827	1.115	1.140	1.624	0.627
1994	1.591	0.796	0.803	1.151	1.265	1.610	0.636
1995	1.638	0.803	0.794	1.252	1.282	1.590	0.600
1996	1.616	0.774	0.784	1.274	1.320	1.585	0.595
1997	1.652	0.750	0.782	1.419	1.216	1.578	0.593

In many cases, efforts to boost economic activity, concentrated on shifting the emphasis of taxation from direct to indirect taxes⁹ in keeping with the thinking at the time that direct taxation was a deterrent to work. This was prompted in part by contemporary views on the positive impact trade liberalisation measures have on the productive sectors of the economy. While this may be true generally the buoyancies estimated indicate some mixed results over the period of review. It must be noted however that most of the territories experienced difficulties in implementing such new taxation measures. Therefore continuous changes were made to the taxes to facilitate administration, improve collection and also to encourage greater compliance. The result in the initial stages was lower tax revenue as reflected in the decreasing buoyancy. Countries therefore have to be mindful of the potential negative impact trade liberalisation measures can have on the buoyancy of their tax systems.

The low overall tax buoyancy in St. Kitts in the early 1980s could have been attributed to a fundamental change in the tax structure before the attainment of independence. In 1982, the government abolished personal income tax and no measure was immediately implemented to replace the loss in revenue. In addition, private sector activity was low, resulting in low GDP growth rates during that period. The higher buoyancy level in the second half of the 1980s resulted from a fundamental reform to the tax structure. In 1985 the government introduced a social security level on personal income to raise revenue intake. Further reforms were made to this levy in the late 1980s and early 1990s. In addition, economic activity was also boosted with the operations of the Four Seasons Hotel. These factors accounted for the higher buoyancy levels as of 1991.

Grenada achieved independence in 1974 and therefore revisions to the tax structure were made much earlier relative to the other islands. The low buoyancy in the first half of the 1980s, reflected the dominance of the state sector in the economy following the triumph of the 1979 Revolution. There were continuous reforms to the tax system as the changes in leadership dominated the island political scene since 1983. These factors would have accounted for the fluctuations in buoyancy during the period of analysis.

The results show that when income tax was eliminated especially in St. Kitts and Grenada, tax revenues fell drastically, especially in St. Kitts during the early 1980s. In contrast, countries like St. Lucia and St. Vincent that maintained direct taxes and in particular income taxes achieved higher levels of buoyancy during the period stated. The reason for this could be explained as follows. Taxes on income are a sure and anticipated source of revenue. They are also easy to administer, cost effective and also closely related to economic activity especially if it is of a progressive nature. Its elimination would immediately result in a loss of revenue unless it is replaced by an appropriate tax. Hence the reason that following continuous fall in buoyancy in the 1980s, the Government of St. Kitts introduced a Security Security Level, which represented a form of income tax.

Table 5 provides evidence of the impact of the shift in the tax system from direct to indirect taxes for Dominica and St. Lucia. In both these countries there are significant improvements in the

⁹ The different tax measures and the reasons for them, implemented by the different islands during the period stated are outlined in Appendix 1.

buoyancies of domestic taxes¹⁰ from 0.77 and 0.66 respectively, to 1.32 and 0.99 whilst that of direct taxes¹¹ has in the case of the former declined slightly or remained stable in the latter. St. Vincent and the Grenadines (tables 6 to 8) also exhibits higher buoyancies in its domestic and international trade taxes than its direct taxes. Unfortunately we do not have the benefit of a trend to determine the relative changes in buoyancies.

Table 5. Tax Buoyancies over 1980 - 1997

YEAR	Dominica a Direct Tax	Dominica Domestic Tax	Dominica a Trade Tax	St. Lucia Direct Tax	St. Lucia Domestic Tax
1980	N.A	N.A	N.A	N.A	N.A
1981	0.443	0.767	0.502	0.402	0.662
1982	0.458	0.903	0.541	0.473	0.671
1983	0.417	0.867	0.486	0.418	0.678
1984	0.421	0.905	0.542	0.409	0.714
1985	0.462	0.958	0.513	0.491	0.826
1986	0.474	1.020	0.518	0.389	0.836
1987	0.375	0.964	0.578	0.373	0.895
1988	0.337	1.170	0.538	0.396	0.887
1989	0.316	1.170	0.609	0.404	0.900
1990	0.341	1.370	0.533	0.388	0.861
1991	0.339	1.360	0.491	0.411	0.930
1992	0.397	1.350	0.466	0.408	0.902
1993	0.340	1.270	0.475	0.390	0.939
1994	0.296	1.260	0.448	0.407	0.938
1995	0.300	1.250	0.443	0.397	0.966
1996	0.397	1.270	0.450	0.390	0.920
1997	0.349	1.320	0.469	0.409	0.993

Unlike Dominica and St. Lucia the buoyancies of direct taxes in St. Kitts & Nevis, Antigua & Barbuda, Grenada and Montserrat are just below unity (about 0.90). However, buoyancy of St. Kitts & Nevis domestic and trade tax revenue is significantly lower at around 0.5 than its direct tax revenue. This may indicate that at least in 1997, the buoyancy of St. Kitts & Nevis tax system as shown in table 4 is really based on direct taxes. We however are tempered in our comments about these results because of the low statistical explanatory power of the model (less than 45%). Indirect tax revenue in Antigua & Barbuda and Montserrat were extremely buoyant in 1997. The estimates of the buoyancies of Anguilla and Grenada (with the exception of trade taxes) are not reliable given the low explanatory power of the model.

¹⁰ Mainly Consumption duties and Hotel turnover taxes.

¹¹ This is comprised of taxes on income, profit and property taxes.

Table 6. Buoyancies of Direct Taxes from OLS Estimates

COUNTRY	Buoyancy	Adjusted R ²
Antigua & Barbuda	0.742	86.4
Grenada	0.900	20.0
Montserrat	0.918	82.8
St. Kitts & Nevis	0.886	42.2
St. Vincent & The Grenadines	0.838	94.5

Table 7. Buoyancies of Domestic Taxes from OLS Estimates

COUNTRY	Buoyancy	Adjusted R ²
Anguilla	0.471	11.6
Antigua & Barbuda	1.15	96.3
Grenada	0.295	22.2
Montserrat	0.988	86.3
St. Kitts & Nevis	0.503	43.0
St. Vincent & The Grenadines	1.007	91.7

Table 8. Buoyancies of Trade Taxes from OLS Estimates

COUNTRY	Buoyancy	Adjusted R ²
Anguilla	0.444	15.4
Antigua & Barbuda	1.052	98.8
Grenada	1.332	94.3
Montserrat	1.785	80.6
St. Kitts & Nevis	0.503	43.1
St. Vincent & The Grenadines	0.831	94.9

In summary, the results point to mixed buoyancy levels in the tax systems of member territories of the ECCB area. These could be attributed to continuous adjustments to their respective tax systems. In most cases the adjustments/reforms were aimed at achieving a number of different objectives. These include raising revenue through lower tax rate and broader base; encouraging increased economic activity through the granting of fiscal incentives and placing greater emphasis on indirect taxes; and the simplification of the tax system by reducing the number of taxes and rates (in the case of indirect taxes, and the number of bands (in the case of income tax). Lower rates also aimed at encouraging tax compliance.

Administration of these taxes was a major factor accounting for their poor revenue and performance and hence their continuous change. In the first place, not only were there delays in legal drafting which accounted for late implementation and the attendant low collection, but the lack of clarity in the law also prevented its immediate application. In addition, with the exception of St. Lucia, the regular reforms did not give sufficient time for a particular measure to prove its worth.

Furthermore, the current tax system is complex, inequitable and inefficient indicating the need for new reforms. Direct taxes can provide a secure and predictable source of revenue in Grenada. The base of indirect taxes can be broadened but lowered to avoid evasion. Stability in the fiscal regime would not only allow more time for improved administration but will also provide an opportunity for the system to prove its worth.

Section 6: Conclusions

The paper employed a Box-Cox transformation methodology which provides time varying tax buoyancies for the tax systems of member territories. The results indicated that over the period 1980-97 there was a mixed performance in the buoyancy of the tax systems of the territories but with the exception of St. Kitts, there was a general decline in buoyancy levels of countries since their independence.

In the cases of Montserrat and Anguilla the high buoyancy levels could have been attributed to the strict administrative control of the colonial administrators which reduced evasion and increased compliance.

Problems in administration after independence and the regular change to tax rate and structure during the period stated would have accounted for the falling buoyancy. The results further suggested that the reduction in buoyancy levels was most pronounced when changes to tax system involved shifting emphasis from direct taxes to indirect taxes and in particular eliminating personal income tax. Although the policy of reducing direct taxes is usually designed to increase economic activity, the negative consequences such measure can have on tax revenue need to be fully borne in mind during implementation.

In general, the results indicated that with the exception of St.Kitts, buoyancy levels in the the tax systems of independent member territories are low and or declining. This should be cause for concern as ideally tax systems should be more buoyant as territories develop and per capita income increases allowing countries to increase revenue and meet public expenditure demands. Raising tax rates or implementing new taxes is not necessarily the best means of achieving this because of the potential for adversely affecting productivity, equity, welfare and savings. Further, some member territories already have fairly high tax systems by international standards as evidenced by Tax to GDP ratios that ranged in 1997 from 19.7% in St.Kitts & Nevis to 27.8% in St.Vincent & The Grenadines. Increasing taxes or tax rates may just make them more burdensome. What is required is more country specific analysis of tax systems using disaggregated and complete data to assess the relative impacts of such elements as tax rates, tax allowances, tax administrative efficiency and the endogenous changes that occur to tax bases.

There is also need for more stability in the tax system. Continually changing rates and application of taxes to tax bases unnecessarily complicates administration, reduces confidence in the system and does not give sufficient time for a particular policy to prove its worth. Countries should seek to simplify the tax system by reducing the myriad of taxes and their rates. Lower tax rates and tax base can also reduce evasion, increase compliance and lead to more equity in the system. Given that direct taxes are a predicted and secured source of revenue, future reforms to tax system should not seek to eliminate such taxes.

Appendix 1: Details of Tax Measures

St. Lucia

The results show that though buoyancy has been high it has been falling continuously for the period 1980-97. On the one hand, the high buoyancy reflects the system's close linkage to GDP that has been growing continuously since 1980. On the other, the falling trend could have been attributed to a number of factors which include the following:

- the passage of Hurricane Allen in 1980
- the leadership struggle within the government
- recession in the United States
- industrial disputes and
- late implementation of proposals for new revenue measures.

Generally, only minor revisions were made to tax rates over the period stated. One such revision took place in 1987 when the economy witnessed a slowdown in real economic growth estimated at 2.1 per cent. The aim was to reduce the tax burden and shifted its emphasis from income to indirect taxes. Some of the measures were as follows:

- a progressive reduction of the maximum rate of company tax from 40 per cent 33-1/3% over a three-year period
- an immediate reduction in the maximum rate of taxes for small businesses from 45% to 25% and progressive increases thereafter to 33-1/3 per cent in three years
- tax holiday up to seven years for hotels and up to ten years for manufacturing industry and reductions to personal income tax.

The fall in revenue as a result of these measures were partially compensated by increases in consumption taxes.

These measures followed other minor revisions to the system the previous years that included an amnesty on the interest due on all income tax arrears if settlement was made by June 30th 1986; and the abolishment of certain aspects of the withholding tax.

No fundamental change has been made to the tax system in St. Lucia in the 1990s, hence the system has been given some time to prove its worth. In this regard, the secular falling trend in buoyancy suggests that the system has matured. The level and composition of central government revenue appear reasonable. In St. Lucia, tax revenue averages 24% of GDP suggesting maximum taxable capacity. Moreover, taxes on income, goods and services and international trade and transactions are well balance, thus making the system less vulnerable. In addition, the tax structure has a broad base with very low rate that has reduced the level of non-compliance and tax evasion. In this regard, higher levels of revenue growth would be difficult to achieve with the present tax structure. In other words, the present tax structure in St. Lucia has served its time and there is need for a complete revamping of the system to make it more buoyant.

This policy has however to be weighed against the level of government's recurrent expenditure and the resulting current account balance. St. Lucia has been achieving current account surplus since 1982, in excess of 3.0 per cent of GDP. This suggests that the taxation system fully supports expenditure levels of government and hence there may not be an urgent and immediate need to revamp the system. Nevertheless, with a more buoyant tax structure not only will the current account surplus be larger but the country will be in a better position to finance its development programme from domestic revenue as well as to seek external support for its development programme. This may however require increasing the tax burden on the population which may not be politically acceptable.

Grenada

Unlike St. Lucia, Grenada's tax structure reflects low buoyancy in the first half of the 1980s and higher buoyancies as of 1986, though not on a consistent basis. The low buoyancy in the first half of the 1980s, reflect the dominance of the state sector in the economy at that time.

Following the demise of the PRG in 1983, efforts were made to transform the tax structure in 1986. The objective was to simplify the tax system, increase investment incentive by abolishing all income taxes and create a system based on indirect taxes, with a value-added tax at the center of the new system. The reforms replaced the former system of approximately 36 different taxes on income, consumption, external trade, and property tax with seven major taxes.

The high buoyancy shown during the period 1986-90 is not in keeping with the results of the measures implemented during that period. Central government finances deteriorated significantly following the 1986 tax reform that undermined the revenue base and weakened tax collection. Tax revenue dropped from 29.5 per cent of GDP in 1985 to 21.9 per cent in 1990. This was because personal income tax, import and export duties, the telecommunications surcharge and entertainment taxes were all eliminated and replaced with a number of other taxes. These include a 20 per cent value added tax, a modified land value tax, a gasoline tax and a 2.5 per cent business levy on gross receipts of domestic businesses. The decline in revenue resulted from the elimination of direct taxes that up to 1985 yielded revenues of about 7 per cent of GDP. At the same time, the new indirect taxes failed to increase revenue, partly because of the granting of exemptions and weaknesses in tax administration.

In 1991, a number of new tax measures were introduced to raise revenue. The business levy was transformed to a corporate income tax, to be chargeable on 33.5 per cent of net profits if the resulting revenue exceeds 2.5 per cent of sales. A debt service levy of 10 per cent on income exceeding ECS12,000 was introduced. The Value Added tax on imports and on domestic goods and services was further modified. A tax on airline tickets was introduced and the property tax was based on the market value of buildings and land of up to 1 per cent and 0.2 per cent respectively. Due to administrative difficulties, the constant changes in the tax system, the numerous exemptions granted and the destruction of the tax records in a fire in 1991, the revenue projected from those measures were not realised.

In 1992, with the adoption of a structural adjustment programme, additional measures were implemented to raise revenue. The debt service levy was restructured through the introduction of four progressive rates; the value-added tax was expanded to include previously exempt items and exemptions previously granted to statutory bodies were removed.

In 1993, efforts concentrated on improving tax administration, streamlining the tax system and finalising plans for the reintroduction of a comprehensive income tax system. The only new tax measure introduced was the 2.5 per cent customs service charge on all imports.

Tax reform continued in 1994 with the reduction of the VAT of a large number of imported goods in an effort to discourage the substantial trade in smuggling. The 2.5 per cent tax on foreign exchange sales was also abolished in 1994.

Despite these efforts, during the period 1990-94 tax revenue as a percentage of GDP averaged 21.4 per cent, moving from 21.9 per cent in 1990 to 20.4 in 1994 much lower than 27.5 per cent in the period 1980-84.

In 1996, the threshold of the personal income tax was increased from \$10,000 per annum to \$60,000 and the customs service charge was increased by 100 per cent. No major change has been made to the tax system since 1997, but during the last five years emphasis has been placed on shifting the dependence from direct tax revenue to indirect.

In summary, the frequent changes in the tax measures have not given sufficient time for the system to work and prove its worth. The results further suggest that the buoyancy of the system is lower with a greater dependence on indirect taxes. In Grenada's case, direct taxes appear to be more buoyant than indirect, and this may be attributed to its lower administrative cost of collection.

Furthermore, the current tax system is complex, inequitable and inefficient indicating the need for new reforms. Direct taxes can provide a secure and predictable source of revenue in Grenada. The base of indirect taxes can be broadened but lowered to avoid evasion. Stability in the fiscal regime would not only allow more time for improved administration but will also provide an opportunity for the system to prove its worth.

St. Vincent & the Grenadines

In the case of St. Vincent, the high buoyancy in the first half of the 1980s reflect the high rates of taxation existing at that time. However, those high levels of income impacted adversely on middle and upper income professional and investor groups. In addition, Traders Turnover Tax placed unfair fiscal burden on companies and unincorporated business.

Since 1986 efforts were made to lower the burden of taxation, increase the level of domestic saving and investment in the productive sectors. The traders turnover tax was repealed with effect October 1st 1984. The top marginal tax rate of 55 per cent was made applicable to income

over \$45,000 instead of the previous \$15,000; and a standard deduction of \$5,000 gave tax relief to low income groups. However a revenue enhancing measure of 5 per cent on the value of all airline ticket originating from St. Vincent was imposed.

Those efforts continued further in 1994 when major changes to the tax structure were made aimed at reducing tax burden, simplifying the tax structure and improving the efficiency of administration. In particular, the maximum income tax rate was reduced from 55 per cent to 45 per cent and the number of bands widened and reduced from 9 to 5; the export tax on banana was also lowered and the banana association was exempt from customs service charge. In 1995, the tax system remained relatively stable, but in 1996 adjustment to the Common External Tariff resulted in minor change in the system. Finally, in 1995 efforts concentrated on improving tax collection through the implementation of ECEMP's tax administration project.

The measures implemented between 1986 and 1994 resulted in a lowering of the buoyancy of the tax structure in St. Vincent & the Grenadines over the period stated, as buoyancy fell from 1.0 in 1986 to 0.6 in 1997. A fundamental factor accounting for the fall in buoyancy seems to be the changes to the income tax structure. In fact, the buoyancy of the system began to fall in 1981 and since then has maintained that secular falling trend. This seems to suggest that changes in the income tax structure had a direct impact on revenue collection.

Commonwealth of Dominica

The secular falling trend in buoyancy typical of St. Vincent and St. Lucia also characterises the tax buoyancy of Dominica for the period 1980-1997. The high buoyancy in the first half of the 1980s was due to high levels of taxation during that period. In 1981 the government entered into a three-year stabilisation arrangement with the IMF to improve the country's fiscal management. Some of the main revenue elements of the programme were an increase of 20 per cent consumption tax on a number of items, the imposition of import duty on building materials and the reorganisation of the public finances to eliminate budgetary transfers to statutory bodies. At the completion of the programme public sector finances strengthened and a current account surplus was realised in 1994.

New tax reform took place during 1987-1992. The reform shifted the burden of taxation from income to consumption in order to generate increased savings.

In 1987, the corporation tax payable by manufacturing enterprises was reduced from 45 to 30 per cent. The bank deposit levy was abolished, the rate applicable to foreign exchange levy was reduced from 2.5 to 1.5 per cent and the foreign exchange tax was only made applicable to non-traded transactions. Moreover, the stamp duty of 1.0 per cent on export sales and duties on exports was removed. However, to offset the loss of revenue, consumption tax on vehicles was increased by 10.0 per cent.

In 1988, in an effort to facilitate the administration of the income tax and to give tax relief to low income groups, the threshold of the income tax was increased from \$3,700 to \$9,000 thus removing over 3,500 persons from the tax net.

In 1990, further changes were made to the corporation and personal income taxes. The corporation tax rate was reduced from 35 to 30 per cent and marginal taxes on personal income tax were reduced with the top marginal tax rate changing from 45 to 40 per cent. The income tax threshold was increased from \$9,000 to \$12,000 per annum, thus removing 849 taxpayers from the income net.

In summary, the measures implemented in the last half of the 1980s were geared towards simplifying the tax system while those of the 1990 aimed at increasing savings and investment. During the last period efforts were also concentrated on strengthening tax administration and collection through support from the ECEMP tax project which commenced in 1994.

Antigua and Barbuda

Antigua and Barbuda abolished personal income tax in December 1976. In the early 1980s there were increases in indirect taxes to compensate for the abolition of personal income tax. In 1980, consumption taxes on a wide range of articles increased. There was also a special drive to collect overdue corporation taxes. In addition, the government received US\$1.5m per year from the US base agreement. The tourist trade also grew substantially during that period. As a result, tax revenue rose to 22.8 per cent of GDP in 1981.

In 1982 the government introduced a tax on unincorporated businesses and increased professional license fees. This increased the contribution of current revenue to GDP.

However, with declining merchandise imports and import duty exemptions granted under the Fiscal Incentives and Hotels Incentive Acts, current revenue share in GDP fell in 1983.

During 1984-86 revenues increased in relation to GDP from 21.6 per cent to 23.4 per cent. This was due to the introduction of a number of revenue measures during the period stated. A customs service charge of 2.5 per cent on all imports (excluding capital goods above \$100,00) was introduced in 1986. A new property tax act became effective as of March 1986. The Stamp Amendment Act of 1986 introduced a 3 per cent tax on loans by local banks to non-residents. The Revenue Act of 1985 raised a variety of license fees and annual charges and the penalties for non-payment were heavily enforced.

From 1987, however, growth slowed, and the ratio of revenue to GDP fell to 20 per cent in 1991. The slowdown reflected economic difficulties related to natural disasters.

However, in the 1990s substantial interference was made to the tax structure to expand the revenue base. As such in 1995, an education levy on wages and salaries and a restaurant tax on sales were introduced. Those efforts created greater difficulties in administration thus affecting the collection of these taxes. Moreover, between 1990-94, economic growth slowed averaging 3.4 per cent thus accounting lower buoyancy. Since then, tax reforms have remained relatively stable in Antigua and Barbuda.

Generally, Antigua and Barbuda has an array of tax that hinders administration and collection. The country also has a low tax ratio¹² compared with other OECS countries. This ratio is above 25 per cent in most OECS countries. In this regard there are possibilities for additional revenue through appropriate taxation measures.

St. Kitts and Nevis

Unlike many of the other OECS countries the buoyancy of the tax structure in St. Kitts and Nevis was extremely low, though rising in the early 1980s. The performance in the 1980s resulted from the additional income provided by the sugar industry whose windfall profits were heavily taxed by government. In addition, consumption taxes and import duties experienced large increases to offset the reduction of income taxes associated with the abolition of personal income tax in 1980. The sugar levy, which contributed 20 per cent of all current revenues in 1981, was abolished in 1982 when the situation of the sugar industry deteriorated. A larger share of the tax burden shifted to taxes on domestic production and consumption. Generally, those measures resulted in narrowing the revenue base of the government.

To widen the tax base, in 1986 the government introduced a number of measures, as follows:

- a social services levy of 4 per cent on wages
- a land transfer tax on special development areas
- an intensification of efforts to collect arrears
- increased collections from water and electricity departments.

Moreover, economic activity was boosted with the coming on stream of the Four Season Hotel. This further accounted for the higher buoyancy levels in the late 1980s.

In the early 1990s, the tax pattern shifted from trade taxes towards domestic taxes, particularly corporate and property taxes, because of a reduction in import taxes in the period 1985-90. In 1991, a 7 per cent restaurant tax on small hotels and restaurants hitherto excluded and a 2 per cent tax on overseas telephone calls were introduced. Further changes were made to the Social Services Levy rate in the 1990s in an effort to raise more revenue. This accounted for the higher buoyancy achieved as of 1991.

¹² Tax ratio can be defined as tax revenue as percentage of GDP

APPENDIX 2

Table : Box-Cox Estimates for the Restricted Models on Direct Taxes

COUNTRY	Restriction	LLF	LR	Estimation Method
Antigua	$\lambda=1$	-45.3521	1.0672	Linear
	$\lambda=0$	-45.2309	0.8248	
	$\lambda=\lambda$	-44.8185		
Dominica	$\lambda=1$	-86.2374	23.4846	Box-Cox
	$\lambda=0$	-121.989	94.9878	
	$\lambda=\lambda$	-74.4951		
Grenada	$\lambda=1$	-66.7703	8.2004	Linear
	$\lambda=0$	-63.2385	1.1368	
	$\lambda=\lambda$	-62.6701		
Montserrat	$\lambda=1$	-26.6298	-0.3524	Double Log
	$\lambda=0$	-27.5960	1.58	
	$\lambda=\lambda$	-26.606		
St.Kitts	$\lambda=1$	-206.301	66.394	Linear
	$\lambda=0$	-239.017	0.962	
	$\lambda=\lambda$	-239.498		
St.Lucia	$\lambda=1$	-97.0816	13.021	Box-Cox
	$\lambda=0$	-121.616	62.089	
	$\lambda=\lambda$	-90.5713		
St.Vincent	$\lambda=1$	-46.9556	0.2584	Linear
	$\lambda=0$	-47.7013	1.7498	
	$\lambda=\lambda$	-46.8264		

Table : Box-Cox Estimates for the Restricted Models on Domestic Taxes

COUNTRY	Restriction	LLF	LR	Estimation Method
Anguilla	$\lambda=1$	-45.3681	0.1492	Double Log
	$\lambda=0$	-53.0349	15.4828	
	$\lambda=\lambda$	-45.2935		
Antigua	$\lambda=1$	-54.3765	-15.4098	Linear
	$\lambda=0$	-47.1409	0.9386	
	$\lambda=\lambda$	-46.6710		
Dominica	$\lambda=1$	-76.1485	13.265	Box-Cox
	$\lambda=0$	-122.218	105.404	
	$\lambda=\lambda$	-69.516		
Grenada	$\lambda=1$	-54.7155	0.4022	Linear
	$\lambda=0$	-54.5408	0.0528	
	$\lambda=\lambda$	-54.5144		
Montserrat	$\lambda=1$	-34.0005	0.6164	Double Log
	$\lambda=0$	-36.3679	5.352	
	$\lambda=\lambda$	-33.6923		
St.Kitts	$\lambda=1$	-217.218	66.088	Linear
	$\lambda=0$	-249.000	2.524	
	$\lambda=\lambda$	-250.262		
St.Lucia	$\lambda=1$	-86.1368	9.9562	Box-Cox
	$\lambda=0$	-122.026	81.736	
	$\lambda=\lambda$	-81.158		
St.Vincent	$\lambda=1$	-40.5564	4.0014	Linear
	$\lambda=0$	-39.0007	0.90226	
	$\lambda=\lambda$	-38.5557		

Table : Box-Cox Estimates for the Restricted Models on Trade Taxes

COUNTRY	Restriction	LLF	LR	Estimation Method
Anguilla	$\lambda=1$	-60.4029	1.9238	Double Log
	$\lambda=0$	-62.2143	5.5466	
	$\lambda=\lambda$	-59.441		
Antigua	$\lambda=1$	-56.144	1.8322	Linear
	$\lambda=0$	-55.8251	1.1944	
	$\lambda=\lambda$	-55.2279		
Dominica	$\lambda=1$	-95.1852	15.549	Box-Cox
	$\lambda=0$	-121.730	68.631	
	$\lambda=\lambda$	-87.4145		
Grenada	$\lambda=1$	-63.1604	0.6518	Double Log
	$\lambda=0$	-64.5965	3.524	
	$\lambda=\lambda$	-62.8345		
Montserrat	$\lambda=1$	-42.1871	-0.0014	Double Log
	$\lambda=0$	-44.3704	4.368	
	$\lambda=\lambda$	-42.1864		
St.Kitts	$\lambda=1$	-188.349	67.302	Linear
	$\lambda=0$	-220.604	2.962	
	$\lambda=\lambda$	-222.009		
St.Lucia	$\lambda=1$	-105.841	4.7461	Double Log
	$\lambda=0$	-121.385	35.834	
	$\lambda=\lambda$	-103.468		
St.Vincent	$\lambda=1$	-54.3063	0.5744	Linear
	$\lambda=0$	-54.1586	0.2786	
	$\lambda=\lambda$	-54.0193		

References

1. Bain, Laurel. 'The Tax Structure of the member countries of Eastern Caribbean Central Bank' , prepared for a meeting of Comptrollers of Customs and Inland Revenue , 1994.
2. Bain, Laurel. ' Tax Concessions and their impact on the Revenue Base of the ECCB Territories', ECCB Staff Paper, March, 30, 1995.
3. Ehdaie, Jaber. "An Econometric Method for Estimating the Tax Elasticity and the Impact on Revenues of Discretionary Tax Measures", Working Papers WPS 334, The World Bank, February 1990.
4. Judge, Hill, Griffiths, Lutkepohl and Lee, " Introduction to the theory and practice of econometrics", 2nd edition, John Wiley & Sons, Inc, 1988.
5. Mansfield, Charles. "Elasticity and Buoyancy of a Tax System: A Method Applied to Paraguay", IMF Staff Papers Vol.35, No. 1, 1988, 181-197
6. Osoro and Leuthold. 'Changing Tax Elasticities Over Time: The case of Tanzania,' African Development Review, Vol. 6, No. 1, June 1994, 31-39.
7. SHAZAM. "User's Reference Manual" version 7.0, by Kenneth J. White, 1993