

## TAX CAPACITY IN THE OECS

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### Introduction

The genesis of measuring a country's tax effort came out of concern over the ability to increase the level of taxation as part of a stabilisation program or for the mobilisation of resources to finance a development program (Lotz and Morss, 1967). Tax effort indices are now widely used by international agencies as a basis for international grants. It is reckoned that a country with a higher tax effort improves its chances of receiving funds because local revenue sources have been stretched relative to a country with a lower tax effort. Individual countries may also use the index to evaluate alternative taxation policies.

Tax effort indices are calculated by comparing the predicted tax share with the actual tax share (usually tax receipts as a percentage of GDP) and where the ratio of actual to predicted is less than one, the country is classified as a low tax effort country. The converse is true if the ratio is greater than one. The predicted share is determined by the tax share being regressed on some factors which are capable of explaining the country's capacity for raising taxes. The regression coefficients are interpreted as relative weights assigned to the different capacity factors and the unexplained residuals of the equation are interpreted as indicators of tax effort.

This study examines tax shares and tax effort indices in the Organisation of Eastern Caribbean States (O.E.C.S.), with the exception of Anguilla because of data limitations. The theoretical basis for our tax share model is similar to Heller (1975) and Leuthold (1991) where a welfare maximising public decision maker is constrained by a budget that accounts for alternative modes of financing. The cross-country approach is combined with the time series approach for the group and individual country, respectively. In order to better understand the tax structure among and across countries, the model is disaggregated by direct and indirect tax shares, along with the total tax share. Finally, to enhance the policy component of the paper, the tax effort index is regressed on the growth in GDP to determine whether or not there is fiscal drag in these economies.

The remainder of the paper has the following sections: Section 2 reviews the tax effort literature. Section 3 develops the theoretical model of tax behaviour. Section 4 presents the data and empirical results. Policy conclusions are made in the final section.

### Literature Review

There has been an appreciable fall-off in studies on tax effort and tax capacity, after the initial spurt of empirical work on developing countries - Musgrave (1969), Lotz and Morss (1967, 1970), Bahl(1971), Chelliah(1971), Chelliah, Baas and Kelly (1975), Shin (1969) Bird (1976) argued that the studies suffered from (1) a lack of theoretical justification underlying the tax capacity models; (2) poor quality of data and (3) the inadequacy of using cross-country data for drawing inferences about changes that occurred over time. In cases where time series analysis was used, recent developments in econometrics methods would reveal considerable shortcomings in the ways in which 'standard' assumptions were dealt with at the time.

Notwithstanding the lack of theoretical justification, more recent studies - Tait, Gratz and Eichengreen (1979), Tabellini (1985) and Tanzi (1981, 1987 and 1991) - continued to identify some correlation between the total share of taxes in GDP and such factors as the share of non-tax revenue, import and export ratios, literacy rates, urbanisation, level of indebtedness, the share of agriculture and the monetization and openness of the economy. Of these, Tanzi (1991) - using a sample of 88 less-developed countries - identified the share of imports in GDP and the share of foreign indebtedness in GDP as having a substantial positive impact on tax levels, and the share of agriculture as having a negative impact.

Burgess and Stern (1993) opined that there are several reasons for the importance of the three factors identified above. Firstly, in developing countries, imports constitute a significant tax base for various types of taxes (import duties, sales taxes and excises). Apart from the obvious objective of raising significant amounts of revenue, De Wulf (1990) suggested that these kinds of taxes are used in LDCs to (a) help keep the level of imports consistent with the other balance of payments components, (b) influence the structure of imports so as to free valuable foreign

exchange for essential or developmental imports, (c) grant protection to local producers of goods that are also imported, and (d) redistribute incomes. It is therefore not surprising that taxes on imports remain the most important single source of government revenue and so the share of imports is a prime factor in explaining tax capacity in LDCs .

Secondly, the need to service rising foreign debt often generates tax increases. Tanzi (1988) argued that a country with large foreign debt payments will often be forced to reduce its imports, in an effort to counteract these outflows, to generate surpluses on its trade account. Such a move would undermine tax revenue collection, especially among the less developed countries where there is a heavy direct and indirect dependence on imports. The obvious policy response would be to impose taxes on non-traded goods and taxes on incomes and property as replacements for import-related taxes. This response leads to the conclusion that rising foreign debt servicing in LDCs encourages tax increases.

And finally, a high share of agriculture in GDP proxies the difficulty of imposing taxation. There are as much compelling theoretical reasons for taxing agricultural land as there are practical reasons for not taxing agricultural land. The most feasible method of agricultural taxation is the land tax. It is well known that the distribution of land in developing countries is very uneven and it can be argued that land is in inelastic supply. In addition land is visible, immovable and serves as a good indicator of wealth. These characteristics make land especially amenable to taxation. On the other hand, Strasma and Others (1990) reasoned that (1) land taxes produce relatively little revenue; (2) land taxes seldom achieve their non-fiscal goals; (3) land taxes sometimes are counterproductive, discouraging production and (4) land taxes are unpopular, costly to administer and plagued with corruption. Whatever reasoning is accepted, it is difficult to impose and collect taxes on agriculture in developing countries.

In conducting cross-country analysis, there is the concern that the average tax performance is not meaningful because of the vastly different characteristics of the countries. The average measure is influenced by differences in scale, the level of development, the degree of openness, monetization and dependence. Not knowing which explanatory variables to include in the

regression analysis is compounded by difficulties of assuming that the regression coefficients are constant over the sample period. Of course the constancy of the parameters is affected by wide differences in the countries' characteristics.

Another concern of previous cross-country studies is the measure of a static rather than a dynamic tax performance. Given the difficulties of finding a reliable point of reference with respect to a country's tax capacity, it is more meaningful for policy-makers to analyze trends in tax performance rather than the tax performance at a particular point in time. Dodsworth and Somersall (1977) observed that a low income tax rating may be explained by differences in the distribution of income, even when average income has been taken into account, but on the same grounds, a falling income tax rating could only be explained by relative changes in income distributions.

There is a dearth of research in the area of tax capacity for the O.E.C.S countries. The pioneering work of Dodsworth and Somersall(1977) reviewed some of the shortcomings of inter-country comparisons of tax effort studies and attempted to avoid them in their analysis of tax performance for Barbados and seven of the eight O.E.C.S countries over the period 1960-73. They identified the setting of the problem and the interpretation of the results as two defective areas, in the vein of the critique above. Notwithstanding their concerns they preceded to rank the countries' tax ratings by estimating four variants of the tax ratio equations over the entire period and three sub-periods. In principle, apart from the homogeneity of the counties - with Barbados being a possible exception - the study suffered the same fate as those analysed by Bird, 1976.

In more recent times, Samuel (1989) used the tax effort ratio to show that the low buoyancy of the tax systems in the O.E.C.S countries has resulted in measures to squeeze more and more revenue out of an increasingly unresponsive tax base. The ratio showed an increase for 1984 over 1971 in all cases but Antigua which also had an income elasticity of government revenue of less than unity.

## The Model of Tax Behaviour

Following Heller (1975) and Leuthold (1991) we assume a welfare maximising public decision maker constrained by a budget that accounts for alternative modes of financing. That is, the agent

$$\text{Max } U = U(Y-T, B, G)$$

subject to

$$T+F+B=G$$

where  $Y-T$  is disposable income in the private sector (equal to gross domestic product  $Y$ , less tax revenue  $T$ ),  $B$  is domestic borrowing,  $F$  is foreign borrowing and  $G$  is total government expenditure. Utility is positively related to disposable income and government expenditure but negatively related to domestic borrowing.

At the moment, the utility function is too general to be helpful. To operationalise the model it is assumed, like Leuthold (1991), that the utility function has a Stone-Geary shape, that is,

$$U = a_1 \ln(Y-T-Y_1) - a_2 \ln B + a_3 \ln(G-G_2)$$

where the  $a$ 's are positive constants,  $Y_1$  and  $G_2$  are subsistence income and public goods and services, respectively, and the other variables are defined as before. Now maximizing  $U$  in equation (3) with respect to  $T$ ,  $B$ , and  $G$ , subject to the constraint (2), yields the following first order conditions:

$$\frac{\partial U}{\partial T} = a_1 / (Y-T-Y_1) + \lambda_1 = 0$$

$$\frac{\partial U}{\partial B} = -a_2 / B + \lambda_1 = 0$$

$$\frac{\partial U}{\partial G} = a_3 / (G-G_2) + \lambda_1 = 0$$

$$\frac{\partial U}{\partial \lambda_1} = Y-T+B-G = 0$$

Rewriting T, B and G in equation (4), (5) and (6), respectively, in terms of  $\lambda_1$  and substituting the resulting expressions in equation (7) gives  $\lambda_1$  as

$$\lambda_1 = [a_1 - a_2 + a_3] Y - Y_s + F - G_s$$

Substitute  $\lambda_1$  in equation (4) and divide by Y, gives the reduced form equation for the desired tax share

$$(T/Y) = (1-a) - a(F/Y) + a(G_s/Y) - (1-a)(Y_s/Y)$$

where  $a = a_1/a_1 - a_2 + a_3$ . Assuming 'a' is positive, that is  $a_1 + a_3 > a_2$ , equation (9) states that the desired tax share is negatively related to the ratio of foreign borrowing to income and to ratio of subsistence income to actual income but positively related to the ration of subsistence level of public goods and services to income.

Assume that the subsistence levels of income and government expenditures are simple linear functions of income, that is,

$$G_s = g_0 + g_1 Y$$

$$Y_s = y_0 + y_1 Y$$

Further postulate that the actual tax share, T/Y, is a positive function of the desired tax share (T/Y)', the share of trade in income (XM<sub>y</sub>) and the share of mining in income (N), for Trinidad and Tobago and Jamaica) or the share of tourism in income (Z) (for Barbados) and negatively related to the share of agriculture in income (A) since agriculture is a difficult sector to tax. Formally

Substituting expressions (10) - (12) in equation (9) gives the following model that we estimate

$$(T/Y) = b_0 + b_1(F/Y) + b_2(1/Y) + b_3 A_y + b_4 XM_y + b_5 N_y + e$$

where  $b_1$  and  $b_2$  are expected to be negative,  $b_3$  and  $b_5$  are expected to be positive, and  $b_4$  is positive or negative depending on the relative magnitudes of g and  $y_0$ . e is assumed identical independent distributed normal with mean zero and constant variance.

#### Data and Empirical Results

The data used covers the period 1977-1994 for the O.E.C.S countries. The source of the data is the Ministry of Finance of the various countries, the Eastern Caribbean Central Bank (ECCB) and the O.E.C.S National Accounts Digest, 1977-1992.

#### Total Tax Model

Table 1 shows the estimates of the coefficients and their statistical properties. The model for the group does not perform well judging from the low R<sup>2</sup> and the appearance of serial correlation. All the variables, with the exception of the external debt variable (LFY), are significant. However the signs of the agriculture (LAY) and tourism (LHY) variables do not satisfy the a priori expectation.

The model performs much better at the country-specific level, where high R<sup>2</sup> and generally acceptable Durbin-Watson statistics are obtained. The models appear free of first order serial

correlation with the possible exception of that for Montserrat. The significance of the variables varies across countries and in signs. In the case of Montserrat, openness (LXY) is the only significant variable in explaining tax capacity whereas the development variable (LPYINV) is the only insignificant variable in the equation for Antigua.

The openness variable - which is measured as the ratio of total imports and exports to GDP - carries the right sign for all the countries with the exception of Dominica. For Grenada, the variable is totally unimportant. These findings confirm the widely held view that the trade base is the most critical of all bases for tax purposes in small open economies.

The external debt variable - defined as total external debt to GDP - is significant only in Antigua, Grenada and St.Kitts but carries the wrong sign for the latter. Given the high external debt in the first two countries the findings are not surprising.

The tourism variable - defined as the ratio of value added in the hotel and restaurants sector to GDP - is significant and carries the right sign for Antigua only. However, though significant for Dominica and St Vincent, the sign is not consistent with theoretical expectation. The underperformance of this variable may be explained by the relative immaturity of the tourism sector in these countries. In addition, governments have traditionally given large incentives and tax concessions to the predominantly foreign investors in the tourism sector.

The agriculture variable - measured as the ratio of value added in the agricultural sector to GDP - is significant in all the countries with the exception of Montserrat (where there is hardly an agricultural sector). The expected sign is achieved in three of the remaining six countries. In the cases where the sign is positive, the presence of an export tax may have counteracted our theoretical position.

The development variable - which is measured as the reciprocal of GDP divided by total population - is significant in all countries with the exception of Antigua, Grenada and Montserrat. The expected sign of this variable depends on the stage of development, and to a

large extent, the political philosophy of the country. These, along with several other factors which determine development, may run counter to each other, thus giving rise to the indeterminacy of the sign.

### Direct Tax Model

Table 2 shows the estimates of the coefficients and their statistical properties. The model for the group does not perform well judging from the low  $R^2$ , despite the fact that all the variables are significant at the 5% level. However the signs of the external debt, tourism and agriculture variables do not satisfy the a priori expectation.

The model performs much better at the country-specific level, where high  $R^2$  and generally acceptable Durbin-Watson statistics are obtained, with the possible exception for St Vincent and Grenada. In these two countries, it is likely that the residuals are serially correlated. The significance of the variables varies across countries and in signs. In the case of St Kitts, only the external debt variable is significant but none of the variables is significant: for Montserrat and St Lucia.

The openness variable is significant in Dominica and St Vincent, but carries the wrong sign in the case of the former. For the other countries, the variable is totally unimportant. These findings are consistent with the fact that imports provide a base for indirect as opposed to direct taxation.

The external debt variable is significant only in St Kitts, but carries the wrong sign. This finding suggests that although debt burden may lead to increased taxation, empirical research cannot determine the form of taxation that should be implemented to deal with such.

The tourism variable is significant for Antigua only. However, the sign is not consistent with theoretical expectation. The irrelevance of this variable may be explained by the relatively low level of taxation that is applied to the sector in all of the countries.

The agriculture variable is significant in all the countries with the exception of Montserrat, St Kitts and St Lucia. The expected sign is achieved in two of the remaining four countries. In the cases where the sign is positive, the presence of an export tax may have counteracted our theoretical position.

The development variable is significant in Antigua, Dominica and Grenada. The expected sign of this variable depends on the stage of development, and to a large extent, the political philosophy of the country. These, along with several other factors which determine development, may run counter to each other, thus giving rise to the indeterminacy of the sign.

#### **Indirect Tax Model**

Table 3 shows the estimates of the coefficients and their statistical properties. As is the case with the models above, the model for the group does not perform well based on the low  $R^2$  and the appearance of first order serial correlation. All the variables, with the exception of the openness and development variables, are significant. Of the statistically significant variables, the external debt variable alone satisfies the a priori expectation.

Again, the model performs much better at the individual country level, with high  $R^2$  and generally acceptable Durbin-Watson statistics being obtained. The models appear free of first order serial correlation with the possible exception of those for Antigua, St Lucia and St Vincent. The significance of the variables varies across countries and in signs.

The openness variable is significant and carries the right sign for all the countries with the exception of Dominica, in which case, the variable is totally unimportant. These findings confirm the widely held view that the trade base is the most critical of all bases for tax purposes in small open economies.

The external debt variable is significant only in Antigua and Grenada, carrying the right sign in

both cases. This result is somewhat consistent with the high level of external debt in these two countries.

The tourism variable is significant and carries the right sign for Antigua only. However, though significant for Dominica and St Vincent, the sign is not consistent with theoretical expectation. The underperformance of this variable may be explained by the relative immaturity of the tourism sector in these countries and the granting of enormous tax holidays to existing investors.

The agriculture variable is significant in all the countries with the exception of Montserrat and St Vincent. The expected sign is achieved in Antigua, Grenada and St Lucia. In the cases where the sign is positive, the presence of an export tax may have counteracted our theoretical position.

The development variable is significant in all countries with the exception of Antigua and Grenada. The expected sign of this variable depends on the stage of development, and to a large extent, the political philosophy of the country. These, along with several other factors which determine development, may run counter to each other, thus giving rise to the indeterminacy of the sign.

#### **Computation of the Tax Effort Index**

Having estimated the model and recovered the residuals, the tax effort index is computed as the ratio of the actual to the fitted values for the dependent variable (tax receipts as a percentage of GDP). For policy purposes, the tax effort index is regressed on GDP growth to determine its possible influence. In most cases the relationship is insignificant, thus showing that the economies in the O.E.C.S. do not suffer from fiscal drag. This is consistent with the finding that tax effort in these countries is not high.

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TABLE 1:  
Signs of significant regression estimates and summary statistics  
for Total Tax / GDP Model

Explanatory Variable	ANT	DOM	GRE	MON	STK	STL	STV	OECS
LXY	+	-		+	+	+	+	+
LFY	+		+		+			
LHY	+	-					-	-
LAY	-	+	+		+	-	-	+
LPYINV		-			-	-	+	-
R <sup>2</sup>	0.90	0.85	0.54	0.44	0.85	0.76	0.82	0.43
D.W	2.33	2.33	2.25	2.61	1.63	2.28	2.23	0.46

**TABLE 2:**

Signs of significant regression estimates and summary statistics  
for Direct Tax / GDP Model

Explanatory Variable	ANT	DOM	GRE	MON	STK	STL	STV	OECS
LXY		-					+	+
LFY					-			-
LHY	-							-
LAY	-	+	+				-	+
LPYINV	+	-	-					-
R <sup>2</sup>	0.67	0.75	0.63		0.57		0.45	0.49
D.W	1.55	1.97	1.11		1.10		1.39	0.41

**TABLE 3:**

Signs of significant regression estimates and summary statistics  
for Indirect Tax / GDP Model

Explanatory Variable	ANT	DOM	GRE	MON	STK	STL	STV	OECS
LXY	+		+	+	+	+	+	
LFY	+		+					+
LHY	+	-					-	-
LAY	-	+	-		+	-		+
LPYINV		-		-	-	-	+	
R <sup>2</sup>	0.90	0.77	0.78	0.55	0.89	0.76	0.69	0.39
D.W	2.70	2.15	1.84	2.02	1.91	1.24	1.52	0.51

**Tax Capacity Indices of the individual countries**

Year	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St. Lucia	St. Vincent
1977	0.996792	0.976437	1.057356	1.023662	0.996797	0.950435	0.978247
1978	0.969615	1.065357	0.998983	1.018650	0.930218	1.054972	1.041569
1979	1.034398	0.983026	0.968099	0.877387	0.990337	0.972318	0.981352
1980	1.014239	0.979867	0.941570	1.080537	0.860468	0.971151	0.992907
1981	1.017886	0.974993	1.036972	1.048182	0.976796	1.063309	1.038282
1982	0.967694	1.042852	0.964482	1.038265	1.083555	1.008943	0.954543
1983	1.014494	0.987413	0.988958	0.985090	1.031181	1.006977	1.037934
1984	1.035968	1.011233	2.979732	0.987839	1.030920	1.020612	1.035252
1985	0.962533	0.969912	0.874131	1.000220	1.003855	0.970510	0.987100
1986	0.975512	1.003640	1.136983	0.947280	1.061241	1.021887	1.018940
1987	0.996443	1.034587	1.014335	1.011619	1.032151	0.998341	0.964946
1988	0.998045	1.003547	1.042360	1.044048	1.121842	0.963609	0.974890
1989	1.017868	0.926756	1.049. 18	0.954063	1.010293	0.993405	0.953875
1990	1.981985	0.972845	1.014916	1.069891	0.909459	1.006105	0.981764
1991	1.010721	1.039265	0.980199	0.860397	1.056466	1.003150	0.996748
1992	1.006089	1.046548	0.971518	1.025714	0.996097	1.006057	1.046829
1993	1.003060	0.978721	0.919968	0.993853	0.975161	0.999401	1.004284
1994	0.996057	1.003880	1.059226	1.033078	0.915094	0.988512	1.010929

**Total Tax Capacity for the OECS<sup>1</sup>**

All Countries					
1	1.227640	1.172708	1.147006	1.149160	1.128677
6	1.065897	1.081765	1.002093	0.931042	0.902098
11	0.927983	0.948017	0.995628	0.970914	1.026003
16	1.023282	1.015336	0.994796	1.192356	1.322072
21	1.195612	1.057212	1.028595	1.076422	0.978799
26	1.003027	0.950196	0.974971	1.003921	1.007987
31	0.990537	1.051886	1.072170	1.067638	1.005206
36	0.999844	1.032204	1.016273	0.970940	0.893772
41	0.915164	0.833244	0.812060	0.808443	0.761757
46	1.007998	0.905282	0.917506	0.937071	0.893452
51	0.873384	0.887655	0.846623	0.975835	1.103657
56	1.017197	0.884054	1.030022	1.013566	1.014356
61	0.965197	0.992589	0.990270	0.939454	0.953908
66	0.976470	0.874584	0.981567	0.767767	0.913296
71	0.964206	0.969190	1.045621	0.835237	0.846851
76	0.801324	0.914493	1.161298	1.263768	1.243106
81	1.254977	1.190040	1.099866	1.168259	1.115715
86	1.151047	1.216046	1.192425	1.136936	1.114382
91	1.014479	1.101664	0.986291	1.039945	1.090187
96	1.047713	1.052482	1.054245	0.988152	1.029720
101	0.941750	0.949325	0.937065	0.960458	0.914458
106	0.928289	0.915396	0.901778	0.966028	1.005438
111	0.924500	0.951137	0.957613	0.861349	0.939245
116	0.910870	0.878480	0.905412	0.894317	0.917388
121	0.915403	0.991743	1.004508	1.070390	1.026937
126	0.965859				

<sup>1</sup>Anguilla is not included.

Direct Tax Capacity Indices of the individual countries

Year	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St. Lucia	St. Vincent
1977	0.922220	0.966915	1.395086	1.024597	0.911146	1.018615	1.012489
1978	1.009141	1.072809	0.902408	1.020398	0.943886	1.036863	1.003170
1979	1.080639	0.991138	0.825744	0.971345	0.940617	0.967872	0.992271
1980	1.044163	0.967932	1.061904	1.012059	0.909094	0.986371	1.016525
1981	0.980833	0.983023	1.045343	1.021960	1.095342	1.004669	1.011767
1982	1.003759	1.014072	0.809329	0.996701	1.085212	0.953147	0.916978
1983	1.003467	1.030964	0.799665	0.969966	1.069886	1.025379	0.984972
1984	1.008557	0.978841	0.936848	0.957925	1.007467	1.024016	1.002597
1985	0.961709	0.935129	0.772010	0.985543	0.989561	0.933698	0.997545
1986	0.989104	1.017188	1.049124	0.950282	1.148605	1.024566	1.017990
1987	0.974320	1.042015	1.029321	1.034155	1.073997	1.004342	1.015748
1988	1.007243	1.052622	1.272958	1.040018	1.059590	1.010661	1.063628
1989	1.024292	0.943290	1.150696	1.024793	0.945659	0.988037	1.021979
1990	0.956375	0.983208	1.242652	1.059204	0.891537	1.017776	0.967869
1991	1.019266	1.011667	0.995140	0.899255	0.955039	0.975266	0.972573
1992	1.015696	0.955954	0.886350	0.974247	1.014896	0.995209	0.982995
1993	0.993727	1.002203	0.807709	0.991358	0.987395	1.028609	1.022743
1994	1.004789	1.051421	1.070370	1.066230	0.966490	1.004904	0.996146

Total Direct Tax Capacity for the OECs<sup>2</sup>

	All Countries							
1	0.997616	1.124734	1.048602	1.121631	1.029749			
6	0.992333	0.969944	0.939774	0.852330	0.908648			
11	0.882816	0.911202	0.952506	0.899892	0.975836			
16	1.010053	1.029712	1.047900	0.994115	1.226114			
21	1.068675	0.995789	0.977697	0.925935	0.850713			
26	0.855482	0.846585	1.008283	1.006971	1.073285			
31	1.007137	1.025551	0.988828	0.950511	0.956721			
36	0.948181	1.068178	1.053674	1.028246	0.848045			
41	0.783826	0.722372	0.703491	0.700889	0.743143			
46	1.196820	1.275992	1.497285	1.399244	1.531238			
51	1.283340	1.123298	1.094069	1.117763	0.896491			
56	0.994585	0.957684	1.017911	1.036816	0.984939			
61	0.922133	0.844691	0.873359	0.900041	1.024111			
66	1.035653	1.005869	1.235637	0.978287	0.977246			
71	0.813644	0.940209	0.992274	0.897718	1.005979			
76	1.163072	1.363671	1.303820	1.317698	1.203576			
81	1.158572	1.169389	1.120737	1.177295	1.096409			
86	1.017699	1.070015	1.055710	1.053839	1.014439			
91	0.980987	1.029948	0.965608	0.942092	0.992762			
96	0.883695	0.889467	1.068578	0.864048	1.027372			
101	1.056134	1.068578	1.032930	1.013359	0.960764			
106	0.964621	0.938268	0.888985	0.869203	0.937739			
111	0.905260	0.873152	0.877843	0.814394	0.892487			
116	0.908237	0.949299	0.996816	0.917705	1.017675			
121	0.957940	0.953730	0.896130	0.941862	0.894408			
126	0.802087							

<sup>2</sup> Anguilla is not included.

Indirect Tax Capacity Indices of the individual countries

Year	Antigua	Dominica	Grenada	Montserrat	St. Kitts	St. Lucia	St. Vincent
1977	1.013285	0.993510	0.977450	1.010797	1.030058	0.951434	0.979797
1978	0.982336	1.017887	1.017470	1.004079	0.975291	1.026923	1.028919
1979	1.004556	0.991905	1.012724	0.908654	1.006443	0.993238	0.989101
1980	0.999258	0.999195	0.970167	1.069606	0.956091	0.981284	0.988183
1981	1.014923	0.987831	1.026821	1.030260	0.977294	1.051409	1.022032
1982	0.980828	1.025818	1.023512	1.038192	1.017198	1.037821	1.006661
1983	1.007359	0.978774	1.020338	1.003223	0.995826	0.992800	1.034394
1984	1.017595	1.018798	0.994005	1.018182	1.016227	1.003941	1.021912
1985	0.985878	1.008004	0.965922	1.007939	1.007765	1.010359	0.991561
1986	0.989376	0.993138	1.027348	0.976749	0.999789	1.003306	1.005050
1987	1.003236	1.003937	1.000805	0.991116	0.998444	0.997527	0.968274
1988	0.997864	0.984566	0.987164	1.016103	1.053640	0.968583	0.961694
1989	1.004992	0.974106	0.997358	0.947188	1.019552	1.001180	0.959699
1990	0.997971	0.988698	0.989915	1.026325	0.966579	0.996478	1.000241
1991	1.001870	1.021195	0.992284	0.938816	1.058568	1.014070	1.010080
1992	1.000364	1.052566	1.000829	1.040677	0.995461	1.006051	1.045380
1993	1.002616	0.984431	0.996289	0.996183	0.984975	0.987710	0.992141
1994	0.997602	0.983759	1.016503	0.992319	0.948640	0.988005	1.011254

Total Indirect Tax Capacity for the OECS<sup>3</sup>

All Countries					
1	1.106539	1.046811	1.048553	1.045839	1.067866
6	1.035667	1.043148	1.004859	0.975624	0.969522
11	0.988878	0.988756	1.006675	1.001149	1.014903
16	1.007767	0.999969	0.986518	1.106992	1.098594
21	1.059694	1.042437	1.028157	1.080222	1.031229
26	1.057080	1.019428	0.975941	0.993185	0.981695
31	0.990562	1.023603	1.043935	1.062292	1.011687
36	1.004827	0.976937	0.969847	0.953240	0.960075
41	1.007016	0.970726	0.961518	0.955038	0.908474
46	0.968916	0.954453	0.937402	0.938177	0.934131
51	0.921464	0.919536	0.908397	0.952851	1.149898
56	1.014691	0.920267	1.024710	1.004936	1.036587
61	1.026409	1.087446	1.051831	1.001882	0.957012
66	0.968384	0.901162	0.943070	0.843150	0.945660
71	1.044123	0.986914	1.039424	0.921901	0.902978
76	0.874833	0.910060	1.009149	1.060378	1.075908
81	1.093622	1.058755	1.021549	1.048404	1.038712
86	1.098536	1.122338	1.103496	1.060919	1.057849
91	1.005342	1.061112	1.000876	1.070366	1.082651
96	1.106156	1.081421	1.063318	1.055022	1.014228
101	0.942916	0.953335	0.954140	0.973095	0.954670
106	0.962369	0.956880	0.959477	0.972233	1.013279
111	0.968961	1.006320	1.006440	0.969551	0.995505
116	0.971268	0.937026	0.939595	0.949949	0.946424
121	0.957509	1.014699	1.043632	1.071722	1.045390
126	1.046335				

<sup>3</sup> Anguilla is not included.

## APPENDIX

$$\text{Max. } U = a_1 \ln(Y - T - Y_d) - a_2 \ln B + a_3 \ln(G - G_d)$$

Subject to

$$T + F + B = G \quad \text{Where } G = G_c + G_d$$

$$L = a_1 \ln(Y - T - Y_d) - a_2 \ln B + a_3 \ln(G - G_d) + \lambda(T + F + B - G)$$

$$\frac{\delta L}{\delta T} = -a_1 / (Y - T - Y_d) + \lambda = 0 \quad (1)$$

$$\frac{\delta L}{\delta B} = -a_2 / B + \lambda = 0 \quad (2)$$

$$\frac{\delta L}{\delta G} = a_3 / (G - G_d) - \lambda = 0 \quad (3)$$

$$\frac{\delta L}{\delta \lambda} = T + F + B - G = 0 \quad (4)$$

From (1) (2) and (3)

$$\lambda = a_1 / (Y - T - Y_d) \quad (5)$$

$$\lambda = a_2 / B \quad (6)$$

and

$$\lambda = a_3 / (G - G_d) \quad (7)$$

From (5) and (6)

$$B = \frac{a_2}{a_1} (Y - T - Y_d) \quad (8)$$

$$G = \frac{a_3}{a_1} (Y - T - Y_d) + G \quad (9)$$

Substituting (8) and (9) into (4)

$$T = \frac{a_3}{a_1} (Y - T - Y_d) + G_s - F - \frac{a_2}{a_1} (Y - T - Y_d)$$

$$\therefore T \frac{(a_1 - a_2 - a_3)}{a_1} = \frac{(a_3 - a_2)}{a_1} Y - \frac{(a_2 - a_3)}{a_1} Y_s - G_s - F \quad (10)$$

Dividing throughout by  $Y$  the inverse of  $a$  where  $a = a_1, (a_1 - a_2 - a_3)$  we get

$$(T/Y) = (1 - a) - a \frac{F}{Y} - a \frac{G_s}{Y} (1 - a) \frac{Y_s}{Y} \quad (11)$$

Since  $G_s$  and  $Y_s$  are unobserved then let

$$G_s = g_0 - g_1 Y$$

and

$$Y_s = y_0 - y_1 Y$$

$$\therefore \left(\frac{T}{Y}\right) = [(1 - a) - a g_1 - (1 - a) y_1] - a \frac{F}{Y} + [a g_0 - (1 - a) y_0] \frac{1}{Y} \quad (12)$$

Substituting (12) into (13) below (same as equation (3) in the text)

$$\left(\frac{T}{Y}\right) = f\left[\left(\frac{T}{Y}\right), A, (X - M) / Y, N\right] \quad (13)$$

and assuming (13) to be a linear function yields the basic model as seen in equation (8) in the text under the section