

**TEXTO PARA DISCUSSÃO Nº 818**

**MEASURING THE TAX EFFORT OF  
DEVELOPED AND DEVELOPING  
COUNTRIES. CROSS COUNTRY  
PANEL DATA ANALYSIS — 1985/95**

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Rio de Janeiro, setembro de 2001

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<sup>\*</sup> Da Secretaria Executiva do Ministério da Fazenda.

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## RESUMO

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Na literatura sobre tributação, o índice de esforço fiscal de um país é medido pela razão entre a carga tributária realizada e a carga tributária prevista, sendo a carga tributária medida pela relação receita realizada/prevista sobre o produto interno bruto (PIB). Este índice reflete a variância da capacidade tributária de um determinado país. Um elevado índice de esforço fiscal revela que um país, em particular, está arrecadando mais receita tributária que o previsto, tendo-se em conta a sua estrutura tributária vigente e as condições estruturais prevalecentes, tanto econômicas quanto sociais. Este trabalho estima o índice de esforço fiscal para uma amostra de 75 países no período 1985/95. Dados disponíveis mais recentes e método econométrico até então nunca utilizado nesse tipo de análise foram utilizados. Os resultados obtidos foram então comparados com trabalhos anteriores existentes e que cobrem diferentes períodos nos últimos 30 anos.

Os resultados deste trabalho sugerem que o nível de renda *per capita*, a razão entre volume de comércio e PIB e a participação relativa do setor agrícola no PIB são os elementos mais significativos na determinação da razão entre receita tributária e PIB. Por outro lado, variáveis usualmente utilizadas em outros trabalhos, tais como relação entre o produto da indústria extrativa mineral e o PIB, relação entre quase-moeda (M3) e PIB deixaram de ter relevância como elementos explicativos da carga tributária. O trabalho mostra os países que melhoraram sua *performance* fiscal, medida pelo índice de esforço fiscal, bem como aqueles com *performance* menos favorável. Índices de esforço fiscal são, em seguida, comparados entre grupos de países de alta, média e baixa renda bem como entre diferentes continentes.

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# ABSTRACT

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In the tax literature, the tax effort index for any country is usually measured by the ratio of the actual tax ratio to the predicted ratio. This reflects mainly the variance in the taxable capacity of a country. A high value of tax effort index indicates that a particular country is collecting more tax than would be predicted, given its tax structure and prevailing economic and social conditions. This paper estimates the tax effort index for a sample of 75 countries for the period 1985/95. It incorporates the most recently available data and also econometric techniques not used before for such a type of analysis. The results are then compared with previous studies encompassing different periods over the last 30 years. The evidence provided in this paper suggests that per capita income, the ratio of trade to GDP, and the share of agriculture in GDP of the product of the agricultural sector are the most consistent explanatory variables of the tax ratio, while several variables used in previous studies, such as the ratio of mining output to GDP, and the ratio of quasi-money to GDP, are not significant in the recent period under analysis. This paper shows those countries that have improved their tax performance, measured by the tax effort index, as well as those which have a less favourable performance. Tax ratios and tax effort comparisons are also made among the developed and developing countries according to income groups and different continents.

*Keywords: tax effort, tax revenue, tax ratio*

*JEL Classification Number: H20, H21, H30*

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## 1 - INTRODUCTION

This paper provides updated estimates of the tax effort for a sample of developed and developing countries. Those most recent data available have been used, and more recent econometric methods have been applied. Comprehensive and pioneering studies on tax effort by Chelliah, Baos and Kelly (1975) and by Tait, Gratz and Eichengreen (1979) were published in the late 1970s and refer to three periods during the decades of the 60s and 70s, generally encompassing three year periods using average cross section data. The basic objectives of this paper are twofold: firstly, to identify possible changes in the tax system performance of a sample of developing countries over a relatively long period of 11 years from 1985 to 1995; and secondly, to update the results of previous studies using both panel and cross section data.

The paper is organised as follows: Section 2 provides an overview of earlier studies including the theory and its results. The motivation for this study is also discussed in this section. Section 3 deals with the data and the estimating procedures. Section 4 provides the empirical evidence. Section 5 presents the tax effort index construction. Section 6 examines trends and tendencies in the tax effort indices. New estimates are compared with those estimated for different periods over the last 30 years. Tendencies are then discussed with regard to differences among the countries. Section 7 discusses possible individual country effects on tax effort. Section 8 concludes.

## 2 - EARLIER STUDIES, THEORY AND THE MOTIVATION

Generally, tax ratio analysis aims to explain the main determinants of differences in the tax ratio across countries. It uses a stochastic model where  $T$  is the total tax revenue,  $Y$  is a proxy for income (either GDP or GNP),  $T/Y$  is the tax ratio,  $X_i$  ( $i = 1 \dots n$ ) represent various independent variables expected to influence the tax ratio and  $U$  is the error term, i.e.:

$$T/Y = f(X_1 \dots X_n, U) \quad (1)$$

The independent variables that have been used by previous researchers are: gross national product per capita which is positively related to  $T/Y$ ; the ratio of trade to GDP (import plus export values over GDP), which is also assumed to be positively related to  $T/Y$  because international trade is still an important source of tax revenue in developing countries; domestic per capita income which is also expected to be positively related to the tax ratio; the share of the mining sector in GDP is also expected to be positively related to the tax income ratio; the share of the agricultural sector in GDP is expected to be negatively related to  $T/Y$  in developing countries and reflect a possible degree of tax evasion in this sector. The high literacy rate and the higher degree of monetisation of the economy are variables which are expected to show a positive relation to the tax ratio.

Given this set of independent variables, intercountry tax effort comparisons can be estimated. Generally, tax effort indices are considered to be superior to tax ratio comparisons because they take into account the differences in the way each country exploits its taxable capacity. Thus, given an estimated equation across countries, the tax effort is measured by the difference between the actual and the predicted values of  $T/Y$ , having substituted the values of independent variables into the equation.

Lotz and Morss (1970) were the first to use the difference between actual and predicted tax ratios for the purpose of making inter-country tax effort comparisons. Bahl (1971) produced an extensive survey of earlier studies of tax effort. He concluded that “among developing countries differences in openness account for differences in government revenue shares at least as well as do differences in per capita income.” He also suggests the existence of “volatility of the statistical results with respect to changes in the composition and to the size of the sample as well as the addition of explanatory variables”. This adds to the statement of Chelliah, Baas and Kelly (1975) that tax effort indices are not designed to be used in a mechanistic fashion but are to be considered as useful information for the analysis of the fiscal performance of a country and for the scope for raising more taxes.

Similarly with earlier studies, Chelliah, Baas and Kelly (1975) and Tait, Gratz and Eichengreen (1979) have also used various combinations of explanatory variables to estimate tax effort indices, baptised now as “international tax comparisons”. Table 1 summarises the earlier results.

As Table 1 reveals, five types of equations have been specified (A, B, C, D and E), encompassing three year periods, from 1966 and 1976. Two types of income proxies have been used: per capita income [Lotz and Morss (1971)]; domestic per capita income [Chelliah (1971), Tait (1979)]. The significance of the income variable in these studies has generally been weak. Neither the Lotz and Morss, Chelliah or Tait studies show either per capita income or domestic per capita income to be important. Positive and significant coefficients were found [Chelliah (1971), Tait (1979) and Bahl (1971)] when the mining sector product as a share in GDP was used alone or jointly estimated with the agricultural sector product as a share in GDP (equations B, D and E). The share of the agricultural sector in GDP has shown a mixed and non-conclusive result (equations D and E), either because coefficients appeared (against the expectations) positive and significant or, with a negative sign but non-significant, also against the expected. The trade variable shows a more consistent fit than the income variables. Two different specifications have been used: trade ( $F/Y$ ) as a share of GDP [Lotz and Morss (1970)] and exports as a share of GDP [Chelliah (1971) and Tait (1979)].



Table 1  
**Earlier Studies: Tax Ratio Equations**

Studies		Variables			$R^2$
Equation A	Constant	$Yp$		$F/Y$	
Lotz-Morss <sup>a</sup>	11.65 (7.77)	0.002 (0.50)		0.06 (2.36)	0.11
Equation B	Constant	$Yp-Xp$	$Ny$	$X'y$	
Chelliah (1) <sup>b</sup>	11.47 (7.84)	0.001 (0.38)	0.44 (5.45)	0.05 (1.17)	0.376
Chelliah (2) <sup>c</sup>	9.994 (6.15)	-0.0008 (-0.34)	0.4068 (5.410)	0.193 (3.120)	0.413
Tait <sup>d</sup>	7.113 (4.820)	-0.002 (-0.94)	0.57 (0.931)	0.221 (4.17)	0.581
Equation C	Constant	$Yp-Xp$		$Xy$	
Chelliah (1)	10.36 (6.31)	0.005 (1.32)		0.15 (3.35)	0.178
Chelliah (2)	8.402 (5.54)	0.0005 (0.22)		0.303 (6.49)	0.47
Tait	7.366 (4.41)	0.003 (0.94)		0.302 (6.19)	0.375
Equation D	Constant	$Ny$	$Ay$	$Xy$	
Chelliah (1)	14.46 (8.12)	0.32 (3.85)	0.07 (2.04)	0.04 (1.10)	0.445
Chelliah (2)	8.084 (4.08)	0.211 (2.82)	0.015 (0.36)	0.245 (4.92)	0.542
Tait	9.185 (4.88)	0.355 (5.51)	-0.024 (-0.61)	0.024 (4.390)	0.593
Equation E	Constant	$Ny$	$Ay$		
Bahl <sup>e</sup>	14.95 (9.682)	-0.074 (2.074)	0.295 (3.678)		0.411
Chelliah (1)	15.66 (4.08)	0.355 (2.82)	0.08 (2.44)		0.302
Chelliah (2)	14.357 (7.67)	0.355 (4.15)	-0.03 (-0.57)		0.302
Tait	14.242 (8.45)	0.451 (-6.59)	-0.0517 (-1.30)		0.475

Variables:  $Yp$  = per capita income;  
 $F/Y$  = share of trade in GDP ( $F=X+M$ );  
 $Yp-Xp$  = domestic per capita income;  
 $Ny$  = mining sector share in GDP;  
 $X'y$  = total exports minus mining exports;  
 $Xy$  = total exports share in GDP; and  
 $Ay$  = agricultural sector product share in GDP.

<sup>a</sup> Lotz and Morss sample of 47 countries: period 1969/71;

<sup>b</sup> Chelliah (1) sample of 47 countries: period 1969/71;

<sup>c</sup> Chelliah (2) sample of 47 countries: period 1972/76;

<sup>d</sup> Tait sample of 63 countries: period 1972/76; e

<sup>e</sup> Bahl sample of 49 countries: period 1966/68.

### 3 - DATA AND ESTIMATING PROCEDURES

Data for the present paper were obtained from *World Development Indicators 1999 and the Government Finance Statistics Yearbook 1997, 1998*. The period under study is 1985 to 1995. The sample size was mainly determined by the availability of information. A set of 75 countries was taken and divided into three groups: 31 in the low income group, 19 in the middle income group and 25 in the higher income group, as defined by the *World Development Indicators 1999*, and published by The World Bank. Total tax revenue refers to Central Government only and is measured in local currency.

For the cross-section regression analysis, the data were averaged over the 11 year period. In the panel data analysis, the full sample of 75 countries and 825 observations were used.<sup>1</sup> The basic cross-section regression estimated for the 75 countries was:

$$T_i/Y_i = f(\text{GNPPC}_i, \text{TRADE}_i/\text{GNP}_i, U_i) \quad (2)$$

where the trade variable is measured by  $X_i + M_i$ , where  $X_i$  and  $M_i$  are the total value of imports and exports, respectively, divided by  $\text{GNP}_i$ , and income is measured by  $\text{GNPPC}_i$ , which is gross national product per capita.  $U_i$  is the error term. Control variables were introduced using the shares of the agricultural, industrial and service sectors in GDP.

The panel data model uses both time series and cross section data. The model was estimated with both “fixed effects” and “random effects”.

The fixed model, for a two way estimate, incorporating time and individual country effects, is:

$$T_{it}/Y_{it} = \alpha_0 + \alpha_1 + \gamma_t + \beta x_{it} + \varepsilon_{it} \quad (3)$$

This model has an overall constant term ( $\alpha_0$ ) as well as a group “effect” for each country ( $\alpha_1$ ) and a time “effect” for each period ( $t$ ).

The random model, also for a two way estimate, is:

$$T_{it}/Y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} + u_i + w_t \quad (4)$$

where  $\varepsilon$  is the time effect,  $u$  is the group effect for each country and  $w$  is the disturbance term for time. The model was estimated using the econometric package, Limdep, Version 7.

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<sup>1</sup> The possibility of heteroscedasticity or simultaneity was checked by estimating a weighted regression, using a weighting variable (per capita GNP). A regression model, with the same data, was run for autocorrelation testing.

## 4 - RESULTS

First the cross section results will be presented. Table 2 shows the cross section results of estimating equation (2) in log form. The tax ratio is first regressed on the per capita GNP and on the share of foreign trade in GDP for the whole sample of countries. This same specification was estimated by Lotz and Morss (1970) for the 1967/68 period and re-estimated twice by Tait, Gratz and Eichengreen (1979), for the period 1972/76, using a different sample of countries. Equation 1 shows that the coefficients of per capita income and the trade share are both significant for the 1985/95 period. Over half the variance in the tax ratio across countries is accounted for by these two variables. Then the share of agriculture, industry and services in total GDP are included into the equations separately. None of these variables proved to be significant, and the coefficients of per capita income and trade share hardly changed.

Table 2

### Tax Ratios: Full Sample, Cross-Section — Mean Values 1985/95

	Dependent Variable: Tax Ratio (Total Tax Revenue/GDP)			
	EQ.1	EQ.2	EQ.3	EQ.4
Constant	0.462 (1.294)	0.986 (1.517)	0.151 (0.352)	0.059 (0.893)
GNPPC	0.155 (5.529)	0.118 (2.52)	0.143 (4.902)	0.13 (4.044)
Trade/GDP	0.293 (3.751)	0.281 (3.554)	0.293 (3.777)	0.295 (3.814)
Agric. GDP Share	-	-0.072 (-0.965)	-	-
Ind. GDP Share	-	-	0.107 (1.272)	-
Serv. GDP Share	-	-	-	0.126 (1.516)
Nobs	825	825	825	825
$R^2$	0.41	0.41	0.41	0.42
<b>F</b>	27.07	18.34	18.74	19.14
Estimator	OLS	OLS	OLS	OLS

Next, the sample is split into low income and middle income countries. Table 3 presents cross section estimates with equations fitted for 31 low income countries. Overall, the results are not so robust as those estimated for the full sample. The share of trade in GDP is statistically significant, but not the GNP per capita. This confirms Bahl's (1971) comment in 1971 that in developing countries, trade tends to be more relevant than per capita income in determining the tax ratio. Including the share of agriculture, industry and services in GDP leaves the results unchanged.

Table 3

**Tax Ratios: Low Income Countries, Cross Section — Mean Values 1985/95**

	Dependent Variable: Tax Ratio (Total Tax Revenue/GDP)			
	EQ.1	EQ.2	EQ.3	EQ.4
Constant	0.374 (0.771)	0.291 (0.320)	0.034 (0.067)	0.184 (0.348)
GNPPC	0.095 (1.127)	0.101 (1.005)	0.068 (0.809)	0.087 (1.012)
Trade/GDP	0.415 (2.758)	0.418 (2.681)	0.434 (2.970)	0.403 (2.657)
Agric. GDP Share	-	0.009 (0.108)	-	-
Ind. GDP Share	-	-	0.127 (1.694)	-
Serv. GDP Share	-	-	-	0.68 (0.899)
Nobs	341	341	341	341
$R^2$	0.41	0.38	0.44	0.40
$F$	11.78	7.59	9.32	8.07
Estimator	OLS	OLS	OLS	OLS

Table 4 gives the results for 20 middle income countries. The trade share is again significant, but the level of per capita income is not. The structure of the economy now seems to matter. The tax ratio is negatively related to the share of agriculture in GDP and positively related to the share of industry in GDP. This reflects, no doubt, the greater ease of taxing the profits of industry than the income from agriculture.

We now turn to the panel data estimates which pool time series and cross section data for the 75 countries. We estimate both a random model and a fixed effects model with group dummies and time effects. The results are shown in Table 5.

The results are satisfactory and superior to those achieved by earlier studies. The fixed effects estimates were considered appropriate with all the coefficients being significant, and the proportion of the explained variance differed significantly from that in the cross section estimates. The structure of the economy matters when the GDP share of the agriculture sector is included.

The coefficient displayed a robust estimate, being significant and according to the expected sign. Inclusion of the industry and services sectors share of the GDP either individually or together, did not matter as the overall fit of equations 3, 4 and 5, in Table 5, did not vary substantially. Comparatively with cross-section estimates in Tables 2, 3 and 4, results of Table 5 show that the fixed effects model, as expected, captured a much higher proportion of the variation in the tax ratio and the coefficients are equally robust.<sup>2</sup>

<sup>2</sup> Heteroscedasticity and autocorrelation have not affected the results. The same data set was used in a regression model with a weighted explanatory variable — GNP per capita. Coefficients of GNP per capita and trade share in GDP (0.224 and 0.173, respectively) were significant at the 1% level.

Table 4

**Tax Ratios: Middle Income Countries, Cross Section — Mean Values 1985/95**

	Dependent Variable: Tax Ratio (Total Tax Revenue/GDP)			
	EQ.1	EQ.2	EQ.3	EQ.4
Constant	0.297 (0.304)	2.201 (1.900)	1.035 (-0.898)	-0.236 (-0.139)
GNPPC	0.127 (1.157)	-0.045 (-0.41)	0.084 (0.798)	0.114 (0.968)
Trade/GDP	0.365 (2.995)	0.338 (3.144)	0.328 (2.849)	0.374 (2.942)
Agric. GDP Share	-	-0.293 (-2.447)	-	-
Ind. GDP Share	-	-	0.458 (1.884)	-
Serv. GDP Share	-	-	-	0.129 (0.390)
Nobs	209	209	209	209
R <sup>2</sup>	0.31	0.47	0.40	0.28
F	5.44	6.69	5.35	3.50
Estimator	OLS	OLS	OLS	OLS

Table 5

**Tax Ratios: Country Dummies and Time Effects; Fixed Effects Full Sample: 75 Countries — 1985/95**

	Dependent Variable: Tax Ratio (Total Tax Revenue/GDP)				
	EQ.1	EQ.2	EQ.3	EQ.4	EQ.5
Constant	0.455 (0.713)	1.742 (5.427)	0.418 (0.658)	0.127 (0.199)	-0.278 (-0.966)
GNPPC	0.224 (3.035)	0.102 (3.668)	0.187 (2.502)	0.181 (2.449)	0.114 (4.917)
Trade/GDP	0.164 (3.400)	0.158 (4.297)	0.118 (2.291)	0.186 (3.841)	0.154 (4.336)
Agric. GDP Share	-	-0.113 (-3.837)	-	-	-
Ind. GDP Share	-	-	0.138 (2.424)	-	0.215 (4.336)
Serv. GDP Share	-	-	-	0.123 (3.283)	0.18 (5.092)
Nobs	825	825	825	825	825
R <sup>2</sup>	0.825	0.838	0.838	0.838	0.838
F	25.87	24.95	25.2	24.5	23.64
Country Effects	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes
Estimator	FEM	FEM	FEM	FEM	FEM
LM	1040.7	1894.2	1032.6	1016.2	1829.1
LM (Statistic)					
Hausman	1.15	2.90	1.9	0.68	4.78
Hausman (Statistic)	(0.56)	(0.40)	(0.59)	(0.87)	(0.31)

Notes: t values in brackets, all variables in logarithmic form;

LM (country effects) represents the Breusch-Pagan Lagrange Multiplier statistic for assessing the appropriateness of FEM estimator, (probabilistic values in brackets), FEM denotes fixed effect model.

## 5 - TAX EFFORT INDICES: CONSTRUCTION

In this section we measure tax effort by comparing the actual tax ratio of a country with that predicted by using equation 2 of Table 5. From an econometric point of view, it would not make any difference if equations, 2, 3, 4 and 5 were chosen to construct the tax effort index. The explained variance is the same. The choice of equation 2 is based on the relative economic importance of the agricultural sector for improving fiscal performance. The highly significant and persistently negative coefficient points to the need for special measures, especially in low and middle income countries, in order to correct the unfavourable fiscal performance of the agricultural sector.

Comparisons with previous studies will be made, and then analysis will be centred on trends and tendencies across countries, groups of countries and continents. Finally, examination of the “country effects” will be discussed. Table 6 shows the constructed tax efforts indices.

It can be seen that 41 countries have a tax effort index higher than 1.0 and 34 countries have indices lower than one. Any country with an index greater than one is collecting more tax revenue than would be predicted, given its economic, social and institutional conditions. This means a proportionally larger number of countries with a “good” fiscal effort than shown by the Chelliah, Baas and Kelly (1975) and Tait, Gratz and Eichengreen (1979) studies within the conditions of their respective samples and time. This paper will consider a classification as follows: high index ( $> 1.00$ ), medium index ( $1.00 > x > 0.84$ ) and low index ( $< 0.84$ ).

Tables 7, 8 and 9 give the results for the high, middle and low income groups of countries respectively. The high income group reveals a favourable picture in terms of tax effort. Most of the countries — 17 out of 25 — are in the upper range of the index, i.e. above unity. Average values for the actual and predicted tax ratios show a considerable discrepancy: 36% and 26% respectively. The middle income countries show a considerably different picture from that of the high income countries. Out of the 19 countries, only six show a tax effort index above unity, with three countries (Malaysia, Chile and Mauritius) on the border line.

The low income group of countries showed a larger number of countries with a tax effort index higher than unity, plus one country (Thailand) on the border line. Actual and predicted average tax ratios showed a small discrepancy within this group of countries.

Table 6  
**Tax Effort Indices — Full Sample**

Countries	Tax Ratio Actual (a)*	Tax Ratio Fitted (b)**	Tax Effort Index (c = a/b)	Countries	Tax Ratio Actual (a)*	Tax Ratio Fitted (b)**	Tax Effort Index (c = a/b)
Fiji	20.595	9.023	2.283	Iceland	24.347	22.018	1.106
Kenya	19.991	10.479	1.908	Indonesia	15.737	14.533	1.083
Belgium	42.357	23.774	1.782	Greece	23.093	21.862	1.056
S. Africa	25.182	15.297	1.646	Brazil	17.103	16.273	1.051
Ntherlands	44.273	27.228	1.626	Malaysia	20.016	20.417	0.980
Ethiopia	11.665	7.502	1.555	Chile	18.801	19.451	0.967
Ghana	11.760	7.776	1.512	Thailand	15.620	16.450	0.950
France	37.808	25.785	1.466	Mauritius	19.667	20.720	0.949
India	10.645	7.279	1.462	Malta	25.688	27.647	0.929
Lesotho	23.370	16.058	1.455	Germany	23.485	26.413	0.889
Italy	37.482	26.176	1.432	Australia	22.017	24.904	0.884
Zimbabwe	21.449	15.062	1.424	Ecuador	14.836	16.819	0.882
Uruguay	25.515	18.089	1.411	Peru	10.728	12.223	0.878
Morocco	22.534	16.027	1.406	Jordan	17.733	20.938	0.847
Namibia	27.595	19.957	1.383	Panama	17.881	22.197	0.806
Egypt	20.704	15.121	1.369	Philippines	13.696	17.218	0.795
Romania	21.053	15.797	1.333	Madagascar	9.174	11.641	0.788
Tunisia	24.165	18.171	1.330	Japan	15.856	20.236	0.784
N. Zealand	32.996	24.815	1.330	R. Dominican	12.677	16.432	0.772
Ireland	34.487	26.496	1.302	Colombia	11.895	15.431	0.771
Norway	32.860	25.263	1.301	El Salvador	12.265	15.979	0.768
Pakistan	12.999	10.058	1.292	Mexico	13.752	18.431	0.746
Denmark	33.840	26.369	1.283	USA	18.020	24.251	0.743
Sri Lanka	17.886	14.422	1.240	Turkey	12.452	16.899	0.737
Zambia	18.286	15.133	1.208	Congo RD	6.885	9.379	0.734
Botswana	26.766	22.224	1.204	S'tzerland	19.878	28.015	0.710
PN Guinea	18.825	15.774	1.193	Nepal	7.160	10.387	0.689
UK	32.752	27.542	1.189	Venezuela	16.119	23.675	0.681
L'embourg	39.923	33.653	1.186	Argentina	11.401	17.434	0.654
Portugal	28.667	24.307	1.179	Canada	18.008	27.743	0.649
Sweden	34.721	29.484	1.178	Bolivia	9.451	14.620	0.646
Costa Rica	20.903	17.913	1.167	S Leone	6.789	10.772	0.630
Cameroon	12.784	11.011	1.161	Korea	15.619	25.678	0.608
Spain	28.326	24.437	1.159	Paraguay	9.139	15.754	0.580
Belise	21.649	18.685	1.159	Guatemala	8.024	14.269	0.562
Finland	28.219	24.777	1.139	Iran	7.423	13.702	0.542
Austria	32.210	28.559	1.128	Singapore	15.672	38.905	0.403
Syria	16.334	14.576	1.121				

Notes: \* Total tax revenue/GDP.

\*\* Derived from Eq.2, Table 5.

Table 7  
**Tax Effort Indices — High Income Countries**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Belgium	42.357	23.774	1.782	Spain	28.326	24.437	1.159
Netherlands	44.273	27.228	1.626	Finland	28.219	24.777	1.139
France	37.808	25.785	1.466	Austria	32.210	28.559	1.128
Italy	37.482	26.176	1.432	Iceland	24.347	22.018	1.106
N. Zealand	32.996	24.815	1.330	Greece	23.093	21.862	1.056
Ireland	34.487	26.496	1.302	Germany	23.485	26.413	0.889
Norway	32.860	25.263	1.301	Australia	22.017	24.904	0.884
Denmark	33.840	26.369	1.283	Japan	15.856	20.236	0.784
UK	32.752	27.542	1.189	USA	18.020	24.251	0.743
Luxembourg	39.923	33.653	1.186	Switzerland	19.878	28.015	0.710
Portugal	28.667	24.307	1.179	Canada	18.008	27.743	0.649
Sweden	34.721	29.484	1.178	Korea	15.619	25.678	0.608
				Singapore	15.672	38.905	0.403
			Average	27,512 (Actual)	26,392 (Fitted)		

Table 8  
**Tax Effort Indices — Middle Income Countries**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
S. Africa	25.182	15.297	1.646	Peru	10.728	12.223	0.878
Uruguay	25.515	18.089	1.411	Philippines	13.218	17.218	0.795
Botswana	26.766	22.224	1.204	Colombia	11.895	15.431	0.771
Costa Rica	20.903	17.913	1.167	Mexico	13.752	18.431	0.746
Indonesia	15.737	14.533	1.083	Turkey	12.452	16.899	0.737
Brazil	17.103	16.273	1.051	Venezuela	16.119	23.675	0.681
Malaysia	20.016	20.417	0.980	Argentina	11.401	17.434	0.654
Chile	18.801	19.451	0.967	Paraguay	9.139	15.754	0.580
Mauritius	19.667	20.720	0.949	Iran	7.423	13.702	0.542
Malta	25.688	27.647	0.929				
			Average	16,947 (Actual)	18,070 (Fitted)		



Table 9  
**Tax Effort Indices — Low Income Countries**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Fiji	20.595	9.023	2.283	PN Guinea	18.825	15.774	1.193
Kenya	19.991	10.479	1.908	Cameroon	12.784	11.011	1.161
Ethiopia	11.665	7.502	1.555	Belize	21.649	18.685	1.159
Ghana	11.760	7.776	1.512	Syria	16.334	14.576	1.121
India	10.645	7.279	1.455	Thailand	15.620	16.450	0.950
Lesotho	23.370	16.058	1.455	Equador	14.836	16.819	0.882
Zimbabwe	21.449	15.062	1.424	Jordan	17.733	20.938	0.847
Morocco	22.534	16.027	1.406	Panama	17.881	22.197	0.806
Namibia	27.595	19.957	1.383	Madagascar	9.174	11.641	0.788
Egypt	20.704	15.121	1.369	R. Dominican	12.677	16.432	0.772
Romania	21.053	15.797	1.333	El Salvador	12.265	15.979	0.768
Tunisia	24.165	18.171	1.330	Congo RD	6.885	9.379	0.734
Sri Lanka	17.886	14.422	1.240	Nepal	7.160	10.387	0.689
Pakistan	12.999	10.584	1.228	Bolivia	9.451	14.620	0.646
Zambia	18.286	15.133	1.208	Sierra Leone	6.789	10.772	0.630
				Guatemala	8.024	14.269	0.562
Average 15.896 (Actual) 14.139 (Fitted)							

## 6 - TAX EFFORT INDICES: TRENDS AND TENDENCIES

We now turn to the tax effort index by continents. Table 10 shows European/OECD countries with a high average actual tax ratio of 35 against a predicted ratio of 26. Larger discrepancies were also detected in Africa (Table 11), while Latin America and Asia/Middle East countries showed small discrepancies (Tables 12 and 13).

Table 10  
**Tax Effort Indices — Europe/OECD**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Belgium	42.357	23.774	1.782	Finland	28.219	24.777	1.139
Netherlands	44.273	27.228	1.626	Austria	32.210	28.559	1.128
France	37.808	25.785	1.466	Iceland	24.347	22.018	1.106
Italy	37.482	26.176	1.432	Greece	23.093	21.862	1.056
New Zealand	32.996	24.815	1.330	Germany	23.485	26.413	0.889
Ireland	34.487	26.496	1.302	Australia	22.017	24.904	0.884
Norway	32.860	25.263	1.301	Japan	15.856	20.236	0.784
Denmark	33.840	26.369	1.283	USA	18.020	24.251	0.743
UK	32.752	27.542	1.189	Switzerland	19.878	28.015	0.710
Luxembourg	39.923	33.653	1.186	Canada	18.008	27.743	0.649
Portugal	28.667	24.307	1.179	Korea	15.619	25.678	0.608
Sweden	34.721	29.484	1.178	Singapore	15.672	38.905	0.403
Spain	28.326	24.437	1.159				
Average 29.218(Actual) 25.824(Fitted)							

Table 11  
**Tax Effort Indices — Africa**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Lesotho	23.370	16.058	1.455	Ghana	11.760	7.776	1.512
Namibia	27.595	19.957	1.383	South Africa	25.182	15.297	1.646
Morocco	22.534	16.027	1.406	Cameroon	12.784	11.011	1.161
Egypt	20.704	15.121	1.369	Sierra Leone	6.789	10.772	0.630
Tunisia	24.165	18.171	1.330	Congo RD	6.885	9.379	0.734
Zimbabwe	21.449	15.062	1.424	Botswana	26.766	22.224	1.204
Kenya	19.991	10.479	1.908	Ghana	11.760	7.776	1.512
Ethiopia	11.665	7.502	1.555	Sierra Leone	6.789	10.772	0.630
Madagascar	9.174	11.641	0.788	Zambia	18.286	15.133	1.208
Average		17,092 (Actual)					13,342 (Fitted)

Table 12  
**Tax Effort Indices — Latin America**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Uruguay	25.515	18.089	1.411	Colombia	11.895	15.431	0.771
Costa Rica	20.903	17.913	1.167	El Salvador	12.265	15.979	0.768
Belize	21.649	18.685	1.159	Mexico	13.752	18.431	0.746
Brazil	17.103	16.273	1.051	Venezuela	16.119	23.675	0.681
Chile	18.801	19.451	0.967	Argentina	11.401	17.434	0.654
Ecuador	14.836	16.819	0.882	Bolivia	9.451	14.621	0.646
Peru	10.728	12.223	0.878	Paraguay	9.139	15.754	0.580
Panama	17.881	22.197	0.806	Guatemala	8.024	14.269	0.562
R. Dominican	12.677	16.432	0.772				
Average		14.832 (Actual)					17.275(Fitted)

Table 13  
**Tax Effort Indices — Asia/Middle East**

Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort	Countries	Tax Ratio Actual	Tax Ratio Fitted	Tax Effort
Fiji	20.595	9.023	2.283	Malaysia	20.016	20.417	0.980
India	10.645	7.279	1.462	Thailand	15.620	16.450	0.950
Sri Lanka	17.886	14.422	1.240	Mauritius	19.667	20.720	0.949
Pakistan	12.999	10.584	1.228	Jordan	17.733	20.939	0.847
PN Guinea	18.825	15.774	1.193	Philippines	13.696	17.218	0.795
Syria	16.334	14.576	1.121	Nepal	7.160	10.387	0.689
Indonesia	15.737	14.533	1.083	Iran	7.423	13.702	0.542
Average		15.332 (Actual)					16.228 (Fitted))

The results of three relevant previous studies on tax effort are listed in Table 14. They show an intertemporal comparison of tax effort indices variance over time. Chelliah, Baas and Kelly (1975) and Tait, Gratz and eichengreen (1979) have estimated tax effort indices for the periods 1966/68, 1969/71 and 1972/76 respectively. The number of countries and the sample size varied from one study to another. Countries listed in Table 14 are those which appeared in all three studies and are part of this work.

Table 14

**Intertemporal Comparison of Tax Effort Indices**

	Tax Effort Index* 1966/68 (a)	Tax Effort Index** 1969/71 (b)	Tax Effort Index*** 1972/76 (c)	Average Index d = (a + b + c)/3	Tax Effort Index****1985/95 (e)
Kenya	1.155	1.090	1.219	1.155	1.908
Morocco	1.163	1.224	1.214	1.200	1.406
Zambia	1.175	-	-	1.175	1.208
Tunisia	1.297	1.639	1.184	1.373	1.330
Ethiopia	0.783	0.705	0.803	0.764	1.555
Sri Lanka	1.270	1.374	0.983	1.209	1.240
Costa Rica	0.813	0.970	0.858	0.880	1.167
Indonesia	0.618	0.658	0.797	0.691	1.083
Brazil	1.779	1.806	1.607	1.731	1.051
Pakistan	0.752	0.728	0.959	0.813	1.292
Chile	1.176	1.159	1.265	1.200	0.967
India	1.052	1.093	1.252	1.132	1.462
Malaysia	1.016	1.193	1.191	1.133	0.980
Ecuador	0.978	1.002	0.680	0.887	0.882
Ghana	1.015	1.154	0.976	1.048	1.512
Thailand	0.996	0.925	0.986	0.969	0.950
Peru	0.923	0.874	0.986	0.928	0.878
Philippines	0.771	0.683	0.718	0.724	0.795
Venezuela	0.971	0.958	0.92	0.950	0.681
Argentina	1.098	0.973	1.099	1.057	0.654
Turkey	1.164	1.197	1.484	1.282	0.737
Bolivia	0.538	0.459	0.742	0.580	0.646
Korea	0.972	-	-	0.972	0.608
Paraguay	0.801	0.867	0.665	0.778	0.580
Singapore	0.752	0.796	0.785	0.778	0.403
Congo RD	1.435	1.276	1.295	1.335	0.734
Guatemala	0.647	0.618	0.558	0.608	0.562
Iran	0.972	0.913	1.72	1.202	0.542
Colombia	0.803	0.901	0.899	0.868	0.771
Nepal	0.300	0.374	0.489	0.388	0.689
Rank Correlation	a,b = 0.944	b,c = 0.702	d,e = 0.852		

\* Chelliah.

\*\* Chelliah.

\*\*\* Tait.

\*\*\*\* Present study.

Out of 30 countries, 10 showed a steady increase in the tax effort index, when comparing the index estimated for the 1985/95 period with the estimated average of the previous studies. Seventeen countries show a lower tax effort index.

Overall this is a result which shows that most of the developing countries still lack a consistent fiscal policy able to achieve stable and higher tax ratio levels. Countries with strong sub-national governments (with a higher degree of autonomy to collect tax), as in the cases of India and Brazil, are likely to have their tax effort index possibly underestimated. The data selected for this study do not comprise subnational governments for the reasons explained in Section 3 above.

## **7 - TAX EFFORT INDEX: COUNTRY EFFECTS**

The remainder of this section will discuss the individual country effects on tax effort indices permitted by the use of panel data. There are inherent reasons why individual country effects can affect the results. Individual countries are likely to face difficulties to raise taxes.

Cultural factors, institutional and legal restrictions may all prevent a country from reaching a solid fiscal position. The estimated country effect in this panel study is the first measurable assessment of this individual ability to increase taxes or not. Tables 15 and 16 attempt to show an additional measure of how far each country has to evolve in order to match the overall intercept and contribute to the tax increase. The deviation column can be interpreted as the differential effort each country is faced with in relation to the overall intercept.

The overall intercept for equation (2) in Table 5 is 1.742. A positive and higher than 1.742 individual country effect represents the contribution of unidentified factors to the tax effort. A lower figure shows a country having less than average incentives (conditions) to increase tax revenues. Negative figures show tendencies for reducing tax ratios and, consequently, tax efforts.

Deviations from the intercept term for the groups of countries are also shown in Tables 15 and 16. The mean deviation is far greater for Europe/OECD and African countries than for the Latin American and Asian/Middle East countries. This indicates that, apart from income, trade and sectorial production share in GDP, other factors represent hindrances for increasing tax ratios in developing countries. Countries could possibly be grouped by similar economic, cultural or institutional characteristics which may have similar factors influencing tax revenue. Legal characteristics or membership of trade blocs can also lead to fiscal mechanisms which prevent higher tax collection.

Table 15

**Country Effect in Selected Developing Countries — Deviation from Overall Intercept<sup>a</sup>**

	Europe/OECD			Africa	
	Effect	Deviation		Effect	Deviation
Netherlands	2.600	0.858	Kenya	2.498	0.756
Ireland	2.507	0.765	Namibia	2.458	0.716
France	2.477	0.735	Morocco	2.422	0.680
Italy	2.464	0.722	Lesotho	2.416	0.674
New Zealand	2.441	0.699	Tunisia	2.397	0.655
Belgium	2.424	0.682	Egypt	2.390	0.648
Denmark	2.378	0.636	South Africa	2.340	0.598
Norway	2.375	0.633	Zambia	2.331	0.589
Sweden	2.306	0.564	Botswana	2.290	0.548
Portugal	2.277	0.535	Ethiopia	2.226	0.484
UK	2.270	0.528	Madagascar	2.194	0.452
Finland	2.258	0.516	Zimbabwe	2.168	0.426
Spain	2.242	0.500	Ghana	2.031	0.289
Austria	2.237	0.495	Cameroon	1.962	0.220
Iceland	2.220	0.478	Sierra Leone	1.570	-0.172
Germany	2.143	0.401	Congo RD	1.452	-0.290
Greece	2.122	0.380			
Luxembourg	2.109	0.367			
Australia	1.996	0.254	Average	2.197	0.455
USA	1.757	0.015			
Japan	1.736	-0.006			
Switzerland	1.711	-0.031			
Canada	1.699	-0.043			
Korea	1.628	-0.114			
Singapore	1.252	-0.490			
Average	2.14516	0.40316			

<sup>a</sup> Constant term Eq.5, Random effects, Table 5.

Table 16

**Country Effect in Selected Developing Countries — Deviation from Overall Intercept<sup>a</sup>**

	Latin America			Asia/M.East	
	Effect	Deviation		Effect	Deviation
Uruguay	2.422	0.680	PN Guinea	2.277	0.535
Costa Rica	2.267	0.525	Sri Lanka	2.257	0.515
Belize	2.233	0.491	Fiji	2.215	0.473
Chile	2.097	0.355	Syria	2.179	0.437
Brazil	2.066	0.324	Indonesia	2.148	0.406
Ecuador	1.979	0.237	Malaysia	2.130	0.388
Colombia	1.940	0.198	Pakistan	2.068	0.326
Panama	1.927	0.185	Mauritius	2.048	0.306
R. Dominican	1.830	0.088	India	1.978	0.236
Mexico	1.775	0.033	Jordan	1.937	0.195
Venezuela	1.709	-0.033	Thailand	1.936	0.194
Peru	1.687	-0.055	Philippines	1.821	0.079
El Salvador	1.673	-0.069	Turkey	1.727	-0.015
Bolivia	1.633	-0.109	Nepal	1.595	-0.147
Argentina	1.622	-0.120	Iran	1.384	-0.348
Paraguay	1.530	-0.212			
Guatemala	1.415	-0.327			
Average	1.871	0.129	Average	1.981	0.239

<sup>a</sup> Constant term Eq.5, Random effects, Table 5.

## 8 - CONCLUSIONS

This paper provides a comprehensive update of the measurement of the tax effort in both developed and developing countries.

The results of this update are fully consistent with, and reinforce, earlier patterns. Namely, the role of per capita income, the trade/GDP ratio and the agricultural sector GDP share are still the most consistent variables for explaining tax ratios, although a number of other variables have also been tested.

Unlike previous studies, however, the role of the agricultural, industrial and service sectors in explaining tax ratios has altered the estimates when taken separately or *together*.

In the cross section estimates, results for the full sample of 75 countries, both the GNP per capita and trade ratios, are significant. Sectoral variables were not always significant. In the middle income results, however, both agriculture and industry show significant results: the first with a robust negative elasticity; the second with a robust positive elasticity.

The panel data estimates confirm the significance of per capita income and the trade share in explaining differences in tax ratios. The share of industry,

agriculture and service sectors also matters. The agricultural sector showed a significant and expected fit, while the industrial and services sectors, despite showing significant results, did not altered overall fit of previous estimates.

Comparison with previous studies showed that the range of the constructed tax effort indices did not vary significantly. High income countries showed sound performance in terms of tax effort. Most of the countries have an index above unity. Middle income countries show a less favourable performance than high income countries. There are fewer countries with an index above unity. The results for lower income countries were unequivocally better than those for middle income countries. A majority of countries show high tax effort indices.

Intemporal comparisons of tax effort indices over the period 1966-1995, carried out in different time periods, indicate that 17 countries out of 30 had lower indices. Country effects suggest, however, that the majority of countries still have unidentified effects pushing down tax revenues. In fact, few countries, such as Kenya, Lesotho, Zambia, Egypt, Ethiopia and Morocco, showed a high fiscal effort index and positive individual country effect. This may indicate that raising tax revenue may not be the strategy for achieving fiscal adjustment.

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