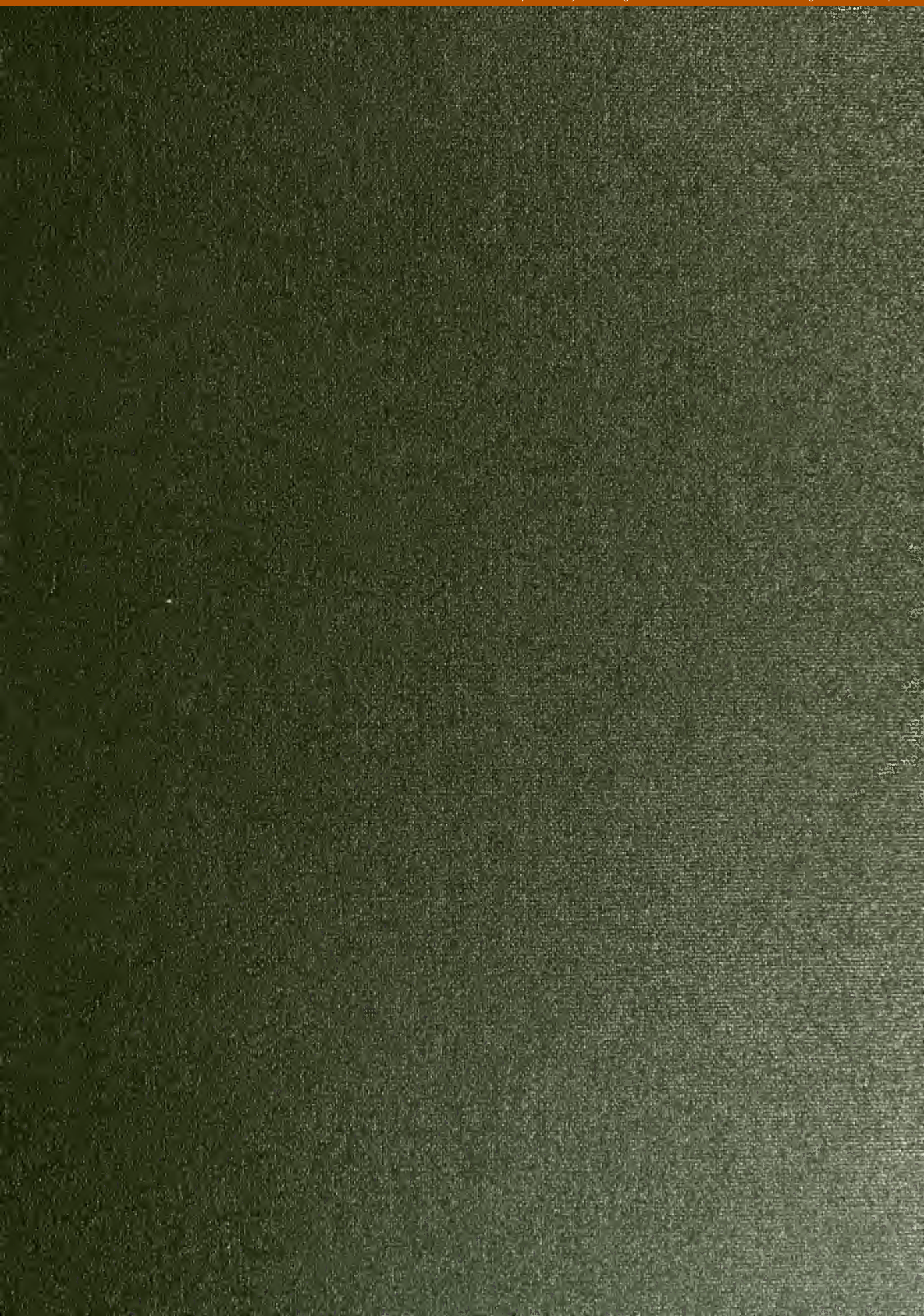

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FACULTY WORKING
PAPER NO. 1272

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August 1986

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Draft: Not for quotation.

We are grateful to the African Studies Center at the University of Illinois, to the Midwest Universities Consortium for International Activities, and to the Centre Ivorien de Recherches Economiques et Sociales in Abidjan for support of this research.

ABSTRACT

The concepts of tax buoyancy and tax efficiency are used to measure the responsiveness of tax revenue to economic growth. Tax buoyancy is a crude measure which does not distinguish between discretionary and automatic growth of revenue. Elasticity is a preferred measure of tax responsiveness since it controls for automatic revenue changes. In this study, the buoyancies and elasticities of the major taxes in a representative developing economy, the Ivory Coast, are estimated using alternative estimation techniques and comparisons between buoyancies and elasticities are drawn. In general, tax receipts in the Ivory Coast tend to be slightly inelastic while particular taxes such as the value added tax are highly elastic. The results of the study have important policy and research implications.

TAX BUOYANCY VS ELASTICITY IN A DEVELOPING ECONOMY

Tax buoyancy is a measure of the responsiveness of tax receipts to economic growth. A tax which is buoyant is one whose revenues increase by more than one percent for a one percent increase in national income or output. In measuring buoyancy, no attempt is made to control for discretionary changes in the tax system or administration. Consequently, buoyancy reflects both discretionary changes and automatic revenue growth.

For policy purposes, it is usually useful to distinguish between revenue growth due to discretionary changes and revenue growth due to changing economic conditions. Tax elasticity is a measure designed for this purpose since it measures the responsiveness of tax revenue to a change in national income or output after controlling for exogenous influences such as discretionary changes in tax policy. If a tax is elastic, a one percent increase in GNP or GDP results in a greater than one percent increase in revenue from the tax holding constant for discretionary tax changes.

For various reasons, studies of tax responsiveness often focus on tax buoyancies rather than tax elasticities. One problem is in obtaining information on discretionary revenue changes. Sometimes this information is available through the Minister of Finance, however this source may not know or be willing to report the discretionary revenue change. At best, the information is an estimate which may or may not be based on a sound economic model.

Secondly, utilizing information on discretionary revenue changes to control for such changes may result in the loss of degrees of

freedom in a regression analysis. This is a particular problem in the study of developing economies since the data series are usually short to begin with. Each new control variable reduces the number of degrees of freedom by one, reducing the efficiency of the regression estimates.

The purpose of the present study is to utilize tax revenue data from a representative developing economy, the Ivory Coast, to estimate tax buoyancies and elasticities using alternative techniques and to evaluate these techniques on the basis of the estimation. A brief description of the tax system in the Ivory Coast follows in section I. In section II is a discussion of the methodology used in this study and section III is a presentation of the results. Section IV is a summary and evaluation.

I. The Tax System in the Ivory Coast

The tax structure in the Ivory Coast is characteristic of that of most developing economies. The composition of the tax structure in 1979 is shown in Table 1. The heavy emphasis on trade and consumption taxes coupled with a lesser reliance on income and property taxes is common in developing countries.

Import duties provide the most important source of revenue in the Ivory Coast. Duties on imports are levied at rates up to forty percent. The second most important revenue source is the value added tax which is similar in operation to the European value added taxes but is limited to the manufacturing stage. Foodstuffs and exports are exempt from the tax and rates are graduated over commodity types with a 10 percent rate for quasi-necessities and 20 and 26 percent rates

Table 1 The Composition of the Tax Structure in the Ivory Coast, 1979

	Percent of Revenue	
INCOME TAXATION		15.7
Profits tax	7.2	
Individual income tax	5.1	
Other income taxes	3.3	
CONSUMPTION TAXATION		32.2
Value added taxes	24.1	
Excise taxes	5.3	
Tobacco	1.5	
Alcoholic beverages	.4	
Gasoline	3.4	
Timber	2.8	
PROPERTY TAXES		1.1
Real estate tax	.9	
Motor vehicle tax	.2	
TRADE TAXES		48.9
Import duties	41.0	
Export duties	7.9	
OTHER		2.2
TOTAL		100.1

Source: Fonds Monetaire International, Analyse et Programmation Fincincieres: Application á la Côte d' Ivoire, Washington, D.C., p. 223.

for luxuries. The tax is imposed on the manufacturing sector with credits for taxes paid on inputs, including investment goods. The Ivory Coast also has a turnover tax on services but service firms may opt for the value added tax.[1]

The individual income tax in the Ivory Coast is schedular in form. Wages and salaries are subject to four different income taxes. The Ivory Coast follows the French pattern of splitting income among husband, wife and children with the husband and wife each allocated one part and each child one-half part up to a maximum of five parts. Rates are graduated up to 60 percent; however, the maximum effective rate is around 33 percent.[2]

Corporate income is subject to three taxes, a tax on corporate profits, a national contribution, and a national investment fund whose combined rates are 50 percent. The tax on corporate profits offers a five year exemption for new businesses with prior approval. A 50 percent investment allowance is also granted for investment in the construction of new buildings or in manufacturing or similar projects.

Other taxes include excise taxes on tobacco, alcoholic beverages, and gasoline, a timber tax, and two property taxes, one on real estate and the other on motor vehicles. Together, these taxes account for less than 10 percent of total revenue.

II. Techniques for Estimating Tax Elasticities

As noted earlier, tax buoyancy measures the responsiveness of tax revenue to changes in income or output with no attempt to control for discretionary changes in policy. The traditional way to estimate the elasticity of a particular tax, k, is with the following model:

$$(1) \qquad \log T_k = a_0 + a_1 \log GDP + e_k$$

where T is tax revenue, GDP is gross domestic product, and e is a stochastic disturbance term. Ordinary least squares is used to estimate the coefficients a_0 and a_1. Since the equation is in double-log form, a_1 provides an estimate of the tax buoyancy because it measures the percentage response in the left-hand variable for a one percent change in the right-hand variable.

Estimating tax elasticity involves modifying the above model to account for discretionary changes in tax policy. One technique for doing this was developed by Prest in studying the personal income tax in the United Kingdom.[3] The technique has been used in several studies including one by Mansfield in 1972.[4] It involves cleansing the data of discretionary revenue changes using data on discretionary revenue provided by the Minister of Finance. This is accomplished by applying the following formula to the data to compute the adjusted tax receipts, AT:

$$(2) \qquad AT_{n-j} = T_{n-j}[AT_{n-j+1}/(T_{n-j+1}-D_{n-j+1})]$$

for j = 1,2,...,n-1 where T is actual tax receipts and D is estimated discretionary tax receipts. The subscript denotes the year of the data. Basically, the technique computes what the tax receipts would be in the absence of a discretionary change. An important underlying assumption of this technique, which may or may not be satisfied in a particular case, is that the discretionary changes are no more or less progressive than the tax structure they modify.

Once the data have been cleansed by the above technique, model (1) is reestimated on the adjusted data:

$$(3) \qquad \log AT_k = b_0 + b_1 \log GDP + e_k$$

and b_1 provides an estimate of the elasticity of the kth tax.

A second technique for estimating tax elasticity is the dummy variable technique developed by Singer.[5] This technique involves introducing a dummy variable into model (1) for each exogenous policy change. The revised model takes the form:

$$(4) \qquad \log T_k = c_0 + c_1 \log GDP + \sum_i c_{2i} D_i + e_k$$

where the dummy variable, D, takes on the value 0 before the discretionary change and 1 after the change. The summation accounts for the possibility of multiple changes during the period. In this model, the coefficient c_1 estimates the elasticity.

The Prest and the Singer techniques were used in this study to estimate the elasticities of Ivorian taxes. The study used International Monetary Fund data for the period 1970 through 1979.[6] The results of utilizing these estimation techniques are reported in the next section.

III. Tax Buoyancy and Elasticity Estimates

To provide a basis of comparison, buoyancy estimates for each of the major Ivorian taxes were obtained through the ordinary least squares estimation of model (1). The results of this estimation appear in Table 2. The buoyancies given by the a_1 were all significantly different from zero at the .99 confidence level. For all but

Table 2 Buoyancies of the Major Ivorian Taxes, 1970-79

Tax	a_0	a_1	R^2	D.W.
All taxes	-1.486**	.983**	.997	1.676
Income and profits taxes	-2.698**	.880**	.933	1.263
Income tax	-3.606**	.841**	.826	1.556
Profits tax	-3.352**	.870**	.962	1.022
Consumption taxes	-4.425**	1.229**	.993	2.191
Value added tax	-6.709**	1.492**	.990	1.546
Excise taxes	-1.019	.519**	.813	1.055
Gasoline tax	-3.015**	.729**	.924	1.475
Trade taxes	-1.679**	.916**	.993	2.128
Import taxes	-3.214**	1.098**	.996	2.110
Export taxes	.582	.373**	.822	2.762

**Significant at the .99 confidence level.

the income tax, excise taxes, and export taxes, the model fit the data very well according to the R-squared statistic which measures the goodness of fit and the Durbin-Watson statistics indicated no problem of autocorrelation among the residuals except for the profits tax and the excise taxes.[7]

As seen in Table 2, the most buoyant Ivorian tax is the value added tax. Value added taxes in developing economies tend to be among the more elastic taxes especially if they exempt foodstuffs as in the case of the Ivory Coast and if they are administered well. The other buoyant taxes are total consumption taxes and import taxes. The remaining taxes have buoyancies less than one meaning that a one percent increase in GDP results in a less than one percent increase in tax revenue. The least buoyant tax is the export tax followed by excise taxes. Overall, the tax system in the Ivory Coast is roughly unit buoyant with a one percent increase in GDP being matched with a 98.3 percent increase in tax revenues.

The results of applying the Prest technique to first cleanse the data of discretionary changes and then to estimate the model using ordinary least squares are shown in Table 3. The coefficient b_1 estimates the elasticity and is always significant at the .99 confidence level. In all but one case, the elasticity estimated using the Prest technique is smaller than the buoyancy. This is expected since the elasticity measures the responsiveness of tax receipts to economic growth net of discretionary changes. In the case of the value added tax, the elasticity and buoyancy are identical because the discretionary changes in that tax were negligible.

Table 3 Elasticities of Major Ivorian Taxes
Using Prest Technique, 1970-79

Tax	b_0	b_1	R^2	D.W.
All taxes	-1.321**	.961**	.997	1.700
Income and profits taxes	-2.429**	.844**	.928	1.218
Income tax	-3.370**	.809**	.819	1.591
Profits tax	-2.932**	.812**	.954	.948
Consumption taxes	-4.347**	1.218**	.993	2.273
Value added tax	-6.708**	1.492**	.990	1.537
Excise taxes	-.801	.491**	.789	1.036
Gasoline tax	-2.605**	.675**	.903	1.365
Trade taxes	-1.477**	.890**	.994	2.204
Import taxes	-3.028**	1.075**	.996	2.014
Export taxes	.806**	.344**	.806	2.811

**Significant at the .99 confidence level.

Finally, the results of applying the Singer dummy variable technique appear in Table 4. In applying this technique, a dummy variable was created if a discretionary change resulted in a greater than three percent change in tax revenue. The dummy variable equalled one in the year of change and each year following. In only four cases, all taxes, excise taxes, the gas tax, and export tax, were there discretionary changes of significant magnitude to warrant a dummy variable. In all cases, the coefficients of the dummy variables were not significant at the .99 confidence level. However, except for the export tax, the coefficient c_1 estimating the elasticity was significantly different from zero at the .99 confidence level.

A comparison of the elasticity estimates using the Prest technique with those using the Singer technique suggests that the techniques give roughly the same estimates for total taxes and for the gas tax. However, excise taxes are more elastic under the Singer technique while export taxes are more elastic under the Prest technique. In choosing between the two techniques, the Prest technique has several advantages. First, the Prest technique preserves the degrees of freedom which are lost each time a dummy variable is used in the Singer technique. Since the data series is short, this may be important. Second, the Prest technique utilizes more information than the Singer technique. Even small discretionary changes (those changing revenue three percent or less) are incorporated into the Prest technique while the Singer technique only accounted for discretionary revenue changes greater than three percent.[8] Finally, as pointed out earlier, the coefficients of the dummy variables using the Singer

Table 4 Elasticities of Major Ivorian Taxes
Using Singer Technique, 1970-79

Tax	c_0	c_1	R^2	D.W.
All taxes	-1.354**	.963**	.997	1.742
Excise taxes	-1.697**	.634**	.854	1.768
Gas tax	-2.603**	.664**	.951	2.716
Export tax	1.407	.241	.846	2.894

**Significant at the .99 confidence level.

technique were never significantly different from zero. While this was probably due to multicollinearity, it tends to reduce confidence in the model.

IV. Conclusions

In this study, two techniques for estimating elasticities were applied to tax revenue data from the Ivory Coast to determine the elasticities of the major Ivorian taxes. In general, the most elastic tax is the value added tax, followed by total consumption taxes and import taxes. The least elastic tax is the export tax followed by excise taxes. Overall elasticity of Ivorian taxes is .961 meaning that tax receipts grow at a slightly lower rate than GDP.

These results are important for policy purposes. An elastic tax system is desirable in a developing economy because it means that tax receipts will grow automatically with growing income without the need for politically sensitive increases in tax rates.[9] As per capita income increases with economic development, the demand for government goods and services such as transportation, communication, and general government administration services also increases.[10] Add to this increasing government demand for funds to finance development related projects like education and agricultural extension, and the benefits of an elastic tax system become evident.

Since elasticity is an important element of taxation in a developing economy, it is crucial that policy makers be able to identify those taxes which are elastic and those which are inelastic. Increasing the overall elasticity of the tax system involves utilizing more

heavily those taxes which are most elastic. Further, the elasticity of individual taxes can be increased by certain measures. One is by improved administration. Taxes which are better administered tend to be more elastic. Another measure is to convert specific excise taxes to ad valorem taxes. Since an ad valorem tax applies a rate to the base, revenues from ad valorem taxes tend to grow with the economy without the need for discretionary increases.

The techniques of this study could be readily extended to the study of taxes in other developing economies. The results of this study suggest some preference for the Prest technique over the Singer technique although further study is necessary to explore this issue. As longer data series become available for developing economies, further research in this area should be rewarding.

Footnotes

[1]For a description of the Ivorian value added tax and its operation, see Moise Koumoue Koffi, La Taxe sur la Valuer Ajoutée dans la Dévelopment de la Côte d'Ivoire, Nouvelles Editions Africaines, Abidjan, 1981.

[2]See Arthur Anderson and Company, A Guide to Taxation in the Ivory Coast, April, 1982, for further details.

[3]Alan R. Prest, "The Sensitivity of the Yield of Personal Income Tax in the United Kingdom," The Economic Journal, vol. 72 (1962), pp. 576-96.

[4]See Charles Y. Mansfield, "Elasticity and Buoyancy of a Tax System: A Method Applied to Paraguay," IMF Staff Papers, vol. 26, no. 2 (1972), pp. 425-426.

[5]Neil M. Singer, "The Use of Dummy Variables in Estimating the Income Elasticity of State Income Tax Revenues," National Tax Journal, vol. 21, no. 2 (1968), pp. 200-204.

[6]The data were obtained from International Monetary Fund, Analyse et Programmation Financieres: Application a la Côte d'Ivoire, Washington, D.C. (1984), Table 1, p. 222. An error in the data resulting in a nine billion CFA understatement of excise taxes, consumption taxes, and total tax receipts in 1977 was corrected. Estimates of the discretionary revenue changes were obtained from Table 2, p. 231, in the same source.

[7]According to a Durbin-Watson two-tail test, the hypothesis of no autocorrelation was rejected at the .05 level for the profits tax and

the excise taxes. The test was inconclusive for the income and profits taxes and for export taxes.

[8]The three percent criterion was chosen arbitrarily so as to capture significant discretionary revenue changes without generating too many dummy variables in any one equation. Two dummies were added to the all taxes equation (1973 and 1976), two to the excise equation (1972 and 1973), three to the gas tax equation (1972, 1973, and 1978), and one to the export tax equation (1976).

[9]John F. Due, Government Finance, Richard D. Irwin, Inc.: Homewood, IL, 1981, p. 550.

[10]Stephen R. Lewis, Taxation for Development, Oxford University Press: New York, 1984, p. 34.