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A Regression Approach to Tax Effort and Tax Ratio Analysis

Roy W. Bahl *

I. Introduction

THE POTENTIAL USEFULNESS of meaningful intercountry comparisons of the size of the public sector has prompted numerous attempts to explain statistically the variation, at a point in time, in tax ratios. These analyses have usually employed a single-equation regression model to identify the determinants of intercountry differences in the tax ratio. In one sense this approach represents an attempt to construct a positive theory of taxation by assuming that measurable characteristics of a country are systematically related to its revealed preference for a given size government, namely, the size of its tax ratio. However, recent studies on tax ratio have turned from strictly positive analyses with an informational objective to a normative application with the objective of making intercountry tax effort comparisons. The use of studies for this latter purpose is limited by a set of conceptual and

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The author is indebted to Richard Goode, Raja Chelliah, David Klein, and Mahla Ong for many helpful suggestions and comments.

1 This is the second in a series of papers originating from a study of taxation in developing countries undertaken by the Fund's Fiscal Affairs Department. The first paper, "Trends in Taxation in Developing Countries," by Raja J. Chelliah, appeared in the July 1971 issue of Staff Papers (pp. 254-331). It is planned to publish another paper by Mr. Bahl, "A Representative Tax System Approach to Measuring Tax Effort in Developing Countries," in the next issue of Staff Papers.

2 Throughout this paper, the term "tax ratio" is used to describe the ratio of tax revenues (excluding social security taxes) to gross national product (GNP).

3 The first to use the statistical results of a tax ratio analysis for the purpose of making tax effort comparisons were Jörgen R. Lotz and Elliott R. Morss in "Measuring 'Tax Effort' in Developing Countries," Staff Papers, Vol. XIV (1967), pp. 478-99.
methodological problems, which stem from the assumptions basic to the analysis.

The basic objectives of this paper are twofold. One is to identify in some detail the necessary assumptions for the ensuing limitations of an analysis that is capable of generating proper intercountry tax effort comparisons. The other is to provide an updated empirical analysis and ultimately a new set of tax effort indices.

**TAX EFFORT VERSUS TAX RATIO ANALYSIS**

Theoretically, the intercountry variance in the tax ratio \( \sigma_t^2 \) may be partitioned into variations attributable to taxable capacity \( \sigma_r^2 \) and variations attributable to tax effort \( \sigma_e^2 \), such that

\[
\sigma_t^2 = \sigma_r^2 + \sigma_e^2. \tag{1}
\]

The conceptual decomposition of the intercountry tax ratio variance shown in equation (1) suggests two possible approaches to identifying the determinants of this variance. If the objective is to explain variations in the tax ratio, a stochastic model such as

\[
T/Y = f(X_1, X_2, \ldots, X_n, U) \tag{2}
\]

could be used where \( T/Y \) is the tax ratio, the \( X_i \) are independent variables that are proxy measures for the determinants of differentials in taxable capacity and tax effort, and \( U \) is an error term. This may be termed a tax ratio approach. On the other hand, if the objective is to identify intercountry differences in tax effort, the \( X_i \) in equation (2) are defined to reflect only, and all, the variance in taxable capacity, and since

\[
\sigma_t^2 - \sigma_r^2 = \sigma_e^2, \tag{2a}
\]

some expression of the residual \( U \) becomes a comparative measure of effort. This may be termed a tax effort approach.

The basic difference between the tax ratio and tax effort views of the problem turns on the restrictive definition of the independent variables in the latter approach. The tax effort formulation requires an a priori justification of the explanatory variables as factors affecting only taxable capacity. It is assumed that these explanatory variables are not proxy measures for those forces that affect the government's willingness to tax, e.g., an independent variable may not be included to reflect a higher level of demand for public expenditures. The problems
associated with such an assumption may be illustrated by considering the possible interpretation of per capita income if included as an independent variable. In the tax effort approach it may be argued that a higher per capita income indicates a greater taxable surplus and therefore a potentially larger tax base. However, it may not be argued that a higher per capita income results in an increased demand for public services and therefore a greater government share in national income. This assumption, that taxable capacity influences dominate expenditure demand influences, is tantamount to assuming that the observed tax ratio is systematically related to taxable capacity factors but not to tax effort factors, such as those that might serve as proxy for the demand for higher levels of public services.

Given correct specification of the model, there are similarities between the two approaches. Most important, both might be used for comparative purposes. The tax effort approach allows explicitly for intercountry comparisons by permitting the calculation of a tax effort index, i.e., the ratio of actual tax collections to estimated tax collections. In this context, estimated tax collection is taxable capacity. Consequently, the tax effort approach would lead to the observation, e.g., that country A’s level of taxation is below what would be expected given (a) the definition of the proxy tax bases of country A and (b) the extent to which the average country in the sample uses these tax bases. As a result, this would show that country A has revealed a preference for a level of taxation below the (sample) average, which is tantamount to saying that country A makes a low tax effort. At this point there is nothing normative in the approach. It only states that a country’s tax effort is comparatively high or low, and not whether it ought to be raised or lowered. The policy implications stem from the fact that since (by assumption) allowance has been made for all taxable capacity factors, the main impediment to a higher tax ratio is the unwillingness of the government to increase taxes. Essentially, the approach is addressed to the question of whether a tax increment is feasible in terms of a country’s taxable capacity and of the practices of other countries.

4 Taxable capacity is defined in this paper as the tax ratio that would result if a country applied to its tax bases a set of “average” effective rates on those bases—these rates are computed as net regression coefficients for the sample of countries included here. The variable indicators of taxable capacity are proxy measures of tax bases.
The tax ratio, explanation-of-variance approach could be addressed to the question of why the level of taxation in a given country is relatively high or low. Significant regression coefficients would suggest that countries having a given set of economic and social characteristics are more likely to have a higher level of taxation than are countries without these characteristics. Although such an equation implies an "expected" level of taxation that may be compared with the actual tax level, it would not seem appropriate to use such residuals to infer the feasibility of a tax increase. More relevant to the tax ratio approach is an informational objective, i.e., an aim to explain the reasons for intercountry variations in the tax ratio.

In either approach under the constraint of a proper a priori model, one intention is to explain as much of the variation in the tax ratio as possible. In a tax ratio analysis, the independent variables are proxy measures of both taxable capacity and tax effort where the latter includes pressures for higher taxes resulting from the demand for higher levels of public expenditure. The sum of the explanatory variables theoretically provides a collectively exhaustive explanation of intercountry tax ratio variations, and therefore any unexplained component is due to omitted variables and a random stochastic component. One objective of the tax effort approach is likewise to explain as much of the variance in the tax ratio as possible, but subject to the constraint that only variables reflecting taxable capacity be included. If a choice should arise between two alternative proxy measures of a certain influence on taxable capacity and both seem equally acceptable on an a priori basis, it can be argued that the variable that explains a greater portion of the variance should be chosen on the grounds that it is simply a better predictor of the intercountry taxable capacity differences that are due to that influence.

WHY TAX EFFORT COMPARISONS?

Theoretically, the "proper" level of revenue for a country is a function of a number of interrelated, identifiable factors, such as the structural characteristics of the economy, the desired growth rate in income, and other national goals. Whether or not macroeconomic models are used to rationalize tax policy actions, government decision makers often resort to the use of comparisons with other countries to gauge the performance of their own fisc. The basic use of tax effort
comparisons is related to this kind of internal fiscal analysis. The model as developed here not only shows the performance rank of a country but also reveals whether or not the basic problem is low taxable capacity, thereby giving some indication of the feasibility of improving the situation.

Tax effort comparisons may aid donor countries as well as international organizations in their evaluation of whether public sector activities in a given country meet certain criteria. For example, suppose that a balance of payments problem in a developing country can be traced to excess aggregate demand created by expenditures financed by continued and heavy government borrowing from the central bank, and to combat this problem a ceiling is placed on domestic credit expansion to the public sector; then the government faces a choice between curtailing expenditures and raising taxes. In such a case, an objective criterion for comparing tax effort would be useful in reaching a decision. Moreover, if a donor country or an international organization were involved in formulating and monitoring a stabilization program, an objective criterion might assist in identifying a proper balance between tax increase and expenditure reduction.

Another hypothetical situation in which an international organization might use an objectively determined tax effort index series would be the existence of a program of unconditional grants to developing countries. The issue in question is the method used in distributing these grants. Because countries make different tax efforts, a distribution on a straight per capita basis or a per capita income basis would implicitly allow some countries to substitute external funds for locally raised funds. The model developed here would allow for an “effort constant” comparison among developing countries, such that an equalizing or straight per capita distribution of grants could be deduced and where there would be no incentive to substitute external funds for what might have been raised domestically.

**Approach**

A critical review of empirical studies pertaining to tax ratio variations among developing countries seems appropriate as an introduction to the statistical analysis presented in Section III.

The present tax effort model, assumptions, and results are presented
in Section III, and the resultant conclusions and policy implications are
the subject of Section IV.

The data used here have been collected for the study of taxation in
developing countries presently being undertaken in the Fiscal Affairs
Department. The fiscal and other economic and demographic variables
are generally averages for the three-year period 1966–68. The sample
covers 49 developing countries. The sources of the data and a discus-
sion of the procedures followed in collecting the data are presented in
Appendix I.

II. Earlier Studies

Review

Since the first attempt to quantify a systematic relationship between
revenue share and stage of development, which was carried out by
Williamson in 1961, progress in understanding the dimensions of tax
effort variation has resulted primarily from (a) increasing the sample
size and varying its composition and (b) adding as explanatory vari-
ables certain general measures of what might be construed as “tax
handles” to the original indicator of the stage of development.

Williamson used per capita income differentials to simulate changes
in the stage of development and fitted an exponential function to data
for a sample of 33 developed and developing countries. His result
indicated that while there was a significant positive relationship between
the tax ratio and per capita income international differences in the
tax ratio were less pronounced than international differences in per
capita income. Plasschaert used a sample of 20 less developed coun-
tries. He reasoned that, as independent variables, per capita income
would serve as a proxy measure of stage of development and that the
import/GNP ratio would indicate the potential for taxing trade. He
estimated the parameters with a joint model and found a significant
relationship between the tax ratio and the import ratio but not between

5 Jeffrey G. Williamson, “Public Expenditure and Revenue: An International
Comparison,” The Manchester School of Economic and Social Studies, Vol. XXIX
6 Ibid.
7 Sylvain Plasschaert, Taxable Capacity in Developing Countries, International
Bank for Reconstruction and Development, Report No. EC-103 (mimeographed,
the tax ratio and per capita income. Hinrichs, in his study of 40 developing and 20 developed countries, found that for all 60 taken together the relationship between tax ratio and per capita income was significant, while for developing countries taken alone it was not a significant determinant.8 He also found that “for less developed countries with per capita incomes below $300, ‘openness,’ [as measured by the import ratio] not per capita income, is a key determinant of government revenue shares of gross national product.”9

Thorn’s results differ from those in the three studies cited above. Using a sample of 32 countries, he found per capita income to be a significant determinant of the tax ratio and the import ratio to be a nonsignificant determinant.10 In addition, he used dummy variables to show that the expected revenue share of GNP was greater for former British dependencies and smaller for highly decentralized government structures, regardless of the level of their per capita income and import ratio. The implication was that there was an effect of “cultural style,” i.e., that preferences for methods of providing services (public versus private) may account for a significant part of the variation in government revenue shares. In a study of 66 developing countries, Weiss added to per capita income and openness a number of dummy variables reflecting social, political, and cultural factors.11 He found that four different socioeconomic variables—urbanization, literacy rate, percentage of employment in agriculture, and an index of degree of mass communications—could be substituted for per capita income without substantially lowering the explained variance. He also found that the qualitative characteristics of general cultural homogeneity and a relatively representative political system had a significant positive impact on the revenue share. The general findings of his statistical analysis indicated that a “geographic” effect on the tax ratio did exist.

Lotz and Morss extended the literature by focusing specifically on factors related to the ease of tax collection and the degree of compli-

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9 Ibid., p. 19.
They introduced, with significant results, a monetization variable, measured in terms of per capita coins and notes. The collinear relationship between per capita income and the monetization variable and the stronger relationship of the monetization proxy to the tax ratio reduced per capita income to a point of nonsignificance. Such a finding is consistent with a hypothesis that per capita coins and notes is a more appropriate measure of the taxable surplus than is per capita income—which includes the intercountry variance in the size of the subsistence sector.13

From these tax ratio studies, one may conclude 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. Moreover, this brief review of explanatory studies suggests a considerable volatility of the statistical results with respect to changes in the composition and to the size of the sample as well as to the addition of explanatory variables.

Lotz and Morss14 initiated a change in the focus of these explanatory studies by inferring from their results tax effort comparisons. They used per capita income and openness (measured as the sum of imports and exports as a percentage of GNP) as independent variables. They found that both significantly and positively influenced the size of the tax ratio. On the basis of per capita GNP above and below $800, they divided the sample into a high-income and a low-income group. Among the high-income countries, they found no significant relationship between the tax ratio and the independent variables. For 52 low-income countries taken separately, they found a significant partial relationship between the tax ratio and both per capita income and openness. However, compared with the entire sample, the total explained variance and the t-value for per capita income dropped substantially, reinforcing the earlier observation that while per capita income as an indicator of wide differences in the stage of development accounts for a significant portion of the intercountry tax ratio variance it is much less useful in explaining

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13 For example, if country A and country B have equal per capita incomes but A has a greater level of per capita “monetization,” it may follow that A has a smaller subsistence sector and therefore a greater taxable capacity.

14 Lotz and Morss, "Measuring 'Tax Effort' in Developing Countries" (cited in footnote 3).
this relationship among the less developed group of countries taken separately.

Shin attempted to broaden the study of tax effort by adding variables, but his analysis suffers in some places from the absence of clearly stated a priori reasoning. Using the Lotz-Morss tax data, he adds three independent variables to income and openness: the ratio of agricultural income to total income, the rate of growth of population, and the rate of growth of prices. He argues that the agricultural income ratio reflects the degree of industrialization, urbanization, and commercialization, and that a high agricultural share means a relatively smaller taxable private surplus. Therefore, his purpose in using the agricultural share is similar to the Lotz-Morss use of the monetization variable. His justification for including the rate of population growth seems weak. It is argued, on the one hand, that a greater rate of population increase will result in greater tax exemptions and hence a lower tax ratio, and, on the other hand, that if the proportion of income tax revenue is very small, the response may actually be positive because of greater consumption expenditures. Shin's reasons for including the rate of increase in the consumer price index as an independent variable are equally unconvincing:

... a country which has a higher rate of inflation may have a higher tax ratio, if the country has any degree of a progressive tax system. However, if a country relies upon an indirect tax system or proportional personal and corporate income taxes, or if the progressiveness of personal and corporate income taxes is insignificant, the rate of inflation may be neutral.

However, inclusion of the price variable may suggest a simultaneous equation bias, since a low tax ratio may mean that public expenditures were financed relatively heavily by borrowing from the banking system.

Owing to limitations of data Shin selected only 47 of the Lotz-Morss sample of 72 countries, of which 16 were classified as high-income (over $800 per capita) and 31 as low-income. His results also showed that per capita income would help to distinguish between the tax ratios in high-income versus low-income countries but would not do so within either group. For less developed countries he found only the rate of

16 Computed as the percentage increase between 1950 and 1965.
17 Computed as an average of the increase in consumer prices over the preceding four years.
price increase and the rate of population growth to be significant. The significance of the rate of population growth as well as the rate of price increase is difficult to conceptualize but may be due to multicollinearity in the variables. In fact, when Shin eliminated openness from his equation, the patterns of significance changed sufficiently to raise such a suspicion. In any case, it is difficult to justify these on an a priori basis as taxable capacity determinants, i.e., as tax base indicators. Such a justification is necessary if tax effort indices are to be derived and compared.

UNCTAD\textsuperscript{19} has carried out a tax effort analysis by pooling cross-section and time-series data for 36 developing countries for the period 1950–66. The pooled data contained 343 observations, representing annual data for the tax ratio and for each of the explanatory variables. The main advantage of pooling cross-section and time-series data is that it permits a substantial increase in degrees of freedom and hence increases the reliability of the estimates. Cross-section data may be pooled if it can be assumed that the coefficients of the explanatory variables are the same cross-sectionally and over time. However, there is an additional problem with the pooling technique as it is used in the UNCTAD study: since the lagged effect of the dependent variable is implicitly included as an independent variable, the error term is composed of a random effect and what may be termed an individual country effect. In this case, a least-squares estimate will not produce a consistent and unbiased estimator.\textsuperscript{20}

Both per capita income and the share of agriculture in total income (agricultural share) are found to be significant despite their high intercorrelation. However, when the model is tested on cross-section data for particular years, the collinearity between agricultural share and per capita income results in one or both being nonsignificant. The openness ratio remains significant and positive. After accepting the agricultural share as a better measure of economic structure differences than per capita income, and after dropping the “inflation” variable because there seems little a priori reason to include it, their results indicated that the


expected tax ratios are highest for countries with open economies and in which the level of the share of agricultural income is relatively low, and the tax ratios are lowest for countries with closed economies and in which the share of the agricultural income is relatively high.

LIMITATIONS

Two major classes of problems with the earlier statistical analyses should be identified and their implications explored before the model to be tested here is specified. First, in some instances there appear to be shortcomings in the formulation of the a priori models, and, second, interpretation of the statistical results sometimes has been clouded by specification errors, a least-squares bias, and substantial multicollinearity in the variables.

With respect to the problem of formulation, in testing the hypothesis that tax ratios will vary with stage of development, data for both developed and developing countries have been included in many of the cross-section analyses. Hence, inferences drawn from these results as to norms for only developing countries are tenuous. Also, in many earlier studies the meaning of the constant in the estimating equation was ignored. The standard linear equation that has been used to express the tax ratio as a function of per capita income and openness is

\[ \frac{T}{Y} = \alpha + \beta_1 Y_p + \beta_2 (X_y + M_y), \]  

where

\[ Y_p = \text{per capita income} \]  
\[ X_y + M_y = \text{ratio of imports plus exports to GNP}. \]

Multiplying equation (3) by \(Y\), the following is obtained

\[ T = \alpha Y + \beta_1 Y_p Y + \beta_2 (X_y + M_y)Y, \]  

which shows that a basic assumption of this model is that the level of total revenue is initially assumed to be some fraction of total income, before any account is taken of intercountry differences in economic structure, etc.\(^{21}\) As a result, the coefficient of the exogenous variable—per capita income—used to measure the income effect may be understated. Another interpretation is possible. If per capita income is

\(^{21}\) Under certain conditions, another interpretation of the constant is possible. See Appendix II.
included as an independent variable, it measures the surplus that is available for taxation, over and above the sum of the proportion of total income necessary for the subsistence of the private sector plus the proportion of total income that on average a government is able to collect. Thus, it is the taxable surplus embodied in a higher level of development that is measured by the per capita income variable.

The other class of problem involves the specification, estimation, and interpretation of the model. With respect to specification, it has been pointed out that since exports are a component of both GNP and the openness ratio the distinction between the partial effects is distorted and the value of the estimated tax ratio is less reliable.

The traditional model may suffer from a least-squares bias. The use of ordinary least squares requires that the explanatory variables be independent of the error term, which is the same as saying that the direction of causation be one way. If this required assumption is not met, biased and inconsistent estimates of the parameters result. In the traditional model one of the required assumptions would be that income affects taxes but that taxes do not affect income. There is good reason to question the validity of such an assumption, for the openness variable as well as for the income variable.

In addition, the results of some earlier studies have been affected to an unknown extent by the presence of collinearities in the variables. Even the effect on the variability of parameter estimates is unknown in some cases because results that would indicate the degree of these interrelationships have not been presented. Suffice to say that in the presence of strong intercorrelations it is not possible to disentangle accurately the separate effects of the explanatory variables.

III. Intercountry Comparisons of Tax Effort

A clear statement of assumptions is necessary for an understanding of the meaning of the results obtained from a tax effort analysis, and therefore the following section gives a precise definition of the tax effort approach. After a discussion of the implicit and explicit assumptions required for such an analysis, the model is formulated on the basis of a priori reasoning and on the results of an interdependency analysis. The remainder of the section presents and interprets the statistical re-
results and the corresponding tax effort indices, and compares them with tax effort indices derived in other studies.

THE TAX EFFORT APPROACH—ASSUMPTIONS

While the tax ratio is simply the tax yield as a function of income, tax effort may be defined as the extent to which a country makes use of its taxable capacity, i.e., tax effort is the ratio of actual tax collections to taxable capacity. As noted earlier, in order to rank countries on a basis of tax effort, the tax ratio is assumed to be a function of two general factors: taxable capacity ($\hat{T}/Y$); and tax effort ($E$), i.e.,

$$T/Y = f(\hat{T}/Y, E).$$ (5)

Since $\hat{T}/Y$ is the taxable capacity term and since tax effort is defined as the extent to which taxable capacity is being used, effort ratio in any given country may be derived as

$$E = (T/Y)/(\hat{T}/Y),$$ (6)

or,

$$E_i = T_i/\hat{T}_i.$$ (7)

Hence, the effort ratio for the $i^{th}$ country is the ratio of actual tax yield to the tax yield that is expected, given the tax base proxies of the $i^{th}$ country and the average practice of the countries in the sample. Therefore, the first step in the statistical analysis, and surely the most difficult in this approach, is estimating the taxable capacity of a country by using only variables that may be properly classified as noneffort factors.

The residual tax effort factor may be seen as having many determinants—only three are mentioned here. The first is the relative productivity of public as opposed to private sector investments. To make an oversimplified statement for purposes of illustration, let $Y_p =$ per capita income, $G =$ government investment of resources obtained from taxation, and $P =$ private investment. If $\frac{\partial Y_p}{\partial G} > \frac{\partial Y_p}{\partial P}$, *ceteris paribus*, a greater tax effort will be expected. For example, if it is estimated that the returns from investments outlined in the government development plan exceed those that would be obtained by an equal investment in the private sector, a government may be willing to devote a greater share of resources to public purposes. A second (positive) effect on the level
of tax effort may be introduced if government decision makers include in their objective function a desire to intervene in the resource allocation process for distributional reasons, e.g., to force a trade-off between luxury consumption and health expenditures. A third factor that may affect the government’s willingness to tax relates to the nature of the historical arrangements for the division of financial responsibility for certain activities between the public and private sectors. For example, if the church over time has been involved in financing health and education services, or if tuition charges have played a major role in financing education, ceteris paribus, a lower tax effort would be expected. This effect may also be considered a bias in the analysis, stemming from the failure to adjust $T/Y$ for intercountry differences in the package of public goods that is offered. However, note should be taken of the fact that the common issue in these three cases is the willingness of a government to extract a tax share that is either greater than or less than its estimated taxable capacity.

Following the Lotz-Morss study and later ones, the tax ratio may be related directly to certain specified independent variables in a single-equation least-squares model for the purpose of deriving an estimator of taxable capacity. There are implicit assumptions in this approach. First, in using a linear model to estimate fiscal capacity, it is assumed that the government’s share of total income will (at an internationally determined average level of effort) average some constant percentage regardless of the structure of the economy. The independent variables will in general represent upward or downward adjustments of this constant (i.e., of taxable capacity), depending on (1) whether or not there is a taxable surplus in domestically produced and earned income and (2) whether or not it is administratively feasible to tap such a surplus. Also, the use of a linear model involves the assumption that the partial effects of the independent variables are additive.22

NORMATIVE VERSUS POSITIVE ANALYSIS

In the choice of the variables to include in such a model, the approach may be normative or positive. Under one interpretation of a normative approach, it might be argued, e.g., that per capita income and openness are relevant indicators of taxable capacity and that they should be

22 A multiplicative, double-log form was also tested on the data, but in no case did it give a significantly higher explained variance.
included in the estimating equation regardless of the level of variation explained, and regardless of whether or not they are significant. In such a case, the regression analysis is used primarily to assign weights to the tax bases in the taxable capacity equation. If, on the other hand, the approach is positive, the argument is that the "average" behavior of countries—as measured by the (statistical) relationship between the observed tax ratio and hypothesized taxable capacity factors—reveals their propensity to use a particular base, and subsequently reveals the taxable surplus inherent in that base. In such a case, goodness of fit would seem a reasonable criterion for choosing bases that provide the most binding constraints on taxable capacity or, alternatively, for identifying those components of the economic structure where taxable surplus is highest. It also follows that variables that are not significantly related to $T/Y$ would be excluded from the equation that is used to estimate taxable capacity. The approach taken in this paper is positive, and the objective of the regression analysis is precisely to identify the factors that reflect such constraints or surpluses. However, the goodness-of-fit criterion is applied only when there is a choice between variables that seem equally acceptable on conceptual grounds.

Whether positive or normative, the regression approach carries with it the difficulty that a country's preference for taxing or not taxing a particular base, as revealed in the estimated regression coefficient, may include the effects of political influences as well as purely taxable capacity considerations. Such qualifications of the interpretation of results are inherent in this type of analysis.

A TAX EFFORT MODEL

It is possible to consider an almost infinite list of variables that conceivably affect taxable capacity. However, both data limitations and methodological and a priori constraints must be reckoned with. Methodological constraints that must be considered in choosing explanatory variables are the extent to which their measurement is overlapping (e.g., exports are a component of both $X_y$ and $Y_p$) and the extent to which they are collinear. On an a priori basis, only taxable variables that affect capacity may be included, and limitations of data have prohibited the use of certain variables that may be relevant, e.g., personal income, the income distribution, and the true level of subsistence sector income. Accordingly, the recourse is to justify basic factors that affect
taxable capacity and to identify proxy measures for each of these basic factors. This is the subject of the following three sections.

Historically, two types of factors have been used to explain inter-country variations in the tax ratio: stage of development, usually measured by per capita income; and the size of the foreign trade sector, measured in terms of some combination of the import and/or export share of income. The model developed below is in terms of three general determinants of taxable capacity—the size of the foreign trade sector, stage of development, and some measure of the sectoral composition of value added. The conceptual basis for this formulation of the model is developed in the three sections that follow, and the estimating equation is presented in the fourth.

To achieve a better understanding of the empirical dimensions of the proxy measures that are used to reflect stage of development, openness, and the composition of income, the (linear) zero order interrelationships among alternative variable formulations of these factors are discussed below. Where alternative proxy measures seem equally justifiable on an a priori basis, the simple intercorrelation between the proxy variables and the relationship between each proxy and the tax ratio will be relied on for making a choice.

The size of the foreign trade sector

The hypothesis presented here is that taxable capacity is related directly to the size of the foreign trade sector, first, because a greater level of exports relative to income suggests both a greater degree of monetization and an industrial structure that is administratively amenable to taxation, and, second, because the ensuing larger imports may be taxed with a minimum of administrative difficulty. Also, favorable world market conditions for certain primary exports create a relatively large taxable surplus in export earnings, and therefore a greater taxable capacity. In a tax effort approach to the problem, one must reject as an explanation of the influence of the foreign trade sector on taxable capacity the argument that the potential for intercountry tax shifting may be greater (and therefore political resistance to a higher tax ratio may be less) when export earnings are greater. Such a potential may be present, however, because of demand considerations, the higher level of foreign ownership, and crediting arrangements between developed and developing countries regarding foreign earnings.
Conceptualizing the null hypothesis here is a far less difficult task than is defining a measure of the size of the foreign trade sector that properly reflects the resultant greater taxable base. There would seem to be three alternatives: 23 (1) the import ratio ($M_y$); (2) the export ratio ($X_y$); and (3) the ratio of imports plus exports to GNP ($X_y + M_y$). 24 On an a priori basis, the justification for using the openness ratio rests on the assumption that the variable should reflect the total available trade tax base. It is assumed that differences in the composition of a constant trade amount will not affect taxable capacity, i.e., given some level of total foreign trade, intercountry differences in the relative size of the import and export components will have no effect on the tax ratio. The export ratio alone will be more appropriate if the foreign trade variable is meant to reflect the size of the base that is amenable to corporate income or export taxation. If it is more feasible, administratively and politically, to tax large exporters than it is to tax other domestic producers, it follows that the tax ratio will be higher where, ceteris paribus, the export ratio is higher. Alternatively, using the import ratio as an independent variable would reflect an attempt to capture the variance among countries in the size of the import tax base.

The pattern of intercorrelation shown in Table 1 suggests that there is little difference between the import ratio and the openness ratio, as each is related to the structure of the economy in approximately the same manner. However, the export ratio is more closely associated with the mining share of income and the tax ratio than is either the import or the openness ratio. A hypothesis might be postulated for the weaker relationship between the import ratio and the tax ratio. Surely one component of taxable capacity is the base for import taxes—that is, total import value less the value of nontaxable imports. If the proportion of the value of imported goods that are either tax exempt or taxed at preferential rates (e.g., raw materials for export, machinery and equipment, and necessities) does not vary systematically with the total import ratio, then the total import ratio will not be a satisfactory indicator of taxable capacity. Hence, the relationship between the import ratio and the tax ratio would not be strong. The stronger relationship

23 Lotz and Morss, "A Theory of Tax Level Determinants for Developing Countries" (cited in footnote 12).
24 Hereafter, the ratio of exports to GNP will be referred to as the export ratio, the ratio of imports to GNP as the import ratio, and the ratio of imports plus exports to GNP as the openness ratio.
TAX EFFORT AND TAX RATIO ANALYSIS

**Table 1. Simple Correlation Coefficients Between Selected Variables**

<table>
<thead>
<tr>
<th></th>
<th>$Y_p$</th>
<th>$N_p$</th>
<th>$l_p$</th>
<th>$P$</th>
<th>$Q_y$</th>
<th>$X_y$</th>
<th>$M_y$</th>
<th>$X_y + M_y$</th>
<th>$Y_p - X_p$</th>
<th>$A_x$</th>
<th>$N_x$</th>
<th>$T/Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_p$</td>
<td>-0.78</td>
<td>0.40</td>
<td>0.61</td>
<td>-0.17</td>
<td>-0.09</td>
<td>0.43</td>
<td>0.42</td>
<td>0.44</td>
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<td>-0.19</td>
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<tr>
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<td>0.17</td>
<td>-0.04</td>
<td>-0.54</td>
<td>-0.55</td>
<td>-0.56</td>
<td>-0.62</td>
<td>-0.19</td>
<td>-0.53</td>
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</tr>
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<tr>
<td>$X_y$</td>
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<td>0.74</td>
<td>0.48</td>
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<td>$M_y$</td>
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<td>-0.09</td>
<td>-0.19</td>
<td>0.64</td>
<td>0.37</td>
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<tr>
<td>$X_y + M_y$</td>
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<td>-0.16</td>
<td>0.64</td>
<td>0.45</td>
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</tr>
<tr>
<td>$T/Y$</td>
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</tr>
</tbody>
</table>

Key to Variable Coding

- $Y_p$: Per capita gross national product (GNP).
- $A_y$: Per cent of gross domestic product (GDP) originating in agricultural sector.
- $N_y$: Per cent of GDP originating in mining (including oil) sector.
- $l_y$: Per cent of GDP originating in manufacturing sector.
- $P$: Population.
- $Q_y$: Money plus quasi-money as a percentage of GNP.
- $X_y$: Value of exports as a percentage of GNP.
- $M_y$: Value of imports as a percentage of GNP.
- $X_p$: Per capita value of exports.
- $A_x$: Value of agricultural sector exports as a percentage of GNP.
- $N_x$: Value of mining sector exports as a percentage of GNP.
- $T/Y$: Tax ratio.

1 In U.S. dollars.

Exhibited by the export ratio is due to indirect effects (see Table 1) as well as to those direct effects discussed above. Countries with larger mining export shares have larger overall export shares and higher tax ratios, a relationship stemming from the larger taxable surplus embodied in income generated in this sector.

Both the a priori and empirical considerations developed above suggest that the export ratio ($X_y$) is the preferable of the possible indicators of intercountry variations in taxable capacity that result from variations in the size of the foreign trade sector. However, the empirical analysis suggests that the importance of the size of the foreign trade sector as a determinant of the tax ratio may be due largely to the mineral and oil content in total exports and total income.

**Stage of development**

Traditionally, the stage of development has been measured by per capita income—a larger per capita income, ceteris paribus, suggesting a greater taxable capacity. But in earlier studies the use of per capita income as an indicator of stage of development met with mixed results. On one hand, it explains satisfactorily the tax ratio variations between developed and developing countries, but, on the other hand, it is not effective in explaining the variance among only developing countries.
There are at least two possible explanations for this failure. First, per capita income differences may hide an important structural difference—the relative size of the nonmonetized sector—that affects taxable capacity. Second, the accuracy of intercountry comparisons is certainly subject to error owing to the conversion of local currencies into U.S. dollars. The effect of this error on the estimate of taxable capacity may be illustrated by noting that implicitly the use of per capita income as an explanatory variable defines the existing exchange rate as one determinant of a country's taxable capacity. For example, the equation

\[ T/Y = a + bY_p \]  

may be amended to read

\[ T/Y = a + b(Y_p/R), \]  

where \( R \) is the official exchange rate and \( Y_p' \) is measured in local currency units. The partial derivative of equation (9) with respect to the exchange rate is

\[ \frac{\partial(T/Y)}{\partial R} = -\frac{bY_p'}{R^2}, \]  

which shows that for every currency-unit-per-U.S.-dollar difference in the exchange rate (given a per capita income expressed in local currency units) the tax ratio will differ by \(-\frac{bY_p'}{R^2}\). Thus, to the extent that the exchange rates used do not reflect the true intercountry variance in the purchasing power of local currencies, the responsiveness of the tax ratio to a per capita income difference is not estimated accurately.25

An alternative measure of the stage of development is the percentage of income generated in the agricultural sector. Generally, a higher level of activity in the agricultural sector will be associated with a larger subsistence sector, less commercialization and industrialization, and a lower per capita income. Moreover, value added in the agricultural sector may

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25 Intercountry differences in official exchange rates—even if in equilibrium—at best measure variations in the purchasing power of a currency with respect to internationally traded goods and services rather than overall purchasing power. A high degree of incomparability may be introduced when per capita income in U.S. dollars is used in comparing countries at widely different levels of development. For a discussion of this problem and a suggested alternative index, see Wilfred Beckerman, *International Comparisons of Real Incomes* (Organization for Economic Cooperation and Development, Paris, 1966), Chapters I (pp. 7–10) and V (pp. 27–37).
embody a lower taxable surplus because (1) the incomes of agricultural wage earners may be relatively low, (2) profit margins may be relatively low when agricultural output is produced largely by many small farmers, and (3) such enterprises are not as amenable administratively to taxation as enterprises in other sectors of the economy. Two other possible explanations for the (negative) influence of the relative size of the agricultural sector on the tax ratio are the unwillingness of governments to tax domestically grown and consumed food and the effective political resistance to taxation of the agricultural sector. In a tax effort context, these are not acceptable interpretations of the agricultural share as an explanatory variable.

While the agricultural share as the measure of the stage of development also suffers from differing practices among countries in estimating the income generated in the subsistence sector, it is free from the problems created by using official exchange rates. Moreover, there is empirical evidence to support the contention that the agricultural share of employment is related to both the structure of the economy and the tax ratio. In their study of 74 developing countries, Adelman and Morris found that the relative size of the agricultural sector in terms of employment is negatively related to per capita income, the level of education, the extent of mass communications, the strength of an indigenous middle class, and the extent of modernization of outlook. Lotz and Morss, using a factor analytic approach, also found the share of agricultural employment to be negatively related to per capita income, literacy rate, and urbanization. These findings lend some credence to the argument that the relative importance of the agricultural sector is related to the stage of development. The correlation matrix presented in Table 1 shows that countries having a large agricultural income share

26 However, to cite this as supporting evidence for using $A_y$ as an independent variable, it must be argued that the agricultural share of income and of employment are related.


29 Another possibility for measuring the size of the subsistence sector is by constructing a variable to reflect intercountry variations in the degree of monetization. In an earlier study, Lotz and Morss used per capita coins and notes for this purpose. In this paper, the Lotz-Morss formulation is rejected on a priori grounds (see Section II, above) in favor of an expression, "money plus quasi-
tend to have a significantly lower per capita income and significantly smaller import and export ratios. Finally, a larger agricultural share is found to be a strong predictor of a low tax ratio.

In the model tested below, the agricultural share \( (A_y) \) is used to indicate stage of development. The position taken here is that, on a priori grounds, it is as good an indicator of intercountry variations in the level of economic development as per capita income, and, on empirical grounds, it shows a stronger simple relationship with the tax ratio.

The sectoral composition of income produced

It is hypothesized here that the sectoral distribution of income exerts an effect on taxable capacity apart from that of the overall level of economic development and the size of the foreign trade sector. Obviously, the surplus available to government for taxation will vary substantially among these sectors. The specific hypothesis tested here is that the mining sector generally produces a larger surplus than any other sector, and therefore it is a positive determinant of taxable capacity. Because of the heavy fixed investment associated with mining industries, operations will tend to be confined to a few large firms, and accordingly it will be administratively easier to levy income or export taxes. Another plausible explanation for the higher taxable capacity in the mining sector—but one that is unacceptable in a tax effort formulation of the problem—is that, since the mining companies are often largely foreign owned, effective resistance to higher tax levels will be less; or, stated from a point of view of the residents of the country, the burden of a given level of taxes per dollar of income may be less when mining constitutes a relatively large share of total income. It will follow that governments are willing to levy higher levels of taxation because it is politically feasible to do so.

Lotz and Morss found a strong positive association between the relative importance of minerals and oil in total exports and the export ratio and the corporate income tax ratio.\(^{30}\) Further evidence of some money as a percentage of GNP." However, as may be seen from the coefficients in Table 1, there is no apparent relationship between this variable and any other dependent variable or between this variable and the tax ratio. Hence, it is not introduced again in this study.

\(^{30}\) Lotz and Morss, "The Tax Structure of Developing Countries, An Empirical Study" (cited in footnote 28).
need to consider specifically the mining share is found in the results of studies by Lotz and Morss, Shin, and UNCTAD, in which, because no adjustment was made in the fiscal-capacity equation for intercountry differences in the mining share of income, the heavily mining-oriented countries tended to rank high in terms of fiscal effort.

The intercorrelations in Table 1 indicate that countries with larger mining shares tend to have significantly larger per capita incomes, higher export ratios, and smaller agricultural shares. The mining share shows a stronger relationship to the tax ratio than does any other explanatory variable in the analysis, i.e., countries with larger mining shares tend to have significantly higher tax ratios. As would be expected, the mining shares of income and exports are highly intercorrelated, and both are significantly related to the tax ratio. This reinforces the suspicion that the effect on the tax ratio of the openness ratio or the export ratio is particularly pronounced when heavy mining activity is present.

In the statistical analysis that follows, the mining share \((N_y)\) is used as an explanatory variable to indicate the higher taxable capacity in countries with larger mining shares of income and exports.

*The estimating equation*

The hypotheses that have been presented are that taxable capacity is a function of three major factors: (1) the stage of development, (2) the sectoral composition of income produced, and (3) the size of the foreign trade sector. These factors are to be measured, respectively, by the agricultural share of income, the mining share of income, and the export share of income. The simple correlation matrix shows that, taken separately, each of the three proxy variables is significantly related to the level of the tax ratio. In formulating a single estimate of taxable capacity, these three factors somehow should be combined into a single equation so as to permit an estimate of the effects on taxable capacity of, for example, a small difference in the size of the foreign trade sector given that differences in composition of income and the stage of development are held constant. The first objective is to determine whether these partial effects are statistically significant.

The specific hypotheses to be tested on these partial regression coefficients are that taxable capacity is negatively related to the agricultural share \((A_y)\), positively related to the mining share \((N_y)\), and positively
related to the export ratio \((X_y)\).\(^{31}\) The relationship is assumed to be linear, therefore the basic estimating equation is

\[
T/Y = a + b_1A_y + b_2N_y + b_3X_y. \quad (11)
\]

There are at least two statistical estimation problems in relation to the model. First, examination of the components of the three independent variables suggests that there is a specification error, since value added in the mining and agricultural sectors is a component of total exports. The potential result of this kind of error is a biased estimate of the regression coefficient; therefore, some adjustment is necessary in the definition of the variables. Specifically, an alternative estimating equation is also used, in which the share of agricultural exports and the share of mining exports is deducted from the total share of exports.

\[
T/Y = a + b_1A_y + b_2N_y + b_3(X_y - Axy - Nxy) \quad (12)
\]

Moreover, the mining share and export ratio and the mining and agricultural shares are expectedly collinear; hence, interpretations of measures of separate effect must be made with due caution.\(^{32}\) That is to say, a variable may be nonsignificant because it simply is not important in explaining the variation in the dependent variable or because it is important but is intercorrelated with another independent variable. Nonsignificance in the latter case occurs because one effect of multicollinearity is an increase in the standard error of the regression coefficient. Nevertheless, the nonsignificance of an independent variable for either reason will require the omission of the variable from the regression equation.

**Statistical results**

The following regression equation is derived:

\[
\hat{T}/Y = 14.95 - 0.0742A_y^{*} + 0.2951N_y^{**}. \quad (9.682) \quad (2.074) \quad (3.678) \quad (R^2 = 0.411) \quad (13)
\]

\(^{31}\) Given this statement of hypotheses, all significance tests are one-tail. At the 0.05 level of significance, the critical \(t\)-value is 1.6779, whereas at the 0.01 level it is 2.4083. The conventions of describing the 0.05 level as significant and noting it with one asterisk, and the 0.01 level as highly significant and noting it with two asterisks, are adopted here.

\(^{32}\) The simple correlation between \(A_y\) and \((X_y - Axy - Nxy)\) is \(-0.36\), while that between \(N_y\) and \((X_y - Nxy - Axy)\) is not significant.
The figures in parentheses below the regression coefficients are \( t \)-ratios. These results show both the mining and the agricultural share of income to be significant determinants of intercountry differences in taxable capacity.

The high degree of collinearity between the mining share and the export ratio share \( (r = 0.55) \) resulted in the nonsignificance of the latter; hence, it is dropped from the estimating equation.\(^{33}\) Since the exclusion of the export ratio from the model is due in part to its collinearity with the mining share of income and implicitly with mineral exports as a share of income \( (r = 0.74) \), it may not be concluded that the size of the foreign trade sector is an unimportant determinant of taxable capacity but rather that especially the mining share variable accounts for a part of the export ratio effect. Countries with greater mining shares of income have significantly greater export ratios; therefore, it becomes impossible to disentangle their separate effects on taxable capacity, and it may be concluded that the regression coefficient of the mining share to a large extent includes also the influence of higher export shares.

The statistical results presented in equation (13) not only are consistent with the hypothesis developed above but also make some intuitive sense. Taxable capacity responds positively to higher mining shares of income (and implicitly to higher export ratios) and negatively to higher agricultural shares. At first glance, the model seems to miss the higher taxable capacities that may be attributable to manufacturing activities or agricultural exports. However, where manufacturing is important, a relatively more developed economy may be expected—the

\[^{33}\text{When this equation was run, with the overall export ratio as the third independent variable, the results were not markedly different, i.e.,}\]

\[
\frac{T}{Y} = 13.98 - 0.0627A_Y + 0.2667N_y^{**} + 0.0332X_y. \\
(7.300) (1.636) (3.065) (0.860) \\
(\hat{R}^2 = 0.408)
\]

When the export variable is specified to exclude agricultural and mining exports, a similar result is obtained, i.e.,

\[
\frac{T}{Y} = 15.38 - 0.0815A_Y + 0.2855N_y^{**} - 0.0225(X_y - A_x - N_x). \\
(7.853) (1.967) (3.346) (0.358) \\
(\hat{R}^2 = 0.400)
\]

The lower explained variations compared with that of equation (13) indicate that the contribution of either measure of the foreign trade variable to explained variance was more than offset by the loss in degrees of freedom. The non-significance of the \( (X_y - A_x - N_x) \) version of the export size variable is apparently due less to multicollinearity than to a nonsignificant relationship to the tax ratio.
simple correlation between the manufacturing and agricultural shares of
income is $-0.57$. Then, the agricultural share variable generally adjusts
estimated taxable capacity for more developed economies as would the
direct inclusion of the manufacturing income share as an independent
variable. A more formidable problem arises with respect to a possible
understatement of taxable capacity in countries having substantial agri-
cultural exports. For example, in Ghana and Brazil, these exports may
increase the taxable capacity of the country, and the present model will
not reflect this increase. However, from the simple correlation matrix
presented in Table 1, it may be seen that there is no significant relation-
ship between the tax ratio and agricultural exports as a percentage of
income, which suggests little responsiveness of taxable capacity to rela-
tively high levels of agricultural exports. These general relationships,
however, do not negate the possibility that the omission of direct con-
sideration of agricultural exports will result in an understated taxable
capacity for such countries as Brazil, Ghana, and Malaysia.

Further insight into the meaning of the results presented in equation
(13) may be gained by a careful interpretation of the regression coeffi-
cients. An increase of 1 percentage point in the agricultural share is
associated with a decline of 0.07 percentage point in the tax ratio; e.g.,
if the agricultural share of income is 30 per cent in one country and
31 per cent in another country, ceteris paribus, the expected difference
between their tax ratios would be only 0.07 percentage point. Alterna-
tively, a difference of 1 percentage point in the mining shares is asso-
ciated with an expected tax ratio difference of 0.30 percentage point.

Since these are partial coefficients, if the agricultural share is reduced
by 1 percentage point and the mining share is held constant, the net
effect must be to increase the relative share of GNP of all other sectors
by 1 percentage point. The net effect of such action would be an
expected increase in taxable capacity equivalent to 0.07 per cent of
GNP. Thus, the overall problem of identifying the determinants of tax
ratio differences reduces in part to a consideration of the sectoral com-
position of income. Any reduction in the agricultural share of income,
which generally implies an increase in per capita income and in the

34 See Appendix II for a demonstration of alternative interpretations of equa-
tion (13).
35 Since the variables are already presented in terms of percentages of GNP,
the net regression coefficients may be compared directly without problems of scale.
36 These are manufacturing, trade, government, other services, and construction.
degree of openness, results in an increase in taxable capacity. If the shift is to the mining sector, the increase in taxable capacity is more than three times greater than if the shift is to other sectors.

In general, the two independent variables included in equation (13) identify three rather broad types of economic structure. The first type has a high fraction of income generated in the agricultural sector and a relatively large subsistence sector, and the economy is still at a relatively low level of development. In the other two types of economy, countries have reached a higher stage of development: one is characterized by heavy mining activity and a greater level of openness; and the other has achieved economic growth more through import substitution and the export of goods other than minerals and oil, and has a level of openness above that of the first type of country but below that of countries with large mining shares. The negative coefficient of $A_y$ in equation (13) allows for the taxable capacity difference between the first and the other two groups, and hence acts properly as a discriminator in terms of stage of development. The positive sign and statistical significance of $N_y$, allow for the higher taxable capacity of countries with large mineral exports and include a part of what other studies have identified as the openness influence.

**TAX EFFORT RANKINGS**

By using equation (13), countries may be ranked not only according to their taxable capacity but also according to their tax effort. Since tax effort is defined here as the extent to which a country uses its taxable capacity, the effort measure is the actual tax ratio expressed as a fraction of the expected tax ratio; the latter, taxable capacity, is computed from equation (13). This ranking is presented in Table 2, with an index number above 1.00 indicating an above average tax effort.

A brief digression on the meaning of this tax effort measure seems in order here. The denominator, estimated taxable capacity, is expressed in terms of a tax ratio—the tax ratio that would result for a given country if the average effective rates of taxation were applied to the agricultural, mining, and "all other" sectors of the economy. This estimate is denoted $\hat{T}/Y$. Since the numerator of the tax effort measure, the actual level of taxation in the country, is also expressed in terms of a tax ratio ($T/Y$), the tax effort index is in fact the ratio of the
Table 2. Selected Developing Countries: Rankings by Taxable Capacity and Tax Effort

<table>
<thead>
<tr>
<th>Country</th>
<th>Taxable capacity (In per cent)</th>
<th>Tax effort Using Equation (13)</th>
<th>Tax Effort Ranking Using Equation (14) (Lotz-Morss)</th>
<th>Tax Effort Ranking Using Equation (15)</th>
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</thead>
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<td>Ivory Coast</td>
<td>12.09</td>
<td>1.6294</td>
<td>1</td>
<td>10</td>
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<tr>
<td>Brazil</td>
<td>13.50</td>
<td>1.5264</td>
<td>2</td>
<td>1</td>
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<td>Chad</td>
<td>9.86</td>
<td>1.3929</td>
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<td>Zaïre</td>
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<td>3</td>
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<td>1.3742</td>
<td>5</td>
<td>7</td>
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<td>Egypt</td>
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</tr>
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<td>Ceylon</td>
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<td>1.3016</td>
<td>8</td>
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<td>Tunisia</td>
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<td>9</td>
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</tr>
<tr>
<td>Tanzania</td>
<td>11.83</td>
<td>1.2193</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Sudan</td>
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<td>1.1811</td>
<td>11</td>
<td>21</td>
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<tr>
<td>Upper Volta</td>
<td>11.01</td>
<td>1.1785</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Zambie</td>
<td>24.47</td>
<td>1.1689</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Malaysia</td>
<td>14.46</td>
<td>1.1596</td>
<td>14</td>
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<tr>
<td>Morocco</td>
<td>14.48</td>
<td>1.1411</td>
<td>15</td>
<td>12</td>
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<tr>
<td>Guyana</td>
<td>18.24</td>
<td>1.1291</td>
<td>16</td>
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<tr>
<td>Kenya</td>
<td>12.47</td>
<td>1.1148</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Turkey</td>
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<td>1.1006</td>
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<td>Chile</td>
<td>17.84</td>
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<td>China</td>
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<td>1.0791</td>
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<td>Viet-Nam</td>
<td>12.85</td>
<td>1.0664</td>
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<td>Argentina</td>
<td>14.34</td>
<td>1.0332</td>
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<td>India</td>
<td>11.44</td>
<td>1.0146</td>
<td>24</td>
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<td>Jamaica</td>
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<tr>
<td>Venezuela</td>
<td>22.06</td>
<td>0.9867</td>
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<td>Thailand</td>
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<td>0.9758</td>
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<td>Iran</td>
<td>19.95</td>
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<td>Ecuador</td>
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<td>0.9692</td>
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<td>Burundi</td>
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<tr>
<td>Korea</td>
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<td>Peru</td>
<td>15.60</td>
<td>0.8755</td>
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<td>Singapore</td>
<td>14.71</td>
<td>0.8498</td>
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<td>Honduras</td>
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<td>0.8338</td>
<td>34</td>
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<td>Ethiopia</td>
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<td>Costa Rica</td>
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<td>36</td>
<td>40</td>
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<tr>
<td>Colombia</td>
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<td>0.7772</td>
<td>37</td>
<td>33</td>
</tr>
<tr>
<td>Paraguay</td>
<td>12.50</td>
<td>0.7625</td>
<td>38</td>
<td>36</td>
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<td>Philippines</td>
<td>13.01</td>
<td>0.7557</td>
<td>39</td>
<td>35</td>
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<tr>
<td>Rwanda</td>
<td>10.93</td>
<td>0.7549</td>
<td>40</td>
<td>44</td>
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<tr>
<td>Togo</td>
<td>13.52</td>
<td>0.7545</td>
<td>41</td>
<td>38</td>
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<td>Lebanon</td>
<td>14.17</td>
<td>0.7538</td>
<td>42</td>
<td>43</td>
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<td>Pakistan</td>
<td>11.55</td>
<td>0.7152</td>
<td>43</td>
<td>42</td>
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<tr>
<td>Trinidad and Tobago</td>
<td>21.52</td>
<td>0.7045</td>
<td>44</td>
<td>37</td>
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<tr>
<td>Mexico</td>
<td>14.20</td>
<td>0.6939</td>
<td>45</td>
<td>34</td>
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<td>Indonesia</td>
<td>12.08</td>
<td>0.6210</td>
<td>46</td>
<td>46</td>
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<td>Guatemala</td>
<td>12.91</td>
<td>0.6117</td>
<td>47</td>
<td>47</td>
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<tr>
<td>Bolivia</td>
<td>17.74</td>
<td>0.5056</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>Nepal</td>
<td>10.12</td>
<td>0.3151</td>
<td>49</td>
<td>49</td>
</tr>
</tbody>
</table>

1 \( T/Y = 10.48 + 0.0026Y_Y + 0.0614(X_Y - M_Y). \)
2 \( T/Y = 10.05 + 0.0031(Y_Y - X_Y) + 0.3973N_Y + 0.0881(X_Y - N_X). \)
actual tax level to the tax level that would be expected given the
country's capacity, i.e., $\tilde{T}/T$. With some adjustment, the cardinal values
of these effort indices may be given some meaning. The value $\frac{\tilde{T} - T}{T}$
is the percentage by which the current level of taxes must be increased
(reduced) in order to reach an "average" level of taxes. For example,
these results would suggest that, in order to reach an average intensity
of use of taxable capacity, Brazil would have to reduce its current level
of taxes by 53 per cent, and Nepal would have to raise its taxes by 68
per cent.

In Table 2, the ranking of the countries is given on the basis of
taxable capacity estimated from equation (13). Specifically, the figure
shown for a country is an estimate of the tax ratio that corresponds to
the present definition of taxable capacity indicators and to the average
practices of the countries in the sample, e.g., the model predicts a tax
ratio of 12.09 per cent as a norm for Ivory Coast. Although there is no
overall systematic relationship between the measures of effort and
capacity, of the ten countries that have the highest tax effort, eight
have taxable capacities that vary from about average to low. One
possible explanation is that in countries in which taxable capacity is
relatively low a much greater effort is required to provide a minimal
package of public goods. A second explanation is that, in estimating
taxable capacity, some important component of the base is not ac-
counted for in the basic equation, with the result that taxable capacity
is underestimated and therefore tax effort is overstated.

Subject to the foregoing limitations, countries may be grouped
roughly by their effort-capacity characteristics (Table 3). The four
countries that exert relatively high levels of tax effort and have relatively
high taxable capacities have in common a heavy reliance on the mining
sector. By comparison, Trinidad and Tobago and Bolivia also have

| Table 3. Selected Developing Countries: Tax Effort and Taxable Capacity Characteristics |
|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| **High Capacity, High Effort**              | **High Capacity, Low Effort**               | **Low Capacity, High Effort**               | **Low Capacity, Low Effort**               |
| Zambia                                      | Trinidad and Tobago                         | Chad                                       | Nepal                                      |
| Guyana                                      | Bolivia                                     | Mali                                       | Rwanda                                     |
| Zaire                                       |                                             | Sudan                                      | Indonesia                                  |
| Tunisia                                     |                                             | Ivory Coast                                | Pakistan                                   |
high taxable capacities and relatively important mining shares, but each chooses to use this capacity at a much lower level than the international average. Certainly a part of the explanation for this difference could be in differing market conditions for the mineral exports, i.e., conditions in the world market for copper may be more conducive to higher tax levels than are the conditions in the world market for Bolivia's tin. At the opposite end of the spectrum are Nepal, Rwanda, Indonesia, and Pakistan, countries that not only have a very low capacity to tax but also choose to use this capacity less intensively than the average. Other countries with a low level of taxable capacity, however, make a relatively high tax effort, e.g., Chad, Mali, the Sudan, and Ivory Coast. Part of the explanation for the apparently strong tax effort shown by these countries is that the agricultural export base has been ignored and, therefore, taxable capacity is understated. Another explanation is that the governments of these countries provide certain goods and services that the private sector provides in most countries; hence, a correspondingly higher public sector "price" is observed.

**Comparison with results of other studies**

The first attempt to use a stochastic model for the purpose of measuring tax effort was by Lotz and Morss, and their paper has attracted wide attention; therefore, a comparison of their results with those presented here would seem appropriate. Similarly, since per capita income has been included in most earlier studies and since it has significance as a measure of the stage of development and may have normative value, the basic model used here has, for comparative purposes, been reformulated to include per capita income.

When the data used here are applied to the Lotz-Morss equation, the following result is obtained:

\[ \hat{T}/Y = 10.48 + 0.0026Y_p + 0.0614(X_v + M)_t \]

\[ (8.611) (0.726) (2.754) (R^2 = 0.175) \]

The openness ratio is significant, but per capita income is not significant. By contrast, in their study using 1963–65 data for 52 developing coun-

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37 No attempt is made here to relate the notion of the diminishing marginal utility of income to the concept of taxable capacity, since the question of intercountry tax burden differences is not analyzed in this paper. Such an analysis would require detailed consideration of intercountry tax shifting and would change the focus away from the taxable capacity of countries to the taxable capacity of individuals.

38 Lotz and Morss, “Measuring ‘Tax Effort’ in Developing Countries” (cited in footnote 3).
tries, both per capita income and openness were significant.\(^{39}\) The tax effort rankings that result from equation (14) are given in Table 2 for comparative purposes. These rankings and those resulting from equation (13) are not (statistically) significantly different.\(^{40}\) However, this is only to say that by each method the ranking into high, middle, and low is in general the same for the countries, although the particular ranking of a country may be changed. In fact, only five countries retain exactly the same rank under the two systems. The change that does occur for particular countries gives a clue as to the basic difference between the two formulations. The Lotz-Morss equation compared with equation (13) gives a considerably higher tax effort ranking for countries with important mining shares, e.g., Zambia from second to thirteenth; Tunisia from fourth to ninth; Venezuela from eighth to twenty-sixth; and Iran from sixth to twenty-eighth. This seems to result from the failure to account explicitly for the higher taxable capacity generated by a larger mining share. A comparison of these two studies indicates that the array of "expected tax ratios," or taxable capacity, is much more diverse under the present model than under the Lotz-Morss formulation. With the Lotz-Morss equation, Singapore has the largest taxable capacity (21.52 per cent) and Nepal the smallest (11.10 per cent), whereas the present formulation estimates a wider range of taxable abilities with Zambia the largest (24.47 per cent) and Chad the smallest (9.86 per cent). It may be concluded that, while the Lotz-Morss taxable capacity variables in fact distinguished between countries at higher levels of development and those at lower levels, the generally higher taxable capacities of mining-oriented economies were not given sufficient weight.

If the basic model used here is reformulated to include per capita income as the indicator of the stage of development, the mining share of income as the measure of sectoral income distribution, and the export ratio as the measure of openness,\(^{41}\) the following equation is derived.\(^{42}\)

\[
\hat{T}/Y = 10.05 + 0.0031(Y_p - X_p) + 0.3973N_y** + 0.0881(X_v - Nx_v)^* \\
(7.84) \quad (0.77) \quad (5.55) \quad (1.89) \\
\hat{R}^2 = 0.393
\]

\(^{39}\) The results are not strictly comparable, however, because the Lotz-Morss dependent variable included social security taxes, whereas the present dependent variable does not.

\(^{40}\) A Spearman rank correlation coefficient between the two series is 0.8704.

\(^{41}\) With appropriate adjustments for overlapping variables.

\(^{42}\) Such a formulation has been used by the Fiscal Affairs Department for deriving tax effort indices in developing countries.
The use of equation (15) to generate tax effort comparisons requires a departure from the approach taken elsewhere in this paper. First, per capita income is included as an independent variable on the grounds that no other available indicator of the stage of development equally well measures taxable surplus and has the same normative significance. Second, per capita income is retained in the estimating equation even though it does not meet conventional tests of significance. In equation (15) the mining share of income remains the major tax ratio determinant, based on the size of the partial determination coefficient, and by this formulation the size of the foreign trade sector becomes statistically significant. Taxable capacity estimates by this equation vary from 24.34 in Zambia and 22.42 in Venezuela to 10.63 in Nepal. The tax effort rankings obtained with equation (15) do not differ significantly from those obtained either with the present study or with the Lotz-Morss equation (see Table 2).

The effects of geographic region

It is possible that inherent in intercountry tax ratio variations is a geographic or regional effect (Table 4); at least two explanations of such an effect are possible. First, the tax policy actions of a particular country may be affected by the tax policy actions of neighboring countries. It can be argued that the ceiling on the rates of many taxes now in use in less developed countries is heavily influenced by the rates in effect in neighboring countries. For example, relevant to the consideration of whether the sales or income tax is too low in the Philippines is a comparison with the intensity of use of these taxes in other Southeast Asian countries. A second possible source of a geographic effect on the tax ratio is that preferences for public services and for methods of supplying them may be considerably more homogeneous within a region than among regions. Such an argument from the expenditure side would violate the requirements of the tax effort model, as the estimating equation would produce an expected tax ratio based explicitly on factors

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43 The coefficient of variation by equation (15) is 22.59, compared with 23.21 by equation (13) and 15.00 by the Lotz-Morss equation.
44 The Spearman rank correlation coefficients are 0.9541 with the present study and 0.8918 with the Lotz-Morss equation.
45 The grouping of countries by region is shown in Table 4. It is apparent that this grouping is rather arbitrary, and that the results obtained may be affected if the countries are grouped in another way.
other than taxable capacity. Hence, it would not seem appropriate to include these regional effects when making tax effort comparisons.

The objective of this section is to determine the existence of a regional effect on the tax ratio, while allowing for intercountry differences in the agricultural and mining shares. In this context, the effect of region may operate in either or both of two ways. First, even with identical marginal impacts of \( Ny \) and \( Ay \), taxable capacity may be higher or lower in a given region, i.e., the intercept or constant term in the estimating equation may vary among regions. Second, the marginal impact of each of the two independent variables may also vary among regions, that is, the regression coefficient of \( Ay \) and \( Ny \) may be different for each region.

To test the first of these hypotheses, five dummy variables are introduced:

\[ V_1 = 1 \text{ if Asia and the Far East, } 0 \text{ otherwise}; \]
\[ V_2 = 1 \text{ if tropical Africa, } 0 \text{ otherwise}; \]
\[ V_3 = 1 \text{ if South America, } 0 \text{ otherwise}; \]
\[ V_4 = 1 \text{ if Central America and the Caribbean, } 0 \text{ otherwise}; \]
\[ V_5 = 1 \text{ if the Middle East and North Africa, } 0 \text{ otherwise}; \]

### Table 4. Forty-Nine Developing Countries: Regional Groupings

<table>
<thead>
<tr>
<th>Asia and the Far East</th>
<th>Tropical Africa</th>
<th>South America</th>
<th>Central America and the Caribbean</th>
<th>Middle East and North Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceylon</td>
<td>Burundi</td>
<td>Argentina</td>
<td>Costa Rica</td>
<td>Iran</td>
</tr>
<tr>
<td>China</td>
<td>Chad</td>
<td>Bolivia</td>
<td>Guatemala</td>
<td>Lebanon</td>
</tr>
<tr>
<td>India</td>
<td>Zaïre</td>
<td>Brazil</td>
<td>Guyana</td>
<td>Morocco</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Ethiopia</td>
<td>Chile</td>
<td>Honduras</td>
<td>Sudan</td>
</tr>
<tr>
<td>Korea</td>
<td>Ghana</td>
<td>Colombia</td>
<td>Jamaica</td>
<td>Tunisia</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Ivory Coast</td>
<td>Ecuador</td>
<td>Mexico</td>
<td>Turkey</td>
</tr>
<tr>
<td>Nepal</td>
<td>Kenya</td>
<td>Paraguay</td>
<td>Trinidad and Tobago</td>
<td>Egypt</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Mali</td>
<td>Peru</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Rwanda</td>
<td>Venezuela</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>Senegal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viet-Nam</td>
<td>Togo</td>
<td>Upper Volta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zambia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A general equation may be written as:

\[ T/Y = a + b_1A_y + b_2N_y + \sum_{i=1}^{4} c_iV_i. \]  

(16)

Note that, in order to derive a determinant solution, one region must be omitted (tropical Africa in this case) from the estimating equation. The following result is derived.

\[
\hat{T}/Y = 21.37 - 0.1588A_y** + 0.2177N_y** - 4.255V_1** - 4.959V_3** \\
- 6.536V_4** - 2.107V_5 \\
(9.745) (4.087) (2.955) (3.096) (3.012) \\
- 6.536V_4** - 2.107V_5 \\
(3.765) (1.293) \\
(\bar{R}^2 = 0.552) \tag{16a}
\]

These results, even given the arbitrary nature of the country groupings, confirm the suspicion that a regional effect on the tax ratio is operative. Specifically, the effect of allowing for region in the basic model is to increase the adjusted explained variation by a statistically significant amount, from 0.411 to 0.552.46 The significance tests for the partial regression coefficients of the dummy variables may be interpreted as tests of the significance of the distinction between region \( i \) and the omitted region, tropical Africa. Therefore, it may be concluded that, after allowing for the effects of the mining share and the agricultural share, the expected tax ratios in Asia and the Far East, South America, and Central America and the Caribbean regions are significantly lower than that in the tropical Africa region. Central America and the Carib-

\[ 46 \] The significance test for the overall effect of region involves computing an \( F \) statistic on the ratio of the mean square among regions to the residual variance in the regression equation. The variation among the five intercepts (\( \sigma^2 \)) is

\[
\sigma^2 = \frac{\sum_{i=1}^{5} N_i (V_i - \bar{V})^2}{4}
\]

where \( N_i = \text{number of countries in the } i^{th} \text{ class and}

\[
\bar{V} = \frac{\sum_{i=1}^{5} N_i V_i}{\sum_{i=1}^{5} N_i}
\]

bean region also shows an expected tax ratio that is, ceteris paribus, significantly lower than that in the Middle East and North Africa region (Table 5).

Table 5. Five Geographic Regions: Differences in Expected Tax Ratios, Given the Effects of the Agricultural and Mining Shares

<table>
<thead>
<tr>
<th>Region</th>
<th>Expected Tax Ratio</th>
<th>Asia and the Far East</th>
<th>Tropical Africa</th>
<th>Central America and the Caribbean</th>
<th>Middle East and North Africa</th>
<th>South America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia and the Far East</td>
<td>17.12</td>
<td>...</td>
<td>-4.25*</td>
<td>2.29</td>
<td>-2.14</td>
<td>+0.71</td>
</tr>
<tr>
<td>Tropical Africa</td>
<td>21.37</td>
<td>4.25*</td>
<td></td>
<td>6.54*</td>
<td>2.11</td>
<td>+4.96*</td>
</tr>
<tr>
<td>Central America and the Caribbean</td>
<td>14.83</td>
<td>-2.29</td>
<td>-6.54*</td>
<td>...</td>
<td>-4.43*</td>
<td>-1.58</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>19.26</td>
<td>2.14</td>
<td>-2.11</td>
<td>4.43*</td>
<td>...</td>
<td>2.80</td>
</tr>
<tr>
<td>South America</td>
<td>16.41</td>
<td>-0.71</td>
<td>-4.96*</td>
<td>1.58</td>
<td>-2.80</td>
<td>...</td>
</tr>
</tbody>
</table>

Equation (16a) may be interpreted as describing a different estimating equation for each region, with the intercept for the \( i \)th region equation being \((21.37 + c_i V_i)\). The respective regional equations follow.

Asia and the Far East
\[ \hat{T}/\hat{Y} = 17.12 - 0.1588A_y + 0.2177N_y \]

Tropical Africa
\[ \hat{T}/\hat{Y} = 21.37 - 0.1588A_y + 0.2177N_y \]

Central America and the Caribbean
\[ \hat{T}/\hat{Y} = 14.83 - 0.1588A_y + 0.2177N_y \]

Middle East and North Africa
\[ \hat{T}/\hat{Y} = 19.26 - 0.1588A_y + 0.2177N_y \]

South America
\[ \hat{T}/\hat{Y} = 16.41 - 0.1588A_y + 0.2177N_y \]

One of the constraints imposed in the foregoing analysis is the assumption that the partial effects of the two independent variables on
the tax ratio will be constant across regions, i.e., only the intercept is adjusted for a regional effect. It is possible, however, that these partial effects vary among regions. To test the hypothesis that such a regional effect is operative, a set of dummy interaction terms is introduced. To do this, two new variables, $Z_1$ and $Z_2$, are created such that

$$Z_{1ij} = V_i(N_{ij}) , j = 1, 2, \ldots, 49, \quad i = 1, 2, \ldots, 5$$

$$Z_{2ij} = V_i(A_{ij}) , j = 1, 2, \ldots, 49, \quad i = 1, 2, \ldots, 5$$

where $V_i = 1$ if country $j$ is located in region 1, and where $V_i = 0$, otherwise. The general form of the estimating equation (see equation (16)) becomes

$$T/Y = a + b_1 N_i + b_2 A_i + \sum_{i=1}^{4} c_i V_i + \sum_{i=1}^{4} d_i Z_{1i} + \sum_{i=1}^{4} h_i Z_{2i} ,$$

where again the tropical Africa region is omitted. For region 1, the adjusted equation becomes

$$T/Y = (a + c_1) + (b_1 + d_1) N_i + (b_2 + h_1) A_i ,$$

where the significance of $c_1$ may be interpreted as in equation (16a), and the significance of $d_1$ and $h_1$ as indicating whether there is a difference in the marginal effect of the mining and agricultural shares, respectively, on the tax ratio as between region 1 and the omitted region.

In carrying out this analysis, the two possible interaction terms are added in turn to equation (16). If the adjusted determination coefficient is not significantly greater than 0.552, the hypothesis that a regional interaction effect exists is rejected. The results obtained here show that neither of the regional interaction terms increases the explained variance beyond 0.506. In each case, the loss in degrees of freedom outweighs the increase in total explained variation. Therefore, the hypothesis is accepted that the marginal impact of the two independent variables on the tax ratio does not vary among regions. It should be noted, however, that the regression coefficients and significance levels of the explanatory variables, particularly of $A_i$, change substantially, suggesting that a regional factor affects the relationship between the agricultural share and the tax ratio, as shown in equation (13).
IV. Summary and Conclusions

Statistical Results

The conventional wisdom of tax ratio and tax effort analysis holds that the tax revenue share of GNP in developing countries is a function of the stage of development and the openness of the economy. The basic format of the analysis here does not differ markedly from this hypothesis, i.e., the expected tax ratio (or taxable capacity) is still hypothesized to be higher in countries where development has proceeded to a higher level and where the size of the foreign trade sector is larger. Another general factor, the composition of income, is added on the grounds that different economic sectors have different taxable surpluses, and, therefore, the sectoral composition of income, as well as the level of income, affects taxable capacity. However, a simple analysis of the interdependency among proxy measures for these general factors reveals an overlapping that prohibits including the three in an explanatory model. The observed interdependencies do suggest a crude tripartite of the sample: (1) Countries at the lowest stage of development having a large proportion of income generated in the agricultural sector, a relatively large subsistence sector, and significantly smaller import and export shares of GNP. (2) Countries that have achieved a higher level of development through the export of oil and minerals. Generally, the export and import shares of GNP in these countries are significantly higher than in other countries. (3) Countries that have achieved a higher level of development but less through the growth of oil and mineral exports than through import substitution and the growth of nonmining export products. These countries also tend to be more “open” than those at lower stages of development but less “open” than the countries in the latter group.

This framework of analysis permits the use of sectoral components of income to allow for these differences. The agricultural share of income is significantly and negatively related to the tax ratio, reflecting the expected negative relationship between taxable capacity and stage of development. The mining share of income (and implicitly, via intercorrelation, the export ratio) is positively and significantly related to the tax ratio, reflecting the higher taxable capacity of countries that have achieved a higher stage of development through the export of minerals and oil. By implication, countries that have achieved a higher level of
development via import substitution and the growth of nonmining exports have a taxable capacity greater than the countries at the low stage of development, but less than those with large mining shares of income.

This model provides a perspective in which the effects of overlapping dimensions of an economy and their combined effects on taxable capacity are recognized. Moreover, the use of this framework results in a higher explained variance than have other recent analyses. However, two final limiting factors must be considered, since these conclusions are based on a cross-section analysis. First, this technique enables inferences as to how intercountry differences in the tax ratio respond to intercountry differences in selected variables. It may or may not be useful for inferring the responsiveness of a given country's tax ratio to changes in economic structure. Second, while the model appears to fit current circumstances, it may not be appropriate at some point in the future. For example, the high taxable capacity in Zambia and Zaïre are a direct result of high copper prices, and a drastic decline in these prices may well impair the relatively high tax base existing in these countries. However, this general criticism is not necessarily damning, as the basic hypothesis will remain that taxable capacity is a function of taxable surplus, even though the estimating equation may need reformulation to account for time changes in the sectoral location of this surplus. Finally, it is shown above that a part of the residual term is systematically associated with geographic location, possibly reflecting an intraregional homogeneity in public service preference patterns and a tax policy demonstration effect among neighboring countries in the same region.

**TAX EFFORT COMPARISONS**

To use such a model for making tax effort comparisons requires a number of assumptions that are covered in some detail in the manuscript. A comparison of tax effort as derived from this stochastic process is presented in Table 2. The rankings obtained, while not differing significantly (statistically) from the results of the other tax effort studies cited, do reflect substantial adjustments, e.g., countries with high mining shares have, with the present formulation, a lower ranking in tax effort because of the explicit consideration of the greater taxable surplus. The higher explained variance in the present study compared with the
Lotz-Morss work suggests that a part of the residual tax effort term in their analysis was systematically related to the sectoral composition of income. Moreover, it is shown in this study that a significant regional bias exists in the tax effort ranking.

This study focuses on the question of tax effort comparisons. It could as well have taken the objective of explaining tax ratio variations and ignored tax effort rankings; however, such rankings still would have been implied. The approach has been to carry the tax effort methodology to its logical conclusion and to analyze the results, while at the same time it is hoped that it provides a complete discussion of limitations and implied assumptions. The user of such comparisons would do well to examine in some detail the restraining assumptions inherent in the exercise. While the importance of being cautious in accepting such assumptions should be stressed, it would be impracticable to discard completely the idea of developing objective tax effort criteria. Tax effort comparisons will continue to be made, and a method using simple tax/GNP ratios gives markedly different results—it may be argued persuasively on an a priori basis markedly worse results—than does a method that makes adjustment for taxable capacity. While the regression approach presented may not be the only alternative to a simple tax/GNP ratio comparison, it is—at least conceptually—an attractive option.

APPENDICES

I. Note on Sources of Data

Fiscal data have been taken mainly from government sources, such as budget documents or reports of the comptroller general. Where fuller coverage was found in other official documents, e.g., central bank reports, they were used. Sometimes, where consolidated government sector accounts were not readily available directly from published official sources, unpublished (nonconfidential) figures supplied to the Fund have been taken.

GNP data have been taken mainly from the United Nations, Statistical Office, *Yearbook of National Accounts Statistics*, and the International Monetary Fund, *International Financial Statistics (IFS)*. In some cases, unpublished estimates available in the Fund have been used. For Burundi, Chad, Mali, Nepal, Pakistan (first period), Rwanda, Senegal, Somalia, the Sudan, Tanzania, Togo, and Upper Volta, only figures for the gross domestic product (GDP) were available. For all
other countries, GNP figures have been used. Data on the shares of different production sectors in GDP have also been taken mainly from United Nations sources, but certain other sources have been resorted to for a few countries. Data on imports and exports have been taken mainly from the IFS. The main limitation in relation to the tax data is that local governments could not be covered in all cases. Aside from this, the tax figures for different countries are comparable. But, as regards national income data, more than one source has had to be used. This means that the comparability of estimates, which are in any case subject to well-known limitations, is further reduced. This limitation should be kept in mind throughout.

II. Interpretation of the Constant in Equation (13)

Equation (13) in the text may be restated for reinterpretable purpose. Since the mining share \( (N_y) \), the agricultural share \( (A_y) \), and the combined share of all other sectors add to 100 per cent, a determinant solution may be obtained from either

\[
T/Y = a + b_1 A_y + b_2 N_y, \tag{21}
\]

or,

\[
T/Y = c_1 N_y + c_2 A_y + c_3 (100 - A_y - N_y), \tag{22}
\]

where the \( T/Y \) will be identical.

Simplifying equation (22), it is possible to derive

\[
T/Y = 100c_3 + (c_2 - c_3) A_y + (c_1 - c_3) N_y, \tag{23}
\]

or,

\[
T/Y = a + 3 A_y + 7 N_y. \tag{24}
\]

From equation (13), it is now possible to derive the coefficients of equation (22) as

\[
\hat{T}/Y = 0.4446 N_y + 0.0753 A_y + 0.1495 Z_y, \tag{25}
\]

where

\[Z_y = \text{GNP share of all other sectors}.
\]

It should be noted that \( \frac{\partial(T/Y)}{\partial(N_y)} \) and \( \frac{\partial(T/Y)}{\partial(A_y)} \) from equations (22) and (25) are the same as for equation (13), but 0.1495 may now be interpreted more literally as the tax ratio change that accompanies a one-unit change in income originating in all other sectors. The nature of the implied total income increase and reduction in the agricultural and/or mining shares may be deduced from equation (25).
Analyse de l’effort et de la pression fiscale
par la méthode de régression

Résumé

Cette étude présente une analyse systématique comparative de la pression fiscale dans les pays en voie de développement. Elle a pour objet principal 1) d’établir en détail les hypothèses nécessaires, et les limites inhérentes à une analyse permettant d’effectuer des comparaisons valables sur l’effort fiscal entre plusieurs pays et 2) de fournir une analyse statistique qui, en fin de compte, devrait permettre d’établir un ensemble d’indices de l’effort fiscal. Les données fiscales utilisées portent sur la période 1966-68 et ont été rassemblées par le Département des Finances Publiques du Fonds Monétaire International, en général, à partir de sources officielles telles que les documents budgétaires ou les rapports du Ministère des Finances.

La partie théorique de cette étude comprend une appréciation critique des travaux déjà consacrés à ce sujet, un examen détaillé des hypothèses implicites et explicites nécessaires à la formulation de conclusions en matière d’effort fiscal à partir d’une analyse stochastique des pressions fiscales que l’on rencontre à l’heure actuelle dans différents pays. Elle traite également des problèmes économétriques apparemment liés à ce genre d’analyse.

Le modèle statistique mis au point dans cette étude ne diffère pas sensiblement de ceux repris dans les analyses antérieures. Le niveau de développement économique auquel est parvenu un pays, habituellement mesuré par le revenu par tête – et l’importance du commerce extérieur représentée dans une certaine mesure par la part respective des importations et des exportations dans le revenu national – ont servi jusqu’ici à expliquer les variations de la pression fiscale d’un pays à un autre. Le modèle utilisé ici fait intervenir trois facteurs fondamentaux de la capacité contributive d’un pays, à savoir le niveau de développement économique, l’importance du commerce extérieur, et la composition sectorielle du revenu national. Ce dernier critère est établi en fonction de la part du revenu national imputable aux industries extractives, vu le potentiel fiscal plus élevé qu’offre ce secteur. En outre, le niveau de développement est mesuré en fonction de la part du secteur agricole dans le revenu national. Une simple analyse des corrélations montre que lorsque ces deux dernières variables sont comprises dans le modèle, il n’est pas possible de déterminer quelle est à elle seule l’importance du
commerce extérieur. Les résultats statistiques confirment les prévisions, à savoir qu'il existe une relation significative et positive entre la part du secteur des industries extractives et la pression fiscale, tandis que la relation entre la pression fiscale et l'importance du secteur agricole est significative mais de sens contraire. Au surplus, l'explication donnée couvre une marge plus grande de la variation que si l'on avait utilisé les variables habituelles du revenu par tête et du degré d'ouverture de l'économie.

Pour tirer des conclusions en matière d'effort fiscal, la valeur estimative de la pression fiscale pour un pays donné, dérivée de l'équation 13 et des parts du PNB imputées au secteur agricole et à celui des industries extractives, sert à estimer la capacité contributive. La pression fiscale effective, exprimée en pourcentage de la capacité contributive, est retenue comme mesure de l'effort fiscal. Le tableau 2 donne les estimations de la capacité contributive et de l'effort fiscal des pays en voie de développement, ainsi que la position relative occupée par chaque pays.

Cette étude se termine sur une analyse régionale menée à partir d'un ensemble de variables géographiques fictives. Bien que les regroupements par pays soient assez sommaires, la marge de variation expliquée augmente de façon sensible. Ceci suggère qu'il existe un facteur régional dans les variations de la pression fiscale entre les divers pays. Les résultats montrent qu'après avoir éliminé ce facteur dans les parts de revenu national imputables au secteur agricole et à celui des industries extractives, la pression fiscale «escomptée» ou «prédite» est sensiblement plus élevée en Afrique tropicale qu'en Extrême-Orient, en Amérique du Sud et en Amérique centrale.

Un estudio del esfuerzo tributario y de la presión fiscal mediante el análisis de regresión

Resumen

En este estudio se presenta un análisis comparativo de los niveles de tributación en una amplia muestra de países en desarrollo. Concretamente, los dos objetivos básicos son: 1) identificar con cierto detalle los supuestos necesarios, y las limitaciones inherentes, en un análisis
que sea capaz de generar comparaciones apropiadas entre los esfuerzos tributarios de distintos países, y 2) proporcionar un análisis empírico y, en definitiva, un conjunto de índices de esfuerzo tributario. Los datos fiscales utilizados se refieren al período 1966-68 y fueron recogidos por el Departamento de Finanzas Públicas del Fondo, principalmente de fuentes gubernamentales tales como documentos del presupuesto o informes del contralor general.

La sección conceptual de este estudio incluye una evaluación crítica de la literatura anterior sobre la materia, un examen detallado de los supuestos implícitos y explícitos necesarios para extraer conclusiones acerca del esfuerzo tributario partiendo de un análisis estocástico de las presiones fiscales existentes, y un tratamiento de los problemas econométricos que parecen ser inherentes a esta clase de análisis.

El modelo estadístico elaborado en este estudio no difiere mucho, en términos generales, de los análisis anteriores. Para explicar las variaciones en la presión fiscal entre distintos países, los estudios han solido basarse en la etapa de desarrollo—normalmente medida por el ingreso per cápita—y la dimensión del sector de intercambios con el exterior—medida en términos de alguna combinación de las proporciones del ingreso correspondientes a la importación y a la exportación. El modelo aquí utilizado trata tres determinantes básicas de la capacidad tributaria de un país, a saber: etapa de desarrollo, dimensión del sector de intercambios con el exterior, y composición sectorial del ingreso. Esta última se mide por la proporción del ingreso que corresponda a la minería, dado que el potencial de margen gravable es más alto en este sector, y la etapa de desarrollo se mide mediante la proporción del ingreso que corresponda a la agricultura. Un simple análisis de intercorrrelación indica que cuando esas dos variables se encuentran en el modelo no hay una medida independiente de la dimensión del sector de intercambios con el exterior. Los resultados estadísticos son los que cabía esperar, es decir, la proporción de la minería está relacionada con la presión fiscal de forma significativa y positiva, y la proporción de la agricultura es significativa y negativa. Además, se demuestra que la varianza explicada resulta mayor que si se hubieran utilizado las variables convencionales de ingreso per cápita y grado de apertura.

Para extraer conclusiones acerca del esfuerzo tributario, se toma como estimación de la capacidad tributaria el valor estimado de la presión fiscal de un país determinado, sirviéndose de la ecuación (13) y de las proporciones de la minería y de la agricultura en dicho país.
La presión fiscal efectiva, expresada como porcentaje de la estimada, es lo que se toma como medida del esfuerzo tributario. En el Cuadro 2 se muestran para cada país las mencionadas estimaciones de la capacidad tributaria y el esfuerzo tributario, así como la posición relativa ocupada por cada país.

Finalmente, se realiza un análisis regional con un conjunto de variables ficticias geográficas. Aunque la formación de grupos es francamente elemental, se obtiene un aumento significativo en la variación explicada. Esto sugiere que hay un efecto regional en las variaciones de la presión fiscal entre distintos países. Los resultados indican que una vez incluidos los efectos de las variaciones entre los países en las proporciones de la agricultura y la minería, la presión fiscal “esperada” o “pronosticada” es significativamente más elevada en África tropical que en el Oriente Lejano, Sudamérica, y Centro América.