8

Relationship Between Income Tax Ratios and Growth Rates in Developing Countries

A Cross-Country Analysis

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This chapter presents some empirical evidence on the interrelationship between output growth and the reliance of the tax system on income taxes in developing countries, using cross-country and pooled cross-country time-series samples.

Output growth is influenced by many factors, in addition to the structure of the tax system, and these need to be controlled to isolate the net effect of income taxes. The main sources of output growth will first be identified according to the Dennison growth accounting tradition. Then, drawing on the development economics literature, the main determinants of these sources will be analyzed and used as explanatory variables in the final reduced-form equation for growth rates.

The proposition that income taxes have a negative effect on output growth is one of the central arguments in the old controversy in the theory of public finance about the choice between a consumption or an income-based tax system (Hall (1968), Tanzi (1969), Goode (1976), Meade (1978), Pechman (1980)). In recent years, this controversy has been rekindled by the emergence of the supply-side approach, which emphasizes the significant negative effects of high income taxes on savings, productive investment, labor supply, and, consequently, growth (Boskin (1978), Canto, Joines, and Laffer (1983)).[1]

[1]This is one of the major propositions associated with the supply-side school. See Gandhi (Chapter 1).

The theoretical arguments used by the supply-siders are similar in substance to those of the neoclassical economists writing on taxation and, among others, include the following:

- Taxation of capital incomes (through personal and corporate income taxes, capital gains taxes, and so on) distorts the marginal conditions for intertemporal consumption, providing an incentive to substitute current consumption for future consumption, or savings (Atkinson and Stiglitz (1980), Feldstein (1983)).
- Taxation of labor incomes (through personal income tax) distorts the marginal conditions for static labor-leisure decisions, providing an incentive to substitute leisure for labor. This effect is particularly significant for a highly skilled labor force whose incentives to work are easily eroded by high and progressive income tax rates.
- Taxation of labor incomes (through personal income tax—especially at highly progressive rates) seriously distorts the marginal conditions for human capital formation decisions (such as investment in education or training). However, when taxes on labor incomes are proportional and the only costs of human capital formation are forgone earnings, that is, all other costs are fully expensed (or tax deductible), taxes on labor incomes tend to be neutral (see Boskin (1975)). In other words, proportional labor taxes lead to the same investment in human capital as do lump-sum taxes.

These arguments suggest that if two countries were compared that were identical in all respects except that the share of capital income taxes in total taxes was higher for one than for the other, the latter would grow faster, as its savings rate would be higher. Alternatively, if they were identical except that the share of labor income taxes in total taxes was higher for one than for the other, the growth rate for the former would be smaller, provided its higher share of labor income taxes was the result of a progressive rate structure. Combining these arguments for capital and labor income taxes suggests that the higher the share of direct tax revenue, the lower the growth rate, all else being equal.[2]

[2]The skeptic can raise some doubts about the validity of this proposition in the context of the neoclassical growth theory according to which income tax may influence the aggregate level of real variables in the steady-state but not of their growth rates which are dependent only on exogenous variables such as the labor supply growth rate. Even in neoclassical models, however, growth rates can still differ in the transition path to the steady-state. If we assume that developing countries are in such a situation, these models will imply, under a wide range of specifications, that countries that provide disincentives to capital accumulation and/or technological progress, say, through high and progressive income taxes, could well grow slower.

In the end, however, the existence and size of the negative effect of income taxes on capital accumulation and growth must be substantiated by empirical evidence.[3] This chapter attempts to shed some light on the issue by focusing on the empirical analysis of cross-section data from developing countries.[4]

The remainder of this chapter is divided into three sections and an annex. Section I examines the strategy for empirical testing and derives a general regression equation for the growth rate. Section II analyzes the empirical results from the final model. Section III summarizes the findings of the paper. The Annex describes the sources of data and includes some additional regression equations.

I. Strategy of the Empirical Analysis

The empirical analysis in this paper is based on a final regression equation in which output growth, as the dependent variable, is explained by a relatively short list of exogenous determinants for which data are readily available in developing countries. The approach taken for deriving such a regression equation is the growth accounting approach in the Dennison (1962) tradition.

As a first step, the aggregate production possibilities of a country were assumed to be characterized by the inequality:

$$Y(t) \leq A(t)\, F[K(t), H(t)], \qquad (1)$$

where real output (Y) in period t is limited by the state of the technology (A), physical capital (K), and human capital (H). The aggregate production function, $F(\ )$, has constant returns to scale and the usual neoclassical properties.

Rewriting expression (1), we derive:

$$Y(t) \equiv \gamma(t)\, A(t)\, F[K(t), H(t)] \qquad 0 < \gamma(t) \leq 1. \qquad (2)$$

[3]In recent years, there has been some effort in this direction using different techniques or data sets. For instance, using time-series data, see Boskin (1978), Howrey and Hymans (1980), Giovannini (1985); using simulations of general equilibrium models, see Auerbach and Kotlikoff (1983), Kotlikoff (1984), and the references therein; and pairing similar countries with different levels of taxation, see Marsden (1983).

[4]This approach has been interestingly applied to other macroeconomic and fiscal hypotheses in relation to developing countries in recent papers by Kormendi and Meguire (1985). For developed countries, Tanzi (1969) provides case studies and cross-country comparisons of growth rates and the structure of the individual income tax.

where $1 - \gamma$ measures the difference between the current output level and the level attainable on the production possibilities frontier. Expression (2) is tautologically true unless γ or A have restrictions.

The growth accounting identity is, then, obtained from the logarithmic derivative of (2) (suppressing all time arguments):

$$\hat{Y} = \hat{\gamma} + \hat{A} + \alpha\hat{K} + (1 - \alpha)\hat{H}, \tag{3}$$

where growth rates are indicated by circumflex accents and α is the elasticity of output with respect to capital and is equal to the share of capital in total output when factors are paid the value of their marginal product.

In identity (3), following the Dennison tradition, output growth is decomposed into four different sources: (1) physical capital growth, $\hat{K}$; (2) human capital growth, $\hat{H}$; (3) technical change, $\hat{A}$; and (4) change in the efficiency in the use of resources, $\hat{\gamma}$. This expression can be seen as a closing identity of a general model in which each of the growth sources is determined endogenously.

The next step was to derive the basic determinants of each of these sources of growth as a function of a short list of observable exogenous variables. Because reasonably consistent and reliable data had to be readily available for these variables for the period of analysis, the number of these potential exogenous variables was rather limited.

The final step in the process was to obtain the reduced-form equation for output growth, $\hat{Y}$, ready to be used in empirical estimation.

We will start now by examining various determinants of the sources of output growth identified in identity (3) above.

Physical Capital (K)

The change in the capital stock during a given period is equal to investment (I), net of depreciation (δK):

$$\hat{K}_t = \frac{\Delta K_t}{K_t} = \frac{I_t - \delta K_t}{K_t} \qquad 0 < \delta < 1. \tag{4}$$

Denoting the ratio of investment to output as i and the capital-output ratio as u, equation (4) can be rewritten as:

$$\hat{K}_t = \frac{i_t}{u_t} - \delta. \tag{5}$$

From a national accounting perspective, the investment-output ratio is identically equal to domestic savings plus net foreign investment divided by gross domestic product (GDP).[5]

A review of the available literature suggests that the following factors potentially influence capital accumulation.[6]

Reliance on Income Taxes (TI)

The theoretical justification for the inclusion of reliance on income taxes has already been provided in the introductory section.[7] The empirical analysis in this paper makes use of two measures of a country's reliance on income taxes: *TI/T*—the share of income tax revenue in total tax revenue (the focus of the analysis) and *TI/Y*—the share of income tax revenue in GDP. According to supply-side advocates, these two variables should be negatively related to output growth. Part of this effect is likely to come through lower physical capital accumulation from the taxation of capital income.[8]

Capital income is taxed under both individual and corporate income taxes. It is difficult to disentangle their different potential effects on output growth empirically, since the systems of integrating these taxes are varied (in our sample of countries they range between complete nonintegration, in, for example, India, to virtual full integration, as in Greece).[9] Nonetheless, the study will derive some regression results using separate ratios of individual and corporate income taxes to total tax revenue (*TII/T* and *TCI/T*, respectively), in spite of the difficulties in the interpretation of their coefficients.

[5] In the absence of interventions, the quantities observed ex post for these variables reflect the interaction of demand and supply of investable funds in the market. However, for our purpose, we are interested in understanding the exogenous factors ("shift parameters") that determine the position of these demand and supply schedules. Unfortunately, the empirical importance of capital market interventions in developing countries cannot be ignored, especially the widespread existence of nominal interest rate ceilings. (These are documented in Galbis (1979) and International Monetary Fund (1983).)

[6] For a thorough survey of the literature on these issues, both theoretical and empirical, see Ebrill (Chapter 3).

[7] In that section we abstracted from open economy considerations. These considerations do not change the essence of our testable proposition. Investment decisions of foreign economic agents (usually firms) depend on the relative tax treatment of the generated income (among several other factors). Relatively high corporate income tax rates could be expected to decrease foreign investment and, thus, accumulation of capital in a country.

[8] This argument ignores the positive effect that government expenditures may have on physical capital accumulation.

[9] For some considerations on the choice of integration systems, see Prest (1985).

Inflation (INF)

Inflation can have a negative effect on capital accumulation in two main ways. First, it is usually associated with greater uncertainty about the returns on current savings as well as those future relative prices that are important for returns on investment. This increased and, generally, uninsurable uncertainty discourages the accumulation of productive capital (see Mirman (1971)).[10] The second negative impact of inflation arises because nominal interest rates in developing countries are often set by the government at artificially low rates (Galbis (1979)). The adverse effect of such a policy on savings and investment is exacerbated by high rates of inflation, since they lead to highly negative real interest rates for savers which, by reducing the flow of savings, constrain investment.

On the other hand, in some models (see, e.g., Fischer (1979)) inflation is assumed to have positive effect on capital accumulation by virtue of the Tobin-Mundell effect: high anticipated inflation leads to shifts in portfolios away from real money balances and toward real capital.

The relative strength of positive and negative effects of inflation on capital accumulation will need to be determined empirically.

Demographic Variables (AGE)

For explaining savings behavior, life-cycle models stress the importance of the humped shape of earnings profiles and the desire of individuals for a smooth consumption pattern over their lifetimes. These two factors together imply that individuals will accumulate assets in their most productive years to pay for debts incurred when young and for retirement. Thus, we would expect that the percentage of the population that is within the working age, say, 15–65 years of age (*AGE*), might increase savings.[11]

Level of Government Activity (PEX, KPEX)

It is important to separate the effects of the structure of taxation on capital accumulation from the effects of the level of government activity. There are sharp differences of view on these latter effects; according to supply-siders they are substantial and negative, while according to some development economists they may be substantial and positive in developing countries.

[10] High mean inflation (or money growth) is very closely correlated with a high standard deviation of monetary shocks, as calculated by Kormendi and Meguire (1985).

[11] For example, countries with a large percentage of the population below working age (as in many African countries) will be expected to have, ceteris paribus, lower savings ratios.

The level of government activity can best be measured in expenditure terms rather than revenue terms (Kotlikoff (1984)). The ratio of government expenditure to the value of output (PEX) is included as another explanatory variable in the regression for investment. The possible effect on investment of the composition of government expenditure is captured by including the ratio of government capital expenditure to output ($KPEX$). As Blejer and Khan (1984) point out, the sign of the overall effect on capital accumulation will depend on the strength of real and financial "crowding out" effects and on the substitutability or complementarity of government capital expenditure with private investment.

Per Capita Income (YPC)

Finally, standard neoclassical models predict that, in the transition to the steady-state, the lower is the level of income per capita, the faster will be the approach to the steady-state path and, hence, the faster will be output growth. Per capita income is, therefore, also added to the list of variables.

Human Capital (H)

Human capital (H) can be viewed as the product of the number of workers and an index of the average human capital per worker (h). The number of workers in an economy depends on the total population (N) and the labor participation rate (PR):

$$H_t = N_t \cdot PR_t \cdot h_t. \tag{6}$$

Taking percentage changes:

$$\hat{H}_t = \hat{N}_t + \hat{PR}_t + \hat{h}_t. \tag{7}$$

Data on the first two components ($\hat{N}$ and $\hat{PR}$) are readily available and their sum, denoted as labor change (LC), is taken in this paper as an explanatory variable in the final equation. The coefficient on labor change is expected to be positive.

The average human capital component ($\hat{h}$) depends on the education and training of individuals. Since the expected rates of labor taxes are relevant exogenous parameters for human investment decisions, especially when the tax rate structure is progressive and education costs cannot be fully expensed (as is usually the case with individual income taxes), TI/T and TI/Y can affect growth negatively through their effect on human capital accumulation as well. This negative effect of tax variables is particularly reinforced by such factors as the possibility of international mobility

of human capital (especially in the case of highly skilled labor) or of labor shifting to nontaxed sectors of the economy (either underground or nonmarket—household or subsistence—activities). Another potentially important determinant of human capital formation is the degree of public subsidization of marginal human capital investment. A good proxy for it would be the ratio of public expenditure on education to GDP (*EDU*), but there are many problems of availability and homogeneity of cross-country data on this variable; hence, this variable will not be used in the empirical analysis below.

Based on the discussions on physical and human capital, above, the capital accumulation component of equation (3) can now be written as equation (8), which makes it a function of the explanatory variables analyzed in the preceding paragraphs:

$$\alpha\hat{K} + (1 - \alpha)\hat{H} = \Psi\,(TI/T \text{ or } TI/Y,\ INF,\ AGE,\ PEX,\ KPEX,\ YPC,\ LC), \tag{8}$$

where

- TI/T = the share of income taxes in total tax revenues;
- TI/Y = the share of income taxes in GDP;
- INF = inflation;
- AGE = the share of the population at working age;
- PEX = the ratio of government expenditure to the value of output;
- $KPEX$ = the ratio of government capital expenditure to value of output;
- YPC = per capita income; and
- LC = the change in labor (change in total population plus the change in participation rate).

Technological Progress (A)

The economics of technological progress is an area of economic theory that is not well developed yet, perhaps because of its intrinsic theoretical difficulties (see Kamien and Schwartz (1982) for an introduction to these problems). Nevertheless, there are some tentative conclusions that may be drawn upon.

Technological advances in developing countries do not usually come from major breakthroughs in original research, but from adopting and using effectively already established technologies. Thus, it seems likely that countries with lower levels of development (measured by per capita GDP) may have a faster introduction of new technology. Growing contact with more developed countries should also be positively correlated with in-

creased technological progress and, hence, with higher growth. This growing contact might be measured by the outward orientation of a country's development, specifically by a variable such as growth in the ratio of exports to GDP (*XGW*). This variable is also important for measuring the country's capacity to increase foreign capital goods imports—another crucial factor for technological advance by a developing country.

Finally, a variable such as lagged growth rate (growth rate in the 1960s or *G60*) is included, to represent the increase in know-how, learning by doing, and so on associated with a faster path of development in previous periods.[12]

Changes in the Gap Between Actual and Potential Output (γ)

Economies do not usually function on their production possibilities frontier for several reasons. On the one hand, rigidities and inefficiencies may lead to a lower-than-potential level of output, while on the other hand, cyclical oscillations may lead to short-run unemployment of resources.

In the first situation, growth can be related to the rate of removal of the inefficiencies. For many developing countries, obstacles to free trade (such as tariffs, quotas, or exchange and trade controls) are a very important reason for this gap between attainable and actual output. Again, growth in the ratio of exports to GDP (*XGW*) can be used as a proxy for these opening policies.[13]

The second consideration, the existence of cyclical oscillations, implies that a large component of short-run changes in output would not be explainable with the set of variables determining long-run growth. Hence, for our empirical work, we would like to clean our data of these cyclical oscillations. There are different ways to accomplish this. We have chosen to take long-period averages (for five and ten years), and hope that the influences of cyclical fluctuations will cancel out over that period of time, which will allow our set of regressors to explain a major portion of the variance of the growth variable, the primary focus of our study.

Summing up, we can now put all the parts together by expanding equa-

[12] The relation between export performance and economic growth has been a subject of intense debate in the development literature (see Feder (1983), Balassa (1985) among many others). These studies have usually shown a positive contribution to growth arising from increased integration in world markets.

[13] Since trade liberalization is usually closely associated with removal of other policy distortions as well, the variable *XGW* will also pick up some of the influence on output of the reforms in other policies.

tion (3) to obtain a final equation that links growth with a list of explanatory variables described above.

$$\hat{Y} = f(TI/., INF, AGE, PEX, KPEX, YPC, LC, XGW, G60, \ldots), \quad (9a)$$

where

$$TI/. = TI/T \text{ or } TI/Y.$$

II. Empirical Analysis

Econometric Methodology

The empirical analysis below is based on equation (9a), which links long-term output growth of a country, $\hat{Y}$, to a partial list of general explanatory variables.[14] Additional general variables (unobservable or unavailable for the period studied) and idiosyncratic factors are combined in a random error term, ϵ_i, that is expected to have the usual properties. Linearizing equation (9a) (i.e., taking a first order approximation to the function f (.)), we obtain a readily estimable equation:[15]

$$\hat{Y}_i = \beta_1 + \beta_2\, TI/T + \beta_3\, INF_i + \beta_4\, AGE_i + \beta_5\, PEX_i + \beta_6\, KPEX_i + \beta_7\, YPC_i + \beta_8\, LC_i + \beta_9\, XGW_i + \beta_{10}\, G60 + \epsilon_i \quad (9b)$$

$$i = 1, \ldots, N.$$

Since the analysis is cross-country, growth in all the countries included in the sample is assumed to be well described by equations (1) to (9b).[16] Thus, countries whose growth had other country-specific and directly identifiable determinants over the period studied were excluded (such as members of the Organization of Petroleum Exporting Countries or countries involved in prolonged strife, for example, Angola, Nicaragua, and Zimbabwe).

[14]The econometric exogeneity of the variables is based on two considerations: (1) some variables are predetermined before the sample period ($G60$, YPC, AGE, or LC) and (2) other variables are taken to be choice variables for economic policymakers (tax structure, $TI/.$; inflationary financing, INF; and public sector participation in the economy, PEX and $KPEX$).

[15] TI/T is used initially as the tax structure variable.

[16]Cross-sectional data pooled with time series is also used.

The data for the study have been taken from the Fund's *International Financial Statistics Yearbook* (*IFS*), *Government Finance Statistics Yearbook* (*GFS*), and *World Tables* published by the World Bank (for a complete description and comments, see the Annex). The final sample includes observations for 39 developing countries for the 1973–82 period. The relevant data are given in Tables 1 and 2.

The main cross-section regressions use ten-year (1973–82) averages as regressors. Five-year averages were also used, with two observations for each country. By pooling these time-series and cross-section data, the sample size was doubled at the expense of increased standard deviation of the random error (because of additional short-run noise in output growth).

In estimating empirical regression equations, some variables given in equation (9b) may turn out to be irrelevant and, thus, could be deleted from the regression with consequent lower variance in the estimation of the remaining coefficients. This increased precision has to be weighed against the possibility of biased estimation from imposing inexact linear restrictions.[17] For solving this trade-off problem, the choice of the benchmark specification is done by using the Akaike information criterion (*AIC*), that is, by minimizing among all the possible linear specifications the expression:

$$AIC = -(2/N) \ln (L(.)) + (2/N) K_i,$$

where

$L(.)$ = likelihood function evaluated at the restricted maximum likelihood estimates;
K_i = number of regressors; and
N = number of observations.

The *AIC* (Akaike (1974)) is based on the Kulback-Leibler measure of information. This criterion has been shown to have high relative accuracy in applied work (see Geweke and Meese (1981)).

Regression Results and Checks for Robustness

In order to select a benchmark specification, regressions are estimated for all possible subsets of the list of explanatory variables (subset regressions). The specification that minimized the *AIC* (henceforth called

[17]This is a very general econometric problem, the choice of a specific model nested on a general model, for which there is no easy solution. As Judge and others (1980), remark: "the appropriate parameterization of a linear statistical model is a hard and important problem, and [that] despite the productive efforts of many, it remains just that" (p. 442).

benchmark specification) is given in equation (10) in Table 3[18] and includes five explanatory variables (*TI/T*, *LC*, *AGE*, *XGW*, and *INF*), all of them with expected (or plausible) signs. These five variables are able to explain almost 50 percent of the growth variance; variance that, as we saw from Tables 1 and 2, is very high in our sample. All variables are significantly different from zero at the usual 5 percent level. The *F*-statistic, $F = 6.49$, rejects the null hypothesis of no explanatory power for the regression as a whole at better than the 1 percent level.

The estimated equation for the most general model (all nine independent variables contained in equation (9b)) is reported as equation (11) in Table 3. The results are very similar with those of equation (10): all variables common to both equations have the same signs and the coefficients are stable. As expected, the inclusion of four additional variables decreases the precision in the estimation of the other ones although the $\bar{R}^2$ of the second equation (equation (11)) is slightly lower than that of the first (equation (10)): all the *t*-ratios decrease and it cannot be rejected at the 5 percent significance level that the coefficients of *TI/T* and *AGE* are equal to zero, but neither can it be rejected that they are equal to their previous values.

Before focusing on the income tax variables, we shall briefly comment on the results of some of the other regressors.

None of the government expenditure variables appears in the benchmark specification (equation (10)). In the most general regression (equation (11)), total public expenditure over GDP has a negative sign that is nonsignificant (as does total tax revenue over GDP—see equation (A1) in the Annex). Government capital expenditure (*KPEX*) has a positive sign in equation (11) but it is not significantly different from zero either.[19]

Labor force change (*LC*), inflation (*INF*), and export growth (*XGW*) have highly significant coefficients in all specifications given in Table 3. The coefficient of labor force change (*LC*) is higher than one, probably because of the absence of some nonquantifiable and excluded variables that pick up the human capital accumulation effort.[20] In the case of inflation (*INF*), the negative effects on resource allocation seem to outweigh

[18]The same model would have been chosen using several other criteria such as Mallow's C_p or $\bar{R}^2$.

[19]For this variable it would be interesting to try to distinguish between infrastructure expenditure and other types of public investment (as suggested by Blejer and Khan (1984)). Unfortunately, data are not readily available to test for this.

[20]*EDU*, total government expenditure on education over *GDP*, was included but it was not significant. In any case, this variable is not very reliable since local governments are often in charge of education and their data are patchy and incomplete.

Table 1. Selected Developing Countries: Data on Nonfiscal Variables, 1973-82[1]

(In percent unless otherwise indicated)

	GDP Growth Rate	Labor Force Growth Rate	Inflation Rate	Percent of Population in 15-65 Age Group	Growth in Export/GDP	Growth Rates 1960s	GNP Per Capita (In U.S. dollars)
Burma	5.3	2.4	11.5	55.7	4.78	2.6	151
Malawi	2.7	3.0	10.6	50.4	2.01	5.3	205
India	4.1	2.0	9.5	55.5	5.00	4.5	220
Tanzania	3.8	3.5	17.3	51.7	−6.03	6.0	273
Sri Lanka	5.0	1.7	10.9	57.0	3.73	4.9	231
Pakistan	6.0	3.1	14.0	50.6	10.36	7.1	278
Ghana	0.9	2.9	59.1	51.1	−14.37	2.2	470
Kenya	4.7	4.1	13.7	48.1	−0.09	5.9	400
Yemen Arab Rep.	8.1	1.9	20.4	52.7	19.68	5.0	284
Zambia	1.1	2.8	12.8	50.8	−2.36	5.0	688
Bolivia	3.7	2.4	24.9	52.9	0.91	4.8	541
Thailand	7.3	2.4	11.9	52.9	3.15	8.2	525
Philippines	6.2	2.7	14.0	52.2	1.49	5.2	600
Papua New Guinea	3.6	2.6	9.5	54.9	7.38	6.7	776
Morocco	5.1	3.1	10.1	49.5	2.09	5.3	734
Guatemala	4.9	3.3	12.0	52.7	−0.49	5.7	1,004
Peru	3.0	2.7	42.3	52.8	5.27	4.8	1,142
Brazil	6.8	2.9	48.3	54.8	2.90	6.1	898
Dominican Rep.	5.8	2.9	11.2	50.3	1.10	5.6	1,002
Mauritius	6.0	1.5	17.7	58.0	−1.64	1.6	893
Colombia	4.9	2.3	24.2	55.5	−0.52	5.3	1,123
Tunisia	5.3	2.5	6.9	52.5	6.72	5.2	1,259
Costa Rica	4.1	2.5	15.6	50.4	5.58	6.1	1,284
Turkey	4.5	2.2	38.4	55.4	7.07	5.8	1,071
Syrian Arab Rep.	8.6	3.7	13.0	48.2	−1.17	6.5	1,009

Jordan	8.5	2.4	12.1	50.9	13.81	5.0	1,038
Paraguay	9.2	3.4	14.8	51.5	−1.31	7.9	1,020
Korea	8.3	1.7	17.9	58.1	8.22	8.6	1,245
Malaysia	7.9	2.9	7.2	53.5	5.12	6.4	1,592
Panama	5.1	2.8	7.9	54.4	2.10	7.2	1,682
Mexico	6.8	3.1	20.6	50.7	5.19	7.7	1,944
Portugal	4.3	1.0	20.8	62.5	1.64	6.4	2,327
Chile	2.9	1.7	185.0	59.6	10.57	4.2	2,665
Argentina	1.3	1.8	158.5	63.5	3.07	4.1	2,478
South Africa	3.8	2.4	12.1	57.0	2.23	6.2	2,209
Uruguay	3.8	0.7	63.7	63.0	0.61	1.7	1,807
Malta	11.2	2.2	8.2	63.9	5.71	4.7	3,167
Cyprus	2.7	0.6	9.0	61.5	3.19	5.7	3,628
Greece	3.5	1.0	18.0	64.1	6.61	7.5	3,139
Mean	5.1	2.4	26.5	54.6	3.43	5.51	
σ	2.3	0.8	36.9	4.5	5.53	1.6	

Sources: International Monetary Fund, *International Financial Statistics Yearbook, 1984* (Washington); and World Bank, *World Tables, 1980* (Washington).
[1]See the introduction to the Annex for the exact definition of each variable and the specific sources of data.

Table 2. Selected Developing Countries: Data on Fiscal Variables, 1973–82[1]

	In Percent of Total Tax Revenue			In Percent of GDP	
	Income tax	Individual income tax	Corporate income tax	Public expenditure	Public capital expenditure
Burma	0.14	...	...	0.15	0.03
Malawi	0.42	0.16	0.27	0.27	0.10
India	0.25	0.12	0.12	0.13	0.02
Tanzania	0.31	0.05	0.18	0.28	0.09
Sri Lanka	0.24	0.04	0.11	0.28	0.09
Pakistan	0.15	0.09	0.05	0.17	0.03
Ghana	0.23	0.11	0.12	0.15	0.03
Kenya	0.38	0.06	0.34	0.23	0.05
Yemen Arab Rep.	0.07	0.03	0.03	0.31	0.13
Zambia	0.49	0.19	0.19	0.34	0.06
Bolivia	0.15	0.08	0.06	0.13	0.01
Thailand	0.18	0.08	0.10	0.17	0.04
Philippines	0.26	0.12	0.13	0.13	0.02
Papua New Guinea	0.62	0.30	0.32	0.34	0.05
Morocco	0.23	0.07	0.14	0.32	0.11
Guatemala	0.01	0.01	—	0.12	0.04
Peru	0.22	0.05	0.16	0.18	0.04
Brazil	0.18	0.01	0.07	0.18	0.02
Dominican Rep.	0.22	0.07	0.14	0.17	0.07
Mauritius	0.27	0.15	0.13	0.26	0.05
Colombia	0.30	0.14	0.15	0.12	0.04
Tunisia	0.18	0.08	0.08	0.30	0.09
Costa Rica	0.17	0.17	—	0.21	0.03
Turkey	0.50	0.39	0.06	0.24	0.07
Syrian Arab Rep.	0.20	...	...	0.41	0.17

Jordan	0.11	0.03	0.07	0.53	0.16
Paraguay	0.13	0.02	0.11	0.11	0.02
Korea	0.28	0.13	0.12	0.16	0.03
Malaysia	0.38	0.09	0.31	0.27	0.06
Panama	0.27	...	...	0.32	0.07
Mexico	0.41	0.18	0.22	0.17	0.04
Portugal	0.17	0.07	0.03	0.34	0.05
Chile	0.19	0.11	0.07	0.33	0.05
Argentina	0.07	...	...	0.18	0.03
South Africa	0.56	0.22	0.32	0.23	0.03
Uruguay	0.08	0.03	0.05	0.24	0.02
Malta	0.50	0.26	0.23	0.38	0.06
Cyprus	0.24	0.14	0.06	0.26	0.05
Greece	0.15	0.10	0.04	0.33	0.06
Mean	0.25	0.10	0.12	0.24	0.06
σ	0.14	0.09	0.10	0.09	0.04

Note: There may be some apparent inconsistencies because of rounding; ... = data not available; — = negligible.

Sources: International Monetary Fund, *Government Finance Statistics Yearbook, 1984* (Washington), and *International Financial Statistics Yearbook, 1984* (Washington).

[1]See the introduction to the Annex for the exact definition of each variable and the specific sources of data.

Table 3. Regression Results (OLS)[1]

Benchmark regression (TI/T)

$$\hat{Y} = -18.22^{*} - \underset{(-2.24)}{4.98^{*}}\ TI/T + \underset{(3.3)}{2.42^{**}}\ LC + \underset{(2.69)}{0.347^{*}}\ AGE + \underset{(3.74)}{0.2^{**}}\ XGW - \underset{(-3.79)}{0.033^{**}}\ INF \qquad (10)$$

$RSS = 102.6;\ N = 39;\ F\,(5, 33) = 6.49 > F_{0.99} = 3.63;\ AIC = 2.938;\ R^2 = 0.49;\ \bar{R}^2 = 0.41$

General model regression

$$\hat{Y} = -16.12 - \underset{(-1.62)}{4.11}\ TI/T + \underset{(2.82)}{2.27^{**}}\ LC + \underset{(1.79)}{0.30}\ AGE + \underset{(2.77)}{0.19^{**}}\ XGW - \underset{(-3.16)}{0.031^{**}}\ INF + \underset{(0.87)}{4.26.10}\ YPC + \underset{(-0.05)}{0.013}\ G60 \qquad (11)$$

$$- \underset{(-0.6)}{4.08}\ PEX + \underset{(0.85)}{14.28}\ KPEX$$

$RSS = 96.25;\ N = 39;\ F\,(9, 29) = 3.89 > F_{0.99} = 3.08;\ AIC = 2.981;\ R^2 = 0.51;\ \bar{R}^2 = 0.36$

Pooled cross-country time-series regression

$$\hat{Y} = -10.27 - \underset{(-2.23)}{4.97^{*}}\ TI/T + \underset{(2.56)}{1.56^{*}}\ LC + \underset{(2.16)}{0.25^{*}}\ AGE + \underset{(2.18)}{0.09^{*}}\ XGW - \underset{(-4.70)}{0.036^{**}}\ INF \qquad (12)$$

$RSS = 493.26;\ N = 78;\ F\,(5, 72) = 5.64 > F_{0.99} = 3.29;\ AIC = 6.482;\ R^2 = 0.28;\ \bar{R}^2 = 0.23$

Benchmark regression (TI/Y)

$$\hat{Y} = -19.0 - \underset{(-2.08)}{22.1^{*}}\ TI/Y + \underset{(3.12)}{2.33^{**}}\ LC + \underset{(2.66)}{0.36^{*}}\ AGE + \underset{(3.87)}{0.22^{**}}\ XGW - \underset{(-3.58)}{0.032^{**}}\ INF \qquad (13)$$

$RSS = 107.23$; $N = 39$; $F(5, 33) = 5.95 > F_{0.99} = 3.63$; $AIC = 3.05$; $R^2 = 0.47$; $\bar{R}^2 = 0.38$

Source: Author's calculations based on ordinary least squares (OLS) method, where

$\hat{Y}$ = output growth;
TI/T = ratio of income taxes to total tax revenue;
TI/Y = ratio of income tax to GDP;
LC = labor force change;
AGE = share of population of age 15-65 in total population;
XGW = growth of ratio of exports to GDP;
INF = inflation (rate of change of consumer price index);
RSS = residual sum of squares;
N = sample size; and
AIC = Akaike information criterion.

[1]*t*-values are given in parentheses. Marginal significance levels higher than 5 percent and 1 percent are represented by one and two asterisks, respectively.

any possible Tobin-Mundell effect. However, if countries are divided according to whether they have high or low inflation rates (more or less than 25 percent rate of inflation), the negative relation is only significant for the high-inflation countries. For the growth in exports to GDP ratio (*XGW*), our results corroborate other empirical analyses that have used different methodology and data sets (see Balassa (1985) and references therein).

Turning to income tax variables, in the benchmark specification (equation (10)) the coefficient of *TI/T* (the ratio of income taxes to total tax revenue) has a negative sign and is significantly different from zero at the 5 percent significance level. This would seem to give support to the hypothesis of negative correlation between reliance on income taxes and output growth. In fact, the sign of the coefficient for this variable is consistently negative for all the regressions that we ran, although the marginal significance levels are sometimes higher than the usual standard of 5 percent. For instance, this is the case in equation (11).

The stability of the sign and value of the *TI/T* coefficient can be checked further by pooling cross-section and time-series data (two five-year averages for each country). Assuming the same slope and intercept coefficients for the two periods, we obtained equation (12) from ordinary least squares (OLS) estimation. The value of the *TI/T* coefficient is very close to the one estimated in the benchmark specification (equation (10)) of −4.97 compared with −4.98. Taking the two periods separately and performing a Chow test for stability of coefficients, we accept their equality in the two periods at a 1 percent significance level.

When *TI/Y* (the ratio of income taxes to GDP) is included in the regression equation instead of *TI/T*, the previous results remain basically unaffected (see equation (13)). The *TI/Y* coefficient is also negative and significant at the 5 percent level (although with a *t*-ratio lower than for *TI/T*).

The equations given in Table 3, therefore, show that the presumption that the rate of output growth is negatively correlated with the income tax ratio is not rejected by the sample data. Further regressions were run to check if this conclusion holds for subsamples of countries at different levels of development as well. For this purpose, the 39 countries were ordered by gross national product (GNP) per capita and divided into two subsamples of low-income and middle-income countries (with 20 and 19 observations, respectively). The GNP per capita of US$1,000 was used as a cut-off point. Equations (A2) and (A3) in the Annex show that the coefficients for *TI/T* are negative with values (*t*-values in parentheses) equal to −6.47 (−2.61) for low-income countries and −4.69 (−1.35) for middle-income countries. The conclusion is now supported for low-income countries, but is not supported for middle-income countries.

Regressions were also run to check whether the results obtained for total income taxes held for individual and corporate income taxes as well. These substituted total income taxes in the numerator of TI/T by its components: taxes on individual income (TII) and taxes on corporate income (TCI). The regression results reported in the Annex (equations (A4) and (A5)) show that the coefficients remained negative but had low t-values (in parentheses), TII (−1.55) and TCI (−1.34), thereby suggesting that the negative relationship between growth rate and individual or corporate income tax ratios cannot be asserted with much confidence.

Output growth for Malta was almost three standard deviations away from the mean; thus, this country seemed to be very influential in the OLS estimation results. As a sensitivity check, the observation for Malta was deleted and equation (10) was re-estimated. Equation (A6) in the Annex is the re-estimated benchmark specification that shows the relative insensitivity of the coefficients to deleting this possible outlier.

The main conclusion from all these regression exercises is that the sign and size of the TI/T coefficient are robust but the t-ratios are not very high in all cases and that the point estimates of equation (10) can be taken as a good description of the information contained in the sample. This description would be applicable to all economies whose structure could be summarized by equations (1)–(9b). Thus, the estimated equation could also be expected to hold out-of-sample: that is, for different periods and/or countries.

III. Concluding Remarks

The regression analysis that examined the empirical relationship between growth rates in developing countries and the reliance of their tax structures on income taxes had three main results.

1. The sign of the relationship between the ratio of income taxes to total tax revenue and the growth rate of output was found to be consistently negative in all specifications. The coefficient was found to be significantly different from zero (5 percent level) in the benchmark regression equation, but this result did not hold in all specifications. The results from pooling time-series (five-year averages) and cross-section data corroborated the conclusions obtained from the benchmark regression equation—the coefficients for TI/T were almost identical.

2. The coefficient was also negative and statistically significant when TI/T was substituted by TI/Y (the ratio of income taxes to GDP) as a measure of a country's reliance on income taxation.

3. However, when the ratios of individual and corporate income taxes to

total tax revenue were considered, their coefficients were negative, but statistically insignificant in both cases.

In summary, the tentative conclusion that can be drawn from this chapter is that while there is some evidence supporting a negative relationship between output growth rates and the reliance of a country on income taxes, this relationship cannot be asserted with much confidence. This conclusion is, of course, subject to many limitations: cross-country regression analysis can be easily criticized (see Ebrill (Chapter 3, pp. 61–62)), the model specification may be inadequate and will need to be further checked for robustness, and so on. These limitations will have to be overcome in future empirical work on the subject on which the present study is no more than a first step.

ANNEX

Definition of the Variables, Sources of Data, and Additional Regression Equations

Definition of the Variables and Sources of Data

Unless otherwise stated, variables are arithmetic averages of annual observations for the period 1973–82. In a few cases, data were not available in the 1984 issues of the *International Financial Statistics Yearbook* (*IFS*) and the *Government Finance Statistics Yearbook* (*GFS*) for starting and ending years of the period considered. For those cases, averages were taken for the available data within 1973–82. The variables have been defined as follows (*IFS* and *GFS* along with line numbers indicated in parentheses or World Bank, *World Tables*, 1980):

$\hat{Y}$ = growth of real GDP (*IFS* 99 b.p.);
LF = labor force growth (the sum of population growth (*IFS* 99z) and the change in the activity rate—data for 1970 and 1981 were obtained from *World Tables*);
INF = change in the consumer price index (*IFS* 64);
AGE = share of population between the ages 15 and 65 in total population (average of data for 1970 and 1980 in *World Tables*);
XGW = growth of share of exports (*IFS* 90c) in GDP (*IFS* 99b);
YPC = per capita GNP in 1972 (*World Tables*, estimation);
$G60$ = growth rate during the 1960s (*World Tables*);
TI/Y = taxes on income, profits, and capital gains (*GFS* A-IV.1) over current GDP (*IFS* 99b);
TI/T = taxes on income, profits, and capital gains (*GFS* A-IV.1) over total tax revenue (*GFS* A-IV);
TII = taxes on individual income (*GFS* A-IV.1.1) over total tax revenue;
TCI = taxes on corporate income (*GFS* A-IV.1.2) over total tax revenue;

PEX = total government expenditure (*GFS* 7) over GDP;
$KPEX$ = capital expenditure (*GFS* 9) over GDP; and
T/Y = total tax revenue over GDP.

Additional Regression Equations[21]

TOTAL TAX REVENUE (POOLED DATA)

$$\hat{Y} = \underset{}{-10.14} - \underset{(-2.17)}{5.02^{*}\, TI/T} + \underset{(0.08)}{0.57\, T/Y} - \underset{(-4.60)}{0.036^{*}\, INF} + \underset{(2.52)}{1.56^{*}\, LC}$$

$$+ \underset{(1.99)}{0.24^{*}\, AGE} + \underset{(2.11)}{0.08^{*}\, XGW} \qquad \text{(A1)}$$

$RSS = 493.2$; $N = 78$; $F(6, 71) = 4.63$; $AIC = 6.5$; $R^2 = 0.28$

LOW-INCOME COUNTRIES ONLY

$$\hat{Y} = -3.8 - \underset{(-2.61)}{6.47^{**}\, TI/T} - \underset{(-1.09)}{0.028\, INF} + \underset{(0.81)}{0.17\, AGE} + \underset{(2.28)}{0.13^{*}\, XGW}$$

$$+ \underset{(0.41)}{0.52\, LC} \qquad \text{(A2)}$$

$RSS = 27.69$; $N = 20$; $F(5, 14) = 4.1$; $AIC = 1.98$; $R^2 = 0.59$; $\bar{R}^2 = 0.45$

MIDDLE-INCOME COUNTRIES ONLY

$$\hat{Y} = -24.26 - \underset{(-1.35)}{4.69\, TI/T} - \underset{(-3.44)}{0.035^{**}\, INF} + \underset{(2.42)}{0.41^{*}\, AGE} + \underset{(2.02)}{0.23^{*}\, XGW}$$

$$+ \underset{(3.61)}{3.63^{**}\, LC} \qquad \text{(A3)}$$

$RSS = 41.42$; $N = 19$; $F(5, 13) = 5.3$; $AIC = 2.8$; $R^2 = 0.67$; $\bar{R}^2 = 0.54$

INDIVIDUAL INCOME TAX ONLY

$$\hat{Y} = -15.8 - \underset{(-1.55)}{5.4\, TII} - \underset{(-3.41)}{0.03^{**}\, INF} + \underset{(2.33)}{0.31^{*}\, AGE} + \underset{(2.75)}{2.02^{**}\, LC}$$

$$+ \underset{(3.77)}{0.22^{**}\, XGW} \qquad \text{(A4)}$$

$RSS = 110.2$; $N = 39$; $F(5, 33) = 5.53$; $AIC = 3.13$; $R^2 = 0.46$; $\bar{R}^2 = 0.37$

[21]Values in parentheses are *t*-values.

CORPORATION INCOME TAX ONLY

$$\hat{Y} = -17.8 - \underset{(-1.34)}{4.7}\, TCI - \underset{(-3.40)}{0.031^{**}}\, INF + \underset{(2.40)}{0.32^{*}}\, AGE + \underset{(3.00)}{2.3^{**}}\, LC + \underset{(3.61)}{0.21^{**}}\, XGW \qquad (A5)$$

$RSS = 112.1; N = 39; F(5, 33) = 5.33; AIC = 3.18; R^2 = 0.45; \bar{R}^2 = 0.36$

EXCLUDING MALTA

$$\hat{Y} = -16.95 - \underset{(-2.07)}{4.65}\, TI/T^{*} - \underset{(-3.71)}{0.033^{**}}\, INF + \underset{(2.53)}{0.33^{*}}\, AGE + \underset{(3.45)}{0.19^{**}}\, XGW + \underset{(2.78)}{2.18^{**}}\, LC \qquad (A6)$$

$RSS = 103.92; N = 38; F(5, 32) = 5.71; AIC = 3.05; R^2 = 0.47; \bar{R}^2 = 0.39$

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