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Tax Systems in the World: An Empirical Investigation into the Importance of Tax Bases, Administration Costs, Scale and Political Regime

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Abstract

We study the structure of taxation in a sample of 100 democratic and nondemocratic regimes over three time periods. The results provide strong support for several regularities in the world as a whole, specifically (1) *scale effect*: utilization of each tax source increases as the government expands, (2) *base effect*: tax systems rely more heavily on relatively larger tax bases, and (3) *administrative cost effect*: lower costs of administration lead to increased reliance on the corresponding revenue source. We also investigate the role of political regime and find that democracies rely substantially more on personal income taxation, possibly because this tax source requires a higher degree of voluntary compliance.

Keywords: political economy, tax structure, tax mix, tax bases, administration costs, political regime

JEL Code: H2, D72, D78, E31, E51, F13, P35

1. Introduction

Taxation is one of the cornerstones of all political regimes, a point long recognized by diverse authors such as Schumpeter (1991), Musgrave (1959), Brennan and Buchanan (1980), Levi (1988) and others. Over the years, considerable progress has been made in modeling the revenue systems that democratic governments rely upon in a political equilibrium.[1] Generally speaking, in the type of model that has emerged, a version of which is outlined in the next section, governments are forced by competition between parties to adjust the structure of the fiscal system so as to raise taxes with as little overall loss of political support as possible, subject to the general equilibrium structure of the private economy. We show that the application of this recent theoretical work on tax structure in a competitive political system (see, for example, Hettich and Winer, 1988, 1999; Kenny and Toma, 1997) predicts that reliance on a tax source increases as (1) the base for this tax grows, (2) its administration costs fall, or (3) total revenue needed increases.

Much of the empirical testing of this theory of tax structure has been based on time series or cross sectional variation in tax structure *within* a country, or of selected aspects of tax structure across countries. This work does not take advantage of the variation in tax

bases, administration costs, and the size of government that exists across countries, nor of the interconnections between parts of the revenue system viewed as a whole. Analysis of the variation in the complete mix of taxes across countries is likely to provide additional insight into the key factors at work. In this paper we test the predictions outlined above, and others regarding the role of political regime, using a pooled cross-section, time-series set of 269 observations for 100 democratic, socialist and other non-democratic countries for three aggregate time periods (1975–80, 1981–85, 1986–92).[2]

Early work on tax structure in the world focused on empirically modeling variation in the broadly defined direct/indirect tax mix across countries at different stages of economic development (e.g. Hinrichs, 1966; Musgrave, 1969; Dudley and Montmarquette, 1987). More recently, several studies have examined the international experience with specific combinations of taxes, such as trade taxation versus income taxation, and corporate and personal taxation in the light of capital mobility.[3] Most of this empirical research, however, is not conducted in a framework that explicitly allows for all components of the tax mix, including seigniorage, sales and property taxes. As yet, no one appears to have fitted a statistical model of the sort we employ to explain international variation in the tax mix as a whole, while giving attention to the interplay between taxes of various kinds.

We also investigate the relationship between tax systems and the basic nature of political regimes. Some empirical work has recently considered the consequences of democracy for the structure of particular taxes, such as the personal income tax. For example, Mulligan, Gil and Sala-i-Martin (2004) conclude that democracies have flatter personal income tax structures than do non-democratic regimes. This interesting work, as well as other research on expenditure structure in different regimes,[4] does not use a complete representation of the fiscal system, and thus does not provide a foundation for estimating equations that can be used in the present investigation.

While the political economy model we employ as a basis for our estimating equations is perhaps best suited to the study of taxation in democratic political systems, the work of McGuire and Olson (1996) suggests that differences between the behavior of democratic and other types of regimes are muted as a result of the incentive that all regimes have to capture the benefits of efficiency gains defined over large segments of the population. If so, then the predictions of the basic model of taxation in a competitive political system are likely to be supported even in non-democratic regimes. In the absence of a theoretical framework that can explicitly unify the fiscal experience of diverse types of political regimes, we push this model hard, testing its predictions in a large sample containing all types of regimes and in democratic and non-democratic subsamples. Whether the tax structure of democratic, socialist and non-democratic countries is in fact governed by the same data generating process is an empirical issue that has not been explored.

The basic political economy model does not, however, explicitly incorporate a theory of non-democratic regimes. As described in the next section, the literature on such regimes suggests that political repression, political instability, and whether the country is socialist may play some role. To consider the importance of regime type in as robust a manner as possible, we introduce indices of regime type as explanatory variables into the equations based on the model of tax structure in a competitive political system. Our purpose in doing so is to provide some interesting stylized facts that maybe helpful in

building more general models that are capable of unifying abroad range of experiences across the world.

The paper proceeds as follows. The theory of taxation for competitive political systems is developed in section two, along with some key propositions based on this model. In this section we also speculate on the role of non-democratic political regimes in determining tax structure, and we selectively review the statistical literature on tax structure in the international context. In section three we introduce estimating equations that are consistent with the model introduced earlier, and the data on revenue structure employed is discussed. Definitions of the explanatory variables are presented along with the estimation results in section four. Further results concerning the role of political regime are provided in section five, and a concluding section includes a brief consideration of the implications of our results for future theoretical work and for tax reform.

2. Tax Structure in Competitive and Other Political Regimes

The theory of revenue structure we employ as a 'starting point' for our empirical work is based on the view that taxation in competitive political systems is part of a broader political equilibrium. In this theory, competition between political parties for support from heterogeneous voters forces the government to choose a tax structure based on the loss in support —or, political costs—associated with different tax sources. As discussed further below, these political costs depend on losses in full income including excess burdens, on administration and enforcement costs, which represent a wedge between revenues collected and public services provided, and on how these factors are translated into political opposition.

The theory can be extended to account for the grouping of activities into tax bases, the choice of rate structures, and the nature of special provisions such as exemptions and deductions (see for example, Hettich and Winer, 1988, 1999) in addition to the determination of the mix of taxes. However, in this paper we focus on the determination of the equilibrium tax mix, and leave empirical investigation of the tax skeleton as a whole for future research.[5]

2.1. A Basic Model of the Equilibrium Tax Mix

A simple graphical exposition of a model of the tax mix in a democracy, based on Hettich and Winer (1999), is a useful prelude to the specification of estimating equations. Since the equilibrium tax mix in this model reflects a balancing of opposing interests in the pursuit of political support, it may also apply to any political system where the interests of different groups are balanced off by the 'government', even if the distribution of influence is skewed and support is not measured in votes. In the course of our exposition, we derive some key general propositions that we later test.

Assume that the government's sole objective is to get re-elected and that it pursues this aim by choosing policies that maximize total expected support across a heterogeneous electorate. The probability of support from any voter is influenced positively by the

provision of public goods and is affected negatively by the raising of taxes needed to finance public output. It is both realistic and convenient for expositional purposes to assume that individuals regard their own tax payments as being independent of the benefits of the public goods and services they receive.

Taxation affects voters in two basic ways. First, disposable income is reduced. In addition, there is a welfare loss linked to economic adjustments made in response to taxation. We shall refer to the sum of these effects as the loss in full income and assume that opposition to, or the political cost of, taxation is positively related to the loss of full income.

Individuals vary in several respects that are relevant to the full effects of taxation on them and to their political opposition to taxation. They differ with respect to the taxable activities they undertake, in their willingness to substitute between taxable (and other) activities in order to escape taxation, and they face differing costs in organizing political opposition. In addition, they have varying evaluations of public output which matter when the government determines total marginal political benefits from changing the level of the public good.

Given these assumptions, it is possible to graphically illustrate the government's attempt to maximize support across a heterogeneous electorate by making appropriate choices concerning the level of public output and the taxation of different activities. Figure 1 depicts a simple case where there are only two taxable activities or tax bases

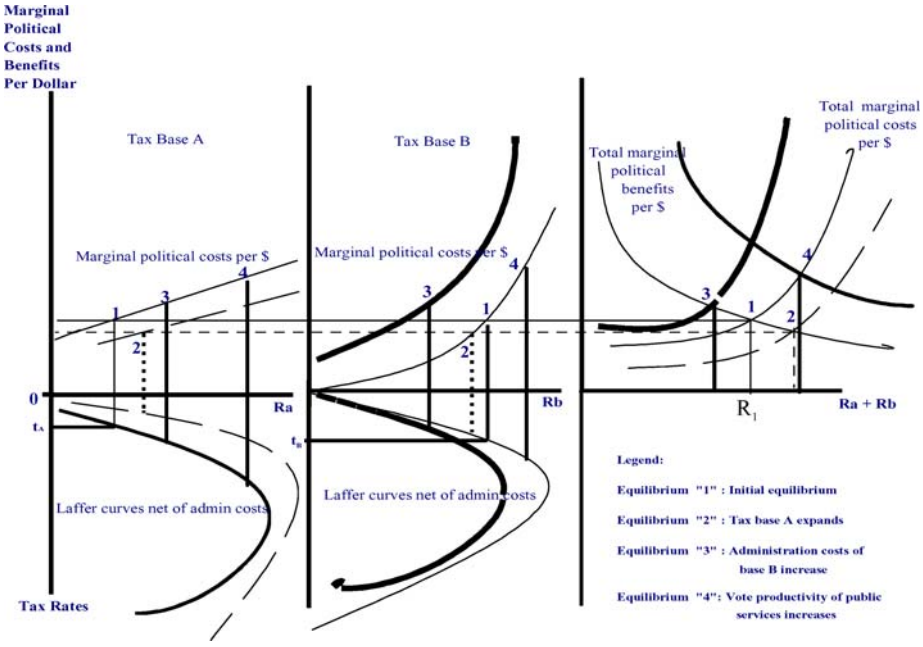

Figure 1. Political equilibria in a competitive political system:
(*Note*. Except by mistake, or in the strenuous pursuit of objectives that necessarily compromise its ability to raise revenue, no government would choose a point on the backward bending part of any rate- revenue (Laffer) curve shown, since this would lead to a marginal political cost that is higher than that implied by the lower tax rate that raises the same revenue.)

engaged in by all taxpayers and one pure public good on which all revenues are spent. We may imagine the taxable activities to be employment income and income from capital. Each tax base has associated with it a unique tax rate—tax revenue relationship or "Laffer curve", as well as a different evaluation by the voters of the full cost of a given nominal tax payment.[6]

The tax rate applied to each base with its associated loss in full income for taxpayers is translated into marginal political opposition by the marginal political cost functions in the upper half of the panels corresponding to the two tax bases, where marginal political cost is expressed per dollar of revenue raised. As shown by curves through the points labeled as "1", marginal political cost per dollar functions differ across the two bases, reflecting differences in how voters evaluate the economic effects of taxation levied on each activity, and on how these evaluations are translated into political opposition.

The third panel on the right side of Figure 1 shows the determination of budget size, with the total marginal political cost per dollar curve representing the horizontal addition of marginal political cost functions from the other two panels. Total marginal political benefits per dollar for the society, equal to the vertical sum of individual marginal political benefit functions, also expressed per dollar of revenue, is given by the downward sloping curve. The desired budget in the initial situation is at point 1, where the total marginal political benefit equals the total marginal political cost.[7] The implication for the structure of taxation of this solution to the government's problem is readily understood if we realize that decision makers who maximize support will minimize total political costs for any given level of revenue collected. This requires that marginal costs per dollar of revenue be equalized across tax bases. The government will then tax both activities and will do so at generally different tax rates.

The analysis is incomplete as long as we fail to incorporate the resource costs of administering, monitoring and enforcing tax collections, as well as compliance costs. We may redefine the Laffer curves to show revenue raised at each tax rate net of the costs (and consequences) of the use of resources for collection, monitoring and enforcement, and acknowledge the role of compliance costs by allowing marginal political cost curves to reflect political reactions to losses in full income defined to include the implications of compliance for taxpayer welfare. Thus, in the full model, the final shape and position of the Laffer curves and the political cost functions, and hence the tax mix, is determined as part of an equilibrium in which administrative as well as economic and political factors all play important roles. Such an equilibrium is represented in Figure 1 by points labeled "1" with associated tax sources, tax rates (t_A and t_B), and government size (R_1).

Figure 1 can be used to illustrate the effects of exogenous shocks of various kinds, and in so doing we may derive a set of key propositions that can be tested. Before turning to this analysis, it is worthwhile to note that the model shown in the figure contains only one type of tax instrument—a single tax rate for each base—although the definition of bases, rate structures and the nature of special provisions for each base may also be adjusted by the government. To allow for this fact, in developing hypotheses and estimating equations it proves useful to consider how policy responses to various shocks are reflected in the equilibrium tax mix. In what follows, we do so

in a manner that is consistent with the existence of multiple tax instruments, and to guide us in this task the model outlined above and illustrated in Figure 1 is sufficiently complex.

Consider first, then, growth in the relative size of tax base A, the result of which is depicted in the figure by the points labeled with a "2". Growth in base A leads to a rightward shift of the Laffer curve for that base. In turn, the corresponding political cost function shifts down. The marginal political cost function shifts down for two related but distinct reasons: first, any given level of revenue from base A can now be collected with a lower rate, thus reducing the loss in full income; and second, given the fixed costs of organizing political opposition, since the same revenue is now spread across a larger base, the incentive any taxpayer has to engage in political activity designed to reduce or alter taxation is reduced. The total marginal political cost function shifts to the right and, as a result, reliance on base A increases while the revenues collected from B declines, as shown in the figure. We shall label the equilibrium increase (decrease) in reliance on a base whose relative size has increased (fallen), the *base effect.*

One should note also that since the total marginal political costs associated with any level of total revenue decline as tax base A expands, the equilibrium size of government increases. Kau and Rubin (1981), Hettich and Winer (1988) and Becker and Mulligan (2003) similarly argue that (what Becker and Mulligan call) 'more efficient' taxation results in a larger government.

An exogenous increase in the costs of administering base B is depicted by a leftward shift of the net of administration cost Laffer curve for this base. Any given level of revenue from base B then must involve a higher tax rate and thus larger losses in full income, and for this reason the marginal political cost function for base B shifts upwards, leading to an upward shift of the total marginal political cost function. As shown in the figure by points labeled with a "3", the result is a shift away from taxation of activity B (as well as a decrease in the equilibrium size of government). The equilibrium movement away from (towards) reliance on a tax source whose cost of administration increases (falls) will be called the *administration cost effect.*[8]

Finally, consider an exogenous increase in the level of the benefits associated with providing any given quantity of the public good. The total marginal political benefit curve shifts to the right, and the new equilibrium at point "4" involves a larger government. The implications of this shock for the equilibrium tax mix depend on the shape of the individual political cost functions. In the figure, base A has associated with it a relatively flat cost function. Thus the use of this base expands more than does that for base B. Note that in this case, while reliance on one base grows relative to the other, *all* bases are used more heavily as total revenues grow, a prediction of the model we shall refer to as the *scale effect.*[9]

As well as suggesting propositions concerning the effect of changes in the relative size of tax bases, administration costs and the scale of the public sector, the preceding discussion also carries with it important implications for the nature of estimating equations. We shall leave a more explicit discussion of these implications for Section 3, where the estimating equations are presented.

2.2. Determinants of the Tax Mix in Non-Democratic Regimes

Should we also expect the type of political regime to matter in an explanation of international variation in the tax mix, and if so how? In addressing this question, in the absence of any unifying theoretical framework we rely on a broad range of studies. Our objective is a set of variables that can be added to those suggested by the model of competitive systems, in order to see how far that model can be pushed in explaining international variation in tax systems. Before turning to this work, it is important to recall that we are mainly concerned with explaining tax *structure,* not the overall size of tax collections.

Wintrobe's (1990, 1998) theoretical analysis of tinpot regimes (that wish to consume as much as possible while maintaining power) and 'totalitarians' (that use all available resources in an attempt to maximize power) is a useful place to start. In Wintrobe's theory, all non-democratic regimes use different mixes of repression and loyalty to generate power, and totalitarians use more repression than do tinpots. Though he does not extend his model in this respect, Wintrobe's framework suggests that we will observe differences across regimes in their use of tax instruments if only because democratic regimes do not generally use physical repression as a governing instrument, and hence must design tax systems that work well without the application of highly repressive measures.

Work on the importance of voluntary tax compliance in democratic states (e.g., de Juan, Lasheres and Mayo, 1994; Pommerehne and Weck-Hannemann, 1996; Alm, 1996; Feld and Frey, 2002) also leads one to suspect that democracies will make greater use of harder to collect revenue sources, such as self-assessed personal income taxation, than repressive regimes since loyalty to the regime is highest in democratic countries. Repression and purchased loyalty can also lead to compliance in non-democratic regimes, but we do not expect that they can act as a perfect substitute for the voluntary compliance found in mature democracies. Thus it appears reasonable to think that variation in the degree of democracy or repression will be important in explaining the tax mix across countries in the world as a whole.

The nature of the tax mix in socialist as opposed to democratic countries has been considered before by Musgrave (1969) in his early work on tax structure in the world. As Musgrave (p. 45) points out, since socialist governments exercise greater control over the economy in general and over wages in particular, the need for taxation of individuals to redistribute income or achieve other social objectives is reduced. Moreover, socialist governments may rely more heavily on taxation of state enterprise, which is a much larger sector in socialist economies. He also suggests that socialist governments may be more ideologically predisposed to the taxation of private business than democratic regimes.

Finally, in this selective review of prior research that bears on taxation in non-democratic regimes, we note that the role of political coups in thwarting the constitutional succession of power has been the subject of much study. Acemoglu and Robinson (2001) argue that coups may often reflect attempts by elites to limit redistribution by the state.[10] Accordingly, and since situations that give rise to coups may also create or coincide with economic and political turmoil that interferes with tax collections, it seems to reasonable to consider whether or not countries that have substantial experience with coups make

less use of the personal income tax, which is likely to be both more redistributive and associated with a more variable and hence less desirable revenue stream than other tax sources.

2.3. Preliminary Consideration of Some Evidence from the Literature

Our objective in setting up the model of a competitive political system, in doing comparative statics with this model concerning base, administration cost and scale effects, and in reviewing work on non-democratic regimes, is to provide a basis for the specification of explanatory variables that can be used to explain tax structure in different types of regimes. Before turning to the specific definitions of the variables and the estimating equations we employ, it is useful to briefly review the cross-country evidence in the literature on the above predictions concerning the determinants of tax structure in competitive and non-democratic countries. Some further comments on the literature are also provided in subsequent sections of the paper where specific estimation results are discussed.

The first feature of existing work that may be noted is that there appears to be very little, if any, evidence concerning the scale effect.[11]

The evidence in this small literature generally supports the hypothesis that an increase in the size of a tax base leads to relatively greater reliance on that base in democratic regimes. An increase in the importance of trade in the economy should result in a greater reliance on trade taxes and less reliance on other taxes. The former prediction was supported by Greenaway (1980) and Riezman and Slemrod (1987), but not by Edwards and Tabellini (1991) or Easterly and Rebelo (1993). Regarding the latter prediction, Edwards and Tabellini (1991) and Cukierman, Edwards and Tabellini (1992) found that an expansion of trade had the expected negative impact on inflation (reflecting less reliance on seigniorage), but Easterly and Rebelo (1993) reported a puzzling positive association with income taxation. World War n interrupted trade flows, which Easterly and Rebelo (1993) found resulted in a fall in trade taxes and a rise in income taxation. Since the income elasticity for currency is less than one (Kenny, 1991), the seigniorage base falls relative to the income tax base as per capita GDP rises; consistent with this reasoning, as per capita GDP increases, Edwards and Tabellini (1991) and Cukierman, Edwards and Tabellini (1992) found that inflation falls, and Easterly and Rebelo (1993) showed that income taxation rises. Finally concerning the base effect, we note that Hettich and Winer (1984) found that the size of resource and sales tax bases were important in determining the extent of reliance by U.S. states on the personal income tax.[12]

Concerning the role of administrative costs, Riezman and Slemrod (1987) found that tariffs were a high share of revenue in countries where the costs of collecting income and sales taxes were high, proxied by low literacy rates and low population density. Based on a similar argument, trade taxes and inflation should be higher in countries with a large agricultural sector or that are less urbanized. The evidence in Edwards and Tabellini (1991) and Cukierman, Edwards and Tabellini (1992) mostly supports these predictions.

As for the roles of repression, socialism and coups—factors that are suggested by research on non-democratic regimes: to the best of our knowledge, no one has empirically investigated the relationship between *tax structure as a whole,* as opposed to the overall *level of taxation,* and political regime. Existing work on the role of regime type is mostly concerned with specific aspects of tax structure, such as Musgrave's (1969) work on the indirect/direct tax mix and the more recent work on personal income rate structures by Mulligan, Gil and Sala-i-Martin (2004). At the empirical as well as at the theoretical level, the issue remains largely unexplored.

3. Estimating Equations and Data

The model of tax structure in competitive political systems outlined in the previous section indicates that four basic types of factors play an important role in determining the nature of the tax mix in a competitive political equilibrium: (i) the size of potential tax bases; (ii) administration costs; (iii) factors that determine how the economic consequences of reliance upon any tax source is translated into political opposition; and (iv) the total amount or scale of tax revenues that are to be collected from all sources. The operationalization of this scheme is by no means straightforward, and will be described briefly in this section, and at more length in the next.

The role of these factors in shaping the equilibria illustrated graphically in Figure 1 may be captured schematically by the following system of reduced form estimating equations, where time and country-specific subscripts are omitted for convenience:

$$R_j/R = f(\mathbf{B}, \mathbf{C}, \mathbf{P}, R/Y) + \in_j; \quad j = 1, 2, \ldots, J \tag{1}$$

where $\in_j$ is an error term, and:

$R_j/R =$ Revenue obtained from source j relative to total tax revenue.

$\mathbf{B} =$ A vector of variables determining the size of potential tax bases

$\mathbf{C} =$ A vector of "administrative cost" variables, which together with B determine the shape of tax rate-tax revenue or 'Laffer' curves associated with each potential tax source

$\mathbf{P} =$ A vector of factors that affect how points on each Laffer curve are translated into political opposition

$R/Y =$ A scale variable, measuring the total tax revenue raised by the government that year relative to GDP.

Since the proportions R_j/R always sum to one across the revenue share equations, the sum across equations (at each point in time, for each country) of the coefficients on each explanatory variable must be zero; if a variable leads to an increase in the relative reliance on one tax source, it must also lead to the reduction in the reliance on some other source. Analogously, the coefficients on the constant terms in each equation must sum to one.[13] Efficient estimation of this seemingly unrelated system may be, and is, conducted by using exactly the same set of explanatory variables in each equation. This approach to estimation is also appropriate from a conceptual point of view: in a political equilibrium, each component of the tax mix depends in principle on all of the factors determining the political costs associated with each tax source, since it is the *relative* marginal political

costs that determine the support maximizing choice of tax structure for a given total revenue.

Similar regressions explaining the size of each revenue source *relative to GDP*, and using the same set of explanatory variables, are also estimated. These regressions are needed to test the scale prediction that taxation of each sector rises as total taxation increases. Note that in this case the effect across equations of an increase in R/Y sums to one.

Equations explaining variation in seigniorage, inflation and the rate of growth in currency outside banks, again using the same set of right hand side variables, are estimated to complement these revenue share equations, permitting a more detailed look at seigniorage as a revenue source. Another regression that explains the variation in average tariff rates adds to what we glean from modeling the share of revenue coming from trade taxes.[14]

In the model of revenue choices outlined earlier, the overall size of government is endogenously determined along with the revenue structure. In (1), however, the scale factor R/Y is assumed to be exogenous or predetermined with respect to the tax mix. By way of contrast, Becker and Mulligan (2003) utilize several measures of what they refer to as the efficiency of taxation to explain government spending. One of their tax efficiency variables is the share of revenue from broad (social security, payroll, and sales) tax bases, which is what, in contrast, we are seeking to explain. Given the difficulty of simultaneously determining tax composition and the overall size of the public sector with our data base, much of our empirical analysis assumes total revenue to be exogenous. However, we also report regressions that deal with the endogeneity of total revenue in various ways. Note that we also restrict the analysis to components of the current revenue mix (including seigniorage), and do not attempt to explain the intertemporal choice between current and future taxation, which is reflected in the deficit.

3.1. Specification of Tax Sources, and Initial Discussion of Explanatory Variables

To implement equations (1) it is necessary to decide upon the aggregation of tax sources into a manageable number of components R_j, and to find suitable variables representing the vectors **B**, **C** and **P**. Specifying and measuring explanatory variables that reflect separate, predetermined economic and political factors is not a simple exercise.

The first row of Table 1 records the seven categories of *central government* revenue used in the empirical work and associated mnemonics, based on the IMF data (Woldemariam, 1995) (1) corporate taxes on income, profit, and capital gains, (CORPORATE); (2) individual taxes on income, capital gains, etc. (INDIVID); (3) social security and payroll taxes (SOC SEC & PAYROLL); (4) domestic taxes on goods and services (e.g., sales, value added, excise, and severance taxes; licenses) (GOODS & SERVICES); (5) international trade taxes (TRADE); (6) taxes on real estate and other wealth (PROPERTY); and (7) non-tax revenue, including seigniorage and net profits from public enterprises and property (NONTAX).[15] Public enterprises include nationalized farms, mining, and manufacturing units, publicly owned electric companies and airlines, port facilities, toll roads, lotteries, postal services, marketing boards, commodity stabilization entities, and

Table 1[a] Tax sources, explanatory variables and mnemonics.

Tax Sources (7)	• Individual Income Taxes (INDIVID)
	• Corporate Profit and Income Taxes (CORPORATE)
	• Social Security and Payroll Taxes (SOC SEC & PAYROLL)
	• Domestic Trade Taxes (GOODS AND SERVICES)
	• Foreign Trade Taxes (TRADE)
	• Property and Wealth Taxes (PROPERTY)
	• Nontax Revenue: including seigniorage and government enterprise profits (NONTAX)
Factors (**B**) affecting the size of potential tax bases	• Real GDP per worker (GDP PER WORKER)
	• % Women in labor force (LF:%FEMALE)
	• Oil extraction: production per capita (CRUDE PETROL)
	• International trade: [exports + imports]/GDP (TRADE)
	• Urbanization: percent of population in urban areas (URBAN)
	• Population density (LOG DENSITY)
	• Education level: average years of educational attainment in the adult population (EDUC ATTAIN); secondary school enrollment as a percent of the population (SECOND ENROLL)
	• Socialist government: the fraction of the time period spent under a socialist government (SOCIALIST)
Factors (**C**) affecting the shape of Laffer curves net of administration costs	• Education level: average years of educational attainment in the adult population (EDUC ATTAIN); secondary school enrollment as a percent of the population (SECOND ENROLL)
	• Urbanization: percent of population in urban areas (URBAN)
	• Population density (LOG DENSITY)
	• Whether a country has a formal federal structure (FEDERAL)
Factors (**P**) affecting the translation of taxation into political opposition	• Coefficient of variation in real GDP (GDP COEF VAR)
	• Political instability: number of non-constitutional exits of the government's leader (COUPS)
	• Socialist government:the fraction of the time period spent under a socialist government (SOCIALIST)
	• Political rights & civil liberties: sum of the Gastil indexes (NO RIGHTS & LIBS)
Scale of the public sector	• Predetermined explanatory variable affecting all revenue sources TOTAL REV/GDP = total revenue/gdp

[a]Hypotheses concerning the sign of coefficients for each variable are developed and tested in Section 4 of the paper. Data sources are given in the Appendix.

so on. Corporations are classified as public enterprises if they are "controlled" by the government or the government owns a majority of stock (International Monetary Fund, 1985, pp. 21–22), and there is undoubtedly some error in classifying corporations as public or private. All revenue variables are measured as a fraction of total central government revenue.

Although these seven categories account for almost all of total revenue, they do not include two very small tax categories: unallocable taxes on income, profits, and capital gains (e.g., agricultural income taxes), and other taxes (e.g., poll and stamp taxes), which are particularly hard to model. As a result, the revenue shares do not exactly sum to 1, and the sum of estimated coefficients across equations are close to, but not exactly equal to, their theoretically correct values as discussed above.

The IMF revenue data are reported for three time periods (1975–80, 1981–85, 1986–92). The use of average revenue data for these 5–7 year time periods reduces the noise in the data due to measurement error and annual fluctuations. Although the IMF report lists 136 countries, it does not contain revenue data on a number of these countries for one or more time periods, and lists no revenue data for half a dozen former communist block countries in this data set.[16] After dropping Belarus for 1986–92 because of errors in the revenue data, there are 335 observations with data on total revenue. Considerable effort was devoted to filling in gaps in the data on the independent variables, particularly in the sparse international trade statistics. Nevertheless, in the end, missing data reduced the sample to 269 observations, representing 100 countries.[17] These countries are listed in the Data Appendix.

As for the explanatory variables listed by type in Table 1 (**B**, **C**, **P** and scale, as in equation (1), product account data are drawn from the Perm World Tables, and the World Bank's *World Data CD* provided much of the socio-economic data used in this study.[18] Other data were obtained from a variety of sources (see the Data Appendix).

The choice of these explanatory variables is not uniquely determined by the theory, and is of course affected by the availability of data. While these variables will be discussed further in section four below when specific hypotheses concerning the effects of changes in these variables are also presented, a brief summary of the explanatory variables listed in Table 1 is worthwhile now. The vector **B**, measuring the relative size of potential tax bases, includes real GDP per worker (GDP PER WORKER); the importance of women in the labor force (LF:% FEMALE); oil extraction as measured by production per capita (CRUDE PETROL); the magnitude of international trade as measured by the sum of exports and imports divided by GDP (TRADE); the percent of the population in urban areas (URBAN); the logarithm of population density (LOG DENSITY); education levels as measured either by average years of educational attainment in the adult population (EDUC ATTAIN), or by secondary school enrollment as a percent of the population (SECOND ENROLL); and the fraction of the time period spent under a socialist government (SOCIALIST).

Building on Kau and Rubin's (1981) and Riezman and Slemrod's (1987) work, the vector **C**, describing administration and enforcement costs that help to determine the shape of Laffer curves, is reflected by EDUCATION ATTAIN and SECOND ENROLL. Also included here are URBAN, LOG DENSITY and FEDERAL, an indicator of a formal federal fiscal system in which both central and provincial governments levy

taxes. For reasons that will be explained later, some variables are regarded as proxies for more than one type of variable. The list of factors affecting the shape of Laffer curves net of administration costs does not include the (endogenously determined) level of resources used in tax collection and enforcement. Also, we were unfortunately unable to obtain enough data on the fraction of workers who are employees, an interesting measure of the likelihood of income tax evasion used by Kau and Rubin, to warrant its use.

Following Winer and Hettich (1991), the vector **P** includes exogenous or predetermined factors that determine how taxation is translated into political opposition. It is quite difficult to find proxies for such factors, and in this study we can only include here the coefficient of variation in real GDP (GDP COEF VAR); whether the country is federal; political instability as measured by the number of non-constitutional exits of the government's leader (COUPS); SOCIALIST, which is suggested by Musgrave's work; and political repression, based on Wintrobe and captured by the sum of the Gastil indexes of political rights & civil liberties (labelled NO RIGHTS & LIBS since a higher number represents a reduction in rights and liberties).

The actual estimating equations also include time-specific fixed effects, discussed further in the next section, to help control for any factors that are not captured by the above variables.

Summary statistics for the explanatory and dependent variables are reported in Table 2. In this sample of 100 countries, the single most important tax is that on domestic goods and services, which typically produces nearly a quarter of government revenue, and the property and wealth tax brings in the least revenue. Note that trade taxes can be as high as 28 percent of GDP and can account for as much as 3/4ths of total revenue. Non-tax revenue is another important source, producing about 17 percent of revenue.

The World Bank produces data on the seigniorage obtained from money creation. SEIGNIORAGE in Table 2 equals their estimate of seigniorage as a fraction of GDP divided by the IMF' s estimate of total revenue as a fraction of GDP, which yields seigniorage as a fraction of total revenue. Seigniorage is one of several revenue sources contained in NONTAX. But, perhaps because of data inconsistencies, the value for this sub-category (SEIGNIORAGE) exceeds the value for the category total (NONTAX) for a quarter of the sample. In any case, Table 2 shows that seigniorage produces 10 percent of revenue on average.

In part B of Table 2, averages by type of tax are given for socialist and non socialist countries, and for three categories of political repression, as measured by the sum of the Gastil indices of civil liberties and political rights, NO RIGHTS & LIBS. It should be noted that the most mature democratic countries, where the NO RIGHTS & LIBS index is less than 5, rely more than twice as much on the individual income tax as do less democratic regimes, and that most of the decline in reliance on the income tax as repression rises occurs between the first and second categories of repression.[19] Since the Gastil indexes tend to be correlated with income, it will be interesting to see if the NO RIGHTS & LIB index remains important after the estimation takes into account all other factors determining tax structure, including GDP per worker.

Table 2. Data characteristics.

	Mean	Standard deviation	Minimum	Maximum
	A. Full sample: 269 Observations			
Independent variables				
TOTAL REV/GDP	0.249	0.114	0.048	0.709
FEDERAL	0.171	0.377	0	1
CRUDE PETROL	0.00103	0.00380	0	0.0333
TRADE	0.677	0.679	0.039	7.138
GDP PER WORKER	11831	10091	677	38492
LF:% FEMALE	32.206	10.727	6	50
EDUC ATTAIN	4.833	3.022	0.364	12.141
SECOND ENROLL	49.708	31.277	2.2	112
URBAN	48.103	26.518	3.7	100
LOG DENSITY	3.804	1.494	0.354	8.380
GDP COEF VAR	0.0636	0.0389	0.0071	0.2144
COUPS	0.204	0.572	0	4
SOCIALIST	0.0705	0.254	0	1
NO RIGHTS & LIBS	7.294	3.924	2	14
Dependent variables				
CORPORATE	0.119	0.105	0	0.694
INDIVID	0.137	0.120	0	0.563
SOC SEC & PAYROLL	0.125	0.142	0	0.540
GOODS & SERVICES	0.239	0.130	0.0027	0.578
TRADE	0.201	0.175	0	0.750
PROPERTY	0.0183	0.0212	0	0.135
NONTAX	0.172	0.157	0	0.971
SEIGNIORAGE	0.103	0.164	−0.0340	1.695
INFLATION	23.150	61.298	−0.3	598.8
CURRENCY GROWTH	36.011	161.29	−5.5	2155
TRADE TAX RATE	0.0833	0.0862	0	0.673

	SOCIALIST		NO RIGHTS & LIBS		
	No	Yes	2.0–4.9	5.0–9.9	10–14
	B. Subsample means				
CORPORATE	0.114	0.181	0.105	0.126	0.130
INDIVID	0.140	0.094	0.218	0.092	0.080
SOC SEC & PAYROLL	0.125	0.128	0.195	0.069	0.060
GOODS & SERVICES	0.233	0.316	0.241	0.265	0.216
TRADE	0.204	0.162	0.109	0.228	0.271
PROPERTY	0.019	0.009	0.020	0.017	0.017
NONTAX	0.172	0.169	0.109	0.195	0.216
SEIGNIORAGE	0.102	0.109	0.052	0.152	0.118
INFLATION	22.717	28.605	16.642	33.828	21.324
CURRENCY GROWTH	36.906	25.230	24.313	58.871	30.851
TRADE TAX RATE	0.081	0.116	0.030	0.090	0.130
NUMBER OF OBS.	249	20	97	74	98

4. Estimation, Specific Hypotheses, and Results

Heteroskedasticity is a potential problem in any cross country study that includes countries with substantial variation in population and per capita income. We have attempted to mitigate this problem by defining most of our dependent variables as a fraction of total revenue or of GDP. As another precaution, Huber-White robust standard errors, which are consistent in the presence of heteroskedasticity, are used to provide accurate t-statistics.

OLS regressions explaining the share of revenue coming from each of these seven IMF revenue sources are reported in Table 3. Since each component of the tax system in every country is part of an optimal political strategy chosen by a government, the equations constitute a system of seemingly unrelated regressions. As noted earlier, and subject to the qualification, also noted above, concerning the measurement of revenues, efficient estimation that preserves the adding up property of the coefficients is conducted by using the same set of explanatory variables in each regression. With the exception of the regressions for corporate and property taxation, the regressions fit the data reasonably well.

Similar regressions explaining the variation in INFLATION, the rate of growth in currency outside banks (CURRENCY GROW), and SEIGNIORAGE using the full sample are reported in Table 4 (regressions 1, 3, and 5). For nine observations, the higher value of the annual rate of inflation or money growth ranges from 100 to 2155 percent. Given the sensitivity of ordinary least squares to extreme values of the dependent variable, these observations were deleted from a second set of regressions in Table 4 (2,4, and 6). Since it is possible to create an average tax rate for one of the revenue categories, the last regression in Table 4 examines the determinants of the TRADE TAX RATE, which equals tax revenue from international trade divided by the value of exports plus imports and which has a mean value in the sample of 0.083.

In the following sections, we present specific hypotheses concerning scale, base and administration cost effects, and concerning the effect of indexes of regime type, along with a discussion of the corresponding estimation results presented in the tables.

4.1. The Scale Effect

An increase in total revenue is expected to result in an increase in revenue drawn from each revenue source. As noted earlier, there is virtually no evidence in cross-country studies on this scale effect. Panel A of Table 5 describes the effect of an increase in the size of total revenue relative to GDP (TOTAL REV/GDP) on component tax revenues, when the latter are measured here *as a share of GDP*, in regressions that are otherwise identical to those in Table 3. TOTAL REV/GDP has a highly significant and positive impact on category revenue in each regression, and the sum of the coefficients across the seven regressions (1.037) is quite close to value of one required to enforce the condition that the total revenue increase be equal to the sum of its increases from individual sources. Thus, as the government gets larger, more taxes are obtained from *each* tax source. In particular, this is so for the corporate tax as well, contrary to results in Slemrod (2004).

Table 3. Category revenue/total revenue regressions (Absolute t-statistics in parentheses, based on Huber-White standard errors)

	NONTAX	CORPORATE	INDIVID	SOC SEC & PAYROLL	GOODS & SERVICES	TRADE	PROPERTY
INTERCEPT	−0.061	0.190	0.302	−0.0591	0.117	0.464	.00395
	(1.00)	(3.85)	(4.33)	(1.21)	(1.94)	(7.53)	(0.37)
TOTAL REV/GDP	0.257	0.0635	−0.0484	0.343	−0.136	−0.377	−0.0285
	(3.01)	(0.81)	(0.79)	(4.07)	(1.72)	(4.39)	(2.34)
FEDERAL	−.00850	0.0746	−0.0118	0.0650	−0.0473	−0.0173	−0.0118
	(0.46)	(2.82)	(0.66)	(2.60)	(2.23)	(1.05)	(3.88)
CRUDE PETROL	15.801	8.303	−7.042	−11.641	−4.220	0.115	−0.977
	(6.33)	(2.11)	(3.56)	(5.59)	(1.89)	(0.04)	(3.21)
TRADE	0.0179	−.00419	−0.0321	−0.0318	−0.0502	0.0924	.00101
	(1.83)	(0.69)	(5.23)	(2.74)	(4.20)	(8.21)	(0.57)
GDP PER WORKER	$.42 \cdot 10^{-5}$	$-.53 \cdot 10^{-5}$	$.36 \cdot 10^{-5}$	$.80 \cdot 10^{-5}$	$-.32 \cdot 10^{-5}$	$-.61 \cdot 10^{-5}$	$.36 \cdot 10^{-6}$
	(2.03)	(3.03)	(2.24)	(4.91)	(1.58)	(3.27)	(1.11)
LF:% FEMALE	−.00408	.00019	.00096	.00063	.00280	−.00016	.00015
	(7.04)	(0.33)	(1.87)	(1.09)	(3.79)	(0.22)	(1.04)
SECOND ENROLL	−.00032	−.00074	$-.25 \cdot 10^{-4}$	.00017	.00089	$.51 \cdot 10^{-4}$	−.00011
	(0.85)	(1.63)	(0.07)	(0.38)	(1.74)	(0.11)	(1.25)
URBAN	$-.61 \cdot 10^{-4}$	.00076	.00013	−.00089	.00138	−.00220	.00020
	(0.16)	(1.34)	(0.31)	(1.91)	(2.48)	(4.36)	(2.26)
LOG DENSITY	.00368	−.00324	−.00924	.00853	.00385	−.00847	.00353
	(0.75)	(0.85)	(1.98)	(1.60)	(0.84)	(1.85)	(3.33)
GDP COEF VAR	0.312	0.246	−0.262	−0.134	−0.188	−0.0320	0.0162
	(1.38)	(1.33)	(1.95)	(0.73)	(0.92)	(0.13)	(0.38)
COUPS	.00495	−0.0106	−.00714	.00568	−.00550	0.0117	−.00185
	(0.50)	(0.75)	(0.78)	(0.48)	(0.45)	(0.97)	(0.93)
SOCIALIST	.00439	0.0439	−.00650	0.0442	0.0816	−0.0972	−.00887
	(0.14)	(1.78)	(0.29)	(1.47)	(2.63)	(3.55)	(2.07)
NO RIGHTS & LIBS: 1st SEGMENT	0.0385	−.00808	−0.0327	−.00014	0.0127	−.00212	−.00164
	(3.83)	(2.38)	(3.13)	(0.05)	(1.57)	(0.39)	(1.01)
NO RIGHTS & LIBS: 2nd SEGMENT	0.0102	.00797	−.00182		−0.0165	.00388	.00118
	(2.94)	(0.61)	(0.71)		(3.20)	(0.54)	(1.99)
1981–85	0.0213	.00103	−.00946	−.00935	−.00651	−.00536	.00030
	(1.44)	(0.07)	(0.68)	(0.48)	(0.39)	(0.32)	(0.11)
1986–92	0.0222	−.00346	−0.0135	−0.0182	−.00723	.00494	.00064
	(1.52)	(0.24)	(0.92)	(0.96)	(0.43)	(0.27)	(0.20)
ADJ. R-SQUARE	.6126	.1541	.4231	.4347	.2788	.5854	.1393
ROOT MSE	.0980	.0962	.0911	.1069	.1102	.1128	.0197
NUMBER OF OBS.	269	248	246	198	269	269	258
SPLINE BREAK	5	11	5		7	9	5
F-TEST:POL VARS	9.76*	2.48*	3.29*	0.45	4.16*	2.97*	1.36

Table 4. Inflation, money growth, seigniorage, and trade tax rate regressions (Absolute t-statistics in parentheses, based on Huber-White standard errors).

	INFLATION		CURRENCY GROWTH		Seigniorage/Total revenue		
	Full	Infl < 100	Full	Infl < 100	Full	Infl < 100	Trade Tax rate
INTERCEPT	44.801	25.542	25.794	6.695	.0133	0.0493	0.158
	(1.92)	(4.84)	(0.49)	(0.85)	(0.18)	(0.76)	(6.77)
TOTAL REV/GDP	−104.10	−25.898	−254.836	−23.673	−0.389	−0.269	−0.0874
	(2.06)	(2.61)	(1.76)	(2.54)	(2.95)	(3.41)	(1.86)
FEDERAL	2.847	−2.827	−8.252	−1.996	−.0305	−0.0200	0.0155
	(0.24)	(1.41)	(0.26)	(1.16)	(1.16)	(1.72)	(1.83)
CRUDE PETROL	778.12	271.533	1911.6	−206.94	−4.260	−4.346	0.522
	(1.18)	(1.55)	(1.01)	(0.87)	(1.98)	(2.26)	(0.43)
TRADE	−4.775	−2.312	−11.291	−3.057	−0.0386	−0.0318	−.00438
	(2.12)	(2.50)	(2.10)	(3.06)	(3.62)	(3.66)	(0.93)
GDP PER WORKER	−.00252	−.00075	−.00200	$-.94\cdot10^{-4}$	$.11\cdot10^{-5}$	$.46\cdot10^{-6}$	$-.36\cdot10^{-5}$
	(2.95)	(4.40)	(0.91)	(0.48)	(0.59)	(0.30)	(4.34)
LF:% FEMALE	0.110	0.0392	0.295	.00100	−.00105	−.00150	−.00021
	(0.52)	(0.58)	(0.69)	(0.15)	(1.39)	(2.51)	(0.53)
SECOND ENROLL	0.0727	0.0128	0.121	0.0278	$.81\cdot10^{-4}$	.00037	.00027
	(0.50)	(0.25)	(0.42)	(0.56)	(0.18)	(1.01)	(1.12)
URBAN	1.080	0.253	1.558	0.111	.00162	.00067	−.00042
	(2.95)	(3.86)	(2.05)	(2.23)	(2.55)	(1.66)	(2.16)
LOG DENSITY	−6.137	−1.177	−15.931	−0.913	−0.0104	−.00193	.00096
	(2.12)	(2.47)	(1.67)	(2.21)	(1.32)	(0.56)	(0.42)
GDP COEF VAR	−51.150	−19.920	−60.328	25.111	0.198	0.304	−0.154
	(0.72)	(1.05)	(0.39)	(1.12)	(0.97)	(1.77)	(1.42)
COUPS	15.037	0.303	48.720	0.289	0.0482	.00721	0.0171
	(1.02)	(0.18)	(1.03)	(0.21)	(1.29)	(0.44)	(1.12)
SOCIALIST	6.939	0.927	7.411	−0.609	0.0214	.00509	−0.0173
	(0.58)	(0.32)	(0.32)	(0.18)	(0.51)	(0.12)	(0.98)
NO RIGHTS & LIBS: 1st SEGMENT	−1.127	−0.291	14.719	4.127	0.0371	0.0236	−.00174
	(0.66)	(1.02)	(1.07)	(3.22)	(2.68)	(2.34)	(0.77)
NO RIGHTS & LIBS: 2nd SEGMENT			−10.298	−0.437	−.00942	.00340	0.0206
			(0.97)	(1.12)	(1.16)	(1.11)	(3.37)
1981–85	10.933	−1.259	32.006	−3.905	0.0497	0.0134	−.00611
	(1.18)	(0.63)	(1.05)	(2.44)	(1.85)	(0.95)	(0.72)
1986–92	12.097	−1.115	31.278	−2.870	0.0166	−.00077	.00283
	(1.64)	(0.54)	(1.66)	(1.46)	(0.85)	(0.05)	(0.30)
ADJ. R-SQUARE	.0875	.1275	.0524	.1686	.2088	.2489	.4582
ROOT MSE	58.55	12.62	157.00	11.76	.1459	.0932	.0635
NUMBER OF OBS.	258	249	261	252	257	248	269
SPLINE BREAK			6	5	6	5	9
F-TEST:POL VARS	1.54	0.24	2.47*	2.40*	4.35*	2.55*	8.33*

Table 5. Category revenue regressions: alternative specifications (Absolute *t*-statistics in parentheses, based on Huber-White standard errors except as noted)

	NONTAX	CORPORATE	INDIVID	SOC SEC & PAYROLL	GOODS & SERVICES	TRADE	PROPERTY
Panel A[a] : Dependent variable = Category Revenue/GDP. OLS							
TOTAL REV/GDP	0.254	0.140	0.112	0.242	0.187	0.0906	0.0111
	(6.65)	(5.32)	(5.29)	(8.70)	(6.50)	(3.08)	(3.79)
NUMBER OF OBS.	269	248	246	198	269	269	258
Panel B[b] : Dependent variable = Category Revenue/GDP. 2SLS							
TOTAL REV/GDP	0.285	−0.217	0.0253	0.634	0.532	−0.0329	0.0189
	(3.29)	(1.70)	(0.26)	(3.07)	(4.36)	(0.49)	(1.59)
NUMBER OF OBS.	183	174	171	151	183	183	176
Panel C: Dependent variable = Category Revenue/Total Revenue (EDUC ATTAIN replaces SECOND ENROLL in Table 3)							
SECOND ENROLL	−.0102	.00073	0.0128	−0.0159	0.00973	−.00230	$.80 \cdot 10^{-4}$
	(2.83)	(0.19)	(2.42)	(3.20)	(1.83)	(0.48)	(0.10)
NUMBER OF OBS.	228	211	209	177	228	228	221

[a]Only the coefficients on TOTAL REVENUE/GDP are reported here, from the full equation for each revenue source relative to GDP.

[b]Only the coefficients on TOTAL REVENUE/GDP are reported here, from the full equation for each revenue source relative to GDP in a two stage least squares procedure in which TOTAL REV/GDP is endogenous. See text. Standard errors are unadjusted.

Comparable regressions for seigniorage as a fraction of GDP, summarized in panel A of Table 6, tell a similar story. As government expands, more seigniorage is collected. Two stage least squares estimates from a system in which TOTAL REV/GDP is endogenous will be described in the Section 4.6.

Additional evidence on the scale effect comes from a simple comparison of changes over time periods in a country's total revenue and its revenue from a particular source. If the tax source's share in GDP rises (falls) as total revenue's share in GDP (TOTAL REV/GDP) rises (falls) *holding nothing else constant*, then the evidence supports the scale effect. This was the case for 67–70% of NONTAX, CORPORATE, INDIVID, SOC SEC & PAYROLL, and GOODS & SERVICES cases and for 52% of TRADE and PROPERTY cases. Thus, in this additional test there is little support for the scale effect for international trade and property taxation, but there is strong evidence favoring the scale effect in the other tax categories.[20]

Although the evidence indicates that the revenue obtained from each tax source increases as total revenue rises, whether or not the *share* of revenue drawn from a source changes as the budget shifts out is another matter. The consequences of a change in scale for the tax mix will depend on the shape of marginal political cost functions for each revenue source (see Figure 1). The data indicate that in general, as governments have expanded around the world over the 1975–1992 period, they obtained a larger share of revenue from social security and payroll taxes and from non-tax sources, and that the shares of revenue coming from trade taxes and from seigniorage fell. Evidence on the

Table 6. Inflation, money growth, seigniorage, and trade tax rate regressions: alternative specifications (Absolute *t*-statistics in parentheses based on Huber-White standard errors except as noted).

	Seigniorage/GDP	
	Full	Infl < 100
Panel A[a] : Dependent variable = Seigniorage/GDP		
TOTAL REV/GDP	.0507	.0340
	(1.66)	(1.84)
NUMBER OF OBS.	257	248
PANEL B[b]: Dependent variable = Seigniorage/GDP		
TOTAL REV/GDP	.0346	.0439
	(0.47)	(0.94)
NUMBER OF OBS.	178	172

	INFLATION		CURRENCY GROWTH		Seigniorage/Total Revenue		Trade
	Full	Infl < 100	Full	Infl < 100	Full	Infl < 100	Tax rate
Panel C: EDUC ATTAIN replaces SECOND ENROLL in Table 4.							
SECOND ENROLL	−0.644	−1.358	−0.835	−0.796	−.00529	−.00631	−.00378
	(0.48)	(2.57)	(0.28)	(1.73)	(1.28)	(1.99)	(2.03)
NUMBER OF OBS.	224	215	224	215	219	210	228

[a]Only the coefficients on TOTAL REVENUE/GDP are reported here.
[b]Only the coefficients on TOTAL REVENUE/GDP are reported here, from the full equation for each revenue source relative to GDP in a two stage least squares procedure in which TOTAL REV/GDP is endogenous. See text. Standard errors are unadjusted.

other forces determining revenue shares also is found in Tables 3 to 6, and it is to this that we now turn.

4.2. The Base Effect and Substitution Among Revenue Sources

Several variables capture tax base effects—that is, the consequences for revenue structure of changes in the relative size of tax bases. Oil production has been an important source of wealth and of government revenue. We measure oil's importance in a country's economy by crude petroleum production per capita in metric tons (CRUDE PETROL). In the IMF Government Finance Statistics Yearbook, separate entries for corporate taxes on *oil* companies and nontax revenue from a country's *oil* operations are found for most of the major oil producing countries. Surprisingly, few countries rely on severance taxes on oil, which are included in goods and services taxes and comprise a only small part of total revenue for the category when used (e.g., 7% for Norway). Consistent with these ways of recording revenue from oil production, CRUDE PETROL has significantly positive coefficients in the NONTAX and CORPORATE regressions in Table 3.[21] Oil producing countries rely more on these oil tax sources and less on individual income taxes, payroll and social security taxes, property taxes, and seigniorage.[22]

Although several authors have investigated the effect of international trade on tax structure, the evidence is not very consistent. Here the importance of trade as a tax base

is measured by the ratio of exports plus imports to GDP (TRADE). As predicted, Table 3 shows that countries with a large international trade sector rely more on taxes on exports and imports; TRADE has a highly significant positive impact on the share of revenue coming from trade taxes.[23]

The effect of an expansion of trade on the trade tax rate considered in Table 4 is less straightforward. With a larger potential trade tax base, the same trade revenue can be raised with a lower tax rate or with more extensive tax loopholes. The larger trade tax base also makes trade taxation more attractive, leading a government to raise its trade tax rate (or, perhaps, to reduce the generosity of exemptions and deductions). It is unclear theoretically which of these effects dominates, and empirically, as shown in the last column of Table 4, the trade base has a negative but insignificant effect on the trade tax rate.

International trade in many countries is indirectly taxed through profits obtained from public enterprises that are involved in the production and marketing of exports or in the importation of goods. These revenue sources sometimes appear as separate entries under nontax revenue (e.g., the Sugar Council in the Dominican Republican). The marginally significant and positive coefficient on TRADE in the NONTAX regression is consistent with these observations. We also find evidence in Tables 3 and 4 of a substitution between trade taxes and other tax instruments that has not been reported in the literature. Countries that trade more rely less on domestic taxes on goods and services, taxes on labor income, and seigniorage. Consequently, inflation tends to be lower in countries where trade is more important.

The size of the income or payroll tax base is partially captured in Tables 3 and 4 by GDP per worker (GDP PER WORKER). This variable has the expected positive impact on social security and payroll taxes and on individual income taxes. As shown in Table 3, these effects are also accompanied by the expected substitution away from several other sources: corporate taxes, trade taxes, and (weakly) sales and excise taxes.[24] Similarly, in Table 4 we see that tariff rates fall as GDP per worker rises. (Note, however, that the results in Table 3 indicate that countries with higher GDP per worker rely more on nontax revenue.)

Since the income elasticity of currency demand is less than one (see Kenny, 1991), the seigniorage tax base falls *relative to* the income tax base as income rises, which should result in a substitution away from money creation and inflation. This hypothesis gets some support in Table 4.

The percentage of the labor force who are female (LF: % FEMALE) captures both the size of the labor income tax base and the size of the domestic goods and services sector, since women are disproportionally represented in that sector. There is evidence in Table 3 that an increase in this variable has the predicted positive impacts on goods and services taxes and on individual income taxes. The regressions also show some substitution away from nontax revenue and seigniorage (a component of nontax revenue) as LF: % FEMALE increases.

The percent living in urban areas (URBAN) and the log of population per square kilometer (LOG DENSITY) capture a variety of tax base effects.[25] Land is more valuable in urban and densely populated areas, thus offering a larger tax base. Consistent with this reasoning, we find that both variables have a significantly positive impact on the use of property taxes in Table 3. An increase in URBAN also leads to more specialization,

more domestic trading and a greater demand for money (again, see Kenny 1991).[26] URBAN's significantly positive coefficients in the GOODS&SERVICES, SEIGNIORAGE, MONEY GROWTH, and INFLATION regressions in both Tables 3 and 4 are consistent with these base effects.

4.3. Administration Costs and Other Related Factors Affecting the Shape of (Net) Laffer Curves

Kau and Rubin (1981) hypothesized that monitoring of tax compliance may be less costly in urban areas, and later Riezman and Slemrod (1987) argued that the administration of income and sales taxes in particular was easier in more densely populated countries. There is little support for this hypothesis in Table 3. URBAN has the predicted positive impact on goods and services taxes, but LOG DENSITY is insignificant in this regression. Neither variable has a significantly positive impact on the use of individual income taxation. Thus, countries rely more on property taxation, seigniorage, and sales taxes as urbanization and density increase. The substitution toward these tax bases is accompanied by less reliance on trade taxation. Both density and urbanization are inversely related to trade taxation, and urbanization has a negative impact on the trade tax rate.

Riezman and Slemrod (1987) recognized that the income tax and goods and services taxes require widespread literacy; obviously, tax forms cannot be filled out unless the taxpayer can read. In countries where few can read and write, the high cost of obtaining income and "sales" taxes should be expected to lead to greater reliance on other taxes, since the Laffer curves net of administration costs for income and sales taxes will tend to bend backwards at relatively low tax rates. The ability to fill out sophisticated tax forms is perhaps best measured by the average years of educational attainment in the adult population (EDUC ATTAIN), which was obtained from a data set compiled by Robert Barro and Jong-Wha Lee (1994). But data on school enrollment are available for a broader spectrum of countries, and a more diverse sample provides a better opportunity to test some of our more novel hypotheses. Accordingly, our main results, reported in Tables 3 and 4, utilize the gross enrollment ratio in secondary school (SECOND ENROLL).[27] Education results from comparable regressions based on EDUC ATTAIN are found in panel C in Tables 5 and 6; the sample in these regressions is 38 observations smaller.

Our hypotheses about the effects of education receive stronger support when the educational attainment measure from Barro and Lee is used, and it is these results, found in Panel C of Table 5, (with one exception noted below) that are now summarized. As educational attainment rises, countries are found to rely more on individual income taxes and on goods and services taxes, which both require widespread literacy. Conversely, reliance on corporate, social security and payroll, and trade taxes is expected to diminish as educational levels increase, since these taxes are handled by a small number of well educated individuals. This hypothesis also receives some support. An increase in educational attainment reduces reliance on payroll taxes, and a rise in school enrollment rates in Table 3 leads to a shift away from corporate taxation. Although educational attainment has no impact on the share of taxes coming from trade taxation, the hypothesis

that the trade tax rate falls as educational attainment rises is supported in Panel C of Table 6.[28]

While we have emphasized the effect of education on the shape of Laffer curves for given potential tax bases, education also may affect the size of the bases. In particular, Kenny (1991) documents a substitution from currency into time deposits as a country's literacy rate rises. The fall in currency usage should make seigniorage less attractive as a revenue source, and in Panel C of Table 6 there is also evidence that an increase in educational attainment leads to less reliance on seigniorage and results in lower rates of inflation and money creation. The significantly negative coefficient on EDUC ATTAIN in the NONTAX regression (see Table 5, Panel C) also provides support for this hypothesis.

Finally we consider the role of federalism, which alters the elasticity of bases controlled by various governments within a country. Central governments in federal structures can be expected to rely more on tax sources that are relatively elastic or which can be controlled more easily at the central level. For this reason, tariff collection, social security revenue and seigniorage are usually the exclusive domain of central governments. The hypothesis that these account for a higher share of central government revenue in federal than in unitary countries is supported for social security revenue but not for seigniorage or trade taxation.

It is also more efficient for the central government to tax corporations which often operate in several provinces or states and trade across national borders. The hypothesis that federal countries obtain a greater share of revenue from corporate taxation than is obtained in other countries is supported in Table 3. Analogously, property taxation generally is done by local governments because this requires some knowledge of local land markets and involves a less mobile base and, as one expects, the share of central revenues coming from property taxation is shown in the Table to be lower in federal countries.

4.4. Factors Affecting the Translation of Taxation into Opposition, and the Role of Political Regime

We now turn from scale, base and administration cost effects to consider the consequences of changes in factors that determine how economic shocks are translated into political opposition, and to examine the role of regime type.

As we argued in section two, since state enterprises are more important in the economy of socialist countries, we should expect the socialist countries to rely more heavily on taxation of state enterprises (recorded in the 'nontax' category of our data). Also, there maybe greater sentiment for taxing private business in socialist regimes. In addition, we noted that a desire for redistribution maybe satisfied by controlling the economy's wage structure, so that we may expect less emphasis on the use of the personal income tax for this purpose.

The index SOCIALIST used in the estimating equations to shed light on these predictions equals the fraction of the time period spent under a socialist government. Kornai (1992) classifies 26 countries, including the former Soviet Union, as socialist. All but two of these were classified by Gastil (various years) as having either (1) a socialist economic system or (2) a mixed socialist economic system and a socialist or communist political

system.[29] Accordingly we include as socialist all countries so classified by Kornai and all other countries that Gastil determined have either of the two socialist/communist criteria described above. In our sample of 100 countries, Benin, Congo, Ethiopia, Guinea, Hungary, Myanmar, Poland, Tanzania, Zambia, and Zimbabwe were classified as socialist sometime in the 1975–92 period.

Our hypotheses about the effects of socialism on the tax mix receive mixed empirical support. First, SOCIALIST is insignificant in the NONTAX regression in Table 3. (However, here one should note that due to difficulties in classifying which businesses are "controlled" by the government, some state enterprises could be classified as private and thus listed as paying corporate taxes.) Second, a socialist predisposition for greater taxation of private business would result in a greater reliance on corporate taxes and perhaps on goods and services taxes. And in fact, in the regressions in Table 3, SOCIALIST has a significant and positive impact on both these tax sources. Third, the regressions in Table 3 indicate that socialism is accompanied by substitution away from trade and property taxes. But there is no evidence here that these countries rely less on individual income taxes.

The volatility of economic conditions in a country is measured by the coefficient of variation in real per capita GDP in the time period (GDP COEF VAR), which equals the standard deviation in per capita GDP in the country divided by mean per capita GDP. In a volatile economy, reliance on a business cycle-sensitive tax base means that taxpayers will face fluctuating tax payments, which increases the full cost of any given average level of taxation and thus increases political opposition. Greater economic fluctuations should therefore be expected to result in less reliance on the relatively more volatile sources such as personal income, corporate, and trade tax bases, and more on stable bases such as property and consumption. The marginally significant t-statistics on GDP COEF VAR in Tables 3 and 4 suggest that governments respond to greater volatility in the economy by relying less on individual income taxes and more on seigniorage (a consumption tax that is included in NONTAX) and on other nontax revenues. It also appears that economic volatility leads to lower tax rates on international trade, which allows governments to reduce the vulnerability of revenues to fluctuations in the value of trade.[30]

Political instability, as measured in our data set by the number of non-constitutional exits of the government's leader during the time period (COUPS),[31] may also lead to a smaller role for income taxation in the revenue mix. If political instability and economic instability are correlated, there will be a tendency to reduce reliance on income taxation in unstable countries for the reason just discussed. In addition, as noted earlier, coups maybe engineered to limit redistribution via income taxation and other means.

Unconstitutional exits of governments were experienced by 29 of the 100 countries in the sample. But for many of these countries, this was not a recurring problem. Fifteen countries experienced 2–4 unconstitutional exits in one 5-7 year time period, and only eight (Bangladesh, Burkina Faso, Burundi, Chad, Ghana, Mauritania, Nigeria, Uganda) experienced a coup in two of the three time periods. Perhaps the infrequency of coups in our sample is not representative. But in any case, COUPS is unrelated to the tax mix and seigniorage in Tables 3 and 4. Thus an hypothesis that countries where coups are more common will rely less on (redistributive) personal income taxation also receives no support.[32]

The variables SOCIALIST, COUPS and the degree of political repression, NO RIGHTS & LIBS, are all indicators of the nature and extent of political opposition to taxation as well as of regime type. We have dealt with results for the first two of these indicators of regime type above. Now we turn to our indicator of political repression, NO RIGHTS & LIBS, the sum of the Gastil indexes of political rights and civil liberties (Gastil, various years). This combined index variable ranges from 2 in the most democratic countries (e.g., Australia, Austria, Barbados, Belgium, Canada, Denmark, Iceland, Netherlands, New Zealand, Norway, United States) to 14 in countries with the least political rights and civil liberties (e.g., Benin, Ethiopia, Myanmar, and Syria). Political and civil rights can be repressed, of course, by right wing dictatorships as well as by totalitarian communist governments.

In panel B of Table 2, it is apparent that although the effect on revenue sources of experiencing a loss of rights and liberties is monotonic in most cases, it is the initial loss (relative to the established democracies) of rights and liberties that often has the greatest impact on tax composition. For example, countries with an repression index of 2–4.9 on average raise 22 percent of their revenue from personal income taxation. Those with an index of 5–9.9 raise about 9 percent of revenue from this source, while the most repressive regimes (10–14) raise about 8 percent of revenue from individual income taxes.

A "spline" is employed to capture this phenomenon. The spline is a continuous function that is piecewise linear and changes slope at a break point. For each regression, we searched over integer values ranging from 4 to 12 for the break point that provided the best fit. If the best fit was obtained at the "corner values" of 4 or 12, there was deemed to be insufficient evidence to favor the spline over the simpler usual linear specification. The traditional linear form was used in these three regressions, and the spline was used in the other eleven regressions. In no case did a quadratic specification using NO RIGHTS & LIBS and that variable squared fit better than the spline specification reported here.

Limitations on political rights and civil liberties generally cause a loss of popular support for, or loyalty to, the regime and thus increase the costs of relying upon complicated taxes, since substitutes for voluntary compliance with such taxes are expensive. Accordingly, governments that restrict rights should be expected to substitute toward taxes that do not rely as much on voluntary compliance and, correspondingly, to move away *from* taxes for which voluntary compliance is important. Furthermore, repressive regimes may try to compensate for their lack of voluntary compliance, for example by creating state enterprises in order to make revenue collection easier. And as we noted previously, repression may also serve as a substitute for voluntary compliance, though the substantial costs of using repression as a policy instrument suggest that it will not completely offset any decline of taxpayer loyalty as rights are diminished.

What does the evidence tell us about freedom and taxation? In Table 3, the results indicate that more repressive regimes rely less on corporate tax revenue (from private firms) as civil liberties and political rights diminish (i.e., as NO RIGHTS & LIBS rises), perhaps in part due to some corporations being nationalized. NO RIGHTS & LIBS has a significantly negative impact on CORPORATE until NO RIGHTS & LIBS equals 11 (e.g., Chile in 1981–85, Iran) and no effect thereafter. Moreover, since the government has a monopoly over currency in usage, compliance is not a problem for seigniorage, and we also see in Table 4 that a reduction in rights results in a higher seigniorage

rate and currency growth; the coefficients on the first spline segment for NO RIGHTS & LIBS in these regressions are significant and positive. The positive coefficients on the NO RIGHTS & LIBS spline variables for the NONTAX component are consistent with the above findings. As repression rises, governments draw a larger share of their revenue from nontax sources, which include governmental enterprises and seigniorage. Note that although both spline coefficients are significant in the NONTAX regression, the coefficient on the second spline segment (for NO RIGHTS & LIBS values above 5) is only a quarter the size of the first segment's coefficient.

The results concerning the personal income tax provide perhaps the most interesting evidence on the effects of repression on tax structure, because this tax is especially dependent on voluntary compliance to control administration and enforcement costs. The results in Table 3 indicate that, controlling with various measures for the size of the income tax base, the share of revenue from income taxation falls until the repression index reaches 5 (e.g., India in 1981–85, Botswana and Colombia in 1975–85), and is more or less unaffected by additional losses of political and civil rights. The latter result suggests that even very high levels of repression are not a substitute for voluntary compliance in democratic societies.

The initial increase in repression is accompanied by substantially less reliance on income taxes. The coefficients in Table 3 for INDIVID (the personal income tax) imply increasing NO RIGHTS & LIBS from 2 to 5 causes the share of revenue obtained from income taxation to fall by $.0327^{*}(5-2) = .0981$, or roughly from 0.22 (for NO RIGHTS & LIBS = 2) to 0.12 for NO RIGHTS & LIBS = 5. Although the second spline segment is not significant, increasing NO RIGHTS & LIBS in this segment from 5 to 14 then causes INDIVID to fall by $0.00182^{*}\ (14-5) = .0163$, down to 0.11.

Our finding that democracies rely substantially more on personal income taxation could be due to there being more citizen consent in democracies or to democracies redistributing more via the tax system than do more repressive regimes. But Mulligan, Gil and Sala-i-Martin's (2004) finding that income tax rate structures are somewhat flatter in democracies than in non-democracies suggests that our result is not due to redistribution being more important in democratic states. Instead, it appears that consent to taxation plays an important role in determining the structure of taxation in a political equilibrium, even after controlling for differences across countries in scale, base, and administration cost effects.

The significantly positive coefficients on the second segment of the NO RIGHTS & LIBS spline (i.e., when the index rises above the value indicated in the row near the bottom of the table labeled SPLINE BREAK) in the PROPERTY and TRADE TAX RATE regressions indicate that the most repressive governments rely more on property taxes and trade taxes, which utilize property assessors and customs officials, in lieu of taxes that depend on self-reporting.[33]

Concerning domestic commodity taxation, the results in Table 3 indicate that an increase in the repression index results in a greater reliance on goods and services taxes until NO RIGHTS & LIBS equals 7; further increases lead to less use of sales and VAT taxes. The first spline segment ($t = 1.57$) is puzzling, since this is a tax for which compliance appears to be important. But the second spline segment dominates the first; countries with index values exceeding 10.8 are estimated to rely less on goods and services taxes than countries with a perfect index value of 2.

To complete the analysis of the role of political regime, the bottom line in Tables 3 and 4 reports the results of F-tests on excluding the variables associated with socialist government (SOCIALIST), nonconstitutional transition of power (COUPS), and political repression (NO RIGHTS & LIBS). As shown, this group of variables generally contributes significantly to the regression's explanatory power; the only exceptions occur in the SOC SEC & PAYROLL and INFLATION regressions. The implication here is that regime type matters in explaining taxation in the diverse cross-section of countries we have explored.

4.5. Allowing for Omitted Factors

To allow for the possibility that we have left out some relevant explanatory variables, each of the 14 regressions in Tables 3 and 4 include two time period dummy variables, representing the second and third of the three time periods. These represent *time period* fixed effects that capture anytime-specific factors that were missed by the other explanatory variables. Only one (see Table 4) of the 28 time dummy coefficients is significant at the 5 percent level using a two tailed test, indicating that the other variables are successfully capturing the changes in tax composition over time.

We do not include *country specific* fixed effects (in addition to already included fixed effects related to federalism). This is primarily because the cross country variation removed by such fixed effects is *precisely* what we are trying to model. One should also note that country specific fixed effects remove or attenuate the role of variables that are fixed or move slowly over our three time periods, and that many of our explanatory variables are of this sort, notably the index of freedom as well as the period averages of population density, female labor force participation and the education measures, among other variables.

4.6. Dealing with the Endogeneity of the Size of Government

The last empirical issue we deal with in this section is the endogeneity of government size. We noted in Section 2.1 that lower administrative costs for any tax make it less costly to expand government. Following similar logic, Becker and Mulligan (2003) argue that the adoption of a more efficient tax structure will lead to a larger government sector. This suggests that our measure of the size of government (TOTAL REV/GDP) is endogenous. We use two strategies to deal with this.

In the regressions in Tables 3 and 4, the dependent variables are the shares of central government total revenue obtained from various tax sources. That is, we merely explain how the revenue pie is divided up. An alternative specification here is a reduced form regression that does not include the potentially endogenous size of government variable, allowing us to test how sensitive our other results are to the omission of TOTAL REV/GDP from the regressions. Unreported reduced form regressions (i.e., excluding TOTAL REV/GDP) correspond to the regressions in Tables 3 and 4. For this comparison, let us group t-statistics according to whether they are 1.64 or lower, 1.65–1.95, or at least 1.96. For only 7 of the 104 pairs of t-statistics in Table 3 and its unreported counterpart regressions did the significance level of the variable differ. In five

of these cases, the variable became more significant when the size of government variable was omitted from the regression. We get similar results when we compare the results in Table 4 and its unreported counterpart regressions where scale is excluded. Based on 103 pairs of t-statistics, a variable became more significant in only three instances and became less significant in only five cases when TOTAL REV/GDP was dropped from the regression. So, whether or not the size of government variable is endogenous, its inclusion has very little impact on what we conclude about the determinants of the tax mix.

The effect of TOTAL REV/GDP on taxes levied from various sources *relative to GDP* is reported in panel A in Tables 5 and 6. This is used to test the prediction about scale—that an increase in total tax revenue leads to an increase in revenue taken from each revenue source. The endogeneity of scale may bias the coefficients, but it is very difficult to find instruments for the size of government that do not belong in the tax composition regressions. Mueller and Stratmann (2003) have found that countries with higher voter participation rates have more equal distributions of income and a larger government sector. Our instruments for a two stage least squares procedure include their voter turnout variable as well as the absolute latitude of the country's largest city as a proxy for basic forces involved in development of the public sector. To minimize the loss of observations due to estimating a system of equations, a two stage least squares system is estimated for each of the seven tax sources. Each 2SLS system has two equations, which explain the size of government (TOTAL REV/GDP) and reliance on each tax source (each source's revenue/GDP). Even so, missing data on voter turnout cause the sample size to fall by about 30 percent. For instance, the 86 observations lost in the NONTAX regression come from 49 mostly developing countries.

Of the two instruments, only a country's latitude has a significant impact on government size in unreported first stage regressions; countries far from the equator have a larger government sector. The other findings are also quite intuitive: total revenues (relative to GDP) are estimated to be higher in oil rich countries; in countries that engage in more international trade; in densely populated countries; and in socialist economies. The central government is smaller in federal countries, in which local governments also provide some services.

The coefficients on TOTAL REV/GDP in these seven 2SLS systems are reported in panel B of Table 5. Five of the seven coefficients have the hypothesized positive sign, and three of these are highly significant. The coefficient for corporate taxation is significantly negative at the six percent level under a one tail test. The sum of the seven coefficients is 1.24, which is a little farther from one than was found in panel A.

Panel B of Table 6 provides scale coefficients for the ratio of seigniorage to GDP regressions that are estimated in similar 2SLS systems. They are positive but are not significant.

5. Further Results on Tax Composition in Democracies and Other Regimes

We pointed earlier to the argument by McGuire and Olson (1996) that all regimes have an incentive to capture the benefits of efficiency gains spread over a large segment of the population. If so, our predictions about scale, tax base and administrative cost

effects should be supported in both types of regimes. We form two subsamples to test whether this is the case. The spline for NO RIGHTS & LIBS had a break point where NO RIGHTS & LIBS equals 5 in three of the regressions in Table 3. Accordingly, the Democracy subsample includes all observations where NO RIGHTS & LIBS is less than or equal to 5 and accounts for 39 percent of our 269 observations. The remaining observations with high values for NO RIGHTS & LIBS are grouped in the Non-Democracy subsample. Unreported regressions similar to those found in Table 3 were estimated for the Democracy subsample and the Non-Democracy subsample. All the regressions using the Democracy subsample are significant, and six of the seven regressions based on the Non-Democracy subsample are significant. Only the regression explaining the variation in the use of personal income taxes in non-democracies is unsuccessful, likely because there is little variation among non-democracies in the use of income taxation. Again using the three categories of t-statistics described earlier, the hypotheses fare better in the Democracy subsample in 14 instances and do better in the Non-Democracy subsample in 17 cases. In general then, it would not be reasonable to conclude that our model of tax composition works for democracies but not for other regimes. Both types of regimes appear to respond to the same economic forces that determine the mix of revenues.

6. Conclusions

Our analysis of tax structure helps to paint a much more complete empirical picture of the determinants of the tax mix in a large sample of countries with widely differing economic circumstances and political regimes. There are a number of novel empirical findings:

- There is little evidence in the cross-country literature on the scale effect. We find strong evidence in OLS regressions and using a simpler ancillary test that governments obtain more revenue from *every* individual source as the total budget expands. There is weaker support for this prediction in 2SLS regressions that allow for endogeneity of government size, perhaps because the sample is one third smaller and has far fewer developing countries.
- Our tax system regressions—with and without allowance for endogeneity of government size—convincingly document the base effect: the substitution toward relatively large tax bases and away from other tax sources. Major oil producing nations draw a larger share of their revenues from nontax revenues and corporate taxes, which include profits from nationalized oil operations and taxes on oil corporations. Countries in which international trade is important rely more on trade taxes. Similarly, a larger tax base for income and payroll taxes leads to greater utilization of both these taxes. As the percent of the population in urban centers and overall population density rises, land values increase, resulting in greater reliance on property taxes. Domestic trade is more important in countries in which more people live in urban areas and in which more women work; as a result, domestic goods and services taxes are more important in these countries. Currency demand is greater in more urbanized and less educated countries, leading to higher money growth, seigniorage and inflation, and to more

nontax revenue which includes seigniorage. All the above shifts toward a larger tax base are accompanied by significant substitutions away from several other tax bases. This research provides comprehensive evidence of the substitution among tax sources due to shifts in the relative size of these bases, which is not apparent in the partial investigations found in the literature.

- Administration costs also appear to play an important role. As educational attainment rises, countries make greater use of taxes that require widespread literacy—individual income taxes and domestic goods and sales taxes—and rely less on payroll and trade taxes that have less demanding literacy requirements. The use of business cycle-sensitive tax bases is costlier in more volatile economies. Nevertheless, there is only weak evidence that countries with greater fluctuations in their economy rely more on stable tax bases (e.g., seigniorage) and less on cycle-sensitive tax bases (e.g., the individual income tax).
- We also investigate the role of political regime. McGuire and Olson (1996) suggest that all types of regimes will attempt to capture efficiency gains and thus will experience similar scale, base and administration cost effects, and we find evidence of these effects in both the Democracy and Non-Democracy subsamples. But the matter is not straightforward. An increase in repression may be expected to lead to less citizen cooperation in raising tax revenue, and consistent with this reasoning, we find that more repressive governments turn away from tax sources requiring a substantial degree of voluntary cooperation, especially personal income taxes, toward property taxes (which rely on property assessors and not self-reporting), trade taxation (which requires a small number of customs agents), seigniorage, and perhaps a greater use of state enterprises. We also find that socialist governments substituted toward corporate and goods and services taxes and away from trade and property taxes, perhaps because the taxation of business is administratively cheaper as well as more attractive to regimes of this type.

What are the implications of these results, and the work as a whole, for theory and policy? We consider these interesting and difficult matters only briefly and in a tentative fashion here. On the theoretical side, the results show that a model of a competitive political system can be used effectively in explaining taxation in the world as a whole and in democratic and non-democratic subsamples. But there clearly are aspects of tax structure that such a model cannot fully capture. In explaining the role of the personal income tax for example, models capable of encompassing both democratic and non-democratic regimes will have to come to terms with what we have interpreted as the role of consent or voluntary compliance, in addition to being able to model scale, base and administration cost effects.

Concerning tax policy, the ability to model the tax mix of a diverse sample of countries raises interesting questions about the possibilities for, and the appropriate nature of, tax reform. It is clear that international differences in the mix of taxes are substantial, and that these differences are to a considerable extent predictable. This in turn suggests that the onus should be on tax reformers to explain why reform proposals should not be well-tailored to a country's specific circumstances, taking into account the various effects that we have delineated, and to justify why any particular country's tax mix should be substantially altered in relation to its existing political equilibrium. In other words, our

empirical work can be seen as clearly adding to the body of opinion that holds that 'one shoe will not fit all sizes', as far as reform proposals are concerned.

Finally, we note that much remains to be done. We have not dealt with the choice between current and future taxation (i.e., the deficit). And allowing for the simultaneous determination of revenue structure and the expenditure side of the budget in cross-country panels of the sort we utilize still presents substantial challenges. A theoretical foundation for the estimating equations that explicitly encompasses both democratic and non-democratic regimes would be of much help in investigating these and related matters. The general approach to revenue systems we have pursued here and the stylized facts that we have uncovered should be useful in developing such a model.

Data Appendix

1. List of 100 Countries (269 Observations)

Data exist for all three periods unless otherwise noted: $A = 1975–80$, $B = 1981–85$, $C = 1986–92$.

Argentina B, C	Honduras A, B	Pakistan
Australia	Hungary B, C	Panama
Austria	Iceland	Papua New Guinea
Bahamas	India	Paraguay
Bahrain	Iran	Philippines
Bangladesh	Ireland	Poland B, C
Barbados	Israel	Portugal
Belgium	Italy	Rwanda A, C
Benin A	Ivory Coast	Senegal A, B
Bolivia B, C	Jamaica A, B	Sierra Leone
Botswana	Japan	Singapore
Burkina Faso A, B	Jordan	Solomon Islands B, C
Burundi	Kenya	South Africa C
Cameroon	Korea	Spain
Canada	Kuwait B, C	Sri Lanka
Central Afr. Rep. B	Lesotho	Sudan A, B
Chad	Liberia A, B	Swaziland
Chile	Luxembourg	Sweden
Colombia	Madagascar	Switzerland A, B
Congo A, B	Malawi	Syria
Denmark	Malaysia	Tanzania A, B
Djibouti	Mauritania	Thailand

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(*Continued*).

Dominican Republic	Mauritius	Togo
Ecuador	Mexico	Tunisia
Egypt	Morocco	Turkey
Ethiopia A, B	Myanmar	United Kingdom
Fiji	Nepal A, B	United States
Finland	Netherlands	Uganda A, C
France	New Zealand	Venezuela
Gabon A	Niger A	West Germany
Gambia	Nigeria	Zaire
Ghana	Norway	Zambia
Greece	Oman	Zimbabwe
Guinea C		

2. Data Sources (See Table 1 for definitions of variables and references for full citations.)

IMF Tax Revenue Data (Woldemariam, 1995): *NONTAX, CORPORATE, INDIVID, SOC SEC & PAYROLL, GOODS & SERVICES, TRADE, PROPERTY, TOTAL REVENUE*
Penn World Tables: *GDP PER WORKER, GDP COEF VAR*
World Bank "World Tables" CD9: *TRADE, LF: % FEMALE, URBAN, DENSITY, SECOND ENROLL*
R.J. Barro and Jong-Wha Lee, "Data Set for a Panel of 138 Countries," 1994: *EDUC ATTAIN*
United Nations Energy Statistics Yearbook: CRUDE PETROL
Gastil (various years): *SOCIALIST, NO RIGHTS & LIBS*
H. Bienen and N. Van de Walle, *Of Time and Power: COUPS*
AL. Griffiths and K. Nemberg (eds.) *Handbook of Federal Countries* : *FEDERAL*

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Notes

1. For recent surveys of this literature, see Winer and Hettich (2003) and Gould and Baker (2002).
2. These periods are the ones used by the International Monetary Fund in its summary data on tax composition, which are analyzed in our study. See Shome (1995) and Woldemariam (1995).
3. See, for example, Greenaway (1980), Riezman and Slemrod (1987), Grilli (1989), Poterba and Rotemberg (1990), Edwards and Tabellini (1991), Cukierman, Edwards and Tabellini (1992), Easterly and Rebelo (1993), Mulligan, Gil and Sala-i-Martin (2004) and Slemrod (2004), among others.
4. Martin and Lewis (1965), Pryor (1968), Habibi (1994), Lindert (1994), and Mulligan, Gil and Sala-i-Martin (2004) have studied the relationship between expenditure structure and the nature of political regime.
5. To the best of our knowledge, no one has yet attempted the difficult task of constructing a simultaneous empirical model of all three of the major elements of the tax skeleton. For an attempt to model empirically two basic elements (a tax rate and a special provision for the base to which this rate applies) in a simultaneous system, see Winer and Hettich in Winer (chapter 3, 2002).
6. Figure 1 is drawn on the assumption that each Laffer curve can be drawn independently of taxation levied on the other base, as well as on the assumption that political support is separable in political benefits from public output and opposition to taxation. A mathematical formulation of the model does not require these assumptions.
7. Note that individual marginal political benefit functions do not count in the determination of the equilibrium size of government; only their sum matters because of the nature of the public good. The first order conditions are derived formally in Hettich and Winer (1999).
8. In an interesting extension, Dudley and Montmarquette (1987) argue that at intermediate levels of development, urban self-employment is an important source of income but not a valuable source of personal income taxation due to bureaucratic tax corruption. In rich countries, most workers are employees and thus more easily taxed. They then show empirically that income taxation is a less important source of revenue in somewhat developed countries than in the poorest or more developed countries.
9. In a general setting, increased reliance on existing bases may be accompanied by taxation of previously untaxed bases for which administration is relatively costly (Becker and Mulligan, 2003, Hettich and Winer, 1988, 1999).
10. Fauvelle-Aymar (1999) suggests that coups reflect a weak government that has lost its legitimacy with the voters and finds that total revenue is lower in governments that experience more coups.
11. This effect implies that, all other things (including other tax policy instruments) held constant, tax rates should move together as total taxation expands or contracts. Grilli (1989), Poterba and Rotemberg (1990), and Edwards and Tabellini (1991) have analyzed time series data for several countries to test whether a country's inflation (reflecting the extraction of seigniorage) and non-inflation tax rates are positively correlated, with mixed results. See Edwards and Tabellini (1991) and Kenny and Toma (1997). Slemrod (2004) does not find a scale effect for the corporation income tax.
12. Further evidence supportive of the base effect is found in Winer and Hettich (1991).
13. The constraints are for each country at a point in time. However, we assume that the coefficients of each explanatory variable are the same over time and across countries.
14. One may note that modeling a (trade) tax rate is not conceptually superior to modeling a tax share. Modeling tax shares encompasses or allows for the existence of multiple tax instruments, including the choice of activities that define a tax base and the nature of special provisions that apply to each base.
15. See International Monetary Fund (1985) for more detail about the classification of taxes.
16. Albania, Czech Republic, Macedonia, Slovak Republic, Slovenia, and Tajikstan.
17. Missing trade statistics data remained the greatest problem. Gaps in the other (non-trade) independent variables would have reduced the sample to 303.
18. These data were supplemented with data from other sources. Where reasonable, data from two time periods were interpolated or extrapolated to obtain data for a third period.
19. For further discussion of the nature of regimes represented by similar categories of the Gastil index, see Islam and Winer (2004).
20. We thank Randy Holcombe for suggesting this auxiliary test.

21. One should note that the effect of changes in the size of tax bases shown in the Tables and discussed here and below is not a 'mechanical' one, due to the collection of more or less revenue at unchanged rates (and with all special provisions and other tax instruments held constant) as bases expand or contract In the model we explore, observed effects are always behavioral, reflecting political reactions to changes in the marginal costs of taxing in different ways.
22. This evidence of a substitution away from other tax sources in response to high oil revenues is precisely the kind of evidence that Becker and Mulligan (2003, pp. 323–326) were seeking to confirm their model of tax determination and government size.
23. Of course, the size of the trade sector is in part determined by the level of taxes. Since high trade taxes discourage trade, the endogeneity imparts a negative bias to the coefficient.
24. This evidence supports prior research finding a negative relationship between trade taxation and GDP.
25. Although these variables capture similar effects, they are not highly correlated (the correlation coefficient is 0.22).
26. Note that Kenny (1991) found money demand to be unrelated to population density.
27. If there is some critical level of education needed for the use of income taxation, the coefficient on education should vary with the level of education. We tried a spline on SECOND ENROLL but found no evidence for a shift in its coefficient as the variable increased.
28. Some (e.g., Mulligan and Sala-i-Martin 2004) claim that another source of differences in administrative costs is a country's legal heritage. We find, in unreported regressions similar to those in Tables 3 and 4, that British Commonwealth countries (excluding the United Kingdom) and former British colonies obtain a larger share of their revenue from individual income taxes and smaller shares from social security and payroll taxes and from property taxes. These differences may be due to better public tax administration in countries with a British legal origin, which facilitates the utilization of taxes with relatively high collections costs (e.g., income taxes). On the other hand, the variable's significantly positive coefficients in the goods and services taxes and non-tax revenue regressions are inconsistent with this interpretation.
29. The two countries classified by Kornai as socialist but not falling into these Gastil groupings are Nicaragua (mixed capitalist economic system, nonmilitary nonparty or dominant party political system) and Zimbabwe (capitalist-statist or mixed capitalist economic system, dominant party political system).
30. But note that GDP COEFF VAR is not significant in the TRADE regression in Table 3.
31. The data, taken from Bienen and Van de Walle (1991) extend only through the first two years (1986-87) of our last period. Confining the analysis to the first two data periods does not, however, alter the results.
32. Or to put this another way, our results suggest that those searching for a link between coups and redistribution must consider methods of redistribution more indirect than formal income taxation.
33. It is puzzling why an increase in NO RIGHTS & LIBS is not associated with an increase in the **share** of revenue coming from trade taxes in Table 3, since compliance should be less of a problem for customs duties than for income taxes. Perhaps corruption in the collection of customs duties plays a role here?

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