Does Tax Evasion influence the composition of tax instruments? Examining the effect of tax evasion on tax structure

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Abstract

This paper develops and tests a revenue-maximizing tax structure model. This model represents one of the first attempts to evaluate and compare the responsiveness of various tax instruments to tax evasion within a tax revenue maximization framework. We use data from both the OECD and East African countries and estimation is via a seemingly unrelated regression model. The GDP share of agricultural income is used as an instrument to correct for the simultaneity between tax revenue shares and tax evasion. Our findings indicate that tax evasion increases the tax authority's reliance on consumption taxes vis-à-vis taxes on income, suggesting that diverse tax instruments respond differently to tax evasion, and as such the choice of a revenue-maximizing tax structure is influenced by the amount of revenue lost through tax evasion.

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I. Introduction

The question of how tax evasion affects the structure of taxes has not been closely examined in the public finance literature. While traditional economic models are generally able to explain the choice of a tax structure as an endogenous outcome of constrained maximizing behavior of political agents (maximizing behavior in which agents choose tax structure to minimize the political costs or the expected loss in votes associated with raising a budget of given size), they are less equipped to answer questions regarding the effect of tax evasion on the structure of taxes. Tax evasion alters the effective tax rates and as such affects the efficiency, equity, and revenue yield of any given tax instrument. This suggests that any meaningful analysis of the attributes of "a good tax system" and consequently the choice of a revenue-maximizing tax system should account for this reality.

Additionally, tax evasion has wide ranging implications especially regarding its effect on tax revenues, excess burden, and the numerous out-of-pocket costs that are typically associated with tax evasion. Government's responses to the revenue short-fall created by tax evasion, such as raising revenues from other sources, reducing the supply of public services, and/or borrowing, could also lead to excess burdens. Related to this is the indirect effect of tax evasion on economic institutions. For instance, when entrepreneurs or any other private individuals are faced with burdensome bureaucracy, extreme levels of corruption, and a deficient legal system, agents may respond by diverting their activities to the shadow or underground economy. This leads to lower tax revenues, additionally compromising the quality of the public administration as well as the quality and quantity of public goods and services. This string of occurrences further

reduces the motivation of businesses and entrepreneurs to operate in the aboveground sector of the economy.

Kesselman (1989) argues that workers might find it almost effortless to evade taxes by moving to sectors of the economy where tax evasion is relatively easier, say, due to cash receipts, no source withholding of tax, and/or no tax information reporting. On the other hand, firms may have an added incentive to fully comply with tax provisions especially if they obtain tax offsets or deductions for the wages and salaries paid.

The tax evasion question is therefore highly relevant to the design of any tax system. Because taxpayers are generally believed to have a greater ability to adjust to income taxes than indirect taxes (especially broad-based consumption taxes), tax policy design can be augmented by a formal analysis of the impact of tax evasion on tax structure. This paper explores the effect of tax evasion on tax structure by examining the responsiveness of tax revenues from different tax instruments to changes in the level of tax evasion using data from both the OECD and East African countries. A seemingly unrelated regression model is specified to exploit the cross-equation correlation inherent in tax share equations. Our estimation methodology is plagued by the potential simultaneity between tax revenue shares and tax evasion. We propose the GDP share of income from the agriculture sector as an instrument to correct for this simultaneity bias.

In the following sections, we first present a brief overview of significant previous research on tax evasion incidence, highlighting some of the gaps in the literature. We then develop our revenue-maximizing tax structure model. The third section provides an overview of the data used in this paper and contains our estimation results. The final section concludes.

II. Significant Previous Research

Hettich and Winer (1984) develop and test a model in which the composition of revenues and the structure of specific taxes arise endogenously as a result of constrained maximizing behavior by political agents. They assume that the political agents choose tax structure so as to minimize the political costs or the expected net loss in votes associated with raising a budget of given size. Their conclusions indicate that the tax structure that minimizes political cost will be determined by the characteristics of many different groups of tax payers, and in particular by the sensitivity of their political opposition to changes in particular aspects of the tax system. Further, their empirical application emphasizes differences in political constraints across jurisdictions, reflecting their belief that the choice of policy instruments results from structural adjustments in response to varying constraints.

Hettich and Winer (1988) further develop this approach by deriving the essential elements of tax systems as an outcome of rational behavior in a model where government maximizes expected support. The upshot of this analysis is that the politically optimal tax structure requires a choice of tax rates that equalizes marginal political costs per dollar of additional revenue across all tax payers. Hettich and Winer (1988) argue that this tax structure will finance a total expenditure such that the marginal political benefit of another dollar of expenditure is equal to the common marginal political cost per dollar of additional revenue.

Gordon and Nielsen (1997) examine the relative vulnerability of consumption and income taxes to tax evasion by measuring the relative amounts of evasion under the two taxes in Denmark using aggregate Danish tax and accounting data from 1992. They argue

that, though a value-added and a cash-flow income tax have similar behavioral and distributional consequences in the absence of tax evasion, the available means of tax evasion under each tax can be very different. Based on their theoretical model and evasion rates computed from 1992 aggregate Danish tax and accounting data, they find that the forecast evasion costs could be reduced by increasing the VAT rate relative to the income tax rate. They conclude that in the presence of tax evasion a country could still make use of both taxes in order to minimize the efficiency costs of evasion activity, relying relatively more on whichever tax is harder to evade, which in this case, is the consumption tax.

Nielsen, Schou, and Sobygaard (2002) also utilize a national income accounts identity for Denmark to show that income is more vulnerable to tax evasion than consumption. They argue that there is an exact relationship between the tax bases for labor income tax and a consumption tax even where both income and consumption taxes are subject to tax avoidance and evasion. Their calculations for the period 1995-1997 reveal that an amount of income in the order of 20 to 40 billion Danish kroner (between 1.8 and 3.6 percent of GDP) could not be accounted for. This is attributed to two different kinds of phenomena: first, a difference between the errors and omissions in the data on each side of the general equation, and second, a difference in tax evasion for each tax base.

In summary, several authors have made arguments in favor of (broad-based) commodity taxation vis-à-vis income taxation. National income accounts analyses have also revealed higher evasion rates for taxes on income relative to taxes on consumption. The tax structure literature on the other hand argues that the composition of revenues and

the structure of specific taxes arise endogenously as a result of constrained maximizing behavior by political agents. The lack of substantial empirical evidence on the responsiveness of different tax instruments to tax evasion provides the motivation for this paper. Here, we consider both theoretically and empirically whether tax evasion should influence the choice or composition of the tax mix.

III. Theoretical framework of tax structure

The theoretical framework in this paper is drawn from Sennoga (2006)and is based on the premise that taxes have to be collected at some cost (administrative costs) to the tax authority and/or the government. We assume that the objective of the tax authority is to collect as much tax revenues as possible[1] while minimizing the costs of collecting these taxes by opting for tax instruments that are relatively harder to evade. It is important to note that other objectives of the tax authority are also possible, but as long as revenues are part of the governments' objective function, our basic framework still holds. In other words, the government's objective is to choose a vector of tax instruments $\underline{\theta}$ so as to collect as much tax revenues as possible, while minimizing the costs of doing so. This choice problem can be represented as a standard revenue maximization problem:

$$[1] \qquad \underset{\theta}{Max}\{[(T(X,C,\theta)-Z(X,C,\theta))+Z(X,C,\theta)]-A(\theta)\},$$

[1] Slemrod and Yitzhaki (1996) consider a framework composed of a social planner and two sets of agents- the tax administrators and the taxpayers. The social planner encompasses the legislative branch, the spending branch, and the judicial system. The tax administrator acts as an agent on behalf of the social planner while the taxpayers pay taxes. In this framework, the only objective of the social planner is to raise a given amount of revenue while keeping the social cost of raising tax revenue (excess burdens, administrative costs, and compliance costs) at a minimum level. Provision of public goods and any other services together with other motives of the social planner such as the maximization of a social welfare function and rent seeking are not considered.

where T is the total (potential) tax revenue and is a function of the tax base (X), characteristics of the economy that determine tax capacity (C), and a vector of tax instruments ($\theta = \{\theta_1, \theta_2, ..., \theta_n\}$).[2] Note that the potential change in tax revenue is T, but, due to taxpayers' responses (say, through tax evasion), the government only collects Z amount of revenue. The amount of revenue Z is also a function of variables X, C, and θ as defined above. Thus, in our framework, Z dollars of tax are collected and $T - Z$ "leaks" out of the tax net. The direct cost incurred by the government (per taxpayer) in implementing the vector of tax instruments θ is denoted by $A(\theta)$. In summary, the goal of the government is to adopt or choose a vector of tax instruments θ so as to collect a particular amount of net tax revenue $R(X, C, \theta) = T(X, C, \theta) - A(\theta)$, given some characteristics of the economy such as the stage of development, sectoral composition of income produced, the level of corruption, the size of the foreign trade sector, the extent of tax evasion, and the direct cost of adopting the vector of tax instruments. Assuming continuous, determinate functions and the presence of non-zero derivatives, the first order conditions with respect to θ_i, for $i = 1, \ldots, n$ are as follows (after some re-arranging):

$$[2] \qquad \frac{\partial Z}{\partial \theta_i} = A'(\theta) - \left\{\frac{\partial (T - Z)}{\partial \theta_i}\right\} \equiv A'(\theta) - \varphi_i,$$

where $A'(\theta) = \frac{\partial A(\theta)}{\partial \theta_i}$ and $\varphi_i = \left\{\frac{\partial (T - Z)}{\partial \theta_i}\right\}$ or the amount that "leaks" out of the tax system.

[2] To simplify the computation, we assume that tax rates are captured in the vector of tax instruments.

Equation [2] indicates that a revenue-maximizing tax structure requires the government to choose tax instruments that equalize a dollar of additional revenue from increased reliance on a given tax instrument θ_i and the marginal direct costs, net of the tax revenue lost via evasion, across all tax instruments in use. This therefore suggests that the choice of a revenue-maximizing tax structure is closely related to the amount of tax revenue that escapes the tax net via tax evasion. Two observations can be made from equation [2]. First, the amount of tax revenue that "leaks" out of the system (φ_i) varies with the tax instrument used, suggesting that the amount of tax revenue that escapes the tax net differs across tax instruments. Second, the amount of tax revenue that "leaks" out of the system (φ_i) either varies inversely or exhibits no variation with the amount of tax dollars actually collected (Z_i).[3] Equation [2] also indicates potential simultaneity or reverse causality in the causal relationship between taxes collected (or tax rates) and the amount of tax revenues that leak out of the tax system through evasion. In particular, an increase in evasion φ_i would be expected to reduce the amount of taxes collected and subsequently affect the effective average tax rates, all else constant. Equation [2] shows that a change in the amount of taxes collected $\partial Z/\partial\theta_i$ also influences φ_i. This reverse causality problem is resolved empirically by using instrumental variables via a two stage least squares estimation procedure as described below.

To summarize, the theoretical framework reveals that tax evasion not only has a negative and/or zero effect on the amount of tax revenues actually collected from a given

[3] The latter is true when the potential amount of revenue T_i equals the amount of tax revenues actually collected Z_i or $(T_i = Z_i)$.

tax instrument, but also affects diverse tax instruments differently. This paper therefore tries to study the effect of tax evasion on the structure of taxes by identifying the sensitivity of tax revenues from different tax instruments to tax evasion.

IV. Empirical Framework

Estimation Issues

The goal of the empirical work is to measure the effects of tax evasion on tax structure. Two issues complicate the estimation strategy: first, because tax shares must sum to one, we need to account for this 'adding up' restriction. Second, there is potential for reverse causality between the dependent variable (GDP tax share) and the measure of tax evasion. This issue arises in the tax evasion literature, which argues that under certain conditions, higher tax rates (and consequently higher tax revenues) increase the incentive to evade.[4] Further, the tax authority may be forced to hike tax rates in response to increased tax evasion levels. To correct for this endogeneity, we use instrumental variables to estimate the effect of tax evasion on the share of tax revenues in GDP. Durbin-Wu-Hausman tests are used to investigate the presence or absence of endogeneity in the relationship between tax evasion and GDP tax shares.

Another estimation concern is the timing of the tax evasion/tax structure interaction. It is reasonable to expect that the present period tax structure is determined by the amount of revenue lost via evasion in the previous period, suggesting that there could be a lag between noticing a change in tax evasion and a change in tax structure. One way of modeling the evasion/tax structure interaction is to use lagged values of our measure of tax evasion. However, because tax evasion data for OECD and East African

[4] See Allingham and Sandmo (1972), Yitzhaki (1974), and Sandmo (2004).

countries are only available for a period of six and eleven years, respectively, using lagged values in our estimation will substantially reduce the degrees of freedom.

The dynamic multiple indicators-multiple causes (DYMIMIC) method used to compute the GDP share of the shadow economy, which is our proxy for tax evasion, for the East African countries accounts for the effects that previous period causes have on present period indicators of the GDP share of the shadow economy (F. Schneider, 2005). The DYMIMIC approach therefore controls for lags in the tax evasion/tax structure response for the East African countries.

Additionally, the GDP share of the shadow economy data are computed for a range of two years rather than just for a single year. For instance, OECD shadow economy data are available for the years 1989/90, 1991/92, 1994/95, 1997/98, 1999/2000, and 2001/2002, while the East African shadow economy data are available for the period 1991/1992 through 2001/2002 (see Appendix A, Tables 5 and 6). Our tax revenue data corresponds to the most recent year in this two-year range, for example, given shadow economy data for the period 1989/90, the matching tax revenue data is for the year 1990. This is done to control for the fact that the structure of taxes responds to tax evasion with a lag.

The SUR Model

In order to account for the fact that tax shares must sum to one, the empirical model can be considered in the seemingly unrelated regression (SUR) framework. This model can be written as follows;

[8] $$s^{j}_{it} = x_{it}'\beta_{j} + \varepsilon^{j}_{it}$$

where s_{it}^{j} is the tax share of tax j in country i at time t, x_{it}^{j} is an $(k \times 1)$ vector of observations on *k* explanatory variables. The tax share superscript, j, runs from 1 through G, meaning that we consider G types of taxes. Note that the parameters, β_j, differ for each tax share, although they are assumed constant across countries and over time. Denote the total number of observations by N, which is equal to the number of countries multiplied by the number of annual observations. The $G \times 1$ vector of errors, ε_{it}, is assumed to be a continuously distributed with $E(\varepsilon_{it} \mid w_{it}) = 0$ and $E(\varepsilon_{it}\varepsilon_{it}' \mid w_{it}) = \Sigma_{G\times G} \otimes I_N$. Here, the $(\ell \times 1)$ vector w_{it} represents instruments, which are assumed to be predetermined. In order to achieve identification, $\ell \geq k$.

Our estimation strategy is essentially a three step procedure. In the first step, we regress X on Z to obtain the predicted value of X or $\hat{X}$. In step two, we regress *y* on $\hat{X}$ to obtain the predicted residuals $\hat{\varepsilon}$, which are then used to form the estimator $\hat{\Sigma}$ and finally $\hat{\Omega}$, where $\hat{\Sigma}_{G\times G} = \hat{\varepsilon}\hat{\varepsilon}'$, and $\hat{\Omega}_{NG\times NG} = \hat{\Sigma}_{G\times G} \otimes I_{N\times N}$. The feasible generalized method of moments (FGMM) estimator is ultimately computed as:

[9] $$\hat{\beta}_{FGMM} = \left[X'Z\left(Z'\hat{\Omega}Z\right)^{-1}Z'X \right]^{-1} * \left[X'Z\left(Z'\hat{\Omega}Z\right)^{-1}Z'y \right].$$

Finally, the third step yields a consistent estimator of the covariance matrix of the disturbances;

[10] $$\text{var}\left(\hat{\beta}_{FGMM}\right) = \left[X'Z\left(Z'\hat{\Omega}Z\right)^{-1}Z'X \right]^{-1}.$$

In summary, the first two steps yield the two stage least squares estimates and an estimator $\hat{\Sigma}$ while the last step involves applying the SUR estimator to obtain a

consistent estimator of the covariance matrix of disturbances found in the previous step. The FGMM estimators are consistent and asymptotically efficient.[5] Estimation of share equations necessitates imposing cross-equation restrictions. Imposing cross-equation restrictions, we have:

$$\sum y_j = 1 \Rightarrow \sum \left[X\beta_j + \mu_j \right] = 1,$$

$$\sin ce \sum \mu_j = 0, \Rightarrow \sum_{j=1}^{G} \beta_{jk} = 1, therefore \beta_{jk} = 1 - \beta_1 - \cdots - \beta_{jk-1}.$$

In view of the fact that we are estimating share equations, we have to impose adding up constraints. The adding up constraint requires that $\sum y_j = 1$, which is satisfied provided that $\sum \beta_{jk} = 1$ and $\sum \beta_j = 0$. This is in effect equivalent to estimating only *NG-1* equations. The estimation results are presented and discussed in the next section. We now turn to a description of the data and explanatory variables.

Data

Tax revenue data used in this paper are obtained from *OECD Revenue Statistics* and the *Government Financial Statistics* CD-ROMs. Shadow economy data are obtained from Schneider and Enste (2000), Schneider (2002), and Schneider (2005). Other data come from the *World Development Indicators* CD-ROM. Data on the East African countries are obtained from various issues of the International Monetary Fund (IMF) country reports and the United Nations National Accounts Publication (UN, 2005).

We consider two samples, from OECD countries and from East African countries. Tables 1 and 2 present the descriptive statistics for the East African and OECD countries,

[5]Davidson and Mackinnon (2004) present an excellent discussion of FGMM estimators.

respectively. Simple correlations for the East African data are shown in Table 3, while Table 4 shows the simple correlations for the OECD data. Our East African sample includes a panel of three (3) countries; Uganda, Kenya, and Tanzania (see Table 5) over the period 1991/1992 through 2001/2002. Thus, each country has a total of 11 observations where available. The OECD sample comprises a panel of twenty one (21) countries (see Table 6). In this sample, shadow economy data are available for the years 1989/90, 1991/92, 1994/95, 1997/98, 1999/2000, and 2001/2002, and, as such, each country has a total of six observations where available.

The OECD and East African samples are considered separately because different methodologies are used to quantify the share of the shadow economy in GDP, which is our proxy for tax evasion.[6] The OECD shadow economy data are primarily from the Currency Demand, estimates while the East African countries' shadow economy data are primarily from the DYMIMIC method; see Schneider and Enste (2002) for details on these two measures of the shadow economy. Lumping together data compiled by these different methodologies might introduce some bias in our results. The other, though more subtle, concern is that these two samples comprise countries with very different characteristics. For instance, different levels of economic growth and development, different tax systems, and different social norms are all factors that may tend to have quite varied effects on any causal relationship between tax evasion and tax revenues if this diverse set of countries is analyzed together. Stated differently, there is a possibility of introducing cross-region and cross-methodology variation (Friedman, Kaufmann, & Zoido-Lobaton, 2000).

[6] Section IV.4 discusses our choice of the share of the shadow economy in GDP as a proxy for tax evasion.

Explanatory Variables

As mentioned earlier, our key independent variable is tax evasion and is measured here as the share of the size of the shadow economy in GDP. Below we discuss the rationale for using the share of the shadow economy as proxy for tax evasion. Bahl (1971) argues that tax capacity is a function of three major factors, namely the stage of development, the sectoral composition of the income produced, and the size of the foreign trade sector. These factors are measured here, respectively, by GDP per capita, mining share of income, and the export share. Other regressors considered to have an impact on tax revenue shares and/or tax ratios include tax evasion and corruption in government. Consider each of these factors in turn.

***Tax evasion*.** As mentioned earlier, we use the share of the shadow economy in GDP to proxy for tax evasion. Though the share of the shadow economy in GDP measures that portion of a country's parallel economy, we find it a suitable proxy for tax evasion due to the following reasons. First, to the best of our knowledge, no estimates of the amount of tax revenues evaded are readily available for our set of countries. Tax evasion estimates for the United States that are publicly available from the Internal Revenue Service (IRS) comprise both the amount of taxes evaded and the estimated penalties, including any accrued interest. As such, an accurate derivation of the amount of taxes evaded from the data provided by the IRS is practically impossible, even for the United States. Second, the share of the shadow economy in GDP used here quantifies economic activity that lies outside the tax net, and consequently escapes taxation. Thus, the share of the shadow economy in GDP measures an economy parallel to the aboveground economy which engages in both legal and illegal production on which no

taxes are imposed. Though it is true that this measure fails to capture the amount of taxes evaded in the aboveground economy, it is used as an indicator of the amount of taxes evaded in this paper due to lack of a better measure of tax evasion.

Further, we use measures of tax evasion computed by Schneider (2002) because the effect of tax evasion on tax structure is more accurately depicted overtime than at a given point in time. In other words, a panel data analysis of the effect of tax evasion on tax structure yields more consistent and efficient estimates compared to a cross-section analysis. To the best of our knowledge, only Schneider (2002) computes measures of the share of the shadow economy in GDP for both OECD and East African countries over time.

The tax evasion literature indicates that tax evasion and/or tax avoidance have a negative impact on tax revenues. We argue here that some taxes are much more prone to tax evasion than others, stated differently, there seems to be a differential response of tax revenues to tax evasion. This is especially true in the case of taxes on wage income versus taxes on business or capital income. The former is subject to third party reporting and, in most cases, to source withholding, which makes this particular category of taxes less susceptible to tax evasion. The latter depends on the honesty of the tax payer as well as the vigilance of the tax authorities, and is thus much more prone to tax evasion.

Other taxes like the value-added tax (VAT) depend on a detailed and sometimes complex invoice system. This system of self-policing and self-assessment is advantageous in more ways than one. First, it tracks down almost all traders and/or producers, enlarging the tax base in the process. Second, traders and/or producers are able to claim refunds or tax off-sets on taxes paid on inputs, a feature that lowers or even

eliminates tax cascading, thereby lowering the tax burden and as such enhancing the efficiency of this tax. Both of these features suggest that the VAT is not only less prone to tax evasion but could also be associated with lower tax burdens and consequently higher efficiency gains. The estimates of the size of the shadow economy (in percent of GDP) for the OECD and East African samples used in this paper are calculated using the Currency Demand and Model (DYMIMIC) approaches.

Size of the foreign trade sector. It is hypothesized that taxable capacity is directly related to the size of the foreign trade sector. Bahl (1971) argues that a greater level of exports relative to income suggests both a greater degree of monetization and an industrial structure that is administratively amenable to taxation. Further, the ensuing larger imports can be taxed with minimal administrative difficulty. Favorable world market conditions for certain primary exports can create a relatively sizable taxable surplus in export earnings and subsequently a greater taxable capacity. Three alternative measures can be used to capture the impact of the foreign trade sector on taxable capacity: (1) the import ratio (value of imports as a percentage of GDP); (2) the export ratio (value of exports as a percentage of GDP); and the ratio of imports plus exports to GDP, or the openness ratio. Use of the openness ratio to measure the influence of the foreign trade sector on taxable capacity is justified based on the assumption that a suitable measure of the foreign trade sector should reflect the total available trade tax base. The export ratio will be more appropriate if foreign trade is meant to reflect the size of the tax base that is amenable to corporate income or export taxation. Additionally, if it is more feasible, both administratively and politically, to tax large exporters relative to domestic producers, it is realistic to expect that the tax ratio will be higher where the

export ratio is higher, everything else constant. The simple correlations presented in Tables 3 (East African countries) and 4 (OECD countries) reveal that there is no significant difference between the import ratio and the openness ratio, as each appears to be related to the structure of the economy in approximately the same way. We use the export ratio as an indicator of inter-country variations in taxable capacity that result from variations in the size of the foreign trade sector since the export ratio is more closely associated with the tax ratio than is either the import or openness ratio.[7]

Stage of development. A prosperous society consumes more goods on average and engenders the production and provision of not only more but also a greater variety of goods and services. The latter also ensures that more workers are hired, a feature that points to increasing purchasing power and consequently increased consumption. All these factors solely or jointly increase the tax base, which increases the amount of tax revenues collected and thus increases the tax revenue shares. In addition, richer societies are characterized by higher demands on the public authorities to provide not only more but also higher quality public goods and services, which can only be possible via increased taxation. Also in some OECD countries like Sweden and Norway, higher taxes have to be collected to enable the government to provide the huge contingent of public services like welfare programs and unemployment insurance. All else constant, these factors seem to suggest that the amount of tax revenues collected and hence tax ratios will increase as the stage of development in a given society improves. Friedman et al. (2000) argue that countries with relatively higher per capita incomes have better-run administrations and

[7] We also used the openness ratio as an indicator of the size of the foreign trade sector. The empirical results were not affected in any significant way.

also higher tax rates. Higher tax rates, all else constant, are likely to translate into higher tax revenues.

We use GDP per capita as a measure of the stage of development in both the OECD and East African countries. Bahl (1971) argues that the percent of GDP originating from the agricultural sector is a better measure of the stage of development, especially for developing countries. This choice is driven largely by two shortcomings of the per capita income measure: per capita income differences may mask the important structural difference or the relative size of the non-monetized sector that affects taxable capacity, and the accuracy of inter-country comparisons is subject to error due to the conversion of local currencies into U.S. dollars (Bahl, 1971). It follows therefore that a higher level of activity in the agricultural sector will be associated with a sizeable subsistence sector, less commercialization and industrialization, and consequently, a lower per capita income. Further, to the extent that incomes of agricultural wage earners may be relatively low and that the agricultural sector is largely composed of many small farmers who are not as administratively amenable to taxation as enterprises in other sectors of the economy, value added in the agricultural sector will embody a lower taxable surplus. However, our options are rather limited in this case since we use the share of income originating for the agricultural sector as an instrument for the GDP share of the shadow economy. Using the GDP share of agriculture both as a regressor and instrumental variable will lead to perfect multicollinearity. As such, we use GDP per capita as a measure of the stage of development for both the East African and OCED countries.

Sectoral composition of the income produced. Bahl (1971) and Alm, Martinez-Vazquez, and Schneider (2004) point out that the sectoral distribution of income exerts an effect on taxable capacity apart from that of the overall level of economic development and the size of the foreign trade sector. They argue that the mining sector generally produces a larger surplus relative to any other sector, and consequently, it is a positive determinant of taxable capacity. The heavy fixed investment associated with mining industries dictates that operations will be confined to a few large firms, subsequently making it administratively easier to levy income or export taxes. Further, to the extent that mining companies are often largely foreign owned, effective resistance to higher tax levels will be relatively less, suggesting that governments will be willing to levy higher levels of taxation since it is politically feasible to do so. We use the mining share of total income as an indicator of the sectoral composition of income produced in OECD and East African countries.

Corruption. Corruption is measured here using the International Country Risk Guide (ICRG) Index, ranging from 1-10, with a higher value indicating a lower level of corruption. The trustworthiness and honesty of the both taxpayers and tax authorities have a significant impact on the amount of tax revenues collected. In some societies, the social norms have come to embrace dishonesty and other unscrupulous ways on several horizons of daily life, horizons that extend beyond tax collection issues. As a result, in such societies individuals will invent and engage in various schemes to "beat" the system, a feature that has substantial adverse effects on the amounts of taxable incomes reported and collected. It is also true that in some societies, the central issue is not so much the embracing of unscrupulous ways by society that is a problem, but rather the failure of the

taxpayers to make a connection between the taxes paid and the (public) services provided. This argument suggests that efforts to minimize corruption, to educate the public about their civic responsibilities (including paying taxes), and to try to link the taxes paid and the services provided will go a long way in ensuring higher tax revenue shares.

V. Empirical Results

Tables 7-11 present the estimation results for the OECD and East African samples. Table 7 presents the first stage least squares results for both OECD and East African countries, while Tables 8 and 9 show the estimation results without accounting for the country fixed effects for the OECD and East African samples, respectively.[8] Tables 10 and 11 present the estimation results after the country fixed effects have been accounted for in the two sets of countries, respectively. OLS and GMM refer to Ordinary Least Squares and Generalized Method of Moments estimates, respectively.

Simultaneity between tax revenues and tax evasion

As mentioned earlier, an estimation concern here is the potential simultaneous determination of tax revenues and tax evasion. It is realistic to expect that higher tax rates (and consequently higher tax revenues) could increase the incentive to evade. Further, the tax authority may be forced to hike tax rates in response to increased tax evasion levels. This paper counters this reverse causality problem by using the share of income derived from agriculture as an instrument for tax evasion. The first stage least squares results in Table 7 reveal that an increase in the share of income derived from the agricultural sector

[8] We report both the no-fixed effects and fixed effects estimation results for comparison purposes.

by one percent leads to an increase in tax evasion by 0.75 percent and 0.69 percent for the OECD and East African countries, respectively. Both these estimates are statistically different from zero at the 1 percent level of significance.[9] Further, the regression-based Hausman test shows evidence of endogeneity of the share of the shadow economy in GDP at the 10 percent level of significance for both the OECD and East African countries. In particular, the t-statistics for the OECD and East African countries are -1.85 and -1.92, respectively. This implies that we reject the null hypothesis of no endogeniety at the 10 percent level of significance in both samples; consequently indicating that ordinary least squares (OLS) will not yield consistent estimates.[10]

OECD Countries

Table 8 shows that an increase in tax evasion by 1 percent reduces the GDP share of total taxes by 1.35 percent. This result is consistent with other studies. For instance, Alm et al. (2004) and Teera (2002) find an inverse relationship between the share of the shadow economy in GDP (our proxy for tax evasion) and the ratio of total tax revenues to GDP.

Several explanations could be advanced for the inverse relationship between tax evasion and the total tax ratio. One explanation is that tax evasion reduces the tax capacity, especially as some taxpayers elude the tax net, leading to a reduction in the total

[9] The identification restriction for instrumental variables requires that the instrumental variable be partially correlated with the variable for which it is instrumenting, once the other exogenous variables have been netted out. This is equivalent to testing the null hypothesis that the coefficient on the instrumental variable is statistically different from zero.

[10] The regression-based Hausman test examines the correlation between the structural and reduced form error terms (Wooldridge, 2001). Our measure of tax evasion will be exogenous if and only if these errors are uncorrelated. This test proceeds by estimating the reduced form equation to obtain the (reduced form) residuals and then estimating the structural equation, with these residuals as one of the regressors. Thus, our measure of tax evasion is exogenous if and only if the coefficient on the reduced form residuals is not statistically different from zero.

tax ratio, all else constant. Another explanation for this negative relationship is that tax evasion has a differential impact on tax ratios. For instance, it is reasonable to expect that tax evasion will lower the total tax share of income taxes in GDP (we call this the "negative effect" of tax evasion), but that taxes on consumption as well as the international-import and export taxes may not be negatively affected (what we refer to as the "positive effect" of tax evasion). Thus, the observed negative relationship could be due to the "negative effect" of tax evasion outweighing the "positive effect."

To analyze further the differential impact of tax evasion on GDP tax shares, we categorize taxes into four broad categories: taxes on income, taxes on consumption, property taxes, and "other" taxes. We also include international trade (export and import) taxes for comparison purposes. "Other" taxes represent all the other tax revenues not otherwise classified under income, consumption, property, and international trade taxes. As mentioned earlier, the estimation of share equations necessitates imposing adding up constraints. Given *NG*-equations, this requires estimating only *NG-1* equations. Our system of equations therefore includes GDP share equations for income, consumption, property, and international trade taxes. The GDP share of "other" taxes is our omitted equation.

Table 8 reveals that tax evasion has a negative effect on the GDP shares of both income and property taxes but no effect on the GDP shares of consumption and international trade (export and import) taxes. Specifically, a one percent increase in the share of the shadow economy in GDP (tax evasion) lowers the GDP share of income and property taxes by 1.32 percent and 0.24 percent, respectively. A similar one percent increase in the share of the shadow economy in GDP has no statistically significant effect

on the GDP share of consumption and international trade taxes.[11] Intuitively, tax evasion alters the return to factors of production in favor of those factors employed in the informal sector, a feature that distorts labor choices leading to diversion of factors of production, especially labor to the informal sector. The upshot of this would be a reduction of the share of taxes on income in GDP. Several studies have highlighted the vulnerability of social security contributions in particular and taxes on income in general especially in the presence of a sizeable informal sector. These studies note that income taxes and social security contributions are comparatively difficult to administer for people who are not formal sector employees.

However, even in cases where taxpayers are driven into the underground sector, they still consume goods produced in the aboveground or formal sector of the economy on which taxes are levied and collected. Thus, consumption taxes may not be affected by tax evasion or reliance on consumption taxes may generally increase. Since VAT and excise taxes form the bulk of consumption taxes in our sample, this finding is therefore consistent with other studies that have called for the increased use of indirect taxes such as the VAT, so as to draw that part of the shadow economy or untaxed sector into the tax net. This is in addition to the other benefits of the VAT, such as being a self-policing tax, a feature that makes it less prone to tax evasion. Bolnick and Haughton (1998) argue that the most compelling reason for the use of excise taxes is that they can potentially raise a great deal of revenue with little distorting effects on producers and consumers. However,

[11] The effects of tax evasion on individual GDP tax shares are consistent with the effect of tax evasion on the GDP share of total taxes. In particular, a one percent increase in tax evasion lowers the GDP share of total taxes by 1.35 percent while a similar one percent increase in tax evasion lowers the GDP tax shares of income and property taxes by 1.32 percent and 0.24 percent, respectively. Further, a one percent increase in tax evasion raises the GDP tax shares of consumption and international trade taxes by 0.21 percent and 0.01 percent, respectively. This suggests that a one percent increase in tax evasion will reduce the GDP share of other taxes by 0.01 percent. Since the omitted category "other taxes" consists of license fees and other small levies, it is logical to expect such a small effect of tax evasion on the GDP share of "other" taxes.

they also note that this is only possible in cases where tax reforms ease the excise burden on the poor while increasing the burden on the well-to-do, as would be the case with ad-valorem as opposed to specific excises. Significant equity gains can be achieved in this particular case. Though these studies are motivated by revenue adequacy, efficiency, and equity paradigms, their general conclusions are consistent with our findings. Further support for broad based consumption taxes comes from Gordon and Nielsen (1997) who argue that an alternative approach to taxing labor income is to tax the income when it is spent rather than when it is earned as would be the case with a value-added tax. They argue that a tax authority's inability to monitor transfer pricing used by multinationals is of no consequence for a VAT since the only price that matters for such a tax is the price paid by the final consumer. Similarly, government's inability to monitor foreign source incomes does not matter for a VAT as long as the government can monitor consumption expenditures.

Since in principle import and export taxes are collected at relatively fewer locations, particularly border crossings and specific entry points like ports and airports, it would appear that it is easier to enforce these taxes and thus they ought to be less prone to tax evasion. However, it is important to note that detection of all imports at the border is an onerous and costly task, which often times compels governments to abandon any attempts at monitoring cross-border shopping by individuals. To the extent that property taxes are imposed on largely immobile bases, taxes on property are difficult to evade and as such it is reasonable to expect that they will not be negatively affected by tax evasion. A plausible explanation for the observed negative relationship between tax evasion and property taxes is that taxpayers who are driven into the underground or informal sector do

not acquire or accumulate property so as to reduce the chances of being detected. This reduces the property tax base, and, all else constant, leads to a reduction in the property tax revenues collected.

The other regressors in our model have the expected signs. For instance, an increase in the GDP share of mining incomes, export ratio, and control of corruption lead to an increase in the tax ratio as well as the GDP shares of income, consumption, property, and international trade taxes. An increase in GDP per capita on the other hand lowers the tax ratio as well as the GDP shares of the taxes studied here. Our trend variable indicates that overall the tax ratio and the GDP shares of the taxes considered in this paper have been declining.

East African Countries

A similar analysis is done on the three East African countries. Due to the unavailability of comprehensive tax revenue data, we only consider income taxes (paid by both individuals and corporations), consumption (VAT, sales, and excise), international trade (import and export) taxes, and "other" taxes. We impose the adding up constraint by omitting the equation for the GDP share of "other" taxes from our system of equations. Our system of equations therefore comprises equations for the GDP shares of income, consumption and international trade taxes. The estimation results for the sample of East African countries are presented in Table 9.

The findings in Table 9 largely mimic those for the OECD countries shown in Table 8. In particular, Table 9 reveals that a one percent increase in tax evasion lowers the total tax ratio and the income tax share of GDP by 0.15 percent and 0.09 percent,

respectively. As in Table 8, a similar one percent increase in tax evasion has no statistically significant effect on the GDP shares of consumption and international trade taxes.[12] These findings emphasize that, even when individuals evade their income taxes, they still purchase goods and services produced and/or traded in the aboveground sector on which taxes are imposed. To the extent that this is largely the case, we would expect tax evasion to have little effect on the share of consumption taxes in GDP. Further, as argued earlier, it is easier to enforce export and import taxes since in principle such taxes are administratively amenable to taxation. One concern with international trade taxes lies with smuggling and with corruption by the tax administrators. Smuggling severely erodes the tax base as imported and/or exported commodities are left out of the tax net.

Corruption of the tax administrators is also detrimental in more ways than one: it erodes the tax base, especially due to the underdeclaration of either the taxable quantities or values, and resources are expended to bribe the administrators leading to inefficient production. This is especially the case since resources are not channeled to their most valued sectors. Table 9 reveals no statistically significant relationship between the control of corruption and the GDP share of international trade taxes for East African countries as opposed to the OECD countries where control of corruption leads to an increase in the share of international trade taxes.

[12] Similar to the OECD countries, the effects of tax evasion on individual GDP tax shares are consistent with the effects of tax evasion on the GDP share of total taxes for the East African countries. Specifically, a one percent increase in tax evasion lowers the GDP share of total taxes by 0.15 percent while a similar one percent increase in tax evasion lowers the GDP tax shares of income, consumption and international trade taxes by 0.094 percent, 0.034 percent, and 0.004 percent, respectively. This suggests that a one percent increase in tax evasion will reduce the GDP share of other taxes by 0.018 percent. Since the omitted category "other" taxes largely comprises license fees and other small fees and levies, it is logical to expect that the effect of tax evasion on the GDP share of other taxes will be of such magnitude.

Country fixed effects

The fixed-effects model is also utilized, and is deemed appropriate for our analysis for two reasons. First, much of the variation in GDP tax shares is between countries rather than within countries overtime. Although it would be difficult to specify all the institutional, economic, and demographic characteristics that determine the differences in GDP tax shares across countries, we can capture permanent differences between countries with country fixed-effects.[13] Similarly, there are many factors that may affect GDP tax shares over time, and these differences are captured using the time trend variable. Second, the fixed-effects model is a within-group estimator that uses a weighted average of the within-country and the across-country variation to compute the parameter estimates.[14] Therefore, our estimate of the effects of tax evasion measures how GDP tax shares change within the different countries in response to tax evasion.[15] The fixed effects results are presented in Tables 10 and 11 for the OECD and East African samples, respectively.

OECD countries (country fixed effects)

Table 10 shows that a one percent increase in tax evasion lowers the tax ratio by 1.69 percent. Further, a one percent increase in tax evasion reduces the GDP share of income and property taxes by 1.59 percent and 0.24 percent, respectively. As in Table 8, an increase in tax evasion does not have a statistically significant effect on the GDP share

[13] Country fixed-effects capture any permanent differences across countries (for instance, tax incentives to attract foreign direct investment, elimination or reduction of customs and import tariffs due to customs unions and/or free trade areas) otherwise not captured by other explanatory variables. Similarly, the time-effects capture any variation in GDP tax shares over time that affects the whole country, such as changes in the tax code or changes in the tax administration.

[14] It is important to note that OLS also accommodates country fixed-effects but does not decompose the fixed effects into within and between-group estimators.

[15] Hsiao (1986) presents an excellent discussion of panel data estimation procedures.

of consumption and international trade taxes. In summary, even after controlling for country specific time-invariant unobservable factors, our results are still consistent with our earlier observation that tax evasion reduces the tax ratio, GDP share of income, and property taxes, but does not have a statistically significant effect on the GDP share of consumption and international trade taxes.

East African countries (country fixed effects)

Table 11 shows that, after controlling for country specific time-invariant unobservable factors, tax evasion has no statistically significant effect on the tax ratio or on the GDP shares of income, consumption, and international trade taxes. However, these disparate results could be due to the fact that our East African sample only has 33 observations, and, as such, controlling for country fixed effects reduces the degrees of freedom.[16] This ultimately reduces the statistical significance of the relationship between tax evasion and the GDP tax shares, even when such a relationship is still economically significant. Further, it is also plausible that the observed relationship between the GDP tax shares and tax evasion in East African countries is due to country fixed effects, so that controlling for these fixed effects washes out any such relationship. Additional analysis to resolve this issue requires expanding the time dimension over which the responsiveness of GDP tax shares to tax evasion is examined. However, this is hampered by the fact that our tax evasion data for East African countries is only available for a period of ten years.

To summarize, our findings reveal that tax evasion lowers the total tax ratio plus the GDP shares of income and property taxes for both the OECD and East African

[16] Since our East African sample has only 33 observations, including six regressors, a constant and two country fixed effects as right hand side variables reduces the actual number of observations used to estimate the causal relationship between the left hand side variable and the covariates to only 24.

countries. The results further indicate that there exists no statistically significant relationship between tax evasion and the GDP shares of consumption and international trade taxes. The latter results are consistent across both samples as well. These results show that different tax instruments respond differently to tax evasion, and therefore tax evasion does affect the evolution of the structure or composition of the tax system.

It is nonetheless noteworthy to point out that advent of e-commerce in general, and internet shopping in particular, may affect the interpretation of our findings especially for the OECD countries. In some OECD countries like the United States, a number of online purchases may go untaxed, a fact that could lower tax revenues from consumption taxes. This consequently suggests that we could observe reduced reliance on consumption taxes by the government when designing a revenue-maximizing tax structure. However, e-commerce is a more recent invention and it is therefore reasonable to assume that our findings still mirror the effect of tax evasion on tax structure in the OECD countries especially since our OECD data are drawn from the years 1989/1990-2001/2002 (see Table 6). Our findings from the East African countries are also not affected by the potential effect of e-commerce on consumption tax revenues for two reasons: first, our East African data are drawn from the years 1991/1992-2001/2002 (see Table 5), a period which was characterized by negligible , if any, internet shopping in this set of countries. Second, computer literacy and usage is still very low in the East African countries, suggesting that very limited shopping takes place over the internet in these countries.

VI. Conclusion

This paper develops and tests a tax structure model within a government revenue-maximization framework. This model attempts to capture the effects of tax evasion on tax structure previously neglected in traditional economic analysis. While traditional economic models are generally able to explain the choice of a tax structure as an endogenous outcome of constrained maximizing behavior of political agents, maximizing behavior in which agents choose a tax structure to minimize the political costs or the expected loss in votes associated with raising a budget of given size, they are less equipped to answer questions regarding the effect of several other factors like tax evasion on the structure of taxes. This paper contributes to the latter goal by developing and estimating a formal tax structure model in which the composition of taxes is influenced by the amount of tax revenues lost through tax evasion. Additionally, this model represents one of the first attempts to evaluate and compare the responsiveness of various tax instruments to tax evasion within a framework of government revenue-maximization. Our estimation methodology is plagued by the potential simultaneity between tax revenue shares and our proxy for tax evasion. We propose the GDP share of income from the agriculture sector as an instrument to correct for this simultaneity bias.

Our findings not only confirm the conventional fact that tax evasion reduces the GDP share of total taxes, but also reveal that the GDP shares of taxes on income and property decline with tax evasion. Further, our results indicate that tax evasion has no statistically significant effect on the GDP shares of consumption and international trade (export and import) taxes. This is especially the case since we typically consider the ability of taxpayers to adjust to income taxes as being greater than for indirect taxes (particularly broad-based consumption taxes). Broad-based consumption taxes have the

advantage of pulling that informal portion of the economy into the tax net, and therefore increased reliance on such taxes will minimize the revenue effects of tax evasion. The basic premise here is that, even in cases where factors of production, especially labor, are driven into the underground sector, the owners of these factors still consume goods produced in the aboveground or formal sector.

The upshot of our findings is that tax evasion does indeed affect the composition of tax instruments. Consequently, the choice of a revenue-maximizing tax structure is closely influenced by the amount of tax revenue lost via tax evasion. This therefore implies that policy recommendations regarding the design of a revenue-maximizing tax structure ought to take into account the responsiveness of different tax instruments to tax evasion. In the presence of tax evasion, the choice of a revenue-maximizing tax structure requires the taxing authority to adjust the tax structure such that the marginal effect on revenue from increased reliance on a given tax instrument exactly equals the marginal cost per dollar of additional revenue, net of the amount of revenue lost through tax evasion, across all tax instruments in use.

Table 1. *Descriptive Statistics: East African Countries*

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
SDWGDP (Shadow Economy, % of GDP)	33	45.13	10.68	32.00	62.30
CORRUPTION	33	2.22	0.22	1.90	2.70
GDP Per Capita (U.S$)	33	276.09	71.01	176.23	354.82
Agriculture income (% of GDP)	33	38.40	10.40	16.40	51.50
Mining income (% of GDP)	33	0.32	0.12	0.21	0.60
Openness(value of exports & Imports, % of GDP)	33	48.10	14.50	22.20	70.50
Export ratio (value of exports, % of GDP)	33	7.20	2.30	3.80	12.40
Import ratio (value of imports, % of GDP)	33	11.10	3.30	6.60	19.50
Exchange Rate (LCU per US$)	33	547.97	479.63	22.92	1644.48
Real GDP (US$ Billions)	33	21.30	9.60	11.20	37.40
Real GNP (US$ Billions)	33	20.00	9.50	9.60	39.10
POPULATION (Millions)	33	25.30	5.00	16.30	33.70
TAX RATIOS					
Total Tax ratio (Total taxes, % of GDP)	33	6.2	1.9	2.9	10.9
Income taxes (% of GDP)	33	1.8	1.0	0.4	4.4
Consumption taxes (VAT + Sales + Excises,% of GDP)	33	2.8	1.0	1.0	4.8
International taxes (export and import taxes, % of GDP)	33	1.3	0.6	0.3	2.7
Value Added Taxes (VAT, % of GDP)	33	1.3	1.1	0	3.5
Sales taxes (% of GDP)	33	0.4	0.6	0	1.9
Excise taxes (% of GDP)	33	1.1	0.4	0.3	2.0
Other taxes (% of GDP)	33	0.36	0.34	0	1.4

Table 2. *Descriptive Statistics: OECD Countries*

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
SDWGDP (Shadow Economy in %of GDP)	126	15.6	5.5	6.7	29
POPN (Population, millions)	105	39.1	59	3.4	274
CRPT (Corruption Index; higher value indicates lower corruption)	126	7.732	1.627	2.99	10.00
Real GDP ($ Billions)	126	1,120	1,910	50.8	9,010
Real GNP ($ Billions)	126	1,110	1,910	46	9,000
GDPC (GDP per capita, in constant U.S.$)	126	25338.920	9049.661	9710.45	46183.19
Agriculture income (% of GDP)	126	3.6	2.1	1.0	10.7
Openness(value of exports & Imports, % of GDP)	126	70.9	34.4	17.9	186.0
Mining income (% of GDP)	126	4.5	7.7	0.1	30.2
Export ratio (value of exports, % of GDP)	126	36.6	20.9	8.5	95.5
Import ratio (value of imports, % of GDP)	126	35.0	17.7	6.6	96.2
TAX RATIOS					
Total Tax ratio (Total taxes, % of GDP)	126	25.1	7.1	7.4	45.0
Income taxes[a] (% of GDP)	126	12.9	4.9	3.5	27.1
Consumption taxes (VAT + Sales + Excises, % of GDP)	126	8.6	3.1	0.0	13.8
Property Taxes (% of GDP)	126	1.8	1.0	0.4	4.7
International taxes (export and import taxes, % of GDP)	126	0.2	0.2	0	1.0
Value Added Taxes (VAT, % of GDP)	126	5.4	2.7	0	10.0
Sales taxes (% of GDP)	126	0.4	0.9	0	3.0
Excise taxes (% of GDP)	126	2.8	1.2	0	5.5
Other taxes (% of GDP)	126	1.6	0.9	0	3.5

[a]Income taxes refer to the sum of personal income taxes, corporate income taxes, social security contributions, and taxes on payroll and workforce.

Table 3. *Simple Correlations: East African Countries*

	yg	yi	yc	yn	yv	ys	ye	sgdp	crpt	gdpc	agric	eratio	iratio
yi	0.9												
yc	0.7	0.6											
yn	0.4	0.3	-0.2										
yv	0.6	0.6	0.9	-0.2									
ys	-0.2	-0.3	-0.6	0.5	-0.8								
ye	0.3	0.2	0.7	-0.5	0.6	-0.6							
sgdp	0.1	-0.1	-0.2	0.4	-0.3	0.5	-0.3						
crpt	-0.1	-0.3	-0.1	0.0	-0.1	0.2	-0.1	0.3					
gdpc	-0.1	0.1	0.3	-0.6	0.4	-0.6	0.5	-0.9	-0.3				
agric	-0.3	-0.5	-0.5	0.3	-0.6	0.6	-0.5	0.7	0.5	-0.7			
eratio	0.7	0.8	0.6	0.0	0.7	-0.4	0.3	-0.2	-0.2	0.2	-0.5		
iratio	0.4	0.2	0.0	0.4	-0.2	0.5	-0.2	0.8	0.1	-0.7	0.3	0.2	
ming	-0.5	-0.6	-0.2	-0.4	-0.2	-0.1	0.1	0.2	0.0	0.1	0.2	-0.4	0.1

yg	Total Tax ratio
yi	Income taxes (% of GDP)
yc	Consumption taxes (VAT + Sales + Excises, % of GDP)
yn	International taxes (export and import taxes, % of GDP)
yv	Value Added Taxes (% of GDP)
ys	Sales taxes (% of GDP)
ye	Excise taxes (% of GDP)
sgdp	Shadow Economy, % of GDP
crpt	Corruption
gdpc	GDP Per Capita (U.S$)
agric	Agriculture income (% of GDP)
eratio	Export ratio (value of exports, % of GDP)
iratio	Import ratio (value of imports, % of GDP)
ming	Mining income (% of GDP)

Table 4. *Simple Correlations: OECD Countries*

	yg	yi	yc	yw	yn	yv	ys	ye	sgdp	crpt	gdpc	agric	open	ming	eratio
yi	0.9														
yc	0.6	0.3													
yw	0.3	0.3	-0.2												
yn	0.2	0.2	-0.1	0.2											
yv	0.5	0.2	0.9	-0.4	-0.2										
ys	0.1	0.2	-0.4	0.6	0.4	-0.7									
ye	0.6	0.4	0.8	-0.1	-0.1	0.6	-0.3								
sgdp	0.2	0.0	0.5	-0.3	-0.3	0.4	-0.3	0.4							
crpt	0.5	0.6	0.1	0.2	0.2	0.0	0.2	0.2	-0.5						
gdpc	-0.2	0.1	-0.4	-0.1	-0.3	-0.3	0.0	-0.3	-0.4	0.3					
agric	0.1	-0.1	0.3	-0.2	0.3	0.3	-0.1	0.2	0.3	-0.2	-0.6				
open	0.2	0.1	0.3	-0.2	-0.1	0.3	-0.2	0.2	0.1	0.2	-0.0	-0.0			
ming	0.0	-0.1	0.2	-0.2	0.1	0.1	-0.1	0.4	0.1	0.0	-0.3	0.2	0.4		
eratio	0.2	0.2	0.2	-0.2	-0.2	0.2	-0.2	0.2	0.1	0.2	0.1	-0.1	0.9	0.5	
iratio	0.2	0.1	0.3	-0.2	-0.2	0.3	-0.2	0.2	0.2	0.1	-0.1	0.0	0.9	0.5	0.9

yg	Total Tax ratio (Total taxes as % of GDP)
yi	Income taxes (% of GDP)
yc	Consumption taxes (VAT + Sales + Excises, % of GDP)
yw	Property taxes (% of GDP)
yn	International taxes (export and import taxes, % of GDP)
yv	Value Added Taxes (% of GDP)
ys	Sales taxes (% of GDP)
ye	Excise taxes (% of GDP)
sgdp	Shadow Economy, % of GDP
crpt	Corruption
gdpc	GDP Per Capita (U.S$)
agric	Agriculture income (% of GDP)
eratio	Export ratio (value of exports, % of GDP)
iratio	Import ratio (value of imports, % of GDP)
ming	Mining income (% of GDP)

Table 5. *Tax Burden and the Size of the Shadow Economy in East African Countries*

Country	Year	% of GDP				
		Direct Taxes	Indirect Taxes	Customs & Import duties	Overall Tax burden	Shadow economy
Uganda	1991/92	0.9	2.4	3	6.3	38.4
	1992/93	1.1	2.6	3.4	7.1	38.8
	1993/94	1.3	3.3	3.7	8.3	39.2
	1994/95	1.6	4.1	3.6	9.3	40.1
	1995/96	1.5	7.1	1.3	9.9	40.7
	1996/97	1.6	8.1	1.1	10.8	41.2
	1997/98	1.8	8.4	1.1	11.3	42.1
	1998/99	1.9	8.8	1.0	11.7	42.6
	1999/00	2.1	8.4	1.1	11.7	43.1
	2000/01	2.1	8.0	1.1	11.3	43.0
	2001/02	2.3	8.5	1.0	11.8	43.1
Kenya	1991/92	7	10.4	2.1	19.0	32.1
	1992/93	6.7	10	2.4	19.1	33.4
	1993/94	10	11	4	25.0	37.3
	1994/95	10.1	10.5	4.3	24.9	37.1
	1995/96	9.9	10.7	4.4	25.0	37.2
	1996/97	8.6	9.6	4	22.2	35.9
	1997/98	8.5	9.9	3.7	22.1	35.6
	1998/99	7.7	9.7	4	21.3	34.9
	1999/00	7.1	9.2	3.7	20.0	34.3
	2000/01	6.6	9.4	3.4	19.4	34.0
	2001/02	6.1	9.1	2.4	17.6	32.0
Tanzania	1991/92	3.3	4.7	3.1	11.1	62.3
	1992/93	2.9	3	2	7.9	58.0
	1993/94	2.9	3.5	2.5	8.9	58.2
	1994/95	3.3	2.7	3.4	10.4	60.5
	1995/96	3.3	3.1	3.6	10.0	59.8
	1996/97	3.2	3.3	4.1	10.6	60.2
	1997/98	3	4.7	1.7	9.4	59.4
	1998/99	2.7	4.9	1.5	9.1	58.6
	1999/00	3	4.6	1.3	8.9	58.3
	2000/01	2.5	5.9	1.2	9.6	58.9
	2001/02	2.7	6.2	1	9.9	59.1

Table 6. *The Size of the Shadow Economy in OECD Countries*

Size of the Shadow Economy (in % of GDP) using the Currency Demand Method						
OECD-Countries	Average 1989/90	Average 1991/92	Average 1994/95	Average 1997/98	Average 1999/2000	Average 2001/2002[1)]
1. Australia	10.1	13.0	13.5	14.0	14.3	14.1
2. Belgium	19.3	20.8	21.5	22.5	22.2	22.0
3. Canada	12.8	13.5	14.8	16.2	16.0	15.8
4. Denmark	10.8	15.0	17.8	18.3	18.0	17.9
5. Germany	11.8	12.5	13.5	14.9	16.0	16.3
6. Finland	13.4	16.1	18.2	18.9	18.1	18.0
7. France	9.0	13.8	14.5	14.9	15.2	15.0
8. Greece	22.6	24.9	28.6	29.0	28.7	28.5
9. Great Britain	9.6	11.2	12.5	13.0	12.7	12.5
10. Ireland	11.0	14.2	15.4	16.2	15.9	15.7
11. Italy	22.8	24.0	26.0	27.3	27.1	27.0
12. Japan	8.8	9.5	10.6	11.1	11.2	11.1
13. Netherlands	11.9	12.7	13.7	13.5	13.1	13.0
14. New Zealand[2)]	9.2	9.0	11.3	11.9	12.8	12.6
15. Norway	14.8	16.7	18.2	19.6	19.1	19.0
16. Austria	6.9	7.1	8.6	9.0	9.8	10.6
17. Portugal	15.9	17.2	22.1	23.1	22.7	22.5
18. Sweden	15.8	17.0	19.5	19.9	19.2	19.1
19. Switzerland	6.7	6.9	7.8	8.1	8.6	9.4
20. Spain [3)]	16.1	17.3	22.4	23.1	22.7	22.5
21. USA	6.7	8.2	8.8	8.9	8.7	8.7
Unweighted Average over 21 OECD countries	13.2	14.3	15.7	16.7	16.8	16.7

Note. From "The Value Added of Underground Activities: Size and Measurement of the Shadow Economies of 110 Countries All Over the World," by F. Schneider, 2002, p. 21. Copyright 2002 by Schneider, Friedrich. Reprinted with permission.

The DYMIMIC and Currency demand approaches were used to calculate the Shares of the Shadow economy for the East African and OECD countries, respectively (Friedrich Schneider, 2002; Friedrich Schneider & Enste, 2000):

1) Preliminary values.

2) The figures are calculated using the MIMIC-method and Currency demand approach. Source: Giles (1999b).

3) The figures have been calculated for 1989/90, 1990/93 and 1994/95 from Mauleon (1998) and for 1997/98 and 1999 figures are from Schneider (2002).

Table 7. *First Stage Least Squares Estimates (OECD and East African Countries)*

	OECD	East Africa
	Dependent variable: Tax evasion	
Constant	12.902	18.690
Agriculture(% of GDP)	0.747*** (0.001)	0.689*** (0.000)
Corruption	-1.634*** (0.000)	2.253 (0.401)
Mining	0.348** (0.022)	3.646*** (0.000)
GDPC	-0.214*** (0.000)	-1.751*** (0.000)
Export ratio	0.045** (0.017)	0.778*** (0.007)
Trend	0.983*** (0.000)	-0.019 (0.933)
R-squared	0.497	0.448
Durbin-Watson	1.909	2.218
Observations	126	33

Note. P-values in parenthesis.

*,**,*** denote significance at 10%, 5% and 1%, respectively.

Table 8. *OLS and GMM Estimates with no Fixed Effects (OECD Countries)*

	OLS	GMM			
	Tax ratio	Income	Consumption	Property	International trade
Constant	51.059	38.068	4.447	5.527	0.169
Tax evasion	-1.351*** (0.008)	-1.320*** (0.000)	0.216 (0.264)	-0.243*** (0.000)	0.010 (0.396)
Corruption	1.144*** (0.008)	0.654** (0.032)	0.380** (0.021)	0.194*** (0.000)	0.043*** (0.000)
Mining	0.128 (0.611)	-0.110 (0.541)	0.178* (0.067)	0.006 (0.854)	0.012** (0.042)
GDP per capita	-0.293*** (0.002)	-0.067 (0.300)	-0.137*** (0.000)	-0.046*** (0.000)	-0.007*** 0.000)
Export ratio	0.075** (0.017)	0.044* (0.047)	0.029** (0.015)	-0.013*** (0.000)	-0.001 (0.189)
Trend	-0.109 (0.771)	-0.178 (0.504)	-0.004 (0.980)	0.065 (0.174)	-0.060*** (0.000)
R-squared	0.185	0.190	0.282	0.225	0.484
Observations	126	126	126	126	126

Note. P-values in parenthesis.

*,**,*** denote significance at 10%, 5% and 1%, respectively.

Table 9. *OLS and GMM Estimates with no Fixed Effects (East African Countries)*

	OLS	GMM		
	Tax ratio	Income	Consumption	International trade
Constant	13.951	6.462	0.039	5.088
Tax evasion	-0.159** (0.032)	-0.094*** (0.000)	-0.034 (0.497)	-0.004 (0.872)
Corruption	0.607 (0.565)	0.075 (0.839)	0.960 (0.188)	-0.583 (0.132)
GDP per capita	-1.641*** (0.002)	-0.606*** (0.001)	0.034 (0.918)	-0.534*** (0.005)
Mining	-0.016 (0.995)	-0.214 (0.803)	0.350 (0.833)	-1.574* (0.081)
Export ratio	0.508*** (0.000)	0.249*** (0.000)	0.253*** (0.001)	-0.008 (0.835)
Trend	-0.180** (0.052)	-0.110*** (0.001)	0.022 (0.717)	-0.054* (0.100)
R-squared	0.750	0.852	0.480	0.609
Observations	33	33	33	33

Note. P-values in parenthesis.

*,**,*** denote significance at 10%, 5% and 1%, respectively.

Table 10. *OLS and GMM Estimates with Fixed Effects (OECD Countries)*

	OLS	GMM			
	Tax ratio	Income	Consumption	Property	International trade
Constant	-0.034	-0.081	-0.004	0.056	-0.006
Tax evasion	-1.692*** (0.003)	-1.597*** (0.000)	0.129 (0.549)	-0.247*** (0.001)	0.022 (0.182)
Corruption	1.034** (0.015)	0.464 (0.136)	0.304** (0.063)	0.223*** (0.000)	0.042*** (0.000)
Mining	0.137 (0.568)	-0.102 (0.566)	0.208** (0.027)	0.023 (0.470)	0.008 (0.134)
GDP per capita	-0.228*** (0.009)	-0.043 (0.502)	-0.128*** (0.000)	-0.050*** (0.000)	-0.006*** (0.001)
Export ratio	0.065** (0.027)	0.047** (0.031)	0.033*** (0.004)	-0.013*** (0.000)	-0.001** (0.043)
Trend	0.010 (0.976)	0.023 (0.921)	0.001 (0.993)	-0.016 (0.700)	0.002 (0.824)
R-squared	0.175	0.202	0.267	0.236	0.288
Observations	126	126	126	126	126

Note. P-values in parenthesis.

*,**,*** denote significance at 10%, 5% and 1%, respectively.

Table 11. *OLS and GMM Estimates with Fixed Effects (East African Countries)*

	OLS	GMM		
	Tax ratio	Income	Consumption	International trade
Constant	0.267	0.117	0.061	0.063
Tax evasion	-0.052 (0.483)	-0.035 (0.168)	-0.005 (0.918)	0.006 (0.793)
Corruption	0.593 (0.610)	0.057 (0.884)	1.058 (0.171)	-0.645* (0.099)
GDP per capita	-0.174*** (0.004)	-0.067*** (0.001)	-0.004 (0.909)	-0.049*** (0.011)
Mining	0.306 (0.908)	0.115 (0.897)	0.785 (0.650)	-1.880** (0.037)
Export ratio	0.180*** (0.001)	0.095*** (0.000)	0.079*** (0.013)	0.002 (0.883)
Trend	-0.045** (0.498)	-0.019 (0.383)	-0.010 (0.811)	-0.010 (0.627)
R-squared	0.691	0.829	0.384	0.542
Observations	33	33	33	33

Note. P-values in parenthesis.

*,**,*** denote significance at 10%, 5% and 1%, respectively.

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