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Changing Tax Elasticities Over Time: The Case of Tanzania

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ABSTRACT

The elasticity, which measures responsiveness of tax revenue to income growth, is assumed in many studies to be constant over time by the use of a double-log tax function. In this study, use of a flexible form tax function admits the possibility of fluctuating intertemporal tax elasticities. The model is applied to tax revenue data for a representative developing economy, Tanzania, and intertemporal tax elasticities are estimated for the major Tanzanian taxes. The general finding of the study is that while the elasticity of the total tax system in Tanzania remains fairly stable over time, the elasticities of particular taxes show definite trends and cyclical variation. The income tax, for example, is becoming more elastic over time while the sales tax is declining in elasticity. The results of the study have important policy and research implications.

CHANGING TAX ELASTICITIES OVER TIME:

THE CASE OF TANZANIA

I. Introduction

Tax elasticity is a measure of the responsiveness of tax receipts to economic growth. If a tax is elastic, a one percent increase in national income or output results in a greater than one percent increase in revenue from the tax. It is necessary when estimating tax elasticities to control for exogenous influences such as discretionary changes in tax policy, because tax receipts may increase for reasons other than economic growth.

An elastic tax system is desirable in a developing country because it implies that tax receipts will grow automatically with growing income without the need for politically sensitive increases in tax rates or bases (Due 1981:550). As per capita income increases with economic development, the demand for government goods and services tends to increase. This is often the case with goods such as transportation, communication and general government administrative services (Lewis 1984:34). In addition, the demand for social services tends to increase with per capita income. Combine this with increasing government demand for funds to finance development-related projects such as education and agricultural extension, and the benefits of an elastic tax system become evident.

However, an elastic tax system is not without shortcomings. Revenue from an elastic tax system tends to be more volatile than revenue from an inelastic tax system. If a tax system is elastic, a one percent decrease in income results in a greater than one percent

decrease in tax receipts. Instability of tax revenue can make planning for economic development difficult.

Further, since an elastic tax system is likely to be associated with high marginal rates, an elastic tax system may distort economic-decision making and generate undesirable excess burdens.[1] Decisions to work, save and invest may be adversely affected by the high marginal tax rates characterized by an elastic tax system. This can consequently result in large excess burdens because excess burdens increase with the square of the marginal tax rate.[2]

Hence, a balance must be struck between the desire for revenue responsive tax structure and other development goals. Since the overall elasticity of a tax is a weighted average of the elasticities of the taxes that make up the system, the elasticity of the entire system can be increased by utilizing more heavily those taxes that are most elastic.[3] In general, this involves heavy reliance on taxes with high marginal rates.[4]

As a country develops, the elasticity of the tax system can be expected to change. Tax bases of broad-based income and consumption taxes tend to grow faster than GDP since the taxed modern sector grows faster than the untaxed subsistence sector, leading to increasing intertemporal elasticities (Goode, 1984:93). By the same token, improved tax enforcement and administration may lead to increasing tax elasticities over time as can the use of ad valorem rather than specific taxes.

On the other hand, exemptions from taxation of the more elastic bases can lead to reduced tax elasticities. Many countries provide tax

investment incentives by exempting certain businesses from taxation for specified periods of time, or attempt to stimulate exports with exemptions from export duties.

On balance, it is difficult to predict whether tax elasticities will increase or decrease over time. The purpose of the present study is twofold: first, to test the hypothesis that tax elasticities fluctuate over time in a representative developing country, Tanzania; and second, to provide estimates of the intertemporal elasticities of the major Tanzanian taxes.

Most studies of tax elasticities in developing countries implicitly assume constant tax elasticities over time by their assumption of double-log function of the form:

$$\log T = a_0 + a_1 \log Y \qquad (1)$$

where a_1 is the constant tax elasticity, T is tax revenue, and Y is income. Other functional forms for the tax function would admit increasing or declining intertemporal tax elasticities. In this study, a model of Box and Cox (1984) is applied to tax data for Tanzania to determine the appropriate functional form for tax functions in that country.[5] Following a technique developed by Prest (1962), the data are adjusted to net out the effect of discretionary tax changes on revenue. The general finding of this study is that tax elasticities in Tanzania are variable over time, although some taxes are characterized by constant or near constant elasticities. A brief description of taxation in Tanzania follows in Section II. In Section III is a

discussion of the methodology used in this study and Section IV is a summary and evaluation.

II. The Tax Structure in Tanzania

The tax system in Tanzania has characteristics of most developing economies. The composition of the tax structure in the fiscal year 1987/88 is depicted in Table 1. The heavy emphasis on trade and consumption taxes coupled with a lesser reliance on income and property taxes is common in developing countries.

The sales tax, which was introduced in Tanzania twenty-one years ago, is today the major central government tax revenue source. In fiscal year 1987/88, it accounted for over one-half of total tax revenue. The current structure of sales tax is complicated by a multiplicity of rates on different types of goods depending on their end-use. Before July 1989 there were 20 rate categories with rates ranging from "zero" to 300 percent. Since then, the number of rate categories has been reduced to four ("zero," 20, 30, and 40 percent). However, despite recent government measures to simplify sales tax, the tax structure is still complicated.[6]

The income tax, introduced in Tanzania in 1973 by the Income Tax Act, is the second largest tax revenue source. In the fiscal year 1987/88, it accounted for well over one-quarter of total tax revenue. When the income tax was initially introduced, its rates were made very progressive in order to achieve equity. The marginal rates ranged from 25-95 percent. However, the minimum wage was exempt from tax. Due to constant rise in the cost of living unmatched by growth in wage incomes through the 1980s, the government has been revising income tax

Table 1: The Composition of the Tax Structure in Tanzania, 1987/88

Tax	Tshs. Million	% of total tax
Import Duties	5,572.6	12.9
Consumption Taxes	23,209.7	53.9
Sales Tax	22,736.3	52.8
Local Goods	17,784.1	41.3
Imports	4,952.2	11.5
Hotel Levy	332.9	0.8
Foreign Travel Levy	100.6	0.2
Entertainment Tax	39.9	0.1
Motor Vehicle Taxes	617.8	1.4
Motor Vehicle Licenses	161.5	0.4
Motor Vehicle Tax on Transfer	39.9	0.1
Motor Vehicle Registration Tax	28.4	0.1
Motor Vehicle Road Licenses	163.7	0.4
Road Toll Tax	224.2	0.5
Miscellaneous Taxes & Licenses	1,614.3	3.7
Stamp Duty	1,509.9	3.5
Business Licenses	58.6	0.1
Income Tax	11,811.6	27.4
PAYE	2,753.7	6.4
Individuals	794.8	1.8
Companies	7,296.2	16.9
Withholding Tax	155.2	0.7
Capital Gains	87.7	0.2
Shipping Tax	180.2	0.4
Payroll Tax	422.9	1.0
Other		
Personal Tax	35.3	0.1
Property Taxes	77.9	0.2
TOTAL TAX REVENUE	43,060.8	100.0

Source: URT, Financial Statement and Revenue Estimates, June 1988/90, Government Printer, Dar es Salaam.

rates downwards to increase workers' take-home pay (Budget Speech, June 1986, 1989 and 1990). The current marginal rates range from 7.5-40 percent with a threshold income of Tshs. 2,250. It should, however, be noted that these rates are regressive at high income brackets, although the average tax rates still remain progressive. A company tax of 50 percent is levied on resident company profits, while non-resident company profits are subject to a 55 percent tax. The company tax is the major contributor to income tax revenue, and would be even more important if enterprises were producing at higher capacity utilization rates. But at present most firms are producing at below 40 percent capacity utilization (Osoro 1988).

Unlike most developing countries (Sudan, etc.), the import duty is not the most important source of central government tax revenue. It contributed about 13 percent in fiscal year 1987/88, ranking third after sales tax and income tax. Its relatively low contribution to revenue appears to be attributable to a low volume of imports due to lack of foreign exchange which was very critical during the 1980-86 period, import restrictions which prevailed from early 1970s to 1984, and high tax rates. However, the contribution of the import duty to tax revenue has started to pick up after the trade and import liberalization of 1984 and is expected to rise rapidly. Like sales tax, import duty has suffered from a multiplicity of rates.[7]

Other taxes, including the stamp duty, land rent, business licenses, hotel levy, airport and port departure service charges, TV and VTR fees, motor vehicle licenses and fees, foreign travel levy, video

tax and other fees and charges, accounted for less than 8 percent of total central government tax revenue in the fiscal year 1987/88.

III. Methodology

In order to allow for the possibility of changing tax elasticities over time, a model suggested by Box and Cox (1964) is applied in this study.[8] If T_{it} is revenue from the ith tax in period t and Y_t is gross domestic product in time t, then the model is:

$$T_{it}^{(\lambda)} = \alpha_0 + \alpha_1 Y_{it}^{(\lambda)} + e_{it} \tag{2}$$

where e_{it} is a random disturbance and:

$$T_{it}^{(\lambda)} = \begin{cases} (T_{it}^{(\lambda)} - 1)/\lambda & \text{for } \lambda \neq 0 \\ lnT_{it} & \text{for } \lambda = 0 \end{cases}$$

and:

$$Y_{it}^{(\lambda)} = \begin{cases} (Y_{it}^{(\lambda)} - 1)/\lambda & \text{for } \lambda \neq 0 \\ lnY_{it} & \text{for } \lambda = 0 \end{cases}$$

If the transformation parameter, λ, equals one, the model takes on the linear form:

$$T_{it} = \alpha_0 + \alpha_1 Y_{it} + e_{it} \tag{3}$$

while if λ equals zero, the model takes on the traditional double-log form:

$$lnT_{it} = \alpha_0 + \alpha_1 lnY_{it} + e_{it} \tag{4}$$

Other values of λ lead to alternative nonlinear tax equations.

The tax elasticities depend on the values of the coefficient of the income variable, α_1, and on the transformation parameter, λ. For the ith tax, the elasticity is given by:

$$\epsilon_i = \alpha_1 (Y_{it}/T_{it})^{\lambda} \qquad (5)$$

In the special case when the transformation parameter equals zero and the tax function takes on the double-log form, the elasticity reduces to α_1 and is constant over time. When λ is different from zero, the elasticity depends on the ratio Y_{it}/T_{it}, which may vary over time causing intertemporal variation in the elasticity.

The above model was estimated on data for the major Tanzanian taxes covering the time period 1977/78 through 1987/88. The data were adjusted to net out the effect of discretionary tax changes following a procedure developed by Prest (1962) in studying the personal income tax in the United Kingdom. The method requires estimates of the effects of discretionary tax changes on the year's tax receipts by type of tax. For this study, these were based on estimates developed by the Treasury. Adjustment factors were computed for each tax for each year and applied to receipts to obtain receipts net of discretionary tax changes. The data formed the basis for the estimation of this study. The results of the estimation are presented in the next section.

IV. Estimating Results

The model described in the previous section was estimated using the SHAZAM statistical package. The results of each tax are shown in Table 2. The slopes (α_1 in the model above) were all significantly different from zero at the .99 confidence level except for the import

Table 2: Estimating Results Using the Box-Cox Transformation, 1977/78-1987/88

Tax	Intercept	Slope	Transformation parameter	Adjusted R^2
Total Taxes	2.2975**	0.63165**	0.0400	.9778
Income Tax	3.3775*	0.43874**	0.2100	.9463
Sales Tax	-3.5734**	2.3888**	-0.3900	.9545
Import Duty	413.4700	0.0038*	-1.0300	.2760

**Significantly different from zero at the .99 confidence level.
*Significantly different from zero at the .95 confidence level.

duty equation whose slope was significantly different from zero at the .95 confidence level. For all taxes the transformation parameters were different from zero, indicating changing tax elasticities over time. The model fits the data very well according to the adjusted R-squared statistic, which measures the goodness of fit.

Table 3 shows the elasticities evaluated at the mean. They range from .845 for the sales tax to .439 for the import duty. All taxes are inelastic (have elasticities less than one), suggesting that revenue from these taxes grows more slowly than GDP. The low elasticity of the income tax seems to have been caused by a narrow tax base, and possible tax evasion by the small businesses, while a low sales tax elasticity may be due to low compliance and generous exemptions, which narrow the tax base. The import duty is the most inelastic tax, probably attributable to the low import volume caused by import restrictions between 1971 and 1984, lack of foreign exchange, and generous exemptions.

For comparison, estimates of the elasticities for each of the taxes based on the double-log model are also shown in Table 3. The double-log model sometimes overestimates and sometimes underestimates the elasticities based on the Box-Cox model. The largest percentage difference is exhibited by the import duty, while very little difference between the models is detected for total taxes.

Table 3: Comparison of Elasticities of Tanzanian Major Taxes Computer Using the Box-Cox Transformation and Double Log Function

Tax	Box-Cox Elasticity (1)	Double-Log Elasticity (2)	Percentage Difference $\frac{(2) - (1)}{(1)} \times 100$
Total Taxes	.683	.680	-.44
Income Tax	.788	.736	6.60
Sales Tax	.845	.732	-13.37
Import Duty	.439	1.345	180.79

Finally, elasticities were calculated for each tax year of the data. These are depicted in Table 4. As can be observed from the table, the elasticities vary over time, but in general, not monotonically. Total taxes, income taxes, and the import duty have become clearly more elastic. Taxes like sales taxes and import duties show cyclical variation. However, the overall trend of the import duty is of increasing elasticity, whereas that of sales taxes is a declining elasticity over time. In total, the elasticity of Tanzanian taxes has increased very marginally. The overall trend has been more or less constant.

IV. Conclusions

The results of the study suggest that over the period of study, the elasticities of Tanzanian taxes have varied. A Box-Cox model was estimated for each of the major Tanzanian taxes and found to fit the data better than the standard double-log model in almost every case. This result has important implications for the study of tax elasticities in developing economies.

Dependence on the double-log model to estimate tax elasticities, apart from giving mistaken estimates, restricts the elasticities to be constant over time. The Box-Cox model, however, does not restrict the elasticities, and, as shown for Tanzania, this can be important for certain taxes. Basing policy decisions on incorrect elasticities can lead to incorrect policies. Consequently, it is important to correctly estimate tax elasticities and their variation over time.

Table 4: Intertemporal Tax Elasticities for Tanzania, 1977-87

Year	Total Taxes	Income Tax	Sales Tax	Import Duty
1977	0.672017	0.781183	0.855518	0.121061
1978	0.672687	0.762365	0.891195	0.120739
1979	0.675669	0.740575	0.885307	0.207648
1980	0.676540	0.743931	0.929040	0.299997
1981	0.679289	0.742762	0.915422	0.716086
1982	0.679715	0.746257	0.913319	0.801350
1983	0.680948	0.782493	0.922748	0.969778
1984	0.682353	0.796408	0.901865	0.749184
1985	0.689576	0.804299	0.789253	1.040566
1986	0.688799	0.832937	0.793807	0.555269
1987	0.687663	0.801706	0.789531	0.584366

The technique of this study could be readily extended to the study of taxes in other developing economies. As the tax systems of the developing economies mature with the introduction of new taxes and the redesign of existing taxes, fluctuating intertemporal elasticities can be expected. If the development policy involves placing more reliance on the more elastic taxes, it is important for policy-makers to be able to correctly identify those taxes. Further, since tax elasticities are sometimes used for forecasting expected tax revenues, accurate tax elasticity estimates are essential. To this end, the research presented in the present study holds for policy-makers and researchers alike.

NOTES

[1]By definition, elasticity = $(\partial T/T)/(\partial Y/Y) = (\partial T/\partial Y)/(T/Y)$ = marginal tax rate)/(average rate) where T is tax receipts and Y is income. If the tax is elastic, the elasticity is greater than one, and the marginal tax rate exceeds the average tax rate.

[2]Standard formula for excess burden of a tax is $W = (1/2)E_S E_D t^2 PQ/(E_s+E_Q)$ where E_S and E_D are the elasticities of supply and demand, t is the marginal tax rate, and PQ is total expenditures on the taxed good. From this formula, it follows that doubling the marginal tax rate quadruples the excess burden of the tax. See Browning and Browning (1983, pp. 315-317).

[3]The overall elasticity of a tax system is given by $E = (T_1/T) \times E_1 + \ldots + (T_n/T) \times E_n$ where T_k/T is the share in total receipts of the kth tax and E_k is the elasticity of the kth tax for $k = 1,\ldots,n$. See Mansfield (1972, p. 426) for the derivation.

[4]One exception is the value added tax which, in a developing economy, may be relatively elastic while utilizing low marginal rates. Heavy reliance on the value added tax may, therefore, lead to an elastic tax structure in a developing economy.

[5]Greytak and Thursby (1979) apply this technique to the New York State income tax and find it to be characterized by a constant elasticity.

[6]After the reintroduction of the excise duty in June, 1989, sales tax rate categories were trimmed to 8 and the range of rates reduced to "zero" to 50 percent. All items that were previously subject to over 50 percent sales tax had a 50 percent sales tax levied on them, plus an excise duty (Finance Bill, June 1989).

[7]In June 1990, the number of customs tariff rate categories was reduced to four, ranging from 20% to 60%.

[8]See Judge et al. (1980, pp. 308-311) for a description of the Box-Cox model and its properties.

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