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Decomposition of the Tax-to-Income Elasticity of Major Taxes in Kenya

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Abstract
According to Kotut S and Menjo I the Major tax components and the tax systems exhibit non elasticity therefore raising the question of the decomposition of tax to income elasticity of the major taxes in the country, These study therefore purposed to investigate the decomposition of tax to income elasticity in Kenya using time series data from KNBS, the Central Bank and the KRA, the empirical results show that the decomposition of the tax-to-income elasticity into its constituent parts, i.e. tax-to-base and base-to-income showed that the inelasticity of the Kenya tax system is due to the low tax-to-base elasticity of individual taxes since the base-to-income elasticities for all taxes were found to be approximately above unity. The tax-to-income elasticity can be improved by raising the responsiveness of the individual taxes to the bases, this study therefore recommend that appropriate policy measure to be put in place so as to cattail the discretionary measures on tax and macroeconomic environments.
Key words: - Tax, Income Elasticity, Tax Decomposition,

1.0 Introduction

The major shortcoming of Kenya's tax structure is its over-dependence on a small number of sources of tax revenue, namely trade taxes, sales tax/VAT and income tax (Ole, 1975, Wawire, 1991, Wawire, 2000, Muriithi and Moyi, 2003, Wawire, 2003 and Wawire, 2006). The trade taxes, sales tax/VAT on various imported products are vulnerable to external events because their prices are determined in the world market and tend to be volatile. This has therfore resulted to inadequate tax revenues and persistentce of budget deficits.

The sources of inadequacy of revenue from taxation include tax structure that is not buoyant or income-elastic, a long time lag between government revenue collection and spending, lack of fiscal discipline, and reluctance of the government to control its expenditures, and lack of information about the behavoiur of Kenya's tax revenue functions. This study therefore seeks to investigate the decomposition of the tax-to-income elasticity of major taxes in Kenya:

2.0 Methodology

2.1 Model specification

Assessing tax productivity is important not only because it allows us to examine the responsiveness of the tax system, but also because it affects the system's equity and efficiency effects. The income elasticity of a tax can be studied in two for that is tax-to-base and base-to-income elasticities. This implies that the elasticity of a tax is essentially the product of the elastic relative to the base and the elasticity of the base-to-income.

According to Muriithi and Moyi (2003), the decomposition of elasticity into tax-to-base and base-to-income is useful for two reasons. First, it allows identification of the source of either fast revenue growth or lagging revenue growth. Second, it highlights that component of growth or lagging revenue growth. Second, it highlights that component of growth that is amenable to policy manipulation. For example, while the tax-to-base ratio is within the control of the authorities, the base-to-income lies beyond the scope of control.

Mansfield (1972) assumes a system of *n* taxes to show that the tax revenue-to income elasticity is the weighted sum of the individual tax elasticities. This can be expressed as follows:

Elasticity of total tax revenue to income

$$E_T tY = (\Delta T_t / \Delta Y)(Y / T_t) \quad \text{.....(1)}$$

Elasticity of k^{th} individual tax to income

$$E_T kY = (\Delta T / \Delta Y)(Y / T_k) \quad \text{.....(2)}$$

Elasticity of k^{th} individual tax to base

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$$E_T kY = (\Delta T_t / \Delta B_K)(Y / T_k) \quad \text{.....(3)}$$

Elasticity of k^{th} individual base to income

$$E_B kY = (\Delta B_k / \Delta Y_k)(Y / B_k) \quad \text{.....(4)}$$

Where T_t is total revenue, T_k is tax revenue from the k^{th} tax, Y is income measured by gross domestic product, B is the base of the k^{th} tax, and Δ is a discrete change in the variable associated with it.

In a tax system made up of several taxes

$$E_T tY = \frac{T_1}{T_t}\left[\frac{\Delta T_1}{\Delta Y} \times \frac{Y}{T_1}\right] + ... + \frac{T_k}{T_t}\left[\frac{\Delta T_k}{\Delta Y} \times \frac{Y}{T_k}\right] + ... + \frac{T_n}{T_t}\left[\frac{\Delta T_n}{\Delta Y} \times \frac{Y}{T_n}\right] \quad \text{..... (5)}$$

The elasticity of total tax revenue to income is equal to the weighted sum of individual tax elasticities, with the functional distribution to total tax by each individual tax serving as its weight. The elasticity of any individual tax can be decomposed into the product of elasticity of the tax to its base and the elasticity of base to income as follows:

$$E_T kY = \left[\frac{\Delta T_k}{\Delta B_k} \times \frac{B_k}{T_k}\right]\left[\frac{\Delta B_k}{\Delta Y} \times \frac{Y}{B_k}\right] \quad \text{..... (6)}$$

Combination of the equation 5 and 6 will lead us to equation 7, Which is the elasticity of total revenue to income in a system of *n* taxes where elasticity depends on the product of the elasticity of tax to base and the elasticity of base to income for each separate tax, weighted by the importance of each tax in the total tax system

$$E_I kY = \frac{T_1}{T_t}\left[\left(\frac{\Delta T_1}{\Delta B_1} \times \frac{B_1}{T_1}\right)\left(\frac{\Delta B_1}{\Delta Y} \times \frac{Y}{B_1}\right)\right] + ... + \frac{T_k}{T_t}\left[\left(\frac{\Delta T_k}{\Delta B_k} \times \frac{B_k}{T_k}\right)\left(\frac{\Delta B_k}{\Delta Y} \times \frac{Y}{B_k} + ... + \frac{T_n}{T_t}\left[\left(\frac{\Delta T_n}{\Delta B_n} \times \frac{B_n}{T_n}\right)\left(\frac{\Delta B_n}{\Delta Y} \times \frac{Y}{B_n}\right)\right]\right]\right] \quad \text{.... (7)}$$

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2.2 Estimation procedure

Generally, the elasticity concept assumes the following functional relationship:

$$T^* = \alpha B^{\beta} \varepsilon \quad \text{.....(8)}$$

Where T is tax revenue, B is tax base, α and β are parameters to be estimated, and ε is the multiplicative error term. To convert the model to a linear form we take the logarithms hence having the following equations;-

$$LogT = \log \alpha + \beta \log B + \log \varepsilon \quad \text{.....(9)}$$

The standard form;

$$\log T_t^* = \alpha + \beta \log B_t \upsilon_t \quad \text{.....(10)}$$

β; tax elasticity is defined as the responsiveness of revenue yields to movements in the base.

The proportional adjustment (PA) method of eliminating the discretionary effects from the revenue series was adopted in the study because of its superiority. The method follows the following steps

First compute:

$$T_{tt} = T_t - D_t$$

Where:

T_t = the actual tax yield in the t^{th} year

D_t = the budget estimate of the discretionary change(s) in the t^{th} year

$T_{t,t}$ = the actual collection of the t^{th} year adjusted to the structure of that year.

PA method requires that the revenue yield for each year in the sample period be adjusted to generate a revenue yield based on the structure of a reference year. $T_{t,t}$ are to be converted to the reference year. To obtain the adjusted series for the t^{th} year, we multiplied $T_{t,t}$ by the previous year's ratio of the adjusted tax revenue with reference to the base year[1] $(T^*)_{t-1}$ over the actual tax revenue (T_{t-1}), that is,

$(T^*)_1 = T_{1,1}$

$(T^*)_2 = [(T^*)_1 / T_1].T_{2,2}$

$(T^*)_t = [(T^*)_{t-1} / T_{t-1}].T_{t,t}$

Buoyancy of taxes with respect to their bases was derived by logarithmic regressions of unadjusted revenue data on these bases.

[1] The year 2005 was chosen as the base year adopted in this study because the price we deemed stable during the period

1.3 KPSS Test

Kwiatkowski, Philips, Schmidt and Shin (KPSS, 1992) test use the LM statistics to test the unit root. The times series rid_t is the sum of the deterministic trend, a random walk and error term. The KPSS model is as follows;-

$$v = T^{-2}\sum_{i}^{T}\frac{s_t^2}{\sigma_k^2} \quad \text{.....(11)}$$

$$s_t = \sum_{i=1}^{t} e_t, \quad \text{where t=1.....,T} \quad \text{.....(12)}$$

Where e_t is the regression coefficient if rid_t, on intercept and time t, σ_k^2 is the variance of rid_t in long period, k is the number of lagged periods, T is the number of the sample, and v is the asymptotic distribution. The null hypothesis is that rid_t has a unit root. If v is larger than the significant level, we will reject the null hypothesis and conclude that rid_t, has a unit root.

3.0 Findings, Discussion of Findings, Conclusion and Recommendation

3.1Regression results for a decomposition of the tax-to-income elasticity of major taxes

The specific objectives of this study were: (i) to determine tax-to-base elasticity of major taxes, and, (ii) to determine base-to-income elasticity of major taxes, therefore testing the hypotheses that: (i) tax-to-base elasticity of major taxes is unit, and, (ii) base-to-income elasticity of major taxes is unit.

The regression and p-value used in this regard are shown in table 1. Income tax has a tax-to-base elasticity of 0.192 with p-value of 0.507 and base-to-income elasticity of 0.988 with a p-value of 0.0000 in nominal terms. In real terms the tax-to-base elasticity and base-to-income elasticity of Income tax are 0.221 with p-value of 0.022 and 1.065 with a p-value 0.0000 respectively. This implies that tax-to-base elasticity and base-to-income elasticity of income tax in real term are statistically significant different from 1 at 1% level of significance.

Import duties have a tax-to-base elasticity of 0.016 with p-value of 0.596 and base-to- income elasticity of 2.519 with a p-value of 0.228, in nominal terms. This implies that they are not statistically significant different at 10% test level. In real terms, its tax-to-base elasticity is 0.165 with p-value of 0.018 and base-to-income elasticity is 1.238 with a p-value of 0.000. This is statistically different from 1 at 5% level of significance.

For the case of Excise duties, tax-to-base elasticity and base-to-income elasticity in nominal terms are 0.159 with p-value of 0.715 and 1.121 with p-value of 0.000 respectively. This means that tax-to-income elasticity of Excise duties is not statistically different from 1 at 10% level of significance. In real term, its tax-to-base elasticity is 0.166 with p-value of 0.013 and base-to-income elasticity is 1.188 with p-value of 0.000, both being statistically significant different at 5% level of significance.

Sales/VAT tax has a tax-to-base elasticity of 0.159 with p-values 0.482, which is not statistically significant different from 1 at 10% test level, and base-to-income elasticity of 1.121 with p-value of 0.0000 in nominal terms, which is statistically significant different from 1 at 1% level of significance. In real terms, the tax-to-base elasticity and base-to-income elasticity of sales/VAT tax are 0.166 with p-value of 0.013 and 1.188 with p-value of 0.000 respectively. Both of them are statistically significant different from 1 at 5% level of significance.

All major tax components reported however tax-to-base elasticity which was not statistically significant different from 1 in nominal terms but in real terms, they are statistically different from 1. On the other had all these major tax components had base-to-income elasticity which was statistically significant above 1 except income tax which had base-to-income elasticity of 0.988 in nominal terms and in real terms it had an elasticity of 1.065.

The low tax-to-base elasticity of sales tax/VAT could be as a result of the combined effect of evasion and inefficiency tax administration over the period despite the introduction Electronic Tax Register. Low tax-to-base elasticity of the Excise indicates either inefficiency in tax administration or the existence of black market for taxable goods. High proxy base-to-income elasticity reflects a faster growth in manufacturing output relative to GDP. Income tax had base to income elasticity of 0.988, but reported tax-to-base elasticity of 0.192. This could signify tax evasion.

Decomposition of the tax-to-income elasticity into its constituent parts, i.e. tax-to-base and base-to-income (GDP) as shown in table 1 showed that the inelasticity of the Kenya tax system is due to the low tax-to-base elasticity of individual taxes since the base-to-income elasticities for all taxes were approximately above unity. The tax-to-income elasticity can be improved by raising the responsiveness of the individual taxes to the base.

3.2 Conclusions.

We therefore conclude from the findings that the major tax components are tax-to-base inelastic, but Import duties, Excise duties and Sales tax/VAT showed base-to-income elasticity of above 1, while income tax had approximately unity base-to-income elasticity, hence to the concluding that, DTMs impact favorably to all major taxes and therefore implying that that lager percentage of tax revenue comes from discretionary tax policy and not from pure responsiveness of tax revenue to changes in national income.

3.3Recommendations

Although there were major tax administration reforms in 1995 during the formation of KRA with the aim of enhancing efficiency in tax collection and reduction of tax evasion. Based on the findings of this study the problems of inefficiency and evasion seem be prevailing, we therefore recommend a revision of the tax modernization strategies in the country so as to close the lope holes in the system as well as streamlining the conduct of taxation system.

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APPENDIX

Table 1: A decomposition of the tax-to-income elasticity of major tax components, 1985-2009

Type of tax	Tax-to-base-Elasticity	t-ratio	p-value	Base-to-income-elasticity	t-ratio	p-value
Income tax	$0.192^{\Delta n}$	0.674	0.507	$0.988^{\Delta n}$	12.913	0.0000
	0.221^{r}	2.475	0.022	1.065^{r}	49.276	0.0000
Import duties	$0.016^{\Delta n}$	0.537	0.596	$2.519^{\Delta n}$	1.241	0.228
	0.165^{r}	2.575	0.018	1.238^{r}	8.293	0.000
Excise duties	$0.159^{\Delta n}$	0.715	0.482	$1.121^{\Delta n}$	7.155	0.000
	0.166^{r}	2.741	0.013	1.188^{r}	10.437	0.0000
Sales tax/VAT	$0.159^{\Delta n}$	0.715	0.482	$1.121^{\Delta n}$	7.155	0.0000
	0.166^{r}	2.741	0.013	1.188^{r}	10.437	0.0000

Source: Research data 2012

Table 2A: Regression results of tax-to-base elasticity

Tax revenue	elasticities	t-statistics	p-value	R^2	DW
Income tax	0.9706	33.576	0.0000	0.980	0.365
	0.1917	0.6736	0.5075	0.020	0.723
	0.2205	2.474	0.022	0.234	0.743
Import Duties	0.8477	10.041	0.0000	0.8143	1.0594
	0.0163	0.5368	0.5968	0.0129	0.6087
	0.1649	2.5745	0.0181	0.249	0.824
Excise duties	0.8965	33.007	0.0000	0.9793	0.3907
	0.1593	0.7152	0.4820	0.0227	0.7341
	0.1657	2.7411	0.0125	0.2730	0.7391
Sales tax/VAT	0.897	33.007	0.0000	0.9795	0.3907
	0.1593	0.7152	0.4820	0.0227	0.7341
	0.1657	2.7411	0.0125	0.2730	0.7391

Source: Research data 2012

Table 2B: Regression results of base-to-income elasticity

Tax revenue	elasticities	t-statistics	p-value	R^2	DW
Income tax	1.0112	252.69	0.000	0.9996	0.9350
	0.9879	12.9133	0.0000	0.8834	2.3066
	1.0653	49.2760	0.0000	0.9918	1.0689
Import Duties	0.9578	10.359	0.0000	0.8235	1.2897
	2.5190	1.2406	0.2278	0.0653	1.1992
	1.2383	8.2935	0.0000	0.7747	0.8713
Excise duties	1.0938	140.570	0.0000	0.9988	1.0355
	1.1216	7.1552	0.0000	0.6994	2.3570
	1.435	21.524	0.0000	0.9586	0.5286
	1.1878	10.437	0.0000	0.8514	2.0617
Sales tax/VAT	1.0938	140.570	0.0000	0.9988	1.0355
	1.1216	7.1552	0.0000	0.6994	2.3570
	1.435	21.524	0.0000	0.9586	0.5286
	1.1878	10.437	0.0000	0.8514	2.0617

Source: Research data 2012

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