BUOYANCY AND ELASTICITY OF TAX: EVIDENCE FROM GHANA

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Abstract

In public finance, two important measures that have been used to assess the efficiency of any tax system in terms of its mobilization capacity are tax buoyancy - total response of tax revenue to changes in national income and discretionary changes in tax policy over time; and tax elasticity - automatic response of tax revenue to GDP changes less the discretionary tax changes. In this study, we used the Dummy Variable Technique to control for effects of the Discretionary Tax Measures on Historical Time Series Data for the period 1970-2007 to estimate the elasticity of the Ghanaian tax system.

Our findings revealed that the overall tax system in Ghana was buoyant and elastic in the long run and buoyancy exceeded the elasticity, but in the short run the reverse was the case. We also observed an improvement in both buoyancy and elasticity over the reform period (1985-2007) as evidenced in pre-reform buoyancy and elasticity coefficient which were generally less than unity but became greater than one after the reform. Decomposition of the buoyancy coefficients into tax-to-base and base-to-income elasticities showed that the former was greater than the latter by their indices indicating that there is potential revenue in the economy which is untaxed. Overall tax elasticity was estimates to be about 1.03, suggesting that the responsiveness of the tax system to a unit change in GDP was more that unity thereby rejecting the hypothesis that the overall tax system is income inelastic in the long run. General and specific recommendations aimed at improving tax collection are made.

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Wagner's law stipulates that public expenditure is a natural consequence of economic growth (Demirbas, 1999). Many developing countries including Ghana in their attempt to increase growth have increased public expenditure but not been able to match it with revenue mobilization through taxation and has resulted in huge budget deficit. Economic theory posits that instability in an economy may arise out of deficit financing mainly

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through foreign borrowing which may affect domestic interest rates, balance of payments and the exchange rate of the domestic currency relative to other currencies and consequently may plunge the economy into crisis. Various efforts aimed at obtaining optimal fiscal policies with emphasis on the role of taxation as an instrument of economic development has been implemented but the results seem not to be that encouraging. Information from the World Development Indicators of the World Bank indicates that tax revenue in Ghana as a ratio of Gross Domestic Product (GDP) is about 14% in 2007, lower than the sub Saharan African average of 18%. The responsiveness of tax to income changes is an important indicator used in projecting tax revenue and a simple criterion for assessing a good tax system. This responsiveness is measured using two concepts - tax elasticity and buoyancy. While tax elasticity measures the response of revenue to income changes, net of discretionary tax measures, tax buoyancy measures the total response of tax revenue to changes in income.

In the early 1980 the economy of Ghana was in a virtual state of collapse. An attempt to revive the economy led to the introduction of the Economic Recovery Programme (ERP) in 1983. One of the main aims of the ERP was to increase domestic revenue mobilization to meet expenditure demands. As such major reforms involving granting autonomy to Revenue Agencies, the introduction of the Value Added Tax (VAT) to replace the sales tax which has a wider tax base and more recently the establishment of the Large Tax Payers unit and the Revenue Agencies Governing Board to improve tax administration, as well as the partial removal of exemptions, harmonization of customs duty rates, narrowing the tax rate bands, reduction of tax rates, introduction of vehicle insurance tax (VIT) and tax stamps for the informal sector have been implemented. Since the introduction of these reforms, not much has been done to assess the elasticity and buoyancy of the tax system. Research questions which arise are: What is the value of buoyancy and elasticity of different taxes? What is the tax buoyancy and elasticity of the overall tax? Has the reforms improved tax elasticity and buoyancy? The aim of this study is to analyze the buoyancy and elasticity of the Ghanaian tax system by estimating their numerical values for the overall tax system and the individual tax categories and to examine the extent to which these indices explain tax revenue performance in terms of adequacy and resource allocation in the country.

This study is very important as it will help ascertain if the government is keeping track on tax mobilization with GDP growth. Additionally, estimation of individual tax buoyancy and elasticity would help the fiscal authorities to identify those taxes which are income elastic or otherwise and therefore aim at directing their efforts at the more elastic ones to raise overall tax revenue. Furthermore, estimation of decomposed buoyancy in the periods 1970-1984 and 1985-2007 will help shed more light on the weaknesses and strengths of the systems that existed before the reforms and what pertains today and consequently identify issues that need improvement and restructuring by the tax authorities.

The study has 6 sections. Section 1 introduces the study while section 2 discusses the overview of tax administration reforms in Ghana. Section 3 reviews the literature on the subject and section 4 discusses the methodology. Sections 5 discuss the results of our estimations while the last section concludes the paper and make policy recommendations.

OVERVIEW OF TAX ADMINISTRATION REFORMS IN GHANA

Tax administration in Ghana has a relatively long history. Information from the Internal Revenue Service (IRS) indicates that the first customs law was passed under colonial rule in 1855 and later replaced in 1876 by a customs law based on the United Kingdom Customs Consolidated Act, 1876. The tax authorities were responsible for collecting Import Duty, Export Duty and other taxes. The Income Tax Ordinance of 1943 introduced taxation on income. Initially taxes were collected from a few companies and a very small number of individuals. Over the years, other taxes and duties such as Mineral Duty 1952, Betting Tax 1952 and Casino Revenue Tax 1955 were added to the Income Tax. Between 1961 and 1963, additional taxes and duties such as Property Tax (1961), Entertainment Duty Tax (1962), Airport Tax, Hotel Customers Tax, Standard Assessment and Excess Profit Tax were introduced. Tax administration reforms in Ghana have undergone major reforms since the ERP. Specifically, two Laws - Customs, Excise and Preventive Law, Provisional National Defense Council (PNDC) Law 144 and the Internal Revenue Service Law (PNDC Law 143), were passed in 1986 which granted full operational and partial financial autonomy to these institutions. In line with the harmonization of tax administration and policies and to adhere to global trends, the Value Added Tax (VAT) was introduced under legislative Act 546, in 1995 with the responsibility of administering general consumption tax. All these measures had positive impact ontax collection.

The current tax structure is therefore diversified comprising two main direct taxes - individual income tax and corporate tax and three main indirect taxes -Value Added Tax, excise and customs duties. In the area of direct taxes, major reform initiatives include the amendment of the Internal Revenue Service (IRS) Act, 2000, (Act 592) to give a proper administrative policy direction and to enable the administration of taxes in an efficient and effective manner, the introduction of a common nationwide Tax Identification Number (TIN) to replace the local registration numbers, simplification of self-assessment procedure, establishment of Large Taxpayers' Unit and the introduction of Tax Stamps among others. In the area of indirect tax, the introduction of VAT, Act (546) in 1995 to replace Sales and Service tax, widening of VAT net, strengthening of VAT administration, amendment of Customs Act, improvement in information system, establishment of the Ghana Community Network (GCNet) Services, establishment of the Revenue Agencies Governing Board (RAGB) (Act 558) and the establishment of the National Tax Audit Team are the main reforms in the sector.

Income taxes levied under the Internal Revenue Act, 2000, (Act 592) and its amendments comprises personal income tax, corporate tax, withholding tax, rental income tax and tax on interest, among others. Personal income tax which is levied on formal sector employees is the most important in Ghana and charged at a graduated scale. The rate structure has always been progressive, but the level of exempted income and the progressivity of the rates are often modified under political motivation. The Value Added Tax is a multi-stage consumption tax based on the destination principle and applied to the sale of goods and services at all stages of the production and distribution chain. Currently a fixed rate of 12.5% is applied with the exception of some commodities such as produced text and exercise books, locally manufactured agricultural machinery, implements and foodstuffs produced in Ghana and sold in their raw state. Excise Duty is collected on only petroleum, cigarettes, beer, spirits and some soft drinks. Customs duty is levied on the Cost, Insurance and Freight (C.I.F.) value of imported goods while Import Duty is levied only on goods imported into the country. Apart from a few items which are exempted from payment of customs duties, all imports attract import duties. The current structure of the tariff bands are 0% for raw materials, 10% for intermediate goods and 15% for finished product and are basically *ad valorem* for most items.

There exist other taxes such as export tax on cocoa beans and hydrocarbon oils and "Miscellaneous Taxes" such as capital gain tax, gift tax, mineral royalties, stamp duties, business registration fees, vehicle insurance tax and the Communication Services tax. Also, there are other levies on services such as the Educational Trust Fund and National Health Insurance Levies which attract 2.5% each on incomes. Additionally, there are numerous taxes and levies that are being charged at metropolitan, municipal and district assemblies. These taxes have not been covered in this study as it was not possible to isolate the impact of discretionary tax measures and the contribution of these taxes to the total tax revenue are not significant.

In recent years, tax collections have increased from about GHC 423.58 million in 2000 to about GHC 3971.42 million in 2008 at an average annual growth of about 33 %. In terms of collection of the various agencies as a percent of total tax, collection by Customs Excise and Preventive Services (CEPS) alone is more than that of the other two agencies. CEPS collections have averaged about 54% of total tax revenue. About 40% of these collections come from Import VAT which is eventually credited to the accounts of VAT services in addition to the Domestic VAT thereby making VAT a better performing tax in Ghana. Import duties form about 30% of CEPS revenue while the rest comes from National Health Insurance Levy (NHIL), Petroleum Tax and Export duty which together form about 30%. Tax collected by the VAT Services' is below 15% of total tax revenue except 2007 and 2008 which inched up slightly above the 15%. Collection by IRS over the period (table 1) is slightly above 30% of total tax revenue with 45 % coming from company tax and 30% from personal Income. The rest comes from the other taxes in the sector.

Table 1: Tax Revenue by Agencies, 2000-2008 (in % of Total Tax Revenue)

Agency	2000	2001	2002	2003	2004	2005	2006	2007	2008
IRS	31.9	32.4	33.0	32.0	32.0	31.3	31.0	30.0	33.0
VATS	13.6	11.6	12.7	11.9	12.7	13.6	15.0	15.3	15.5
CEPS	55.5	56.0	54.3	56.1	55.3	55.1	54.0	54.7	51.5
TOTAL*	**423.58**	**655.7**	**860.81**	**1278.28**	**1686.5**	**2057.6**	**2370.82**	**3040.23**	**3971.42**

Source: Author's computation *Note: * Totals are actual values in million Ghana Cedis*

In spite of the efforts that are being made, there are some challenges in tax administration. Tax revenue to GDP remains low at about 14% in 2007 compared to sub Saharan African average of 18%. Also, the heavy reliance on Indirect Taxes poses a major challenge. About 70% of total tax revenue in Ghana is comprised of indirect taxes - mainly VAT and trade taxes. Revenue from direct taxes has risen over the last decade but has never exceeded 30% of total tax revenue. Additionally, the narrow tax base presents a risk to the government and poses a serious challenge. Disaggregated data reveals that the tax system depends on a small number of large taxpayers who contribute the largest share of tax revenue – about 60% of the total income tax and 90% of the total turnover for VAT purposes.

LITERATURE REVIEW

Theoretical Literature

Hindrichs (1966) and Musgrave (1969) explained the role of various tax categories in determining *tax effort* that expresses the ratio of the actual tax collected to potential tax and used as an indicator of how much a country is utilizing its taxable capacity. According to the authors, the four main approaches to assess tax performance are- ability to give up approach, efficient resource use approach, ability to collect approach and comparison with average performance (stochastic) approach. The commonly used approach for measuring tax effort is to regress the tax to output ratio on a set of variables including the major determinants of output (Bahl, 1971; Chelliah, 1971) that serves as proxies for *tax handles*. The predicted tax ratio therefore gives the ratio that the country would have if it had made the average tax effort. Thus, it becomes a measure of the taxable capacity of the country while the regression coefficients act as the *average* effective rates on the base.

The tax effort approach to measuring tax performance is termed "static" in that it gives the potential for tax increase at a given point in time through comparisons with other

countries. However, in order to determine if a country has made efforts at increasing tax revenue over a period - tax performance in the dynamic sense which measures the sensitivity and response of the tax system with respect to income/GDP such as tax buoyancy should be used. The buoyancy of a tax system reflects the total response of tax revenue to changes in national income as well as discretionary changes in tax policies over time. Though closely related to buoyancy, the elasticity of the tax system measures the responsiveness of tax revenue to changes in national income resulting from discretionary changes in the tax structure. Hence, in estimating the elasticity of the tax system, one must correct for the effects of discretionary changes in tax policy on historical tax revenue series.

It is important to obtain both the buoyancy and elasticity of the tax system because the responsiveness of tax revenue to changes in GDP is of two types – automatic response to GDP change and the response resulting from discretionary changes in the tax policy such as changes in the tax rate and/or base; changes in the efficiency of tax administration; the introduction of new taxes and the abolition of others, etc. Therefore, historical tax revenue series have to be refined by adjusting them to exclude revenue changes attributable to discretionary measures. Estimating the income tax elasticity is useful for displaying the extent to which tax system is responsive to changes in the tax composition and the value of GDP (Teera, 2002). When the elasticity of major revenue sources remains low either due to low base or evasion or avoidance, the governments raise additional resources through discretionary measures. Then, the growth of tax revenue comes through high buoyancy rather than through elasticity. The coefficient of elasticity depends on the level of tax base to changes in income. This makes it possible to break up the value of elasticity into two components - the response of the tax base to a change in income, and the response of the tax yield to a change in the tax base of individual taxes through decomposition of elasticity (Musgrave, 1959). The value of base-to-income elasticity does not depend on the progressivity of tax rates; it simply relates the responsiveness of the tax-base to a change in income. The growth of the base depends on the way the structure of the economy changes with economic growth. The tax-to-base elasticity depends on the tax rate; if the rate structure is progressive or if there is an improvement in tax administration; the tax-to-base elasticity will be raised by preventing evasion. The decomposition of elasticity in this manner permits us to identify the source of growth of tax revenues.

Empirical Literature

There are several empirical works that have measured the impact of GDP on tax revenues. Osoro (1993) examined the revenue productivity implications of tax reforms in Tanzania for the period 1979 to 1989. In the study, the tax buoyancy was estimated using double log form equation and tax revenue elasticity using the proportional adjustment method. The result gave an overall elasticity of 0.76 and a buoyancy of 1.06.The study concluded that tax reforms in Tanzania had failed to raise tax revenues. These results were attributed to the government granting numerous tax exemptions and poor tax administration within the sample period. In another study, Osoro (1995) estimated the individual tax elasticity and that of the overall tax system from 1970-1980. He established that the elasticity of the overall tax system declined from 0.85 in 1970 to 0.782 in 1980. Income tax and Sales tax, which were elastic in the 1970s, became inelastic in the 1980s. Import duty, which was inelastic in the 1970s, became elastic in 1980s. He attributed these changes to reduction in import duty rates and a rise in imports, rapid changes in the tax base, stemming from steep exchange rate depreciation.

Ariyo (1997) evaluated the productivity of the Nigerian tax system for the period 1970-1990 using the double log form and the proportional adjustment methods. His results revealed an overall satisfactory tax productivity level but wide variations in the level of tax revenue by various tax sources attributable to the laxity in administration of non-oil tax sources during the oil boom periods. Chipeta (1998) studied the effects of tax reforms on tax yields in Malawi for the period 1970 to 1994. The results indicated buoyancy of 0.95 and an elasticity of 0.6 and concluded that the tax bases had grown less rapidly than GDP. A study by Kusi (1998) on tax reform and revenue productivity of Ghana for the period 1970 to 1993, using the Proportional Adjustment method established a pre-reform buoyancy of 0.72 and elasticity of 0.71 for the period 1970 to 1982. The period after reform, 1983 to 1993, showed increased buoyancy of 1.29 and elasticity of 1.22. The low buoyancy and elasticity during the pre-reform period was attributed to smuggling, unrecorded trade, tax evasion and laxity in tax collection. The study concluded that the reforms had contributed significantly to tax revenue productivity from 1983 to 1993.

Faiz Bilquees (2004) studied the Elasticity and Buoyancy of the Tax System in Pakistan by using the Divisia Index method over the 1974/75 to 2003/04 period. The results gave a total tax buoyancy and elasticity after the reform as 0.92 and 0.88 respectively and concluded that, overall the use of discretionary tax measures has been relied upon significantly as a source of revenue in Pakistan. Using the dummy variable method, Kabbashi (2005) looked at the impact of trade liberalization on revenue mobilization and stability in Sudan. The result revealed that the overall elasticity was inelastic with an index of 0.82 whiles the elasticities of the individual taxes were divergent with the following indices: import duty - 0.83, Excise tax - 0.82, income tax - 1.26 and profit tax - 1.57. The conclusion was that less

buoyant and elastic system provides an explanation for the low tax efforts and the relatively low and declining government spending.

Ayoki et. al (2005) researched on the tax reforms and domestic revenue mobilization in Uganda by using the proportional adjustment method. Their findings revealed that, reforms had a positive impact on direct taxes as tax-to-income elasticity index grew from 0.706 to 1.082 after the reforms whiles indirect taxes also moved from 1.037 to 1.306. They concluded that the reform was necessary to the economy but there was more room for improvement. A study by Muriithi and Moyi (2003) on Kenya showed that tax reforms had a positive impact on the overall tax structure and on individual tax handles except VAT which failed to respond to changes in income. Brafu-Insaidoo and Obeng (2008) studied the effect of import liberalization on Tariff revenue in Ghana for the period 1966 to 2003, using the Singer (1968) approach to estimate the duty buoyancy and elasticity. The result indicated overall buoyancy of 0.556 and elasticity of 0.282. The period before import liberalization (1965-1982), gave buoyancy of 0.33 and elasticity of 0.814, and for the period after the import liberalization (1983-2003), buoyancy was 0.313 and elasticity was 0.049. From the result, duty buoyancy outweighed duty elasticity for the entire study period, meaning that discretionary tax measures (DTMs) have improved tariff revenue mobilization over the period.

Choudhry (1979) estimated the elasticity of tax revenue of the United States, United Kingdom, Malaysia and Kenya. The overall elasticities were 1.04 and 1.24 for the United States and United Kingdom respectively. Malaysia and Kenya had slightly higher elasticities of 1.57 and 1.32 respectively. Estimation of buoyancy revealed that in the United States and the United Kingdom, revenue reducing discretionary changes in income taxation contributed to the low buoyancy and elasticity, while in Malaysia and Kenya, revenue increasing DTMs contributed to the comparatively higher buoyancy and elasticity. Comparism of the Proportional Adjustment method, Constant Rate method and the Divisia index method to estimate the elasticity revealed that while proportional adjustment method gave estimates closer to those of the Divisia index, the constant rate structure approach uniformly gave the lowest estimates.

Our study differs from others conducted in Ghana in that it adopts the Dummy Variables Approach to correct for the effects of DTMs unlike that of Kusi (1998) which used the Proportional Adjustment Approach applicable to estimated tax data but not actual data. Insaidoo and Obeng (2008) albeit used the Dummy Variable Approach but focused on the effects of import liberalization on only one tax category -Import Tariff revenue unlike our study which considers the overall tax as well as the other taxes. Additionally, both studies by Kusi (1998) and Insaidoo and Obeng (2008) evaluated the long run effect of a policy unlike our study which evaluates both the short-run and long-run impacts of tax reforms.

METHODOLOGY

Tax Elasticity

One of the commonest and most important empirical issues in applied public sector economics is to estimate the likely behavior of tax receipts in relation to changes in the tax base. Mathematically tax elasticity can be expressed as:

$$E_{tY} = \frac{\%\Delta T}{\%\Delta Y} = \frac{\Delta T}{T} \times \frac{Y}{\Delta Y} = \frac{\Delta T}{\Delta Y} \times \frac{Y}{T}$$

where T is Tax Revenue, Y is GDP and E_{TY} is income elasticity of tax.

A tax system is considered elastic if the incremental tax revenue/national income ratio is greater than the average/national income ratio given that the tax structure does not change. Income elasticity of a given tax is determined by the relationships between the marginal rate of taxation, average rate of taxation, marginal share of tax base in national income and average share of tax base in national income (Ghai, 1966). A given tax is said to be elastic if the marginal tax rate exceeds the average tax rate, given that the average share of tax base in national income remains constant. The tax elasticity will be unitary if the marginal and the average rates of taxation are equal and it becomes inelastic if the marginal is less than the average rate of taxation. Therefore a tax with a progressive rate structure may be income inelastic and a tax with a regressive rate structure may be income elastic provided the marginal share of tax base to national income exceeds the average rate.

Conventionally, the elasticity of total tax revenue to income is presented in an aggregate form as a single value, but realistically the overall elasticity of a tax system is the weighted average of the sum of individual tax elasticity that responds in various ways to changes in income. This implies that an evaluation of the overall tax elasticity must begin with an examination of the individual elasticities. Jenkins (2000) defined these elasticities as follows:

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Elasticity of total tax revenue to income : $$ET_{tY} = \frac{\Delta T_t}{\Delta Y} \times \frac{Y}{T_t}$$

Elasticity of k^{Th} individual tax to income: $$E_{kY} = \frac{\Delta T_k}{\Delta Y} \times \frac{Y}{T_k} \quad (1)$$

Elasticity of the k^{Th} individual tax to base: $$\mathrm{E}T_k B_k = \frac{\Delta T_k}{\Delta B_k} \times \frac{B_k}{T_k} \quad (2)$$

Elasticity of k^{Th} individual base to income: $$\mathrm{E}B_{kY} = \frac{\Delta B_k}{\Delta Y} \times \frac{Y}{B_k} \quad (3)$$

Where T_t is total tax revenue, Y is income (GDP), B_k is base of k^{th} tax, T_k is revenue from k^{th} tax. Given these definitions of elasticity, it follows that in a system of n taxes:

$$\mathrm{E}T_{tY} = \frac{\Delta T_t}{\Delta Y} \times \frac{Y}{T_t} = \frac{T_1}{T_t}\left(\frac{\Delta T_1}{\Delta Y} \times \frac{Y}{T_1}\right) + \frac{T_2}{T_t}\left(\frac{\Delta T_2}{\Delta Y} \times \frac{Y}{T_2}\right) + ... + \frac{T_n}{T_t}\left(\frac{\Delta T_n}{\Delta Y} \times \frac{Y}{T_n}\right) \quad (4)$$

where subscripts *1*, *2* and *n* refer to the different individual taxes which are expressed as a ratio of total tax revenue indicated by the subscript *t* to give the individual tax weight. The elasticity of any individual tax with respect to income may be decomposed into the product of the elasticity of the tax-to-base and the elasticity of the base-to-income. Mathematically

$$\mathrm{E}T_{kY} = \left(\frac{\Delta T_k}{\Delta B_k} \times \frac{B_k}{T_k}\right)\left(\frac{\Delta B_k}{\Delta Y} \times \frac{Y}{B_k}\right) \quad (5)$$

Combining equations (4) and (5) gives:

$$\mathrm{E}T_{tY} = \sum_{i=1}^{n} \frac{T_i}{T_t}\left[\left(\frac{\Delta T_i}{\Delta B_i} \times \frac{B_i}{T_i}\right)\left(\frac{\Delta B_i}{\Delta Y} \times \frac{Y}{B_i}\right)\right] \quad (6)$$

Equation (6) implies that the elasticity of total revenue in a system of *n* taxes depends on the product of the elasticity of tax base to income for each individual tax, weighted by the importance of each tax in the overall tax system (Osoro, 1995).

The calculation of tax elasticity excludes the impact of discretionary policy changes. The most important use of tax elasticity is to identify which taxes are naturally elastic. An elastic tax system enables the public sector to appropriate a growing share of the marginal increases in income. With an inelastic tax system, a rising public expenditure is financed either through higher money supply with all the attendant problems of inflation

and balance of payment crises, or by annual upward revisions of the existing tax rates. Also, an elastic tax system is efficiency and acts as an instrument of stabilization.

Buoyancy of Tax

The global buoyancy of a tax system is usually measured by the proportional change in total tax revenue with respect to the proportional change in national income and can be expressed as:

$B_{TY} = \frac{\Delta T}{\Delta Y} \times \frac{Y}{T}$, where T is total tax revenue, Y is income/GDP. The global buoyancy can be decomposed into individual tax buoyancy as:

$$B_{TY} = \frac{T_1}{T_t} B_{T_1 Y} + \frac{T_2}{T_t} B_{T_2 Y} + \ldots + \frac{T_n}{T_t} B_{T_n Y}$$

Where:
$T_t = T_1 + T_2 + \ldots + T_n$ and n is the number of taxes. The global buoyancy is a weighted sum of the individual tax buoyancy (Sohato, 1961) and used to obtain the elasticity of tax revenue with respect to *tax-to-base* and *base-to-income* as:

$$Tax - to - base - elasticity = \frac{\Delta T}{\Delta B} \times \frac{B}{T}$$

And

$$Base - to - income - elasticity = \frac{\Delta B}{\Delta Y} \times \frac{Y}{B}$$

Thus, global buoyancy

$$B_{TY} = \left(\frac{\Delta T}{\Delta B} \times \frac{B}{T} \right) \times \left(\frac{\Delta B}{\Delta Y} \times \frac{Y}{B} \right)$$

MODEL SPECIFICATION

To estimate the built-in elasticity of a tax system, the historical tax revenue data need to be refined to exclude revenue changes attributable to discretionary measures. Two techniques - historical time series tax data (HTSTD) adjusted for (DTMs) and the unadjusted (HTSTD) with dummy variables introduced as proxies for (DTMs) are used to clean data in order to control for the impact of the (DTMs) and hence obtains estimates of tax elasticity. The usual practice in the former technique is to run the proportional adjustment for cleansing the (HTSTD) – as in Mansfield (1972), Kusi (1998) and Osoro (1993) – or to use the constant rate structure as in Andersen (1973) and Choudhry (1975). In the latter technique a Divisia index has been used as in Choudhry (1979) and sometimes simple or mixed dummies are used as proxies for each DTM over the estimation period as in Singer (1968) and Artus (1974).

A complete adjustment of historical revenue series is not possible in any of the methods. The Proportional Adjustment method requires the use of budget estimates of tax yields resulting from discretionary changes. Not only are such data difficult to obtain, their reliability is questionable as the actual discretionary outcomes may differ significantly from the changes proposed in the budget. The data on discretionary revenues provided by Revenue Agencies are incomplete and may suffer from the non-implementation of measures proposed in the budget. The Constant Rate Structure method requires data on effective tax rates and the changing composition of the availability of data (Anderson, 1973). The Divisia Index method uses only historic data and does not require the collection of specific information on revenue effects of discretionary tax changes, or on the frequency of past discretionary tax changes though it may underestimate or over-estimate the revenue effects of discretionary tax, change in case of large revenue effects. The dummy variable method does not require the use of disaggregated data on taxes, but it cannot be used properly when discretionary tax changes are quite frequent in the past. Furthermore, even if the discretionary changes are not many, the specification of the estimation equations can be problematic unless there is information on the nature of the tax changes and the extent to which their effects are independent of one another.

This study adopts the unadjusted Historical Time Series Tax Data (HTSTD) with time trends or dummy variables incorporated as proxies for discretionary tax measures as in Singer (1965) and Artus (1974) to evaluate the buoyancy and elasticity of the tax system due to its non –intensive data requirement and the non-requirement of disaggregated data set as compared to the other methods.

Buoyancy and Elasticity of Tax

We begin by specifying a Cobb-Douglas function of the form:

$$\log TR = \log\alpha + \beta \log Y + \varepsilon \quad (7)$$

Ordinary Least Square (OLS) is then applied to estimate the parameters *a* and β, where the coefficient β is an estimate of tax *buoyancy* and ε is the stochastic term. From the above relationship, *elasticity* estimates is obtained by replacing historical tax revenue series by tax revenue series at a constant tax structure. The revenue at a constant tax structure is obtained from the historical series of tax revenue by cleaning the tax series for effect of changes in tax rates and tax base during the reference period. This requires information on the revenue effects of DTMs introduced in the reference period which is under the manipulation of policy maker unlike non-discretionary changes that are due to natural growth of the economy. From equation (7) the tax buoyancy can be decomposed into two:

Tax-to-Base component: $\log TR_k = \alpha_o + \alpha_k \log B_k + \nu \quad (8)$

Base-to-Income component: $\log B_k = \delta o + \delta_k \log Y + \mu \quad (9)$

Where TR_k is the unadjusted HTSTD of the k^{th} tax, B_k is tax base for the k^{th} tax, Y is nominal GDP which is the overall base, a_k is elasticity of the k^{th} tax to its base, δ_k is the elasticity of k^{th} tax base to income, a_o and δ_o are constants and ν and μ are stochastic error terms.

With the help of the two kinds of elasticity we obtain the elasticity of the k^{th} tax to income H_K as the product of a_k and δ_k. To capture the effects of the reforms in the short run, a dummy variable *D* is introduced into the decomposed elasticity equations above. The modified short run elasticity and buoyancy functions are:

$$\log TR_k = \alpha_0 + \alpha_k \log \beta_k + \sum_{i=1}^{k} \alpha_{2i} D_i + \upsilon_k \quad (10)$$

$$\log B_k^t = \delta_0 + \delta_k \log Y + \sum_{i=1}^{k} \delta_{2i} D_i + \mu_k \quad (11)$$

Where α_{2i} and δ_{2i} are the dummy coefficients and the summation sign represents the total DTMs under the reforms.

The Dummy Variable Approach makes use of unadjusted historical time series tax data with time trends or dummy variables incorporated as proxies for DTMs. This is done to capture the elasticities. From equation (7) the empirical model can be expressed as:

$$\log TR_t^k = \log \alpha + \beta_1 \log Y_t + \beta_2 \log Y_{t-1} + \sum_{i=1}^{k} \beta_{3i} D_i + \varepsilon_t \qquad (12)$$

Where TR_t^k denotes tax revenue for k^{th} tax, β is the elasticity and D is the dummy variable, which takes a value of one for discretionary tax measures and zero otherwise. The summation accounts for the multiple discretionary tax changes over the sample period. Two dummies are considered here - a tax reform dummy, D_{1985} introduced to capture tax reforms undertaken in 1985 to accommodate the fiscal policies of the ERP and an interactive term D_{slope}, which is the slope of the tax revenue function as a result of the tax reforms. The expectation is that over this period not only the intercept but also the slope of the function may change. D_{slope} is defined as $TR \times D_{1985}$. The lagged base is introduced to account for the administrative efficiency, or otherwise, in tax collection. The error term is assumed to follow one-way error specification as: $\varepsilon_t = \nu_t + \mu_t$.

Estimation Technique

The Engle-Granger two steps Cointegration procedure was used to establish the long-run relationship between the relevant variables and to generate the Error Correction term for the aggregate and individual tax functions. The Durbin Watson Statistic (DW) is used to detect the presence of serial correlation in the data set (Hendry and Doornik, 2001). We segment the study period (1970 to 2007) into two - pre tax reform period (1970 to 1984) and post tax reforms period (1985 to 2007). The parameters in the estimated regression models are used to represent the tax buoyancy or the income elasticity of the tax base and tax yield functions. The analyses were done using PcGive 10 econometrics software.

We considered 5 different types of tax : aggregate tax revenue function and the individual taxes that forms the total tax in the analysis of buoyancy. With regards to the proxy tax base for the taxes considered in this study, there is no precise legal definition for tax bases and this is a limitation to the tax data set. Mtatifikolo (1990) argues that proxy bases are what is considered a reasonable representative of the component of national wealth of transactions upon which a particular tax can be assessed. The World Bank (1984) estimate the tax elasticity of the Ghanaian tax system for the period 1970/71-1980/81 – using GDP, private consumption expenditure, non-oil imports and cocoa export receipts as proxy base for income tax, taxes on domestic production and consumption (i.e. excise tax and sales), import duty and export tax respectively. This study adopts some of the proxies (table 2) used by the World Bank, Osoro (1993) and Kusi (1998) largely as a result of data limitations.

The relevant data set for the period 1970 to 2007 was obtained mainly from Government of Ghana (GoG) - various issues of Quarterly Digest of Statistics (QDS) and Economic Survey Reports of the Ghana Statistical Services, Annual Budget Statement and Economic Policy of the Government from the Ministry of Finance and Economic Planning as well as other data from the Revenue agencies. Information from the International Monetary Fund (IMF) was obtained from the Government Finance Statistics Yearbook.

Table 2: Explanation of Various Taxes and their proxy bases

Tax Type	Definition	Proxy Base	Definition
Total Tax Revenue (TTR)	Summation of all individual tax revenues in Ghanaian tax system.	*Gross Domestic Product (GDP)*	Difference between the Gross National Product and Net Factor Income and used as the proxy base for overall tax system (TTR).
Personal Income Tax (PYTAX)	Tax levied on personal incomes and earnings of employees based on the principle of "Pay as You Earn".	*Current Personal Income (CUPY)*	Defined to include public and private employee emoluments, plus incomes from the trading and commercial sectors as proxy measure of self-employed income.
Company Tax (COTAX)	Tax levied on business incomes and profits.	*Corporate Current Income (COCY):*	Defined to include incomes from the highest concentration of corporate activities, i.e. logging, manufacturing, mining, construction, finance, water and electricity.
Value Added Tax (VAT)	Tax levied on goods and services and it covers both the retail and wholesale sectors..	*Total Private Final Consumption (TPCON):*	Aggregation final private consumption based on the fact that VAT covers both retail and wholesale level of output.
Excise Tax (EXTAX)	Tax levied on goods and services. Usually levied on consumption of selected products like alcohol and tobacco.	*Total Private Final Consumption (TPCON):*	Aggregation final private consumption based on the fact that VAT covers both retail and wholesale level of output.
Import Duty (IMPDU)	Tax levied on all eligible goods entering a country.	*Total Imports (TIMP), c.i.f.*	Value of all goods and services that legally enter the country as recorded in the Balance of Payment (BOP). It includes government imports which do not bear import taxes

RESULTS

Unit Root test results (appendix 1) for the ADF in both levels and first differences of the variables revealed that all the variables are unambiguously integrated of order one indicating that stationary is attained in first difference. Results of the Engle-Granger two-step Cointegration test for the Buoyancy equation (appendix 2) also show that all the residuals are stationary in levels which support the existence of a cointegration relationship in the buoyancy estimation equations of all the variables. Furthermore, all the residuals are stationary in levels (appendices 3 and 4) as depicted by their ADF statistics which are significant and supports the existence of a cointegration relationship in the tax-to-base and base-to- income estimation equations.

All the estimated regression models for the long and short run tax buoyancy model, tax-to-base elasticity, base-to-income elasticity performed well in terms of goodness of fit and joint significance with an Adjusted R^2 of above 81 % and F-statistic, being significant at considerable levels. The diagnostic tests showed that the residuals were normally distributed and stable as indicated by the graphs of the Recursive Residual Test in Appendix 4. Also, the functional forms of the models were correctly specified as shown by the Ramsey RESET Test results in Appendix 5. Where the value of Durbin Watson (DW) statistic suggests high degree of residual autocorrelation, the problem was corrected by the use of first order error process of the r^{th} order autoregressive least squares (RALS), estimation procedure.

Our result (table 3) shows that in the short run the overall tax system and the various tax categories are not buoyant except personal income tax (PYTAX) as indicated by their respective coefficients which are less than one. With respect to company tax (COTAX), one period lagged GDP values exert a positive influence on it and this may be attributed to the institutional rigidities that hinder submission of tax returns on time hence payments are made in arrears. VAT and EXTAX had their dummy variable coefficients being significant, indicating that reforms in the (VAT) tax system had an impact on the tax category in the short run.

Table 3: Estimated Tax Buoyancy Results of the Tax system in Ghana

	Short Run Dynamic				Long Run Static		
Tax equation	Variables	Buoyancy	DW	$\bar{R}^2$	Buoyancy	DW	$\bar{R}^2$
TTR	LGDP**	0.74	2.04	0.91	1.08	1.79	0.93
	ECMTTR_	-0.34					
PYTAX	LGDP**	1.08	2.34	0.92	1.17	2.02	0.92
	$ECMPYT_{-1}$*	-0.25					
COTAX	LGDP**	0.85	2.01	0.94	0.97	1.67	0.95
	$LGDP_{-1}$*	1.05					
VAT/SALES	LGDP**	0.90	1.93	0.95	1.20	1.58	0.96
	DUM*	0.42					
	ECMVAT_	-0.30					
EXTAX	LGDP**	0.83	1.90	0.91	0.89	1.54	0.92
	DUM*	0.47					
IMPDU	LGDP**	0.95	2.15	0.93	1.10	1.92	0.92
	$ECMIMP_{-1}$**	-0.19					

*Source: Authors' Estimation, Note: ** denotes significance at 1% and * denotes significance at 5%*

The negative and significant coefficients of the one period lagged Error Correction Term (ECT_{-1}) for all the models except COTAX could mean that there are economic forces that operate to restore the long-run equilibrium path of revenue following short-run disturbances. For example the TTR and PYTAX regression models had negative coefficients of 0.34 and 0.25 respectively. This means that the TTR model adjusts to its long run equilibrium at a speed of 34% whiles the PYTAX model is doing same at a speed of 25%. The long run buoyancy coefficients for the overall tax system and individual tax categories were more than unity except COTAX and EXTAX. This means that tax revenue from these taxes grow faster than the GDP and could imply that the discretionary changes implemented have generally been effective at increasing the tax revenue for majority of the taxes compared to proportionate change in GDP. Our result is similar to that of Osoro (1993) which provided an overall buoyancy of Tanzania tax system as 1.06 but not in line with that of Chipeta (1998) which established the overall buoyancy of Malawi to be 0.95.

Results from the Decomposition of Buoyancy into tax-to-base elasticity (table 4) indicate that in the long run, the overall tax system and the various tax categories with the exception of IMPDU are elastic as indicated by the tax-to-base elasticity coefficients which are greater than unity. This means that a percentage change in GDP resulted in more than a percentage change in tax revenue from the various tax categories. However, a percentage change in revenue from IMPDU is less than a percentage change in GDP. This results is in line with that of Kusi (1998) which established an overall tax elasticity of 1.22 for Ghana between 1983 and 1993 but does not confirm the findings of Insaidoo

and Obeng (2008) which revealed that income elasticity of Tariff revenue in Ghana was inelastic for the period 1966-2003. The short run results also show that the total tax system and the individual tax categories are not elastic as reflected by the coefficients which are less than unity. The one period lagged COCY's positive influence on company tax could be a reflection of arrangements whereby tax returns are submitted in arrears. The dummy variable coefficient was only significant in PYTAX and EXTAX. This indicates that there is a short run impact of the reforms on these taxes in terms of improving tax-to-base elasticity. The Error Correction Term coefficients are also statistically significant for TTR (-0.34), IMPDU (-0.18) and VAT (-0.28).

Table 4: Estimated Tax-to-Base Elasticity of the Ghanaian Tax System

	Short Run Dynamic				Long Run Static		
Tax equation	**Variables**	**Elasticity**	**DW**	$\overline{R}^2$	**Elasticity**	**DW**	$\overline{R}^2$
TTR	LGDP**	0.74	2.04	0.87	1.08	1.79	0.91
	$ECMTTR_{-1}$**	-0.34					
PYTAX	LCUPY**	0.66	2.23	0.86	1.21	2.03	0.92
	DUM**	0.20					
COTAX	LCOCY**	0.88	2.15	0.86	1.02	1.98	0.87
	$LCOCY_{-1}$*	0.61					
VAT/SALES	LTPCON**	0.70	2.04	0.88	1.09	1.88	0.90
	$ECMVAT_{-1}$*	-0.28					
EXTAX	LTPCON**	0.64	1.98	0.87	1.14	1.67	0.88
	DUM*	0.26					
IMPDU	LTIMP**	0.52	1.79	0.91	0.98	1.55	0.87
	$ECMIMP_{-1}$**	-0.18					

*Source: Authors' Estimation, Note: ** denotes significance at 1% and * denotes significance at 5%*

Results of the estimation of the base-to-Income elasticity models (Table 5) indicate that all the individual tax categories are not base-to-income elastic in the long run except import duty (IMPDU) whose base (TIMP) has a coefficient of more than unity. This seems to justify the concern that the country's tax base is not wide enough to capture many tax payers due to the presence of a significant underground economy thereby resulting in excess burden on few people in the tax net. Similar concerns were also raised by Osoro (1993) and Kabbashi (2005) as the causes of low elasticity in Tanzania and

Sudan respectively. With regards to the short run model, all the individual tax categories are base-to-income inelastic as reflected by the coefficients which are less than unity.

Table 5: Estimated Base-to-Income Elasticity of the Ghanaian Tax System

	Short Run Dynamic				Long Run Static		
Base equation	**Variables**	**Elasticity**	**DW**	$\overline{R}^2$	**Elasticity**	**DW**	$\overline{R}^2$
CUPY	LGDP*	0.74	1.83	0.88	0.81	1.94	0.92
	$ECMCPY_{-1}$*	-0.28					
COCY	$LGDP_{-1}$**	0.89	2.17	0.90	0.75	1.79	0.95
	$ECMCCY_{-1}$*	-0.41					
TPCON	$LTPCON_{-1}$*	0.55	2.22	0.83	1.88	0.89	0.90
	DUM*	0.16					
TIMP	LGDP**	0.77	1.91	0.84	1.17	1.99	0.87
	$LGDP_{-1}$**	-0.61					
	$LGDP_{-2}$*	-0.48					
	$ECMTIM_{-1}$*	-0.62					

*Source: Authors' Estimation, Note: ** denotes significance at 1% and * denotes significance at 5%*

The result also show that in the short run, GDP in first lag has a positive influence on COCY and a negative influence on TIMP and for that matter COTAX and IMPDU respectively. Additionally, it is observed that TPCON in first lag has a positive influence on VAT/Sales Tax and EXTAX. The positive impact of both GDP and TPCON in the first lag may be interpreted as a reflection of institutional arrangements whereby the tax authorities make a refund in case of overpayment since some companies often make upfront payment before their tax liabilities are properly assessed by the tax authorities and the negative influence may be due to corruption on the part of the tax authorities.

Comparison of the performance of the tax system before (1970-1984) and after (1985-2007) the reforms (table 6) indicate that overall tax buoyancy and that of the other tax categories showed a rise after the reform in 1985. Specifically, whiles the overall tax and the individual taxes were not buoyant before the reforms (buoyancy coefficients of less than one) all the taxes except EXTAX became buoyant (buoyancy coefficient more than one) after the reforms. It must be noted that our results for the partitioned periods may suffer from small sample biases especially for a dynamic setting where lags are introduced, and therefore should be interpreted with care.

Table 6: Estimates of Long Run Tax Buoyancies over 1970-1984 and 1985-2007 Periods

Tax Equation	1970 – 1984			1985 – 2007			Difference
	Buoyancy	DW	$\overline{R}^2$	Buoyancy	DW	$\overline{R}^2$	
TTR	0.86	1.93	0.84	1.19	1.98	0.91	0.33
PYTAX	0.89	2.07	0.87	1.24	1.87	0.94	0.35
COTAX	0.77	1.85	0.85	1.12	2.11	0.90	0.35
VAT/SALES	0.87	1.99	0.83	1.41	2.03	0.95	0.54
EXTAX	0.85	2.02	0.83	0.92	1.74	0.86	0.07
IMPDU	0.90	1.80	0.93	1.16	2.01	0.89	0.26

Source: Authors' Estimation

The performance of VAT/Sales tax can be attributed to the fact that VAT which came to replace the Sales Tax has a broader base and captures more tax payers.This result confirms that of Kusi (1995) but contradicts that of Brafu-Insaidu and Obeng (2008) who had realized a marginal drop in duty buoyancy after the trade liberalization policy in Ghana.

Results of the decomposition of buoyancies over the pre-reform and post-reform periods (table 7) indicate that all the tax categories were base-to-income inelastic prior to the reform period. With the reforms, they all became base-to-income elastic except COTAX. The base-to-income inelasticity of the COTAX is indicative of slow growth in taxable corporate income as most of these companies could be making business losses and folding. For instance, the textile industry in Ghana has virtually collapsed due to cheap imports of fabrics, poor performance of the few existing state owned enterprises and many tax holidays granted to new companies. However, COTAX measured by Tax-to-Base elasticity, rose by 22% over the reform period suggesting an improvement in tax administration.

The highest growth of base-to-income occurred in PYTAX during the reform period reflecting the high growth in its base (CUPY) and a high growth of labour share in national income coupled with regular adjustment of nominal wage due to inflation and the administrative measures taken to roll in a greater part of the private sectors into the tax net. There was also an impressive growth in VAT/Sales tax measured in terms of tax-to-base elasticity during the reform period as it grew by over 80% becoming elastic from its inelastic state before the reforms.

The impressive performance in VAT revenue could be attributed to administrative restructuring that saw the establishment of VAT services as an autonomous body whose wider base was very responsive to economic growth. EXTAX performed abysmal with over 20% fall in terms of tax-to-base elasticity over the reform period. This may be

attributed to the decline in growth of excisable commodities and reduction in collection. Also, commodities such as beer, cigarettes and other alcoholic beverages which generate over 80% of the excise revenue are price inelastic hence the cause of the slow growth of the tax base. In a gist, it appears that over the reform period, the high growth of proxy base for personal income tax (PYTAX) in proportion to the GDP, accounts for the rise in tax yield for this tax whiles the price inelastic nature of excisable commodities seems to affect the tax base hence a decline in excise revenue. Efficient tax administration and collection appear to be the main causes of increase in tax effort for Value Added Tax.

Table 7: The Decomposed Tax Buoyancies over 1970–1984 and 1985–2007

Period	1970 – 1984			1985 – 2007			Difference
	Elasticity	DW	$\overline{R}^2$	Elasticity	DW	$\overline{R}^2$	
Base-to-Income Elasticity							
PYTAX	0.75	1.74	0.90	1.14	2.14	0.89	0.39
COTAX	0.81	1.79	0.83	0.93	2.07	0.85	0.12
VAT/SALES	0.79	1.89	0.81	1.11	1.92	0.91	0.32
EXTAX	0.79	1.89	0.88	1.11	1.92	0.82	0.32
IMPDU	0.88	2.04	0.82	1.24	2.30	0.89	0.36
Tax-to-Base Elasticity							
PYTAX	1.13	2.03	0.81	1.57	1.88	0.90	0.44
COTAX	0.87	1.89	0.82	1.09	2.14	0.87	0.22
VAT/SALES	0.72	1.96	0.89	1.31	2.04	0.94	0.59
EXTAX	1.24	1.99	0.83	0.95	1.91	0.90	-0.29
IMPDU	0.91	2.24	0.84	1.29	2.11	0.88	0.38

Source: Authors' Estimation

Using Singer's (1968) technique we estimate the long run elasticities of the total tax revenue and the individual categories of tax. Overall tax elasticity was 1.03. This means that the tax system yielded a more than one percent change in the GDP. The coefficient is significant at 5% level and on that basis we reject the hypothesis that the overall tax system is income inelastic over the long run period. This result is similar to the study by Kusi (1998) on Ghana which also found the overall tax system to be elastic.

Table 8: Estimated Elasticities of the Tax System in Ghana

Tax Equation	Elasticity	Reform Dummy	Slope Dummy	Lagged Base	$\bar{R}^2$	DW
TTR	1.03* (24.17)	- 0.25 (-1.48)	0.35** (7.30)	0.15 (0.54)	0.84	1.84
PYTAX	1.05**(14.82)	- 1.50** (-10.22)	0.45**(10.30)	0.12 (0.48)	0.87	2.09
COTAX	1.09* (9.42)	- 0.29 (-1.71)	0.36** (7.05)	0.56* (1.89)	0.81	1.99
VAT	1.11**(13.75)	- 0.37* (-2.03)	0.51** (9.62)	0.18 (0.58)	0.89	2.00
EXTAX	0.96 (3.05)	0.79 (1.88)	- 0.20 (-1.62)	0.48 (0.68)	0.90	1.64
IMPDU	0.92** (8.24)	- 0.43(-2.32)	0.43** (7.78)	-0.19* (-0.60)	0.87	1.78

*Source: Authors' Estimation, Note: ** denotes significance at 1% and * denotes significance at 5%, t-values are reported in parenthesis.*

Also the elasticities of PYTAX, COTAX and VAT/Sales Tax were found to be greater than unity hence elastic and were significantly different from zero at 1%, 5% and 1% respectively. Thus, we reject the hypothesis that they are income inelastic whiles EXTAX and IMPDU were inelastic. For PYTAX, being elastic over the study period conforms to economic theory as this is a progressive tax and is therefore expected to be elastic. These results conform to the findings of Osoro (1993) in Tanzania and Kusi (1998) in Ghana. IMPDU had a lagged negative (-0.19) base and significant at 5% level. This could be the result of administrative inefficiencies in the collection of this tax hence its low performance. The Reform dummy was significantly negative for PYTAX and VAT at 1% and 5% levels respectively. However, their slope dummies were both significantly positive at 1% making it difficult to assess the impact of the reforms on tax yield from these sources since there are opposing influences from the two dummies. Also, the reform dummy coefficients were not significant for the rest of the taxes, indicating that the tax reforms have not impacted on these revenue sources. This result can be compared to Kabbashi (2005) where trade liberalization dummy and slope shift dummy had opposing influence on income tax yield thereby making it difficult to assess the impact of liberalization on tax yield from this source.

Comparison of Tax Buoyancy and Elasticity over 1970–2007

Summary of estimated values of the buoyancy and elasticity over the sample period (table 9) shows that the estimated coefficients of buoyancy and elasticity is positive for the overall tax and the individual tax categories except for COTAX and EXTAX which were negative. The implication is that the various discretionary tax measures undertaken during the reform period has improved tax yield in these taxes. However the percentage rise in tax yield with respect to GDP was marginal. That is, for any one percent (1%) increase in the national income, the discretionary tax measures mobilized an additional 0.05% of revenue from the overall tax system. For the other tax handles, the discretionary tax policies yielded 0.12%, 0.09% and 0.18% revenue increases in PYTAX, VAT and IMPDU respectively for every 1% growth in GDP.

Table 9: Estimates of Long Run Tax Buoyancy and Elasticity over

Tax Equation	Buoyancy	Elasticity	Difference
TTR	1.08	1.03	0.05
PYTAX	1.17	1.05	0.12
COTAX	0.97	1.09	- 0.12
VAT	1.20	1.11	0.09
EXTAX	0.89	0.96	- 0.07
IMPDU	1.10	0.92	0.18

Source: Authors' Estimation

In contrast, the negative difference implies that the DTMs introduced during the reform period have had adverse effect on COTAX and EXTAX. Specifically, for every 1% rise in GDP, the discretionary tax measures led to 0.12% and 0.07% losses in revenue from COTAX and EXTAX respectively. The loss of revenue from COTAX could be attributed to shrinking of the tax base (corporate income) resulting from weak administration and increasing number of tax holidays and tax exemptions schemes introduced to encourage local production and import-substituting industrialization. The low revenue from EXTAX may stem from the fact that demand for alcoholic beverages, cigarettes and other excisable goods and services frequently rises less quickly than GDP, so excise revenue is likely to be less elastic. This is in line with Kusi (1995) who obtained the following percentage differences: overall tax -*1.5,* personal income tax -*2.42*, company tax - -*1.0*, Sales tax - *1.09*, Excise tax --*10.6*, Import tax -*3.12* and cocoa export tax - *4.21*.

CONCLUSION AND RECOMMENDATIONS

Our result shows that in the short run the overall tax system and the individual tax categories are not buoyant except personal income tax. However, in the long run the overall tax system and individual tax categories were buoyant except COTAX and EXTAX. Results of the estimation of the base-to-Income elasticity models indicate that all the individual tax categories are not base-to-income elastic in the long run except import duty. In the short run all the tax categories were base-to-income inelastic. The long run-base to income elasticity could confirm the fact that Ghana's tax base is not wide enough to capture many tax payers due mainly to the large informal economy which is not virtually taxed.

Comparison of the performance of the tax system before and after the reforms indicates that whiles the overall tax and the individual taxes were not buoyant before the reforms except excise tax; they were buoyant after the reforms. Decomposition of buoyancies over the pre-reform and post-reform periods also indicate that all the tax categories were base-to-income inelastic prior to the reform period but were base-to-income elastic after the reform except corporate tax. This means that the tax reforms have impacted positively on the Ghanaian tax system. Also decomposition of the buoyancy coefficients into tax-to-base and base-to-income elasticities show that the former was greater than the later by their indices hence the gap between them depicts potential revenue in the economy which is untaxed. Overall tax elasticity was estimates to be about 1.03, indicating that the tax system yielded a more than one percent change in the GDP. This permits us to reject the hypothesis that the overall tax system is income inelastic over the long run period.

Measures therefore need to be put in place by government to ensure a broad tax base. Such measures may include creating an enabling business environment (i.e. one-stop business registration centers across the country which will deal with issues of registration, taxation and incentive packages) for companies to flourish to enhance the company tax base, making effort at improving productivity and consequently wages and eventually increasing the base of personal income tax, identifying new items to bring into the tax net such as building plots left idle for at least five years by their owners or raising rates on items with low excise duty such as locally brewed spirit and other alcoholic beverages so as to increase the yield of this tax while curbing the consumption of such commodities. It will also be imperative to strengthening the capacity of the revenue agencies to register more eligible tax payers through the use of ICT and design of tax stamps for various groups of commercial entities in the informal sector to broaden the tax base since there is more room for improvement in collection especially import duties and excise tax.

It is desirable to have a built-in flexibility in the tax structure that will enable revenue to increase by greater proportion relative to increase in income. In this regard, reducing some import duty rates in order to reduce tax evasion and to expand the tax base, imposition of relatively higher duty rates on commodities with higher income elasticity of demand which are not produced locally. For VAT and EXTAX, an imposition of higher tax rates on identified goods with high price elasticity of demand will help improve their tax to base elasticity, however this must be done with caution as it has the potential of discouraging the production as well as consumption of such commodities. With regards to personal income tax, there would be the need to reduce allowances and fringe benefits as well as policies to improve coverage by capturing the informal sector workers through effective monitoring of businesses particularly private ones and ensuring every worker is registered with local and district tax offices. Probably taxation in the agricultural sector which has mainly been in the form of export taxes should be shifted to other forms such as land tax which may be a good option as it is collected from economic rent without harming production decision. Finally, effective tax administration is needed to improve tax compliance, enhance revenue collection and to prevent tax evasion. To harmonization the operations of revenue agencies, there is the need to resource the Revenue Agency Governing Board to perform its duties effectively.

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Appendix 1: Results of Augmented Dickey-Fuller (ADF) Test for Unit Root

Variable	Definition of Variable	ADF Statistic	1% Critical Value	5% Critical Value	Order of Integration
LTTR	Total Tax Revenue	-0.4067	-3.617	-2.942	I(1)
DLTTR		-4.55**	-3.623	-2.945	I(0)
LPYTAX	Personal Income Tax	0.4497	-3.617	-2.942	I(1)
DLPYTAX		-6.078**	-3.623	-2.945	I(0)
LCOTAX	Company Tax	0.0215	-3.617	-2.942	I(1)
DLCOTAX		-4.064**	-3.623	-2.945	I(0)
LVAT/S.	Value Added/Sales Tax	0.1844	-3.617	-2.942	I(1)
DLVAT/S.		-3.981**	-3.623	-2.945	I(0)
LEXTAX	Excise tax	-1.853	-3.617	-2.942	I(1)
DLEXTAX		-5.581**	-3.623	-2.945	I(0)
LIMPDU	Import Duty	0.0811	-3.617	-2.942	I(1)
DLIMPDU		-5.392**	-3.623	-2.945	I(0)
LGDP	Gross Domestic Product	-1.126	-3.617	-2.942	I(1)
DLGDP		-4.754**	-3.623	-2.945	I(0)
LTPCON	Total Private Consumption	-1.235	-3.617	-2.942	I(1)
DLTPCON		-4.573**	-3.623	-2.945	I(0)
LTIMP	Total Imports c.i.f.	-0.0524	-3.617	-2.942	I(1)
DLTIMP		-5.77**	-3.623	-2.945	I(0)
LCOCY	Corporate Current Income	0.0392	-3.617	-2.942	I(1)
DLCOCY		-5.047**	-3.623	-2.945	I(0)
LCUPY	Current Private Income	2.553	-3.617	-2.942	I(1)
DLCUPY		-3.91**	-3.623	-2.945	I(0)

Appendix 2: Engle-Granger Two Step Cointegration Test: Buoyancy Results

Tax Equation	Residuals	ADF-Stat.	1% critical value	5% critical value	Inference
TTR	TTRres	-5.09**	-2.63	-1.95	I(0)
PYTAX	PYTAXres	-6.55**	-2.63	-1.95	I(0)
COTAX	COTAXres	-2.09*	-2.63	-1.95	I(0)
VAT/Sales	VATres	-1.96*	-2.63	-1.95	I(0)
EXTAX	EXTAXres	-3.72**	-2.63	-1.95	I(0)
IMPDU	IMPDUres	-2.82**	-2.63	-1.95	I(0)

Appendix 3: Engle-Granger Two Step Cointegration Test: Tax-to-Base Elasticity Results

Tax	Residuals	ADF-	1% critical	5% critical	Inference
TTR	TTRres	-5.09**	-2.63	-1.95	I(0)
PYTAX	PYTAXres	-6.77**	-2.63	-1.95	I(0)
COTAX	COTAXres	-4.80**	-2.63	-1.95	I(0)
VAT/Sales	VATres	-3.94**	-2.63	-1.95	I(0)
EXTAX	EXTAXres	-2.57*	-2.63	-1.95	I(0)
IMPDU	IMPDUres	-2.48*	-2.63	-1.95	I(0)

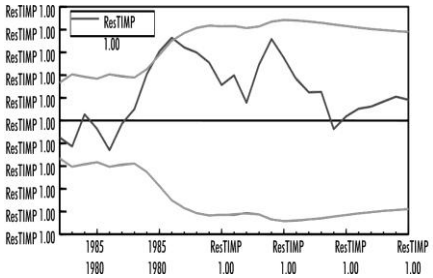
Appendix 4: Engle-Granger Two Step Cointegration Test: Base-to-Income Elasticity Results

	Residuals	ADF-	1%critical	5% critical	Inference
CUPY	CUPYres	-3.83**	-2.63	-1.95	I(0)
COCY	COCYres	-2.56*	-2.63	-1.95	I(0)
TPCON	TPCONres	-2.26*	-2.63	-1.95	I(0)
TIMP	TIMPres	-4.98**	-2.63	-1.95	I(0)

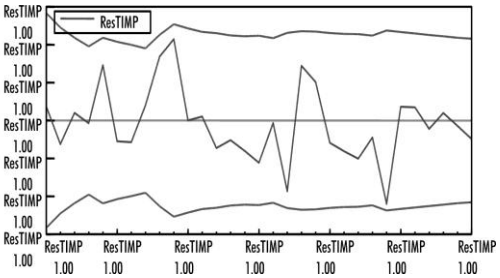
*Note: ** denotes significance at 1% and * denotes significance at 5%*

Appendix 5: Stability Test - Recursive Residual Tests Buoyancy
Total Tax Revenue (TTR)

Long Run

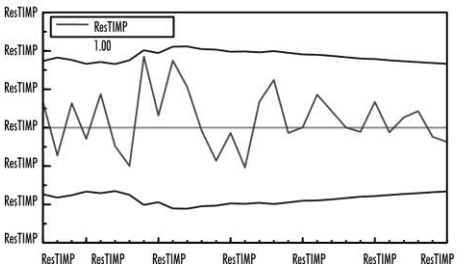


Short Run

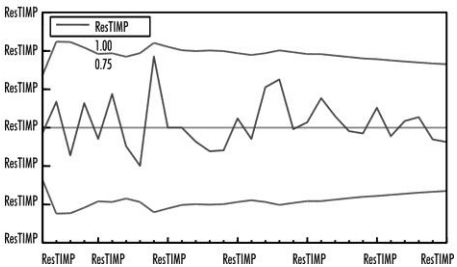


Personal Income Tax (PYTAX)

Long Run

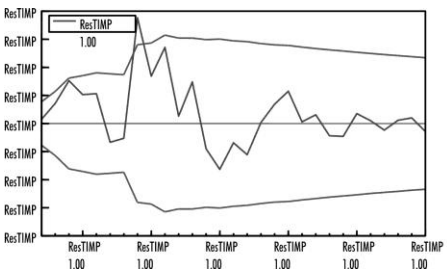


Short Run

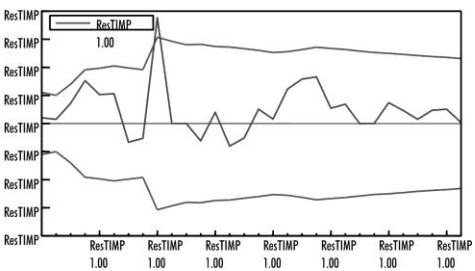


Company Tax

Long Run

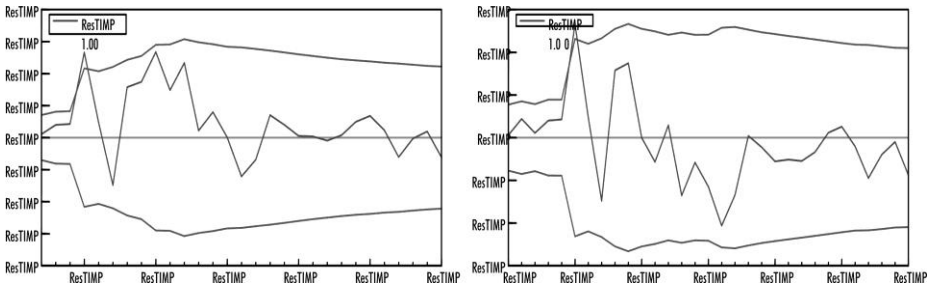


Short Run



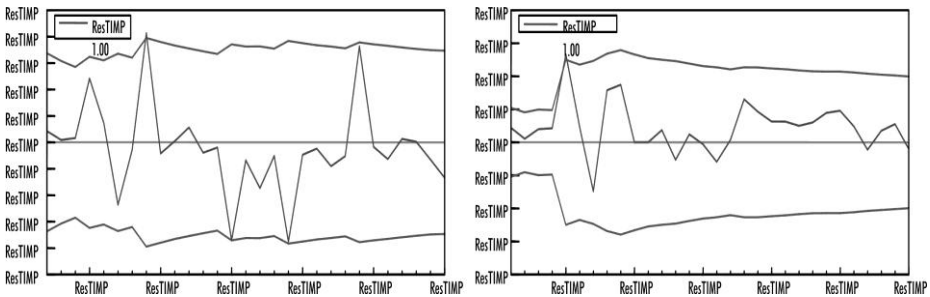
Value Added Tax/Sales Tax (VAT)

Long Run Short Run



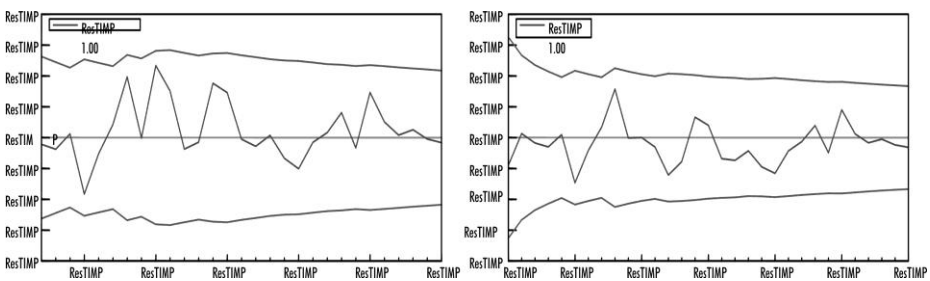
Excise Tax (EXTAX)

Long Run Short Run



Import Duty (IMPDU)

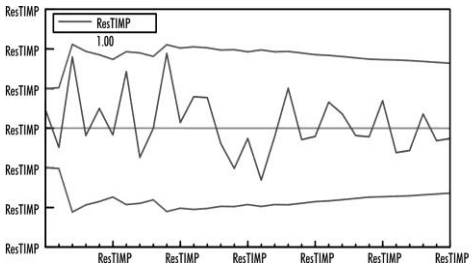
Long Run Short Run



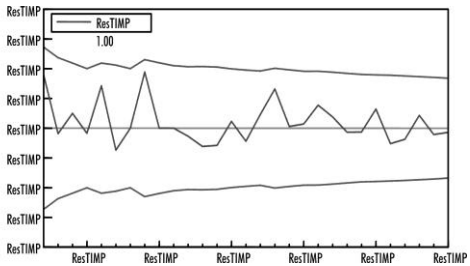
TAX-TO-BASE ELASTICITY

Personal Income Tax (PYTAX)

Long Run

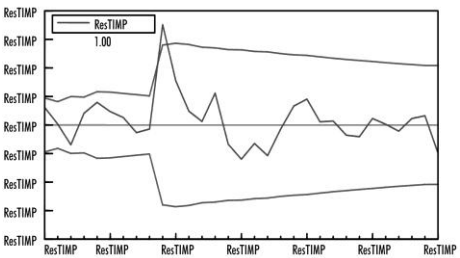


Short Run

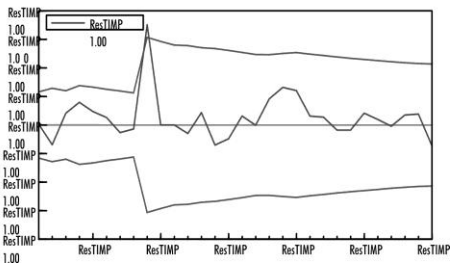


Company Tax (COTAX)

Long Run

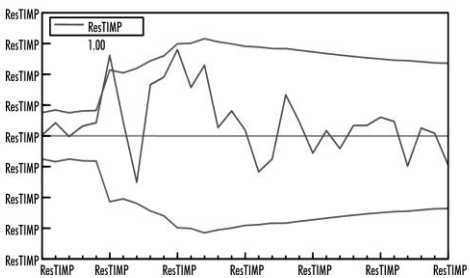


Short Run

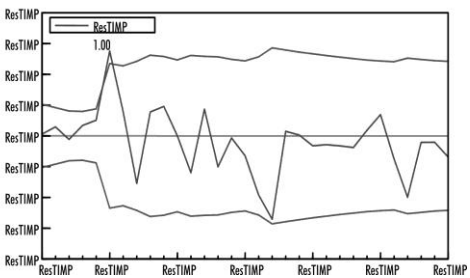


Value Added/Sales Tax (VAT)

Long Run

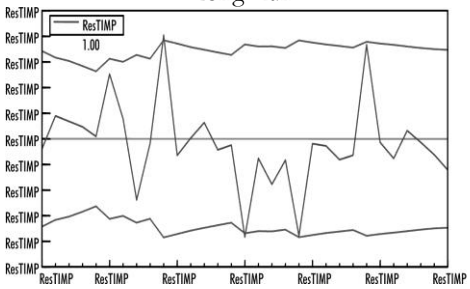


Short Run

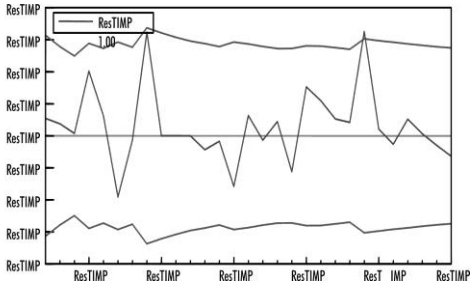


Import Duty (IMPDU)

Long Run

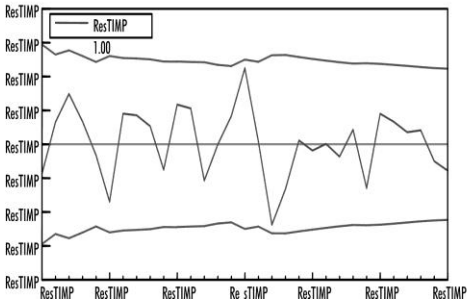


Short Run

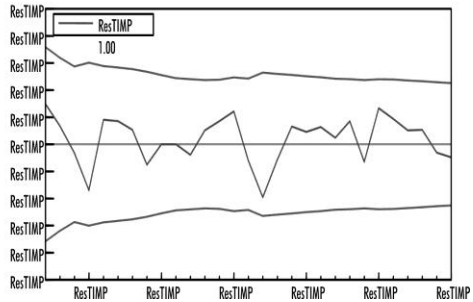


Excise Tax (EXTAX)

Long Run

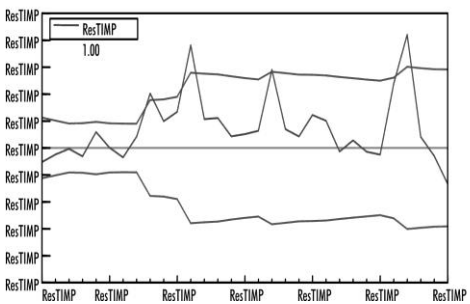


Short Run

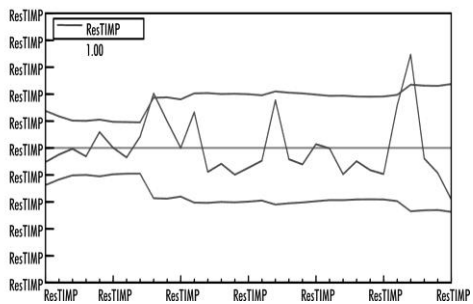


Base-To-Income Elasticity
Current Personal Income (CUPY)

Long Run

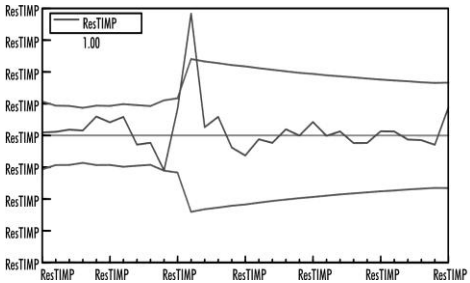


Short Run

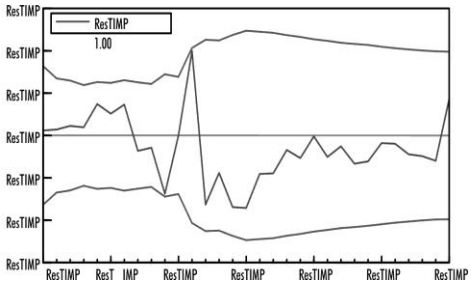


Corporate Current Income (COCY)

Long Run

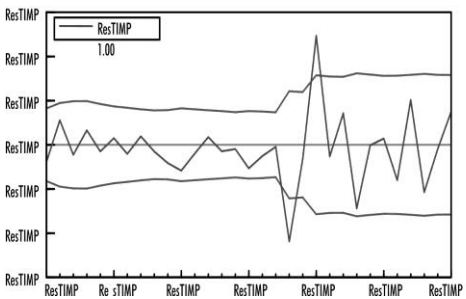


Short Run

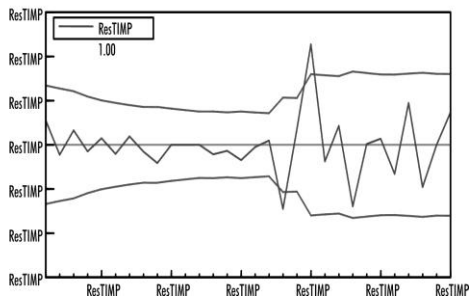


Total Private Consumption (TPCON)

Long Run

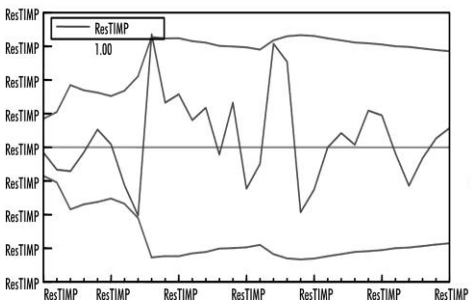


Short Run

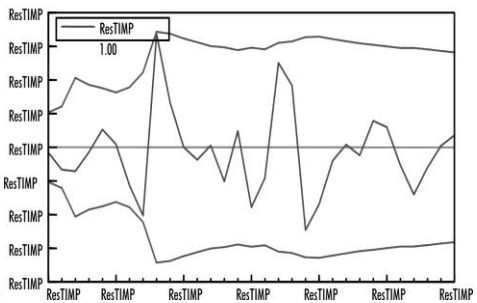


Total Imports (TIMP)

Long Run



Short Run



Appendix 5: Specification Test - Ramsey RESET Test Buoyancy

Tax Equation	Short Run Regression		Long Run Regression	
	F-Statistic	Probability	F-Statistic	Probability
TTR	0.0169	0.8974	0.7094	0.4055
PYTAX	3.6724	0.1640	6.1999	0.2178
COTAX	7.0021	0.3124	8.2870	0.1569
VAT/SALES	0.5290	0.4722	1.7212	0.1983
EXTAX	0.2581	0.6148	0.0772	0.7829
IMPDU	1.0293	0.3177	0.1402	0.7104

Tax - to – Base Elasticity

Tax Equation	Short Run Regression		Long Run Regression	
	F-Statistic	Probability	F-Statistic	Probability
TTR	0.0169	0.8974	0.7094	0.4055
PYTAX	0.0771	0.7830	0.0234	0.8792
COTAX	0.7461	0.3940	0.8779	0.3554
VAT/SALES	0.0508	0.8231	7.2496	0.2933
EXTAX	0.4169	0.5229	0.0648	0.8006
IMPDU	1.3735	0.2496	1.2534	0.2707

Base-to-Income Elasticity

Proxy Base Equation	Short Run Regression		Long Run Regression	
	F-Statistic	Probability	F-Statistic	Probability
CUPY	0.9846	0.3283	0.7247	0.4006
COCY	5.0618	0.2312	1.8721	0.1802
TPCON	0.0261	0.9383	0.1909	0.6649
TIMP	1.7501	0.1950	1.4311	0.2399