An Analysis of Excise Taxation in Kenya

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Abstract

This paper analyzes the structure of excise taxation in Kenya and investigates the extent to which the taxes have met their commonly stated objectives - that is, to raise substantial revenue for Government, to discourage consumption of certain potentially harmful products and to promote equity. An overview of the excise tax system in Kenya is provided. Demand equations are estimated for alcoholic beverages and tobacco products in order to measure own and cross-price elasticities and income elasticities. The buoyancy and elasticity of excise taxes in Kenya is also estimated.

The study finds that there is some scope for additional revenue from excise taxes on cigarettes and beer (except Guinness). Overall, the excise system does not require major changes: excise revenue amounts to 4.5% of GDP and has an income elasticity close to one. It might be wise to exclude perfumes, mineral waters and soft drinks from excises, while expanding collections to cover small manufacturers. The importance of excise taxes would justify a separate administrative unit, apart from the Customs Department.

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Table of Contents

I. INTRODUCTION

An excise tax can be defined as a levy applied selectively on particular goods and services. Such levies are applied for a variety of reasons, the main one being their ability to raise substantial revenue for government at relatively low administrative or compliance costs. Excise taxes are mainly levied at relatively high rates on a few commodities, which are produced by a few large producers. The main characteristic of such commodities is that they tend to have a low own-price elasticity of demand. This implies that there is minimum shifting of consumer purchases when prices change and thus very high tax rates can be applied. This coupled with strict administrative controls by tax authorities normally results in substantial tax revenue.

The other reason for the imposition of these selective taxes is to correct for negative externalities arising from the consumption of the taxed products. The consumption of certain products, e.g. smoking cigarettes or excessive drinking of beer and other alcoholic beverages, is harmful not only to the individual consuming the product but also to society at large, both in the short-run and in the long-run. In such cases, market forces produce distorted prices, which exclude the cost to society of consuming these commodities and hence result in higher consumption. The outcomes produced by the market forces then need to be corrected for these negative externalities. The relatively high taxes imposed on these products are, therefore, meant to ensure that individuals internalize the cost to society of their consuming these products.

Finally, excise taxes are applied to improve the vertical equity of the tax system. Levying them on commodities that can be described as being luxuries that are consumed in higher proportions by higher-income individuals normally does this. Excise taxes are also used to promote equity by spending the collected revenue on employment-generating and poverty alleviation programmes, which benefit low-income groups.

Some doubts, however, have been raised about the use of excise taxes to meet the objectives stated above. The basic argument is that these selective taxes, and particularly those on cigarettes, are regressive; consumption of such items is relatively greater as a percentage of income at the lower income levels than at higher (Due 1988). In addition, given the addictive nature of some of these products, the taxes may not be effective in reducing negative externalities. If consumption of these products is fairly insensitive to changes in relative price, the more significant impact of imposing high taxes on them will be a reduction of real income for those who consume them in spite of the higher price, rather than a reduction in consumption. (McLure and Thirsk, 1979). McLure and Thirsk conclude that sumptuary taxes fail to achieve their commonly stated ends - the discouragement of consumption of potentially harmful products - and render attainment of society's equity goals more difficult. This line of argument, however, is not entirely accurate since internalizing an external cost does not necessarily mean reduced consumption. An excise tax can offset a negative externality with or without reducing consumption, depending on the price elasticity of demand.

Notwithstanding the above concerns, excise taxes remain the best alternative for goods that have to be taxed at relatively higher rates for one reason or the other. Indeed, countries that have implemented tax reform programs have made excise tax reform a major component of the overall reform package. They have had to make a choice between a multiple rate VAT or, for example, a single rate VAT with high selective taxes. In this regard, they have imposed excise taxes on selected products and raised existing excise tax rates in order to offset the anticipated loss of revenue due to the rationalization of other indirect taxes.

In Kenya excise taxes have continued to play an important role in raising additional government revenue during the reform period. Tables 1, 2 and 3 indicate that excise tax revenue in Kenya has increased in both real and nominal terms during the period 1980 - 1996, both as a percentage of total ordinary revenue and also as a percentage of gross domestic product (GDP). Excise taxes have nearly doubled as a percentage of total ordinary revenue rising from 9% in financial year (FY) 1980/81 to 16.3% in FY 1995/96, and to 17.7% in FY 1996/97. As a percentage of GDP, the performance of excise taxes has been even more dramatic, growing from about 1.7% in the late 1980s to about 4.6% in FY 1995/96, and dropping slightly to 4.4% in FY 1996/97.

Table 1. Central Government Tax Revenue by Source *(millions of Kenyan pounds)*

Fiscal year	Import duty	Sales tax/VAT	Excise tax	Income taxes	Other taxes and revenue	GDP
1980/81	149	179	60	198	85	2,827
1981/82	189	195	64	200	90	3,244
1982/83	172	196	74	231	125	3,696
1983/84	181	254	80	251	124	4,158
1984/85	179	274	79	301	142	4,652
1985/86	251	304	89	355	161	5,394
1986/87	281	398	106	386	174	6,217
1987/88	288	520	123	455	168	6,987
1988/89	327	588	138	512	289	7,967
1989/90	303	640	149	599	273	9,171
1990/91	252	766	185	713	348	10,517
1991/92	256	851	341	851	394	12,218
1992/93	367	1,107	418	997	395	14,954
1993/94	735	1,453	561	1,829	370	18,734
1994/95	1,014	1,230	967	2,196	548	22,088
1995/96	1,120	1,420	1,131	2,405	855	24,890
1996/97	1,139	1,452	1,239	2,463	725	26,843

Source : Ministry of Finance Documents

Compared to other taxes, excises are the only ones that have consistently shown a rising trend of performance as a percentage of GDP. In this regard, the performance of other forms of taxes - including income taxes - has either increased only slightly or actually declined in recent years (e.g. VAT and import duties). Table 3 indicates that income taxes experienced a modest increase, as a percentage of GDP, from 7.0% in FY 1980/81 to 8.7% in FY 1996/97. Whereas, sales tax / VAT and import duties actually declined as a share of GDP during the same period, from 6.3% to 5.1% and 5.1% to 4.0% respectively. The dramatic performance of excise taxes during this period can be attributed to the expansion of the excise tax base to cover other products previously subject to sales tax only (e.g. petroleum products). Performance has also been increased as a result of the extension of excise taxes to cover imports in addition to domestic products, the upward adjustment of excise tax rates, and the conversion from set rates to rates determined on an ad valorem basis.

Table 2. Central Government Tax Revenue by Source (% of total tax revenue)

Fiscal year	Income tax	Sales tax/VAT	Import duty	Excise duty	Other taxes, fees and income
1980/81	29.4	26.7	21.7	9.0	13.2
1981/82	27.1	26.4	24.9	8.7	12.9
1982/83	29.0	24.6	20.7	9.3	16.4
1983/84	28.2	28.5	19.2	8.9	15.1
1984/85	30.9	28.1	15.6	8.1	17.3
1985/86	30.6	26.2	18.3	7.7	17.3
1986/87	28.7	29.6	18.4	7.9	15.5
1987/88	29.2	33.5	17.5	7.9	11.9
1988/89	27.6	31.7	16.2	7.4	17.0
1989/90	30.5	32.6	15.4	7.6	13.9
1990/91	31.5	33.8	11.1	8.2	15.4
1991/92	31.6	31.6	9.5	12.6	14.6
1992/93	30.4	33.7	11.2	12.7	12.0
1993/94	37.0	29.4	14.8	11.3	7.5
1994/95	36.9	20.6	17.0	16.2	9.2
1995/96	34.7	20.5	16.2	16.3	12.3
1996/97	35.1	20.7	16.2	17.7	10.3

Source: Ministry of Finance, Kenya

Excise taxes have always been useful whenever the Government wanted to raise additional revenue to contain the level of its budget deficit. Indeed, most of the recent upward adjustments to tax rates outside the usual annual government budget have been on excisable products.

Table 3. Central Government Tax Revenue by Source (% of GDP)

Fiscal year	Income tax	Sales tax/VAT	Import duty	Excise duty	Other taxes, fees and income
1980/81	7.0	6.3	5.2	2.1	3.1
1981/82	6.2	6.0	5.7	2.0	2.9
1982/83	6.3	5.3	4.5	2.0	3.5
1983/84	6.0	6.1	4.1	1.9	3.2
1984/85	6.5	5.9	3.3	1.7	3.6
1985/86	6.6	5.6	3.9	1.7	3.7
1986/87	6.2	6.4	4.0	1.7	3.3
1987/88	6.4	7.4	3.9	1.7	2.6
1988/89	6.3	7.3	3.7	1.7	3.9
1989/90	6.4	6.8	3.2	1.6	2.9
1990/91	6.7	7.2	2.4	1.7	3.3
1991/92	7.1	7.1	2.1	2.9	3.3
1992/93	6.9	7.7	2.5	2.9	2.7
1993/94	10.2	8.1	4.1	3.1	2.1
1994/95	10.3	5.8	4.7	4.5	2.6
1995/96	9.9	5.8	4.6	4.6	3.5
1996/97	8.7	5.1	4.0	4.4	2.4

Source : Ministry of Finance, Kenya

The particularly important role that excise taxes play as a major and growing source of Government revenue should impel an investigation into whether or not these taxes have been able to address the issues raised in the initial paragraphs of this section. The specific questions that need to be answered are:

- to what extent have excise taxes been able to generate substantial additional revenue and at what cost?
- have excise taxes been able to discourage the consumption of potentially harmful products?
- what are the revenue maximizing rates of tax? and
- have excise taxes in Kenya been able to promote vertical equity?

In Kenya and much of the Africa region, few studies have been done on excise taxation in general or on the specific aspects of excise taxation. Most of the studies that have been done in Kenya on consumption taxes have been on the sales tax / VAT and have largely concentrated on estimating the incidence of this tax. This study will bridge this gap by providing an insight into excise taxation in Kenya. In particular it will do the following:

1. Examine the structure, administration and performance of excise taxation in Kenya.

2. Evaluate the revenue productivity of the excise tax system in Kenya through the estimation of its buoyancy and elasticity.

3. Estimate the demand equations for beer and cigarettes, and analyze the effects of excise taxation on output, consumer demand, and tax revenue.

The study will restrict itself to the traditional excises (that is excises on cigarettes, beer and on petroleum products) mainly because these are the dominant products, accounting for about 93% of total excise tax revenue, and also due to data constraints on the other products. The next section provides the historical background of excise taxation in Kenya. Section III reviews the administrative aspects of excise taxation in Kenya, while section IV presents an analytical framework, the estimation and the results. Finally, section V interprets the results and concludes this study.

II. HISTORICAL BACKGROUND

Historically, excise taxes in Kenya were levied on the *domestic production* of only four product groups, namely cigarettes and tobacco, sugar, beer and spirits, and matches. Table 4 indicates that during the period FY 1980/81 to 1989/90, cigarettes and tobacco accounted for an average of 58% of total excise revenue while alcoholic beverages, sugar and matches accounted for 22%, 19% and 1% respectively. Cigarettes were subject to an ad valorem rate of excise tax while beer and spirits, sugar, and matches were subject to specific rates of excise tax. Cigarettes and tobacco, sugar and matches were subject to excise tax only, while alcoholic beverages were subject to high rates of sales tax in addition to excise tax. During the entire period, beer and cigarettes were produced domestically by one large manufacturer for each product, namely Kenya Breweries Limited (KBL) and British American Tobacco (BAT) respectively, while sugar and matches were manufactured by seven firms each.

It should be noted that during the period up to 1993, prices of all commodities in Kenya were controlled by the central government. As a result it was common practice at that time for the government to continuously adjust upwards not only the excise tax rate but also the ex-factory value of these products in order to adjust for increases in the cost of production and inflation. There does not seem to have been any clear policy influencing the selection of the four products for excise taxation other than revenue considerations. Other consumer products that are usually candidates for excise taxes such as petroleum products, soft drinks, and motor vehicles were subject to high sales tax.

Table 4. Excise Revenue by Commodities (% of total excise revenue)

Fiscal year	Alcoholic beverages	Cigarettes & tobacco	Petroleum products	Other products
1980/81	29.43	46.06	n/a	24.51
1981/82	27.03	49.86	n/a	23.12
1982/83	20.28	51.65	n/a	28.07
1983/84	22.44	54.92	n/a	22.64
1984/85	21.64	57.88	n/a	20.48
1985/86	22.81	60.48	n/a	16.71
1986/87	22.45	60.89	n/a	16.66
1987/88	20.42	64.85	n/a	14.73
1988/89	18.29	64.81	n/a	16.90
1989/90	15.65	71.42	n/a	12.93
1990/91	32.09	53.69	n/a	14.23
1991/92	53.46	32.28	n/a	14.26
1992/93	53.80	34.63	n/a	11.57
1993/94	53.51	37.16	n/a	7.33
1994/95				
1995/96				
1996/97	31	19	43	7

Source: Ministry of Finance, Kenya. *Note:* n/a = not applicable.

In addition there was no clear distinction between the excise taxes and sales taxes, as both were levied at very high rates on certain products and applied to the ex-factory price of products. The only notable differences were that sales tax applied both to domestic production and imports, while excise taxes applied to domestic production only; and excisable products were subject to much more physical control by the Customs and Excise Department.

In the late 1980s the Government began to implement a tax modernization program the major objective of which was to reform the tax system through the standardization and rationalization of tax structures. The tax system had been previously composed of extremely high rates, many rate brackets, and a generous exemption structure. This resulted in an extremely complex structure, which led to administrative problems and low compliance levels. For example, in 1987 the customs duty structure was composed of a top rate of 170% and 24 tax bands. The VAT structure on the other hand in 1990 comprised a top rate of 150% with 15 tax bands. During the reform period, attempts were therefore made to reduce the number of tax bands and the rates. In addition, a VAT was introduced in 1990 to replace the previous sales tax. Over the years the customs duty structure has been rationalized to 3 positive rates and a top rate of 25%, while the VAT structure consists of 2 positive rates and a top rate of 15%. As a result excise tax took the role of capturing the high tax rate element for a number of luxury goods such as tobacco products and alcoholic beverages, where the VAT was not the appropriate tax for such a role. (Budget

Speech, 1994/95).

Specifically, the major effort to reform excise taxation was undertaken in 1991 when fundamental changes were made to its structure. It was extended to cover not only an additional range of domestic goods, such as wines and carbonated soft drinks, but also imported goods as well. A number of excise rates were also converted from a specific to an ad valorem basis. Cigarettes, tobacco, and matches were also made subject to VAT at the standard rate of 18% in addition to excise tax.

Extending the excise tax to imports effectively changed the excise tax from a tax on domestic production to a tax on consumption. This also removed the interaction between import duties and excise taxes. When excise was a tax on domestic production, import duties only provided trade protection to the extent that import duties exceeded the excise taxes. This point can be illustrated as follows: Without the imposition of excise tax on imports, the nominal rate of protection can be expressed as:

$$\frac{(1+M)(1+V)}{(1+E)(1+V)} - 1 = \frac{(1+M)}{(1+E)} - 1, \tag{1}$$

While with the imposition of excise tax on imports, the nominal rate of protection is expressed as follows:

$$\frac{(1+M)(1+E)(1+V)}{(1+E)(1+V)} - 1 = M, \tag{2}$$

where *M = Import duty, E = Excise tax,* and *V = Value added tax.*

This means that the imposition of excise taxes on domestic production alone effectively reduces the level of protection for local manufacturers against imports.

The elimination of price controls in 1993 and the conversion from specific to ad valorem rates increased the temptation among manufacturers to cheat on valuation by excluding certain cost elements such as distribution costs in order to avoid some burden of excise tax. This problem was addressed the same year by providing a more comprehensive definition of value for excise duty purposes that included all the costs which are directly related such as packaging, advertising, and distribution but excluding normal volume discounts or the cost of returnable containers. This brought the excise tax base definition in line with the VAT. At the same time, excise tax on sugar and sugar related products was eliminated and replaced with VAT, while larger luxury class vehicles (i.e. with an engine capacity exceeding 1800cc's) were made excisable as well as subject to VAT.

In 1994, the coverage of excise taxes was extended to mineral and aerated waters and petroleum products, and to cosmetics in 1995. Petroleum products had been previously subject to VAT, but this was converted to an excise tax for revenue purposes. Matches were dropped from the list of excisable products in 1997.

Excise taxes are currently levied on both the domestic production and imports of seven product groups, namely alcoholic beverages, tobacco products, petroleum products, motor vehicles, perfumes, mineral water, and soft drinks (see table 5). During FY 1996/97, excise tax revenue from alcoholic beverages, cigarettes and tobacco, and petroleum products accounted for 31%, 19% and 43% of total excise tax revenue respectively, while the other five products accounted for 7%. The first three product groups therefore provide about 93% of total excise tax revenue. All excisable goods, with the exception of petroleum products, are subject to ad valorem rates of excise tax and are subject to VAT as well.

Table 5. Excise Tax Rates, FY1997/98

	Commodity	Units	Tax Rate
1.	**Alcoholic beverages**		
	Stout and porter		60%
	Malt beer		100%
	Non-malt beer		15%
2.	**Tobacco products**		135%
3.	**Petroleum products**		
	Aviation spirit (gasoline)	per 1000l@20°C	12,650 shillings
	Motor spirit (gasoline), premium	per 1000l@20°C	12,650 shillings
	Motor spirit (gasoline), regular	per 1000l@20°C	12,350 shillings
	Jet fuel, spirit type	per 1000l@20°C	12,650 shillings
	Gas oil (automotive, light amber)	per 1000l@20°C	6,770 shillings
4.	**Motor vehicles**		
	w/ engine 1800-2000cc		10%
	w/ engine 2001-3000cc		20%
	w/ engine capacity >3000cc		40%
5.	**Carbonated soft drinks**		15%
6.	**Mineral water**		10%
7.	**Cosmetics**		10%

III. ADMINISTRATIVE ASPECTS

Administrative Structure and Controls

Excise taxes in Kenya are imposed under the Customs and Excise Act *(Chap 472).* The administration of excise taxes, therefore, is the responsibility of the Customs and Excise Department of the Kenya Revenue Authority. Under the Customs and Excise Department is the excise unit responsible for administrative operations. An Assistant Commissioner of Excise to whom all Excise Officers are answerable heads the unit. For the administration of excise taxes, Excise Officers are either assigned to and stationed in specific firms or can be assigned to a number of firms producing excisable products and make regular visits to them. They are mandated to supervise the production process, the entry of materials into the firm and the delivery of finished products for sale or transfer to other bonded facilities. No deliveries or transfers can be made without the permission of the Excise Officers.

Unlike other taxes, a unique control system applies to the establishment of a plant that will produce excisable goods. Some controls also apply to the production and sale of the goods. Any firm wishing to manufacture excisable goods has to apply to the Commissioner of Customs and Excise for a license. This license is subject to annual renewal. In addition, any firm manufacturing excisable goods wishing to change its ownership, location, or manufacture another class of excisable goods, must also apply to the Commissioner of Customs and Excise for a license.

When the license to manufacture excisable goods has been approved, the applicant is required to provide the Customs and Excise Department with detailed information on the nature and physical layout of the entire plant and equipment he proposes to use in the manufacture or storage of materials or excisable goods. He must also specify the purpose for which each building, room, or piece of equipment is to be used. In the course of manufacture or storage of materials and excisable goods, the manufacturer is not allowed to use the building or equipment for any other purposes, or make any alterations, without prior permission of the Customs and Excise Department.

The manufacturer is required to prepare a daily account of materials acquired, total production, and sales made. This information has to be counter-checked on a daily basis by an Excise Officer attached to that firm. In addition, the manufacturer is required to prepare and submit to the Customs and Excise Department a monthly production summary containing detailed information regarding materials acquired, total production and total sales. The summary, accompanied by a monthly excise account, is submitted to the Customs and Excise Department by the 18th day after the end of the month in which sales are made. The monthly excise account gives details of the stock brought forward from the previous period, additional production during the month, sales during the month, and stock carried forward to the next month. Gross excise duty due is then calculated by applying the relevant excise tax rate to the ex-factory value of the sales during the month in question. A remission of excise tax is provided for any exports of the excisable product, sales to duty free shops for diplomats and international travelers, and the Kenyan armed forces, which are tax exempt institutions, and also for excisable goods purchased for use in the production of other excisable goods. Net excise tax due is then calculated and paid to the Commissioner of Customs and Excise.

A different administrative structure and control, however, applies to petroleum products. Petroleum products are mainly imported into Kenya in crude form and are then refined into final products. The refinery, pipelines and tanks are all bonded facilities (i.e. duties and excise taxes are only charged on the products withdrawn from these facilities). On importation, each consignment of crude oil is pumped into specific tanks at the refinery and is given a batch[1] number by an Excise Officer. The refinery is then required to give the Excise Officer a formula specifying how much of each final petroleum product is expected from that batch, including any losses. The crude oil is then refined into petroleum products and each product is then pumped to its respective tank. This is the final taxable product, but no tax is paid at this stage. The Excise Officer then applies the formulae previously provided to him to crosscheck against the product pumped into the tanks. If the loss exceeds 0.5% per volume, then the refinery is required to pay excise tax on the excess.

After this stage, the refined products are then pumped to the tanks of the marketers, who are also bonded facility providers. The Excise Officers stationed at the premises of the marketers have to

[1] A batch number refers to a specific quantity of crude oil pumped into the refinery at any given time.

acknowledge the receipt of the products. To ensure consistency, this information is then compared with the data on what was pumped out of the refinery tanks. The marketers can now sell the products to retailers and it is at this point[2] that excise tax is payable.

This bonded refinery and storage structure has special implications for the interpretation of the taxes on petroleum products. Essentially, whether a petroleum product is imported or domestically produced, it is subject to the same excise and import duties. This means that there is no meaningful economic distinction between import duties and excise taxes on petroleum products as both are taxes on domestic consumption.

IV. ANALYTICAL FRAMEWORK, ESTIMATION AND RESULTS

This section sets out the econometric results in some detail. Readers more interested in the end-results may want to turn immediately to section V where the findings are summarized and evaluated.

Buoyancy and Elasticity of Excise Tax

The growth in tax revenue in response to GDP growth can be decomposed into two components: *automatic* growth in response to GDP and the growth resulting from *discretionary* changes in tax rates and legislation. Therefore, the buoyancy of a tax system reflects the total response of tax revenue to changes in national income as well as effects of discretionary changes in tax policies over time (Jayasundera, 1991). The elasticity, on the other hand, measures the responsiveness of tax revenue changes in national income if the tax structure would have remained unchanged. To estimate the elasticity of any tax system, revenue series have to be corrected for effects of discretionary changes in tax policy.

Buoyancy

Generally the buoyancy of excise tax revenue to GDP for any period t can be expressed as follows:

$$\varepsilon_t^b = \frac{\text{Percentage change in excise tax revenue}}{\text{Percentage change in GDP}} \tag{3}$$

or

$$\varepsilon_t^b = \left(\frac{\Delta T}{\Delta Y}\frac{Y}{T}\right) \tag{4}$$

where

ε_t^b	=	Buoyancy of excise tax revenue to GDP
Δ	=	Change
T	=	Excise tax revenue.

[2] At the point of sale to retailers.

Y = Gross Domestic Product.

For purposes of this study, buoyancy of the excise tax revenue will be estimated through a simple double log function as follows:

$$\log RT = \alpha_0 + \alpha_1 \log RY + \mu_t \tag{5}$$

where

	α_0	=	constant
	RT	=	Real excise tax revenue.
	α_1	=	Buoyancy of excise tax revenue to GDP.
	RY	=	Real Gross Domestic Product
and,	μ_t	=	error term

Elasticity

The elasticity of excise tax revenue with respect to GDP will also be estimated using a double log function as follows:

$$\log RT^* = \beta_0 + \beta_1 \log RY + \mu_t \tag{6}$$

where

	β_0	=	constant
	RT^*	=	Adjusted real excise tax revenue.
	β_1	=	Elasticity of excise tax revenue to GDP.
	RY	=	Real Gross Domestic Product
and,	μ_t	=	error term.

Adjusting Excise Tax Revenue for Discretionary Changes in Tax Policy

To adjust excise tax revenue series for discretionary changes in tax policy, we will apply the proportional data adjustment method[3]. This method permits adjustment of a tax revenue series without any information on the tax base. The only information required is data on the actual excise tax revenue collections and estimates of the quantitative impact on revenue of discretionary changes for the years in which the changes took place. Let us assume the following series of actual excise tax revenue collection in years 1 through n:

$$T_1, T_2, T_3, \ldots, T_{n-1}, T_n,$$

where n is the reference year. Also assume the ex-post revenue effect of discretionary changes in

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[3] The proportional data adjustment method as explained and applied in this study is based on a 1991 report by Jayasundera on "Buoyai and Elasticity ", and a 1975 IMF study on "Revenue Forecasting".

the years in which they occur to be:

$$D_1, D_2, ..., D_n$$

The ex-post discretionary revenue effects of discretionary measures are derived by taking the estimates of revenue effects of discretionary measures as contained in the Financial Statement prepared with every budget speech and updating them using the ratio of actual to estimated excise tax revenue for each year. This assumes that the percentage error in estimating the revenue effect of a discretionary change of excise tax would be the same as the percentage error in forecasting. This also assumes a unit elasticity of discretionary change in any year with any other year.

Table 6. Proportional Adjustment Method (Reference Year : Fiscal Year 1995/96)

	1	2	3	4	5	6	7	8
FISCAL YEAR	ACTUAL EXCISE TAX REVENUE	ESTIMATED EXCISE TAX REVENUE	RATIO OF (1) TO (2)	EX-ante DISCRETIONARY MEASURES	Ex-post DISCRETIONARY MEASURES	ADJUSTMENT FACTOR	Cumulative ADJUSTMENT FACTOR	ADJUSTED EXCISE TAX REVENUE
	K £ Million	K £ Million		K £ Million	K £ Million			K £ Million
70/71	15.01	13.29	1.13	0.00	0	1	6.79	101.95
71/72	15.96	15.85	1.01	2.90	2.92	1.22	5.55	88.57
72/73	16.66	17.95	0.93	0.00	0.00	1.00	5.55	92.43
73/74	20.76	17.50	1.19	-0.35	-0.42	0.98	5.66	117.51
74/75	22.13	22.00	1.01	0.35	0.35	1.02	5.57	123.25
75/76	20.15	26.00	0.78	-1.25	-0.97	0.95	5.84	117.63
76/77	28.22	26.01	1.09	5.00	5.43	1.24	4.72	133.06
77/78	38.47	38.00	1.01	-1.60	-1.62	0.96	4.91	189.03
78/79	49.02	48.00	1.02	6.40	6.54	1.15	4.26	208.76
79/80	59.45	60.00	0.99	5.20	5.15	1.09	3.89	231.24
80/81	60.24	60.00	1.00	3.65	3.66	1.06	3.65	220.04
81/82	63.96	65.80	0.97	0.00	0.00	1.00	3.65	233.64
82/83	73.95	70.00	1.06	0.00	0.00	1.00	3.65	270.13
83/84	79.43	81.50	0.97	0.00	0.00	1.00	3.65	290.13
84/85	78.78	95.00	0.83	8.00	6.63	1.09	3.35	263.53
85/86	89.04	101.20	0.88	6.90	6.07	1.07	3.12	277.55
86/87	106.27	108.00	0.98	7.00	6.89	1.07	2.92	309.78
87/88	123.06	118.60	1.04	6.60	6.85	1.06	2.75	338.75
88/89	137.45	138.52	0.99	9.90	9.82	1.08	2.56	351.32
89/90	149.36	158.80	0.94	15.00	14.11	1.10	2.31	345.71
90/91	185.16	182.40	1.02	25.50	25.89	1.16	1.99	368.67
91/92	340.46	342.11	1.00	142.11	141.42	1.71	1.16	396.29
92/93	418.35	388.45	1.08	3.00	3.23	1.01	1.15	483.19
93/94	561.37	550.89	1.02	58.90	60.02	1.12	1.03	579.05
94/95	966.61	1,090.75	0.89	15.70	13.91	1.01	1.02	982.71
95/96	1,130.59	1,062.55	1.06	17.40	18.51	1.02	1.00	1,130.59

Source : Ministry of Finance, Kenya

Taking a reference year of FY 1995/96, therefore, we can construct an excise tax revenue series that reflects revenue under a system assumed to remain unchanged throughout the period. As a result the actual excise tax revenue and adjusted excise tax revenue for the reference year would be the same. However, actual revenue collection in year n-1, n-2, ... , 2, and 1 will be adjusted to remove the effects on excise revenue from discretionary measures and to construct an excise tax revenue series that reflects hypothetical revenue under the system prevailing during the reference year.

Under the proportional adjustment hypothesis, the series of adjusted excise tax revenue with n as the reference year, becomes as follows:

$$T^*_{n-1} = T_{n-1} * (T_n / (T_n - D_n))$$

$$T^*_{n-2} = T_{n-2} * (T_n / (T_n - D_n)) * (T_{n-1} / (T_{n-1} - D_{n-1}))$$

:
:

$$T^*_2 = T_2 * (T_n / (T_n - D_n)) * (T_{n-1} / (T_{n-1} - D_{n-1})) * \ldots * (T_2 / (T_2 - D_2))$$

$$T^*_1 = T_1 * (T_n / (T_n - D_n)) * (T_{n-1} / (T_{n-1} - D_{n-1})) * \ldots * (T_2 / (T_2 - D_2)) * (T_1 / (T_1 - D_1))$$

The detailed calculations are set out in Table 6.

Demand Equations of Beer and Cigarettes

The effect of price and income changes on the demand for the various products can be analyzed through the estimation of their demand equations. The quantity of any good demanded can be influenced by the price of the commodity, the price of other goods which are either substitutes or complementary to the good, the income or purchasing power of consumers, and the tastes, preferences and lifestyles of the consumers. As a result, a simple demand function can be formulated as follows:

$$Q_{dt} = f(P_{it}, P_{jt}, Y_t, \text{tastes}) \qquad (7)$$

where

Q_{dt} is the quantity of the good demanded at time t,
P_{it} is the price of the good at time t,
P_{jt} is a vector of prices of other goods at time t,
and, Y_t is income at time t.

From equation (7) a double logarithmic function can be developed as follows:

$$\log(Q_{dt}) = \alpha_0 + \alpha_1 \log(rP_{it}) + \alpha_2 \log(rP_{jt}) + \alpha_3 \log(rY_t) + \varepsilon_t \qquad (8)$$

where

α_0 is a constant,
α_1 is the own price elasticity of demand,
α_2 is the cross price elasticity of demand, (for the case of one other good),
α_3 is the income elasticity,

rP_{it} is the real price of the good at time t,
rP_{jt} is the real price of other goods at time t,
rY_t is real income at time t,
and ε_t is the error term.

Where monthly data portrays some seasonal patterns associated with it, these patterns can be captured by the use of monthly dummy variables. A time trend may also be included in an attempt to capture changes in consumption due to changes in tastes over time. Equation (8) then appears as follows:

$$\log(Q_{dt}) = \alpha_0 + \alpha_1 \log(rP_{it}) + \alpha_2 \log(rP_{jt}) + \alpha_3 \log(rY_t) + \alpha_4 \text{time trend} + \sum_{i=1}^{11} \alpha_{5i} D_{i,} \qquad (9)$$

where $D_i = 1$ for month *i* and is set equal to 0 otherwise. This is a constant elasticity model and assumes that the elasticity coefficients α_1, α_2 and α_3 remain constant throughout. For the purposes of this study, this is the initial model used to estimate the demand equations for Guinness beer, Other beer, Filter cigarettes and Plain cigarettes.

Descriptive Data Analysis (Normality tests)

Before launching into the details of the estimation, it is helpful to examine whether the data exhibit normality. Although OLS does not require normality of the variables, non-normality of the variables may affect the normality of the resultant residuals, may be associated with the presence of hetroscedasticity and may highlight outliers. Since most macroeconomic variables are lognormally distributed and the models in this study are in logarithmic form, normality tests are done for both raw data and data in logarithmic form.

The normality tests results show that the logarithmic transformations of the original data improved their distribution, except for G^q, G^p, P^p,T and Y*. This implies that as far as a Box-Cox transformation is concerned, the log-log models (equations 5, 6, and 9) are more appropriate than the linear models using the same data. (Johnston 1991, pp 61 – 68).

Table 7. *Normality tests for raw data*[4]

Variable	Mean	Standard Deviation	Skew-ness	Excess Kurtosis	Min	Max	Normality Test Statistic	Normality Probability
G^q	176556	87625	1.083	-0.128	77114	403422	82.61	0.0000**
G^p	180.19	15.83	-0.159	-0.873	147.20	210.77	5.41	0.067
O^q	1974650	402026	0.058	-0.487	1013973	3008934	0.708	0.702
O^p	170.54	16.78	-0.001	0.014	131.52	207.58	0.307	0.858
F^q	17198665	2069620	0.7684	1.011	12432850	25532200	17.725	0.0001**
F^p	8.42	0.568	-0.201	-0.483	7.02	9.59	3.87	0.1444
P^q	6288036	1589425	-0.299	-0.397	2846500	10157750	5.8616	0.0534
P^p	3.812	0.4623	0.499	0.447	2.65	5.68	7.782	0.0204*
T	100.29	36.53	2.05	3.91	58.21	218.56	27.823	0.0000**
T*	309.53	104.29	0.065	-0.69	123.94	539.43	0.08054	0.9605
Y	4491.34	792.14	-0.2254	-0.91	3052.55	5650.54	1.0945	0.5785

4 For period and nature of data see section V

Table 8. ***Normality test for data in logarithmic form***

Variable	Mean	Standard Deviation	Skew-ness	Excess Kurtosis	Min	Max	Normality test statistic	Normality Probability
G^q	11.79	0.45	0.58	-0.82	11.25	12.91	25.95	0.0000**
G^p	5.19	0.09	-0.31	-0.81	4.99	5.35	8.03	0.02*
O^q	14.47	0.21	-0.397	-0.38	13.83	14.92	5.36	0.069
O^p	5.13	0.099	-0.31	0.21	4.88	5.33	2.098	0.35
F^q	16.65	0.12	0.39	0.14	16.33	17.05	5.18	0.075
F^p	2.13	0.0681	-0.354	-0.363	1.948	2.26	7.692	0.0214*
P^q	15.63	0.28	-0.94	0.47	14.86	16.13	49.87	0.0000**
P^p	1.325	0.162	0.0025	-0.1062	0.974	1.737	0.0438	0.9783
T	4.56	0.298	1.17	1.502	4.06	5.39	6.589	0.0371*
T*	5.67	0.37	-0.63	-0.34	4.82	6.29	2.88	0.237
Y	8.39	0.18	-0.51	-0.69	8.02	8.64	2.9118	0.2332

where

G^q is the quantity of Guinness beer (cases),
G^p is the real price of Guinness per case (Kshs),
O^q is the quantity of Other beer per case,
O^p is the real price of Other beer per case (Kshs),
Y is the real annual GDP (market prices),
F is the quantity of Filter cigarettes (packets),
F^p is the real price of Filter cigarettes per packet (Kshs),
P^q is the quantity of Plain cigarettes (packets),
P^p is the real price of Plain cigarettes per packet (Kshs),
T is the real actual excise tax,
T* is the real adjusted excise tax for discretionary tax measures.

The stars in the last column refer to the probability of committing a type I error by rejecting a true null hypothesis in the Jarque-Bera tests. * means the hypothesis of normality of the variable is rejected at 5% while, ** means the hypothesis of normality is rejected at 1%.

Data Stationarity (Unit Root Tests)

This section identifies the order of integration (presence of unit roots) in each of the variables because integratedness of time series is a problem in econometric analysis (Deadman and Chareza, pp 124). For instance, if the time series data to be used in estimating models 5, 6, and 9 are integrated in any order and there is no co-integration (long-run relationship) among the variables in each model, the resultant regression equations are likely to be spurious. This means that models 5, 6, and 9 would produce regression equations for beer, cigarettes, tax buoyancy and tax elasticity with promising diagnostic statistics (significant t and F statistics) that may not be accurate.

The unit root tests were performed using the Augmented Dickey Fuller test (ADF), the general equation of which can be expressed as follows:

$$\Delta X_t = \alpha_0 + \rho X_{t-1} + \alpha_2 + \sum_{i=1}^{k} \gamma_i \Delta X_{t-i} + \alpha_3 S^D + \varepsilon_t \qquad (10)$$

where X = any one of the variables to be used in the estimations.

ρ = coefficient used in unit root tests. The null hypothesis is that $\rho = 0$ (there are unit roots) against the hypothesis that $\rho < 0$ (the variable is stationary).

t	=	time trend.
S^D	=	seasonal dummy.

The unit root results below use different versions of the above ADF equation.

Table 9. ***Unit Root Tests for the Variables in Logs***

Variable	Nature of Selected ADF equation	ADF value	IDW	Order of Integration
G^q	S^D, 3 lags	-4.769**	2.558	I(1)
G^p	3 lags	-5.827**	2.519	I(1)
O^q	4 lags	-5.019**	2.774	I(1)
O^p	3 lags	-5.838**	2.506	I(1)
Y	3 lags	-3.579**	1.769	I(1)
F^q	4 lags	-4.522**	1.299	I(0)
F^p	3 lags	-8.521**	2.138	I(1)
P^q	3 lags	-9.308**	3.163	I(1)
P^p	3 lags	-7.642**	1.984	I(1)
T	3 lags	-3.038**	2.459	I(2)
T*	3 lags	-2.563**	1.743	I(1)
Y*	1 lag	-3.495**	1.967	I(1)

Notes: IDW is the Integrated Durbin-Watson test. The S^D are seasonal dummy variables in the general Augmented Dickey Fuller equation. ** means that the differenced equation is stationary, at the 1% level. The ADF and IDW statistics presented here are for the final stationary processes (i.e. after differencing).-

Cointegration Analysis

It has been established that all the variables are integrated (non-stationary). The implication of this is that unless there is cointegration (long-run relationship among the variables in each model), the resultant regressions are likely to be spurious. Therefore, to build an econometric model which makes sense in the long-run, we have to test if the variables form a cointegrating relationship or not. This was done using the Granger-Engle two step procedure. The logic behind the test is that integrated variables are cointegrated if their linear combination produces stationary residuals. The test therefore assumes that there is one cointegrating vector described by the linear combination given in equations 5, 6 and 9. Therefore, if the residuals from these regression equations are stationary, then there is cointegration among the variables in the model. The Unit root test on the residuals was performed using a general ADF equation of the form:

$$\Delta e_{it} = \alpha_0 + \rho\,\varepsilon_{it1} + \alpha_1 t + \sum_{i=1}^{k} \gamma_i \Delta e_{iti} + \alpha_2 S^D + \varepsilon_{it} \qquad (11)$$

where *e* refers to the residuals from equations 5, 6 and 9.

Since the residuals are stationary, the regression equations derived from models 5, 6 and 9 are cointegrating.

Table 10. ***Unit root test results on the residuals***

Residual	Nature of ADF equation	ADF value	IDW	Order of Integration
$\varepsilon^{\text{Guiness}}$	4 lags	-2.824**	0.714	I(0)
$\varepsilon^{\text{Other Beer}}$	4 lags	-5.161**	1.578	I(0)
$\varepsilon^{\text{Filter Cigarettes}}$	4 lags	-3.56**	1.635	I(0)
$\varepsilon^{\text{Plain Cigarettes}}$	4 lags	-3.173**	0.384	I(0)
$\varepsilon^{\text{Tax Buoyancy}}$	3 lags	-2.043**	0.792	I(0)
$\varepsilon^{\text{Tax Elasticity}}$	3 lags	-1.979**	1.199	I(0)

Notes: The residuals for Plain cigarettes come from equation 9, for tax buoyancy from equation 5, and for tax elasticity from equation 6.

The Database

The data for excise tax revenue, gross domestic product, commodity sales and prices used in this study were obtained from the Ministry of Finance's database. The Ministry of Finance periodically updates its database on sales of beer and cigarettes using actual data obtained from the products' major manufacturers. In the case of beer, the data are on a monthly basis covering the period July 1987 to August 1996. Quantity demanded is represented by the amount of monthly sales, i.e. the number of bottles of different brands of beer sold to distribution agents every month. It is assumed that beer sold to distribution agents is resold to the retailers and finally to consumers within a period of one month, since distributors stock beer in response to demand from retailers. Other beer is the sum of seven different brands of beer taxable at the same rate of excise duty. The price used in this case is a weighted average price. Uniform weights are used representing the current market share of each category of brands over the entire period. The prices are recommended retail prices inclusive of cost, all trade margins and all taxes. GDP at market price is used as a proxy for income. Price and income are converted to real terms with 1986 as the base year using CPI.

Cigarette data is also a time series covering the period FY 1981/82 – 1995/96. Actual number of cigarettes sold every month to distribution agents represents quantity demanded. Filter and plain cigarettes are a sum total of different types of cigarettes with similar characteristics. A similar approach, as has been explained above for beer, was applied for cigarettes.

Estimation

It has been established that the regression equations from models 5 6, and 9 are cointegrating. This means that the estimated parameters of the various regression equations are the long-run coefficients that link the variables (cointegrating vectors). However, the estimated standard errors and consequently the t-statistics from the cointegrating regressions follow an unknown distribution and cannot therefore be used for hypothesis testing. It is because of this that the t-values and standard errors are not reported in the following cointegrating regression results.

(I) The OLS results of the cointegrating regressions

In this section we summarize the results of the cointegrating vectors, which give the long-run elasticities in the model. Fuller results are shown in the Appendix.

a. Guinness (G)

The estimated equation is as follows:

$$\ln G^q = 22.4 - 5.494 \ln G^P + 3.850 \ln O^P - 0.112 \ln Y - 0.007\text{Trend} - \text{seasonal terms} \qquad (12)$$

The results indicate that in the long-run, the model explains about 68% of the variation in the demand for Guinness. The F statistic clearly indicates that the variables are jointly significant. The low Durbin-Watson statistic indicates that the model suffers from serial autocorrelation implying that the estimated coefficients may be inefficient.

b. Other Beer (O)

The static long-run equation for Other Beer is given by

$$\ln O^q = 12.56 + 0.537 \ln Y - 1.111 \ln O^P + 0.300\ G^P - 0.002\text{Trend} - \text{seasonal terms} \qquad (13)$$

The results show that in the long-run, about 92% of the variations in the demand for other beer is explained by the variables in the model. The F-statistic indicates that the variables are jointly significant.

c. Filter Cigarettes (F)

Here the static long-run equation is given by

$$\ln F^q = +12.24 - 0.85 \ln F^P - 0.14 \ln P^P + 0.557 \ln Y \qquad (14)$$

The results indicate that in the long-run about 29% of the variations in the demand for Filter cigarettes is explained by the variables in the model. The F statistic shows that the variables in the model are jointly significant

d. Plain cigarettes (P)

In this case the estimated static long-run equation is

$$\ln P^q = + 4.27 - 1.432 \ln F^P - 0.38 \ln P^P + 1.30 \mathrm{l}Y \qquad (15)$$

The results show that in the long-run, about 73% of the variations in the demand for Plain cigarettes is explained by the variables in the model. The F statistic shows that the variables are jointly significant in explaining the behavior of the demand for Plain cigarettes.

e. Tax Buoyancy (T)

Based on a sample of annual data running from 1972/73 to 1995/96, the estimated static long-run equation is:

$$T = -0.597 + 0.606\,Y + 0.818S1994 \qquad (16)$$

Here S1994 is a step dummy variable for 1994 when petroleum products were made excisable. The results indicate that in the long-run, about 71% of the variations in actual excise tax revenues is explained by the income and step dummy variables. The F statistic shows that the income and step dummy variables are jointly significant in explaining the variations in excise taxes in Kenya.

f. Tax elasticity (T)

Again, based on a sample from 1972/73 through 1995/96, the estimated static long-run equation yields

$$T^* = -3.843 + 1.244\,Y + 0.655S1994 - 0.074Trend \qquad (17)$$

The results indicate that in the long-run, income and trend explain about 95% of the variations in the excise revenue adjusted for discretionary measures. The F statistic indicates that the income, trend and step dummy variables for 1994 are jointly significant in explaining the variations in the excise revenue adjusted for discretionary measures.

The Error-Correction Results

It has been established that there is cointegration in the various models and the respective cointegrating regressions have been estimated. It has further been noted that although the cointegrating vectors are the long-run coefficients, the t-values cannot be used to test the significance of the variables in each model. However, one way out of this impasse is the formulation of error- correction models. This is based on the Granger Representation Theorem, which states that cointegration implies that the equations can be re-parameterized in error-correction form (Granger and Engle, 1987). This involves adding and subtracting terms to come up with equations containing variables in their stationary forms (differenced variables) and an error-correction term (ECM) which captures the adjustment towards the long-run.

Here are the error-correction models from equations 5, 6 and 9:

For the demand equations (Beer and Cigarettes)

$$\Delta lnQ_{it} = \lambda_0 + \lambda_1 \Delta lnP_{it} + \lambda_2 \Delta lnP_{jt} + \lambda_3 \Delta lnY_t + \lambda_4 S^D + \delta_d\, ECM_{it-1} + +\varepsilon_d \qquad (18)$$

where *ECM* is the residual from the relevant co-integrating equations.

For Tax Buoyancy

$$\Delta\Delta\, InT_t = \Psi_0 + \Psi_1 \Delta InY_t + D^s + d_b ECM_{t-1} + e_{bt} \qquad (19)$$

For Tax Elasticity;

$$\Delta InT_t^* = \Omega_0 + \Omega_1 \Delta InY_t + D^s + d_e ECM_{t-1} + e_{et} \qquad (20)$$

Note that D^s is a step dummy variable for 1994, when the government made petroleum products excisable. It is assumed that the residuals from the above error-correction models are white noise processes. All the variables in these models are stationary and the t-statistics can be used for testing the significance of the parameters. The error-correction model results and diagnostic statistics reported below are for the preferred model after using a general-to-specific strategy with a view to coming up with a parsimonious model.

Table 11. *Estimation results of error-correction model for Guinness*

Variable	Coefficient	Std.Error	t-value	t-prob	PartR^2
Constant	-0.000	0.016	-0.015	0.99	0.00
ΔInG^P	-1.126	0.597	-1.886	0.06	0.04
ΔInY	1.003	0.917	1.093	0.28	0.01
ΔinO^P	0.624	0.608	1.027	0.31	0.01
Season	-0.483	0.078	-6.206	0.00	0.29
Season1	-0.267	0.078	-3.412	0.00	0.11
Season2	0.002	0.078	0.021	0.98	0.00
Season3	-0.252	0.078	-3.233	0.00	0.10
Season4	-0.131	0.081	-1.607	0.11	0.03
Season5	-0.360	0.079	-4.584	0.00	0.18
Season6	-0.205	0.079	-2.603	0.01	0.07
Season7	-0.195	0.076	-2.578	0.01	0.07
Season8	-0.199	0.078	-2.548	0.01	0.07
Season9	-0.114	0.079	-1.433	0.16	0.02
Season10	-0.356	0.078	-4.556	0.00	0.18
ECM_{Gt-1}	-0.289	0.064	-4.528	0.00	0.18

Notes: R^2 = 0.51. F(15, 93) = 6.52 [0.0000]. DW = 2.17. BIC = -3.0821. FPE = 0.0310. AR 1- 7F(7, 86) = 2.1715 [0.0446] *. ARCH 7 F(7, 79) = 2.1752 [0.0452] *. Normality Chi2(2)= 3.266 0.1953]. RESET F(1, 92) = 1.3876 [0.2419].

The BIC and FPE are the Schwarz Information Criterion and the Final Prediction Error statistics respectively. If the BIC rises (or FPE falls) when a variable is removed, then the resulting model is better, in the sense of being more parsimonious. The BIC and FPE statistics shown here are for the final best model. AR is the serial autocorrelation statistic for an autoregressive error process of order one to seven. This statistic shows that there is some serial autocorrelation of a higher order than what the Durbin Watson statistic measures. ARCH is the Autoregressive Conditional heteroscedasticity. The null hypothesis of no ARCH process in the model is rejected at 5% level of significance. Normality is the Jarque-Bera normality test of the error term. The statistic indicates that in this case the error term is normally distributed. This means that the estimates are efficient and consistent. RESET is the Regression Specification Test, which is used to detect mis-specification due to non-linearity in the model. The results indicate that there is no mis-specification with regard to non-linearity of the model. A high BIC (i.e. less negative) and low FPE show that the model contains much of the information as compared to other rival models and has a very small final prediction error.

The results show that in the short-run (adjusted for long-run variation by the error-correction term), about 51% of the variation in the demand of Guinness is explained by its own price, the price of other beer, income and seasonal variation. The F statistic shows that the variables in the error-correction term are jointly significant.

The error-correction term has the expected negative sign and shows that about 29% of the discrepancy between the demand for Guinness beer and its equilibrium value is corrected each month.

Table 12. *Estimation results of error-correction model for Other Beer*

Variable	Coefficient	Std.Error	t-value	t-prob	PartR2
Constant	-0.004	0.006	-0.609	0.54	0.00
ΔlnG^P	0.095	0.219	0.435	0.66	0.00
ΔlnO^P	-0.744	0.220	-3.388	0.00	0.11
ΔlnY	0.175	0.338	0.518	0.61	0.00
ECM_{Ot-1}	-0.810	0.103	-7.829	0.00	0.40
Season	-0.454	0.028	-15.981	0.00	0.73
Season1	-0.282	0.029	-9.860	0.00	0.51
Season2	-0.125	0.029	-4.373	0.00	0.17
Season3	-0.321	0.029	-11.254	0.00	0.58
Season4	-0.187	0.030	-6.260	0.00	0.30
Season5	-0.266	0.029	-9.277	0.00	0.48
Season6	-0.139	0.029	-4.815	0.00	0.20
Season7	-0.172	0.028	-6.213	0.00	0.29
Season8	-0.251	0.029	-8.788	0.00	0.45
Season9	-0.132	0.029	-4.538	0.00	0.18
Season10	-0.241	0.029	-8.469	0.00	0.44

Notes: R^2 = 0.831. F(15, 93) = 30.381 [0.0000]. DW = 1.99. BIC = -5.09415. FPE = 0.00414. AR 1- 7F (7, 86) = 0.80527 [0.5852]. ARCH 7 F(7, 79) = 0.26767 [0.9647]. Normality Chi2(2)= 42.754 [0.0000] **. RESET F(1, 92) = 0.84168 [0.3613].

The AR and DW statistics in Table 12 show that there is no serial autocorrelation of order one to seven. The ARCH statistic indicates that there is no Autoregressive Conditional heteroscedasticity condition in the model. The normality test statistic shows that the error term is not normally distributed and implies that the estimates are both inefficient and inconsistent. The RESET test shows that there is no mis-specification due non-linearity of the model.

The results show that in the short-run (adjusted for long-run variation by the error-correction term), about 83% of the variations in the demand for other beer is explained by their weighted price, the price of Guinness beer, and income and seasonal variation. The F statistic shows that the variables in the error-correction term are jointly significant in explaining the variation of other beer.

The error-correction term has the expected negative sign and shows that about 81% of the discrepancy between the demand for other beer and the total equilibrium value is corrected each year.

Table 13. ***Estimation results of error-correction model for Filter Cigarettes***

Variable	Coefficient	Std.Error	t-value	t-prob	PartR2
Constant	0.993	2.001	0.497	0.62	0.00
ΔlnF^P	-0.995	0.324	-3.065	0.00	0.05
ΔlnP^P	-0.226	0.279	-0.812	0.42	0.00
ΔlnY	0.309	0.466	0.665	0.51	0.00
F^{q-1}	0.940	0.120	7.828	0.00	0.14
ECM_{Ft-1}	-0.764	0.138	-5.554	0.00	0.14

Notes: R^2 = 0.306. F(5, 184) = 16.21 [0.0000]. DW = 2.03. BIC = -4.4859. FPE = 0.01017. AR 1- 7F (7,177) = 4.5714[0.0001]**. ARCH 7 F(7, 170) = 2.6184[0.0136]*. Normality Chi^2(2)= 8.1848[0.0167]*. RESET F(1, 183) = 4.309 [0393]*.

The results in Table 13 show that in the short-run (adjusted for long-run variation by the error correction term), about 31% of the variations in the demand for Filter cigarettes is explained by its own price, the price of Plain cigarettes and income. The F statistic shows that the variables in the error-correction term are jointly significant in explaining the variation of the demand for Filter cigarettes. The error-correction term has the expected negative sign and shows that about 76% of the discrepancy between the demand for other beer and the total equilibrium value is corrected each year.

Table 14. ***Estimation results of error-correction model for Plain Cigarettes*** $(DInP)$

Variable	Coefficient	Std.Error	t-value	t-prob	PartR2
Constant	-0.054	0.023	-2.399	0.02	0.03
ΔlnF^P	-0.489	0. 362	-1.348	0.18	0.01
ΔlnP^P	-0.670	0.310	-2.160	0.03	0.03
ΔlnY	0.330	0.544	0.606	0.55	0.00
Trend	0.001	0.000	2.582	0.01	0.32
ECM_{Pt-1}	-0.196	0.045	-4.317	0.00	0.10

Notes. R^2 = 0.5104. F(16, 172) = 11.208 [0.0000]. DW = 2.88. BIC = -4.05773. FPE = 0.01292. AR 1-7F(7,165) = 20.098[0.0000]**. ARCH 7 F(7, 158) = 3.9198[0.0006]**. Normality Chi^2(2)= 0.49509[07807]. RESET F(1, 171) = 1.8883 [0.1712].

The results show that in the short-run (adjusted for long-run variation by the error correction term), about 51% of the variations in the demand for Plain cigarettes is explained by its own price, the price of Filter cigarettes and income. The F statistic shows that the variables in the error-correction term are jointly significant in explaining the variation of the demand for Plain cigarettes.

The error-correction term has the expected negative sign and shows that about 19% of the discrepancy between the demand for Plain cigarettes and its equilibrium value is corrected each period.

Table 15. *Estimation results of error-correction model for Tax Buoyancy(DDlnT)*

Variable	Coefficient	Std.Error	t-value	t-prob	PartR2
Constant	-0.011	0.050	-0.223	0.83	0.00
ΔlnY	1.415	0.626	2.261	0.04	0.20
S1994	-0.098	0.194	-0.504	0.62	0.01
ECM_{Tt-1}	-0.033	0.328	-0.102	0.92	0.00

Notes: R^2 = 0.24. F(3, 20) = 2.1077 [0.1313]. DW = 2.24. BIC = -2.72553. FPE = 0.0623. AR 1- 2F(2, 18) = 2.9515 [0.0779]. ARCH 1 F(1, 18) = 2.972 [0.1018]. Normality Chi2(2)= 1.2245 [0.5421]. RESET F(1, 19) = 0.37203 [0.5491].

The AR and the DW statistics show that there is no serial autocorrelation of order one to seven. The ARCH statistic indicates that there is no Autoregressive Conditional heteroscedasticity condition in the model. The normality test statistic shows that the error term is normally distributed implying that the estimates are both efficient and consistent. The RESET test statistic shows that there is no mis-specification due to the non-linearity of the model.

The results show that in the short-run (adjusted for long-run variation by the error-correction term), about 24% of the variations in the actual excise revenue is explained by GDP. The F statistic shows that the variables in the error-correction term are not jointly significant in explaining the variation of the actual excise revenue.

Table 16. *Estimation results of error-correction model for Tax Elasticity (DlnT*)*

Variable	Coefficient	Std.Error	t-value	t-prob	PartR2
Constant	-0.067	0.023	-2.915	0.01	0.29
ΔlnY	1.127	0.266	4.237	0.00	0.46
S1994	0.243	0.082	2.955	0.01	0.29
ECM_{T*t-1}	-0.328	0.227	-1.445	0.16	0.09

Notes: R^2 = 0.646. F(3, 21) = 12.784 [0.0001]. DW = 1.82. BIC = -4.13703. FPE = 0.0132. AR 1- 2F(2, 19) = 2.592 [0.1011]. ARCH 1 F(1, 19) = 2.5353 [0.1278]. Normality Chi2(2)= 0.16996 [0.9185]. RESET F(1, 20) = 2.9058 [0.1037].

The AR statistic shows that there is no serial autocorrelation of order one to seven. The ARCH statistic indicates that there is no Autoregressive Conditional heteroscedasticity condition in the model. The normality test statistic shows that the error term is normally distributed implying that the estimates are both efficient and consistent. The RESET test statistic shows that there is no mis-specification due non-linearity of the model.

The results show that in the short-run (adjusted for long-run variation by the error-correction term), about 65% of the variations in the excise revenue adjusted for discretionary measures is explained by the income and step dummy variables. The F statistic shows that the variables in the error-correction term are jointly significant in explaining the variation of the excise revenue adjusted for discretionary measures.

The error-correction term has the expected negative sign and shows that about 33% of the discrepancy between the excise revenue adjusted for discretionary measures and its equilibrium value is corrected each period.

V. INTERPRETATION OF RESULTS AND CONCLUSION

The main results are gathered for convenience in Tables 17 and 18. The numbers in Table 17 show the following:

- That the demand for cigarettes is inelastic to price both in the long-run and in the short-run. This means that excise tax can be levied at high rates on this product with minimum shifting of demand, and higher revenue.

- Plain cigarettes are an inferior good. That is, the consumption of this inferior cigarette drops as income rises and consumers switch to filter cigarettes instead.

- The demand for Guinness beer is price elastic both in the short-run and in the long run. This means that an increase in excise tax would induce a more than proportionate drop in consumption and adversely affect revenue.

- The demand for other beer is inelastic to price in the short-run but high; and is elastic to price in the long-run.

The results mean that there is still scope for additional excise revenue from cigarettes and other beer.

Table 17. Summary of elasticities for alcoholic beverages and cigarettes

	Long-run elasticities			Short-run elasticities		
	Price	Cross	Income	Price	Cross	Income
Guinness	-5.49	3.88	-0.11	-1.13	0.62	1.00
Other beer	-1.11	0.30	0.54	-0.74	0.09	0.17
Filter cigarettes	-0.36	-0.11	0.47	-0.4	-0.07	0.48
Plain cigarettes	-0.26	0.26	-1.92	-0.35	0.38	-0.39

Table 18 indicates that the excise tax system has been efficient over the period as evidenced by an elasticity of 1.13. In addition, several factors seem to have paid dividends as evidenced by a buoyancy of 1.41. These factors include government efforts to increase the rate of excise tax in line with inflation where specific rates applied, and the conversion of most excise tax rates to an ad valorem basis. Also, the expansion of the excise tax base to include an additional range of products including imports, and the redefinition of the excise tax base itself have contributed to buoyancy. This means that although the growth in excise tax can mainly be attributed to the growth in GDP, the effects of discretionary changes were also successful in generating additional revenue. In the long-run, however, the results predict that excise tax revenue will continue to grow faster than the growth in GDP, but that discretionary measures will be inefficient in generating additional revenue as evidenced by an elasticity of 1.24 and a buoyancy of 0.61.

Table 18. Summary of Buoyancy and Elasticity Estimates

	Long-run	Short-run
Buoyancy	0.61	1.41
Elasticity	1.24	1.13

The general impression is that the excise system is now quite solid. Perhaps it may be necessary in the future to narrow the base to exclude perfumes, mineral water and soft drinks since their contribution to revenue is too low. The items should be taxed effectively under the VAT. However, the base of the excise tax should include all manufacturers of the remaining items, including the "small" manufacturers, in order to avoid distorting the market by moving people to consumption of untaxed products. Since excise tax has now become a major tax, it is also necessary to create its own administrative structure separate from the Customs Department.

APPENDIX

Detailed OLS Results for the Co-integrating Regressions

Table A1. ***Regression Results for Guinness (G)***

Variable	Coefficient
Constant	22.399
lnG^P	-5.494
lnO^P	3.850
lnY	-0.112
Time trend	-0.007
Season	-0.259
Season 1	-0.351
Season 2	-0.182
Season 4	-0.249
Season 6	-0.188
Season 7	-0.215
Season 8	-0.157
Season 10	-0.196

Notes: R=0.679. F(13,96) = 15.64 (0.00). DW = 0.72.

Table A2. ***Regression Results for Other Beer (O)***

Variable	Coefficient
Constant	12.560
lnO^P	-1.111
lnG^P	0.300
lnY	0.537
Time trend	-0.002
Season	-0.306
Season 1	-0.306
Season 2	-0.217
Season 3	-0.320
Season 4	-0.298
Season 5	-0.348
Season 6	-0.269
Season 7	-0.232
Season 8	-0.267
Season 9	-0.181
Season 10	-0.211

Notes: R=0.926. F(15,94) = 78.01 (0.00). DW = 1.58.

Table A3. ***Regression Results for Filter Cigarettes (F)***

Variable	Coefficient
Constant	10.547
lnF^P	-0.731
lnP^P	-0.120
lnY	0.480
F^{q-1}	0.138

Notes: R=0.29. F(4,185) = 18.75 (0.00). DW = 1.98.

Table A4. ***Regression Results for Plain Cigarettes (P)***

Variable	Coefficient
Constant	0.804
lnF^P	-0.2696
lnP^P	-0.071
lnY	0.245
P^{q-1}	0.812

Notes: R=0.73. F(4,185) = 126.11 (0.00). DW = 2.89.

Table A5. ***Regression Results for Tax Buoyancy (T)***

Variable	Coefficient
Constant	-0.59735
lnY	0.60632
S1994	0.81842

Notes: R=0.71. F(2,22) = 27.37 (0.00). DW = 0.82.

Table A6. ***Regression Results for Tax Buoyancy (T)***

Variable	Coefficient
Constant	-2.8532
lnY	0.92330
lnT^*_{t-1}	0.25755
S1994	0.48632
Time trend	-0.05465

Notes: R=0.96. F(4,20) = 108.54 (0.00). DW = 1.34.

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