Demand Elasticities of Excisable Goods in Kenya: Estimation Using Almost Ideal Demand System

James Ochieng and Rodgers Agwaya[†]

Excise taxes are an important source of revenue in most developing countries including Kenya. Between 1980 and 2018, excise taxes constituted a significant proportion of revenue in Kenya, yielding an average revenue contribution of 3.1 percent of GDP. Over the years, imposition of excise duty has been expanded from products considered harmful to society to include financial services as part of revenue raising measures. However, this expansion of excisable goods and services may distort consumer behaviour, resulting in low tax revenue generation. This paper estimates the price elasticity of demand of various excisable goods and services in Kenya. Price elasticity of demand, which is the responsiveness of change in quantity demanded of a good or service with respect to a change in its price, is essential in the formulation and design of tax policies as it helps in assessing who ultimately bears the tax burden. Using the 2015/16 Kenya Integrated Household Budget Survey data and employing Deaton's Almost Ideal Demand System model, demand elasticities for tobacco, alcoholic products, financial services, and petroleum products are estimated to assess the responsiveness of their quantity demanded with respect to a change in their prices. From the analysis, alcohol, soft drinks, petroleum products and financial services are all price inelastic. However, tobacco is price elastic with an elasticity of -1.046 while cigarettes have an elasticity of -0.920 which tends to 1, thus approaches unitary elasticity. Therefore, if the policy objective is to increase excise tax revenues, then commodities with lower price elasticities of demand should bear a larger tax burden. However, levying of higher excise duty should be applied with caution as any increases in excise tax rates may result in undesirable outcomes and therefore, should not be guided by the concept of elasticity alone.

1. INTRODUCTION

Excise taxes have been an important component of total tax revenue in Kenya. Excise taxes, also termed "sin taxes", are levied with discriminatory intent (Bolnick & Haughton, 2001). Goods selected for excise tax are often luxury goods and services. These taxes also tend to be levied on specific types of commodities, and different countries levy them for different reasons. They can be applied to compel the users of excised commodities to internalize the negative externalities that excisable

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commodities such as tobacco, alcohol and petroleum products tend to have. In Kenya, excise duty is levied mainly on alcoholic products, cigarettes and tobacco, soft drinks and juices, mineral water, airtime, financial transactions, automobiles etc. Excise taxes may also be used merely to generate revenue at relatively low administrative and compliance costs and improve the vertical equity of the tax system. In developed countries, excise taxes are sometimes levied to steer the industry concerned towards a desired strategic direction.

In theory, excise taxes have several advantages over other types of taxes, such as administrative ease of collection (Okello, 2001). For this reason, coupled with its ease of compliance, excise taxes are attractive to governments as sources of additional revenue to finance budget deficits. In the case of Kenya, one can discern that excise taxes have been levied to meet the revenue requirements of the government. However, the revenue structures of most developing countries have not been as productive as desired (Osoro *et al.,* 2001). Too often the growth in revenue has failed to catch up with government spending pressures, a situation that has occasioned huge imbalances between the demand and supply of public budgetary resources. These countries have then had to reform their tax structures, with the general objectives of revenue adequacy, economic efficiency, equity and fairness, and simplicity.

Several policy and administrative reforms have been implemented by the Government of Kenya, through the Kenya Revenue Authority, aimed at increasing efficiency and boosting tax revenue collections. Excise tax reforms have been a key component of the overall reform package, for example, implementation of excise goods management system in 2013, widening of excise tax base to include other goods and services and increasing of excise tax rates over the years (Karingi and Wanjala 2005; Ronge and Moyi 2006; KRA 2019).

Despite these reforms, overall tax revenue mobilization, including excise taxation remains low. The Kenya Vision 2030 target was to increase revenues from 20.7 percent of the Gross Domestic Product (GDP) in 2006/7 to 25 percent of the GDP in 2017/18 and maintain that level to 2030 (GoK, 2012). Tax revenues as percentage of GDP have stagnated about 20 percent in two last decades, with excise taxes averaging 3.6 percent of the GDP. Moreover, the share of excise tax revenue in total tax revenue declined from 17 percent between 1991 and 2004 to about 12.7 percent between 2007 and 2017.

Tax policy should take into consideration the potential effect that taxes have on consumer behaviour, particularly demand for various products, to optimize revenue collection. In light of this, this paper estimates the price elasticities of demand of a basket of excisable goods and services in Kenya with a view of providing more insights that could improve the tax policy formulation to enhance domestic resource mobilization and consequently attain Vision 2030 revenue targets.

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Since the aim of excise duty has expand beyond imposition of sin tax on harmful products to include other goods and services as part of revenue raising measures, this paper contributes to the existing literature by estimating demand elasticities of financial services. Secondly, the paper uses a recent nationally representative survey data that may capture any change in consumer patterns affected by recent tax changes and consumer preference.

The rest of the paper is organized as follows: Section 2 reviews the related literature on excise taxation. Section 3 describes the estimation model employed and the survey data used in the analysis. In section 4, the study presents and discusses the estimated results. Lastly, section 5 concludes and gives policy implications based on the findings.

2. REVIEW OF EXISTING LITERATURE ON DEMAND ELASTICITIES

There has been an increasing interest on research with a focus on price elasticities of goods regarded as harmful to the society. These growing body of literature largely focus on consumption pattern of tobacco products, sugar sweetened beverages and alcohol, and the economic approach to reduce their consumption.

John (2008) estimated the price elasticity of tobacco products in India using the Almost Ideal Demand System (AIDS) and household survey data. The study found tobacco products had negative price elasticities ranging from -0.4 to -0.9. Hand-rolled smoked tobacco and leaf tobacco had price elasticities close to unity. Similarly, Selvaraj et al., (2015) found tobacco products to be price inelastic [1]using ordinary least square regression while estimating price elasticity of tobacco products among different economic classes in India. Cigarettes had the highest price elasticity (-0.832) among the poorest group. In Albania, tobacco was found to be price inelastic, with an elasticity of -0.57 (Gjika *et al.,* 2020). Jawad et al., (2018) conducted a meta-analysis on price elasticity of demand for tobacco products and found the estimated price elasticities ranging from -0.21 for smokeless tobacco to -0.83 for cigars. Similar results were found in respective studies in Tanzania and Uganda (Osoro et al., 2001; Chelwa & Van Walbeek 2019). However, Nikaj & Chaloupka (2014) found cigarettes to be price elastic (-1.5 for a sample containing high, middle and low income countries, and -2.2 for a sample restricted to low and middle income countries) among the youths.

Other studies have investigated price elasticity of sugar sweetened beverages (SSB). SSB were found to be price elastic in Mexico (Colchero et al., 2015), Ecuador (Paraje*,* 2016; Segovia *et al.,* 2020), Chile (Guerrero-López et al., 2017). Similarly, water was price elastic in Chile and Mexico, with price elasticities of -3.24 and -1.23,

[1] A good is said to be price inelastic if a change in its price results in a less than proportionate change in quantity demanded. This happens when the price elasticity of demand of a particular good is less than 1 in absolute terms.

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respectively. However, water was price inelastic in Ecuador, with an elasticity of -0.74 (Segovia et al., 2020).

Osoro et al. (2001) estimated the elasticity and buoyancy of excise taxes in Tanzania using an error correction framework using quarterly data for the period 1990-1998. Their results reveal that alcoholic products have inelastic demand both in the short-and long-run. The price elasticity for beer in the short-run and long-run was -0.22 and -0.31, respectively. The findings was consistent with the case for India (Kumar, 2017), China (Tian & Liu, 2011) and United Kingdom (Pryce *et al.,* 2019).

In Kenya, much of the research is limited to alcohol and tobacco products. However, the findings from these are inconclusive. For instance, Okello (2001) found cigarettes to price inelastic with long-run price elasticity of demand at -0.36 for filter cigarettes and -0.26 for plain cigarettes while employing an error correction model. On the other hand, Kiringai et al. (2002) found a long-run price elasticities of demand between -1.78 for all cigarette types to -1.36 for filter cigarettes in their ordinary least square estimates using monthly data covering the period 1981-2000. Besides cigarettes, Okello (2001) found beer Guinness beer to be price elastic both in the short-and long-run, but the other beer brands were price inelastic in the short-run but elastic in the long-run. Specifically, the prices elasticity of demand for Guinness and other beer were -1.13 and -0.74 in the short-run and -5.49 and -1.11 in the long-run respectively.

Another attempt at estimation of other excisable goods in Kenya was made by Ngui et al. (2011) using survey data from 3665 households sampled across Kenya to estimate the income and price elasticities of household demand for different kinds of fuels. Employing the Linear Approximate of Almost Ideal Demand System (LA-AIDS) estimation model, the study found demand for motor spirit premium (petrol), automotive gas oil (diesel) and lubricants to be price elastic while fuel wood, kerosene, charcoal, liquefied petroleum gas and electricity were price inelastic.

From the review, the inconclusive results of estimated price elasticities of demand of some products could arise from the use of different estimation models and data sets. However, the LA-AIDS model has an advantage of other models when estimating demand functions since it allows imposition and testing of homogeneity and symmetry conditions. Therefore, this paper adopts the LA-AIDS model in its estimation.

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3. METHODOLOGY AND DATA

3.1 Almost Ideal Demand System

The study adopts the Almost Ideal Demand System (AIDS) model by (Deaton & Muellbauer, 1980). The model is applicable in general empirical demand analysis like in the estimation of demand for various goods consumed by different households. AIDS model is a popular approach because of its generality and satisfies many properties of standard utility functions. The AIDS model is chosen because of several strengths: the model provides arbitrarily the first order approximation for any demand system and definite estimations of axioms of choice. It aggregates consumers perfectly (price-independent, generalized logarithmic, "PIGLOG", class). Further, the model has a functional form which is consistent with household budget data (Blanciforti & Green, 1983). In addition, it is easier to make estimations in the form of linear approach and easily used to test homogeneity and symmetry constraints. Therefore, the empirical model adopted in this paper follows Deaton and Muellbauer AIDS model.

According to Deaton & Muellbauer (1980), the demand functions derived expresses budget shares (w_i) as functions of prices ((P_j) for good j and P for the price index) and income Y: The model is specified as:

$$w_i = \alpha_i + \sum_{j=1}^{N} \varphi_{ij}\, lnP_j + \delta_i \ln\left(\frac{Y}{P}\right) + \sum_{k} \varphi_k\, D_k, \qquad (1)$$

$$i = 1, 2, \dots, N \; and \; j = 1, 2, \dots, N$$

Where w_i is the share of a good *i* in the total expenditure; P_j are prices; *Y* is the total expenditure on all products; P is the price index; *i* and *j* are goods; $D_k$is the demographic and socioeconomic characteristics. The price index is defined as:

$$\ln P = \alpha_0 \sum_{i=1}^{N} \alpha_i\, lnP_i + \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} \varphi_{ij}\, lnP_i lnP_j \qquad (2)$$

Where α_0, α_i, δ_i, and φ_{ij} are different parameters to be estimated.

To ensure the demand system takes a linear form and minimize the inconsistencies associated with the price index, Equation (2) is usually replaced by a Stone price index defined as:

$$P^* = \ln P = \sum_{h=1}^{N} w_h\, ln\, P_h \qquad (3)$$

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Where w_h is the mean of the budget share in period *t*.

The expression of the budget shares in terms of the Stone geometric index is obtained by substituting equation (3) into (1):

$$w_i = \alpha_i + \sum_{j=1}^{N} \varphi_{ij}\, lnP_j + \delta_i \ln\left(\frac{Y}{P^*}\right) + \sum_{k} \varphi_k\, D_k + \mu_i \qquad (4)$$

Equation (4) (budget shares) are referred as the LA-AIDS because the model yields a system of linear parameters. One advantage of using budget shares is that zero consumptions are taken into account, contrary to the case where the demand equation is expressed in a logarithmic form.

For consistency with microeconomic theory, additive, homogeneity, and symmetry restrictions must be satisfied. They are denoted as:

Adding up

$$\sum_{i=1}^{N} \alpha_i = 1, \sum_{i=1}^{N} \varphi_{ij} = 0, \sum_{i=1}^{N} \delta_i = 0, \qquad (5)$$

The adding-up restriction given by Equation (5) ensures that budget shares add up to total expenditures.

Homogeneity

$$\sum_{j=1}^{N} \varphi_{ij} = 0, \qquad (6)$$

The homogeneity restriction given by Equation (6) ensures that demands are homogenous of degree 0 in prices and income.

Symmetry

$$\varphi_{ij} = \varphi_{ji} \qquad (7)$$

For $i = 1, 2, \dots, N \; and \; j = 1, 2, \dots, N$

Equation (7) ensures that the Slutsky matrix is symmetric.

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Using the specified equations 5-7, Marshallian (uncompensated) and expenditure elasticities can be derived (Hayes *et al.,* 1990).

The estimated Marshallian own-price elasticity of demand is given as:

$$\varepsilon_{ii}^{M} = -1 + \frac{\varphi_{ij}}{w_i} - \delta_i \tag{8}$$

The estimated Marshallian cross-price elasticity of demand is obtained as:

$$\varepsilon_{ij}^{M} = -\gamma_{ij} + \frac{\varphi_{ij}}{w_i} - \delta_i \left(\frac{w_j}{w_i}\right) \tag{9}$$

Expenditure elasticities is given by

$$\eta_i = 1 + \frac{\delta_i}{w_i} \tag{10}$$

Where $\gamma_{ij} = 1$ for $i = j$ and $\gamma_{ij} = 0$ for $i \neq j$. ε_{ij}^{M} and η_i are Marshallian and expenditure elasticities, respectively. The Hicksian (compensated) elasticities can be derived the Marshallian elasticities using the Slutsky equation. The Hicksian elasticities are given as:

Hicksian own-price elasticities

$$\varepsilon_{ij}^{H} = -\gamma_{ij} + \frac{\varphi_{ij}}{w_i} + w_{jt} \tag{11}$$

Hicksian cross-price elasticities

$$\varepsilon_{ij}^{H} = -\gamma_{ij} + \frac{\varphi_{ij}}{w_i} + w_{jt} \tag{12}$$

The computation of expenditure shares and price elasticities for a given group of products is based on a Stata program *aidsills* developed by Lecocq and Robing (2015). *AIDSILLS* uses the Iterated Linear Least Squares (*ills*) estimator by Blundell and Robin (1999) to generate the estimates.

3.2 Data

Estimation of the LA-AIDS model requires data on budget shares of the excisable goods and their respective prices. For this study, household expenditures are distributed on main product groups: Tobacco products: cigarettes and tobacco pipe/raw (snuff); Alcoholic products: beer and traditional beer; Soft drinks: mineral

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water, squashes, sodas, and other drinks; and Financial Services. Data on expenditure on tobacco products, alcoholic products, soft drinks and financial services was obtained from Kenya Integrated Household Budget Survey (KIHBS) conducted by the Kenya National Bureau of Statistics for 2015/16 period. The data is from a comprehensive national sample size comprising of 23,880 households. Budget shares for the respective excisable goods are obtained by dividing household expenditure on a particular commodity group by the total household expenditure.

One advantage of using household survey data over aggregate data is that it is possible to estimate a system of demands, accounting for different kinds of goods purchased, instead of a single demand equation. The estimation of a single demand equation may give a wrong picture of consumption patterns because substitution and complementarity effects between different kinds of commodities are discarded.

4. RESULTS AND DISCUSSION

4.1 Expenditure Shares and Budgets Elasticities for Tobacco Products

For the entire population, the expenditure share for cigarettes and tobacco are 73.2 percent and 26.8 percent respectively in Table 1. This implies that cigarettes take the largest budget share compared to raw tobacco products. The expenditure elasticities for cigarettes and tobacco 1.148 and 0.595 respectively.

Table 1: Expenditure shares and budget elasticities for tobacco products

Commodity	Share	Budget
Cigarettes	0.732***	1.148***
	(0.019)	(0.031)
Tobacco	0.268***	0.595***
	(0.019)	(0.087)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

The results for Marshallian- and Hicksian own-price elasticities are reported in Table 2. Marshallian or uncompensated elasticities are demand elasticities derived from the Marshallian demand equation that maximizes utility subject to a budget constraint. Hicksian or compensated elasticities are demand elasticities derived from the Hicksian demand equation that minimizes expenditure at a certain utility level.

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Table 2: Price elasticity of demand for tobacco products

	Marshallian		Hicksian	
Commodity	**Cigarettes**	**Tobacco**	**Cigarettes**	**Tobacco**
Cigarettes	**-0.920*** (0.048)**	0.017 (0.035)	**-0.236*** (0.039)**	0.236*** (0.039)
Tobacco	-0.220 (0.131)	**-1.046*** (0.097)**	0.657** (0.088)	**-0.657** (0.088)**

**p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

The Marshallian own-price elasticities of demand for the two commodities have negative signs. This implies that they have downward sloping demand curves. The Marshallian own-price elasticity of demand for cigarettes is -0.92, implying that though price inelastic, it is tending towards unitary elasticity of demand. However, tobacco is price elastic with an elasticity of -1.046. The Hicksian own-price elasticities of demand range between -0.236 (for cigarettes) and -0.657 (for tobacco). The Hicksian cross-price elasticities between cigarettes and tobacco are all positive implying that they are substitutes to each other. The implication is that an increase in price of cigarettes would increase the quantity demanded of tobacco as consumers will switch from cigarettes to other substitutes.

4.2. Expenditure Shares and Budgets Elasticities for Alcoholic Products

The aggregate data indicates that expenditure of beer (lagers and stouts) is the largest in total alcoholic expenditure (Table 3). The expenditure on beer constitutes 72.3 percent against 27.7 percent of the traditional beer expenditure. In addition, the budget elasticity of beer is relatively inelastic at 0.46 against 2.38 for the traditional beer which is highly elastic. A decrease in the consumers income would not significantly lead to a fall in consumption of beer as it would for the traditional beer.

Table 3: Expenditure shares and budget elasticities for alcoholic drinks

Commodity	Share	Budget
Beer	0.723*** (0.003)	0.460*** (0.016)
Traditional Beer	0.277*** (0.003)	2.385*** (0.051)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

The results for Marshallian own-and Hicksian price elasticities are reported in Table 4.

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Table 4: Marshallian and Hicksian price elasticity of demand for alcoholic products

Commodity	Marshallian		Hicksian	
Beer	**-0.366*** **	-0.094***	**-0.037** **	0.047**
	(0.012)	(0.005)	**(0.015)**	(0.012)
Traditional Beer	-1.652***	**-0.755*** **	0.091**	**-0.117** **
	(0.043)	**(0.012)**	(0.037)	**(0.028)**

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Alcoholic products have inelastic price elasticities of demand, with elasticities ranging between -0.366 and -0.755. Beer products have the most inelastic price elasticities of demand at -0.366. This implies that a 10 percent increase in the price of beer would lower consumption by 3.7 percent. The price elasticity of demand for traditional beer is -0.76, therefore, inelastic and implies that a 10 percent increase in the price of traditional beer would result in a 7.6 percent decrease in the quantity demanded. The findings of this study are consistent with previous studies by Okello (2001) and Osoro et al. (2001). The Hicksian own-price elasticities of demand for alcohol range between -0.117 (for traditional beer) and -0.037 (for beer). The implication is that increases in prices of beer would make some consumers to switch to traditional beer, hence increasing the quantity demanded for traditional beer.

4.3. Expenditure Shares and Budgets Elasticities for Soft Drinks

Table 5 shows the expenditure shares and budget elasticities of soft drinks by households.

Table 5: Expenditure shares and budget elasticities for soft drinks

Commodity	Share	Budget
Mineral Water	0.233***	0.732***
	(0.005)	(0.051)
Squashes	0.430***	0.615***
	(0.004)	(0.021)
Sodas	0.336***	1.678***
	(0.007)	(0.051)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Expenditure on squashes constitute the largest expenditure on soft drinks by households. Overall, households spend 43 percent of their expenditures on soft drinks on squashes, followed by soda drinks at 33.6 percent. Households spend the least amount in mineral water with a budget share of 23.3 percent. In terms of budget elasticities, squashes and mineral water are inelastic with budget elasticities of 0.615 and 0.732 respectively. This implies that an increase in household income will lead to

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a less than proportionate increase in their quantity demanded. Sodas have income elasticities of 1.678, hence income elastic, implying that households consider it as a luxury commodity. The price elasticities of demand for soft drinks are presented in Table 6.

Table 6: Marshallian and Hicksian price elasticities of demand for soft drinks

	Marshallian			Hicksian		
Commodity	**Mineral Water**	**Squashes**	**Sodas**	**Mineral Water**	**Squashes**	**Sodas**
Mineral Water	**-0.210*** (0.045)**	-0.266*** (0.158)	-0.257*** (0.048)	**-0.039 (0.040)**	0.049 (0.033)	-0.010 (0.042)
Squashes	-0.081*** (0.017)	**-0.319*** (0.015)**	-0.214*** (0.127)	-0.062*** (0.016)	**-0.055*** (0.013)**	-0.007 (0.018)
Sodas	-0.444*** (0.040)	-0.686*** (0.035)	**-0.548*** (0.049)**	-0.053 (0.037)	0.036 (0.032)	**0.016 (0.043)**

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Soft drinks have inelastic price elasticities of demand, ranging from -0.21 and -0.548 for the aggregate data. Mineral water has the most inelastic price elasticity of demand of -0.21, implying that a 10 percent in prices of mineral water would result only in 2.1 percent decrease in quantity demanded. Squashes have price elasticity of demand of -0.32 which is inelastic. This means that an increase in prices of squashes by 10 percent would lower consumption by 3.2 percent. Sodas have a price elasticity of -0.548, slightly higher than that of mineral and squashes. This implies that households will reduce their consumption of Sodas by 5 percent if their prices increase by 10 percent. It is also notable that all the cross-price elasticities of demand are negative and statistically significant, implying that the commodities are complementary, and households tend to consume them together. The compensated prices elasticities of demand range from -0.039 to 0.016. However, only the compensated price elasticity of demand for squashes is statistically significant.

4.4. Expenditure shares and budget elasticities for financial services

The largest expenditure by households on financial related services is on mobile money transfer services Table 7. Households spend 42.8 percent of the financial related expenses on mobile money transfer. This is followed by expenditure on banker's cheque services and Automated Teller Machine (ATM) and other bank charges at 34.2 and 23 percent, respectively. In terms of income elasticities, mobile money transfer charges are the most income elastic at 1.39, implying that any increase in household income will result in more than proportionate increase in household's expenditure on mobile money transfer services. Banker's cheque charges and ATM

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and other bank charges are relatively budget inelastic with budget elasticities of 0.55 and 0.94 respectively.

Table 7: Expenditure shares and budget elasticities for financial services

Service	Share	Budget
ATM and other bank Charges	0.230***	0.937***
	(0.008)	(0.283)
Bankers Cheque Charges	0.342***	0.550***
	(0.006)	(0.156)
Mobile Money Transfer Charges	0.428***	1.394***
	(0.006)	(0.108)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

The Marshallian price elasticities of demand for financial services are presented in Table 8.

Table 8: Marshallian price elasticity of demand for financial services

Financial service	ATM and other bank Charges	Bankers Cheque charges	Mobile Money Transfer Charges
ATM and other bank services	**-0.267**	-0.342***	-0.328**
	(0.094)	(0.104)	(0.101)
Bankers Cheque	-0.110**	**-0.203**	-0.236***
	(0.040)	**(0.075)**	(0.052)
Mobile Money Transfer	-0.306***	-0.454***	**-0.635*** **
	(0.027)	(0.044)	**(0.047)**

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Table 9 presents the Hicksian price elasticities of demand for financial services.

Table 9: Hicksian price elasticity of demand for financial services

Financial service	ATM and other bank Charges	Bankers Cheque charges	Mobile Money Transfer Charges
ATM and other bank services	**-0.052**	-0.021	0.073
	(0.035)	(0.028)	(0.039)
Bankers Cheque	0.016	**-0.015**	-0.001
	(0.019)	**(0.024)**	(0.028)
Mobile Money Transfer	0.015	-0.023	**-0.038** **
	(0.017)	(0.018)	**(0.018)**

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

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All financial related transactions have inelastic price elasticities of demand ranging from -0.20 to -0.64 (***Table 8***). Banker's cheque charges have the most inelastic price elasticity of demand of -0.20, implying that bank customers are likely to be less responsive to changes in banker's cheque charges. Similarly, ATM and other bank services have elasticity of demand of -0.27, which is inelastic. Therefore, increases in cost of withdrawals at ATM's are less likely to significantly lower the usage of ATM services such that a 10 percent increase in ATM withdrawal charge would only reduce the usage of ATM services by 2.7 percent. Mobile money transfer service has a price elasticity of demand of -0.64, implying that at 1 percent level of significance, a 10 percent increase in the cost of mobile money transfer services would result in a 6.4 percent decline in demand for mobile money transfer services. The negative and statistically significant cross-price elasticities of demand for financial products indicate that most household always use the all the different categories of financial services products. The Hicksian price elasticities of demand for financial services range from -0.015 to -0.052.

4.5. Expenditure Shares and Budgets Elasticities for Petroleum Products

The expenditure share and budget elasticities for petroleum products were computed and presented in Table 10.

Table 10: Expenditure shares and budget elasticities for petroleum products

Fuel	Share	Budget
Diesel	0.510***	1.013***
	(0.015)	(0.037)
Petrol	0.490***	0.986***
	(0.015)	(0.038)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Households consume almost proportionate amounts in petroleum products. Households spend 51 percent of their petroleum products expenditure on diesel against 49 percent on petrol. The budget elasticities of petroleum products are almost unitary. Petrol and diesel have budget elasticities of 0.99 and 1.01 respectively, this implies that any change in household income would result in proportionate change in consumption of petroleum products. The Marshallian price elasticities of demand for petroleum products are presented in Table 11.

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Table 11: Marshallian and Hicksian price elasticities of demand for petroleum products

	Marshallian		Hicksian	
Fuel	**Diesel**	**Petrol**	**Diesel**	**Petrol**
Diesel	**-0.665*** **	-0.348***	-0.148***	0.148***
	(0.025)	(0.057)	(0.035)	(0.035)
Petrol	-0.349***	**-0.637*** **	0.154***	-0.154***
	(0.022)	**(0.052)**	(0.039)	(0.039)

** p<0.05, *** p<0.01, standard errors are in parentheses
Source: Author's own computation

Petroleum products exhibit inelastic price elasticities of demand. Diesel and petrol have price elasticities of demand of -0.67 and -0.64 respectively. A 10 percent increase in the prices of diesel and petrol would respectively result in a 6.7 and 6.4 percent decrease in the quantity demanded these products, respectively. This contradicts with the findings of Ngui *et al.* (2011) whose estimates indicated that petrol and diesel were price elastic. However, in both studies, while Marshallian cross price elasticities of the fuels are negative, the Hicksian estimates are positive. This suggests that the income effect outweighs the substitution effect, such that a fall in price of one fuel results in an increase of a household's real income, causing it to consume more of the substitute fuel.

5. CONCLUSION AND POLICY IMPLICATIONS

Several reforms, both administrative and policy, have been undertaken by the government of Kenya through KRA, aimed at improving excise tax collections. However, these efforts have not yielded much with excise tax revenue collection remaining low. Therefore, understanding the consumption pattern of various excisable commodities is critical in the design of excise tax policy. The estimation of demand elasticities of various commodities and services is important in the formulation and review of tax policy which should rely heavily on the nature of elasticities of various commodities for optimum tax revenue. Using the KIHBS 2015/16 survey data, this paper employed the LA-AIDS model to estimate the price elasticities of demand for tobacco products, alcohol, soft drinks, petroleum products and financial services.

From the analysis, alcohol, soft drinks, petroleum products and financial services are all price inelastic. However, tobacco is price elastic with an elasticity of -1.046 while cigarettes have an elasticity of -0.92 which tends to 1, thus approaches unitary elasticity. Beer has a price elasticity of -0.366 while soft drinks have an elasticity ranging from -0.210 for mineral water, -0.319 for squashes, and -0.548 for sodas. Diesel and petrol have elasticities of -0.665 and -0.637, respectively. When it comes to financial services products, banker's cheque and ATM services have an elasticity of -

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0.203 and -0.267, respectively while mobile money transfer service is the least inelastic at -0.635.

From the foregoing results, except for tobacco, all other excisable goods and services are price inelastic. This has an implication on the economic welfare of both producers and consumers of excisable goods and services. Price elasticity of demand partly determines the proportion of tax burden that producers and consumers bear in the short run. In instances where demand is price inelastic while supply is price elastic, the consumers bear a disproportionate tax burden. In cases where the supply is also inelastic, tax burden is shared between producers and consumers in varying proportions. Therefore, keeping in line with the canon of equality, policy makers should take into consideration demand elasticities when designing tax policies.

Theory of demand suggests that commodities with highly inelastic price elasticities of demand are less responsive to price changes. Therefore, if the policy objective is to increase excise tax revenues, then commodities with lower price elasticities of demand should bear a larger tax burden. From a policy perspective, commodities such as mineral water, squashes, beer and financial services such as banker's cheque and ATM services are highly inelastic, indicating that increase in excise duty imposed on them will not lower their consumption significantly.

However, depending on the policy objective, the levying of excise duty needs careful considerations. For instance, caution should be taken especially for the mobile money transfer and other financial services as heavy taxation on the sector may reverse the gains made on financial inclusion among low-income households.

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