Responsiveness of Cigarette Demand to Price Changes in Botswana

Botswana Institute for Development Policy Analysis

Submitted to:
The African Capacity Building Foundation
P. O. Box 1562
Harare, Zimbabwe

February 2022

Author(s)

i. **Tshepiso Gaetsewe** (Ms): Research Fellow – Industry & Private Sector Development Specialist, Botswana Institute for Development Policy Analysis, *tgaetsewe@bidpa.bw*

ii. **Goitseone Khanie** (Ms): Research Fellow – Industry and Private Sector Development Specialist, Botswana Institute for Development Policy Analysis, *gkhanie@bidpa.bw*

Table of Contents

Abstract

The aim of this study is to analyse the responsiveness of cigarette demand to price changes in Botswana. This is done by estimating the conditional price elasticity of cigarette demand using Deaton's model and the Botswana Multi-Topic Household Survey (BMTHS) of 2015/16. The cigarette price elasticity of demand in Botswana is estimated to be -0.86. The results indicate that a 10% increase in the price of cigarettes will reduce cigarette demand by 8.6% among smokers. These findings provide the first scientific evidence of conditional elasticity on consumption for policy-makers in Botswana. These findings are expected to guide policy-makers, and those involved in tobacco control, in formulating the most effective policies for regulating and controlling the consumption of tobacco in Botswana.

1. Introduction and Background of the study

The epidemic of tobacco use is a global public health concern, and it has substantial economic and social effects on consumers, households, communities and the economy. Tobacco has many evidence-based negative impacts, such as respiratory diseases, cardiovascular diseases and cancer, which affect active as well as passive smokers (Sinha et al, 2017). Globally, it is estimated that more than 8 million people are killed each year by smoking-related diseases (WHO, 2019).

Botswana is a middle-income country located in Southern Africa, with a population of just over 2 million. In 2018, the country recorded over 1500 deaths a year which are due to smoking-related illnesses, (Mbongwe et al, 2018); but the number of deaths has since increased to 1900 a year (Tobacco Atlas, *online*). Yet, according to the Global Adult Tobacco Survey (GATS) of 2017, about 240,000 adults (15 years and older) continue to use tobacco every day. Currently, the prevalence of tobacco use among adults in Botswana is 17.6% (27.0% males and 8.8% females). According to the GATS (2017), this rate is among the highest adult tobacco use rates in the WHO African Region. Another area of concern around tobacco consumption is the increase in trade of illicit tobacco products. In 2019, Botswana recorded an estimate of 10% in illicit trade in cigarettes, (World Bank, 2019). Trade in illicit cigarettes has likely increased drastically due to the ban in sales of tobacco during COVID 19 lockdowns.

To curb and reduce the negative impacts of tobacco use, the country has put some control measures in place to regulate the use of tobacco products. Botswana enacted its first law on tobacco control in 1992, the Control for Smoking Act (CSA), which was amended in 2004. The act aims to control the smoking of tobacco and tobacco products in the country. The Act includes, among others, a ban on smoking in any enclosed venue, in indoor designated non-smoking areas of any workplace, private or public, or in any public place. The act also prohibits the advertising of tobacco and tobacco products, as well as the sale of tobacco to persons under the age of 18 years (Government of Botswana, 1992).

Botswana signed the Framework Convention on Tobacco Control (FCTC) in 2003 and ratified it in 2005. The FCTC is a World Health Organization (WHO) public health treaty which was developed in response to the global nature of the tobacco epidemic. Subsequent to signing the FCTC, the Ministry of Health developed and drafted the Tobacco Products Control Bill (TPCB) in 2003, the aim of which was to refine the CSA and align it to the provisions of the Convention (ATN, 2012). However, it is only recently that the bill was passed in parliament (Government of Botswana, 2021), and is awaiting to be published officially as an Act.

Moreover, Botswana signed and is currently in the process of ratifying the Protocol to Eliminate Illicit Trade in Tobacco Products (which was adopted in 2013), another international treaty, which is based on Article 15 of the WHO FCTC.

Despite policies aimed at reducing tobacco consumption in Botswana, the use of tobacco products is still widespread in the country. Government efforts to control the use of tobacco products through policies do not seem to be effective. This may be because the demand for tobacco and tobacco products is most affected by changes in tobacco prices and taxes, as is shown in the literature. According to IARC (2011), raising excise taxes on tobacco is the single most effective instrument for controlling tobacco consumption. As a result, it is necessary to investigate how taxes and changes in price can be used to reduce the use of tobacco products in Botswana.

Research on tobacco control is very limited in Botswana. Studies that have attempted to research the subject focus more on determining the prevalence and risk factors of smoking (Mbongwe et al., 2017), analysing the effects of the ban on tobacco advertising and promotion (Mbongwe & WHO, 2004), and providing a situational analysis of tobacco control (Mbongwe et al., 2018). There is currently no study that has carried out a quantitative analysis of tobacco taxation in Botswana, in particular estimating how the demand for tobacco of smokers would change if prices were to change.

This study therefore seeks to analyse how the demand for cigarettes responds to price changes in Botswana. The specific objective of the study is to provide the first published estimates of the price elasticity of demand for cigarettes in Botswana. This will fill a gap in the evidence for the local impact of price changes on cigarette demand among smokers in Botswana, which could inform policy on effective tobacco-control measures in the country.

The rest of the paper is organised as follows: section 2 discusses taxation as a tool for tobacco control in Botswana, and section 3 reviews the related empirical literature on how cigarette demand responds to price changes. In section 4, the paper outlines the methodological approach used to achieve its objectives. The empirical results are analysed in section 5, and the conclusion and policy recommendations are provided in section 6.

2. Tobacco Taxation in Botswana

In Botswana, taxes imposed on cigarettes and other tobacco products include the sales/value added tax (VAT), the specific excise tax and the tobacco levy. The VAT, which applies to all taxable goods in the country, was increased from 12% to 14% in April 2021. The specific

excise tax is determined regionally between the Southern African Customs Union (SACU) member states. The agreement is that South Africa sets specific excise taxes on tobacco products, and member states adopt the same rates.

In addition to the specific excise tax, SACU member states are allowed to impose extra taxes independently which do not form part of the SACU revenue pool. That is why Botswana introduced, in 2014, an additional 30% levy on the value of production or importation of tobacco products as a way of controlling the use of tobacco in the country. As advocated by the Anti-Tobacco Network, the tobacco levy was introduced to reduce access to tobacco products, especially by children and young adults, and the income generated from the levy was expected to fund anti-tobacco initiatives. Some of the proposed initiatives to be funded by the levy include the provision of support to those trying to quit smoking and promotion of public health among Botswana's citizens (Mbongwe et al, 2018).

In 2019, the overall proportion of the retail price of cigarettes accounted for by taxes in Botswana was estimated to be 50%, (World Bank, 2019); which has likely increased (ranging from 51% to 60%) due to the increase in VAT and the specific excise tax. This total tax share is, however, below the World Health Organization benchmark of 75% of the retail price of tobacco products. It is therefore important to find out how the changes in price resulting from this tax influence the demand for tobacco products, especially cigarettes, in Botswana.

3. Literature Review

The use of tax measures to increase the retail prices of cigarettes and other tobacco products has been widely recognised to be the single most effective method of reducing demand for these products. As stated in Article 6 of the WHO Framework Convention on Tobacco Control, price and tax measures are an effective and important means of reducing tobacco consumption by various segments of the population. Existing literature shows that there is a negative relationship between tobacco taxation and tobacco consumption (Mugosa, 2020; Ahmed et al., 2019; Nayab et al., 2018 and Chavez, 2016). As a result, higher tobacco taxes can reduce the prevalence and incidence of tobacco use: they encourage smokers to quit, prevent initiation of smoking by non-smokers (especially the youth), and can also reduce consumption among those who continue to use tobacco (Eozenou and Fishburn, 2009; U.S NCI and WHO, 2016; Ntale and Kasirye, 2018).

However, the extent of the impact of raising taxes on cigarettes depends on the responsiveness of consumers to the relative price change (Chaloupka and Warner, 1999). This responsiveness

to price increases is often captured by the price elasticity of demand. Price elasticity of demand is generally defined as a percentage change in consumption in response to a percentage change in price. Consumer response to changes in price varies across different commodities. By nature, cigarettes are addictive, and an increase in price would be expected to decrease the quantity demanded proportionally less than the price increase. This means that the demand for cigarettes is expected to be price inelastic. However, changes in quantity demanded due to price increases have been proved to vary among different income groups. For example, in High Income Countries (HICs), price elasticity estimates range from -0.2 to -0.6, clustering around -0.4; and in LMICs, elasticity estimates range from -0.2 to -0.8, clustering around -0.5 (U.S NCI and WHO, 2016). This shows that people in LMICs are more responsive to tax and relative price increases than people in HICs.

Various methods are used to estimate the price elasticity of demand, but the Almost Ideal Demand System (AIDS), introduced by Deaton and Muellbauer (1980), is the most popular for working with cross-sectional data. The model that is commonly known as Deaton's model (1988) is founded on Deaton and Muellbauer's (1980) AIDS model, but it differs in that it allows for zero purchases. This means that it allows for those consumers that do not consume a product to participate, as not everybody in the population would consume that particular good (John et al., 2019). Several studies have followed Deaton and estimated the price elasticity of demand for cigarettes. Table 1 provides a summary of studies that used Deaton's model and the estimated price elasticities.

In line with earlier findings that the price elasticity of cigarette demand is inelastic, most studies arrived at estimates in the range of -0.2 to -1.0. These results imply that, in most countries, the decrease in the quantity of cigarettes demanded is less than proportionate to the price increase. Only a handful of studies that used Deaton's model arrived at elastic price elasticity estimates. Using household survey data, Gligoric et al. (2020) estimated the price elasticity of demand for cigarettes to be elastic (-1.366) for Bosnia and Herzegovina. Similarly, a study conducted in Iran by Rad et al. (2020) also arrived at price elasticity estimates of -1.42 for non-Iranian cigarette brands.

Table 1: Studies that Applied Deaton's Model

Author(s)	Title	Data Source	Price Elasticity Estimates
Mugosa et al. (2020)	Accelerating progress on effective tobacco tax policies in **Montenegro**	Household Budget Survey Data 2006-2017	-0.62 and -0.80
Rad et al. (2020)	Quality and quantity of price elasticity of cigarette in **Iran**	2017 Iranian Household Income and Expenditure Survey	-0.42 and -0.56 for Iranian brands of cigarette -1.42 for non-Iranian cigarette brands
Gligoric (2020)	Price elasticity demand for cigarettes in **Bosnia and Herzegovina**: microdata analysis	Household Budget Survey in B&H, 2011 and 2015	-1.366
Chelwa and Walbeek (2019)	Does cigarette demand respond to price increases in **Uganda**? Price elasticity estimates using the Uganda National Panel Survey and Deaton's method.	Uganda National Panel Survey	-0.26 and -0.33
Adeniji (2019)	Consumption function and price elasticity of tobacco demand in **Nigeria**	Harmonized Nigerian Living Standards Survey, 2009 - 2010	-0.62 national -0.63 and -0.49 rural and urban respectively
Chavez et al. (2016)	Price elasticity of demand for cigarettes and alcohol in **Ecuador**, based on household data	National Survey of Urban and Rural Households Income and Expenditures, 2011-2012	-0.87
Salti et al. (2015)	The effect of taxation on tobacco consumption and public revenues in **Lebanon**	2005 National Survey of Households Living Conditions	-0.70 for imported products and -0.90 for local products
Eozenou and Fishburn (2009)	Price elasticity estimates of cigarette demand in **Vietnam**	Vietnam Living Standards Survey, 1998	-0.53
John (2008)	Price Elasticity Estimates for Tobacco Products in **India**	National Sample Survey Organisation	-0.4 and -0.9
John (2005)	Price Elasticity Estimates for Tobacco and other addictive goods in **India**	National Sample Survey Organisation	-0.5 and -1.0 with cigarette being the least price elastic

Source: Compiled by Authors using past studies

4. Methodology

4.1 Model

To analyse the responsiveness of cigarette demand to price increases in the Botswana economy, this paper uses the method proposed by Deaton (1988, 1989,1990) to evaluate price elasticities. This method has been used by various studies, including in Uganda (Chelwa and van Walbeek, 2019); Lebanon (Salti et al., 2015), Vietnam (Eozenou and Fishburn, 2009), and Poland (Gardes and Starzec, 2004). It is useful for LMICs as it considers that the prices of most goods in LMICs fluctuate across geographical space. Furthermore, prices are similar within various clusters, such as villages, mostly because of significant transportation costs as goods are moved from cluster to cluster (Chelwa and van Walbeek, 2019). Deaton's method uses household expenditure surveys, which is good for the African continent, as the data is usually more available than aggregate time-series data on tobacco prices and consumption. However, as most household expenditure surveys in LMICs do not include data on prices, the method proposes using "unit values" as a proxy for prices.

The first step of Deaton's method is to compute the unit values. Unit values for cigarettes can be defined as the ratio of total household expenditure on cigarettes to the quantity of cigarettes purchased by the household. The unit values are computed as follows:

$$u_{ic} = \frac{E_{ic}}{Q_{ic}} \qquad (1)$$

Where; u_{ic} is the unit value of cigarettes, E_{ic} is the expenditure on cigarettes and Q_{ic} is the quantity of cigarettes, for household *i* situated in cluster *c.* The expenditure on, and consumption of cigarettes have been quantified in months, and the clusters are represented by enumeration areas taken from the Botswana Multi-Topic Household Survey (BMTHS).

Secondly, the method assesses whether the main identifying assumption holds, namely that prices (unit values) vary spatially. This is achieved through an analysis of variance (ANOVA), where we divide total variation in unit values into 'within cluster variation' and 'between cluster variation'. The result will be an F-statistic which will allow us to draw a conclusion that unit values fluctuate across space. An F-statistic that is large and significant would indicate that unit values vary spatially across clusters.

We then proceed to estimate 'within cluster regressions' of the form:

$$\ln u_{ic} = \beta + \mu \ln z_{ic} + \partial \boldsymbol{X}_{ic} + \delta \ln \pi_c + e_{ic} \qquad (2)$$

$$w_{ic} = \alpha + \rho \ln z_{ic} + \gamma \boldsymbol{X}_{ic} + (FE_c + v_{ic}) \qquad (3)$$

Where;

$\ln u_{ic}$ is the log of the unit value.

$\ln z_{ic}$ is the log of the total household expenditure, and $\ln\pi_c$ are the unobserved prices.

$\boldsymbol{X}_{ic}$ is the vector for the specific household characteristics; these are: household size, gender of household head, proportion of males in the household, proportion of adults in the household, age of household head, employment status of household head, and years of schooling of household head.

w_{ic} is the proportion of cigarette expenditure to the total expenditure for household *i* in cluster *c*.

FE_c are the cluster fixed effects.

e_{ic} *and* v_{ic} are the standard error regression terms.

Equation (2) is the unit value equation, while equation (3) is a standard demand equation. The unit value equation checks for the existence of quality effects in the unit value data. When there is a positive and significant relationship between the household expenditure and the unit values, this would indicate the presence of quality effects. This means that households that have higher incomes have higher unit values, as they are purchasing higher quality[1] and more costly cigarettes. The demand equation regresses the budget share of cigarettes on household income (proxied by household expenditure), household characteristics and prices. Prices are proxied by cluster fixed effects (FEc), as we do not have individual price data, because we assume that prices are fixed within clusters. Cluster fixed effects also permit us to hold constant cluster-level tastes and preferences. Equation (2) and (3) also contain the measurement error at the household level.

The method then proceeds to strip the household-level demand and unit values of the effects of household expenditure, as well as household characteristics, and these are then averaged across clusters. This is necessary in order to estimate elasticity at the cluster level using cluster demand and the cluster unit value of all other factors. The following equations are derived in this step:

$$\hat{y}_c^1 = \frac{1}{n_c}\sum_{i=1}^{n_c}(\ln u_{ic} - \mu \ln z_{ic} - \partial X_{ic}) \qquad (4)$$

$$\hat{y}_c^2 = \frac{1}{n_c}\sum_{i=1}^{n_c}(w_{ic} - \rho \ln z_{ic} - \gamma X_{ic}) \qquad (5)$$

[1] Higher quality does not mean the cigarette is better or safer than a less quality cigarette. It simply means the cigarette is more refined and more expensive.

Where;

n_c is the number of households in cluster *c*, and

$\hat{y}_c^1$ *and* $\hat{y}_c^2$ are cluster average unit value and cluster average demand estimates, respectively, after stripping the effects of household expenditure and household characteristics.

The Deaton method next proceeds to regress cluster-level demand on cluster-level unit values. This step, computed as price elasticity of demand, can only be found by observing how cluster-level demand responds to changes in cluster-level prices. This is done by dividing the covariance between the cluster average unit value and the cluster average demand estimates by the variance of the cluster average unit value. This is shown by the following equation:

$$\widehat{\emptyset} = \frac{Cov(\hat{y}_c^2, \hat{y}_c^1) - \frac{\hat{\sigma}^{12}}{n_c}}{Var\left(\widehat{y_c^1}\right) - \frac{\hat{\sigma}^{11}}{n_c^+}} \qquad (6)$$

Where; n_c^+ is the number of households in a cluster that have spent money on tobacco, n_c is the total number of households in a cluster, $\hat{\sigma}^{12}$ is the covariance of errors in equations (2) and (3), and $\hat{\sigma}^{11}$ is the variance of errors in equation (2).

Equation 7, the last step, gives the price elasticity of demand by applying quality correction formulas:

$$\widehat{\in} p = \left(\frac{\hat{\tau}}{\bar{w}}\right) - \hat{\varphi} \qquad (7)$$

Where; $\bar{w}$ is the average proportion of total household expenditure spent on cigarettes in the sample, and $\hat{\varphi}$ *and* $\hat{\tau}$, are the coefficients on the unobserved prices from equations (2) and (3), and are recovered as follows:

$$\hat{\varphi} = 1 - \frac{\hat{\mu}(\bar{w} - \hat{\tau})}{\hat{\rho} + \bar{w}} \qquad (8)$$

$$\hat{\tau} = \frac{\widehat{\emptyset}}{1 + \bar{w}\left(1 - \widehat{\emptyset}\right)\widehat{\propto}} \qquad (9)$$

$$\widehat{\propto} = \frac{\hat{\mu}}{\hat{\rho} + \bar{w}(1 - \hat{\mu})} \qquad (10)$$

$\hat{\mu}$ is the estimate of the coefficient on total household expenditure in equation (2), and the within-cluster unit value equation.

$\hat{\rho}$ is the estimate of the coefficient on total household expenditure in equation (3) and the within-cluster demand equation.

$\widehat{\emptyset}$ is the estimate of the coefficient of a regression of cluster-level demand on the cluster-level unit value.

The Deaton method also has a formula to compute the estimate of the expenditure elasticity ($\widehat{\in} I$) of demand as follows:

$$\widehat{\in}_I = 1 + \left(\frac{\hat{\rho}}{\bar{w}}\right) - \hat{\mu} \qquad (11)$$

We expect the price elasticity for cigarettes to be negative, which would show that an increase in cigarette prices in Botswana would lead to a decrease in demand for cigarettes.

4.2 Data and Descriptive Statistics

The study employed cross-sectional data from the 2015/16 Botswana Multi-Topic Household Survey (BMTHS), sourced from Statistics Botswana. The BMTHS was conducted from November 2015 to November 2016, and it is a multi-modular survey. The main objective of the BMTHS was to provide a broader set of indicators for poverty and the labour market; the survey has modules on household consumption and expenditure, education, employment, access to health amenities, community activities, and other information on school and health facilities, as well as household characteristics. The survey gathered household information from cities/towns, urban villages, and rural villages.

Sampling of respondents in the 2015/16 BMTHS involved a two-stage sampling design. The first stage was the selection of 599 Enumeration Areas (EA) as the primary sampling units; these were drawn with probability proportionate to size. The second stage involved selecting 7060 households, which were systematically selected from the households listed in the selected EAs.

The BMTHS is a nationally representative survey that captures consumption and expenditure patterns of households across the country, cigarette smoking included. The two important variables used in the analysis of price elasticity for cigarettes, using Deaton's method, are cigarette consumption and cigarette expenditure. The recall period for cigarette expenditure, as

used in the BMTHS, was 7 days, while for consumption it was a daily average over the past month. When analysing and converting the individual survey data to household data, Statistics Botswana converted the expenditures (cigarette expenditure and total household expenditure) to a monthly average. To standardise the 'consumption of cigarettes' variable, consumption was converted to represent monthly consumption rather than daily consumption, which was then aligned with the monthly expenditure. The variable on cigarette consumption, which was previously reported in sticks, was converted to packs by dividing the variable by 20, as there are 20 cigarette sticks in a pack.

The study only focuses on estimating the price elasticity of cigarettes, as the BMTHS only captures information on cigarettes and not on other tobacco products. This is also the reason why the study does not attempt to estimate cross-price elasticities. Another important variable in the study is the cluster variable, which can be a geographical unit, or a survey wave if one is combining different surveys (John et al., 2019). The study adopts Enumeration Areas (EA) to represent clusters, as they are the primary sampling units in the BMTHS, and similar characteristics of households would be expected in the same EA.

The BMTHS captured a total of 7060 households, of which 1611 were found to spend money on and consume cigarettes. However, after extensive cleaning of the data, only 620 households were included in the model. Data cleaning was necessary as the data had outliers, especially variables such as total household expenditure, cigarette consumption and cigarettes expenditure. Furthermore, there were many observations that had missing data which required that the observations be removed before any analysis could be done. Even though many observations were dropped, the cleaned data gives a representation of the population of smokers and reduced the chances of having distorted results.

The study estimates conditional price elasticities instead of unconditional price elasticities. Conditional price elasticities estimate the elasticities for smoking households only and omits households that do not have smokers. This decision was taken after discovering that the survey included many households that had either a zero expenditure on cigarettes but a positive consumption of cigarettes in the household or had a zero consumption of but positive expenditure on cigarettes. This discovery showed that the survey does not differentiate between zero expenditure and missing values, where a household's cigarette expenditure or consumption is simply not captured for whatever reason. The study will adopt the same method as John (2008) and recently Chelwa (2015), who chose to include only households that spent money on cigarettes (and also consumed cigarettes).

Table 2: Descriptive Statistics of Variables from BMTHS

Variable	Description	Mean	Min	Max
Cigarette Expenditure (BWP/Month)	Monthly cigarette expenditure	490.74	42.10	4,210.80
Total Household expenditure (BWP)	Monthly total household expenditure	3467.46	471.29	27,034.00
Cigarette Consumption	Monthly quantity of cigarettes consumed (in packs)	8.25	1.52	53.2
Household Size	Household size	2.95	1	12
Age	Age of the household head in years	41	18	94
Education	Years of schooling of household head	10.62	1	23
Gender	1 if household head is male, 0 otherwise	0.78	0	1
Males	Proportion of males (18 years and above) in a household	0.63	0	1
Adults	Proportion of adults (18 years and above) in a household	0.83	0.22	1
Employ	1 if household head is employed, 0 otherwise	0.83	0	1

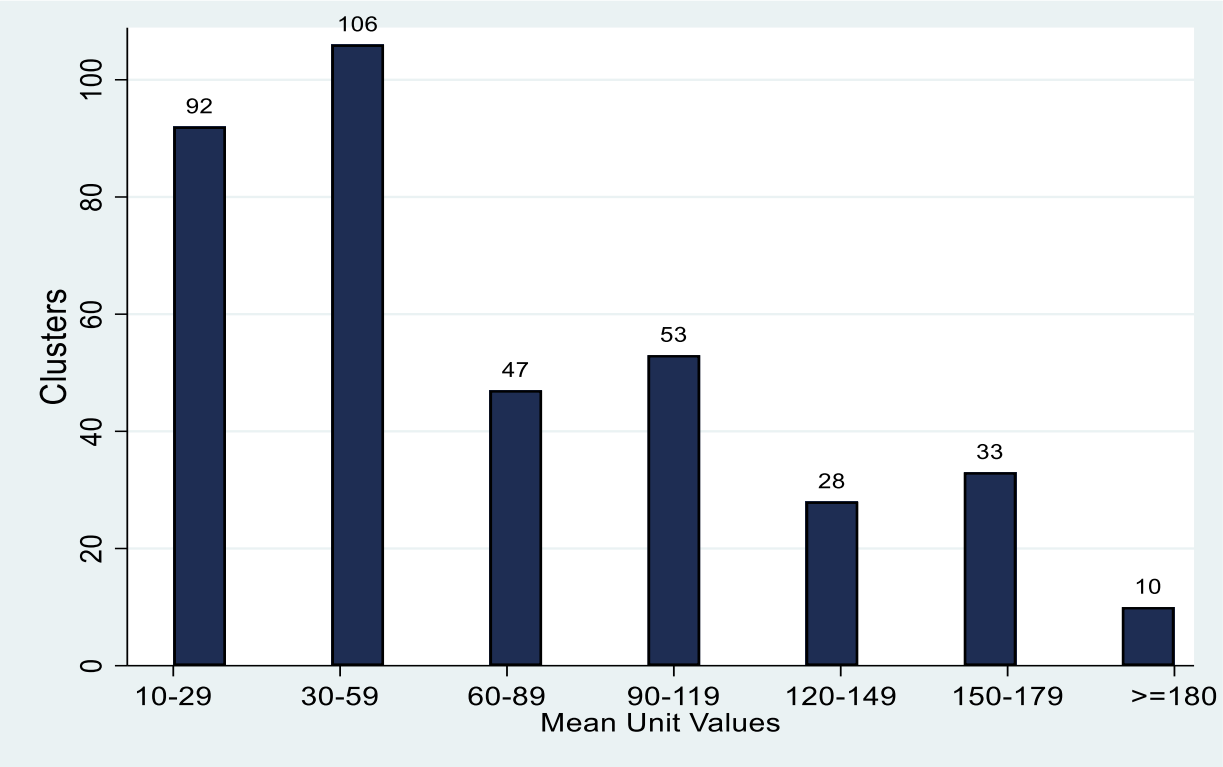
Source: Computed by Authors from 2015/16 BMTHS

Table 2 gives the descriptive statistics for the variables used in the model. On average, household monthly cigarette expenditure is P490.74, with the lowest amount spent being P42.10 and the highest being P4,210.80. Total monthly household expenditure on average is P3,467.46, with the lowest amount spent being P471.29 and the highest being P27,034.00. Monthly consumption ranges between 1.52 and 53.2 packs of cigarettes, and on average 8.25 packs are consumed in a household. There is an average of 3 people per household, and the largest household contained 12 people. The average age of the household head is 41 years, with the youngest household head being 18 and the oldest being 94. The average level of education of the household head is 10 years of schooling, with the lowest level being only 1 year and the highest 23 years of schooling. Households are mostly headed by males (78%), and on average 63% of household members are male. The high proportion of males is not surprising as the BMTHS shows that age distribution of household heads ranging between 20-49 years are mostly males, and this is the age group that is working and spends on cigarettes. The adult ratio to total household size is 0.83, implying that 83% of household members are adults (over the age of 18 years). Approximately 83% of household heads are employed.

5. Empirical Results

This section presents the results of the regression analysis from the application of Deaton's method. Deaton's method is based on the assumption that prices of cigarettes vary spatially across geographical locations. Figure 1 shows the distribution of unit values across clusters.

Figure 1: Histogram on Unit Values by Clusters



Source: Computed by Authors

Table 3 presents the results of the ANOVA which tested this critical assumption in the method. The results of the ANOVA show that our F-statistic is large and significant; this validates the assumption that unit values vary across the geographical clusters. Furthermore, the R-squared is estimated at 65%. This measures the proportion of total variation in the unit values between the clusters. The data corroborate the assumption of spatial variation in prices across clusters.

Table 3: Variation in Log of Unit Values of Cigarettes

	F-statistic	**P-value**	**R-Squared**	**Observation (n)**
Cluster	1.26	0.024**	0.6506	620

Source: Computed by Authors from 2015/16 BMTHS (Note: *** p<0.01, **p<0.05, *p<0.1)

Table 4 presents the results for the unit value regression and Table 5 reports results for the budget share regression (as shown in equations 2 and 3). This stage estimates the within-cluster regressions. Unit value results in Table 4 show that the expenditure elasticity variable is significant and positive (0.336). This shows the presence of quality effects in the model, which means that, other variables held constant, those households that have higher expenditures report higher unit values. Therefore, a 10% higher expenditure will lead to households purchasing cigarettes that are 3.33% more expensive (other variables held constant). These results were expected and are consistent with similar studies in the literature on this topic (Chelwa and van Walbeek, 2019; Chavez, 2016; C; Salti et al., 2015; Eozenou and Fishburn, 2009; and Gardes and Starzec, 2004). Other explanatory variables were not statistically significant.

Table 4: Unit Value Regression

Variable	**Coefficients (Standard Errors)**
Log Household Expenditure	0.336*** (0.676)
Log Household Size	-0.001 (0.117)
Age	-0.038 (0.149)
Education	0.071 (0.799)
Gender	0.033 (0.139)
Employ	-0.803 (0.123)
Males	0.238 (0.246)
Adults	-0.321 (0.351)
Constant	1.506* (0.799)
No. of Households	620
R-Squared	0.6889

*** p<0.01, **p<0.05, *p<0.1

Source: Computed by Authors from 2015/16 BMTHS

The budget share regression analyses how households/consumers would apportion their budget share on cigarettes if household expenditure was to change. The results in Table 5 show that there is a negative and statistically significant relationship between the share of the budget spent on cigarettes and household expenditure. If household expenditure was to increase by 10%, then the share of the budget spent on cigarettes would decrease by 0.41%. These results are consistent with the literature, as we expect that increases in household expenditure would tend to decrease the budget share for cigarettes.

Other variables are not statistically significant, apart from gender of the household head, which is positive and statistically significant. This can be interpreted as indicating that households

that are headed by males are more likely to allocate a larger budget share towards cigarette spending.

Table 5: Budget Share Regression

Variable	Coefficients (Standard Errors)
Log Household Expenditure	-0.041*** (0.011)
Log Household Size	0.020 (0.019)
Age	0.001 (0.025)
Education	0.001 (0.015)
Gender	0.047** (0.023)
Employ	-0.009 (0.020)
Males	0.042 (0.041)
Adults	0.042 (0.058)
Constant	0.388*** (0.132)
No. of Households	620
R-Squared	0.6650

*** p<0.01, **p<0.05, *p<0.1

Source: Computed by Authors from 2015/16 BMTHS

To obtain the conditional price elasticity of quantity demanded of cigarettes, we used parameters obtained from equations 4 to 10. The key parameters are shown in Table 6 below.

Table 6: Key Parameters

μ	0.45822
ρ	-0.027165
$\hat{\sigma}^{11}$	0.45583
$\hat{\sigma}^{12}$	0.01248
n_c^+	1.3568
n_c	1.3568
$\overline{w}$	0.18535
$\widehat{\emptyset}$	107.80091
$\hat{\varphi}$	-0.00149
$\hat{\tau}$	-0.160378
$\hat{\alpha}$	6.2553

Source: Computed by Authors

Using the results generated in the first stage, the expenditure elasticities of demand estimates were generated from equation (11), as shown in Table 7. The income elasticity (measured by expenditure elasticity) is found to be positive (0.44) and statistically significant at 1%, suggesting that a 10% increase in household income increases cigarette consumption by 4.4%. The income elasticity is limited in that it is measured by expenditure and does not capture the actual income of the household.

Table 7: Estimates of the Expenditure Elasticity for Cigarettes

Cigarettes	Coefficient	Bootstrapped Standard Errors	95 % Confidence Intervals
E_I	0.440***	0.075	(0.294, 0.586)

Source: Computed by Authors from 2015/16 BMTHS (Note: *** p<0.01, **p<0.05, *p<0.1)

Table 8 presents the price elasticity of demand estimates for cigarettes in Botswana. The results of the estimation show a negative price elasticity of cigarettes (-0.86). This indicates that cigarettes in Botswana are price inelastic. The standard errors are obtained using the bootstrapping method, and they indicate that price elasticity is significantly lower than zero: a 10% increase in the price of cigarettes will reduce demand for cigarettes by 8.6%.

Table 8: Estimates of the Price Elasticity of Demand for Cigarettes

Cigarettes	Coefficient	Bootstrapped Standard Errors	95 % Confidence Intervals
Ep	-0.864***	0.003	(-0.869, -0.857)

Source: Computed by Authors from 2015/16 BMTHS (Note: *** p<0.01, **p<0.05, *p<0.1)

The estimates for price elasticity of demand are consistent with previous empirical research, where price elasticity of demand for cigarettes is found to be inelastic. Botswana's price elasticity of demand is slightly above the LMICs range of -0.2 to -08. This is to be expected as Botswana identifies as an Upper Middle-Income Country (UMIC), and the -0.86 price elasticity estimate is consistent with other UMICs' such as -0.87 in Ecuador (Chavez, 2016), and a range of -0.7 to -0.9 in Lebanon (Salti et al., 2015). Increasing taxes increases the retail price of cigarettes and this reduces demand for cigarettes. However, tax increases are only effective if demand is responsive to price changes. The results of the price elasticity of demand (-0.86) show that cigarette demand is responsive to price changes in Botswana.

While the study shows that increasing taxes would reduce the demand for cigarettes, this would be ineffective if trade in illicit cigarettes is not controlled. With the recent growth of the illicit market, increasing prices of cigarettes in the licit market may drive smokers into the illicit market. An illicit market often shows that the authorities overseeing the tobacco market have left gaps for illicit traders and smokers; where there may be weak administration and/or ineffective enforcement measures, (Dare et al., 2021). To curb the evasion of tax by cigarette smokers and traders, it is imperative that government formulates and implements strong and effective measures to augment the increase in taxes that are meant to reduce cigarette demand.

6. Conclusion and Policy Recommendations

The aim of this study was to analyse the responsiveness of cigarette demand to price changes in Botswana. This was done by estimating the conditional price elasticity of cigarette demand using Deaton's model and the Botswana Multi-Topic Household Survey of 2015/16. The BMTHS shows that, on average, 8.25 packs of cigarettes are consumed per month per household, and there is a monthly average expenditure of P490.74 on cigarettes per household. Several tobacco products are consumed in Botswana, with cigarettes being the most popular. This study only analyses cigarette consumption because of the unavailability of data for other tobacco products. The cigarette price elasticity of demand in Botswana is estimated to be -0.86. The results indicate that a 10% increase in the price of cigarettes will reduce cigarette demand by 8.6% among smokers. The results are consistent with findings in the international literature for Upper Middle-Income countries such as Botswana.

The results provide evidence on how effective a tax increase would be in reducing cigarette demand in Botswana; this is necessary for policy makers when formulating policies targeting tobacco control. The study recommends that policy changes should be geared towards tax increases. This would lead to a reduction in tobacco consumption, which would ultimately reduce health expenditure on non-communicable diseases that are attributable to smoking. Furthermore, the revenues generated from tax increases should be invested in health programmes. The programmes could include raising awareness of the harmful effects of tobacco use, treating tobacco related illnesses, and providing rehabilitation and psychological assistance to smokers.

References

Adeniji F. (2019). Consumption function and price elasticity of tobacco demand in Nigeria. Tobacco prevention & cessation, Vol. 5, No. 48. https://doi.org/10.18332/tpc/114084

Ahmed, N., Hossain, J., Huque, R., Hassan, M.T. and Mozumder, T.A. (2019). The Economics of Tobacco Taxation in Bangladesh, Brac Institute of Governance and Development, Brac University.

Anti-Tobacco Network (2012). Implementing the Framework Convention on Tobacco Control, A Civil Society Report, Botswana.

Chaloupka, F.J. and Warner, K.E. (1999). The Economics of Smoking, National Bureau of Economic Research, Working Paper 7047.

Chavez, R. (2016). Price Elasticity of Demand for Cigarettes and Alcohol in Ecuador, based on household data. Rev Panam Salud Publica, Vol. 40, No. 4, pp. 222-228.

Chelwa, G. (2015). The Economics of Tobacco Control in some African Countries, University of Cape Town, Cape Town, South Africa.

Chelwa, G. and van Walbeek. (2019). Does cigarettes demand respond to price increases in Uganda? Price elasticity estimates using the Ugandan Panel Survey and Deaton's method. BMJ Open.

Dare, C., Boachie, M.K., Tingum, E.N., Abdullah, S.M. and van Walbeek C. (2021). Estimating the Price Elasticity of demands for cigarettes in South Africa Using the Deaton Approach. BMJ Open 2021; 11: e046279. doi:10.1136/bmjopen-2020-46279

Deaton A. and Muellbauer, J. (1980). An Almost Ideal Demand System, The American Economic Review, Vol. 70, No. 3, pp. 312-326

Deaton, A. (1988). Quality, Quantity and Spatial Variation of Price. American Economic Review.

Deaton, A. (1989). Household survey data and pricing policies in developing countries. World Bank Economic Review.

Deaton, A. (1990). Price elasticities from Survey Data: extensions and Indonesian Results. Journal of Econometrics.

Eozenou, P. and Fishburn, B. (2009). Price elasticity estimates for cigarette demand in Vietnam. Development and Policies Research Centre (DEPOCEN), Working paper series 2009/05.

Gardes, F. and Starzec, C. (2004). Are tobacco and alcohol expenditures price-elastic? The case of Poland consumption. CERSEM working paper.

Gligoric, D., Pepic, A., Petkovic, S., Ateljevic, J. and Vukojevic, B. (2020). Price elasticity of demand for cigarettes in Bosnia and Herzegovina: microdata analysis. Tob Control, Vol. 29, pp. 304-309. doi;10.1136/tobaccocontrol-2019-055258.

Global Adult Tobacco Survey (2017). Botswana

Government of Botswana, (2021). The Botswana Government Gazette, Department of Government Printing and Publishing Services, Gaborone, Botswana.

Government of Botswana, (1992). Control for Smoking Act, Botswana.

International Agency for Research on Cancer (2011). Effectiveness of Tax and Price Policies for Tobacco Control. Tobacco Control, Vol 14 (2011).

John R.M. (2005). Price Elasticity Estimates for Tobacco and Other Addictive Goods in India. Indra Gandhi Institute of Development Research, Working Paper Series No. WP-2005-003.

John, R.M. (2008). Price Elasticity Estimates for Tobacco Products in India. Health Policy Plan, Vol. 23, No. 3, pp. 200-209. Doin:10.1093/heapol/czn007.

John R.M., Chelwa G., Vulovic V. and Chaloupka F. (2019). Using Household Expenditure Surveys for Research in the Economics of Tobacco Control. A Tobacconomics Toolkit. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, 2019. www.tobacconomics.org

Mbongwe B., Tapera R., Katlholo T., Erick P., Rahube T., Nseluba N., Mokgethi I., Chuma M., Boitumelo K., Molebatsi M., Tumoyagae T. (2018). Situational Analysis on Tobacco Control in Botswana. University of Botswana. Gaborone, Botswana.

Mbongwe B, Tapera R, Phaladze N, Lord A, Zetola NM (2017) Predictors of smoking among primary and secondary school students in Botswana. PLoS ONE 12(4): e0175640. https://doi.org/10.1371/journal.pone.0175640

Mbongwe, Bontle & WHO Tobacco Free Initiative. (2004). Country report on tobacco advertising and promotion ban - Botswana / Bontle Mbongwe. World Health Organization. https://apps.who.int/iris/handle/10665/68648

Mugosa, A., Cizmovic, M., Lakovic. T. and Popovic, M. (2020). Accelerating progress on effective tobacco tax policies in Montenegro, Tob Control, Vol. 29, pp. 293-299. Doi:10.1136/tobaccocontrol-2019-055197

U.S. National Cancer Institute and World Health Organization, (2016). *The Economics of Tobacco and Tobacco Control.* National Cancer Institute Tobacco Control Monograph 21. NIH Publication No. 16-CA-8029A. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and Geneva, CH: World Health Organization; December 2016.

Nayab, D., Nasir, M., Memon, J.A., Khalid, M. and Hussain, A. (2018). Economics of Tobacco Control and Consumption in Pakistan, Pakistan Institute of Development Economics, Islamabad.

Ntale, A. and Kasirye, I. (2018). Tobacco Control in Uganda: An Analysis of the Impact of taxation in Consumption patterns, Economic Policy Research Centre.

Rad, E.H., Pulok, M.H, Rezaei, S. and Reihanian, A. (2020). Quality and Quantity of Price Elasticity of Cigarette in Iran, Int J Health Plann Mgmt, (2020), pp. 1-11. Doi:10.1002/hpm.3062.

Salti N., Chaaban J., Nakkash R. and Alaouie H. (2015). The Effect of taxation on tobacco consumption and public revenues in Lebanon, Tob Control, 2015; 24: pp. 77-81

Sinha, D. N., Kumar, A., Bhartiya, D., Sharma, S., Gupta, P. C., Singh, H., & Mehrotra, R. (2017). Smokeless Tobacco Use Among Adolescents in Global Perspective. Nicotine & Tobacco Research

U.S. National Cancer Institute and World Health Organization (2016). *The Economics of Tobacco and Tobacco Control.* National Cancer Institute Tobacco Control Monograph 21. NIH Publication No. 16-CA-8029A. Bethesda, MD: U.S. Department of Health and Human

Services, National Institutes of Health, National Cancer Institute; and Geneva, CH: World Health Organization.

World Bank Group (2019). Confronting Illicit Tobacco Trade: A Global Review of Country Experiences, Technical Report of the World Bank Group Global Tobacco Control Program, 18 January, 2019.

World Health Organization Report on the Global Tobacco Epidemic, 2019. Geneva: World Health Organisation; 2019.