The demand for cigarette in Tanzania: A temporal approach

The study presented here attempts to estimate the effect of increased price of cigarettes on the corresponding consumption in Tanzania. The study is based on household panel survey data that were conducted over three periods in 2008, 2010 and 2012. For each period price is estimated indirectly. The price increase was substantial and higher than the corresponding aggregate Consumer Price Index (CPI). An attempt is made to relate the increase in price with a possible decrease in cigarette consumption. The methods of analysis are descriptive tabular statistics and the «two-equation econometrics» approach.

Over the study period, the descriptive approach showed a substantial increase in price but a modest decrease in cigarette consumption prevalence rate, intensity rate and per capita consumption. When a more robust and powerful econometric method was applied, the results showed a substantial decrease in consumption. There was a significant reduction in intensity compared to participation. Between 2008 and 2010 total price elasticity of demand decreased from –0.686 to –0.727. In 2012 the value was −1.139. The reduction in consumption was much higher among the very poor and the poor (−2.387 and −1.967 respectively). When cross classified by age group the youth (20 years or less) showed a high elasticity of −1.672.

The results suggest that in a typical African country smokers (who are relatively poor) will react to substantial price increase in a predictable manner. Price elasticity of demand greater than absolute unity need not be unusual.

Keywords: cigarette; demand; price; smoking participation; smoking intensity.

JEL classification: C01; D12.

1. Introduction

Smoking related diseases are the most preventable cause of death. WHO (World Health Organization) estimates indicate that by 2012 more than 5 million people may have died from tobacco related illnesses. Unless some control measures are introduced, the mortality estimate could increase by 60% and reach up to 8 million by 2030 (WHO, 2012). According to WHO statistics, the tobacco prevalence rate among Tanzanian adults (25 to 64 years) is estimated at 23 percent. Among youth aged 13 to 15, the prevalence rate is 3.8 percent for males and 0.4 percent

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for females (WHO, 2012). For the Eastern Africa region, the prevalence rate is 29 percent for males and 4 percent for females.

Smoking causes a huge economic burden to society, this effect is even more pronounced in many developing African countries. Tanzania’s per capita GDP is only 650 US dollars ranking it as one of the poorest countries in the world (URT, 2012). It has also been verified that the majority of Tanzanians smokers belong to low income group, in other words, any expenditure on cigarette or tobacco is at the expense of basic necessities especially food or calorie intake (Kidane et al., 2015b). In general the many and varied negative consequence of cigarette consumption will be high among the poorest countries including Tanzania.

Several studies have verified that an effective means of controlling or reducing cigarette smoking is to raise tobacco excise taxes (Chaloupka et al., 2000; Chaloupka, Warner, 2000). The WHO Framework Convention on Tobacco Control highlights the importance and effectiveness of tobacco excise tax which leads to increased retail price, this in turn leads to a reduction in demand for cigarette. Many studies reveal that increasing the excise tax on tobacco will not only reduce consumption of tobacco but also may help generate more revenue to the government (WHO, 2010). The effect of increased price through the imposition of excise and related taxes on cigarette consumption is studied through the estimation of demand equation where quantity consumed (demanded) and price are highlighted; this would enable one to estimate participation, intensity and total elasticity.

We have already noted that large proportion of cigarette smokers in Tanzania are low income household heads or members and that cigarette expenditure constitutes a relatively higher rate of their total expenditure (Kidane et al., 2015b), the burden of an excise tax on cigarettes is more likely to affect the poor, who make up 32 percent of the Tanzanian population. Several studies reveal that cigarette affordability is a major determinant of cigarette consumption. Affordability may be determined by income, price, residence, gender, level of education and the like. Other determinants of cigarette consumption include non income and non price factors such as the implementation of strong and effective tobacco control measures, the latter include health warning education, smoke free policies and the like (van Walbeek, 1996, 2002).

One of the most effective ways of reducing smoking prevalence rate or of quitting smoking is to impose retail excise tax so as to increase the price of the same (WHO, 2010). It is already noted that the effect of price increase on cigarette consumption is measured through elasticity. The estimated elasticity may vary by country. The reliability and stability of price elasticity of demand estimates may also depend on whether the estimate is based on short run or long run, the method of measuring demand, the internal consistency of data set and availability of close substitutes. Other factors affecting elasticity estimates include issues on whether the data set is cross section, time series and a combination thereof. Different estimates of the price elasticity of demand for cigarette have been reported for many countries and over a period of time. Many elasticity estimates appear to have an absolute value of less than unity. Within countries there may be variations by income or age groups. In many third world countries a 10 percent increase in the tax rate will reduce cigarette consumption by about 8 percent (WHO, 2012).

This study attempts to compare temporal price increase for three periods: 2008, 2010 and 2012. Once the prices are given, the corresponding decrease (if any) in cigarette prevalence rate, intensity of smoking and per capita consumption rate will be estimated. The methodology adopted here will be both descriptive and analytical statistics. The aim at this stage is to see whether temporal increase in price will lead to decreased prevalence, intensity and per capita consump-
tion. After presenting the descriptive results, an attempt will be made to use standard economet-
ric techniques to estimate the demand for cigarette equation where price is highlighted. This will
enable one to estimate various versions of price elasticity of demand.

Most studies on the relation between increased price of cigarettes and the corresponding
change in quantity consumed are based on the effect of imposing an excise tax on cigarettes. A
study by Lee et al. (2004) showed an elasticity ranging from –0.309 to –0.528. A similar review
study by Bader et al. (2011) concludes that imposition of excise tax on cigarettes would result
in the reduction of cigarette consumption, the responses are still inelastic. Unlike our approach
which is temporal, the above studies consider a demand for cigarette function at a point in time.
Most of the absolute elasticity estimates are less than unity.

This study will not directly consider the effect of increased cigarette price via excise tax. It
will only consider the effect of periodic increase in cigarette price on consumption for the years
2008, 2010 and 2012. This paper has four sections. Section 2 will highlight the methodology
as well as data sources. Section 3 will present the empirical findings along with the discussion
while Section 4 will present conclusions and policy implications.

2. Methods and data sources

2.1. Methods

The econometric method that will be adopted is the «two-part model» (Mao et al., 2008). The
first equation is a logit regression which enables us to estimate the determinants of smok‑
ing participation, the second is the OLS based «smoking intensity equation» which considers
the determinants of the amount smoked among current smokers. The logit regression will en‑
able us to see if increased cigarette price will result in quitting smoking while the OLS regres‑
sion will test if increased price will lead to reduction in the amount smoked. Both models are
demand equations as price is the major explanatory variable of cigarette smoking. Besides price,
other relevant explanatory variables such as gender, age, residence, income will be included.
Both equations will have the same explanatory variables. The combined equations will enable
us to estimate total elasticity. The two regression equations are given below

\[
\text{Prob}(CS_i = 1) = \frac{1}{1 + e^{-\left(c_1 + c_2 \ln P_i + \beta_1 X_i + \epsilon_1\right)}} = 1/(1 + e), \quad (1)
\]

\[
\ln(Q_i | CS_i = 1) = c_2 + \alpha_2 \ln P_i + \beta_2 X_i + \epsilon_2, \quad (2)
\]

where:

- \(CS_i\) is a binary variable, which equals 1 if person \(i\) currently smokes and 0 otherwise;
- \(\text{Prob}(CS_i = 1)\) is the probability that person \(i\) currently smokes;
- \(Q_i | CS_i = 1\) are the packs of cigarettes smoked per month conditional upon smoking for person \(i\);
- \(P_i\) is the regional price of cigarettes faced by person \(i\);
- \(X_i\) is a vector of other explanatory variables including gender, age, education, residence, annual
income proxied by expenditure;
- \(c_1, c_2, \alpha_1, \alpha_2, \beta_1, \beta_2\) are the coefficients to be estimated;
- \(\epsilon_1\) and \(\epsilon_2\) are random error terms.
The overall demand for cigarette for person $i$ is given as follows:

$$E(Q_i) = \text{Prob}(CS_i = 1) \times E(Q_i | CS_i = 1).$$  \hspace{1cm} (3)

Total price elasticity of the overall demand for cigarettes is obtained as follows:

$$\eta = \eta_{sp} + \eta_{si} = (1 - \bar{CS}) \cdot \alpha_1 + \alpha_2,$$  \hspace{1cm} (4)

where:

- $\eta$ is the total elasticity,
- $\eta_{sp}$ is the price elasticity of smoking participation, and
- $\eta_{si}$ is the price elasticity of smoking intensity conditional upon current smokers,
- $\bar{CS}$ denotes the population mean of current smoking prevalence,
- $\alpha_1$ is the price coefficient in Equation (1), and
- $\alpha_2$ is the price coefficient in Equation (2).

2.2. Data source

The data for the study is based on household budget survey conducted by Tanzanian National Bureau of Statistics that was conducted over three periods, 2008, 2010 and 2012 (URT, 2012). The sample size for the stated periods are 3265, 3924 and 5010 respectively. One of the information that was available in each of the three surveys deals with weekly expenditure on cigarettes. The questionnaire does not contain information on the unit price of cigarette or the quantity consumed (demanded). The two equation model described above requires information on unit price and the quantity consumed or purchased. Estimated cigarette price in 2008 was obtained from different sources (Kidane et al., 2015a). For 2010 and 2012 price is indirectly estimated by multiplying the 2008 price by the CPI based cigarette price increase. Quantity consumed or purchased was obtained by dividing the total expenditure (from the survey) by the indirectly estimated price.

3. Result

3.1. Temporal cigarette price change and cigarette usage: descriptive approach

Table 1 shows descriptive statistics of selected variables. Between 2008 and 2010 there was 78 percent increase in the price of cigarettes. The corresponding price increase between 2010 and 2012 is 12.2 percent. The annual price increase between 2008 and 2012 is 25.0 percent. For the same period, the overall annual CPI price increase for Tanzania is only 14 percent. In other words, compared to other commodities included in the CPI, annual cigarette price increase is higher by 79 percent. There is not wide variation in prices within each period. The stated cigarette price increase does not emanate from increased cigarette tax; the price increase appears to be the result of inflation. During the same period the daily consumption of cigarettes has also shown an annual increase of 25 percent.

Monthly household expenditure (a proxy for income) showed an annual growth of 14.5 percent. There is not much variation in age, education and residence.
Table 1. Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (per stick)*</td>
<td>67.63</td>
<td>120.4</td>
<td>135.06</td>
</tr>
<tr>
<td>Daily Quantity (in sticks)</td>
<td>7.41</td>
<td>10.7</td>
<td>13.45</td>
</tr>
<tr>
<td>Age (15–90)</td>
<td>34.82</td>
<td>34.01</td>
<td>34.1</td>
</tr>
<tr>
<td>Primary education</td>
<td>0.28</td>
<td>0.22</td>
<td>0.29</td>
</tr>
<tr>
<td>Secondary education</td>
<td>0.07</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Urban</td>
<td>34.02</td>
<td>28.7</td>
<td>30.78</td>
</tr>
<tr>
<td>Total Monthly Expenditure*</td>
<td>266026.6</td>
<td>318695.6</td>
<td>412097.5</td>
</tr>
</tbody>
</table>

Note: * — Tanzanian shillings.

Table 2 shows increase in prevalence rate and intensity in smoking among smokers as well as per capita consumption. The substantial increase in cigarette price during 2008, 2010 and 2012 does not appear to decrease the smoking prevalence rate significantly. The overall decrease in the smoking prevalence rate is only 2.33 percent. When cross classified by expenditure group, the decrease in the prevalence rate seems to be high among very poor and the poor, the decrease in intensity seem to be high among middle income group; also the decrease in per capita consumption appears to be high among the very poor. When cross classified by age group decrease in the prevalence rate appears to be high among the 40–60 year age group while intensity is high among the elderly (60 or more years). Increase in per capita cigarette consumption does not show much variation across all age group.

Table 2. Effect of price increase on prevalence, intensity and per capita consumption (2008–2012)

<table>
<thead>
<tr>
<th></th>
<th>Prevalence rate</th>
<th>Intensity rate**</th>
<th>Per capita consumption***</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>69.63</td>
<td>120.4</td>
<td>135.06</td>
</tr>
<tr>
<td>Income groups (monthly)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low1</td>
<td>72.10</td>
<td>95.41</td>
<td>134.32</td>
</tr>
<tr>
<td>Low2</td>
<td>69.99</td>
<td>100.86</td>
<td>140.40</td>
</tr>
<tr>
<td>Middle3</td>
<td>70.83</td>
<td>103.54</td>
<td>138.92</td>
</tr>
<tr>
<td>High4</td>
<td>65.78</td>
<td>142.07</td>
<td>131.61</td>
</tr>
<tr>
<td>Age groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>69.31</td>
<td>113.67</td>
<td>134.93</td>
</tr>
<tr>
<td>20–40</td>
<td>68.82</td>
<td>128.31</td>
<td>134.36</td>
</tr>
<tr>
<td>40–60</td>
<td>67.79</td>
<td>118.34</td>
<td>135.67</td>
</tr>
<tr>
<td>60+</td>
<td>68.36</td>
<td>108.51</td>
<td>133.37</td>
</tr>
</tbody>
</table>

Note: * — per stick, ** — sticks per day, *** — sticks per day, 1 = less than 117000, 2 = 117000–200000, 3 = 200000–360000, 4 = greater than 360000.
3.2. Temporal variation in participation, intensity and total elasticity

3.2.1. Participation and intensity equations

This section estimates participation, intensity and total elasticity of demand for cigarette in Tanzania. The main coefficient here is the price elasticity of demand. Table 3 gives a Logit regression on the determinants of smoking participation along with the OLS regression which is a measure of smoking intensity. Other determinants of both participation and intensity include gender, residence, level of education as well as total expenditure (a proxy for income). When the two regression estimates are compared, the OLS based smoking intensity equation appears to give more stable, predictable and significant results. For participation equations non price variable appear to be more important than the price variable. For the OLS based intensity equation price variable appears to be a significant variable with a priori predictable signs. It is thus safe to conclude that cigarette price increase as having greater effect on smoking intensity when compared to participation.

Table 3. Smoking participation and intensity

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Logprice</td>
<td>0.239*</td>
<td>0.144</td>
<td>–0.539***</td>
<td>–1.085***</td>
<td>–1.036***</td>
<td>–0.827***</td>
</tr>
<tr>
<td>Age</td>
<td>0.009***</td>
<td>0.007**</td>
<td>0.125***</td>
<td>–0.001</td>
<td>–0.001</td>
<td>–0.005**</td>
</tr>
<tr>
<td>Male</td>
<td>0.188**</td>
<td>0.285**</td>
<td>0.303***</td>
<td>0.025</td>
<td>–0.046</td>
<td>–0.009</td>
</tr>
<tr>
<td>Primary</td>
<td>–12.084</td>
<td>–11.892</td>
<td>–11.296</td>
<td>0.380</td>
<td>0.163</td>
<td>0.014</td>
</tr>
<tr>
<td>Secondary</td>
<td>–12.618</td>
<td>–12.466</td>
<td>–11.873</td>
<td>0.669</td>
<td>0.409</td>
<td>0.167</td>
</tr>
<tr>
<td>Tertiary</td>
<td>–13.472</td>
<td>–13.031</td>
<td>–12.607</td>
<td>0.788***</td>
<td>0.7048***</td>
<td>0.161**</td>
</tr>
<tr>
<td>Urban</td>
<td>–1.089***</td>
<td>–1.366***</td>
<td>–0.944***</td>
<td>0.003*</td>
<td>–0.003</td>
<td>0.003***</td>
</tr>
<tr>
<td>Total Expend.</td>
<td>–0.004***</td>
<td>–0.007</td>
<td>–0.001***</td>
<td>4.823***</td>
<td>5.521***</td>
<td>5.443***</td>
</tr>
</tbody>
</table>

Note: ** — significant at 5%, *** — significant at 1%.

3.2.2. Total elasticity

Table 4 compares total elasticity for the three periods. The total price elasticity of demand for 2008, 2010 and 2012 are –0.686, –0.727 and –1.139 respectively. This result is consistent with the annual increase of 23.5 percent during 2008 to 2012. The results suggest that a 10 percent increase in price 2008 will lead to a 6.86 percent reduction in demand for cigarettes. The corresponding 10 percent increase in 2012 would lead to 11.39% decrease in demand.

When cross classified by expenditure (income) group the increase in absolute total elasticity appears to be highest among the poorest and the poor. The response price elasticity of demand is minimal among the high income group. Cross classification of price elasticity by age group does not appear to show a clear pattern. Compared to the relatively young, the elderly response to price increase appears to be relatively low.
Table 4. Total elasticity: overall, by expenditure and age groups

<table>
<thead>
<tr>
<th>exhibit</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>For all</td>
<td>–0.686</td>
<td>–0.727</td>
<td>–1.139</td>
</tr>
<tr>
<td><strong>Income groups</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very poor</td>
<td>–0.305</td>
<td>–1.208</td>
<td>–2.387</td>
</tr>
<tr>
<td>Poor</td>
<td>–0.749</td>
<td>–1.497</td>
<td>–1.967</td>
</tr>
<tr>
<td>Middle</td>
<td>–1.562</td>
<td>0.169</td>
<td>–0.993</td>
</tr>
<tr>
<td>High</td>
<td>–0.289</td>
<td>–0.811</td>
<td>–0.569</td>
</tr>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 20</td>
<td>0.975</td>
<td>0.337</td>
<td>–1.672</td>
</tr>
<tr>
<td>21 to 40</td>
<td>–0.579</td>
<td>–0.929</td>
<td>–0.835</td>
</tr>
<tr>
<td>41 to 60</td>
<td>–1.493</td>
<td>–0.497</td>
<td>–1.382</td>
</tr>
<tr>
<td>Above 60</td>
<td>–0.706</td>
<td>–2.727</td>
<td>–0.871</td>
</tr>
</tbody>
</table>

4. Conclusion

The preceding findings for Tanzania suggest that a periodic price increase in cigarette would lead to lower cigarette consumption. This is more so when the rate of cigarette price increase is considerably higher than other CPI based consumption goods and services. The descriptive statistics show modest and predictable reduction in prevalence, participation and per capita rates. A more robust econometric method shows significant result with the expected sign. There appears to be higher and predictable response to smoking participation in general and smoking intensity in particular.

The total elasticity show a significant reduction in demand with a higher negative elasticity dropping from 0.686 in 2008 to –1.139 in 2012. It is already noted that many cigarette smokers in Tanzania belong to low income group where cigarette expenditure constitutes a significant percent of total income. These low income smokers are mostly household heads with large household size (Kidane et al., 2015b). Their dependents are mostly children with a deficit of calorie intake. A significant and greater than unity total elasticity is to be expected. When the total elasticity is estimated by expenditure or income group, the response among the very poor and the poor appear to be the highest. It is also in order to note that the total price elasticity of demand among the younger age group (20 years or less) as being the highest. The income of this age group is also expected to be low; many are likely to be dependents.

The results confirm that a higher price of cigarette is likely to reduce smoking participation rate in general and intensity in particular. The results also suggest that the price elasticity of demand for cigarette in a typical African country like Tanzania may be relatively higher than unity.

Acknowledgements. This study was supported by a grant from United States National Institutes of Health–Fogarty International Center and National Cancer Institute R01TW009295.
References


Received 06.12.2016; accepted 15.03.2017.