Consumer demand for alcoholic beverages and tobacco in Lesotho: A double-hurdle approach

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Consumer Demand for Alcoholic Beverages and Tobacco in Lesotho: A Double-Hurdle Approach*

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Abstract

In this paper, we estimate income elasticities and investigate the determinants of alcohol and tobacco consumption in Lesotho using a Double-Hurdle model on the 2002/03 Lesotho HBS data. The results reveal that both alcohol and tobacco are income inelastic with estimated elasticities of 0.6553 and 0.3561, respectively. Given this, therefore, we argue that differentiated tax hikes, with a relatively higher rate on tobacco, can be more effective both as a consumption deterrent and revenue increasing policy, without much compromise on employment and poverty. Further, we find evidence that alcoholic beverages and tobacco are complementaries, suggesting the need for a more holistic social policy aimed at curbing consumption of these two goods.

JEL Classification: C31, C34, C54, D12

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1 Introduction

The recent global financial (economic) crisis and the subsequent fall in the Southern African Customs Union (SACU) revenue pool have wreaked havoc on Lesotho's economy. First, the global fall in demand for her textile exports led to massive layoffs in the textile and garment manufacturing industry, which potentially has negative effects on (Value Added Tax) revenue collections[1]. Second, the fall in import demand by SACU member states led to a plunge in customs revenue collections and hence a 50% decline in Lesotho's share of the revenue (Kingdom of Lesotho, 2011). For Lesotho, the share from the SACU revenue pool constitutes about 60% of all government revenue collections (and about 55% if we include grants). Therefore, the decline in SACU revenue has put a huge strain on Lesotho's ability to finance its expenditure and has resulted in a 9.1 percentage points increase in the budget deficit from a meagre 3.5% in 2009/2010 to 12.6% of gross domestic product (GDP) in 2010/2011 fiscal year.

In a frantic effort to bring the budget deficit back to sustainable levels in the medium term, the government has begun a series of expenditure cutting measures

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[1]Most of the revenue collected from the factory workers is through the Value Added Tax (VAT) because they are part of the low income class absolved from income tax obligations. However, there is no statistics indicating the percentage of their income used on taxable commodities.

and the search for ways to increase its domestic tax collections as part of its austerity plan. As the Lesotho's Finance Minister put it in his 2011/12 budget speech, "If the Government is to raise funds, it can only do so by raising taxes and nobody wants this" (Kingdom of Lesotho, 2011:16). Therefore, an excise tax increase on alcoholic beverages and tobacco is on the table due to the unique characteristics these commodities have in consumer utilities and the associated social concerns. Such a policy could be easy to sell by the government because it acts as a partial solution to both fiscal needs and social ills associated with their consumption, such as alcoholism, drunk driving fatalities and the resulting increase in government health bill. For example, of the 24,100 general crime cases reported in 2010, 4,006 (17%) were traffic offences, 206 (1%) were habit drugs (e.g. illicit drugs) offences, and 85 (0.4%) were liquor offences, and all of them appear to be on an upward trend (Bureau of Statistics, 2012)[2].

Nevertheless, in undertaking this exercise, the government should always be on the lookout for the potential backlash of the policy as it can negatively affect employment in the affected industries, particularly the alcoholic beverages industry. For this purpose, Wang *et al.* (1996) propound that the estimation of demand elasticities and the effects of household characteristics on alcohol and tobacco demand provide essential clues for the formulation of public policies.

However, for Lesotho, such information is non-existent and hence tax policy changes are largely not informed by any empirical evidence. Since the excise tax is both an economic and a social policy, the question that still begs an immediate answer is: How elastic is the demand for alcohol and tobacco to income changes in Lesotho? Ignoring this question makes the government susceptible to proposing and implementing excise tax increases that can have negative repercussions on employment. Therefore, the aim of this paper is to close this research lacuna. First, we search for the best fitting model for our data between the Heckman two-step and Cragg's Two-Part model. Second, we estimate the income elasticities of demand for alcoholic beverages and tobacco separately, which allows us to draw appropriate policy suggestions.

Taxes affect the prices of commodities upon which they are levied and hence influence consumers' behaviour. An excise tax increase, for example, will increase the price of the good upon which it is levied and then trigger the consumer's response. Knowing the price elasticities of these commodities is therefore crucial for any tax policy design because they tell us how consumers will respond to tax changes, everything else held constant. But, because the data used in this study is cross-sectional and does not have price information, it is impossible to calculate price elasticities. However, it is known that individual economic agents are always faced with budget constraints and hence whatever happens to their budgets is reflected by changes in quantities demanded of the goods in their respective baskets. Through their effect on prices, changes in excise taxes will affect the consumer's real income and hence trigger the reallocation process. The magnitude of the change in demand for any good will therefore depend on its income elasticity. By Slutsky decomposition theorem[3], any price change has both a substitution effect and an income effect such that

[2]Moreover, it cannot be ruled out that alcohol drinking has played a role in the other 6,956 (29%) common assault cases.

[3]In elasticity form the Slutsky's equation is given as $\varepsilon_{ij}^{M} = \varepsilon_{ij}^{H} + \epsilon_j \eta_i$, where ε_{ij}^{M} is the uncompensated price elasticity, ε_{ij}^{H} is the compensated price elasticity and η_i is the income elasticity while ϵ_j is the income share of good j in the total budget. If $\varepsilon_{ij}^{M} - \varepsilon_{ij}^{H} < \epsilon_j$, then $0 < \eta_i < 1$.

any observed income elasticity is actually the difference between the uncompensated and compensated elasticities.

Young and Bielińska-Kwapisz (2002) have shown, using United States data, that retail alcohol prices rise by more than the amount of the excise tax within 3 months. This over-shifting of the burden is more likely in imperfect markets such as monopoly markets[4] and thus we can safely assume that this is also the case in Lesotho where we have only one brewery company and all tobacco products are imported. Therefore, we argue that, to the extent that excise tax increases are over-shifted, they will be reflected as a fall in the consumer's real income and hence (in)elastic income elasticities of demand for alcoholic beverages and tobacco can be informative on whether any proposed tax policy will be effective in raising revenue or not, ceteris paribus.

The remainder of the paper is organized as follows: section 2 discusses the theoretical modelling issues. Section 3 outlines the double hurdle model, the approach chosen for the analysis. In section 4 we deal with data description while the estimated results are discussed in section 5. Finally, section 6 provides concluding remarks and policy implications.

2 The theoretical model

Systems of demand equations are used to analyse the effect of, for example, income, tax and/or price changes on consumer demand. Since the unit of analysis in this paper is the household, the starting point is that a household maximizes utility as a function of quantities of the goods consumed, $U(q_1, q_2, \ldots q_n)$ subject to some budget constraint, m. From this maximization process, it is possible to derive the Marshallian demand functions for each good as

$$q_j = g_j(m, \mathbf{p}) \tag{1}$$

where q_j denotes the quantity of good j, m denotes total income and $\mathbf{p}$ is a vector of prices of all relevant goods. For a utility maximizing household, total income (m) exactly equals minimum expenditure required to achieve utility level, u, $(e(u, \mathbf{p}))$.

If the expenditure function, $e(u, \mathbf{p})$, is firstly continuous and non-decreasing in prices and utility, and secondly concave and homogeneous of degree one in prices, a theoretically plausible system of demand equations, the Almost Ideal Demand System (AIDS), may be derived from that function (Deaton and Muellbauer, 1980; Silberberg and Suen, 2001). These AIDS demand functions can be expressed in household budget share forms given as

$$w_j = \alpha_j + \sum\nolimits_j \gamma_{kj} \ln p_j + \beta_j \ln \left\{ \frac{m}{P} \right\} \tag{2}$$

where $w_j = \frac{p_j q_j}{m}$ denotes the expenditure share of good j and P represents the price index. Deaton and Muellbauer (1980) call this equation the PIGLOG Engel curve. From equation 2, both price and expenditure elasticities for all goods can be calculated and they indicate whether the good is a luxury, a necessity or an inferior good. However, if the prices do not vary overtime, as in cross-sectional data, Leser

[4]See Young and Bielińska-Kwapisz (2002:58) for a simple presentation of this fact.

(1963) recommends the estimation of the following Engel curve, first estimated by Working (1943);

$$w_j = \alpha_j + \beta_j \ln[m] \tag{3}$$

This amounts to the assumption that households face the same relative prices (Aristei *et al.*, 2008). Banks, *et al.* (1997) have since shown that this Engel curve does not permit goods to be luxuries at some income levels and necessities at others and therefore proposed the Quadratic Almost Ideal Demand System (QUAIDS) which includes quadratic terms in the logarithm of the expenditure and is given as

$$w_j = \alpha_j + \beta_j \ln[m] + \varphi_j \{\ln[m]\}^2 \tag{4}$$

Since the actual household expenditure on any good j, and hence the expenditure share, do not only depend on income and prices but also on household characteristics such as household composition and location, equation 4 can be written as

$$w_{ji} = \beta_j \ln\{m_i\} + \varphi_j \{\ln[m_i]\}^2 + \mathbf{A}_i\boldsymbol{\tau} \tag{5}$$

where $\alpha_j = \mathbf{A}_i\boldsymbol{\tau}$ and $\mathbf{A}_i$ is a $1 \times K$ vector of variables (including a constant) representing other household $i's$ characteristics and $\boldsymbol{\tau}$ is the associated $K \times 1$ vector of parameters (see Garcia and Labeaga, 1992). The expenditure elasticity is therefore given as[5]

$$\varepsilon_j = 1 + \frac{\beta_j}{w_{ji}} + 2\varphi_j \frac{\ln[m_i]}{w_{ji}} \tag{6}$$

3 The Econometric Model of Alcohol and Tobacco Consumption: Dealing with data challenges

This study uses the latest available micro-level data in Lesotho, the 2002/03 Lesotho Household Budget Survey, and a practical problem that emerges here is that there is a plethora of zero responses, such that the optimal demand and expenditure (resulting from utility maximisation) on particular commodities may be zero (Ground and Koch, 2008; Verbeek, 2000). The two primary reasons why individuals may not spend on certain commodities are[6]: (*i*) budgetary constraints, such that at current prices and income level, the consumer is not able to buy any positive amount of the commodity; (*ii*) abstention, which occurs when the consumer's marginal utility of the commodity is everywhere less than its price. This implies that alcohol and/or tobacco may be a bad for some individuals. This phenomenon poses a problem for the researcher, as the standard regression analysis can be misleading in these circumstances (Garcia and Labeaga, 1992).

To model consumption behaviour under these conditions, one approach would be to use the well-known Tobit model. However, this model has a very restrictive

[5] Differentiating eq. 5 w.r.t m_i gives: $p_j \frac{\partial q_j}{\partial m_i} \cdot m_i = p_j q_j + \beta_j m_i + 2m_i\varphi_j \ln[m_i] \Longrightarrow \frac{\partial q_j}{\partial m_i} \cdot \frac{m_i}{q_j} = 1 + \frac{\beta_j m_i}{p_j q_j} + 2\frac{m_i}{p_j q_j}\varphi_j \ln[m_i] = 1 + \frac{\beta_j}{w_{ij}} + 2\varphi_j \frac{\ln[m_i]}{w_{ij}}$. (See Banks *et al.* 1997:534).

[6] Apart from these two reasons, observed zero responses may be due to infrequent purchases (where items are purchased only occationally, for example in the case of semi-durable goods like clothing) and under-reporting (where individuals may report small expenditures as zeros) (see Ground and Koch, 2008; Madden, 2008; Garcia and Labeaga, 1992).

assumption that the zeros arise from corner solutions when the non-negativity constraint of the budget share (w_{ji}) becomes binding. This implies that, as argued by Verbeek (2000:213), the household's budget constraint and preferences "are such that the optimal budget shares of alcohol and tobacco, as determined by the first order conditions and in the absence of non-negativity constraint, would be negative", something which does not make economic sense. A further restriction of the Tobit is that both the decision to consume alcohol or tobacco and the amount expended on each commodity are determined by the same variables, and hence the variable that increases the probability of consumption also increases the amount spent on the commodity (Matshe and Young, 2003).

These restrictions have attracted a barrage of criticism for the Tobit and hence several alternatives have been proposed. Cragg (1971) pioneered the double-hurdle model which assumes that two hurdles must be overcome before we can observe consumption. In the present case, the first hurdle corresponds to the decision whether or not to smoke or drink alcohol (*the participation decision*) and the second hurdle corresponds to how much to spend on either good given participation (*the consumption decision*). Although this model is an improvement to the Tobit I model, it assumes that the shocks affecting *consumption* are not affected by the shocks to *participation* which might not be true in the present case. For example, a widely held view is that depression (which is in the *participation* error term) may lead one into drinking. In fact depression often does not only lead to alcohol tasting but also to a drinking binge. Hence it does not just affect *participation* but also *consumption*.

Heckman (1976, 1979) proposed a model, sometimes referred to as the Tobit II (or *Heckit*), which assumes dependence between the *participation* and *consumption* decisions and models budget shares jointly with the binary decision of whether to consume or not. The main purpose of the *Heckit* model is to address both the selectivity bias and the omission of variables bias which may result as a consequence of a non-random sampling nature of the data. It therefore proposes a two-step procedure. First, the probit selection equation is estimated and, second the probit results are used to derive an 'additional regressor', the inverse Mills ratio, which is then used to augment the OLS equation (i.e. consumption equation) in order to correct the selectivity bias. The key assumption under this approach is that the outcome equation errors are correlated with probit selection model errors, which then requires exclusion restrictions for identification[7] (Cameron and Trivedi, 2005).

The main application of the *Heckit* was in the context of wage equation estimation in which the interest was on modelling potential wages that individuals could earn were they to work (Heckman, 1979; Madden, 2008). In dealing with expenditures however, there is no corresponding idea of potential expenditure of non-spenders given that we only observe spenders. We are instead interested in knowing the effects of individual characteristics on actual as opposed to potential drinking and/or smoking (Madden, 2008). In fact, even in full random sampling, there will still be many zero responses, not because of the non-random sampling nature of the data but due to reasons mentioned earlier. Drawing on Heckman's idea, Jones (1989) formulated an econometric model that endogenises the participation decision but still different to the consumption decision. This model offers a more general approach to modelling participation (i.e. whether to smoke or not) and consumption decisions. We now present the details of the model below because it is the basis for our analysis.

[7] At least one covariate that determines participation should be excluded in the outcome model.

3.1 The double hurdle model

There are three constituents to the double-hurdle approach and these are: observed consumption, the participation equation and the consumption equation (see Jones, 1989). The superiority of this model derives from the fact that it nests both the Tobit I and Cragg's independent double hurdle and can be tested against these two. Formally, following Jones (1989), the three constituents of the model are defined as:

Observed consumption:

$$w = dw^{**} \tag{7}$$

Participation equation:

$$y = \mathbf{z}_i\boldsymbol{\gamma} + \varepsilon_i, d = 1 \text{ if } y > 0,\ 0 \text{ otherwise.} \tag{8}$$

Consumption equation:

$$\begin{aligned} w^{**} &= \max[0, w^*] \\ w^* &= \mathbf{x}_i\boldsymbol{\beta}+u_i \end{aligned} \tag{9}$$

Both hurdles, (8) and (9), are assumed to be linear in their parameters ($\boldsymbol{\gamma}$, $\boldsymbol{\beta}$), with additive disturbance terms ε and u, where $\mathbf{z}$ represents those individual-specific characteristics[8] used to explain the participation decision and $\mathbf{x}$ represents those variables used to explain the expenditure decision. We observe a positive level of alcohol/tobacco consumption w only if the household is a potential alcohol-drinker/smoker ($d = 1$) and actually consumes alcohol/tobacco (w^{**}). Aristei and Pieroni (2008) assert that it is for this reason that, in double-hurdle models, observed zero expenditures are the result of either participation or consumption decisions and potential alcohol drinkers/smokers may have zero tobacco expenditure. This is different from Heckman selection model in which zeros are not affected by the consumption decision.

If it is assumed that the error term ε is normally distributed, the first hurdle (i.e. the participation equation) corresponds to a Probit model. Having cleared the first hurdle, the level of consumption (which is the second hurdle) is given by (9) and takes the form of Tobit model, capable of generating zero levels of expenditure independent of the first hurdle. Furthermore, if we assume that the disturbance terms are randomly distributed with a bivariate normal distribution, i.e. $(\varepsilon, u) \sim BVN(0, \sum)$, $\sum = \begin{bmatrix} 1 & \rho\sigma \\ \rho\sigma & \sigma^2 \end{bmatrix}$, we will have the full double-hurdle model (Jones, 1989). However, if we assume that the errors are independent, the model reduces to the independent Cragg model. This independence assumption can be relaxed by assuming the first-hurdle dominance, i.e. the participation decision dominates the consumption decision. Ground and Koch (2008) argue that the first-hurdle dominance model is relevant in the case where the good is perishable. Therefore, due to the properties of the survey data used in this study, we assume first-hurdle dominance and that the household inventories are in steady-state, such that purchases are made to replace stock (see Ground and Koch, 2008). If the sample is divided into those with zero consumption (denote 0) and those with positive consumption (denoted +) the likelihood function to be estimated is given as

[8] Note that not all individual-specific characteristics influence participation hence some will have zero parameters. Note further that the variable and parameter vectors, $\mathbf{A}_i$ and $\boldsymbol{\tau}$, seen in equation 6 above, are given as $\mathbf{A}_i = [\mathbf{z}_i\ \mathbf{x}_i]$ and $\boldsymbol{\tau} = \left[\begin{smallmatrix}\gamma \\ \beta\end{smallmatrix}\right]$, respectively.

$$L_H = \Pi_0[1 - p(\varepsilon > -\mathbf{z}_i\boldsymbol{\gamma})]\Pi_+ p(\varepsilon > -\mathbf{z}_i\boldsymbol{\gamma})g(w|\varepsilon > -\mathbf{z}_i\boldsymbol{\gamma}) \quad (10)$$

This likelihood function corresponds to the Heckman's sample selection model (see Jones, 1989). Cameron and Trivedi (2005:545) posit that if the selection and consumption errors are independent, the double-hurdle approach reduces to a probit for participation and the truncated regression for the consumption equation (i.e. the two-part model) estimated over those with observed positive consumption with the following likelihood function:

$$L_{2P} = \Pi_0[1 - p(\varepsilon > -\mathbf{z}_i\boldsymbol{\gamma})]\Pi_+ p(\varepsilon > -\mathbf{z}_i\boldsymbol{\gamma})g(w) \quad (11)$$

This is the Two Part model proposed by Cragg (1971) and it is what Ground and Koch used in estimating alcohol and tobacco expenditures in South Africa.

Jones (1989) applied the double-hurdle model to model cigarette consumption in the UK and to compare the performance of the two-part model with the Heckman-type sample selection model (the first hurdle dominance model) in which the decision to participation dominates the consumption decision. A number of other researchers have used this model in analysing alcohol and/or tobacco expenditure, including but not limited to: Atkinson *et al.*(1990), Wang *et al.* (1996), Madden (2008), Yu and Abler (2008). Double hurdle models have also been widely used in other fields such as labour economics (see for example, Blundell and Meghir 1986; Matshe and Young, 2003). However, because one cannot know before hand whether the best-fitting model is the Heckman's two-step procedure or the Two-Part model, Leung and Yu (1996) argue that the collinearity between the inverse Mills Ratio and the other regressors should be the deciding factor and Puhani (2000) strongly recommends this approach. Madden (2008) found that in his case the Two-Part model performs better than the sample selection model but stressed that comparison be done on a case-by-case basis.

3.2 Identification issues

As is customary in these models, we have to impose some exclusion restrictions across the two vectors of explanatory variables in order to adequately identify the parameter estimates. The procedure is that at least one variable which influences participation and not consumption be excluded from the consumption model such that the participation equation includes at least one more variable than in the consumption equation (see Cameron and Trivedi, 2005; Verbeek, 2000). This is often arbitrarily done as theory offers little guidance and hence we seek guidance from the empirical literature.

In a study on tobacco consumption in Italy, Aristei and Pieroni (2008) included a dummy variable in the participation equation indicating whether the household displays a high expenditure level (that is, over 75th percentile of the observed distribution) on tobacco as a proxy for habit formation. More generally, Newman, *et al.* (2003) have argued that the underlying assumption of the double-hurdle model is that the first hurdle is a function of non-economic factors determining households' decisions to participate in the market which, in our case, therefore warrants that economic factors such as household's income (proxied by total expenditure[9]), tobacco

[9] See Ground and Koch (2008) and Garcia and Labeaga (1992).

expenditure and alcohol expenditure be excluded from the *participation* equations of alcohol and tobacco, respectively.

In most of the cases, alcohol and tobacco are complementary such that those who smoke also drink and hence expenditure on one good, say alcohol, is more likely to positively affect expenditure on tobacco. Moreover, *participation* in either of the two activities is likely to influence *participation* in the other. In fact, the 2002/03 HBS data has about 589 (1%) household heads who are both alcoholic beverages drinkers and smokers influenced by their unobserved preferences. Therefore, a dummy variable for smoking is included in the alcohol participation equation and that for drinking is included in smoking participation equation.

For the *consumption* equation however, this warrants that we include tobacco expenditure in the alcoholic beverages regression and alcoholic beverages expenses in the tobacco regression, as is done by Aristei and Pieroni (2008). But doing this can potentially confound the results due to the potential simultaneity problem. Hence, this points out the need to implement the instrumental variable strategy to deal with this problem. To instrument for tobacco expenditure, John (2008) and Pu *et al.* (2008) used the ratio of adult males (18 years or older) to adult females (the adult-sex ratio)[10]. The argument here is that the prevalence of smoking is very different between genders with males having a higher prevalence rate. Moreover, the rate of smoking is much higher among adults than among the under 18-year-olds (this is partly due to cultural norms and national laws in place that prohibit minors from smoking), which thus implies that the adult-sex ratio ought to influence the tobacco expenditure level within the household but not the other way round. For alcohol expenditure, Pu *et al.* (2008) used the adult-ratio within the household arguing that the national law (that is, Lesotho's law in this case) forbids drinking under the age of 18 and that there has not been any clear gender differences observed in alcohol expenditure patterns. We first empirically deal with this simultaneity issue in section 5 below but now we describe our data.

4 Data and Variables

To carry out our analysis, we use data from the 2002/03 Household Budget Survey (2002/03 HBS) collected by the Lesotho Bureau of Statistics (BoS) from a representative sample of 5992 households over a twelve-month period to capture the seasonal variations across time. The main objective of the data set is to determine household commodities that constitute the updated consumer basket for the computation of the Consumer Price Index (CPI) (BoS, 2006). Therefore, to ensure fair geographical representation, the survey was stratified by rural and urban dichotomy, which has six agro-ecological areas: Maseru urban, Other urban, Rural Mountains, Rural lowlands, Rural foothills, and Rural Senqu River Valley (BoS, 2006).

The data provides detailed information on individual characteristics including their drinking and/or smoking behaviour. Household heads were asked, among others, about their monthly expenditure on alcoholic beverages and tobacco, split into four weeks of the month. No price or quantity information is reported and consumption of each good or service is recorded as expenditure. We therefore infer participation in consumption of either good based on recorded positive expenditure. The fact that data was collected at the household level rather than the individual

[10] We thank an anonymous referee for pointing us to this literature.

level, with no information on intra-household resource allocation necessitates the use of equivalent scales to account for the household composition effects when analysing the data.

Table 2 gives summary statistics of all the relevant variables for the total sample, drinkers, smokers and for those who drink and smoke. From a total of 5992 households, 1046 of them (17.5%) recorded positive alcohol expenditure with a range of M2,296.88 and average of M50 in per adult equivalent[11] terms, while 1752 of them (29.2%) had positive expenditure on tobacco with a range of M239.94 and the average of M17.60 in per adult equivalent terms. Furthermore, the data reveals that the average adult-sex ratio in 'drinking' households and smoking households is 52% and 51%, respectively. It can also be seen from Table 2 that adulthood is correlated with alcohol use and smoking. About 75% of household members in 'drinking' households and 71% of household members in 'smoking' households are adults, as indicated by their respective mean adult-ratios.

Table 3 further reveals that the income shares of alcohol and tobacco decline at different rates from the first decile to the top decile of their respective income distributions. The bottom 10% of those who drink allocate 9.6% and the top 10% allocate 6.4% of their income to alcohol while smokers at the bottom 10% of the income distribution allocate 8.6% and those at the top 10% allocate 2.1% of their income to tobacco. Moreover, if we use the national poverty line of R149.91 (BoS, 2006), it turns out that 58% of drinkers and 43% of smokers are poor. Clearly, any excise tax policy that does not take these facts into account will potentially have unintended consequences, not only on employment but also on poverty.

5 Results

We first deal with the potential simultaneity between alcohol and tobacco expenses. Table 4 in Appendix shows results for the Hausman simultaneity test between alcohol expenditure and tobacco expenditure, where the main dependent variable is log of tobacco expenditure per adult equivalent. From these results, we fail to reject the null hypothesis of no simultaneity bias. In fact, it turns out that the instrument for alcohol expenditure, adult ratio has the wrong sign and no significant relationship with alcohol expenditure which signifies that it is an extremely weak instrument in our case. Similar results (table not produced) were obtained for adult-sex ratio and tobacco expenditure. In the light of this, we use alcohol expenditure per adult equivalent in the tobacco regression and tobacco expenditure per adult equivalent in the alcohol regression as done by Aristei and Pieroni (2008).

The double hurdle models for alcohol and tobacco demand were estimated for all 5992 households. Table 5 (in the Appendix) presents the double hurdle (the Heckman two-step) model for alcohol and tobacco demand, respectively. Following Puhani's (2000) recommendation on double-hurdle model selection, we conducted the collinearity test of the inverse Mills ratio (IMR) in the Heckman model with other regressors using the variance inflation factor (VIF). The VIF was found to be 6.09 for alcohol demand and 6.07 for tobacco demand, indicating that collinearity

[11] The equivalence scale used here is the Anzagi-Bernard (1977) scale used in Kenya by Greer and Thorbecke (1986) and Mwabu *et al.* (2000). Persons aged 0-5 years have been assigned a weight of 0.24, those aged 6-14 a weight of 0.65 and those aged 15 years or more have been assigned a weight of 1.00.

is not a serious problem in the Heckman model[12]. Given this, the Heckman model was favoured over the two-part (2P) model and the following analysis is based on this model results for both alcohol and tobacco demand.

The results reveal that household income (as proxied by log expenditure) has a significant impact on households' expenditure on alcohol and tobacco, having controlled for other social-economic factors. As income increases, the household's shares of expenditure on tobacco and alcohol first decrease and then increase. These results are in line with the evidence by Ground and Koch (2008). Since the interest here is the income elasticities of the two goods, we only calculate and interpret the unconditional income elasticities, leaving out the probability elasticities. Following Atkinson *et al.* (1990) and Verbeek (2000)[13], the calculated income elasticity of alcohol demand in Lesotho is 0.6553 while that of tobacco demand is 0.3561[14], a value very much close to the 0.2638 found by Aristei, *et al.* (2008) for Italy. This, therefore, implies that a 1% increase in income will increase alcohol expenses by 0.6553% and tobacco expenses by 0.3561%, which signals that both alcohol and tobacco are income inelastic and hence necessary goods in Lesotho[15]. These elasticities further indicate the relative ease of reducing alcohol consumption (and possibly quitting drinking) compared to tobacco consumption. To link these results with our tax policy problem, we use the Slutsky decomposition theorem (see footnote 3). Suppose that alcohol is a normal good and its price increases by more than the increase in the excise tax, leading to a 1% fall in the households' real income. This will only lead to 0.6553% decline in alcohol demand implying that the government can increase its revenue by increasing such taxes. Given the addictive nature of alcohol and its crowding out effects on other goods (Pu, *et al*, 2008), its compensated elasticity will be less than the uncompensated elasticity, in absolute terms, thereby making the result more likely.

Furthermore, we find that household size has a significant negative impact on both alcohol and tobacco expenditure shares of the household, an indication of the presence of utility inter-dependence within the household. A member increase in the household reduces the household's expenditure share on alcohol and tobacco by 1.04 percentage points and 0.33 percentage points, respectively. This finding supports Ground and Koch (2008) results in South Africa. We further find that there are no significant gender differences on alcohol expenditure but there are on tobacco spending. A male headed household's expenditure share on tobacco is 3.6 percentage points higher than it is in its female headed counterpart. This points to the fact that tobacco in Lesotho is largely a male product.

The alcohol income share of those with university education is 13.8 percentage points more than that their counterparts with no education. This may be an indication of differences in tastes between the low and highly educated, with those highly educated opting for more expensive brands of alcoholic beverages. It may as well imply that those with more education spend more on the same brands purchased

[12] According to Belsley (1991), cited in Madden (2008), a VIF in excess of 30, or R^2 of 99% is a cause for concern. But Gujarati (2005) and Simon (2004) put this threshold at 10 or R^2 of 95%.

[13] We first take the average expenditure share for households with positive expenditures and then compute the first ratio in equation 6. To evaluate the second ratio, we used the average log of expenditure in the overall sample.

[14] These elasticity values are significant at 1% level, under $H_0 : \varepsilon_j = 0$. The bootstrap standard errors are 0.07993, for alcohol elasticity, and 0.05798, for tobacco elasticity.

[15] This only points to the fact that these goods are addictive. Atkinson et al. (1990) instead found that alcohol is income elastic in the UK.

by the less educated.

The results confirm the complementarity between alcohol consumption and smoking (see Aristei *et al.* 2008). Conditional on drinking, a 1% increase in tobacco expenditure per adult equivalent will increase alcohol expenses by 1.22%, everything else being constant. Symmetrically, a 1% increase in alcohol expenditure per adult equivalent will lead to a 1.22% increase in tobacco spending, conditional on participation. It is also important to mention that, unlike other previous studies (cf. Aristei *et al.* 2008) we do not find any evidence in support of the quadratic relationship between alcohol and tobacco expenditure on the one hand and income on the other hand.

The household's decision to participate in either alcohol or tobacco consumption is influenced by a number of demographic factors; age, gender, whether the head consumes either of the two goods and education. A one year increase in the household head's age increases his likelihood to drink alcohol until age 44.34 when the probability starts to decline. The probability of smoking, on the other hand, decreases with age[16]. This indicates that smoking is more prevalent in young households than in old ones. Male household heads have a higher probability of smoking than female heads, contradicting what Aristei *et al.* (2008) found in Italy. Further, those who smoke are more probable to take alcohol. Similarly, those who do drink alcohol are more likely to smoke. This finding further lends support to the complementarity observed between these goods as alluded to above.

Finally, education is found to affect smoking and alcohol drinking differently. While having secondary and university education increase the probability of alcohol drinking, it reduces the likelihood of smoking. Similar results obtain when the household head has 'teacher/technical' education, although this variable is not significant for alcohol drinking. None of these two education levels influence consumption except for the university education level which positively affects both the decision to drink alcohol and the level of consumption. This negative impact of education on the probability of smoking was also found by Aristei, *et al.* (2008) using Italian data.

6 Conclusion and Policy Implications

In this paper we have estimated income elasticities and investigated the determinants of alcohol and tobacco consumption in Lesotho, respectively, using the 2002/03 HBS data. Some particular attention was also given to selecting the model that provides a satisfactory fit for the data and hence the lack of any serious multicollinearity between the IMR and other covariates informed our decision to work with the Heckman two-step model.

The results reveal that the demand for alcohol and tobacco are income inelastic with tobacco income elasticity about half that of alcohol thereby indicating the relative ease of reducing alcohol consumption (and possibly quitting drinking) compared to tobacco consumption. This means that raising taxes on these commodities would be an effective revenue-increasing policy because, in as much as it would discourage consumption, total expenditure on them would be high, implying more revenue

[16] The quatratic of age was left out of the regression mainly because the inclusion of this variable was not improving the model fit and was also rendering a lot of variables, including age and household size, insignificant. Aristei, *et al.* (2008) also did not include this variable in the participation equation.

collected. However, given that these goods are also addictive, a uniform excise tax increase could have negative unintended consequences on both employment and the poverty situation in Lesotho. A too high excise tax increase would be good for revenue but would also hurt the most those poor households whose heads would find it difficult to cut alcohol expenditure and possibly force the brewing company to cut employment due to a possible fall in demand. Therefore, differentiated tax hikes (with a relatively higher rate on tobacco) in this case could prove more effective as both a consumption deterrent and revenue increasing policy, without compromising employment in the alcoholic beverages industry while softening the negative impact on the poverty.

Moreover, the result that education negatively affects the decision to smoke points out that targeting the uneducated masses with anti-smoking campaigns may prove an effective health policy. This would help to discourage the populace to develop the smoking habit as it would become more expensive to get them out of smoking. These can be done by increasing the excise tax on tobacco products, and hence increase the revenue and discourage smoking, which is an external diseconomy to the public.

In sum, we have established that alcohol and tobacco consumption have different demand properties which can have a significant influence on the determination of excise tax increases on these goods. We have also found evidence that alcoholic beverages and tobacco are complementaries, suggesting the need for a more holistic social policy aimed at curbing consumption of these two goods.

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A Appendix

Table 1: Variable Description

Variable	Definition
TotExpPerAd	Total expenditure per adult equivalent (p.a.e)
lnTtExp	Log of total expenditure p.a.e
lnTobExp_PA	Log of tobacco expenditure p.a.e
TobExpShare	Share of tobacco exp. p.a.e. in total exp. p.a.e.
lnAlcExp_PA	Log of alcohol expenditure p.a.e
AlcExpShare	Share of alcohol exp. p.a.e. in total exp. p.a.e.
age	Age of household head
agesq	Age of household head squared
lnTtExpSq	Square of log of total expenditure p.a.e.
male	Dummy for HH head's sex and equal 1 if male
hhsize	Household's size
rural	Dummy for region of residence. equal 1 if rural
married	Status dummy: 1=never married; 2=married; 3=divorced; 4=widowed; 5=cohabiting
educhigh	Education dummy: 1=no education; 2=primary; 3=secondary; 4=vocational; 5=teacher; 6=University
inc_source	Income source dummy: 1=Public sector ; 2=Private; 3=farming; 4=hh business; 5=pension; 6=remittances; 7=other
adult_sex	The adult sex ratio within a household. Adults are those 18 years and above.
adult_ratio	The adult ratio within a household
habit	Dummy for habit formation. Equals 1 if total expenditure is over 75th percentile of the observed distribution.
Children14	Dummy for presence of children aged 14 years and below in a household
Alcdrink	Dummy = 1 if HH head drinks alcohol, 0 otherwise
Tobsmoke	Dummy = 1 if HH head smokes tobacco, 0 otherwise

Table 2: Descriptive statistics

	Summary statistics: means and standard errors							
Variable	Full sample: n=5992		Drinkers: n=1046		Smokers: n=1752		Drinking smokers	
TotExpPerAd	230.3864	(433.1733)	321.6159	(501.3057)	210.6746	(290.8094)	290.7898	(400.5099)
lnTtExp	4.784064	(1.17034)	5.17307	(1.118376)	4.783533	(1.078835)	5.125176	(1.060976)
lnTobExp_PA	0.965143	(1.316692)	1.368106	(1.345754)	0.965143	(0.965143)	1.368106	(1.345754)
TobExpShare	0.012906	(0.035866)	0.026153	(0.045063)	0.044141	(0.054971)	0.046445	(0.051623)
lnAlcExp_PA	1.820354	(1.512841)	1.820354	(1.512841)	1.876249	(1.540408)	1.876249	(1.540408)
AlcExpShare	0.012522	(0.047025)	0.071734	(0.091794)	0.026237	(0.068472)	0.078043	(0.099558)
lnTtExpSq	24.25674	(11.14806)	28.01023	(11.5121)	24.0454	(10.38521)	27.39119	(10.85834)
age	49.02053	(15.36505)	48.56597	(14.47079)	50.21347	(15.05797)	48.19185	(14.12441)
agesq	2639.058	(1629.242)	2567.857	(1523.612)	2748.006	(1617.474)	2521.615	(1485.351)
male	0.643024	(0.479148)	0.738050	(0.439906)	0.718607	(0 .44981)	0.782683	(0.412771)
hhsize	4.618992	(2.531232)	4.226577	(2.645806)	4.709475	(2.704051)	4.271647	(2.685479)
rural	0.488818	(0.499917)	0.553537	(0.497363)	0.622717	(0.484845)	0.621392	(0.485452)
married	2.600467	(0.989303)	2.523901	(0.960912)	2.631279	(0.967137)	2.567063	(0.940944)
educhigh	1.789184	(1.163061)	1.800191	(1.203361)	1.484018	(0.868759)	1.612903	(1.01832)
inc_source	3.423231	(1.932196)	3.316444	(1.926461)	3.593607	(1.919667)	3.516129	(1.949663)
adult_sex	0.446253	(0.280232)	0.522410	(0.298916)	0.510057	(0.269571)	0.565272	(0.287995)
adult_ratio	0.691031	(0.396553)	0.746944	(0.442614)	0.706856	(0.410082)	0.742752	(0.466587)
habit	0.301569	(0.458977)	0.424474	(0.494499)	0.281964	(0.450084)	0.393888	(0.489026)
Children14	0.720461	(0.448810)	0.635755	(0.481448)	0.698059	(0.459231)	0.640068	(0.480388)
Alcdrink	0.174566	(0.379627)	1	(0)	0.336187	(0.472539)	1	(0)
Tobsmoke	0.292390	(0.454898)	0.563098	(0.49624)	1	(0)	1	(0)

Note: Standard errors in parentheses. Full sample statistics report lnTobExp_PA for n=1752 and AlcExp_PA for n=1046

Table 3: Expenditure Distribution

Summary of expenditure shares by deciles		
Expenditure Deciles	Alcohol	Tobacco
1	0.096	0.086
	(0.0986)	(0.0726)
2	0.111	0.068
	(0.1090)	(0.0585)
3	0.092	0.049
	(0.0985)	(0.0429)
4	0.084	0.052
	(0.0788)	(0.0689)
5	0.064	0.041
	(0.0948)	(0.0484)
6	0.076	0.038
	(0.0822)	(0.0609)
7	0.053	0.033
	(0.0590)	(0.0471)
8	0.063	0.028
	(0.0837)	(0.0323)
9	0.060	0.027
	(0.0862)	(0.0392)
10	0.064	0.021
	(0.1098)	(0.0298)
Sample size	1046	1752
Notes: Standard errors in parenthesis		

Table 4: Hausman Test for Simultaneity

	(1)	(2)	(3)
VARIABLES	Full Model	Reduced form model	Artificial model
lnTtExp	0.269***	0.690***	-9.276
	[0.0762]	[0.0710]	[7.809]
lnAlcExp_PA	0.307***		14.12
	[0.0396]		[11.31]
age	-0.0199	-0.0259	0.339
	[0.0189]	[0.0208]	[0.292]
agesq	0.000229	0.000174	-0.00218
	[0.000178]	[0.000210]	[0.00196]
hhsize	-0.0990***	-0.158***	2.064
	[0.0194]	[0.0234]	[1.775]
male	0.612***	0.466***	-5.817
	[0.131]	[0.164]	[5.291]
_Ieduchigh_2	-0.142	0.211*	-3.066
	[0.122]	[0.122]	[2.399]
_Ieduchigh_3	0.0987	0.208	-2.743
	[0.159]	[0.198]	[2.282]
_Ieduchigh_4	0.228	0.838	-11.33
	[0.595]	[0.640]	[9.483]
_Ieduchigh_5	0.795**	0.612*	-7.679
	[0.347]	[0.328]	[6.924]
_Ieduchigh_6	0.0173	0.975***	-13.44
	[0.327]	[0.298]	[11.01]
adult_ratio		-0.00856	
		[0.104]	
errors			-13.81
			[11.32]
Constant	-0.251	-0.288	3.907
	[0.623]	[0.642]	[3.489]
Observations	589	589	589
R-squared	0.414	0.472	0.415

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Heckit models

	Alcohol Heckit Model		Tobacco Heckit Model	
VARIABLES	AlcExpShare	Alcdrink	TobExpShare	Tobsmoke
lnTtExp	-0.0500**		-0.0445***	
	[0.0227]		[0.0109]	
lnTtExpSq	0.00262		0.00163	
	[0.00224]		[0.00108]	
lnTobExp_PA	0.0160***			
	[0.00331]			
age	0.00274	0.0243*	-0.00101	-0.00869***
	[0.00243]	[0.0133]	[0.000827]	[0.00315]
agesq	-2.97e-05	-0.000274**	1.01e-05	
	[2.46e-05]	[0.000124]	[7.49e-06]	
male	0.0426	0.378***	0.0345**	0.617***
	[0.0275]	[0.102]	[0.0155]	[0.126]
hhsize	-0.0104***	-0.0534***	-0.00329***	-0.00264
	[0.00351]	[0.0132]	[0.000902]	[0.0167]
rural		0.174**		0.214**
		[0.0715]		[0.0954]
_Ieduchigh_2	0.0172	0.132*	-0.00503	-0.0532
	[0.0123]	[0.0780]	[0.00545]	[0.103]
_Ieduchigh_3	0.0308	0.439***	-0.0104	-0.307**
	[0.0282]	[0.136]	[0.0114]	[0.148]
_Ieduchigh_4	0.0529	0.247	-0.0340	-0.913***
	[0.0558]	[0.429]	[0.0334]	[0.353]
_Ieduchigh_5	0.0320	0.340	-0.00795	-0.734***
	[0.0370]	[0.246]	[0.0240]	[0.227]
_Ieduchigh_6	0.0127**	0.965***	-0.0218	-0.399
	[0.0604]	[0.363]	[0.0191]	[0.276]
habit				-0.0406
				[0.0899]
Tobsmoke		6.680***		
		[0.352]		
lambda	0.103		0.0412	
	[0.0838]		[0.0380]	
lnAlcExp_PA			0.00995***	
			[0.00157]	
Alcdrink				7.089***
				[0.247]
Constant	0.112	-7.765	0.172***	-7.372
	[0.149]	[0]	[0.0497]	[0]
Observations	5,534	5,534	4,828	4,828

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Notes: We have also controlled for marital status and main income source.