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Tobacco Substitution and the Poor[•]

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Abstract

Tobacco control policies have effectively raised the price of cigarettes and other tobacco products. However, these price increases have been shown to disproportionately fall upon poorer households, with fewer resources. In this analysis, we provide an initial indication of the effect increased prices might have on household allocations, by considering substitution and complementation related to tobacco consumption. Our results show substitution between tobacco and most household consumption items, although elasticities tend to be highest amongst the poorest households.

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Keywords: Crowd-out, Crowd-in, 3SLS, Tobacco Substitution Elasticity

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1. Introduction

According to Sitas et al (2004) and South African Death Certificates from 1998, about 8% of adult deaths in South Africa could have been avoided were it not for smoking. Similarly, estimates of tobacco's burden of disease in 2000, provided by Groenewald et al (2007), suggest that 8-9% of South African adult deaths and approximately 4% of DALYs are caused by smoking, which places smoking third amongst 17 examined disease risk factors. Tobacco control policy has generally been driven by the aforementioned negative health consequences associated with tobacco use. The most prominent control measures include higher tobacco excise taxes, health-related warning labels on tobacco products and, especially in the United States, civil litigation aimed at cigarette companies, all of which are expected to either directly or indirectly increase prices, and, thus, reduce consumption.

In an analysis of South African data, Van Waalbeek (2006) shows that increased cigarette excise taxes, which were raised by the ANC from 32% of the retail price in 1994 to 50% in 1997, were associated with a significant decrease in cigarette consumption.[1] In the US, where civil litigation has been a common force for tobacco control, Franks et al (2007) find that cigarette smoking prevalence declined following the Master Settlement Agreement (MSA) between US states and most of the large cigarette manufacturers. Given the recent observed reduction in tobacco prevalence in many countries, the

[1] Although it is tempting to declare that the 46% reduction in per capita consumption between 1993 and 2005 is a causal effect of cigarette excise tax increases, and, there is no doubt that some of the decrease was due to the excise tax increase, no counterfactual evidence exists supporting the causal effect claim. In other words, it is not clear how large the decrease might have been even without the excise increases. Importantly, the anti-smoking lobby gained considerable power over the period, even before 1994, and their political influence is likely to have been due to the increase in negative information regarding the direct and passive effects of smoking.

tobacco disease burden is likely to fall in future, even though the reported burden remains high.[2]

Unfortunately, there is a caveat to these control policies. Given the pattern of tobacco purchases, these cost increasing measures are likely to be regressive, i.e., a relatively larger burden of the cost increase is paid by poorer households. Colman and Remler (2007), for example, find that because the participation and intensity elastiticities are not empirically large enough, excise taxes remain regressive. Their analysis of US data suggests that a $1 per pack increase in excise taxes would result in an increase in the share of income devoted to tobacco of 2.5%, 1.1% and 0.6% for low-income, middle-income and high-income smokers, respectively. Van Walbeek (2002a) has found similarly regressive estimates in South Africa. Data from 1990, by lowest quartile first, shows that smoking households spent 1.55%, 0.84%, 0.56% and 0.29% of their income, respectively, on cigarette excise taxes. In addition to the regressive nature of the tax burden, it is true that expenditure used for the purchase of tobacco cannot be used to purchase other items. Analysis of expenditure patterns and the effect of tobacco induced expenditure crowding in the US (Busch et al, 2004), China (Wang et al, 2006, and Pu et al, 2008) and India (John, 2008), provides some substance to this, although it has not been considered in any country in Africa.[3]

Reduced smoking is likely to have economic benefits, in addition to the well-known health benefits, and these might be more important amongst poorer households, whose resources are quite limited. These economic benefits are more likely to obtain if the

[2] Due to the cumulative effects of lifetime smoke inhalation, it is possible that the benefits of reduced smoking had not accrued for a long enough time to result in an observable reduction in smoking related deaths by either 1998 or 2000, the years the aforementioned studies were conducted.
[3] Crowding-out, a concept borrowed from public finance, relates to substitution from one form of expenditure to another, while crowding-in relates to complementation between forms of expenditure.

poorer are more strongly influenced by tobacco control measures than richer households; empirically, the poorer are more strongly influenced, at least in the US. Colman and Remler (2007) find that the participation elasticity falls with income; their estimates are -0.24 for the low-income group, -0.20 for the middle-income group and -0.12 for the high-income group. More recently, Franks et al (2007) find that, before the MSA, poorer individuals were more responsive to price changes than richer households; their estimated participation elasticities were -0.45 and -0.22, amongst the poorer and richer, respectively. Other authors considering US data have uncovered results that are similar to Colman and Remler.[4] However, very little is known about price elasticity in developing countries, and we were not able to find any studies regarding these elasticities across income groups in developing countries. Mao and Xiang (1997) find participation elasticities of -0.89 and intensity elasticities of -0.18 using data from China, while Akin et al (2004) find participation elasticities of -0.05 and -0.10 and intensity elasticities ranging from -0.63 to 0.03 and -0.26 to 0 in China and Russia, respectively. Although little is known about tobacco participation elasticities across income groups in developing countries, the preceding analyses of China and Russia, which can largely be classified as poor countries, with a smattering of rich elite, suggest that the proposed economic benefits associated with increased tobacco costs might not be realized in developing countries, since poorer developing economy consumers are not very responsive to prices. Furthermore, increased taxes may, instead, hurt households, by forcing a reallocation of expenditure, which the literature refers to as crowding-out, in order to cover the higher cost of tobacco purchases.

In this paper, we examine the effect that tobacco consumption has on household expenditure patterns, pointing, primarily, to the potential crowding-out effect using data

[4] See, for example, Evans et al (1999) and Farrelly et al (2001).

from South Africa. The analysis is further disaggregated to consider various poverty lines that have been proposed in South Africa to determine if there are differences in allocation decisions between the poorest and the less poor households. The final component of the analysis is a calculation of crowd-out elasticities based upon the demand system that is estimated, although we are not able to estimate detailed price elasticities with our data.[5] The analysis is structured within a demand system allowing us to consider household expenditure patterns, and how those patterns are affected by tobacco consumption. The empirical analysis is based upon a linearized approximation to the Quadratic Ideal Demand System developed by Banks, Blundell and Lewbel (1997), and is, therefore, similar to that undertaken by John (2008). The main difference between our model, and the model adapted by John (2008) is that we focus our attention on smoking households, in order to observe substitution patterns amongst the very poor, and the less poor. Given that South Africa, like India, is a middle-income, developing, country with high levels of poverty and income inequality, we expected to find results similar to those reported by John (2008). Although some similarities were uncovered, we find that crowding-out in tobacco consuming households, whether above or below the analysed poverty lines, is particular to fuel, clothing, health care, transport and education, although amongst the poorest, food is also crowded-out.

The rest of the paper is organized as follows. Section 2 continues with a discussion of the methodology applied in the analysis. The data used, and descriptive statistics related to that data are discussed in Section 3. The primary results are available in Section 4, while Section 5 provides concluding comments.

2. Methodology

[5] Although we do not have price data, we make use of standard notions of elasticity to calculate a meaningful measure of the direct effect of tobacco consumption on household consumption allocations.

2.1 Background

The first study to consider the effect of tobacco consumption on the allocation of household resources was Efroymson et al (2001). In their analysis of Bangladesh, which is not based upon an empirical or theoretical model of demand, they reallocate all tobacco expenditure to basic household needs suggesting that up to 50% more could be spent on food, which would translate into a caloric intake increase from 1837 per person per day to 2942 per person per day. Although their analysis was not underpinned by a theoretical model, and, therefore was *ad hoc*, a number of researchers have provided stronger empirical and theoretical foundations to Efroymson et al's (2001) ideas making use of demand system regressions, such as Deaton and Muelbauer's (1980) Almost Ideal Demand System, as well as Banks, Blundell and Lewbel's (1997) Quadratic Almost Ideal Demand System. Furthermore, researchers have included Vermeulen's (2003) notion of conditional demand to analyse differences in consumption behaviour across households.[6]

These more recent analyses have made use of data from the East and the United States. Wang et al (2006), for example, estimates expenditure shares via fractional logit to estimate the extent of crowding-out associated with tobacco expenditure in China. They find that crowding-out affects all goods for high tobacco spending households. For lower tobacco spending households, on the other hand, they find that tobacco expenditure only negatively affects education, social activities, rent, utility and insurance. Although their analysis is insightful, they did not control for potential endogeneities within the demand system. More recent work by Pu et al (2008) and John (2008) controls for endogeneity using data from Taiwan and India, respectively. Pu et al find that the poor sacrifice some of everything to consume tobacco, while the wealthier only

[6] Vermeulen's (2003) model is an extension of Deaton et al's (1989) model. The model provides for a statistical test of differences in consumption behaviour across smoking and non-smoking households, which can be attributed to differences in preferences.

sacrifice more luxurious items. John (2008), meanwhile, shows that tobacco expenditure is associated with reductions in food, education and entertainment expenditure shares; on the other hand, tobacco expenditure is associated with increases in health care, clothing and fuel expenditure shares.

The preceding research did not provide exact estimates of tobacco elasticities, due to the fact that very little data on prices were available. However, US data, which tends to be deeper and can be matched with price data, allows researchers to estimate price elasticities. Busch et al (2004) provide estimates of own-price and cross-price elasticities using the quarterly Consumer Expenditure Survey. Their estimated uncompensated elasticities can be used to explain the patterns of substitution observed across smoking and non-smoking households. Their results also suggest that an increase in cigarette prices, through an excise tax, would provide benefits for many households, although they are quick to point out that the regressive nature of these taxes might create more negative effects than positive effects. Franks et al (2007) similarly argue that the potential for excise taxes to alter consumption behaviour may have 'run its course'.

2.2 Empirical Considerations

The primary interest of our paper is in whether or not poorer smoking households behave differently than smoking households that are less poor. Modifying Banks et al (1997) we estimate a Quadratic Almost Ideal Demand System (QUAIDS) of expenditure shares as a function of tobacco expenditure, per capita net expenditure and household adult equivalency. The analysis considers eleven categories of household consumption: housing, food, alcohol, household fuel, clothing for adult, and clothing for children, healthcare, transport, entertainment, education, and other. In order to understand those

potential differences, we estimate equation (1) using the 2000 South African Income and Expenditure Survey.

$$w_{ij} = \omega_0 + \omega_1 \ln T_i + \omega_2 AE_i + \omega_3 \ln\left(\frac{X_i - T_i}{AE_i}\right) + \omega_4 \left[\ln\left(\frac{X_i - T_i}{AE_i}\right)\right]^2 + \varepsilon_{ij}, \quad j = 1,...,11 \quad (1)$$

In equation (1), w_{ij} is the budget share of the j^{th} good for household i, $\ln T_i$ is the log of tobacco expenditure, $\ln AE_i$ is the log of household adult equivalency, and the bracketed term is net expenditure $(X_i - T_i)$ per adult equivalent (AE_i), based on Yatchew et al (2003).[7] In the following discussion, the per adult equivalent net expenditure, the parenthetical expression in equation (1), is referred to as y_i. The system is estimated via Three-Stage Least Squares (3SLS) for each sub-population in the sample.

Due to the fact that expenditure shares, w_{ij}, are part of a demand system, and that w_{ij}, $\ln T_i$ and $\ln y_i$ reflect consumption decisions that are made simultaneously, it is likely that $\ln T_i$, $\ln y_i$ and ε_{ij} are correlated in the sense that $E\left[\varepsilon_{ij} \middle| T_i, AE_i, y_i\right] \neq 0$.[8] Therefore, to adjust for endogeneity, per adult equivalent net expenditure and tobacco expenditure are instrumented using, respectively, per adult equivalent income and a composite smoking prevalence rate, calculated using figures of smoking prevalence rates by demographic characteristics in South Africa (Van Walbeek, 2002b). Given that there are two endogenous variables and two instruments, the system is exactly identified.

[7] Yatchew et al (2003) provide semiparametric estimates of South African household adult equivalence scales based upon the 1993 PSLSD. They estimate the following scale, which we use to calculate adult equivalence in the 2000 IES: $AE = (A + .74K)^{.59}$, where AE is the adult equivalence, A is the number of adults, and K is the number of children.

[8] Normally, in a demand system, the conditional correlation is expected to be zero; however, adding tobacco expenditure, which is determined within the system, as one of the conditioning variables yields a non-zero expectation.

In order to use these instruments, we assume that heterogeneity in the smoking prevalence rate and household earnings are not correlated with households' consumption preferences. We test the validity of this assumption using the Kleibergen-Paap Wald weak identification test, as well as the Anderson-Rubin Wald test of joint significance of the endogenous regressors; see Baum et al (2007) for details. Intuitively, the tests determine whether or not the instruments are both uncorrelated with the underlying error term, but correlated with the variables that are believed to be endogenous.

3. Data

3.1 The South African Income and Expenditure Survey of 2000

The Income Expenditure Survey (IES) of South Africa, conducted in October 2000 by Statistics South Africa is the source of our data. The IES, a quinquennial cross-sectional survey is conducted primarily for the purposes of establishing the consumption basket used to construct the consumer price index. Given the focus of the survey, detailed expenditure and demographic information is available, and it has been used extensively for consumption and income studies and poverty studies.[9] Furthermore, the data is appropriate for considerations regarding expenditure on very specific items. Van Walbeek (2005), Pereira-Cardoso (2007), Tsishwaka-Kashalala (2007), Ground and Koch (2008), Ground, Koch and Van Wyk (2008) have examined tobacco and alcohol consumption, while Alaba and Koch (2008) have considered the effects of health insurance. Although a number of authors have considered alcohol and tobacco expenditures, these analyses were done primarily with regard only for alcohol or tobacco expenditure, such that the systemic influences related to tobacco consumption have not been considered. The exception is Tsishwaka-Kashalala (2007), which considers

[9] See, for example, Burger, Van der Berg and Nieftagodien (2004), Simkins (2004), Özler and Hoogeveen (2005) and Koch (2007).

systemic effects, conditional demand and a number of other features of household demand, although not the direct relationship between crowding elasticities and poverty.

The IES has been widely criticized, regarding quality, and, therefore, we trimmed the top and the bottom of the data distribution, based upon food expenditures. Trimming of this nature is due to the fact that both the top and the bottom of the distribution are thought to have misrepresented their income and expenditure reports; see, for example, Burger et al (2004), Simkins (2004) and Van Walbeek (2005). Given the focus of the study, we further restricted attention to smoking households, and, therefore, non-smoking households were eliminated from the data set. The result of our sampling choices left a remaining sample of 7259 households.

3.2 Poverty Lines in South Africa

We chose to conduct our analysis based upon poverty figures prominent in the literature related to South Africa. Woolard and Leibbrandt (2001) develop a Household Subsistence Line of R251.10 per capita per month in 1993 prices, which is R410 in 2000 prices. More recently, Van Der Berg, Louw and Burger (2007) use R250 per capita per month, while Streak, Yu and Van Der Berg (2008) consider R380 per capita per month. All of these numbers are consistent with Özler (2007), and are part of a preliminary discussion on the creation of national poverty lines (National Treasury and Statistics South Africa, 2007). Özler's (2007) analysis places the poverty line between R322 and R593 per person per month in 2000 prices. In our analysis, we chose to use R173 and R346, which are approximately $2 and $4 per person per day; the latter of which agrees with per capita expenditure for the 40^{th} percentile. As can be seen in Table 5, for instance, 29.5% of smoking households survive on less than $2 per person per day, while

56.8% of smoking households survive on less than $4 per person per day. In other words, smoking is not exclusively an activity undertaken only by the wealthy.

3.2 Descriptive Statistics

The data used in the analyses are summarized in Tables 1, A1 and A2 in the Appendix. Table 1 illustrates the differences in smoking behaviour across households by poverty status, based upon the two poverty lines applied in the paper, while Table A2 presents the shares for non-tobacco related products across the different poverty lines. Table A1, on the other hand, includes variable definitions for the endogenous, exogenous and instrumental variables used in the analysis, including descriptive statistics of those variables.

As can be seen in Table 1, poorer households, regardless of which measure of poverty is used, expend a larger proportion of their budget on tobacco products than non-poor households.[10] For example, considering households in the 80th percentile (and above) of tobacco expenditures, poor households (based on R346 per capita per month) expend 15.1% of their budget on tobacco products, compared to 9.6% for non-poor households. At R173 per capita per month, the proportions are 17.7% (poor) and 10.5% (non-poor). If, on the other hand, we consider low (tobacco) expenditure households, based upon the 20th percentile, the poor still expend a greater share of the budgets on tobacco than the non-poor by a margin of between 0.7% and 1.0%. These numbers suggest that smoking in poorer households might involve potentially significant costs to other members of the household. Clearly, if budgets are fixed, larger shares of budgets devoted to tobacco expenditure require reductions in purchases of other products. Table A2, in the appendix, provides a preliminary indication of which products are being

[10] In this analysis, poor refers to households below a particular poverty line, while non-poor refers to households above the relevant poverty line.

affected by tobacco expenditures. Given that the share of expenditure devoted to, for example, food across smoking levels within the same poverty category is generally decreasing, we might suspect that tobacco and food were substitutes, possibly due to the eating-suppression characteristics of nicotine. A similar pattern emerges when considering fuel and health care shares. On the other hand, the pattern of expenditure shares in Table A2 suggests that housing, transport, entertainment and education are complementary to tobacco consumption.

4. Empirical Results

Although the preliminary results are suggestive, a more detailed analysis is required to determine whether or not tobacco crowds-out or crowds-in the consumption of other goods. Therefore, the empirical model in equation (1) is estimated on five different population subgroups of smokers, everyone and two separate poverty line subgroups. The first two subgroups are on either side of the R173 per capita per month poverty line, while the second two subgroups are split by the R346 per capita per month poverty line. We report on only 10 of the 11 categories; the coefficients for the other goods category could be calculated from the adding-up properties of the coefficients within the demand system.

As noted in the methodology, a number of tests were undertaken to determine the validity of the instruments used in the model. According to both the Kleibergen-Paap *rk* statistic $\left(\chi_1^2 = 57.77, p < 0.0001\right)$ and the Anderson-Rubin $\left(\chi_3^2 = 1372.74, p < 0.0001\right)$ statistic, the instruments used in the analysis are strongly correlated with the variables that are believed to be endogenous in the system.[11]

[11] The same tests were true within sub-samples, although the test-statistic values differ across sub-samples. The results are available from the authors, upon request.

4.1 All Smoking Households

Initially, the analysis is conducted upon all smoking households, which is likely to mask important differences based upon overall total expenditure. The coefficient results from the 3SLS are presented in Table 2. The results suggest that tobacco expenditure crowds-in expenditure on housing food, and entertainment, while crowding-out expenditures on fuel, adult and child clothing, healthcare, transport and education. The budget shares for adult and child clothing, healthcare and transport are concave in per capita expenditure, while housing shares and entertainment shares are convex in per capita expenditure. Finally, the share of the budget devoted to food, housing and tobacco is lower for larger families; for most of the other expenditure categories, the budget shares are increasing in the size of the household, as measured by adult equivalence.

4.2 $2 per day

As already noted, R173 per capita per day (in 2000 prices) is approximately $2 per day, and, as seen in Table 1, the heavy smokers in the poorer income groups allocated a large proportion of the expenditures on tobacco. In this subsection, we consider the expenditure behaviour differences due to tobacco choices that can be observed across the $2 per day poverty line. The empirical results are presented in Table 3.

For those above the $2 a day cut-off, tobacco expenditure complements housing, food and entertainment, but substitutes for fuel, clothing (for young and old, alike), healthcare, transport and education, while being unrelated to alcohol expenditure shares. For the very poor, on the other hand, tobacco expenditure crowds-in housing, alcohol and entertainment, while crowding-out food, fuel, kids clothing, healthcare, transport and education. Tobacco expenditure is statistically unrelated to the share of expenditure devoted to adult clothing. Comparatively speaking, the biggest differences across the

poverty line are for food, alcohol, and adult clothing. From the point of view of subsistence, the fact that for the poor tobacco crowds-in alcohol expenditures, while crowding-out food expenditures is particularly worrying.

For those below the poverty line, per adult expenditure and its square are only significant in the food share and transport share regressions, which suggests that all other product shares are fixed by the household, once the effect of tobacco expenditures and household size have been controlled. In terms of household size, expenditures were inversely related to the adult equivalence scale for housing and alcohol shares, but directly related to food, youth clothing, health care and education shares.

4.3 $4 per day

The second analysis doubled the poverty line to R346 per capita per day, to see if the actual poverty line impacted the preceding empirical conclusions. The expenditure share regression results for those households above and below the slightly higher poverty line are presented in Table 4. For households above the poverty line, we once again observe that tobacco expenditures complement housing, food and entertainment shares, while substituting for fuel, (young and adult) clothing, health care, transport and education. Alcohol expenditure, meanwhile, remains unrelated to tobacco expenditures at conventional levels of significance.

As with the lower poverty line, for the very poor, tobacco crowds-in housing and entertainment, while crowding-out fuel, healthcare, transport and education. Only a few changes are observed for these households below this slightly higher poverty line. The changes occur in relation to food, alcohol and (young and adult) clothing consumption. At the lower poverty line, food and tobacco are substitutes, while alcohol and tobacco

are complements; clothing is only marginally substitutable for tobacco consumption. After raising the analysed poverty line to R346 per capita per month, neither food shares nor alcohol shares are significantly affected by tobacco consumption, while tobacco consumption crowds-out expenditures on clothing for the young and old, alike.

The observed patterns with regard to per capita expenditure and the adult equivalence scale are broadly similar regardless of the choice of poverty line, although some differences are worth noting. For the poorest (under the lower poverty line) food expenditure shares depend upon the size of the household, which is not true for those households below the larger poverty line; the opposite is true for transport expenditure. As already noted in the preceding subsection, many of the expenditure shares are independent of per capita expenditure and its square; however, doubling the poverty line results in significant effects related to per capita expenditure due primarily to more precision across the estimates.

4.4 Crowd-out and Crowd-in Elasticities

The preceding discussion focussed on the estimated coefficients, which does not pin-down the importance of the estimated effect. In order to wrap-up the discussion, we further estimated the underlying expenditure share elasticities with respect to tobacco consumption (to be referred to as the tobacco crowd-out/crowd-in elasticity). This elasticity can be used to determine the expected percentage change in household expenditure shares that would result from a fixed percentage change in tobacco consumption. Due to the fact that expenditure shares are a proportion, while the natural

log of tobacco consumption was included in the regression, the crowd-out or crowd-in elasticity for each household can be determined for any share by the following equation:[12]

$$\xi_{w_{ij}T} = \frac{dw_{ij}}{d\ln T} = \frac{T_i}{w_{ij}}\left[\frac{\omega_1}{T_i} - \frac{\omega_3}{X_i - T_i} - \left(\frac{2\omega_4}{X_i - T_i}\right)\cdot \ln\left(\frac{X_i - T}{AE_i}\right)\right] \qquad (2)$$

As noted in equation (2), the elasticity was calculated for all households and all commodities; we made further calculations for each sub-sample used in the analysis. From these calculated values, the sub-sample mean elasticity for each commodity group j, $\bar{\xi}_{w_jT} = N^{-1}\sum_N \xi_{w_{ij}T}$, was estimated.[13] Those estimates are available in Table 5, and they highlight the observed behavioural differences across households according to poverty status, as well as the differences across the poorest households, depending upon the chosen poverty line. Furthermore, the elasticities can be used to pin-down the economic meaning behind the estimated crowding that has been observed in the analysis.

The estimated crowding elasticities are not all that similar in magnitude across the different subgroups of households, although, as expected from the preceding discussion, there are some similarities, especially in terms of direction. In particular, tobacco expenditure crowds-in housing and entertainment expenditures, but crowds-out fuel, young and adult clothing, healthcare, transportation and education expenditures. Furthermore, with the exception of households below the R173 poverty line, we find that food expenditure is crowded-out, while alcohol expenditure is crowded-in. Finally, as can be seen in the table, elasticities range from very inelastic, near zero and rather elastic, well above 2.

[12] Given that some shares are zero for some households, calculating the elasticity is not possible for all households, since the calculation would result in division by zero. Therefore, we use the underlying average share in the calculation. That is, we replaced w_{ij} with $\bar{w}_j$ in equation (2).

[13] We report only the estimates for the ten shares that were estimated.

For all smokers, see column 1, food, youth clothing, health care, transport and education expenditure crowd-out elasticities exceed unity, and are elastic, as a 10% increase in tobacco expenditures would decrease the shares of total expenditure devoted to these products by between 10.7% and 14.2%. Crowding-in elasticities for both housing and entertainment suggest that a 10% increase in tobacco expenditure would results in 12.0% to 15.7% increases in the expenditure shares of these products.

Columns 2 and 3, however, provide elasticities for those above and below the R173 per person per day poverty line. The biggest difference between the two columns is in the magnitude of the elasticities, in addition to the change in direction associated with food and alcohol, as already mentioned. Surprisingly, the elasticities are not obviously smaller or larger across the range of expenditure items. For example, crowding-in related to housing and entertainment is much higher for the poorer households, while crowding-out, with the exception of health care, is smaller for the poorer households. The estimated elasticities indicate that a 10% increase in tobacco expenditure would result in an 8.3% reduction in fuel expenditures for the poor, compared to a 20.4% reduction for the less poor.

Finally, columns 4 and 5 of the table provide a comparison for those above and below the slightly higher R346 per person per day poverty line. Once again, there is no absolute pattern related to the magnitude of the change in the estimated elasticities. For example, a 10% increase in tobacco expenditures is associated with a 13.0% decrease in the feul expenditure share for those below, and a 20.2% decreased for those above the poverty line, while that same tobacco percentage change results in a 21.6% decrease in the transportation expenditure share for those below, but only a 6.8% decrease for those above the poverty line.

Comparing the estimated elasticities for the two poorest groups, meanwhile, suggests that those below R173 have generally larger crowding-in elasticities and lower crowding-out elasticities than those below R346, with the exception of transportation expenditures. However, for the two different groups above the poverty line, all crowding elasticities are larger for the group above R173 compared to the group above R346, with the exception of education expenditures.

5. Conclusions and Recommendations

In this paper, we have considered the effect of tobacco expenditure on household resource allocations. The analysis was based upon a linearized QUAIDS model, and was separated by poverty lines that have been proposed in the South African poverty literature. The results are consistent with models of household behaviour based upon limited household resources. We find that crowding-out elasticities in the poorest households tend to exceed those calculated for the better-off households, although the same comparison cannot be drawn when the poverty line is raised. Like many researchers, we also find that crowding-out is most commonly associated with fuel, clothing, health care, transport and education. Unlike other researchers, we have not generally identified a strong complementary between alcohol consumption and tobacco consumption, and we only find that the food is crowded-out for the poorest of the poor smoking households. One possible reason for the difference between our results, and those of others, is the fact that we have only focussed upon smoking households in our analysis.

Previous researchers have used their analysis to argue that tobacco use is undertaken at a significant opportunity cost, especially for children and women, who often are not

allowed to determine household decisions. Efroymson et al (2001) argue that there is scope for a paternalistic government to improve, for example, nutrition in the country by controlling tobacco usage. Wang et al (2006), meanwhile suggest that the reductions in household investments that can be correlated with tobacco expenditure are alarming, and that policy should address these affects. On the other hand, Busch et al (2004) imply that providing information on the opportunity costs of tobacco consumption might be a better control policy than the policy currently being used, a contention that is further supported by Franks et al (2007), who believe that excise taxes are no longer an effective means of controlling tobacco consumption.

Our analysis adds further evidence to the literature showing that tobacco consumption must be paid for through a reduction in other consumption, as one would expect given that household resources are limited. For that reason, our results could be used to suggest that additional measures be taken to further control tobacco consumption. However, as suggested by Busch et al (2004), Franks et al (2007), Van Walbeek (2002a) and our analysis, increases in excise taxes may only raise the amount of expenditure that must be allocated to tobacco (presuming it's addictive nature). A further increase in tobacco excise taxes would further undermine the household's, especially for the poorer households, ability to purchase the goods that are crowded-out by tobacco expenditure.

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Table 1: Tobacco share spending patterns across the poverty divide

	R173 Poverty Line		R346 Poverty Line	
	Non-poor (n=5,120)	*Poor (n=2,139)*	*Non-poor (n=3,135)*	*Poor (n=4,124)*
Low smokers				
Mean log tobacco	2.13	2.08	2.06	2.10
Budget share tobacco	1.8%	2.5%	1.3%	2.3%
Medium smokers				
Mean log tobacco	3.80	3.46	3.90	3.56
Budget share tobacco	5.4%	6.7%	4.8%	6.4%
High smokers				
Mean log tobacco	5.22	5.07	5.24	5.11
Budget share tobacco	10.5%	17.7%	9.6%	15.1%

Source: 2000 South African Income and Expenditure Survey

Table 2. Three Stage Least Squares estimates over all smoking households

COEFFICIENT	Housing	Food	Alcohol	Fuel	Clothing (kids)	Clothing (adlts)	Healthcare	Transport	Entertment	Education
T	0.209***	0.0395*	-0.00883	-0.0602***	-0.0249***	-0.0468***	-0.0126***	-0.0814***	0.00920***	-0.0218***
	(0.0329)	(0.0204)	(0.00924)	(0.00980)	(0.00542)	(0.0104)	(0.00277)	(0.0155)	(0.00195)	(0.00583)
lms	-0.0970***	-0.169***	0.0122	0.0210**	0.0221***	0.0616***	0.0105***	0.116***	-0.00424**	0.0252***
	(0.0303)	(0.0188)	(0.00851)	(0.00903)	(0.00499)	(0.00962)	(0.00255)	(0.0143)	(0.00179)	(0.00537)
lms2	0.0623***	-0.0204***	-0.0134***	-0.00299	-0.00732***	-0.0220***	-0.00345***	-0.00119	0.00415***	0.00409***
	(0.00768)	(0.00476)	(0.00216)	(0.00229)	(0.00127)	(0.00244)	(0.000646)	(0.00362)	(0.000455)	(0.00136)
lscale	-0.0602***	-0.0250***	-0.0398***	0.00382	0.0360***	0.00518	0.00427***	0.0441***	0.00112	0.0297***
	(0.0130)	(0.00806)	(0.00366)	(0.00388)	(0.00214)	(0.00413)	(0.00109)	(0.00613)	(0.000771)	(0.00231)
Constant	-0.0159	1.476***	0.0414**	0.136***	-0.0375***	-0.136***	-0.00847	-0.367***	-0.00608	-0.0766***
	(0.0711)	(0.0440)	(0.0200)	(0.0212)	(0.0117)	(0.0226)	(0.00598)	(0.0335)	(0.00421)	(0.0126)
Observations	**7259**	**7259**	**7259**	**7259**	**7259**	**7259**	**7259**	**7259**	**7259**	**7259**

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: 2000 SA IES: 3SLS estimates

Table 3A. Three Stage Least Squares estimates for smoking households below R173 per person per day poverty line

COEFFICIENT	Housing	Food	Alcohol	Fuel	Clothing (kids)	Clothing (adlts)	Healthcare	Transport	Entertment	Education
T	0.191***	0.0861***	-0.0144	-0.0666***	-0.0234***	-0.0517***	-0.0118***	-0.0906***	0.00875***	-0.0260***
	(0.0395)	(0.0272)	(0.0121)	(0.0121)	(0.00596)	(0.0135)	(0.00327)	(0.0209)	(0.00239)	(0.00783)
lms	-0.114**	-0.269***	0.0297**	0.0238	0.0348***	0.102***	0.0130***	0.152***	-0.00778***	0.0326***
	(0.0476)	(0.0327)	(0.0146)	(0.0146)	(0.00718)	(0.0163)	(0.00393)	(0.0252)	(0.00287)	(0.00942)
lms2	0.0746***	0.0217**	-0.0201***	-0.00318	-0.0137***	-0.0421***	-0.00490***	-0.0196**	0.00636***	0.000797
	(0.0159)	(0.0109)	(0.00488)	(0.00486)	(0.00240)	(0.00543)	(0.00131)	(0.00841)	(0.000959)	(0.00314)
lscale	-0.0221*	-0.0181**	-0.0518***	0.00837**	0.0269***	-0.0125***	0.00161	0.0341***	0.00325***	0.0296***
	(0.0125)	(0.00859)	(0.00383)	(0.00382)	(0.00188)	(0.00426)	(0.00103)	(0.00661)	(0.000753)	(0.00247)
Constant	0.142	1.914***	-0.0420	0.142***	-0.120***	-0.363***	-0.0260*	-0.550***	0.0165*	-0.106***
	(0.162)	(0.111)	(0.0498)	(0.0496)	(0.0244)	(0.0553)	(0.0134)	(0.0857)	(0.00977)	(0.0321)
Observations	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: 2000 SA IES: 3SLS estimates

Table 3B. Three Stage Least Squares estimates for smoking households above R173 per person per day poverty line

COEFFICIENT	Housing	Food	Alcohol	Fuel	Clothing (kids)	Clothing (adlts)	Healthcare	Transport	Entertment	Education
T	0.191***	0.0861***	-0.0144	-0.0666***	-0.0234***	-0.0517***	-0.0118***	-0.0906***	0.00875***	-0.0260***
	(0.0395)	(0.0272)	(0.0121)	(0.0121)	(0.00596)	(0.0135)	(0.00327)	(0.0209)	(0.00239)	(0.00783)
lms	-0.114**	-0.269***	0.0297**	0.0238	0.0348***	0.102***	0.0130***	0.152***	-0.00778***	0.0326***
	(0.0476)	(0.0327)	(0.0146)	(0.0146)	(0.00718)	(0.0163)	(0.00393)	(0.0252)	(0.00287)	(0.00942)
lms2	0.0746***	0.0217**	-0.0201***	-0.00318	-0.0137***	-0.0421***	-0.00490***	-0.0196**	0.00636***	0.000797
	(0.0159)	(0.0109)	(0.00488)	(0.00486)	(0.00240)	(0.00543)	(0.00131)	(0.00841)	(0.000959)	(0.00314)
lscale	-0.0221*	-0.0181**	-0.0518***	0.00837**	0.0269***	-0.0125***	0.00161	0.0341***	0.00325***	0.0296***
	(0.0125)	(0.00859)	(0.00383)	(0.00382)	(0.00188)	(0.00426)	(0.00103)	(0.00661)	(0.000753)	(0.00247)
Constant	0.142	1.914***	-0.0420	0.142***	-0.120***	-0.363***	-0.0260*	-0.550***	0.0165*	-0.106***
	(0.162)	(0.111)	(0.0498)	(0.0496)	(0.0244)	(0.0553)	(0.0134)	(0.0857)	(0.00977)	(0.0321)
Observations	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**	**5120**

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: 2000 SA IES: 3SLS estimates

Table 4A. Three Stage Least Squares estimates for smoking households below R346 per person per day poverty line

COEFFICIENT	Housing	Food	Alcohol	Fuel	Clothing (kids)	Clothing (adlts)	Healthcare	Transport	Entertment	Education
T	0.214***	0.0387	0.0117	-0.0733***	-0.0277***	-0.0389***	-0.0122***	-0.104***	0.00781***	-0.0140**
	(0.0418)	(0.0276)	(0.0112)	(0.0157)	(0.00803)	(0.0127)	(0.00374)	(0.0215)	(0.00223)	(0.00605)
lms	-0.186**	-0.290***	-0.0128	0.0486*	0.0428***	0.106***	0.0154**	0.238***	-0.00524	0.0398***
	(0.0761)	(0.0502)	(0.0205)	(0.0285)	(0.0146)	(0.0230)	(0.00680)	(0.0391)	(0.00405)	(0.0110)
lms2	-0.0168	-0.118***	-0.0117	0.00905	0.00928	0.0274***	0.00209	0.0763***	-0.000721	0.0215***
	(0.0343)	(0.0226)	(0.00924)	(0.0129)	(0.00660)	(0.0104)	(0.00307)	(0.0176)	(0.00183)	(0.00497)
lscale	-0.0962***	0.00372	-0.0351***	0.00910	0.0399***	0.00690	0.00543***	0.0401***	-0.0000497	0.0256***
	(0.0175)	(0.0115)	(0.00470)	(0.00656)	(0.00336)	(0.00530)	(0.00156)	(0.00898)	(0.000931)	(0.00253)
Constant	0.543	2.185***	0.111	0.0120	-0.156**	-0.437***	-0.0411	-1.016***	0.00834	-0.191***
	(0.339)	(0.223)	(0.0911)	(0.127)	(0.0650)	(0.103)	(0.0303)	(0.174)	(0.0180)	(0.0490)
Observations	**4124**	**4124**	**4124**	**4124**	**4124**	**4124**	**4124**	**4124**	**4124**	**4124**

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: 2000 SA IES: 3SLS estimates

Table 4B. Three Stage Least Squares estimates for smoking households above R346 per person per day poverty line

COEFFICIENT	Housing	Food	Alcohol	Fuel	Clothing (kids)	Clothing (adlts)	Healthcare	Transport	Entertment	Education
T	0.154***	0.0776**	-0.0129	-0.0456***	-0.0119**	-0.0481***	-0.0116***	-0.0712***	0.0102***	-0.0400***
	(0.0463)	(0.0333)	(0.0150)	(0.0111)	(0.00604)	(0.0171)	(0.00399)	(0.0258)	(0.00339)	(0.0118)
lms	-0.104	-0.416***	0.0596**	-0.00550	0.0429***	0.174***	0.0202**	0.186***	-0.0215***	0.0625***
	(0.0920)	(0.0662)	(0.0299)	(0.0220)	(0.0120)	(0.0340)	(0.00792)	(0.0513)	(0.00673)	(0.0235)
lms2	0.0732**	0.0859***	-0.0299***	0.00416	-0.0178***	-0.0715***	-0.00810***	-0.0382**	0.0123***	-0.0104
	(0.0334)	(0.0240)	(0.0108)	(0.00799)	(0.00435)	(0.0123)	(0.00287)	(0.0186)	(0.00244)	(0.00851)
lscale	0.0317*	0.0245**	-0.0723***	0.00487	0.0108***	-0.0467***	-0.00140	0.0135	0.00574***	0.0286***
	(0.0165)	(0.0119)	(0.00536)	(0.00395)	(0.00215)	(0.00610)	(0.00142)	(0.00919)	(0.00121)	(0.00421)
Constant	0.219	2.895***	-0.240*	0.250**	-0.218***	-0.839***	-0.0731*	-0.846***	0.0978***	-0.241**
	(0.437)	(0.314)	(0.142)	(0.105)	(0.0570)	(0.162)	(0.0376)	(0.244)	(0.0320)	(0.111)
Observations	**3135**	**3135**	**3135**	**3135**	**3135**	**3135**	**3135**	**3135**	**3135**	**3135**

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: 2000 SA IES: 3SLS estimates

Table 5. Estimated Tobacco Expenditure Elasticities

COEFFICIENT	All Smokers	Below 173	Above 173	Below 346	Above 346
Housing	1.2046	1.9942	0.9250	1.8984	0.6149
Food	0.0758	-0.0610	0.1704	0.0778	0.1674
Alcohol	-0.1644	0.8328	-0.2443	0.2895	-0.2057
Fuel	-1.4236	-0.8255	-2.0417	-1.2995	-2.0234
Youth Cloting	-1.0728	-0.4420	-1.2561	-0.9740	-0.7698
Adult Clothing	-0.8061	-0.4786	-0.7807	-0.8646	-0.6607
Health Care	-1.2758	-1.0345	-1.2414	-1.1833	-1.2804
Transportation	-1.1117	-1.6425	-1.0469	-2.1649	-0.6795
Entertainment	1.5667	2.5382	1.2828	1.9404	1.2313
Education	-1.1323	-0.7647	-1.3699	-0.8731	-1.8253
Observations	7259	2139	5120	4124	3135

Source: Author's calculations from empirical estimates; see equation (2).

Table A1. Descriptive Statistics of Analysis Variables

Variable	Mean	S.D.	Definition
Endogenous			
1. Conditional Budget Shares			
Housing	0.1708	0.17	Cost of housing including domestic workers services
Food	0.5483	0.19	Cost of food except beverages
Alcohol	0.0492	0.07	Alcohol consumed away from and at the point of purchase
Household fuel	0.0422	0.06	Fuel for household use (not transport)
Clothing(kids)	0.0229	0.03	Boys', girls', and infants' clothing and footwear
Clothing(adults)	0.0568	0.06	Men's and women's clothing and footwear
Healthcare	0.0098	0.02	Cost of medical care for non-medical aid members
Transport	0.0737	0.1	Private, public and hired transports
Entertainment	0.0057	0.01	Recreation and entertainment goods and services
Education	0.0196	0.04	Cost of education paid out-of-pocket or by loans
Other	0.0008	0	Reading matter and stationery
2. Others			
log of spending on tobacco	3.7082	1.09	Log of monthly spending on tobacco
log of net total expenditure	6.1665	0.87	Log of monthly total expenditure net of spending on tobacco
log of net total expenditure squared	0.7572	1.06	Demeaned log of net total expenditure squared
Exogenous			
log of equiv. scales	0.6217	0.39	Equivalence scales following Yatchew et al (2003)
Instruments			
log of income	9.7275	1.01	Log of total regular and other incomes
log of income squared	1.0292	1.67	Demeaned log of total regular and other incomes
smoking prevalence	0.0095	0.01	Calculated based on Van Walbeek (2001)

Table A2. Conditional budget shares for smoking households across the distribution of smoking expenditure and poverty measures

			Conditional Budget Shares (%)									
		Household	*Housing*	*Food*	*Alcohol*	*Fuel*	*Cloth(kids)*	*Cloth(adlts)*	*Healthcare*	*Transport*	*Entertnmnt*	*Education*
173 Poverty line	>=173	*Low smoking*	15.1	58.6	4.3	5.7	1.7	5.6	1.1	6.3	0.3	1.3
		Medium smoking	18.8	52.1	5.8	3.5	1.9	6.6	1.0	8.0	0.5	1.8
		High smoking	25.7	43.9	5.2	1.8	1.7	6.3	0.8	10.9	1.1	2.5
	< 173	*Low smoking*	9.6	66.4	2.6	6.7	3.5	3.7	1.1	3.9	0.3	2.1
		Medium smoking	9.3	64.3	4.1	6.5	3.4	4.3	1.1	4.6	0.4	2.0
		High smoking	9.6	63.6	4.8	5.1	3.4	3.5	0.9	6.2	0.5	2.4
346 Poverty line	>=346	*Low smoking*	19.2	52.9	4.4	4.9	0.9	6.2	1.1	8.0	0.4	1.8
		Medium smoking	22.9	46.6	6.1	2.6	1.5	7.2	1.0	9.6	0.6	2.0
		High smoking	28.2	40.9	5.3	1.4	1.5	6.5	0.7	11.8	1.2	2.5
	< 346	*Low smoking*	10.7	64.9	3.1	6.5	3.1	4.2	1.1	4.3	0.3	1.8
		Medium smoking	11.5	61.7	4.8	5.5	2.9	5.1	1.0	5.3	0.4	1.7
		High smoking	13.2	59.4	4.9	4.1	3.0	4.9	0.9	6.5	0.6	2.4