The Effect of Tobacco and Alcohol Control Policies on Household Spending Patterns in Kenya: An Approach Using Matched Difference in Differences

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Abstract

This paper examines the effect of tobacco and alcohol control policies on tobacco and alcohol consumption patterns and the evolution of crowding-out effects on other household expenditure in Kenya. The current literature on crowding-out does not provide a defensible instrumental variable for a system of demand equations. This paper uses Matched Difference in Differences (MDID) as an alternative strategy and data from two nationally representative surveys in Kenya conducted ten years apart (2005/6 and 2015/16). We find that tobacco-control policies contributed to a decrease in the proportion of tobacco-consuming households between 2005 and 2015. Alcohol-control policies were only effective in reducing the proportion of alcohol-consuming households in the bottom quartile of the expenditure distribution. Overall, tobacco-consuming households had lower expenditure on education, communication, and some food items. Alcohol-consuming households also had lower expenditure on some food items, but expenditure on transportation was the only non-food item crowded out. Tobacco and alcohol control policies, when they result in reduced consumption of these products, can increase household expenditure on human capital development in the long run.

1 Introduction

Smoking and harmful alcohol consumption have been identified as major contributors to premature death (WHO, 2009, 2010, 2014, 2017). Since 2000 a literature has developed, focused primarily on tobacco, in which researchers

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have focused not just on the public health effects of tobacco use, but also on the impact that expenditure on tobacco has on other household expenditures. Expenditure on tobacco has been found to adversely affect spending on education, food, energy, transport, communications, and medical care (John, 2008; John et al., 2012; Chelwa & Van Walbeek, 2014; Do & Bautista, 2015; Chelwa & Koch, 2019; John et al., 2019). The specific goods and services that are crowded out may differ because of heterogeneity between countries.

Tobacco and alcohol are consumed as complements by some segments of the population. Some studies that have estimated the crowding-out effect of tobacco expenditure have also concluded that spending on tobacco consumption "crowds *in*" expenditure on alcohol (Wang et al., 2006; Koch & Tshiswaka-Kashalala, 2008; Chelwa & Koch, 2019). This prompted a few studies to investigate the crowding-out effects of both tobacco and alcohol expenditures. In Taiwan, for example, the household expenditures that were crowded out by tobacco consumption differed from those that were crowded out by alcohol consumption (Pu et al., 2008). However, in India, similar expenditures were crowded out by both tobacco and alcohol consumption (Jumrani & Birthal, 2017).

The methodology used in the estimation of the crowding-out effects of tobacco and alcohol consumption has evolved. Initial studies compared household expenditure on food and other basic needs, without considering the differences in household structure and socio-economic status between smoking and non-smoking households (Efroymson et al., 2001). Subsequent studies advanced the literature by incorporating household characteristics (Busch et al., 2004; Wang et al., 2006).

Recently, the literature has concerned itself with addressing the likely endogeneity of household tobacco expenditure in a system of demand equations. Given that the majority of tobacco consumers are adult males in many developing countries, the household adult-sex ratio has been proposed as an instrumental variable for tobacco expenditure (John, 2008; Pu et al., 2008; John et al., 2012; San & Chaloupka, 2016). Similarly, the household adult ratio has been used as an instrumental variable for household expenditure on alcohol (Pu et al., 2008).

Chelwa and Van Walbeek (2014) pointed out that the adult-sex ratio was an imperfect instrumental variable in the sense that it was likely to be correlated with the error term. Making some assumptions about the direction of this correlation, they used the method of bounds (Nevo and Rosen, 2012) to investigate crowding-out. Recently, Chelwa & Koch (2019) have proposed Genetic Matching as a better method of addressing the endogeneity of household tobacco consumption given the *ad hoc* nature of the assumptions needed to derive the bounds in Chelwa and Van Walbeek (2014). Genetic Matching allows for the comparison of household expenditure on food and non-food items between matched tobacco- and non-tobacco-consuming households. Unlike regression estimation, which requires correct model specification, Genetic Matching is non-parametric as a model is not specified. Consequently, parametric assumptions about the relationship between covariates and household expenditures are avoided (Fowlie et al., 2012).

Genetic Matching uses observed covariates to match households and, therefore, does not take into account any unobservable variables that may differ between tobacco- and non-tobacco consuming households. In this study, we propose an alternative method, Matched Difference in Differences (MDID), that addresses this shortcoming. MDID uses kernel matching on repeated cross-sectional data to match tobacco-consuming households to similar households that do not consume tobacco. This allows for the creation of a pseudo-panel that can be used to analyse the evolution through time of the opportunity costs associated with household tobacco expenditure.

We apply Matched Difference in Differences (MDID) to the two most recent waves of the Kenya Integrated Household and Budget Survey (KIHBS), a nationally representative survey of between 13,158 households in 2005/6 and 21,773 households in 2015/16. The two waves are ten years apart, with the latter wave having taken place after the introduction of a series of tobacco control measures in 2007 and alcohol control measures in 2010 (see Section 2 for a detailed discussion of these measures).

Kenya presents an interesting case for applying MDID to the study of crowding-out. Even though adult smoking prevalence has held steady at 13% over the last two decades (slightly below the African average of 15%), there is every expectation that it will increase in the near future as a result of economic growth (WHO, 2008; Sornpaisarn et al., 2013; Ahluwalia et al., 2016; WHO, 2019). This increase is likely to be driven by female smoking prevalence, which increased from 1.9% in 2004 (African average of 4.8%) to 4.1% in 2015 (African average of 4.6%) (WHO, 2008, 2019). Similarly, alcohol consumption increased from 1.3 litres of pure alcohol per capita in 2000 (African average of 3.2 litres) to 1.9 litres in 2015 (African average of 3.6 litres) (WHO, 2018a). Kenya's pure alcohol consumption in 2025 has been projected at 3.1 litres per capita against an African average of 4.9 litres per capita (WHO, 2018a). These developments and projections have led the authorities to introduce the aforementioned tobacco and alcohol control policies in an effort to stem the tide. This presents a unique opportunity to study crowding-out in an environment where consumption and prevalence are relatively high compared to peers and expected to rise. Additionally, the introduction of control measures allows us to see what happens to consumption when the policy landscape changes.

Our approach in this paper is close to that of San and Chaloupka (2016) and Ross et al. (2017) who analysed the effects of different tobacco control policies on crowding-out in Turkey and Mauritius respectively. Both studies used two cross-sectional household surveys conducted about five years apart. The first set of surveys was conducted before the tobacco-control interventions and the second set after and the policies were introduced. However, both studies analysed the two cross-sectional surveys separately, unlike our approach in this paper which combines them to form matched "treated" and "untreated" households. Further, Ross et al. (2017) did not address endogeneity concerns about tobacco consumption, whereas San and Chaloupka (2016) used the adult-sex ratio as an instrumental variable. In this paper, we use MDID as an alternative method of addressing endogeneity concerns about both alcohol and tobacco consumption.

Our analysis focused on the crowding-out effects of tobacco and alcohol expenditure, and the effect of control policies on tobacco and alcohol consumption patterns. We found that, between 2005/06 and 2015/16, tobacco-control policies were responsible for a decrease of six percentage points in the proportion of households that consume tobacco. The decrease in the proportion of tobacco-consuming households was driven primarily by a large decrease in the proportion of tobacco-consuming households in the bottom quartile of the household expenditure distribution. Alcohol-control policies, on the other hand, were only effective in reducing alcohol-consumption prevalence among the poorest households. However, an increase of four percentage points in alcohol-consuming households in the top quartile resulted in an increase of one percentage point in overall alcohol consumption prevalence between 2005/6 and 2015/16. There was also an increase of two percentage points in the overall average budget share spent on alcohol over this period. The biggest increase in alcohol spending was on spirits.

The rest of this paper is organised as follows: the background to tobacco and alcohol control policies in Kenya is discussed in section 2, the method used is described in Section 3, the data are described in Section 4, and the results are presented in Section 5 and discussed in Section 6. The final conclusions of the paper are presented in Section 7.

2 Tobacco and Alcohol Control Policies in Kenya

At the turn of the 21^{st} century, tobacco products were freely available for purchase in Kenya and the advertising of tobacco products was extensive and unregulated (ÅSTRØM & Ogwell, 2004). Easy access to tobacco products contributed to increased tobacco prevalence among the youth. For example, tobacco prevalence among school-going children aged 13 to 15 years increased from 7.2% in 2001 to 9.8% in 2007 (Maina et al., 2013). This period was also marked by an increase in alcohol consumption with the average per capita consumption of pure alcohol by individuals over 15 years increasing from 1.3 litres in 2004 to 1.8 litres in 2010 (WHO, 2014, 2018b). Further, over 50% of the alcohol consumed in the country was unrecorded informally-produced alcohol (WHO, 2014, 2018b). Kenya's informally produced alcohol has been found to contain methanol and other hazardous additives such as formalin and battery acid. These hazardous additives have adverse effects on the health of consumers. For instance, in November 2000, over 100 people died, and many went blind from consuming informally produced alcohol (Carey et al., 2015; WHO, 2004).

The adverse effects from alcohol consumption and the increased prevalence of tobacco use, especially among the youth motivated the introduction of new tobacco and alcohol control policies contained in the Tobacco Control Act of 2007 and the Alcoholic Drinks Control Act of 2010.

The Tobacco Control Act of 2007 established a Tobacco Control Board and a Tobacco Control Fund. The Act also banned smoking in public areas including restaurants, hotels, and bars, to limit exposure to second-hand smoke. Further,

the Act banned self-service product displays, the sale of single units, the sale of tobacco products to individuals under the age of 18 years, and advertising and promotional activities. Warning labels with health messages in both English and Kiswahili, Kenya's national language, were required on the packaging of tobacco products.

Most importantly, the Act required that the Minister of Finance put in place measures to adjust excise taxes levied on tobacco products periodically. As a result, the excise tax burden on tobacco products, defined as the percentage of the retail price that is due to the excise tax, increased from 28% in 2006 to 52% in 2018 (WHO, 2008, 2019). The periodic increases in taxes were combined with the increased capacity of the Kenya Revenue Authority (KRA) to limit illicit trade (Ross, 2017).

The Alcoholic Drinks Control Act of 2010 established an Alcoholic Drinks Control Fund that was to be used for, among other things, research and the promotion of national cessation and rehabilitation programs. District Committees were set up to issue licenses for the manufacturing, production, or sale of all alcoholic drinks. Strict licensing hours were introduced for hotels, restaurants, bars, clubs and other retailers allowed to sell alcohol. Further, the Act required that health warnings in both English and Kiswahili appear on all alcoholic products. To protect minors, the sale of alcohol products from vending machines was banned. In addition, alcohol companies were not allowed to run promotional campaigns targeted at persons under the age of 18. The Act also required that the health consequences of alcohol consumption, its addictive nature and the threats that it posed be taught in all schools.

To curb the consumption of informally-produced brews, the Alcoholic Drinks Control Act of 2010 decriminalized the manufacture and sale of all traditional brews. The Act sought to reduce the prevalence of alcohol poisoning by regulating the informal brewing industries. However, most informal brewers continue to brew illegally, because of the stringent standards that were set and the associated costs of meeting those standards (Carey et al., 2015).

3 Method

Conditional Engel curves from the Quadratic Almost Ideal Demand Systems (QUAIDS) have been used to estimate the crowding-out effects of tobacco and alcohol expenditures (John, 2008; San & Chaloupka, 2016; Pu et al., 2008; Jumrani & Birthal, 2017; John et al., 2019). Studies that focus on the difference in household expenditure on food and non-food items between tobacco-(alcohol) and non-tobacco-consuming (non-alcohol-consuming) households have estimated QUAIDS that take the following form (Chelwa & Van Walbeek, 2014; Paraje & Araya, 2017; Ross et al., 2017):

$$w_{ij} = \beta_{1i} + \beta_{2i}\, d_j + \beta_{3i} ln M_j + \beta_{4i} \left(ln M_j\right)^2 + \zeta_i \mathbf{Z}_j + u_{ij} \tag{1}$$

where w_{ij} is the budget share of commodity i for household j in the remaining budget after the expenditure on tobacco (alcohol) is netted out, M_j is the

total expenditure less the expenditure on tobacco (alcohol), d_j is a dummy variable that takes value one if household j consumes tobacco (alcohol) and zero if household j does not consume tobacco (alcohol). u_{ij} is the error term.

$\mathbf{Z_j}$ is a vector of household characteristics. Variables such as educational level of the household head, log of household size, average age of adults, average age of children, proportion of adults to children, number of people employed, religion of the household head, and location (urban or rural) have been included in the vector of household characteristics.

β_{2i} is used to establish whether the expenditure patterns of tobacco- or alcohol-consuming households differ from those of non-consumers. A negative and significant β_{2i} is used to identify the expenditure categories that are crowded out by tobacco or alcohol, *ceteris paribus.* However, since it is unlikely that tobacco or alcohol consumption is randomly assigned across households, instrumental variables such as the adult sex ratio for tobacco, and adult ratio for alcohol, have been used to correct for the possible endogeneity (Pu et al., 2008; Chelwa & Van Walbeek, 2014; San & Chaloupka, 2016).

The instrumental variables that are used may not meet the exclusion restriction because differences in preferences between adult males and adult females and between adults and children may influence household expenditure patterns on goods other than tobacco and alcohol. Chelwa and Koch (2019) used Genetic Matching to match tobacco-consuming and non-tobacco-consuming households, based on observed household characteristics, as a way of addressing concerns about endogeneity.

In this paper, we use Matched Difference in Differences (MDID) to estimate the crowding-out effects of tobacco and alcohol consumption. MDID controls for time-invariant unobservable variables, as well as for macroeconomic variables which are assumed to have the same effect on both treated and non-treated matched households (Heckman et al., 1997; Blundell & Dias, 2009; Stuart et al., 2014).

MDID has similar advantages to Genetic Matching because crowding-out effects are estimated using households with balanced observable characteristics. However, by controlling for time-invariant unobserved variables, MDID has an added advantage over Genetic Matching which only uses observed household characteristics. Further, MDID provides an opportunity to establish the evolution of the crowding-out effects of tobacco or alcohol consumption among matched households. In the rest of this section, we provide an intuitive explanation of our application of MDID followed by a more formal presentation of the MDID estimator. In this paper, we consider both tobacco and alcohol. We treat them separately in the subsequent analysis. To avoid confusion, in the formal explanation that follows we will only discuss tobacco, but the same principle applies to alcohol as well, unless explicitly stated otherwise.

MDID estimation uses data from two time periods, $t_0 \, and \, t_1$, where $t_0 < k < t_1$; k refers to the period when new tobacco control policies were implemented. This results in four categories of households: tobacco-consuming households interviewed in period t_1 (group A), households interviewed in period $t_1$that did not consume tobacco or alcohol (group B), tobacco-consuming households that

were interviewed in period t_0 (group C) and households that did not consume tobacco or alcohol that were interviewed in period t_0 (group D). The categories of households used for estimating the crowding-out effects of tobacco consumption are presented in Table 1.

Let $\mathbf{X}_j$ be the set of observable household characteristics $\mathbf{Z_j}$ and M_j. Kernel matching with the enforcement of common support uses the set of observable variables $\mathbf{X}_j$ to create a counterfactual for households in group A. Household characteristics that are used in this paper include the adult sex ratio, log of household size, level of education of the household head, number of people employed, age of household head, average age of adults, religion of household head, number of children below the age of five, number of children between fifteen and eighteen years old, and geographical location (rural/urban). In addition to the rural/urban geographical variable, county fixed-effects are also included because tastes may vary across different regions and households within each geographical location often face similar relative prices (Deaton, 1987, 1988, 1990, 1997).

Differences in the share of total expenditure on food and non-food items between the matched households are used to determine the crowding-out effects of tobacco expenditure. Specifically, the difference between group C and group D ($w_i^C - w_i^D$) and the difference between group B and group A ($w_i^A - w_i^B$) post-matching are used. If the difference for a given item of expenditure is found to be significantly lower in both periods, that expenditure is considered to be crowded out by tobacco consumption, *ceteris paribus*. Further, the difference in differences $\left(w_i^A - w_i^B\right) - \left(w_i^C - w_i^D\right)$ post-matching is used to estimate the evolution of crowding-out over the two periods. If the difference in differences is negative and significant for a given expenditure item, that expenditure is also considered to have been crowded out by tobacco/alcohol consumption. What follows is a formal presentation of the MDID estimator.

Estimation using matching methods can be done using longitudinal or cross-sectional data. To provide a better understanding, we first discuss a model without a time dimension and subsequently incorporate the time dimension. To identify the average effect on households that were treated (ATT) matching assumes that, conditional on **X,** the unobserved variables are independent of d_j, that is $u_{ij} \perp d_j|\mathbf{X}$. This assumption is known as the Conditional Independence Assumption (CIA) (Blundell & Dias, 2009).

However, a weaker version CIA, $E[\,u_{ij}|d_j, \mathbf{X}] = E[\,u_{ij}|\mathbf{X}]$ is sufficient to estimate the ATT on households using matching based on observable characteristics **X**. A second assumption is that a counterfactual for tobacco-consuming households can be created based on observable household characteristics. Matching is only possible if $\mathbf{X_j}$ does not predict the tobacco consumption status perfectly ($P[d_j = 1|\mathbf{X_j} < 1]$). Based on the two assumptions, the matching ATT estimator can now be defined. Let S represent the subspace of the distribution of **X** that is represented both among tobacco-consuming households and households that do not consume tobacco or alcohol. S is known as the common support of **X**. The ATT over the common support S is:

$$ATT\,(S) = E[w^A - w^B|d = 1, \quad X \quad \epsilon \quad S] \tag{2}$$

The matching estimator is the empirical counterpart of $ATT\,(S)$. It is obtained by averaging over S the difference in outcomes among tobacco-consuming households and households that do not consume tobacco or alcohol with equal household characteristics $\mathbf{X}$, using the empirical weights of the distribution of $\mathbf{X}$ among the treated. Formally, the matching estimator (ME) of the ATT is:

$$ME = \sum_{j\,\epsilon\,T} \left\{ w_{ij} - \sum_{l\,\in\,NC} \tilde{WH}_{ijl} w_{ij} \right\} WH_j \tag{3}$$

where T represents tobacco-consuming households and NC represents households that do not consume tobacco or alcohol. $\tilde{WH}_{ijl}$ is the matching weight placed on comparison household j when constructing the counterfactual for the tobacco-consuming household i. WH_j accounts for the reweighting that reconstructs the outcome distribution for the tobacco-consuming households (Blundell & Dias, 2009).

The extension of the matching model to include a time dimension involves making similar assumptions to those presented above. Both panel data and repeated cross-sectional data have been used for matching estimation with a time dimension (Blundell et al., 2004; Blundell & Dias, 2009; Gebel & Voßemer, 2014; Ryan et al., 2019; Deryugina et al., 2020). The CIA is modified to $\left(u_{ij_{t1}} - u_{ij_{t0}}\right) \perp d_{jt_1} | \mathbf{X}$, which means that conditional on $\mathbf{X}$ the evolution of the unobserved variables is independent of d_j. Further, for repeated cross-sectional data, the common support hypothesis needs to be strengthened to ensure households in group A can be reproduced in the other three control groups. As noted earlier, matching is only possible if $\mathbf{X_j}$ does not predict the tobacco consumption status perfectly $(P[d_j = 1|\mathbf{X_j} < 1])$. Based on these assumptions, the matching difference-in-differences estimator (MDIDE) for repeated cross-section data is given by:

$$MDIDE = \sum_{j\,\epsilon\,A} \left\{ \left[w_{ijt_1} - \sum_{l\,\in\,C} \tilde{WH}_{jlt_0} w_{ijt_0} \right] - \left[\sum_{l\,\in\,B} \tilde{WH}_{jlt_1} w_{ijt_1} - \sum_{l\,\in\,D} \tilde{WH}_{jlt_0} w_{ijt_0} \right] \right\} WH_j \tag{E4}$$

where $\tilde{WH}_{jlt_0}$ represents the matching weight attributed to household l interviewed at time t_0 when creating the counterfactual for household j that consumed tobacco. WH_j accounts for reweighting that reconstructs the outcome distribution for the tobacco-consuming households in group A. Further details on MDID estimation and large sample properties of matching estimators are contained in Blundell et al. (2004), Abadie and Imbens (2006) and Blundell & Dias (2009).

4 Data

The data for the study were obtained from the two most recent Kenya Integrated Household and Budget Surveys (KIHBSs). These data are publicly available from the Kenya National Bureau of Statistics Website (http://statistics.knbs.or.ke/nada/index.php/home).

The two surveys were carried out by the Kenya National Bureau of Statistics (KNBS) in 2005-2006 and 2015-2016. The surveys were undertaken to collect socioeconomic indicators that are used to analyse changes in living standards in Kenyan households. Data from the surveys were also used to update the system of national accounts and the Consumer Price Index (CPI).

Both datasets consisted of stratified samples selected in two stages. In 2005-2006, stratification was done by district and by whether a household was urban or rural, while in 2015-2016 stratification was done by county and by whether urban or rural. In the first stage, clusters were selected with equal probability from each stratum, while in the second stage ten households were selected with equal probability from each cluster.

There were 69 districts in 2005-2006 and 47 counties in 2015-2016. Counties were created after the promulgation of a new constitution in 2010. Of the 69 districts that existed in 2005-2006, 27 became counties. 18 counties contained two districts each and two counties had three districts each. Consequently, the geographical boundaries of 27 districts were the same as the geographical boundaries of 27 counties. On the other hand, the geographical boundaries of 18 counties were created by combining the geographical boundaries of two neighbouring districts and the geographical boundaries of two counties were created by combining the geographical boundaries of three neighbouring districts.

For the MDID analysis, we used county fixed-effects to account for the possible differences in expenditure patterns across regions. The 69 districts from 2005-2006 were grouped into the 47 counties that were used in 2015-2016. After the grouping of the 2005-2006 districts into counties, the geographical boundaries in both datasets were the same. Both datasets were collected over a 12-month period (May 2005 to April 2006 and September 2015 to August 2016). We used the monthly CPI to adjust the expenditures to February 2009 prices.

The 2005-2006 KIHBS covered a total of 1,343 clusters, while the 2015-2016 survey covered 2,400 clusters. The survey included 13,158 households in 2005-2006 and 21,773 households in 2015-2016. The increase in the sample size between the two surveys was in line with Kenya's population growth. Kenya conducted population censuses in 1999, 2009 and 2019. The results from the 1999 census indicated that the population was 28.7 million individuals and 6.4 million households, while the 2009 census reported a population of 38.6 million individuals and 8.8 million households. The number of sampled households in the 2005-2006 and 2015-2016 rounds of the KIHBS was about 0.2% of the number of households reported in the 1999 and 2009 censuses.

Details of household consumption and expenditure on food items, regular non-food items, and durables were collected using similar questionnaires for both surveys (questionnaires are publicly available from the Kenya National Bureau of Statistics Website at: http://statistics.knbs.or.ke/nada/index.php/catalog/88 and http://statistics.knbs.or.ke/nada/index.php/catalog/8). A summary of the household characteristics and household budget shares from the two surveys is presented in Table 2 and Table 3. The final survey weights were used to generate the descriptive statistics of household characteristics, household budget shares and subsequent statistics presented in this paper. KNBS adjusted the design

weights using the survey response rates when generating the final survey weights. We split the samples into tobacco-consuming households, alcohol-consuming households, households that did not consume tobacco or alcohol and households that consumed both tobacco and alcohol.

The proportion of tobacco/alcohol-consuming households and budget shares allocated to tobacco/alcohol by quartile are presented in Table A 1 to Table A 4 in the appendix. Classification by quartile was based on real *per capita* household expenditures. The proportion of tobacco-consuming households decreased from 16% in 2005-2006 to 11% in 2015-2016. The largest decrease in tobacco-consuming households occurred in the bottom quartile. Over the same period, the overall proportion of alcohol-consuming households increased slightly from 13% to 14.7%. However, the proportion of alcohol-consuming households decreased by 1.4 percentage points in the bottom quartile.

There was a decrease in both monthly tobacco expenditure and tobacco budget shares. The tobacco budget share among households that consumed tobacco decreased from 3.9% to 3.4%. Among alcohol-consuming households, the alcohol budget share increased from 9% to 11%. The combined budget share spent on tobacco and alcohol increased in households that consumed both of these products.

5 Results

The difference in percentage points of the weighted mean expenditure shares on food and non-food items between households that consumed tobacco/alcohol and those that did not consume tobacco or alcohol is presented in Table 4. Tobacco-consuming households had consistently and significantly lower expenditures on education, rent, milk, and eggs. Alcohol-consuming households spent less on energy, water, transport, rent, communication, and bananas and tubers. However, the difference in expenditure shares could have been due to differences in household characteristics between tobacco/alcohol-consuming households and households that did not consume tobacco or alcohol.

The main results for the effect of tobacco expenditures on household expenditure patterns are presented in Table 5. Kernel matching with enforcement of common support was used to match tobacco-consuming households that were surveyed in 2015-2016 to similar households in the other three categories. The balanced t-tests for post-matching household characteristics are presented in Table A 5. The p-values from the t-tests indicated that, after matching, all the household characteristics for households that consumed tobacco and those that did not consume tobacco or alcohol were balanced.

After limiting the sample to a pseudo-panel with matched household characteristics, we found that tobacco-consuming households consistently spent less on some food items, such as milk and eggs, as well as on non-food items such as education, transport, and communication.

There was a 0.4 percentage point decrease in the tobacco budget share and a 1.3 percentage point increase in the alcohol budget share among tobacco-

consuming households. The net result was a 0.7 percentage point increase in the combined tobacco and alcohol budget shares. An increase in the budget share of alcohol among tobacco-consuming households contributed to the crowding-out of expenditures on some food items, such as vegetables, bread, and cereals.

For comparability with previous studies, Table A 7 presents MDID results after matching tobacco-consuming households to households that did not consume tobacco. The results from matching tobacco-consuming households and households that did not consume tobacco confirmed that expenditures on education, communication, and food items such as milk, eggs, vegetables, bread and cereals were crowded out. Further, tobacco expenditure crowded *in* expenditure on alcohol.

Alcohol-consuming households were also compared to matched households that did not consume tobacco or alcohol. The balanced t-tests for post-matching household characteristics are presented in Table A 6 The p-values from the t-tests indicated that after matching, all the household characteristics for households that consumed alcohol and those that did not consume tobacco or alcohol were balanced. The MDID results for alcohol-consuming households are presented in Table 6.

The combined budget share for tobacco and alcohol increased by 1.6 percentage points among alcohol-consuming households. This increase in expenditure on alcohol contributed to the crowding-out of expenditures on bread and cereals, as well as on other non-food items that were not considered in this paper. Alcohol-consuming households consistently spent less on transport. Lower expenditure on transport was confirmed when alcohol-consuming households were matched to households that did not consume alcohol (for results see Table A 8).

6 Discussion

Kenya implemented major tobacco-control measures between 2006 and 2015. The Tobacco Control Act passed into law in September 2007. The provisions of the Act, such as a ban on smoking in public areas, health warnings on cigarette packets, and a ban on tobacco promotion and advertising, were successfully implemented (Mohamed et al., 2018). Consequently, Kenya had one of the highest implementation rates of the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) articles in Africa (Husain et al., 2016).

The successful implementation of tobacco-control measures contributed to a decrease in the prevalence of tobacco consumption. The proportion of tobacco-consuming households decreased from 16% to 11%. The tobacco-control measures were most effective in reducing the proportion of tobacco-consuming households in the bottom quartile. Other studies have found that the implementation of tobacco-control policies contributed to a decrease in tobacco-consumption prevalence in Turkey (San & Chaloupka, 2016) and Mauritius (Ross et al., 2017).

Tobacco-control policies have been found to have little impact on household spending on tobacco products for households that continue smoking in countries such as Turkey and Mauritius (Ross et al., 2017; San & Chaloupka, 2016). This

was also the case in Kenya where tobacco-control policies contributed to a small decrease in the tobacco budget share among tobacco-consuming households. Therefore, the impact of tobacco-control policies on the opportunity cost associated with tobacco spending is mainly through a reduction in the prevalence of tobacco use, especially among households in the bottom quartile.

The proportion of alcohol-consuming households in the bottom quartile also declined by one percentage point. However, alcohol control policies implemented between 2006 and 2015 were not effective at reducing the overall prevalence of alcohol consuming households. The overall proportion of alcohol-consuming households increased by 1.5 percentage points, with the largest increase occurring among households in the top quartile. An increased prevalence of consumption of spirits was the main driver of the growth in the proportion of alcohol-consuming households in the top two quartiles. Other studies have pointed out that the effort to reduce alcohol consumption in Kenya through policies contained in the Alcohol Control Act of 2010 have not been successful (Muturi, 2014; Mkuu et al., 2019).

The increase in the consumption of spirits was also reflected in the increased budget share of spirits among alcohol-consuming households. The average budget share of spirits among households that consumed alcohol increased by 3 percentage points. Data from the Kenya National Bureau of Statistics (KNBS) also indicated that the real excise revenues from wines and spirits increased by 9% annually between 2009 and 2014, which corresponds with the findings of this study.

Expenditure on tobacco (alcohol) was found to crowd *in* expenditure on alcohol (tobacco) in Kenya. This finding is similar to the results of other studies in China, Turkey, India and South Africa (Wang et al., 2006; Önder & Yürekli, 2014; Jumrani & Birthal, 2017; Chelwa & Koch, 2019).

The results presented in the previous section show that spending on transport, was crowded-out in alcohol consuming households, while tobacco consuming households had lower expenditures on non-food items, such as education, and communication, and some food items, such as milk, eggs, bread, and cereals.

More food items were crowded out in tobacco-consuming households than in alcohol-consuming households. Tobacco-consuming households were relatively poorer. Some previous studies have found that less well-off tobacco-consuming households were more likely to forgo spending on food items in favour of tobacco/alcohol consumption (John, 2008; Koch & Tshiswaka-Kashalala, 2008; Jumrani & Birthal, 2017; Chelwa & Koch, 2019). The tendency of tobacco-consuming households to have lower expenditures on education has also been found in Zambia and Chile (Chelwa & Van Walbeek, 2014; Paraje & Araya, 2017), while lower expenditure on communication has also been found in South Africa (Chelwa & Koch, 2019).

A limitation of our study is that since tobacco- and alcohol-control policies were implemented in the entire country, and there was a ten-year gap between the two cross-sectional surveys, some of the households that did not consume tobacco or alcohol before the control policies were implemented may have consumed tobacco or alcohol in the subsequent survey, and vice versa. Further,

there is a possibility that implementation of tobacco and alcohol control policies may have changed the willingness to admit purchase of tobacco and alcohol products by some households. Consequently, panel data may provide better estimates of the impact of the control policies discussed in this paper. Unfortunately, Kenya does not currently collect panel data.

7 Conclusion

This study set out to estimate the effect of tobacco/alcohol-control policies on tobacco/alcohol consumption patterns and the effect of tobacco/alcohol consumption on other household expenditure in Kenya. The analysis was done using the two most recent nationally representative surveys, carried out in 2005-2006 and 2015-2016 by the Kenya National Bureau of Statistics.

A Matched Difference in Differences (MDID) technique was used to estimate the effect of tobacco and alcohol consumption on household spending patterns. MDID was used as a new way of controlling for endogeneity associated with the inclusion of the tobacco/alcohol consumption status of households in a system of demand equations. MDID is similar to genetic matching because it involves matching households based on household characteristics. However, in addition to controlling for time-invariant unobservable variables, MDID has the advantage of estimating the crowding-out effects of tobacco/alcohol consumption over time.

Our analysis found that alcohol/tobacco expenditures crowded-out expenditures on some food items such as vegetables, bread, cereals, milk and eggs as well as non-food items such as education, transport and communication. The expenditures that are crowded out in tobacco- and alcohol-consuming households such as education and food items are important for human capital development. Consequently tobacco- and alcohol-control policies, that result in reduced demand for these products are likely to increase household expenditure on human capital development in the long run.

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Table 1 Categories of households used for Matched Difference in Differences estimation

	Household consumed tobacco	Household did not consume tobacco or alcohol
Period t_0	Group C	Group D
Period t_1	Group A	Group B

Notes: The table shows the categories of households used for Matched Difference in Differences estimation of the crowding-out effects of household tobacco expenditure. A similar table can also be constructed for alcohol expenditure.

Table 2 Descriptive statistics from the 2005-2006 and 2015-2016 Kenya Integrated Household Budget Survey (KIHBS)

	2005-2006 KIHBS						2015-2016 KIHBS				
		Consumed						Consumed			
Statistic	Full Sample	Tobacco	Alcohol	Neither	Both		Full Sample	Tobacco	Alcohol	Neither	Both
Number of households	13,158	2,237	1,804	9, 923	806		21,773	2,551	3,083	17,204	1,065
Percentage of tobacco-consuming households	16.37%	100%	45.94%	0.00%	100%		10.68%	100%	32.18%	0.00%	100%
	(0.605)		(1.754)				(0.352)		(1.281)		
Percentage of alcohol-consuming households	13.25%	37.18%	100%	0.00%	100%		14.73%	44.38%	100%	0.00%	100%
	(0.486)	(1.513)					(0.436)	(1.577)			
Percentage of households in Rural areas	74.51%	81.72%	76.40%	73.31%	82.91%		56.44%	67.15%	56.61%	55.57%	66.57
	(1.706)	(2.023)	(2.010)	(1.822)	(2.282)		(1.538)	(2.021)	(2.145)	(1.598)	(2.743)
Percentage of households in Urban areas	25.49%	18.28%	23.60%	26.69%	17.09%		43.56%	32.85%	43.39%	44.43%	33.43%
	(1.706)	(2.023)	(2.010)	(1.822)	(2.282)		(1.538)	(2,021)	(2.145)	(1.598)	(2.743)
Average real monthly tobacco expenditure Ksh.	77.59	474.05	244.39	0.00	531.99		43.51	407.33	137.66	0.00	427.78
	(5.461)	(29.476)	(20.824)		(41.473)		(2.108)	(14.879)	(8.974)		(21.218)
Average real monthly alcohol expenditure Ksh.	200.52	547.25	1,513.73	0.00	1,471.97		270.32	726.17	1,835	0.00	1,636.42
	(12.209)	(44.974)	(78.651)		(104.750)		(14.589)	(56.83)	(76.03)		(109.203)
Average real monthly alcohol & tobacco expenditure Ksh.	278.11	1,021.30	1,758.11	0.00	2,003.96		313.83	1133.50	1,972.79	0.00	2,064.20
	(12.582)	(59.956)	(86.991)		(128.515)		(15.039)	(61.030)	(76.471)		(114.679)
Average real monthly per capita expenditure Ksh.	4,488	3,937.94	6,332.43	4,320.50	4,919.39		5,903.70	5,975.25	8,096.95	5,559.88	7,126.67
	(156.62)	(229.070)	(478.873)	(144.24)	(499.065)		(151.41)	(305.25)	(433.30)	(140.18)	(621.464)
Average household size	5.09	5.17	5.15	5.08	5.33		3.97	3.98	3.81	4.00	3.90
	(0.054)	(0.106)	(0.100)	(0.057)	(0.150)		(0.036)	(0.074)	(0.073)	(0.038)	(0.108)
Percentage of adults in household	58.50%	61.25%	61.24%	57.70%	61.78%		63.38%	68.43%	69.67%	61.92%	69.95%
	(0.438)	(0.802)	(0.889)	(0.484)	(1.241)		(0.430)	(0.842)	(0.846)	(0.455)	(1.276)
Percentage of male adults	46.81%	53.72%	55.10%	44.65%	56.35%		46.93%	62.58%	59.87%	43.64%	65.14%
	(0.402)	(0.755)	(0.815)	(0.454)	(1.188)		(0.383)	(0.932)	(0.905)	(0.426)	(1.264)
Average age of children in household	8.47	8.53	8.77	8.44	8.91		8.13	8.54	8.27	8.09	8.64
	(0.060)	(0.125)	(0.142)	(0.068)	(0.183)		(0.060)	(0.125)	(0.120)	(0.654)	(0.190)
Average age of adults in household	36.94	39.49	37.61	36.44	38.86		37.71	41.86	37.93	37.28	40.47
	(0.195)	(0.404)	(0.395)	(0.206)	(0.542)		(0.191)	(0.360)	(0.313)	(0.210)	(0.453)
Average number of employed	1.17	1.24	1.12	1.16	1.32		1.58	1.76	1.73	1.54	1.84
	(0.018)	(0.036)	(0.037)	(0.019)	(0.056)		(0.013)	(0.032)	(0.027)	(0.014)	(0.048)
Average age of household head	44.85	47.66	45.66	44.32	47.60		43.23	48.20	43.54	42.71	46.74
	(0.283)	(0.514)	(0.540)	(0.302)	(0.711)		(0.251)	(0.437)	(0.412)	(0.276)	(0.577)
Percentage of households where household head has at least a primary school certificate	68.25%	59.21%	64.70%	69.80%	57.72%		73.45%	59.19%	68.99%	75.13%	57.29
	(0.861)	(1.922)	(1.810)	(0.918)	(2.762)		(0.665)	(1.692)	(1.366)	(0.687)	(2.520)

Notes: Ksh refers to Kenya shillings. Expenditures were adjusted to February 2009 CPI (consumer price index). Total household expenditure refers to the sum of household expenditure on the food and non-food items considered in this paper. Percentage of male adults calculated as the total number of male adults/total number of adults. Survey weights were used to generate these statistics. The total number of households equals tobacco consumers plus alcohol consumers plus households did not consume tobacco or alcohol minus households that consumed both tobacco and alcohol. Clustered standard errors are in brackets.

Table 3 Household Budget shares from the 2005-2006 and 2015-2016 Kenya Integrated Household Budget Surveys

	2005-2006 KIHBS						2015-2016 KIHBS				
		Consumed						Consumed			
AVERAGE BUDGET SHARES	**Full Sample**	**Tobacco**	**Alcohol**	**Neither**	**Both**		**Full Sample**	**Tobacco**	**Alcohol**	**Neither**	**Both**
Number of households	13,158	2,237	1,804	9, 923	806		23,773	2,551	3,083	17,204	1,065
Tobacco	0.63%	3.87%	1.66%	0.00%	3.61%		0.36%	3.35%	1.05%	0.00%	3.27%
	(0.034)	(0.157)	(0.105)		(0.196)		(0.016)	(0.109)	(0.065)		(0.155)
Alcohol	1.16%	3.52%	8.76%	0.00%	9.46%		1.65%	4.85%	11.20%	0.00%	10.92%
	(0.057)	(0.230)	(0.302)		(0.487)		(0.065)	(0.290)	(0.312)		(0.510)
Alcohol plus tobacco	*1.79%*	*7.38%*	*10.41%*	*0.00%*	*13.07%*		*2.01%*	*8.20%*	*12.25%*	*0.00%*	*14.18%*
	(0.073)	(0.287)	(0.347)		(0.575)		(0.074)	(0.322)	(0.321)		(0.559)
Education	4.68%	2.98%	3.90%	5.06%	3.27%		5.49%	4.88%	5.25%	5.58%	4.88%
	(0.120)	(0.171)	(0.218)	(0.137)	(0.289)		(0.114)	(0.263)	(0.240)	(0.123)	(0.369)
Energy (electricity/gas/ fuels/ heat)	4.73%	3.82%	3.72%	4.99%	3.27%		6.42%	6.65%	5.55%	6.52%	5.85%
	(0.087)	(0.114)	(0.119)	(0.099)	(0.124)		(0.104)	(0.202)	(0.159)	(0.114)	(0.261)
Bread and cereals	14.54%	16.74%	13.60%	14.28%	15.11%		16.51%	15.81%	13.49%	16.99%	13.60%
	(0.275)	(0.461)	(0.445)	(0.284)	(0.603)		(0.186)	(0.342)	(0.264)	(0.201)	(0.421)
Banana and tubers	3.96%	3.88%	3.26%	4.05%	3.25%		2.11%	1.96%	1.73%	2.19%	1.81%
	(0.134)	(0.215)	(0.197)	(0.141)	(0.239)		(0.050)	(0.100)	(0.073)	(0.055)	(0.138)
Meats	4.09%	4.41%	4.45%	3.96%	4.09%		4.74%	4.62%	5.22%	4.66%	4.70%
	(0.105)	(0.273)	(0.207)	(0.103)	(0.261)		(0.082)	(0.226)	(0.178)	(0.089)	(0.275)
Fish and sea food	1.31%	1.18%	1.28%	1.33%	1.11%		1.40%	1.09%	1.45%	1.42%	1.16%
	(0.064)	(0.101)	(0.101)	(0.069)	(0.134)		(0.053)	(0.103)	(0.086)	(0.056)	(0.116)
Milk and eggs	6.67%	6.33%	6.04%	6.80%	5.96%		6.74%	5.24%	5.27%	7.09%	4.74%
	(0.120)	(0.289)	(0.222)	(0.122)	(0.310)		(0.090)	(0.175)	(0.125)	(0.102)	(0.203)
Fruits	2.69%	2.68%	2.56%	2.72%	2.69%		2.78%	2.70%	2.55%	2.82%	2.59%
	(0.070)	(0.134)	(0.133)	(0.075)	(0.206)		(0.051)	(0.118)	(0.088)	(0.054)	(0.155)
Vegetables	5.68%	5.59%	5.62%	5.69%	5.41%		4.97%	4.31%	4.30%	5.13%	4.07%
	(0.098)	(0.174)	(0.180)	(0.104)	(0.234)		(0.057)	(0.119)	(0.097)	(0.062)	(0.138)
Restaurant food	1.87%	2.29%	2.23%	1.74%	2.17%		1.88%	2.01%	2.54%	1.77%	2.33%
	(0.113)	(0.253)	(0.183)	(0.114)	(0.301)		(0.126)	(0.187)	(0.199)	(0.146)	(0.275)
Other foods	17.58%	17.97%	15.92%	17.71%	16.66%		7.80%	6.99%	6.90%	8.00%	6.62%
	(0.209)	(0.327)	(0.326)	(0.228)	(0.491)		(0.091)	(0.167)	(0.160)	(0.100)	(0.258)
Healthcare	0.75%	0.78%	0.61%	0.76%	0.68%		1.79%	1.87%	1.81%	1.79%	1.92%
	(0.025)	(0.079)	(0.043)	(0.026)	(0.076)		(0.051)	(0.136)	(0.136)	(0.055)	(0.231)
Clothing and footwear	6.99%	6.31%	6.70%	7.12%	6.85%		4.04%	3.88%	3.69%	4.10%	3.76%
	(0.170)	(0.282)	(0.313)	(0.186)	(0.404)		(0.064)	(0.127)	(0.119)	(0.072)	(0.192)
Water	0.82%	0.84%	0.70%	0.83%	0.64%		0.80%	0.81%	0.65%	0.82%	0.73%
	(0.049)	(0.088)	(0.087)	(0.051)	(0.094)		(0.032)	(0.060)	(0.055)	(0.035)	(0.075)
Transport	3.59%	2.92%	3.09%	3.73%	2.48%		5.03%	4.82%	4.57%	5.17%	4.65%
	(0.108)	(0.171)	(0.175)	(0.119)	(0.196)		(0.109)	(0.223)	(0.190)	(0.122)	(0.334)
Furnishings & maintenance to dwelling	3.13%	2.94%	2.68%	3.21%	2.65%		0.90%	0.89%	0.75%	0.91%	0.66%
	(0.063)	(0.141)	(0.104)	(0.074)	(0.141)		(0.024)	(0.055)	(0.040)	(0.028)	(0.052)
Rent	2.22%	1.12%	1.68%	2.44%	0.77%		3.75%	2.70%	2.94%	3.96%	2.33%
	(0.195)	(0.176)	(0.207)	(0.220)	(0.147)		(0.195)	(0.30)	(0.201)	(0.218)	(0.234)
Communication	1.41%	0.80%	1.17%	1.53%	0.74%		4.38%	4.06%	4.04%	4.48%	4.13%
	(0.059)	(0.078)	(0.091)	(0.066)	(0.088)		(0.073)	(0.247)	(0.191)	(0.071)	(0.508)
Other expenditures	11.37%	8.37%	11.12%	11.30%	8.66%		16.47%	16.51%	15.03%	16.66%	15.28%
	(0.156)	(0.264)	(0.338)	(0.173)	(0.459)		(0.173)	(0.435)	(0.379)	(0.185)	(0.704)

Notes: These are the average budget shares for the different food and non-food household expenditures. Survey weights were used to generate these budget shares. The data used were from the 2005-2006 and 2015-2016 Kenya Integrated Household and Budget Surveys (KIHBS). The total number of households equals tobacco consumers plus alcohol consumers plus households that did not consume tobacco or alcohol minus households that consumed both tobacco and alcohol. Clustered standard errors are in brackets. Rent expenditure refers to the actual rent paid.

Table 4 Differences in weighted mean expenditure shares between households that consumed Tobacco (Alcohol) and those that did not consume Tobacco and alcohol

	2005/2006			2015/2016	
Commodity	**Tobacco**	**Alcohol**		**Tobacco**	**Alcohol**
Tobacco	3.87***	1.66***		3.35***	1.05***
Alcohol	3.52***	8.75***		4.85***	11.20***
Tobacco plus alcohol	7.38***	10.41***		8.20***	12.25***
Education	-2.09***	-1.16***		-0.70***	-0.33
Energy	-1.17***	-1.26***		0.13	-0.97***
Bread and cereals	2.46***	-0.68*		-1.18***	-3.50***
Banana and tubers	-0.16	-0.78***		-0.22**	-0.45***
Meats	0.45**	0.49***		-0.04	0.56**
Fish and sea food	-0.15*	-0.05		-0.32***	0.04
Milk and eggs	-0.46**	-0.76***		-1.86***	-1.82***
Fruits	-0.04	-0.16		-0.12	-0.27***
Vegetables	-0.10	-0.08		-0.82***	-0.84***
Restaurant food	0.55**	0.49***		0.24	0.77***
Other foods	0.26	-1.74***		-1.01***	-1.10***
Health	0.02	-0.15***		0.08	0.03
Clothing & footwear	-0.82***	0.13		0.22	-0.41***
Water	0.01	-0.13**		-0.13	-0.17***
Transport	-0.81***	-0.64***		-0.30	-0.55***
Furnishings	-0.27**	-0.53***		-0.02	-0.16***
Rent	-1.32***	-0.76***		-1.25***	-1.01***
Communication	-0.73***	-0.36***		-0.41*	-0.43**
Other non-food expenditures	-2.93***	-1.83***		-0.14	-1.62***

The coefficients are the differences in the weighted mean expenditure shares expressed as percentage points. Survey weights were used to generate these coefficients. A positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco and alcohol. *p<0.1, **p<0.05, ***p<0.01.

Table 5 Matched difference in differences results for Tobacco and non-tobacco/alcohol-consuming households

	2005/2006				2015/2016				
	Tobacco consumption				Tobacco consumption				
	Consumers	Non-consumers	Difference		Consumers	Non-consumers	Difference		Difference in Differences
Commodity									
Tobacco	4.110	0.000	4.110***		3.586	0.000	3.586***		-0.424***
			(0.142)				(0.098)		(0.172)
Alcohol	4.285	0.000	4.285***		5.537	0.000	5.537***		1.252***
			(0.248)				(0.238)		(0.344)
Alcohol & tobacco	8.176	0.000	8.176***		8.884	0.000	8.884***		0.708*
			(0.282)				(0.254)		(0.380)
Education	3.209	4.500	-1.291***		5.024	5.627	-0.603**		0.688**
			(0.218)				(0.252)		(0.333)
Energy	4.438	5.082	-0.644***		3.815	3.790	0.025		0.669***
			(0.135)				(0.158)		(0.207)
Bread & cereals	14.439	13.862	0.577		16.621	17.512	-0.892***		-1.468***
			(0.399)				(0.314)		(0.508)
Banana & tubers	3.635	3.481	0.154		2.209	2.376	-0.167		-0.321
			(0.203)				(0.095)		(0.224)
Meats	4.094	4.120	-0.026		4.582	4.784	-0.201		-0.175
			(0.190)				(0.225)		(0.295)
Fish and sea food	1.227	1.074	0.153		1.297	1.277	0.021		-0.133
			(0.096)				(0.100)		(0.139)
Milk and eggs	5.923	6.527	-0.604***		5.300	6.428	-1.128***		-0.523**
			(0.190)				(0.155)		(0.245)
Fruits	2.797	2.793	0.004		3.015	3.014	0.001		-0.003
			(0.136)				(0.123)		(0.183)
Vegetables	5.299	5.143	0.156		4.559	4.751	-0.192*		-0.348**
			(0.139)				(0.105)		(0.174)
Restaurant food	3.003	2.834	0.168		2.330	2.248	0.081		-0.087
			(0.281)				(0.200)		(0.345)
Other foods	18.053	17.513	0.540		7.399	7.582	-0.183		-0.723*
			(0.338)				(0.165)		(0.376)
Healthcare	0.754	0.739	0.015		1.918	1.959	-0.041		-0.057
			(0.056)				(0.146)		(0.157)
Clothing/footwear	7.227	7.487	-0.260		4.167	4.219	-0.052		0.208
			(0.311)				(0.148)		(0.344)
Water	0.904	0.957	-0.053		0.822	0.846	-0.025		0.028
			(0.072)				(0.062)		(0.095)
Transport	3.270	3.900	-0.630***		4.850	5.279	-0.429**		0.201
			(0.178)				(0.217)		(0.281)
Furnishings	3.232	3.193	0.039		0.901	0.960	-0.058		-0.098
			(0.171)				(0.061)		(0.181)
Rent	1.902	2.547	-0.645***		2.438	2.737	-0.299*		0.347
			(0.183)				(0.162)		(0.244)
Communication	1.135	1.620	-0.484***		3.916	4.290	-0.373***		0.111
			(0.099)				(0.127)		(0.161)
Other expenditures	9.926	11.238	-1.312***		15.862	17.569	-1.707***		-0.349
			(0.311)				(0.374)		(0.486)
Sample size	**1,380**	**7,541**			**1,862**	**13,545**			**24,328**

Notes: These are the matched difference in differences estimation results that compared households that consumed tobacco and those that did not consume alcohol/tobacco. Data used was from two nationally representative samples surveyed in 2005/6 and 2015/16. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Clustered standard errors are in brackets.

Table 6 Matched difference in differences results for alcohol and non-tobacco/alcohol consuming households

	2005/2006				2015/2016				
	Alcohol consumption				Alcohol consumption				
	Consumers	Non-consumers	Difference		Consumers	Non-consumers	Difference		Difference in Differences
Commodity									
Tobacco	1.854	0.000	1.854***		1.315	0.000	1.315***		-0.539***
			(0.111)				(0.069)		(0.131)
Alcohol	9.154	0.000	9.154***		11.227	0.000	11.227***		2.072***
			(0.281)				(0.235)		(0.366)
Alcohol & tobacco	10.744	0.000	10.744***		12.328	0.000	12.328***		1.584***
			(0.381)				(0.248)		(0.403)
Education	4.153	5.186	-1.032***		5.694	5.952	-0.258		0.774**
			(0.235)				(0.223)		(0.325)
Energy	4.419	5.149	-0.731***		3.770	3.816	-0.045		0.685***
			(0.135)				(0.115)		(0.177)
Bread & cereals	11.994	11.767	0.227		15.815	16.504	-0.689***		-0.917**
			(0.357)			(0.252)	(0.252)		(0.437)
Banana & tubers	3.257	3.230	0.027		2.029	2.113	-0.084		-0.111
			(0.178)				(0.070)		(0.191)
Meats	4.945	4.152	0.793***		5.529	4.838	0.691***		-0.102
			(0.191)				(0.164)		(0.251)
Fish and sea food	1.394	1.244	0.150		1.695	1.517	0.179**		0.029
			(0.108)				(0.084)		(0.136)
Milk and eggs	5.937	6.229	-0.292		5.976	6.693	-0.717***		-0.425*
			(0.188)				(0.138)		(0.233)
Fruits	2.674	2.619	0.055		2.936	2.861	0.074		0.019
			(0.130)				(0.093)		(0.159)
Vegetables	5.397	5.100	0.297**		4.880	4.879	0.001		-0.297*
			(0.144)				(0.97)		(0.173)
Restaurant food	3.441	2.870	0.571**		3.129	2.216	0.913***		0.343
			(0.270)				(0.174)		(0.321)
Other foods	16.568	15.621	0.947***		7.674	7.586	0.088		-0.859**
			(0.308)				(0.148)		(0.342)
Healthcare	0.614	0.720	-0.105**		1.930	1.877	0.053		0.158
			(0.043)				(0.125)		(0.113)
Clothing/footwear	8.263	7.944	0.319		4.380	4.271	0.108		-0.211
			(0.355)				(0.123)		(0.356)
Water	0.820	0.842	-0.022		0.696	0.789	-0.093*		-0.071
			(0.065)				(0.049)		(0.081)
Transport	3.752	4.625	-0.873***		4.846	5.306	-0.460**		0.413
			(0.214)				(0.180)		(0.280)
Furnishings	3.199	3.242	-0.043		0.864	0.949	-0.085		-0.042
			(0.156)				(0.048)		(0.163)
Rent	2.942	3.347	-0.405*		2.854	3.189	-0.335**		0.069
			(0.236)				(0.152)		(0.281)
Communication	1.859	2.061	-0.202		4.299	4.465	-0.166		0.035
			(0.128)				(0.119)		(0.175)
Other expenditures	11.201	12.414	-1.214***		15.036	17.524	-2.488***		-1.274***
			(0.350)				(0.295)		(0.458)
Sample size	**1,384**	**7,461**			**2,640**	**13,465**			**24,950**

Notes: These are the matched difference in differences estimation results that compared households that consumed tobacco and those that did not consume alcohol/tobacco. Data used was from two nationally representative samples surveyed in 2005/6 and 2015/16. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Clustered standard errors are in brackets.

Appendix

Table A 1 Share of tobacco and alcohol consuming households in each quartile (2005-2006 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco/Snuff		Alcohol	Traditional brews	Beers	Spirits
Quartile 4	13.22%	12.23%	1.16%		16.09%	4.03%	11.10%	3.00%
	(1.093)	(1.078)	(0.234)		(0.967)	(0.494)	(0.819)	(0.431)
Quartile 3	15.86%	11.94%	3.96%		13.12%	8.68%	4.20%	0.94%
	(1.017)	(0.895)	(0.480)		(0.835)	(0.673)	(0.500)	(0.249)
Quartile 2	16.06%	9.36%	6.85%		11.33%	10.09%	1.09%	0.33%
	(0.873)	(0.670)	(0.563)		(0.705)	(0.697)	(0.295)	(0.126)
Quartile 1	20.21%	7.28%	10.48%		12.78%	12.19%	0.37%	0.16%
	(1.132)	(0.638)	(0.881)		(0.858)	(0.854)	(0.129	(0.078)
Full Sample	16.37%	10.19%	5.67%		13.25%	8.84%	4.02%	1.08%
	(0.605)	(0.461)	(0.395)		(0.486)	(0.440)	(0.403)	(0.131)
Sample Size	**2,237**	**1,253**	**872**		**1,804**	**1,172**	**568**	**170**

Notes: These statistics were generated from the 2005-2006 Kenya Integrated Household and Budget Surveys (KIHBS). They are the shares of households that consumed tobacco/alcohol products. Survey weights were used to generate the shares. The quartile classification is based on *per capita* household expenditures. Quartile 1 represents the bottom 25 percent. Clustered standard errors are in brackets.

Table A 2 Share of tobacco and alcohol consuming households in each quartile (2015-2016 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco/Snuff		Alcohol	Traditional brews	Beers	Spirits
Quartile 4	11.02%	9.23%	2.01%		20.78%	5.22%	10.73%	6.87%
	(0.627)	(0.587)	(0.221)		(0.908)	(0.450)	(0.672)	(0.583)
Quartile 3	11.05%	8.62%	2.53%		12.63%	5.72%	5.43%	2.43%
	(0.660)	(0.575)	(0.321)		(0.653)	(0.438)	(0.439)	(0.284)
Quartile 2	10.44%	7.27%	3.48%		12.27%	7.59%	3.05%	2.19%
	(0.569)	(0.503)	(0.311)		(0.632)	(0.476)	(0.317)	(0.359)
Quartile 1	9.98%	4.95%	5.42%		11.39%	9.77%	1.24%	0.60%
	(0.633)	(0.386)	(0.535)		(0.629)	(0.596)	(0.196)	(0.109)
Full Sample	10.68%	7.74%	3.19%		14.73%	6.83%	5.61%	3.33%
	(0.351)	(0.290)	(0.217)		(0.436)	(0.304)	(0.280)	(0.234)
Sample Size	**2,551**	**1,645**	**985**		**3,083**	**1,691**	**1,017**	**576**

Notes: These statistics were generated from the 2015-2016 Kenya Integrated Household and Budget Surveys (KIHBS). They are the shares of households that consumed tobacco/alcohol products. Survey weights were used to generate the shares. The quartile classification is based on *per capita* household expenditures. Quartile 1 represents the bottom 25 percent. Clustered standard errors are in brackets.

Table A 3 Tobacco and alcohol budget shares by quartile (2005-2006 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco/Snuff		Alcohol	Traditional brews	Beers	Spirits
Quartile 4	4.64%	4.86%	1.49%		11.04%	7.05%	11.23%	6.39%
	(0.384)	(0.404)	(0.294)		(0.617)	(0.998)	(0.696)	(0.811)
Quartile 3	3.78%	4.49%	1.39%		8.91%	6.57%	11.92%	7.17%
	(0.267)	(0.312)	(0.261)		(0.603)	(0.725)	(0.872)	(1.301)
Quartile 2	3.83%	5.47%	1.36%		6.77%	6.31%	10.11%	4.28%
	(0.252)	(0.361)	(0.140)		(0.428)	(0.391)	(2.286)	(1.282)
Quartile 1	3.50%	5.62%	1.98%		7.78%	7.55%	15.17%	7.96%
	(0.310)	(0.648)	(0.296)		(0.514	(0.512)	(4.516)	(1.001)
Full Sample	3.87%	5.02%	1.65%		8.76%	6.87%	11.44%	6.46%
	(0.157)	(0.199)	(0.155)		(0.302)	(0.310)	(0.561)	(0.628)
Sample Size	**2,237**	**1,253**	**872**		**1,804**	**1,172**	**568**	**170**

Notes: These statistics were generated from the 2005-2006 Kenya Integrated Household and Budget Surveys (KIHBS). They are the weighted household budget shares among households that consumed the relevant tobacco/alcohol products. The quartile classification is based on *per capita* household expenditures. Quartile 1 represents the bottom 25 percent. Clustered standard errors are in brackets.

Table A 4 Tobacco and alcohol budget shares by quartile (2015-2016 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco/Snuff		Alcohol	Traditional brews	Beers	Spirits
Quartile 4	3.47%	3.80%	0.74%		12.91%	6.64%	13.16%	10.85%
	(0.208)	(0.240)	(0.080)		(0.574)	(0.574)	(0.804)	(0.769)
Quartile 3	3.40%	4.11%	0.86%		11.14%	6.87%	12.92%	11.05%
	(0.193)	(0.219)	(0.113)		(0.467)	(0.433)	(0.683)	(0.881)
Quartile 2	3.24%	4.08%	1.19%		9.38%	7.18%	11.70%	9.90%
	(0.219)	(0.269)	(0.170)		(0.428)	(0.399)	(0.100)	(0.969)
Quartile 1	3.22%	4.64%	1.70%		8.91%	8.14%	13.16%	9.46%
	(0.200)	(0.289)	(0.219)		(0.487)	(0.526)	(1.531)	(1.133)
Full Sample	3.35%	4.13%	1.21%		11.20%	7.27%	12.91%	10.69%
	(0.109)	(0.130)	(0.103)		(0.312)	(0.279)	(0.531)	(0.542)
Sample Size	**2,551**	**1,645**	**985**		**3,083**	**1,691**	**1,017**	**576**

Notes: These statistics were generated from the 2015-2016 Kenya Integrated Household and Budget Surveys (KIHBS). They are the weighted household budget shares among households that consumed the relevant tobacco/alcohol products. The quartile classification is based on *per capita* household expenditures. Quartile 1 represents the bottom 25 percent. Clustered standard errors are in brackets.

Table A 5 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco)

	Tobacco				
Weighted Variable(s)	**Mean non-consumers**	**Mean consumers**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Milk and eggs budget share	6.527	5.923	-0.604	3.18	0.002**
Proportion of male adults	0.591	0.592	0.002	0.21	0.832
$\boldsymbol{lnM}$	11.9	11.884	-0.016	0.58	0.560
$(\boldsymbol{lnM})^2$	142.342	141.923	-0.419	0.63	0.529
Proportion of adults	0.623	0.621	-0.002	0.2	0.843
$\boldsymbol{ln\ household\ size}$	1.385	1.383	-0.002	0.08	0.939
Household head qualification certificate					
Primary	0.284	0.289	0.004	0.31	0.760
Secondary	0.136	0.131	-0.006	0.56	0.575
Post-secondary	0.147	0.136	-0.011	1.09	0.276
Other	0.005	0.005	0.000	0.00	1.000
Number employed	1.261	1.261	0.000	0.01	0.993
Average age adults	36.788	36.491	-0.297	0.74	0.462
Number of children below 5 years	0.694	0.699	0.005	0.16	0.874
Number of children 16 to 18 years	0.215	0.207	-0.008	0.54	0.591
Average age of household head	42.932	42.562	-0.371	0.76	0.450
Place of residence					
Urban	0.345	0.334	-0.01	0.64	0.522
Religion of household head					
Protestant	0.372	0.359	-0.013	0.8	0.425
Other Christian	0.083	0.076	-0.007	0.83	0.406
Muslim	0.094	0.096	0.002	0.16	0.873
Other	0.096	0.104	0.008	0.69	0.491
County fixed effects	**Yes**	**Yes**			
Sample Size	**9,923**	**2,237**			

Notes: These are the results of the two-sample t-test for the matched households in period zero (2005-2006). *p<0.1, **p<0.05, ***p<0.01. For brevity, non-consumers, refers to households that did not consume alcohol/tobacco. I only report results for the most crowded out expenditure item. No certificate was the omitted qualification. Catholic was the omitted religion.

Table A 6 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol)

	Alcohol				
Weighted Variable(s)	**Mean non-consumers**	**Mean consumers**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Transport budget share	4.625	3.752	-0.873	4.07	0.000**
Proportion of male adults	0.588	0.593	0.005	0.56	0.577
$\boldsymbol{lnM}$	12.082	12.061	-0.021	0.65	0.517
$(\boldsymbol{lnM})^2$	146.862	146.344	-0.519	0.64	0.520
Proportion of adults	0.635	0.633	-0.002	0.27	0.788
$\boldsymbol{ln\ household\ size}$	1.330	1.332	0.002	0.08	0.937
Household head qualification certificate					
Primary	0.253	0.249	-0.004	0.29	0.771
Secondary	0.163	0.156	-0.007	0.57	0.570
Post-secondary	0.240	0.237	-0.003	0.23	0.817
Other	0.006	0.007	0	0.16	0.876
Number employed	1.216	1.200	-0.015	0.51	0.611
Average age adults	35.539	35.600	0.061	0.18	0.855
Number of children below 5 years	0.640	0.650	0.01	0.35	0.723
Number of children 16 to 18 years	0.222	0.220	-0.001	0.09	0.926
Average age of household head	41.895	41.968	0.073	0.17	0.863
Place of residence					
Urban	0.435	0.424	-0.011	0.60	0.548
Religion of household head					
Protestant	0.407	0.398	-0.009	0.55	0.586
Other Christian	0.094	0.090	-0.004	0.41	0.682
Muslim	0.021	0.018	-0.003	0.85	0.398
Other	0.099	0.102	0.003	0.25	0.804
County fixed effects	**Yes**	**Yes**			
Sample Size	**9,923**	**1,804**			

Notes: These are the results of the two-sample t-test for the matched households in period zero (2005-2006). *p<0.1, **p<0.05, ***p<0.01. For brevity, non-consumers, refers to households that did not consume alcohol/tobacco. I only report results for the most crowded out expenditure item. No certificate was the omitted qualification. Catholic was the omitted religion.

Table A 7 Matched difference in differences results for Tobacco-consuming and non-tobacco-consuming households

	2005/2006				2015/2016				
	Tobacco consumption				Tobacco consumption				
	Consumers	Non-consumers	Difference		Consumers	Non-consumers	Difference		Difference in Differences
Commodity									
Tobacco	4.114	0.000	4.114***		3.587	0.000	3.587***		-0.527***
			(0.142)				(0.098)		(0.172)
Alcohol	4.293	1.076	3.217***		5.527	1.553	3.974***		0.757**
			(0.255)				(0.244)		(0.353)
Alcohol & tobacco	8.188	1.076	7.112***		8.875	1.553	7.323***		0.210
			(0.287)				(0.260)		(0.387)
Education	3.204	4.381	-1.177***		5.027	5.450	-0.423*		0.753**
			(0.208)				(0.244)		(0.321)
Energy	4.440	4.947	-0.507***		3.814	3.703	0.111		0.618***
			(0.129)				(0.154)		(0.201)
Bread & cereals	14.436	13.781	0.655*		16.628	17.287	-0.659**		-1.314***
			(0.389)				(0.305)		(0.494)
Banana & tubers	3.641	3.444	0.189		2.209	2.332	-0.113		-0.311
			(0.194)				(0.089)		(0.213)
Meats	4.094	4.135	-0.041		4.584	4.809	-0.225		-0.184
			(0.186)				(0.220)		(0.288)
Fish and sea food	1.228	1.092	0.136		1.298	1.273	0.024		-0.111
			(0.092)				(0.097)		(0.134)
Milk and eggs	5.920	6.466	-0.546***		5.301	6.298	-0.997***		-0.451*
			(0.182)				(0.149)		(0.235)
Fruits	2.800	2.734	0.006		3.016	2.965	0.050		-0.016
			(0.129)				(0.120)		(0.176)
Vegetables	5.303	5.130	0.173		4.560	4.732	-0.173*		-0.346**
			(0.135)				(0.103)		(0.169)
Restaurant food	3.003	2.813	0.189		2.331	2.330	0.001		-0.189
			(0.272)				(0.191)		(0.332)
Other foods	18.004	17.497	0.547*		7.400	7.543	-0.142		-0.689*
			(0.327)				(0.163)		(0.356)
Healthcare	0.755	0.711	0.044		1.919	1.940	-0.021		-0.065
			(0.055)				(0.143)		(0.153)
Clothing/footwear	7.233	7.442	-0.210		4.165	4.133	0.032		0.242
			(0.299)				(0.142)		(0.331)
Water	0.905	0.945	-0.040		0.822	0.800	0.022		0.062
			(0.068)				(0.057)		(0.089)
Transport	3.268	3.773	-0.504***		4.851	5.082	-0.231		0.274
			(0.171)				(0.208)		(0.269)
Furnishings	3.235	3.201	0.034		0.902	0.921	-0.019		-0.053
			(0.174)				(0.058)		(0.183)
Rent	1.901	2.525	-0.624***		2.432	2.649	-0.217		0.407*
			(0.171)				(0.157)		(0.232)
Communication	1.134	1.589	-0.455***		3.913	4.187	-0.275**		0.180
			(0.096)				(0.123)		(0.155)
Other expenditures	9.913	10.974	-1.061***		15.861	17.207	-1.345***		-0.284
			(0.298)				(0.364)		(0.471)
Sample size	**1,379**	**8,357**	**9,736**		**1,861**	**15,331**			**26,928**

Notes: These are the matched difference in differences estimation results that compare households that consumed tobacco and those that did not consume tobacco. Data used were from two nationally representative samples surveyed in 2005/6 and 2015/16. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Clustered standard errors are in brackets.

Table A 8 Matched difference in differences results for alcohol-consuming and non-alcohol-consuming households

	2005/2006				2015/2016				
	Alcohol consumption				Alcohol consumption				
	Consumers	Non-consumers	Difference		Consumers	Non-consumers	Difference		Difference in Differences
Commodity									
Tobacco	1.851	0.547	1.304***		1.318	0.360	0.958***		-0.346**
			(0.116)				(0.071)		(0.136)
Alcohol	9.142	0.000	9.142***		11.228	0.000	11.228***		2.086***
			(0.280)						(0.366)
Alcohol & tobacco	10.730	0.547	10.183***		12.332	0.360	11.972***		1.789***
			(0.316)				(0.248)		(0.401)
Education	4.150	5.106	-0.956***		5.688	5.883	-0.194		0.726
			(0.227)				(0.218)		(0.315)
Energy	4.414	5.062	-0.648***		3.767	3.830	-0.064		0.584
			(0.126)				(0.116)		(0.171)
Bread & cereals	11.998	11.929	0.069		15.832	16.492	-0.660***		-0.730
			(0.351)				(0.249)		(0.430)
Banana & tubers	3.267	3.236	0.031		2.028	2.096	-0.067		-0.098
			(0.031)				(0.069)		(0.186)
Meats	4.946	4.100	0.847***		5.524	4.797	0.727***		-0.120
			(0.186)				(0.164)		(0.248)
Fish and sea food	1.398	1.231	0.167		1.708	1.502	0.207**		0.040
			(0.106)				(0.087)		(0.137)
Milk and eggs	5.940	6.164	-0.223		5.975	6.627	-0.652***		-0.429*
			(0.182)				(0.136)		(0.227)
Fruits	2.676	2.580	0.096		2.936	2.860	0.076		-0.020
			(0.124)				(0.090)		(0.153)
Vegetables	5.396	5.117	0.279**		4.877	4.875	0.003		-0.276
			(0.140)				(0.096)		(0.169)
Restaurant food	3.448	2.913	0.535**		3.127	2.173	0.954***		0.419
			(0.261)				(0.166)		(0.3090
Other foods	16.573	15.818	0.755**		7.670	7.556	0.114		-0.641*
			(0.298)				(0146)		(0.334)
Healthcare	0.615	0.724	-0.109***		1.928	1.869	0.059		0.168
			(0.042)				(0.124)		(0.130)
Clothing/footwear	8.253	7.846	0.408		4.377	4.282	0.095		-0.313
			(0.320)				(0.120)		(0.342)
Water	0.820	0.844	-0.023		0.696	0.787	-0.092**		-0.068
			(0.064)				(0.047)		(0.079)
Transport	3.747	4.482	-0.735***		4.842	5.276	-0.434**		0.301
			(0.202)				(0.178)		(0.269)
Furnishings	3.196	3.228	-0.013		0.863	0.960	-0.097**		-0.006
			(0.154)				(0.047)		(0.161)
Rent	2.942	3.220	-0.278		2.851	3.163	-0.312**		-0.034
			(0.223)				(0.149)		(0.269)
Communication	1.860	1.981	-0.122		4.294	4.428	-0.134		-0.012
			(0.123)				(0.117)		(0.170)
Other expenditures	11.193	12.246	-1.053***		15.032	17.494	-2.462***		-1.409***
			(0.341)				(0.287)		(0.445)
Sample size	**1,384**	**8,243**			**2,643**	**14,439**			**26,709**

Notes: These are the matched difference in differences estimation results that compared households that consumed alcohol and those that did not consume alcohol. Data used were from two nationally representative samples surveyed in 2005/6 and 2015/16. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Clustered standard errors are in brackets.