ESSAYS ON THE ECONOMICS OF TOBACCO AND ALCOHOL CONTROL POLICY IN KENYA

By

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DECLARATION

I, Abel Otwori Nyagwachi, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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ABSTRACT

This thesis uses data from Kenya to contribute to the literature on tobacco and alcohol control policies in low and middle-income countries. The thesis uses the two most recent household and budget surveys (2005/6 and 2015/16), to examine some of the effects of the tobacco and alcohol control policies that were implemented in Kenya between 2005 and 2015. Chapter 2 considers the impact of consumption and taxation of tobacco and alcohol on household spending patterns.

An instrumental variable approach is used in the estimation of the difference in spending patterns, between tobacco-consuming (alcohol-consuming) households and households that do not consume tobacco (alcohol). Following the precedent of some other studies, the adult sex ratio is used as an instrumental variable for the tobacco and alcohol consumption status of households. However, the adult sex ratio may not meet the exclusion restriction. In order to address this concern, I change the specification of the instrumental variable and relax the exclusion restriction. As a result, the upper and lower bounds of the difference in expenditure shares between households that consumed tobacco (alcohol) and the households that did not consume tobacco (alcohol) are estimated.

A natural experiment involving tobacco and alcohol taxes occurred during the data collection period of one of the household surveys: the excise tax on tobacco and alcohol was increased during the data collection phase. A matched difference-in-differences (MDID) technique is used to estimate the implication of a tobacco (alcohol) tax increase on household spending patterns.

The pseudo-panel generated from MDID also provided a new way of controlling for possible endogeneity arising from time-invariant unobservable variables. Therefore, MDID is used as a new approach, for comparing household spending patterns of tobacco-consuming (alcohol-consuming) households with those of households that do not consume tobacco (alcohol).

The price and non-price tobacco-control policies that were implemented between 2005/6 and 2015/16 contributed to a decrease in household tobacco use prevalence. However, alcohol-control policies implemented over the same period did not successfully reduce the overall prevalence of alcohol consumption among Kenyan households.

Tobacco- and alcohol-consuming households were found to spend less on education, energy, rent, healthcare, and food items. MDID results confirmed that tobacco and alcohol consuming households had lower expenditure shares on items necessary for human capital

development. The increase in tobacco taxes did not have an impact on household spending patterns among tobacco-consuming households. However, an increase in taxes on alcohol led to further crowding out of expenditure on fruits.

Chapter 3 uses the risk of child malnutrition in Kenya, to examine the effectiveness of tobacco and alcohol control policies, in reducing tobacco and alcohol consumption prevalence among vulnerable households. Past studies in this literature did not explicitly control for cluster/village level factors that may affect child nutrition.

A multilevel/mixed effects logit and general equations estimation logit model are used to estimate the difference in the risk of child malnutrition, between households that consumed tobacco and alcohol and those that did not consume the two goods. The two models account for the possibility of correlation in nutritional outcomes for children living in the same cluster/village. The two methods also allowed for the inclusion of contextual effects that could inform public health policy in Kenya.

In 2005/6 the odds of long-term child malnutrition were higher for children living in tobacco and alcohol consuming households in rural Kenya. The tobacco and alcohol control policies implemented between 2005/6 and 2015/16 were more effective in reducing tobacco and alcohol consumption prevalence among the poorest rural households. As a result, the decrease in child malnutrition prevalence was greater among households that consumed tobacco and alcohol. In 2015/16 the risk of child malnutrition in tobacco and alcohol consuming households was similar to that of non-consuming households.

The results from chapter 3 indicate that tobacco and alcohol control policies that were implemented in Kenya over the ten-year period, contributed to the reduction in consumption of the two goods among the poorest rural households. Therefore, very poor households invested resources, which could have been used for tobacco/alcohol consumption, on human capital development.

Chapter 2 and chapter 3 provide evidence on some of the opportunity costs associated with tobacco/alcohol consumption as well as potential benefits that may arise from controlling consumption of the two goods. Subsequently, Chapter 4 focuses on the price elasticity of demand for tobacco and alcohol products. Tax-induced price increases is one of the most effective policy tools for controlling the demand for the two goods.

The effectiveness of price policy in controlling demand for tobacco and alcohol may be hindered by among other things, the consumption of informally produced alcohol and non-cigarette tobacco products as well as other stimulants. Majority of the relatively few studies

done on African countries were on South Africa and most of them estimated the price elasticity of demand for cigarettes and formally produced alcohol products. Further, I am not aware of any peer-reviewed study that has estimated the price elasticity of demand for alcohol and tobacco products in Kenya.

Household survey data is used to estimate the own-price and expenditure elasticities (as proxies for income elasticities) of demand for tobacco and alcohol products in Kenya. The responsiveness of the demand for informally produced alcohol as well as non-cigarette tobacco products to changes in prices of cigarettes and formally produced beers is also estimated. This thesis also estimates the responsiveness of demand for *khat* to changes in the price of cigarettes and formally produced beers. *Khat* is a stimulant mostly consumed in Arabia and the Horn of Africa.

One of the concerns about the use of taxes as a measure to control tobacco and alcohol consumption is the possible regressive nature of tobacco and alcohol taxes. Therefore, chapter 4 also examines the impact of price and non-price tobacco- and alcohol-control policies on the regressivity/progressivity of household tobacco and alcohol burdens (budget shares).

Tobacco-control policies implemented between 2005/6 and 2015/16, contributed to a reduction in the regressivity of household tobacco budget shares. The changing profile of tobacco consuming households as well as economic growth over the period may have also contributed to the increase in the estimated price elasticity of demand for cigarettes. Over the ten-year period, the estimated price elasticity of demand for cigarettes increased from -0.63 to -0.42. *Khat* and snuff tobacco were found to be complements for cigarettes.

Khat and informally produced spirits were found to be substitutes for formally produced beers. Further, the demand for formally produced beers was found to be price elastic. The alcohol-control policies that were implemented over the ten-year period, contributed to a reduction in the regressivity of overall alcohol budget shares. However, over the ten-year period, there was a rapid increase in demand for spirits in Kenya.

DEDICATION

This thesis is dedicated to my parents; George Barongo Nyagwachi and Josephine Mwango Nyagwachi for their love and support.

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CHAPTER 1: INTRODUCTION

The World Health Organization (WHO) has flagged both tobacco consumption and harmful alcohol consumption as major public health concerns and contributors to premature deaths. Globally, between 1998 and 2016, tobacco related deaths increased from 3.5 million to 7 million each year. The number of deaths is expected to rise to 8 million per year by 2030, with three-quarters of those deaths expected to occur in developing countries. Deaths attributed to alcohol have shown an upward trend, increasing from 2.5 million in 2004 to 3 million (5.3% of global deaths) in 2016 (WHO, 2009, 2010a, 2014a, 2017, 2018).

There are important differences between the harmful effects associated with tobacco and those of alcohol consumption. As a result, there are some commodity-specific control policies for alcohol and tobacco. However, the similarities between the two goods allows for the transferability of evidence-based interventions. Specifically, strategies on pricing, advertising, communication, regulating product content, and elimination of the illicit trade have proven to be effective in controlling the consumption of both goods (Casswell and Thamarangsi, 2009).

Alcohol and tobacco are widely believed to be complements in most countries; this has been confirmed by studies such as Cameron and Williams (2001), Pierani and Tiezzi (2009) and Tauchmann *et al.* (2013). However, for some segments of the population the two goods have been found to be either asymmetrical complements (instances where changes in price of one of the goods affects demand for the other but the reverse in not true) or substitutes. Consequently, policy makers have recommended the adoption of a unified strategy for controlling the consumption of both goods (Decker and Schwartz, 2000; Picone *et al*., 2004; Yu and Abler, 2010; Koksal and Wohlgenant, 2016).

The harm caused by tobacco and alcohol consumption is not just a public health issue. In households where tobacco and alcohol products are consumed, other household members are affected through crowding-out effects of the expenditure on those two goods. The harm to other household members is more pronounced in developing countries, which have a larger share of poor households (Koch and Tshiswaka-Kashalala, 2008; John, 2008a; Do and Bautista, 2015; Jumrani and Birthal, 2017).

Expenditure on alcohol and tobacco has been found to be negatively correlated with household spending on human capital development. Owing to heterogeneity across countries, the specific goods and services that are crowded out may differ. Furthermore, in some countries

the expenditures that are crowded out by alcohol differ from those that are crowded out by tobacco. The items that tobacco-consuming and alcohol-consuming households spend less on, may also differ across income groups as well as between urban and rural households (Busch *et al*., 2004; John, 2008a; Pu *et al*., 2008; John *et al*., 2012; Chelwa and Van Walbeek, 2014; Do and Bautista, 2015).

Lower expenditure on items necessary for human development, such as food and healthcare, may have an adverse effect on child nutrition. The two most immediate causes of child malnutrition are low calorie intake and disease. Therefore, children living in tobacco-consuming and alcohol-consuming households may be at higher risk of being malnourished (UNICEF, 1991; Efroymson *et al*., 2001; Best *et al*., 2007; John, 2008a).

Tax-induced price increases for tobacco and alcohol products have been found to be effective in reducing demand. Young adults and low-income individuals or households have been found to be more price responsive. Most of the evidence on the price elasticity of demand for tobacco and alcohol products is from developed countries. Studies on sub-Saharan Africa have been relatively few, and the few studies done on Africa have mostly been on South Africa (IARC, 2011; WHO, 2007, 2015; Chelwa, 2015).

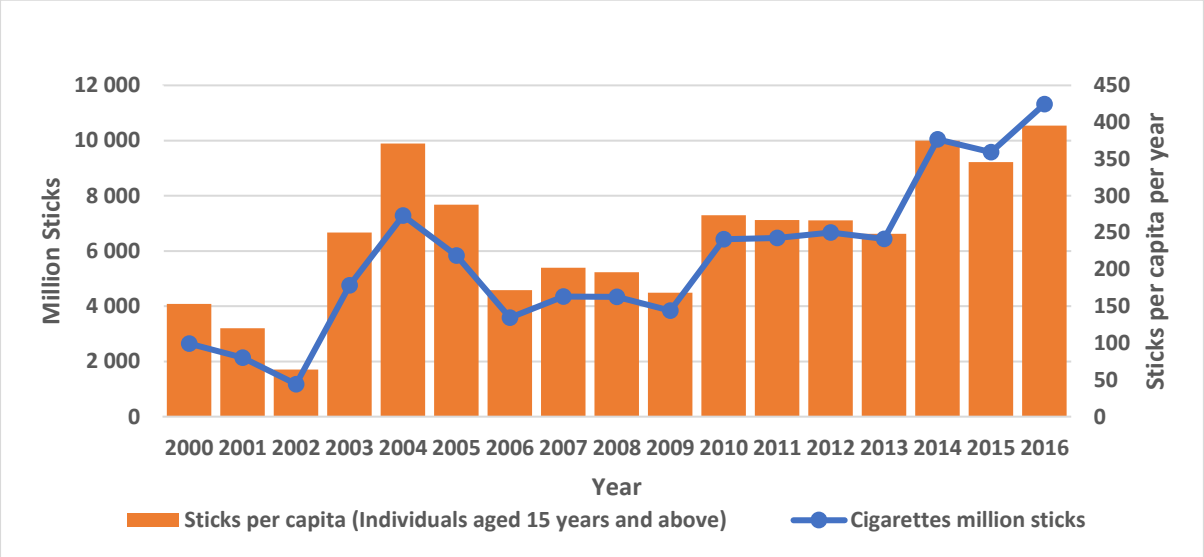
Africa faces unique challenges in the implementation of tobacco and alcohol control polices. The continent's demographics, governance, and economic growth have made it a target for a tobacco industry that is adjusting from decreased demand in developed countries (Ahluwalia *et al*., 2016; Husain *et al*., 2016). Rising *per capita* income across the continent is also expected to contribute to a continued increase in demand for alcohol (Sornpaisarn *et al*., 2013).

African countries south of the Sahara also have relatively weaker institutions. As a result, they have limited capacity to prevent smuggling and the illegal production of alcohol and tobacco products. Consequently, they tend to have higher production/consumption rates for informally produced alcohol and non-cigarette/smokeless tobacco products (Sornpaisarn *et al*., 2013; Jawad *et al*., 2018).

Kenya, like some of the other sub-Saharan African countries, has experienced an increase in tobacco and alcohol consumption since at least 2000. Figure 1.1 and Figure 1.2 present aggregate cigarette and beer consumption data, from annual statistical abstracts. The annual statistical abstracts are published by the Kenya National Bureau of Statistics (KNBS). Beer and cigarettes are the only alcohol and tobacco products whose aggregate consumption is reported by KNBS. The aggregate consumption only captures legally-sold (taxed) cigarettes

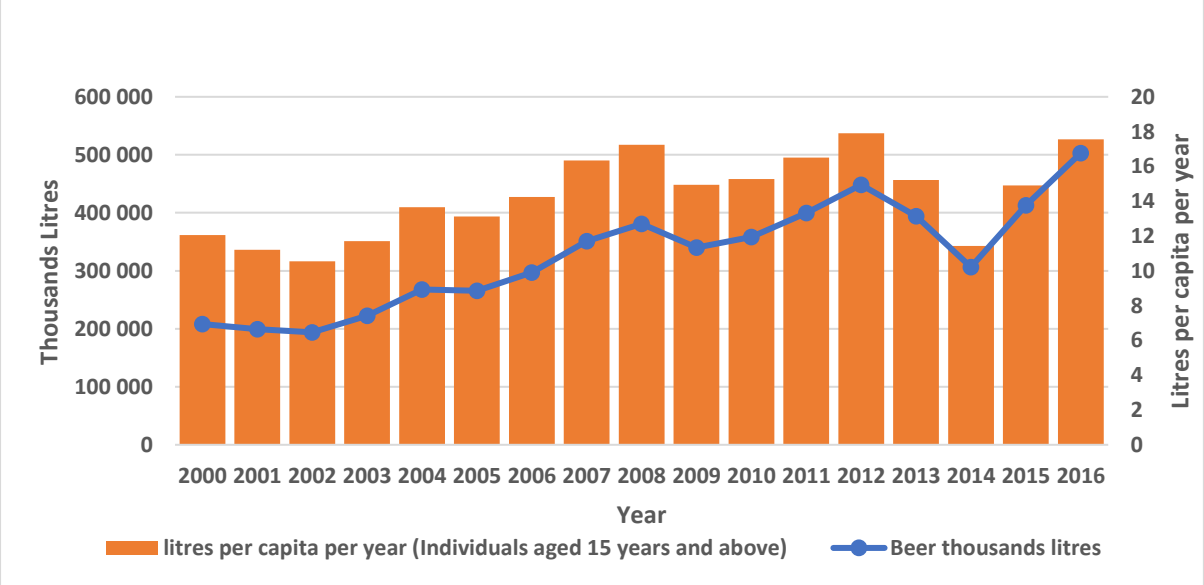
and beer. The effect of various tax reforms, and tobacco and alcohol policies, on annual aggregate taxed consumption, is discussed later in this chapter. Policy changes implemented over this period explain the variability in the reported aggregate taxed consumption of the two goods.

Figure 1.1 Annual aggregate taxed cigarette consumption in Kenya



Source of Data: Kenya National Bureau of Statistics (Annual statistical abstracts)

Figure 1.2 Annual aggregate taxed beer consumption in Kenya



Source of Data: Kenya National Bureau of Statistics (Annual statistical abstracts)

Cigarette consumption per adult[1] per year, increased from 288 sticks in 2005 to 395 sticks in 2016. Over the period 2000 to 2016, the average annual increase in cigarette consumption *per capita* was 1.9%. *Per capita* Beer consumption increased by an average of 2.6% per year between 2000 and 2016. Over the period 2000 to 2016, data from the World Bank (2018b) indicated that Kenya's *per capita* real Gross Domestic Product (GDP) grew by an average of 1.8% per annum.

The increase in tobacco and alcohol consumption in Kenya outpaced the growth in real *per capita* GDP. This suggests that the household budget share for tobacco and alcohol products may have increased over this period. As a result, it is possible that the spending on other goods was being traded off.

Consumption of tobacco and alcohol in Kenya is not limited to formally-produced alcohol products and cigarettes. Smokeless tobacco products are widely used in Kenya. The Global Adult Tobacco Survey (GATS) that was carried out in 2014 estimated that the overall tobacco-use prevalence among Kenyan adults was 11.6%. This was broken down to an overall smoking prevalence of 7.8% and an overall smokeless tobacco use prevalence of 4.5%.

Consumption of informally produced alcohol is also widespread in Kenya. Between 2008 and 2010, the estimated average consumption of pure alcohol in Kenya was 4.3 litres, of which 2.5 litres was unrecorded alcohol (WHO, 2014a). Unrecorded alcohol refers to alcohol which is not taxed and is outside the usual system of government control. This includes home- or informally-produced alcohol, smuggled alcohol, surrogate alcohol, or alcohol obtained through cross-border shopping (WHO, 2014a).

Informally produced alcohol in Kenya includes traditional beers such as *busaa* and *muratina* as well as spirits such as *changa'aa*. *Changa'aa* is a spirit that is made from millet, maize, or sorghum. Like other informally produced alcohol, *changa'aa* 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 *chang'aa* (WHO, 2004; Carey *et al*. 2015).

In addition to informally produced alcohol and non-cigarette tobacco products, another product that may influence the effectiveness of tobacco and alcohol control policies in Kenya is *khat*. *Khat* or *miraa* refers to the twigs and leaves of the *Catha edulis* tree. The twigs and

[1] Adult in this case referred to those over the age of 15 years.

leaves are chewed for their stimulant and euphoriant effect. *Khat* is mostly consumed in the Arabian peninsula and East Africa (Hodgkinson, 1962; Kalix, 1988). *Khat* has been identified as one of the possible contributing factors to initiation, sustenance, and relapse amongst smokers (Kassim *et al*. 2014). Some studies have also found positive correlation between *khat* chewing and alcohol use in some regions of Kenya (Omolo and Dhadphale, 1987).

In Kenya, taxation has mainly focused on cigarettes and formally-produced alcoholic beverages. Tobacco and alcohol taxes are an effective tool for reducing demand, but they are also known to be regressive (Ataguba, 2012; Koch, 2018). The regressive nature of tobacco and alcohol taxes has prompted studies on the equity impact of different tobacco and alcohol control policies (Hill *et al*., 2014; Bosdriesz *et al*., 2015; Vandenberg and Sharma, 2016; Koch, 2018).

1.1 Tobacco and alcohol control policies in Kenya

This section discusses some of the major tobacco and alcohol control policies that were implemented in Kenya between 2000 and 2017. The focus is on the period 2000 to 2017 because this is the period relevant to this thesis.

1.1.1 Tobacco control policy in Kenya 2000 - 2017

Tobacco use has been identified as a public health concern by the WHO from the 1990s. To stem the tide of tobacco related deaths, the first global health treaty, the WHO Framework Convention on Tobacco Control (FCTC), was adopted by the World Health Assembly in May 2003. The FCTC was open for signature between June 2003 and June 2004. 168 countries were signatories at the close of the signature period, making it one of the most widely-embraced treaties in United Nations history (WHO, 2009).

The FCTC entered into force on 27th February 2005, 90 days after it had been ratified, approved, accepted, or acceded to by 40 countries. The FCTC outlined strategies that were aimed at controlling the demand for and supply of tobacco. The core demand-reduction policies contained in articles 6 to 14 include the use of price/tax to reduce demand, as well as non-price demand-reduction measures such as polices on packaging and labelling, tobacco advertising and promotion, protection from exposure to tobacco smoke, education, and public awareness. The core supply-reduction polices contained in articles 15 to 17 include measures to counter the illicit trade in tobacco products, the sale to and by minors, and viable alternative economic activities for tobacco growers and workers (WHO, 2005).

As of December 2018, 39 out of the 47 countries in the WHO African Region had ratified the FCTC (Husain *et al*., 2016; United Nations, 2018). Husain e*t al*. (2016) carried out an analysis of the implementation status of the FCTC for 23 countries in the WHO Africa region. At 9%, Sierra Leone had the lowest average implementation rate for articles 6 to 22. Burkina Faso, Ghana, Kenya, Nigeria, Senegal and Seychelles all had implementation rates of over 60%. Kenya had an implementation rate of 78%, which was the highest among the 23 countries that were evaluated by the study.

Kenya ratified the FCTC on 25th June 2004, making it one of the first 40 countries to become parties to the FCTC (WHO, 2009; Shoba, 2013). The tobacco control measures included in the FCTC were passed into law in Kenya through the Tobacco Control Act of 2007. The Act was assented to on 27th September 2007 and came into force on 8th October 2007.

The Tobacco Control Act, 2007, established a Tobacco Control Board and a Tobacco Control Fund. The Tobacco Control Fund was to be used for research on tobacco products, for the promotion of national cessation and rehabilitation programmes. The government was required to create public awareness about the addictive nature and health threats posed by consumption of tobacco products.

The Act introduced a ban on smoking in public areas including restaurants, hotels, and bars, in order to limit exposure to second-hand smoking. The Act also 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 promotion actions. Warning labels with health messages in both English and Kiswahili (Kiswahili is Kenya's national language) were required on the packaging of tobacco products. The warning labels were required to be no less than 30% of the total surface area of the front and 50% of the rear of the pack. The Act included a provision that allowed the Minister to propose the adoption of pictorial warning labels.

After the passing of the Tobacco Control Act in 2007, the article requiring health information warnings on the back and front of cigarette packs was fully implemented. The prohibition on smoking in public places was also enforced in most areas. The prohibition on tobacco promotion, advertising, and sponsorship was also implemented. However, in some cities and towns there were still visible outdoor advertisements on buildings or billboards. Training of enforcement officers, the media, and civil society organizations by the government increased awareness and contributed to the implementation of other provisions of the Act (Mohamed *et al*., 2018).

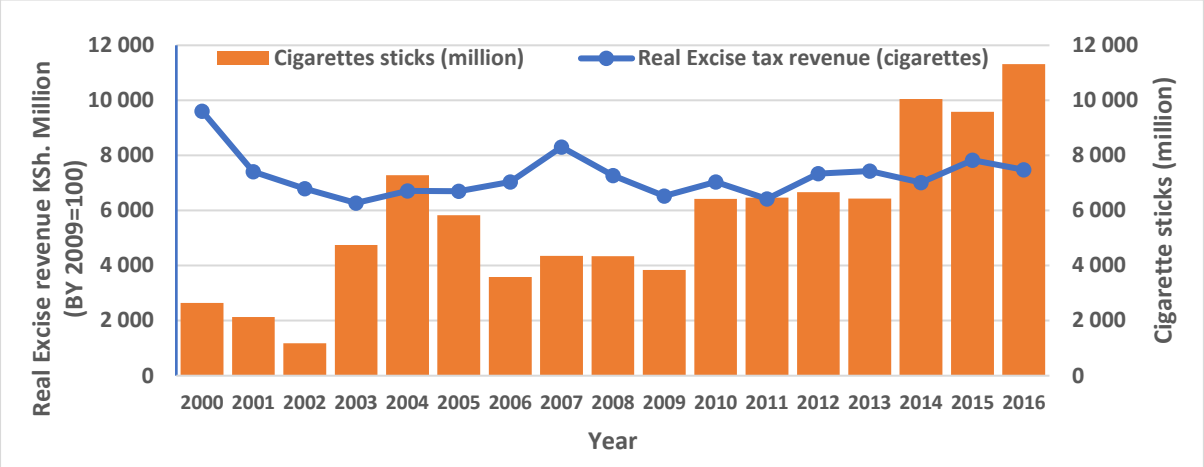
The Tobacco Control Act of 2007 had some shortcomings. With regard to banning advertising, promotion, and sponsorship, the law fell short because it did not define tobacco sponsorship clearly. Moreover, even though it prohibited the sponsorship of events, it did not prohibit the tobacco industry's sponsorship of organizations and individuals. The law did not fully comply with the FCTC on smoking in public areas, because it allowed for designated smoking zones, thereby making the ban on public smoking partial (Tumwine, 2011).

A lack of adequate resources has hindered the full implementation of the Act. For instance, in the initial period after commencement of the Act, the Tobacco Control Fund was not allocated resources by the Ministry of Finance. The efficient utilization of the funds that were subsequently allocated for tobacco control initiatives, may have been hindered by the lack of clear demarcation between the roles of the Tobacco Control Board and of the Tobacco Control Unit within the Ministry of Health. As is the case in other countries, tobacco industry interference was also a barrier to implementation of the Act (Mohamed *et al*., 2018).

Measures to curb the illicit trade of tobacco products was one of the tobacco control initiatives championed by the FCTC. The government of Kenya has taken steps to limit the illicit trade in tobacco products. In 2003, Kenya introduced tax stamps that had unique serial numbers and identifiers for the different types of cigarette (Ross, 2017). The year 2003 was also a year of political transition. In December 2002, Kenyans voted out the Kenya National African Union (KANU), the party that had held power for thirty-nine years. One of the priorities of the new government was the reform of public sector institutions.

The political events of this period, as well as the effectiveness of the tax stamps, were evident in the aggregate taxed cigarette consumption, which is presented in Figure 1.3. Legal cigarette consumption/sales increased by 300% in 2003 and 53% in 2004. However, counterfeiting of the tax stamps resulted in a decline in legal sales of cigarettes between 2004 and 2006 (Ross, 2017). After 2006, the legal sales levelled off and remained relatively unchanged until 2009.

Figure 1.3 Real excise revenue and taxed consumption (cigarettes)



Source of Data: Kenya National Bureau of Statistics (Annual statistical abstracts)

In 2010, the Kenya Revenue Authority (KRA) implemented additional measures to limit illicit trade. They set up new tax enforcement units that conducted periodic checks on cigarette manufacturers. They also started carrying out tax stamp verification at four points in the supply chain. The KRA also launched an electronic cargo tracking system (ECTS) in 2010. The ECTS tracked cigarettes and other goods that were in transit to Kenya's landlocked neighbours and those that were produced for export (Ross, 2017). These and other measures taken by KRA contributed to a 67% increase in legal sales of cigarettes in 2010, a level which remained relatively unchanged between 2010 and 2013.

Between April 2013 and March 2014, Kenya set up an Excisable Goods Management System (EGMS) for alcohol and tobacco products. The system allowed for the tracking and tracing of products, production counting, the processing of tax stamps, and the collection of other business intelligence. EGMS made it easier to prevent the falsification of production volumes and to detect counterfeit goods (Ross, 2017). The introduction of EGMS contributed to a 56% increase in legal cigarette sales in 2014.

Taxation as a measure to raise the price of tobacco products was also championed by the FCTC as an effective demand-control policy. Consequently, the Tobacco Control Act of 2007 required the Minister for Finance to implement taxes that contributed to the objectives of the Act. Kenya has had various excise tax systems for cigarettes in the recent past. Between 2000 and 2002, the country had an *ad valorem* tax of 130% of the ex-factory price of cigarettes. In 2003, the government introduced a tiered tax system that had four bands, based on the retail price. Band A consisted of the cheapest cigarettes and band D of the most expensive. Each

band had a different specific excise tax. The specific excise tax charged in each band increased with the retail selling price.

The complexity of tiered excise tax systems has been found to be a deterrent in the use of taxation to achieve public health objectives. The complexity of the system also places an administrative burden on the tax authorities. However, policy makers in Kenya such as Members of Parliament defended the implementation of a tiered tax system because it favoured poor smokers (Nargis *et al.*, 2015). Table 1.1, Table 1.2, Table 1.3, and Table 1.4 provide the tax rates for the different bands. The tax base in the Finance Acts was stated in Kenya Shillings (Ksh.) per mille (1,000 cigarettes).

Table 1.1 Cigarette excise tax rate in Kenya (2003-2007)

		2003	2005	2006	2007
	Retail selling price (Ksh. per mille)	**Tax (Ksh. per mille)**	**Tax (Ksh. per mille)**	**Tax (Ksh. per mille)**	**Tax (Ksh. per mille)**
Band A	<=1,500	460	495	495	500
Band B	1,501 – 2,500	650	715	715	800
Band C	2,501 – 3,500	900	990	990	1200
Band D	>3,500	1,400	1540	1690	2000

Notes: The tax rates and retail selling price are in Kenya shilling (Ksh.). The source of these rates was the Finance Act 2003, 2005, 2006 and 2009. Period average exchange rate (Ksh. to 1 USD) 2003 (Ksh. 79.94) 2005 (Ksh. 75.55) 2006 (Ksh. 72.10) 2007 (Ksh.67.31) source World Bank.

Table 1.2 Cigarette excise tax rate in Kenya (2008-2010)

			2008	2010
	Description	**Retail selling price (Ksh. per mille)**	**Tax (Ksh. per mille)**	**Tax (Ksh. per mille)**
Band A	Plain cigarette	<=2,500	700	700
Band B	Soft cap cigarette	2,501 – 3,500	1,000	1,000
Band C	Soft cap Cigarette	3,501 – 4,500	1,500	1,500
Band D	Hinge lid	>4,500	2,500	2,500

Notes: The tax rates and retail selling price are in Kenya shilling (Ksh.). The source of these rates was the Finance Act 2008 and 2009. Period average exchange rate (Ksh. to 1 USD) 2008 (Ksh. 69.18) 2010 (Ksh. 79.23) Source World Bank.

Table 1.3 Per pack cigarette excise tax rate in Kenya (2003-2007)

		2003	2005	2006	2007
	Retail selling price (Ksh. per pack)	**Tax (Ksh. per pack)**	**Tax (Ksh. per pack)**	**Tax (Ksh. per pack)**	**Tax (Ksh. per pack)**
Band A	<=30	9	9.9	9.9	10
Band B	30.02 - 50	13	14.3	14.3	16
Band C	50.02 - 70	18	19.8	19.8	24
Band D	>70	28	30.8	33.8	40

Notes: The tax rates and retail selling price are in Kenya shilling (Ksh.). The source of these rates was the Finance Act 2003, 2005, 2006 and 2009. The rate per pack was calculated based on the rates per 1,000 cigarettes. A pack contains twenty cigarettes. Period average exchange rate (Ksh. to 1 USD) 2003 (Ksh. 79.94) 2005 (Ksh. 75.55) 2006 (Ksh. 72.10) 2007 (Ksh.67.31) source World Bank.

Table 1.4 Per pack cigarette excise tax rate in Kenya (2008-2010)

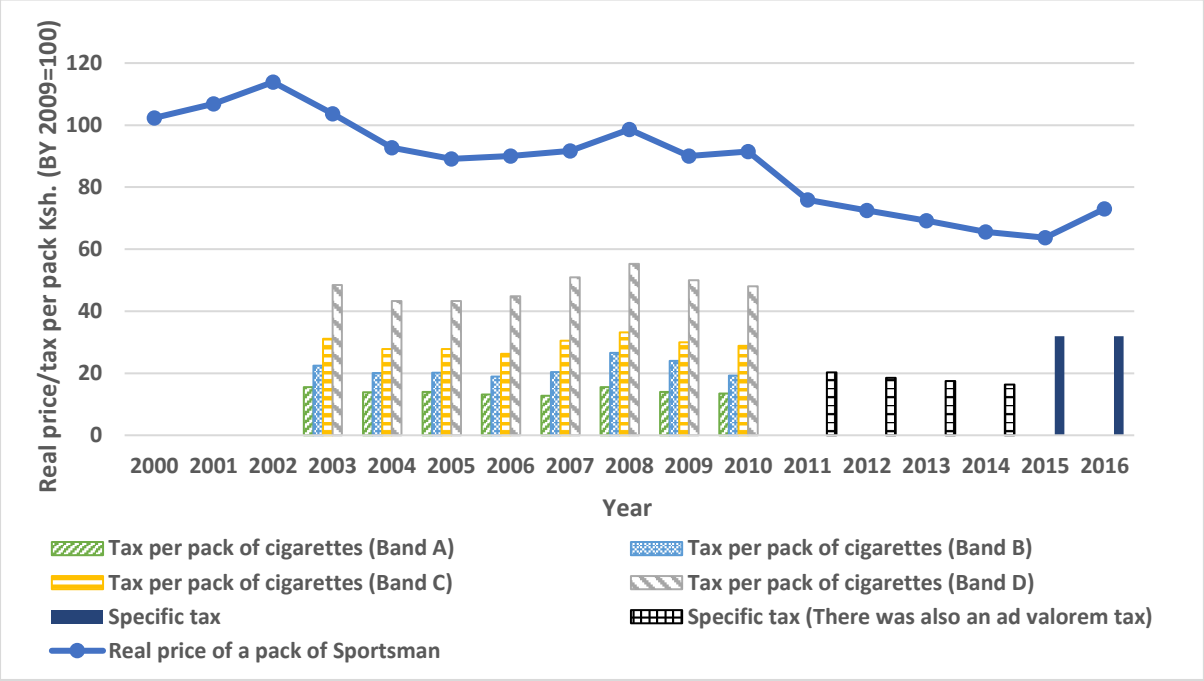
			2008	2010
	Description	**Retail selling price (Ksh. per pack)**	**Tax per (Ksh. Pack)**	**Tax (Ksh. per pack)**
Band A	Plain cigarette	<=50	14	14
Band B	Soft cap cigarette	50.02 - 70	24	24
Band C	Soft cap Cigarette	70.02 - 90	30	30
Band D	Hinge lid	>90	50	50

Notes: The tax rates and retail selling price are in Kenya shilling (Ksh.). The source of these rates was the Finance Act 2008 and 2009. The rate per pack was calculated based on the rates per 1,000 cigarettes. A pack contains twenty cigarettes. Period average exchange rate (Ksh. to 1 USD) 2008 (Ksh. 69.18) 2010 (Ksh. 79.23) Source World Bank.

In 2008, the excise tax regime was changed to a mixed-tier tax system. The excise tax on the four bands was based on the retail selling price and the type of packaging. In 2011/2012, the tiered tax system was replaced with a new mixed excise tax system that included a specific and an *ad valorem* tax. The excise tax in 2011/2012 was Ksh. 1,200 per mille or 35% of retail selling price (whichever was higher). The *ad valorem* rate was to be revised in subsequent years.

The tax system was changed again in 2015, to a specific tax of Ksh. 2,500 per mille for all cigarettes. The specific tax was to be adjusted for inflation every year. However, the tax rate was revised in 2017, to a specific tax of Ksh. 2,500 per mille for filtered cigarettes and Ksh. 1,800 per mille for unfiltered cigarettes. The inflation adjustment was also changed from once a year to once every two years. The real tax rates and real price of a pack of Sportsman cigarettes are presented in Figure 1.4. Sportsman was estimated to have a market share of 51.2% in 2012 (Nargis *et al.*, 2015). The specific taxes in 2004, 2009 and 2013/2014 were assumed to be unchanged from the preceding year.

Figure 1.4 Real tax rates, real price (cigarettes)



Notes: Generated using data from Kenya National Bureau of Statistics (KNBS), statistical abstracts and Finance Act 2003, 2005,2006,2007,2008,2010,2012,2017 and excise duty Act 2015. Specific taxes in 2004, 2009 and 2013/2014 assumed to be unchanged from previous year

The real price of Sportsman cigarettes, which was in Band C in most years and Band D in some years, increased between 2005 and 2008, and again in 2010. The real price of Sportsman decreased between 2011 and 2014, which coincided with the period when a mixed excise tax system, comprising a specific tax and an *ad valorem* tax, was in place. The real excise tax revenue from cigarettes (see Figure 1.3) increased between 2003 and 2007 as well as in 2012/2013 and 2015. The increase in real excise tax revenue from cigarettes after 2003 coincided with the introduction of tax stamps by the KRA.

There was an 8% increase in real excise tax revenue from cigarettes in 2010. This was likely the result of the introduction of the ECTS and other measures discussed earlier. There was also a 14% increase in real excise tax revenue from cigarettes in 2012. The 2012 increase in revenue occurred during the change from a tiered to a mixed specific and *ad valorem* tax system. The shift from a mixed specific and *ad valorem* tax system to a single specific tax for all cigarettes, in 2015, contributed to a 12% increase in real excise tax revenues from cigarettes.

1.1.2 Alcohol control policy in Kenya 2000 - 2017

In recognition of the negative effects of harmful alcohol use, the World Health Assembly, endorsed, in May, 2010, a Global Strategy to reduce the harmful use of alcohol

(WHO, 2010a). This provided guidance on actions to be taken at the global and national levels. The Strategy outlined priority areas, policy options, and measures that could be tailored by individual countries as needed. Some of the main target areas were health services' responses, drunk-driving countermeasures, limiting the availability of alcohol and the marketing of alcoholic beverages, pricing, and the reduction of the public health impact of illicit and informally produced alcohol (WHO, 2010a).

The Global Strategy to reduce the harmful use of alcohol also noted that local contexts were important for the successful implementation of alcohol-control policies. Public health priorities, capacities, resources and religious, and cultural contexts were some of the factors that needed to be taken into consideration (WHO, 2010a). The WHO African region gathered evidence about the applicability of the Global Strategies in the African context. They subsequently developed a strategy for the reduction of harmful alcohol use in the WHO Africa region that was endorsed by the regional committee in 2012 (Ferreira-Borges *et al*., 2013).

The main concerns that informed the development of a regional strategy for Africa were the increasing deaths attributed to the harmful use of alcohol in Africa and evidence that linked alcohol use with risky sexual behaviour and the transmission of HIV. Deaths attributed to harmful alcohol use in the African region had risen from 2.1% in 2000 to 2.4% in 2004 (Ferreira-Borges *et al*., 2013).

The African region also had challenges associated with a relatively high consumption of unrecorded alcohol. It was estimated that about 50% of the overall quantity of alcohol consumed in the WHO Africa region was unrecorded (Ferreira-Borges *et al*., 2013). Therefore, even though the WHO Africa policy measures were similar to those of the global strategy, there were some differences in the proposed interventions. For instance, with regard to addressing the problem of illegal and informal alcohol, the African strategy proposed that producers of traditional brews should be licensed and trained. Further, it proposed that funds should be made available to assist informal producers of alcohol to establish alternative means of earning a living (Ferreira-Borges *et al.*, 2013).

Over the years, Kenya, like other African countries, has grappled with the problem of the consumption of informally produced alcohol. In 1978, *chang'aa* accounted for approximately 36% of all the alcohol consumed in Kenya. Because of the many deaths and instances of blindness that were linked to *chang'aa*, the *Chang'aa* Prohibition Act was passed in 1980. The Act declared the manufacture, sale, supply, and consumption of *chang'aa* illegal. Violation of the Act was punishable by a fine of up to Ksh. 10,000 or an imprisonment term of

up to two years, or to both fine and imprisonment. However, the ban failed to curb *chang'aa* consumption and instances of deaths or blindness linked to *chang'aa* consumption persisted (Carey *et al.*, 2015).

In 2010, Kenya changed its approach in the fight against consumption of harmful informally produced alcohol. The Alcoholic Drinks Control Act of 2010 decriminalized the manufacture and sale of *chang'aa*. The Act sought to reduce the prevalence of alcohol poisoning by regulating the *chang'aa* and informal brewing industries. However, most informal brewers continued to brew *chang'aa* and other traditional brews illegally, because of the stringent standards that were set and the associated costs of meeting those standards. Carey *et al.* (2015) estimated that the cost of meeting the new standards was approximately 4,600 USD whereas the cost of setting up a new informal *chang'aa* den was 90 USD.

The Alcoholic Drinks Control Act of 2010 did not just target the production and the consumption of informally produced alcohol. Its main objective was to curb harmful alcohol use. For this reason, the Act overhauled Kenya's alcohol-control policy framework and integrated some of the measures proposed by the Global Strategy to reduce the harmful use of alcohol into Kenya's laws.

The Act 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. Licensing hours were introduced for hotels, restaurants, bars, clubs and other retailers that were allowed to sell alcohol. Restaurants, bars, and general retailers were authorized to sell alcohol between 5:00 p.m. and 11:00 p.m. on weekdays and 2:00 p.m. and 11:00 p.m. on weekends, while supermarkets were authorized to sell alcohol between 10:00 a.m. and 8:30 p.m.

The Act also required that health warnings in both English and Kiswahili appear on all alcohol products and included a provision that allowed the Minister to propose the adoption of pictorial warning labels on alcohol products. To protect minors, the Act banned the sale of alcohol products from vending machines. Further, it banned promotion by alcohol companies for events that were associated with persons under the age of 18 years. The selling of alcoholic drinks in residential areas or in areas near primary and secondary schools was also banned. The Act also required that health consequences of alcohol consumption, its addictive nature and the threats it posed be taught in all schools.

Young people's consumption of alcohol has been found to be more price responsive than that of older people (WHO, 2007; Anderson *et al.*, 2009). As a result, Kenya has taken measures to reduce the affordability of alcohol products for minors. In 2013, the Alcoholic Drinks Control Act was amended to introduce a ban on the sale of alcohol products in sachets or containers of less than 250 millilitres. Other price-related alcohol control policies have been implemented through taxation.

The taxation of alcohol in Kenya has had to contend with the high prevalence of consumption of informally produced alcohol. In 2004, one of Kenya's leading brewers, East Africa Breweries Limited (EABL), launched Senator Keg. Senator Keg is a beer that is made from sorghum and was aimed at the lower end of the market. Preferential tax treatment for beers that were not made from malt, in 2003 and subsequent years, made Senator Keg competitive against informally produced alcohol. The remission of excise tax on beer not made from malt was increased to 42% in 2005 and 100% in 2006 (Mailu and Mulinge, 2016).

The preferential tax treatment for beers not made from malt is one of the factors that contributed to the growth in aggregate consumption of legally sold beer between 2005 and 2012 (see Figure 1.2). Over this period, Senator Keg took over an estimated 40% of the informal alcohol market share and became one of EABL's leading beer brands. Owing to challenges in administratively differentiating between the different beer products for tax purposes, in 2013 the Minister for Finance reduced the remission granted to beers not made from malt from 100% to 50% (Mailu and Mulinge, 2016).

The increase in taxes on beers not made from malt, which included Senator Keg, contributed to a 12% decrease in the aggregate consumption of formally produced beer in 2013 and a 22% decrease in 2014. East African Breweries Limited (2018) reported that the net sales of Senator Keg dropped by 75% in 2014, after the implementation of the 2013 directive.

In 2015, the Alcoholic Drinks Control Act was amended to introduce a 90% remission of excise duty for beers made from millet, sorghum, or cassava that was grown in Kenya. This is one of the factors that contributed to a 35% increase in aggregate consumption of legally sold beers in 2015 and a 21% increase in 2016. East African Breweries Limited (2018) also reported that in 2015/16 sales of Senator Keg more than trebled.

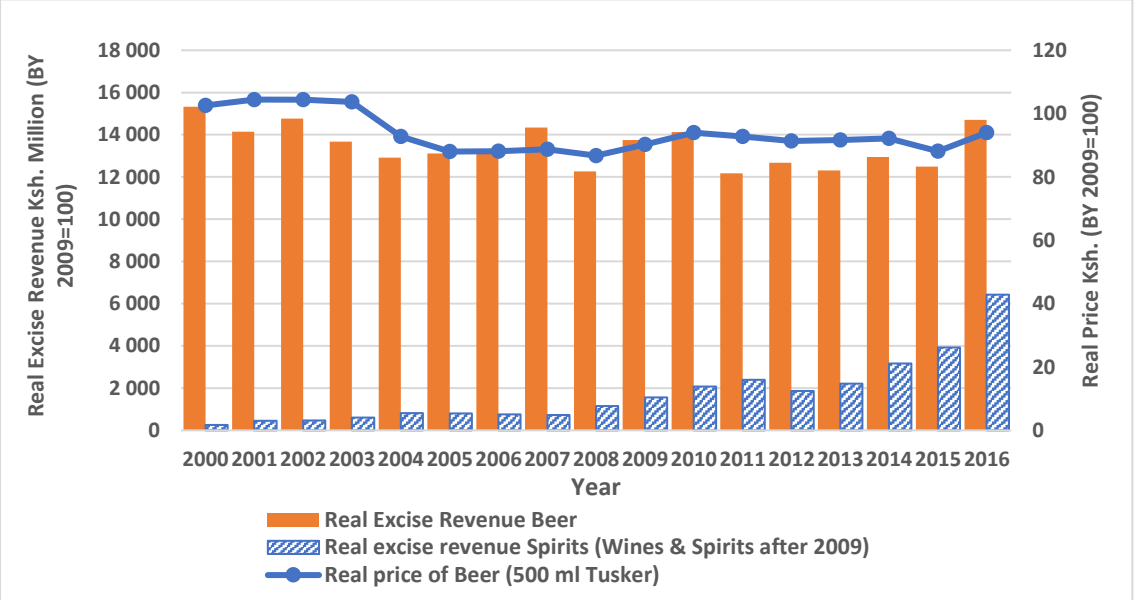
Tax increases on beers made from malt and other beers aimed at the top end of the market have been relatively small. As a result, between 2000 and 2016, there was a 1.2% average annual decrease in the real price of Tusker beer. Over the same period, there was a 0.4

percent average annual decrease in the real excise revenue from beer. Tusker beer is one of the most widely available formally-produced beers in Kenya (Hesse, 2015).

The only significant increases in the real price of Tusker beer was a 1.8% increase in 2002, 4% increase in 2009 and 2010, and a 6% increase in 2016. The increase in the real price of Tusker beer, as well as in excise taxes on other beers in 2009 and 2010, was accompanied by a decrease in aggregate consumption of formally produced beers in both years.

Figure 1.5 presents the real price of Tusker beer together with the real excise tax revenue from beers, wines, and spirits. There was a rapid growth in the real excise tax revenues from formally produced wines and spirits after 2007. The annual average increase in real excise tax revenue from wines and spirits between 2008 and 2016 was 27.5%. This indicated that, in addition to an increase in the aggregate consumption of beers, Kenyans were also increasing their consumption of wines and spirits.

Figure 1.5 Real price of beer, real excise tax revenue from beers, wines and spirits



Notes: Generated using data from Kenya National Bureau of Statistics (KNBS), statistical abstracts.

1.2 Themes of the thesis

This thesis considers several related themes on the economics of tobacco and alcohol control policy in Kenya. Chapter 2 focuses on the implications of tobacco and alcohol consumption and taxation on household spending patterns. Chapter 3 uses the risk of child malnutrition to evaluate the effectiveness of tobacco and alcohol control policies in reducing the consumption prevalence of both goods among vulnerable households in Kenya.

Chapter 4 estimates the responsiveness of demand for both formally and informally produced tobacco and alcohol products, as well as *khat*, to changes in the price of cigarettes and formally produced beers. Chapter 4 also presents an analysis of the impact of tobacco and alcohol control policies on the regressivity/progressivity of household tobacco and alcohol burdens (i.e. tobacco and alcohol budget shares). Chapter 5 presents a summary of the main findings and areas of future research. Each of the three main chapters is briefly discussed below.

1.2.1 Impact of tobacco and alcohol consumption and taxation on household spending patterns

Households that consume tobacco and alcohol have been found to spend less on items that are necessary for human capital development. The crowding-out effect of both tobacco and alcohol expenditures may be more severe in LMICs, which have a relatively larger share of poor households (John, 2008a; Pu et al., 2008; John et al., 2012; Jumrani and Birthal, 2017). The few studies on the opportunity cost of tobacco and alcohol consumption that have been done on sub-Saharan African countries have all focused on household tobacco consumption or spending (Koch and Tshiswaka-Kashalala, 2008; Chelwa and Van Walbeek, 2014; Ross et al., 2017).

San and Chaloupka (2016) and Ross *et al*. (2017) extended the literature on the crowding-out effects of tobacco expenditure/consumption by evaluating the effects of tobacco-control policies on household spending patterns. Both studies used two cross-sectional household surveys that were about five years apart. They did not reach a definitive conclusion on the effects on household spending patterns of the different tobacco-control policies implemented in the two contexts.

In Chapter 2, I use the two most recent Kenya Integrated Budget and Household Surveys (KIHBSs) to contribute to the literature on the opportunity costs of tobacco and alcohol consumption. The first objective of chapter 2 is the estimation of the difference in household spending patterns between households that consume tobacco or alcohol and those that do not. Past studies have used conditional Engel curves in the estimation of the crowding-out effects of tobacco/alcohol expenditures. Due to the endogeneity associated with tobacco/alcohol expenditures, as well as the tobacco/alcohol consumption status, researchers have used instrumental variable techniques.

The adult sex ratio has been used as an instrumental variable for the tobacco expenditure/consumption status of households. The choice of the adult sex ratio is based on the

prevailing patterns of tobacco use. In contexts where the majority of the smokers or tobacco consumers are adult males, the adult sex ratio has been found to be a good predictor for the tobacco-consumption status of households (John, 2008a; Chelwa and Van Walbeek, 2014; San and Chaloupka, 2016). A similar argument was used by Pu *et al*. (2008) to justify the use of the adult ratio as an instrumental variable for alcohol expenditure in Taiwan.

Chelwa and Van Walbeek (2014) pointed out that despite the adult sex ratio being a good predictor for the tobacco-consuming status of households, it may violate the exclusion restriction, because it may directly influence the expenditures on other items. Therefore, they used the method developed by Nevo and Rosen (2012) to relax the exclusion restriction. They subsequently generated upper bounds for the difference in expenditure patterns between tobacco and non-tobacco consuming households in Zambia.

This study also uses the method developed by Nevo and Rosen (2012) to relax the exclusion restriction. However, by adopting the specification of the adult sex ratio used by San and Chaloupka (2016), I generate both the upper and lower bounds for the difference in expenditure patterns between households that consumed tobacco (alcohol) and those that did not.

The second part of chapter 2 considers the impact of tobacco and alcohol taxation on household spending patterns. This exploits a natural experiment that occurred during the Kenya Integrated Household and Budget Survey (KIHBS) 2015-2016 data collection period. A change in the excise tax system during the data collection period resulted in two groups of nationally representative subsamples. One subsample (interviewed before the tax change) were subjected to lower taxes and prices and the other subsample (interviewed after the tax change) were subjected to higher taxes and prices.

This chapter uses matched difference-in-differences (MDID) technique to estimate the effect of a tobacco (alcohol) tax increase on household spending patterns in a LMIC. The pseudo-panel generated during MDID also provides a new way of controlling for possible endogeneity arising from time-invariant unobservables. Therefore, the MDID results also provide a robustness check for the other methods that have been used to estimate the difference in expenditure patterns between tobacco (alcohol) consuming household and households that did not consume tobacco (alcohol).

1.2.2 The risk of child malnutrition in tobacco- and alcohol-consuming households

The two most immediate causes of malnutrition are low calorie intake and disease (UNICEF, 1991). Tobacco- and alcohol-consuming households have been found to spend less on items necessary for human capital development, such as food and healthcare. As a result, children living in tobacco-consuming households may be at more risk of being malnourished (Efroymson et al., 2001; John, 2008a).

The prevailing expenditure patterns of tobacco-consuming households were the motivation for studies by Semba *et al*. (2007) and Best *et al*. (2007, 2008), which found that children whose parents consumed tobacco were at a higher risk of being malnourished. Previous studies on the risk of child malnutrition in tobacco-consuming households were done on Asian countries. These focused on the youngest child in each household and did not explicitly address the cluster/village level factors that may have influenced child nutrition.

Kenya, like other developing countries in sub-Saharan Africa, has relatively high levels of both short-term and long-term child malnutrition. WHO (2012) estimated that in 2005/6 18.4% of children in Kenya were underweight and 40.9% were stunted. The rate of child malnutrition in Kenya was higher in rural areas, where more than 60% of children under the age of five years resided.

Chapter 3 uses data from the two most recent KIHBSs to investigate the risk of child malnutrition in tobacco and alcohol-consuming households. There was a 10-year gap between the two KIHBSs. Over that 10-year period, Kenya implemented new price and non-price tobacco and alcohol control policies. The objective of chapter 3 is to determine whether the risk of child malnutrition differs between children living in tobacco and alcohol-consuming households and those who live in households that do not consume tobacco/alcohol. The chapter also seeks to establish whether the risk of child malnutrition in tobacco and alcohol-consuming households changed over the 10-year period.

Multilevel logit is used to estimate the difference in the risk of child malnutrition between households that consumed tobacco and alcohol and those that did not consume the two goods. Multilevel logit was selected because it accounts for the possibility of correlation in nutritional outcomes between children living in the same cluster/village. Use of the multilevel model also accommodates the inclusion of contextual effects in the estimated model.

Contextual effects refer to the effects of cluster/village level variables on a child's nutrition outcomes. Inclusion of cluster/village level variables such as sanitation, access to

water, and healthcare facilities may provide information on public health interventions that could improve child nutrition outcomes in Kenya. As a robustness check, models using logit (with cluster fixed effects) and General Estimation Equations are also estimated.

1.2.3 Expenditure burdens and price elasticity of demand for tobacco and alcohol in Kenya

Tax-induced price increases are one of the most effective policy tools for controlling the demand for tobacco and alcohol. Most of the early evidence on the responsiveness of demand for tobacco and alcohol to changes in their respective prices was based on aggregate state- or country-level data. The studies were mostly conducted on developed countries, because many LMICs lacked reliable aggregate data (IARC, 2011; WHO, 2007, 2015; Chelwa, 2015).

The use of household/individual level survey data has aided the estimation of the price elasticity of demand for tobacco and alcohol in some LMICs (John, 2005, 2008b; Selvaraj *et al.*, 2015; Fuchs Tarlovsky *et al*., 2018). However, studies on sub-Saharan Africa have been relatively few, and the few studies done on Africa have focused on formally produced alcohol products and cigarettes.

African countries south of the Sahara, have relatively weaker institutions than those of developed nations. As a result, they have limited capacity to prevent smuggling as well as illegal production of alcohol and tobacco products. Consequently, they tend to have higher consumption rates of informally produced alcohol and non-cigarette/smokeless tobacco products (Sornpaisarn et al., 2013; Jawad et al., 2018). As is the case with other sub-Saharan African countries, the consumption of informally produced alcohol is widespread in Kenya. There is also a substantial use of non-cigarette and smokeless tobacco products.

The effectiveness of a tax policy which focuses on formally produced alcohol and tobacco products in Kenya, is likely to be influenced by the consumption of informally produced alcohol as well as non-cigarette tobacco products. *Khat* is one substance that may affect the effectiveness of price in controlling the demand for tobacco and alcohol in Kenya.

In Kenya, taxation has mainly focused on cigarettes and formally produced alcoholic beverages. Cigarette taxes are an effective tool for reducing demand, but they are also known to be regressive (Koch, 2018). Similarly, taxes on alcohol in some African countries have also been found to be regressive (Ataguba, 2012). The regressive nature of tobacco and alcohol taxes has prompted studies on the equity impact of different tobacco and alcohol control policies (Hill et al., 2014; Bosdriesz et al., 2015; Vandenberg and Sharma, 2016; Koch, 2018).

Kenyan policy makers have also grappled with the regressive nature of tobacco and alcohol taxes. For example, Parliamentarians have justified the implementation of a tiered tax system for cigarettes on the grounds that it favoured poor smokers (Nargis e*t al*., 2015). Similarly, alcohol products that are mostly consumed by poor Kenyans have also received preferential tax treatment.

Chapter 4 uses the two most recent KIHBSs and the method developed by Deaton (1987, 1988, 1990, 1997) to estimate the own-price and expenditure elasticities of demand for tobacco and alcohol products that are consumed in Kenya. It also estimates the responsiveness of demand for informally produced alcohol, non-cigarette tobacco products and *khat* to changes in the prices of formally produced beers and cigarettes.

In the second part of chapter 4, the two KIHBSs and the method developed by Kakwani (1977) are used to estimate the evolution of the regressivity/progressivity of household tobacco and alcohol burdens. Specifically, the chapter investigates whether tobacco- and alcohol-control policies implemented between 2005 and 2015 had an impact on tobacco and alcohol budget shares of households in different socioeconomic groups.

CHAPTER 2: IMPACT OF TOBACCO AND ALCOHOL CONSUMPTION AND TAXATION ON HOUSEHOLD SPENDING PATTERNS IN KENYA

2.1 Introduction

Smoking and harmful alcohol consumption, have been identified as major contributors to premature death (WHO, 2009, 2010a, 2014a, 2017). However, the harm caused by tobacco consumption is not just a public health issue. In households where tobacco is consumed, other household members may be affected by the crowding-out effects of the expenditure on tobacco. Expenditure on tobacco has been found to adversely affect spending on education, food, clean energy, and medical care. The specific goods and services that are crowded out by tobacco may differ because of heterogeneity between countries (John, 2008a; John *et al*., 2012; Chelwa and Van Walbeek, 2014; Önder and Yürekli, 2014; Do and Bautista, 2015).

San and Chaloupka (2016) and Ross *et al*. (2017) extended the literature by analysing the effects of tobacco-control policies, such as price increases, pictorial warnings, extensions of the ban on smoking in public places, the ban on cigarette advertising and on selling single units, on household budget shares. Both studies used two cross-sectional household surveys that were about five years apart. Because of the time lapse between surveys, they did not isolate the effects of each individual tobacco-control policy on household spending patterns.

Tobacco and alcohol are consumed as complements by some segments of the population. Some studies that have estimated the crowding-out effect of tobacco have also concluded that tobacco expenditure crowds *in* alcohol expenditures (Cameron and Williams, 2001; Busch *et al.*, 2004; Pierani and Tiezzi, 2009; Tauchmann *et al.*, 2013). This prompted a few studies to investigate the crowding-out effects of both tobacco and alcohol expenditures. According to Pu *et al.* (2008) the goods that were crowded out by alcohol expenditure in Taiwan differed from those that were crowded out by tobacco expenditure. However, Jumrani and Birthal (2017) concluded that tobacco and alcohol expenditures crowded out similar goods in Indian households.

The harm caused by tobacco and alcohol consumption is more pronounced in low- and middle-income countries (LMICs), because more households are poor. Poor households have limited income to spend on human capital development. As a result, the crowding-out effect of both tobacco and alcohol has been found to have greater adverse effects among poor households (Do and Bautista, 2015; Jumrani and Birthal, 2017).

Sub-Saharan Africa as a region has a large proportion of poor households. Because of Africa's demographics and economic growth, it has been targeted as a prime market for the tobacco industry (Ahluwalia *et al.,* 2016). This poses an obstacle to efforts to reduce harmful effects of tobacco and may be contributing to the increase in tobacco consumption in some African countries.

Kenya, like some of the other sub-Saharan African countries, has experienced an increase in tobacco and alcohol consumption. Aggregate data from the annual statistical abstracts published by the Kenya National Bureau of Statistics (KNBS) indicated that between 2000 and 2016, the average annual increase in per adult cigarette consumption was 1.9% while the average annual increase in per adult beer consumption was 2.6%. According to World Bank, (2018b) the average annual growth in real *per capita* Gross Domestic Product (GDP) over the same period was 1.8%.

The increase in tobacco and alcohol consumption in Kenya outpaced the growth in real income. This indicated that the household budget share for tobacco and alcohol products may have been increasing. As a result, it was possible that there was a trade-off with expenditure on items necessary for human capital development. This is especially of concern, for the 46% of the population that were classified as poor in 2005 by the World Bank (World Bank, 2018), because tobacco and alcohol could be contributing to intergenerational poverty.

The two most recent Kenya Integrated Household and Budget Surveys (KIHBS) were carried out in 2005-2006 and 2015-2016. A new excise duty law was implemented during the 2015-2016 KIHBS data collection period. This resulted in nationally representative samples that were interviewed before and after implementation of the new taxes on tobacco and alcohol. After implementation of the tax law, the real price[2] of Sportsman cigarettes increased by 21% while that of Tusker beer increased by 14%. Therefore, the 2015-2016 KIHBS data collection process provided a natural experiment which is used to analyse the effects of tobacco/alcohol tax policy on household spending patterns.

The findings from this chapter show that tobacco and alcohol consumption in Kenya were associated with lower expenditures on education, healthcare, energy, and food items. Expenditure on tobacco (alcohol) crowded in expenditure on alcohol (tobacco). These results

[2] Real Prices calculated using monthly price and Consumer Price Index (CPI) published be the Kenya National Bureau of Statistics (KNBS).

are unchanged after relaxing the exclusion restriction by allowing the instrumental variable to be correlated with the error term.

The increase in cigarette prices resulting from the change in tobacco taxes did not have an impact on household spending patterns among tobacco consuming households. An increase in taxes on alcohol was associated with further crowding-out of expenditure on fruits among alcohol-consuming households. These results suggest that tobacco and alcohol consumption may be contributing to intergenerational poverty in Kenya. On the other hand, modest increases in taxes on tobacco may not have an adverse effect on the household budgets of tobacco-consuming households.

The rest of this chapter is organised as follows: the relevant literature is reviewed in section 2.2. Section 2.3 discusses the conceptual framework of how crowding-out may occur. Sections 2.4 and 2.5 contain the empirical strategy and a description of the data. The results and conclusions are presented in Sections 2.6 and 2.7.

2.2 Relevant literature

Households are faced with resource constraints. This is especially true for poor households, which form the majority in low-income countries. Because of the budget constraints that households face, some expenditures have to be foregone when resources are allocated to the consumption of tobacco and alcohol (Busch *et al*., 2004; Pu *et al*. 2008; Wang *et al.*, 2006).

The idea that there is an opportunity cost associated with expenditure on tobacco was proposed by Efroymson *et al.* (2001). Their study analysed the expenditures allocated to tobacco and other basic needs in Bangladesh. They concluded that if some of the expenditure on tobacco was reallocated to food and other basic needs, the nutrition and living standards of poor households could be improved. Further, the study suggested that by linking tobacco use and poverty alleviation, global agencies and governments in poor countries could be persuaded to spearhead tobacco-control efforts.

Research on the opportunity cost of tobacco expenditure has evolved since the study by Efroymson *et al.* (2001). Subsequent studies, such as Busch *et al.* (2004) and Wang *et al*. (2006), advanced the literature by including household characteristics that could determine the spending patterns. Busch *et al.* (2004) used state cigarette prices in the United States of America and consumer expenditure surveys for the period 1995 to 2001, and found that among

low-income households, tobacco expenditure crowded out expenditure on housing. Further, when cigarette prices increased, households spent less on cigarettes and more on food.

Using survey data on China, Wang et al. (2006) found that households that spent heavily on tobacco and alcohol (around 31% of their income on both goods), had 1.5 percentage point less savings compared to households that did not consume either tobacco or alcohol. They concluded that expenditures on food, medical care and utilities were crowded out by tobacco expenditure.

The next advancement in the literature, involved the treatment of the endogeneity associated with the inclusion of household tobacco expenditure in the demand equations. John (2008a) estimated the crowding-out effect of tobacco expenditure in India. He estimated conditional Engel curves using Three-Stage Least Squares (3SLS). Based on the patterns of tobacco use in India (where the majority of tobacco consumers were adult males), the adult sex ratio was used as an instrumental variable for household tobacco expenditure. The adult sex ratio was defined as the ratio of the number of male adults to the total number of adults in a household. The study found that those households that consumed tobacco spent less of their income on clean fuels, education, entertainment, and milk. The study concluded that the expenditures that were crowded out affected women and children more adversely. The crowding-out effect was similar for low- and high-income households.

San and Chaloupka (2016) also used the adult sex ratio as an instrumental variable. However, unlike other studies, they defined the adult sex ratio, as the ratio of female adults to the total number of adults in a household. This resulted in a negative relationship between adult sex ratio and tobacco expenditures, because of lower smoking rates among women in Turkey. The objective of the study was to test whether tobacco-control measures influenced the magnitude and type of expenditures that were crowded out by tobacco consumption in Turkey. They used data from two cross-sectional household surveys (2007 and 2011). They found that tobacco-control measures such as higher cigarette taxes and restrictions on public smoking, implemented between 2007 and 2011, contributed to a drop in the tobacco use prevalence rate. In both cross-sections, expenditure categories such as clothing, housing, and durable and non-durable goods were crowded out. Tobacco crowded in alcohol in both data sets.

Two cross-sectional household surveys for Mauritius were used by Ross *et al.* (2017) to estimate the effect of tobacco-control policies, such as an increase in excise taxes, pictorial warning labels, the banning of cigarette advertising and the sale of single cigarettes, on household spending patterns. The two surveys were carried out in 2006/7 and 2012. They found

that tobacco-control policies had resulted in a six-percentage point decrease in the share of tobacco-consuming households. Using Seemingly Unrelated Regression (SURE), they observed that, in both data sets, the budget share for education, healthcare, and communication was significantly lower for tobacco-consuming households. The negative effect was larger in the later data set. The SURE results were deemed to be lower bounds because analysis of the same data using 3SLS and household sex ratio as an instrumental variable resulted in an upward bias.

San and Chaloupka (2016) and Ross *et al.* (2017) did not use panel data sets that tracked the same households. In the study by Ross *et al.* (2017) there was also a slight change in the data collection method. Therefore, they did not have definitive results on the effects of tobacco control policies on the crowding-out effect of tobacco expenditure. Furthermore, by using two surveys that were done approximately five years apart, they could not isolate the effect of specific tobacco control-policies on household expenditure patterns.

Koch and Tshiswaka-Kashalala (2008) used a composite smoking prevalence rate, calculated from smoking prevalence estimates by Van Walbeek (2002), as an instrumental variable for household tobacco expenditure. In addition to introducing a different instrumental variable, the study focused only on smoking households in South Africa. They found that smoking was associated with lower expenditure on transport, healthcare, fuel, education, and clothing. Lower expenditure on food was only evident in the poorest households. Unlike other studies, they did not find a strong complementarity between smoking and expenditure on alcohol. The lack of strong complementarity may have been a result of focusing only on smoking households.

A more recent study on Africa, where most of the households are poor, was done by Chelwa and Van Walbeek (2014). Some subsequent studies, such as Paraje and Araya (2017) and Husain *et al.* (2018) were similar to that of Chelwa and Van Walbeek (2014), because they compared the expenditure shares between tobacco and non-tobacco consuming households. This was a departure from other studies which analysed the effect of changes in the tobacco consumption budget on the expenditure shares of other goods. Paraje and Araya, (2017) found that, in Chile, the share of expenditure on education, healthcare and housing was lower for tobacco consuming households. While Husain *et al.* (2018) found that in Bangladesh, tobacco-consuming households spent less on education, energy, transport, and communication. However, the two studies did not rule out the possibility that the tobacco consumption dummy was endogenous.

Chelwa and Van Walbeek (2014) analysed the difference in budget shares between smoking and non-smoking households in Zambia. They used the adult sex ratio as an instrumental variable for the household tobacco-consumption dummy. However, unlike the earlier studies, they used the method developed by Nevo and Rosen (2012) to relax the exclusion restriction. Their justification for relaxing the exclusion restriction was based on the possibility that the instrumental variable (the adult sex ratio) may have had a direct effect on some of the expenditure shares. Therefore, the adult sex ratio may not have met the exclusion restriction. The exclusion restriction requires the instrumental variable to be uncorrelated with the unobservable variables in the budget share regression.

After relaxing the exclusion restriction, Chelwa and Van Walbeek (2014) estimated the upper bounds for the coefficient on the tobacco dummy. They concluded that tobacco expenditure crowded out expenditures on food, clothing, water, and education. The categories of expenditure that were crowded out by tobacco consumption in Zambia differed between urban and rural households.

The rural-urban divide in the expenditures that were crowded out by tobacco was also present in Cambodia. John *et al.* (2012), using data from the 2004 Cambodia Socioeconomic Survey, found that, on average, rural households that consumed tobacco spent 2.8% of their income on tobacco while their urban counterparts spent 3.6%. Expenditure on tobacco was associated with lower expenditure on education in both rural and urban areas. Expenditure on clothing by tobacco-consuming households was lower in urban areas only. Further, only rural tobacco consuming households spent more on entertainment and housing. The effect of tobacco expenditure on disaggregated food expenditures was not estimated.

Tobacco and alcohol are consumed as complements by some segments of the population. Past studies have also shown that, at household level, higher expenditure on tobacco was associated with higher expenditure on alcohol (Cameron and Williams, 2001; Busch *et al.*, 2004; Pierani and Tiezzi, 2009; Tauchmann *et al.*, 2013). Based on the consumption patterns of both goods, a few studies have extended the literature on crowding out by considering the crowding-out effects of both tobacco and alcohol expenditures.

Pu *et al.* (2008) analysed the crowding out effects of both alcohol and tobacco expenditures in Taiwan. They instrumented tobacco expenditure by the adult sex ratio and alcohol expenditure by the adult ratio (proportion of adults in a household). The study concluded that the crowding-out effects of the two goods differed within households. Whereas alcohol expenditure crowded out utilities, education, rent, some medical expenditures, and

food, tobacco expenditures were associated with lower spending on clothing, equipment, medical care, durable goods, and transport.

Jumrani and Birthal (2017) also consider the crowding-out effects of both alcohol and tobacco in rural India. Their main contribution was the use of peer effects as an instrumental variable for tobacco and alcohol expenditures among Indian households. They found that the crowding out pattern of tobacco expenditure was similar to that of alcohol expenditures. Both alcohol and tobacco crowded-out food grains, consumer durables, healthcare, and education. However, fuel and light were only crowded out by alcohol expenditures. The crowding-out effect on food grains was greater among poor households. Tobacco did not crowd out education in poor households and upper-castes households. On average, the crowding-out effects of tobacco were greater than that of alcohol.

2.2.1 Contribution to the literature

It is clear from the existing literature, that expenditure on tobacco and alcohol may negatively affect spending on human capital development. This effect is more pronounced in low- and middle-income countries. The affected expenditures have been found to vary between countries (Do and Bautista, 2015). There is also evidence that tobacco and alcohol are consumed as complements in some contexts.

This chapter seeks to extend the literature on the crowding out effects of tobacco and alcohol expenditure. Household data from Kenya is used to estimate the difference in expenditure shares between households that consume tobacco (alcohol) and those that do not consume tobacco (alcohol). The impact of the expenditure on tobacco and alcohol on other household budget shares is also estimated. The few studies done on African countries, have only considered the crowding-out effects of tobacco consumption.

The adult sex ratio, which is used as an instrumental variable in this chapter as well as in previous studies, may not meet the exclusion restriction. This chapter follows the strategy that was used by Chelwa and Van Walbeek (2014) for relaxing the exclusion restriction, and generating upper bounds for the tobacco dummy. However, by adopting the specification of the adult sex ratio that was used by San and Chaloupka (2016) (i.e. proportion of adult females in the overall number of adults in the household) The upper and lower bounds for the difference in expenditure shares between tobacco (alcohol) consuming households and those that do not consume tobacco (alcohol) are generated.

A new tax on tobacco and alcohol was introduced during the KIHBS 2015-2016 data collection period. This offered a natural experiment that could be used to estimate the effects of tobacco/alcohol taxation on household expenditure patterns. Matched difference-in-differences (MDID) is used in the estimation of the effect of tobacco/alcohol taxation on household expenditure patterns.

The matched difference-in-differences creates a pseudo-panel and provides a new method of controlling for possible endogeneity arising from time invariant unobservable variables. It also controls for other macroeconomic variables that may have affected spending on other goods. To the best of my knowledge, this is the first study that has used this technique to study the impact of tobacco- and alcohol-tax policy on household expenditure patterns in the context of a developing country.

2.3 Conceptual Framework

Households' preferences can be represented by a utility function. Households seek to maximise utility (U), subject to their budget constraints, given the prices of the goods in the market and a vector of each household's characteristics.

$$Max\ U = U(x_1, x_2, \dots x_n; \boldsymbol{\theta})\ \ s.t. \sum_{i=1}^{n} p_i\, x_i = y \qquad (2.1)$$

Where x_i is the consumption of the i^{th} good, $\boldsymbol{\theta}$ is a vector of household characteristics, p_i is the price of the i^{th} good and y is the total household expenditure. The utility function can be modified to allow for the consumption of some of the goods (either alcohol or tobacco) to be predetermined. The set of goods whose consumption is predetermined are called the conditioning goods. Households maximise utility from expenditure on all other goods subject to the income available after netting out expenditure on the conditioning goods (Pollak, 1969; John, 2008a). The new household maximisation problem becomes;

$$Max\ U = U(x_1, x_2, \dots x_n;\ \boldsymbol{\theta}) \quad s.t. \quad \sum_{i=1}^{n-1} p_i\ x_i\ = M \qquad (2.2)$$

Where $M = y - p_t t\ \ or\ M = y - p_a a\ or\ M = y - (p_t t + p_a a)$, p_t is the price of tobacco, p_a is the price of alcohol, t is the quantity of tobacco consumed, and a is the quantity of alcohol consumed by each household. The result of the constrained maximisation of utility is the conditional demand function presented in equation (2.3) below. The demand function is for the i^{th} good conditional on consumption of the n^{th} good (tobacco/alcohol). Conditional

demand functions are suitable for modelling consumer behaviour in the short run. Advantages of using a conditional demand approach include ease of testing for weak separability and the avoidance of switching demand systems when there are corner solutions in the conditioning goods. However, for policy formulation it should be noted that conclusions arrived at from the estimation of conditional demand equations are conditional on the quantities of the conditioning goods that are consumed (Pollak, 1969; Browning and Meghir, 1991; John, 2008a).

$$x_i = g^{i,n}(p_1, \dots p_{n-1}, M, x_n; \boldsymbol{\theta}) \ (\forall\, i \neq n) \qquad (2.3)$$

The main estimation equations are based on equation (2.3). This chapter compares household Marshallian demand functions for different commodities. The comparison is made between households that report positive expenditure on tobacco (alcohol) and those that report zero expenditure on tobacco (alcohol). Crowding-out effects of expenditures on tobacco/alcohol are also estimated. This chapter also estimates the effect of tobacco/alcohol taxation on household expenditure patterns.

2.4 Empirical Strategy

The first step involves determining whether there is a difference in the expenditure shares of food and non-food items between households that consume tobacco (alcohol) and those that do not consume tobacco (alcohol). The shares considered include expenditures on different food items, education, healthcare, water, clothing, energy, transport, rent, and communication. However, the difference in expenditure shares for these commodities, could be a result of differences in household characteristics.

The next step involves the comparison of household Marshallian demand functions for the above commodities. Data on prices is not available in most expenditure surveys done on developing countries. Therefore, conditional Engel curves from Quadratic Almost Ideal Demand Systems (QUAIDS) that take the form of equation (2.4), equation (2.5) and equation (2.6) below are used.

Studies such as John (2008a); Pu *et al.* (2008); Chelwa and Van Walbeek (2014); and Jumrani and Birthal (2017) also used QUAIDS for similar analysis. In equation (2.4) below, the budget share for the different household expenditure categories is expressed as a function of household characteristics, log of household expenditure and the tobacco/alcohol consumption status of the household.

w_i is the budget share of commodity i in the remaining budget after the expenditure on tobacco or alcohol is netted out, $p_t t$ ($p_a a$) is the expenditure on tobacco (alcohol), M is the total expenditure less the expenditure on tobacco (alcohol) and $\boldsymbol{\theta}$ is a vector of household characteristics. Variables such as years of schooling of the most educated household member, log of household size, level of schooling of the household head, wage employment status of the household head, age of adults, age of children, proportion of adults to children, number of people in wage employment, religion of the household head and location (urban or rural) are included in the vector of household characteristics. FE refers to cluster fixed effects, ME represents the month/seasonal fixed effects and d is a dummy for the tobacco (alcohol) consumption status of a household.

$$w_i = (a_{1i} + a_{2i}\, d + a_{3i} p_t t + \delta_i' \boldsymbol{\theta} + \alpha_{4i} FE + \alpha_{5i} ME) + (b_{1i} + b_{2i} d) lnM + (r_{1i} + r_{2i} d)(lnM)^2 \quad (2.4)$$

Studies that used equation (2.4) focused on the crowding-out effect of the nominal amounts that households spent on tobacco/alcohol. Therefore, α_{3i} was used to determine the effect of changes in expenditure on tobacco (alcohol) on the expenditure shares of other commodities. If a_{3i} is found to be negative and significant, then the amount spent on tobacco (alcohol) crowds out expenditure on that commodity *ceteris paribus.*

FE captures cluster fixed effects and is included because of the assumption that households within a cluster or geographical location face the same relative prices. It also controls for tastes which could be similar in a cluster but differ across clusters. FE is exogenous because households within each cluster are too small to determine the structure of cluster level price (Deaton, 1987, 1988, 1990; Chelwa and Van Walbeek, 2014).

Month/seasonal fixed effects (ME) are also included in the budget share equations. Seasonal effects are included because household surveys in developing countries are sometimes carried out over several months. Expenditure shares that are allocated to different categories of goods may vary according to the month in which the household was interviewed. For instance, because of the seasonal nature of some of the food items, the expenditure shares by households for different food categories may vary based on the month they were interviewed. Equation (2.5) below is a variation of equation (2.4). The budget share of different commodities is a function of household characteristics, log of total expenditure, and the tobacco/alcohol consumption status. $w_{ij}$is the budget share of commodity i in household j in

the remaining budget after the expenditure on tobacco or alcohol is netted out, d_j is a dummy variable that takes value one if household j consumes tobacco (alcohol) and zero otherwise.

$$w_{ij} = \beta_{1i} + \beta_{2i}\, d_j + \varsigma_i \boldsymbol{\theta}_j + \beta_{3i} lnM_j + \beta_{4i}(lnM)_j^2 + \beta_{5i} FE + \beta_{6i} ME \qquad (2.5)$$

Studies that used equation (2.5) focused on the differences in the expenditure shares of tobacco (alcohol) and non-tobacco (non-alcohol) consuming households, as opposed to the *amount* that was spent on tobacco or alcohol. The difference in the two specifications (equation (2.4) and equation (2.5)) is explored further when explaining the treatment of possible endogeneity. For comparability with earlier studies, both equation (2.4) and equation (2.5) are estimated.

Equation (2.5) is similar to the equation estimated by Chelwa and Van Walbeek (2014) and Paraje and Araya (2017). β_{2i} is used to establish whether the expenditure patterns of tobacco (alcohol) consuming households differ from those of non-consumers. If β_{2i} is negative and significant, then tobacco (alcohol) consuming households have a lower expenditure share for that commodity than non-tobacco (non-alcohol) consuming households, *ceteris paribus.*

An expenditure of zero on tobacco (alcohol) by households may be a result of corner solutions or abstention. The concern that zero expenditures are due to corner solutions is amplified in situations where surveys are conducted over a long period. To determine the possible cause of zero expenditures on tobacco (alcohol) the test developed by Vermeulen (2003) is used. The test which coincides with the consumer separability test, involves checking whether the parameters associated with d in equation (2.4) are jointly significant. If the parameters associated d with are not jointly significant, John et al. (2019) suggested that equation (2.6) below should be used to estimate the crowding out effects of tobacco (alcohol) expenditure. Equation (2.6) is similar to equation (2.4) however, the parameters associated with d in equation (2.4) are not included in equation (2.6).

$$w_i = (a_{1i} + a_{3i} p_t t + \delta_i' \boldsymbol{\theta} + \alpha_{4i} FE + \alpha_{5i} ME) + b_{1i} lnM + r_{1i}(lnM)^2 \qquad (2.6)$$

Heteroscedasticity is the norm in data from cross-sectional household surveys (John et al., 2019). The Breusch-Pagan test for heteroscedasticity is used to determine whether the errors are heteroscedastic. According to Browning and Meghir (1991), there is a possibility of endogeneity associated with $p_t t$ $(p_t a)$, d and M in equation (2.4), equation (2.5) and equation (2.6). If the errors are homoscedastic, the Durbin-Wu-Hausman test for exogeneity is used to

determine whether the three variables are endogenous. However, if the errors are heteroscedastic, the C-statistic test is used to test for endogeneity.

To correct for possible endogeneity, I use instrumental variables. The adult sex ratio is identified as a possible instrumental variable for both the tobacco/alcohol consumption status and the amounts spent on the two goods by households. Studies that focus on the amounts spent on the two goods control for the endogeneity of $p_t t$ $(p_t a)$. Those that focus on consuming/non-consuming households, but not on the amounts spent on the two products, consider the endogeneity of d. Value of household assets is identified as a possible instrumental variable for household expenditure on other goods, after netting out tobacco or alcohol expenditure (Pu *et al.*, 2008; Chelwa and Van Walbeek, 2014).

The reason for the selection of the adult sex ratio as an instrumental variable is based on the consumption patterns of the two goods, reported by WHO (2010b, 2014b, 2016). In 2014, the prevalence of tobacco use in Kenya was estimated to be 19.1% among men and 4.5% among women. In 2010, an estimated 32% of adult men and 13% of adult women consumed alcohol in Kenya. In 2016, this had risen to an estimated 34% of adult men and 14% of adult women in Kenya who consumed alcohol. The value of assets is identified as a possible instrumental variable for M. Other studies on Africa have found the value of assets to be highly correlated with household expenditure and income. Assets also satisfy the exclusion restriction because, demand is seldom estimated with assets as an explanatory variable (Chelwa and Van Walbeek, 2014).

A first stage probit for the alcohol/tobacco consuming status of the households and a linear regression for the log of total household expenditure are run to confirm the relevance of the instruments. Subsequently, because of the expectation of contemporaneous correlation, the system of Engel Curves is estimated using the Three-Stage Least Squares (3SLS) method. The final 3SLS estimation has twenty equations for the 2005-2006 KIHBS, and twelve equations for the 2015-2016 KIHBS. In both estimations, one equation (all other household expenditures not considered) is dropped from the system. Because of the expectation that the errors are heteroscedastic, bootstrapped standard errors from the 3SLS estimation are reported (Chelwa and Van Walbeek, 2014; Jumrani and Birthal, 2017).

The taxes on tobacco and alcohol were increased during the 2015-2016 KIHBS data collection period. This meant that the effect of such a tax on household expenditure patterns could be estimated in a real-world context. Bosch and Koch (2014) used a similar natural experiment to examine tobacco tax regressivity in South Africa. They introduced a tax dummy

in the tobacco budget share equation of tobacco-consuming households. Their idea is adapted here to estimate the effect of a tobacco/alcohol tax increase on the expenditure shares of other goods.

A system of equations focusing only on tobacco (alcohol) consuming households that includes a tobacco (alcohol) tax dummy (τ_j) is estimated. τ_j is assigned value one if household j was interviewed after the tax increase and zero if household j was interviewed before the tax increase. Owing to expected contemporaneous correlation in the equations, Seemingly Unrelated Regression (SURE) is used. Equation (2.7) is similar to equation (2.5) but τ_j is introduced to compare the average expenditure shares before and after the imposition of the new taxes on tobacco and alcohol. However, the SURE estimation does not control for other macroeconomic factors that may have affected expenditure shares on other goods.

$$w_{ij} = \rho_{1i} + \rho_{2i}\,\tau_j + \zeta_i \boldsymbol{\theta}_j + \rho_{3i} lnM_j + \rho_{4i}(lnM)_j^2 + \rho_{5i} FE \qquad (2.7)$$

The natural experiment arising from the change in the tax on tobacco and alcohol during the data collection period resulted in a set of nationally representative sub-samples. The sub-samples were made up of households that were interviewed before and after the tax change. This resulted in four categories of households: tobacco (alcohol) consuming households interviewed after the tax increase (group A), households that did not consume tobacco (alcohol) that were interviewed after the tax increase (group B), tobacco (alcohol) consuming households that were interviewed before the tax increase (group C) and households that did not consume tobacco (alcohol) that were interviewed before the tax increase (group D).

The existence of nationally representative sub-samples that were interviewed before and after the tax change provides an opportunity to carry out a more comprehensive analysis of the implication of the tax increases than the regression in equation (2.7). Consequently, a matched difference-in-differences (MDID) technique is used to analyse the implication of tobacco/alcohol tax increase for household spending patterns. An intuitive summary of MDID is provided before the more technical explanation.

MDID involves three basic steps (for clarity, tobacco consumption is used as an example). The first step involves using propensity score matching (PSM) to match tobacco-consuming households that were interviewed after the increase in tobacco taxes (group A), to similar households in the other three groups (groups B, C, and D). The second step involves getting the difference in expenditure shares of the matched households, specifically, the difference in expenditure shares between tobacco consuming and non-tobacco consuming

households interviewed before the tax increase and the difference between tobacco and non-tobacco consuming households interviewed after the tax increase.

The third step involves getting the difference between the pre-tax and post-tax differences. MDID controls for other macroeconomic shocks that may have affected household expenditure over the two time periods. That is, it controls for other macroeconomic shocks that affected both the tobacco and non-tobacco consuming households. It also controls for time-invariant unobserved variables, thereby minimizing unobserved variable bias. If the difference for a given expenditure category is found to be significantly larger after the increase in tobacco taxes, the widening gap in the differences between tobacco and non-tobacco consuming households over the two periods is attributed to the tax increase, *ceteris paribus*.

Matched difference-in-differences is implemented by using kernel matching with the enforcement of common support, to create a counterfactual for households in group A. The observable household characteristics are used for the PSM. The households in group A are matched to similar households in the other three groups. The matched households constitute a pseudo-panel that is then used to estimate the difference-in-differences. Using MDID controls for time invariant unobservable variables as well as for macroeconomic variables that affect all households (Blundell and Dias, 2009; Stuart *et al.*, 2014; Gertler *et al.*, 2016).

The assumptions and formal presentation of how matched difference-in-differences can be used to estimate the average effect of the tobacco (alcohol) tax on households that consumed tobacco (alcohol) are given below. The presentation follows Blundell and Dias (2009). Let X be the set of observable household characteristics. There are two time periods $t_0 \; and \; t_1$ with $t_0 < k < \; t_1$; k refers to the time when the new tax on alcohol/tobacco was implemented. w_{ijt_1}, is the budget share of good i, in household j that was interviewed in period t_1 (after the tax increase) and u_{jt_1} represents the unobservable variables in period one.

The two main assumptions are: conditional on X, the evolution of the unobservable variables is independent of the tobacco/alcohol dummy and, based on X, households in group A can be matched to similar households in the other three groups. Matching is only possible if X does not predict the tobacco/alcohol consumption status perfectly($P[dj = 1|Xj < 1]$). That is, the region X is present in all the groups. If S is the subspace of the distribution of X that is represented in all the groups, then S is the common support of X. Based on these assumptions, the matching difference-in-differences estimator (MDIDE) for repeated cross-section data is given by;

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

Where $\widetilde{WH}_{jlt_0}$ represents the weight attributed to household l interviewed at time t_0 when comparing with household j that consumed tobacco/alcohol. WH_j accounts for reweighting that reconstructs the outcome distribution for the tobacco (alcohol) consuming households in group A.

2.5 Description of the data

The data for the study were obtained from the two most recent Kenya Integrated Household and Budget Surveys (KIHBSs). The two surveys were carried out by the Kenya National Bureau of Statistics (KNBS) in 2005-2006 and 2015-2016. The surveys were carried out to collect socioeconomic indicators that could be used to analyse the progress made in the improvement of living standards among Kenyan households. Data from the surveys were used to update the system of national accounts and the Consumer Price Index.

The 2005-2006 KIHBS was a national survey that covered a total of 1,343 clusters. The total number of households targeted was 13,430 (ten households per cluster). The 13,430 households were drawn from the rural and urban sections of each of Kenya's 69 districts. The final survey included 13,158 households; 4 clusters were not covered due to inaccessibility and security issues and some clusters did not yield the targeted ten households.

Household expenditure data was collected using diaries issued to the surveyed households. A summary of the household characteristics and expenditure shares from the 2005-2006 KIHBS is presented in Table 2.1. 17% of households consumed tobacco and 14% of households consumed alcohol. 6% of households consumed both tobacco and alcohol, 11% consumed only tobacco and 8% consumed only alcohol. The proportion of tobacco-consuming households was higher in rural areas: 20% of rural households and 12% of urban households consumed tobacco. Alcohol consumption rates were similar for both rural and urban households.

Alcohol-consuming households, on average, dedicated 9.0% of their household budget to alcohol consumption. Tobacco expenditure on average made up 3.6% of household expenditure among households that consumed tobacco. The lion's share of household expenditures was on food. The categories of items with the largest shares of overall expenditure were food (58%) energy and education (9.1%), clothing and footwear (7.2%).

Table 2.1 Descriptive statistics from the 2005-2006 Kenya Integrated Household Budget Survey (KIHBS)

		Tobacco		Alcohol	
Statistic	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Number of households	13,158	10,921	2,237	11,354	1,804
Percentage of tobacco consuming households	17.00%	0.00%	100%	12.60%	44.68%
Percentage of alcohol consuming households	13.71%	9.14%	36.03%	0.00%	100%
Percentage of households in Rural areas	64.41%	80.02%	19.98%	86.30%	13.70%
Percentage of households in Urban areas	35.59%	88.38%	11.62%	86.27%	13.73%
Average monthly tobacco expenditure (in USD)[3]	0.77	0.00	4.55	0.53	2.33
Average monthly alcohol expenditure (in USD)	2.21	1.53	5.54	0.00	16.12
Average monthly household expenditure[4] (in USD)	200.51	208.15	163.20	191.65	256.29
Average household size	5.05	5.02	5.23	5.07	4.96
Percentage of adults in household	58.34%	57.97%	60.17%	57.71%	62.36%
Percentage of male adults[5]	47.03%	45.63%	53.89%	45.54%	56.42%
Average age of children in household	8.47	8.44	8.61	8.43	8.73
Average age of adults in household	36.71	36.11	39.62	36.56	37.59
Average number of employed	1.13	1.12	1.19	1.12	1.17
Share of households where most educated household member has post primary education	48.65%	51.72%	32.70%	48.98%	46.62%
Average age of household head	44.20	43.51	47.64	44.06	45.13
Share of households where household head has post primary education	42.79%	45.10%	28.75%	42.97%	42.72%
Percentage of household heads with regular monthly income	39.18%	40.15%	34.42%	38.99%	40.35%
		Tobacco		**Alcohol**	
AVERAGE BUDGET SHARES	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Tobacco	0.61%	0.00%	3.59%	0.46%	1.56%
Alcohol	1.23%	0.79%	3.40%	0.00%	8.98%
Education	4.49%	4.83%	2.83%	4.62%	3.67%
Energy (electricity, gas, fuels & heat energy)	4.62%	4.83%	3.59%	4.77%	3.69%
Bread and cereal	14.33%	13.87	16.57%	14.59%	12.66%
Banana and tubers	3.48%	3.54%	3.20%	3.56%	3.04%
Poultry	1.03%	1.04%	0.97%	1.00%	1.24%
Meats	4.42%	4.22%	5.37%	4.34%	4.94%
Fish and sea food	1.35%	1.38%	1.22%	1.36%	1.33%
Milk and eggs	6.77%	6.75%	6.90%	6.89%	6.03%
Fruits	2.48%	2.50%	2.39%	2.50%	2.38%
Vegetables	5.17%	5.21%	4.96%	5.15%	5.29%
Other foods	18.99%	18.79%	19.91%	19.29%	17.04%
Health	0.73%	0.72%	0.73%	0.75%	0.59%
Clothing and footwear	7.23%	7.35%	6.62%	7.22%	7.24%
Water	0.90%	0.91%	0.87%	0.93%	0.71%
Transport	3.36%	3.51%	2.59%	3.41%	3.03%
Furnishings & routine maintenance to dwelling	3.01%	3.06%	2.80%	3.06%	2.72%
Rent	3.69%	4.00%	2.18%	3.77%	3.18%
Communication	1.39%	1.52%	0.73%	1.40%	1.32%
Other expenditures	10.78%	11.21%	8.65%	11.00%	9.39%

[3] Converted to US dollars (USD) using end of period exchange rate (December 2005) reported by the Central Bank of Kenya (CBK). The exchange rate was 72.36 KSH to 1 USD.

[4] Based on the summation of relevant expenditure items considered in this study.

[5] Calculated as number of adult males/total number of adults.

The 2015-2016 KIHBS was conducted between September 2015 and August 2016. KNBS set out to collect data from 2,400 clusters in the urban and rural areas of Kenya's 47 counties[6] (The promulgation of a new constitution in 2010 created 47 devolved units called counties). 24,000 households in all were expected to be surveyed over the 12-month period. However, due to the insecurity and unavailability of households in some parts of the country, the final dataset contained 21,773 households.

The descriptive statistics for the 21,773 households surveyed during the 2015-2016 KIHBS are reported in Table 2.2. 11.7% of the households consumed tobacco and 14.2% consumed alcohol. 6.8% of the households consumed only tobacco, 9.3% consumed only alcohol and 4.9% consumed both alcohol and tobacco.

The prevalence of tobacco consumption was higher among rural households. 13.6% of rural households and 9.0% of urban consumed tobacco. The share of alcohol consuming households in rural and urban areas was similar. After accounting for the sampling design of the two surveys, it was evident that the proportion of tobacco consuming households had decreased between 2005-2006 and 2015-2016.

Over the ten-year period, tobacco-consuming households declined from 16.7% to 10.7%. The proportion of tobacco-consuming households in 2015-2016 KIHBS was similar to the prevalence of 11.6% reported by the Global Adult Tobacco Survey (GATS). GATS, which focused on individuals in Kenya, was carried out in 2014.

The percentage of urban tobacco-consuming households also declined from 11.7 % to 8.1% between the two KIHBSs. Similarly, in rural areas, tobacco-consuming households declined from 18.0% to 12.7%. The implementation of some of the provisions of the Tobacco Control Act, 2007, may have been a contributing factor to the decline in the percentage of tobacco-consuming households. Alcohol-consuming households increased from 13.2% to 14.7% over the ten-year period.

The budget share for tobacco, in tobacco-consuming households, had increased slightly, from 3.9% in 2005-2006 to 4.0% in 2015-2016 KIHBS. The alcohol budget share in alcohol-consuming households also increased, from 8.8% to 10.7% over the two surveys. Other major non-food expenditure categories in the 2015-2016 KIHBS were education (6.4%) and energy (7.6%).

[6] The counties were based on districts that existed prior to 2002. Some of these 47 districts were later subdivided to create the 69 districts that were in existence during the 2005-2006 KIHBS.

Table 2.2 Descriptive statistics from the 2015-2016 Kenya Integrated Household Budget Survey (KIHBS)

		Tobacco		Alcohol	
Statistic	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Number of households	21,773	19,222	2,551	18,692	3,081
Percentage of tobacco consuming households	11.72%	0.00%	100%	7.95%	34.57%
Percentage of alcohol consuming households	14.15%	10.49%	41.75%	0.00%	100%
Percentage of households in Rural areas	60.13%	86.45%	13.55%	85.62%	14.38%
Percentage of households in Urban areas	39.87%	91.05%	8.95%	86.20%	13.80%
Average monthly tobacco expenditure (in USD)[7]	0.72	0.00	6.16	0.46	2.28
Average monthly alcohol expenditure (in USD)	3.71	2.87	10.04	0.00	26.23
Average monthly household expenditure[8] (in USD)	190.91	191.17	188.99	183.75	234.35
Average household size	4.26	4.27	4.25	4.29	4.08
Percentage of adults in household	60.46%	59.88%	64.82%	59.52%	66.21%
Percentage of male adults[9]	46.03%	44.32%	58.92%	43.93%	58.77%
Average age of children in household	8.27	8.23	8.60	8.25	8.45
Average age of adults in household	38.65	38.21	41.99	38.64	38.74
Average number of employed	1.58	1.55	1.77	1.55	1.76
Share of households where most educated household member has post primary education	57.29%	59.26%	41.86%	58.20%	51.93%
Average age of household head	44.66	44.15	48.44	44.63	44.80
Share of households where household head has post primary education	44.74%	46.55%	29.84%	45.46%	40.77%
Percentage of household heads that received a wage/income	75.58%	75.64%	75.15%	74.35%	83.02%
		Tobacco		**Alcohol**	
AVERAGE BUDGET SHARES	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Tobacco	0.43%	0.00%	3.70%	0.32%	1.13%
Alcohol	1.50%	1.10%	4.45%	0.00%	10.59%
Education	6.42%	6.79%	3.69%	6.76%	4.33%
Energy (electricity, gas, fuels & heat energy)	7.60%	7.71%	6.71%	7.86%	5.97%
Bread and cereal	20.79%	20.85%	20.33%	21.57%	15.98%
Roots and tubers	1.83%	1.86%	1.61%	1.91%	1.35%
Meats	5.06%	4.99%	5.58%	5.04%	5.19%
Fish and sea food	1.62%	1.67%	1.32%	1.64%	1.53%
Milk and eggs	8.41%	8.64%	6.68%	8.78%	6.19%
Fruits	2.93%	2.91%	3.12%	2.99%	2.57%
Vegetables	6.09%	6.20%	5.26%	6.25%	5.12%
Other foods	14.18%	13.37%	20.34%	12.86%	22.21%
Rent	3.80%	4.06%	1.87%	4.00%	2.59%
Other non-food expenditures	19.32%	19.85%	15.36%	20.00%	15.26%

A new excise duty act (The Excise Duty Act, 2015) came into operation on 1st December 2015. The Excise Duty Act, 2015, marked a transition for Kenya from a mixed *ad valorem* and specific tax system for cigarettes to a single specific tax system. The new tax on tobacco was set to a uniform tax of Ksh. 2,500 per mille (Ksh. 50 per pack). This resulted in an increase in the retail price of the popular mid-range cigarette brands. The tax rates on spirits, wines, and most beers were also increased.

[7] Converted to US dollars (USD) using end of period exchange rate (December 2015) reported by the Central Bank of Kenya (CBK). The exchange rate was 102.31 KSH to 1 USD.

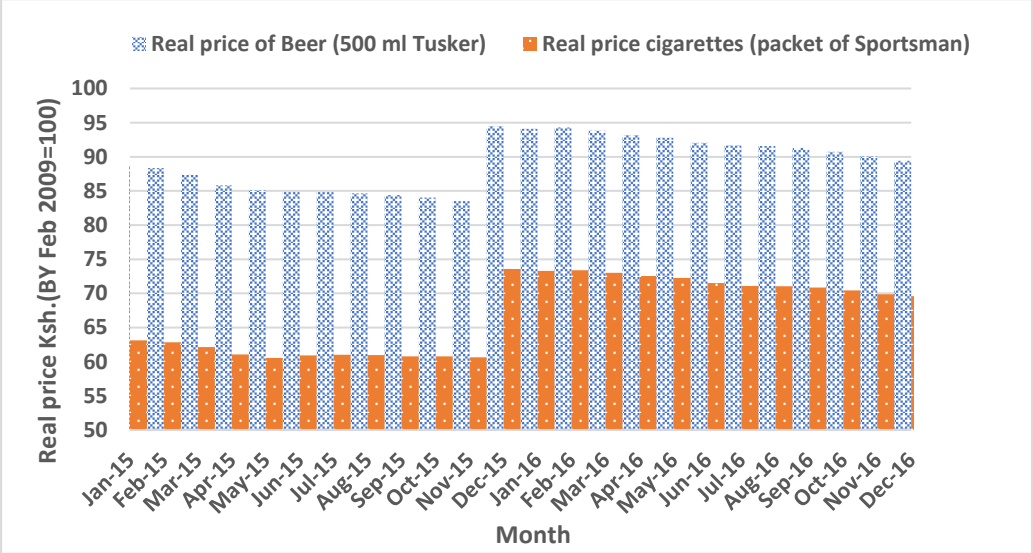
[8] Calculated by summing the relevant household expenditures considered for this study.

[9] Calculated as number of adult males/total number of adults

The effect of the Excise Duty Act of 2015 was evident in the price of Sportsman cigarettes and Tusker beer. These two products are the only tobacco and alcohol products that were included in the average monthly price data published by the Kenya National Bureau of Statistics. Figure 2.1 shows the real average monthly prices of a packet of Sportsman cigarettes and a bottle of Tusker beer.

Between November 2015 and December 2015, the real price of a packet of Sportsman increased by 21.3%. Over the same period, the real price of a bottle of Tusker increased by 13.2%. The average real prices of Sportsman cigarettes (Tusker beer) for the three months[10] after implementation of the higher excise duty was 20.9% (12.3%) higher than the average real price of sportsman cigarettes (Tusker beer) in the three months[11] prior to the imposition of the increased excise taxes.

Figure 2.1 Average monthly real prices of beer and cigarettes (January 2015-December 2016)



Source of data: Kenya National Bureau of Statistics

The implementation of the Excise Duty Act, 2015, coincided with the data collection period for the 2015-2016 KIHBS. KNBS ensured that they had a nationally representative sample in every quarter for the period September 2015 to August 2016. The first nationally representative subsample, consisting of 5,383 households, were visited over a period of three months before the implementation of the new tax system. The rest of the households, who were surveyed in the subsequent three nationally representative subsamples, were visited after the Excise Duty Act came into force.

[10] December 2015 to February 2016
[11] September 2015 to November 2015

Table 2.3 provides a breakdown of the proportion of households that consumed different tobacco and alcohol products in the four nationally representative subsamples. For most of the products considered, the share of consuming households remained relatively unchanged immediately before and immediately after the implementation of the new excise taxes on tobacco and alcohol products.

Table 2.3 Share of tobacco and alcohol consuming households over the KIHBS 2015-2016 survey period

		Month Interviewed				
		September 2015 to November 2015 (Before new excise tax Act)	**December 2015 to February 2016**	**March 2016 to May 2016**	**June 2016 to August 2016**	**Total**
	Number of households	**5,383**	**5,527**	**5,504**	**5,359**	**21,773**
Alcohol	Consumers	14.29%	15.18%	14.64%	12.42%	14.15%
	Non-Consumers	85.71%	84.82%	85.36%	87.55%	85.85%
Tobacco	Consumers	12.37%	12.29%	11.65%	10.54%	11.72%
	Non-Consumers	87.63%	87.71%	88.35%	89.46%	88.28%
Cigarettes	Consumers	7.90%	8.03%	8.03%	6.23%	7.56%
	Non -Consumers	92.10%	91.97%	91.97%	93.77%	92.44%
Beers	Consumers	4.92%	4.90%	4.83%	3.99%	4.67%
	Non-Consumers	95.08%	95.10%	95.17%	96.01%	95.33%
Traditional beers	Consumers	4.22%	5.37%	4.98%	4.35%	4.74%
	Non-Consumers	95.78%	94.63%	95.02%	95.65%	95.26%
Chang'aa	Consumers	4.44%	4.20%	3.71%	3.73%	4.02%
	Non-Consumers	95.56%	95.80%	96.29%	96.27%	95.98%

Notes: The table shows the percentage of households that reported positive consumption of different tobacco and alcohol products over the KIHBS 2015-2016 data collection period. Tax Act refers to Kenya's excise Duty Act, 2015. *Chang'aa* refers to a popular informally produced spirit that is made from sorghum, maize or millet.

2.6 Empirical Results

The difference in percentage points of the weighted mean expenditure shares between households that consumed tobacco (alcohol) and those that did not consume tobacco (alcohol) in the 2005-2006 KIHBS is presented in Table 2.4. The difference in expenditure shares between tobacco and non-tobacco consuming households was statistically significant for most of the expenditure items considered. Both rural and urban tobacco-consuming households had lower expenditure shares on education, energy, clothing and footwear.

Alcohol-consuming households had lower expenditure on education, energy, healthcare, water, and household dwelling maintenance. Both tobacco- and alcohol-consuming households had lower expenditures on milk and eggs. Tobacco-consuming (alcohol-consuming) households spent more on alcohol (tobacco).

Table 2.4 Differences in weighted mean expenditure shares between households that consumed Tobacco (Alcohol) and those that did not consume Tobacco (Alcohol) (KIHBS 2005-2006)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				1.18***	1.35***	1.13***
Alcohol	2.82***	3.37***	2.72***			
Education	-2.03***	-1.79***	-2.15***	-0.89***	-0.41	-1.05***
Energy	-1.09***	-0.97***	-0.97***	-1.16***	-1.79***	-0.92***
Bread and cereal	2.63***	0.36	2.15***	-1.09***	-1.65***	-1.19***
Banana and tubers	-0.10	0.19	-0.44*	-0.81***	-0.60***	-0.95***
Poultry	-0.09	-0.13	-0.20*	0.24**	0.55**	0.13
Meats	0.38**	0.20	0.51**	0.42**	0.10	0.54**
Fish and sea food	-0.16*	-0.21	-0.15	-0.04	-0.30***	0.04
Milk and eggs	-0.40**	-0.38	-0.61**	-0.73***	-1.21***	-0.64**
Fruits	-0.01	0.17	-0.08	-0.15	-0.45***	-0.06
Vegetables	-0.11	-0.23	-0.18	-0.08	-1.04***	0.20
Other foods	1.07***	0.93	0.82**	-1.74***	-1.77***	-1.81***
Health	0.03	-0.09	0.05	-0.16***	-0.26***	-0.14**
Clothing & footwear	-0.82***	-1.23**	-0.84***	0.01	0.52	-0.18
Water	0.02	-0.21	0.15**	-0.14**	-0.31***	-0.07
Transport	-0.80***	0.02	-0.73***	-0.58***	0.03	-0.70***
Furnishings	-0.23*	-0.43**	-0.23	-0.51***	-0.48**	-0.54***
Rent	-1.40***	-2.05***		-0.78***	-2.20***	
Communication	-0.73***	-0.51*	-0.59***	-0.28***	0.25	-0.24***
Other expenditures	-2.83***	-2.52***	-2.77***	-1.47***	-0.25	-1.81***

The coefficients are the differences in weighted mean expenditure shares expressed as percentage points. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). *p<0.1, **p<0.05, ***p<0.01.

The differences in the weighted mean expenditure shares between households that consumed tobacco (alcohol) and those households that did not consume tobacco (alcohol) in the 2015-2016 KIHBS are presented in Table 2.5. Tobacco (alcohol) consuming households had significantly lower expenditure shares on education, energy, rent, other non-food expenditures, and food items such as bread, cereals, tubers, vegetables milk and eggs. In the later survey, tobacco-consuming (alcohol-consuming) households also spent more on alcohol (tobacco).

Table 2.5 Differences in weighted mean expenditure shares between households that consumed Tobacco (Alcohol) and those that did not consume Tobacco (Alcohol) (KIHBS 2015-2016)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				0.84***	0.73***	0.92***
Alcohol	3.59***	3.91***	3.51***			
Education	-3.32***	-3.55***	-3.14***	-2.41***	-2.62***	-2.25***
Energy	-0.99***	-1.35***	-1.15***	-2.00***	-1.60***	-2.32***
Bread and cereal	-0.20	-1.04**	-1.60***	-5.72***	-5.39***	-6.01***
Roots and tubers	-0.18**	-0.25***	-0.33***	-0.65***	-0.59***	-0.70***
Meats	0.11	-0.34	0.36	0.09	-0.30	0.39*
Fish and sea food	-0.36***	-0.04	-0.63***	-0.09	0.19*	-0.02
Milk and eggs	-1.72***	-1.26***	-2.42***	-2.46***	-2.38***	-2.54***
Fruits	0.07	-0.03*	0.05	-0.63***	-0.74***	-0.54***
Vegetables	-0.76***	-0.52**	-1.18***	-1.53***	-1.82***	-1.31***
Other foods	8.01***	9.68***	7.26***	10.24***	11.43***	9.32***
Rent	-3.08***	-4.49***		-1.76***	-4.00***	
Other expenditures	-5.23***	-5.14***	-4.57***	-4.64***	-4.26***	-4.92***

The coefficients are the differences in the weighted mean expenditure shares expressed as percentage points. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). *p<0.1, **p<0.05, ***p<0.01.

The difference in expenditure shares could have been due to differences in household characteristics only, with tobacco or alcohol consumption playing no role. The test for consumer separability coincides with the test for whether the zero expenditure on alcohol and tobacco were due to corner solutions or abstention.

The test developed by Browning and Meghir (1991) and Vermeulen (2003) was used to test for consumer separability. The results presented in Table A1 and Table A2 show that the null hypothesis, of zeros in tobacco and alcohol expenditures arising from corner solutions, was rejected for households surveyed in 2015-2016. These findings were similar to what John (2008a) , Jumrani and Birthal (2017) and Pu *et al*. (2008) found when they carried out the test on household data from India and Taiwan. However, for the households surveyed in 2005-2006 the null hypothesis could not be rejected for about half of the expenditure categories that were considered.

Some of the differences in expenditure shares presented in Table 2.4 and Table 2.5 could have been caused by differences in household characteristics. The differences arising from differences in household characteristics were controlled for by estimating equation (2.5) using the Ordinary Least Squares (OLS) method. The results presented in Table A3 and Table A4 are the OLS estimates for the coefficients of the tobacco/alcohol dummies d, from equation (2.5).

The coefficients of d are the differences, in percentage points, of expenditures shares between households that consumed tobacco (alcohol) and households that did not consume tobacco (alcohol). For most commodities, the results from the OLS estimation of equation (2.5)

were qualitatively similar to the difference in the mean expenditure shares. However, the magnitudes of the difference in expenditure shares are lower for the OLS results.

As indicated in the previous section, past studies found that d and M in equation (2.5) as well as M and $p_t t(p_t a)$ in equation (2.4) and equation (2.6) were endogenous. The results from the C-statistic test for endogeneity are presented in Table A6, Table A7, Table A9, and Table A10 show that for most of the expenditure categories the null hypothesis that they were exogenous was rejected. C-statistic test was selected because the errors in the system of equation were found to be heteroscedastic. The results from the Breusch-Pagan test for heteroscedasticity are presented in Table A5 and Table A8.

As explained in Section 2.4, the adult sex ratio and value of assets were selected from the data sets as possible instrumental variables. The results of the first stage probit regressions presented in Table 2.6 and Table 2.7, as well as the expenditure regressions in Table A11 and Table A12, show that across all data specifications, the adult sex ratio was a good predictor of the household tobacco/alcohol consumption status, and of the amount spent on the two goods.

Pu *et al.* (2008) found that the adult ratio was a good predictor of household alcohol expenditure in Taiwan. In the Kenyan context, the adult sex ratio was found to be a better predictor of both alcohol expenditure and consumption status. The adult sex ratio was found to be a good predictor for all specifications, while the adult ratio was not a good predictor for some specifications. One possible reason was the disparity in alcohol use prevalence between men and women in Kenya. In 2010, an estimated 32% of adult men and 13% of adult women consumed alcohol in Kenya (WHO, 2010b). In 2016, an estimated 34% of adult men and 14% of adult women consumed alcohol in Kenya (WHO, 2016).

Table 2.6 First stage Probit regression for tobacco (alcohol) dummy (Marginal Effects) (2005-2006 KIHBS)

	Tobacco			Alcohol		
Coefficient on	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Adult sex ratio	0.195***	0.143***	0.228***	0.175***	0.178***	0.182***
	(0.0183)	(0.0252)	(0.0238)	(0.0154)	(0.0214)	(0.0229)
Adult proportion	0.0865**	0.0508	0.0896**	0.0199	-0.00404	0.0294
	(0.0351)	(0.0640)	(0.0408)	(0.0281)	(0.0455)	(0.0368)
lnHHsize	0.0633***	0.0689**	0.0586***	0.00639	-0.0121	0.0239
	(0.0161)	(0.0333)	(0.0169)	(0.0125)	(0.0205)	(0.0165)
Head schooling	-0.00143	-0.00597	-0.000406	0.00375*	-1.74e-05	0.00461*
	(0.00263)	(0.00504)	(0.00302)	(0.00215)	(0.00390)	(0.00263)
Wage head	-0.00276	-0.00107	-0.0205*	0.00326**	0.00288*	-0.0160
	(0.00365)	(0.00257)	(0.0105)	(0.00153)	(0.00164)	(0.0109)
Number employed	0.00139	-0.00751	0.00212	-2.15e-06	0.00646	-0.00121
	(0.00556)	(0.0130)	(0.00633)	(0.00458)	(0.00851)	(0.00550)
Age adults	0.00378***	0.00216	0.00420***	0.00121	0.00202	0.00121
	(0.000858)	(0.00182)	(0.000966)	(0.000739)	(0.00139)	(0.000885)
No of children under 5	0.00153	-0.0274	0.00857	0.00599	-0.00316	0.00542
	(0.00721)	(0.0183)	(0.00785)	(0.00567)	(0.0111)	(0.00670)
No. of children over 15	-0.0130	-0.00388	-0.0159	0.00491	0.0156	-0.00351
	(0.00918)	(0.0188)	(0.0105)	(0.00700)	(0.0133)	(0.00836)
Age head	-0.00262***	-0.00206	-0.00283***	0.000427	-5.64e-05	0.000287
	(0.000789)	(0.00161)	(0.000888)	(0.000641)	(0.00121)	(0.000770)
Most educated	-0.0118***	-0.00613	-0.0128***	-0.00725***	-0.00137	-0.00984***
	(0.00311)	(0.00568)	(0.00366)	(0.00246)	(0.00447)	(0.00300)
Non-poor	0.0207*	0.0640***	0.00589	-0.00144	0.0257*	-0.00999
	(0.0107)	(0.0202)	(0.0120)	(0.00886)	(0.0150)	(0.0109)
Urban	-0.0221			-0.00809		
	(0.0157)			(0.0112)		
Protestant	-0.0580***	-0.0476**	-0.0677***	-0.0861***	-0.0608***	-0.104***
	(0.0120)	(0.0241)	(0.0135)	(0.00953)	(0.0152)	(0.0125)
Other Christians	-0.0642***	-0.0552*	-0.0685***	-0.0887***	-0.0833***	-0.0934***
	(0.0164)	(0.0316)	(0.0183)	(0.0129)	(0.0202)	(0.0172)
Muslim	0.0146	0.00725	0.0163	-0.148***	-0.135***	-0.150***
	(0.0301)	(0.0376)	(0.0476)	(0.0147)	(0.0215)	(0.0252)
Other religions	0.128***	0.0422	0.149***	0.0440**	-0.0362	0.0595**
	(0.0280)	(0.0405)	(0.0354)	(0.0214)	(0.0306)	(0.0277)
Month FE	chi2=15	chi2=24.00**	chi2=15.82	chi2=12.99	chi2=16.79	chi2=10.73
District FE	chi2=241.29***	chi2=3630.03***	chi2 =1.6e+05***	chi2=689.92***	chi2=206.90***	chi2 =2.3e+04***
Sample size	**8,767**	**3,512**	**5,170**	**8,702**	**3,491**	**5,127**

Notes: The table shows the results from estimating a probit model for the tobacco (alcohol) consumption status of a household. The dependent variable in the probit is a tobacco (alcohol) dummy (assigned a value 1 if the household consumes tobacco (alcohol) and zero otherwise). In all data specifications, adult sex ratio was a good predictor of whether the household consumed tobacco (alcohol). The omitted religion is Catholic. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

The value of assets was found to be correlated with variations in total household expenditure in the 2005-2006 KIHBS. The coefficient for assets in Table A13 was found to be significant across all the data specifications. The F statistic for the relevant coefficients was consistently above 10 for all the data specifications, indicating that they were relevant instruments.

Table 2.7 First stage Probit regression for tobacco (alcohol) dummy (Marginal Effects) (2015-2016 KIHBS)

	Tobacco			Alcohol		
Coefficient on	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Adult sex ratio	0.221***	0.191***	0.251***	0.183***	0.129***	0.254***
	(0.0125)	(0.0199)	(0.0153)	(0.0174)	(0.0228)	(0.0202)
Adult proportion	0.0718***	0.0666*	0.0749***	0.0759**	-0.0338	0.133***
	(0.0228)	(0.0351)	(0.0275)	(0.0324)	(0.0559)	(0.0368)
lnHHsize	0.0562***	0.0528***	0.0528***	0.00824	-0.0746***	0.0694***
	(0.0106)	(0.0171)	(0.0132)	(0.0162)	(0.0271)	(0.0161)
Post primary vocational	0.00727	0.0802	-0.0439*	-0.0179	0.0438	-0.0498*
	(0.0282)	(0.0554)	(0.0225)	(0.0299)	(0.0588)	(0.0269)
Secondary	-0.0358***	-0.0336***	-0.0357***	-0.0335***	-0.0265*	-0.0308***
	(0.00675)	(0.0100)	(0.00865)	(0.00868)	(0.0142)	(0.0101)
College	-0.0475***	-0.0328**	-0.0623***	-0.0309**	-0.0207	-0.0349**
	(0.0110)	(0.0160)	(0.0120)	(0.0141)	(0.0208)	(0.0153)
University	-0.0853***	-0.0663***	-0.110***	-0.00417	0.00600	-0.0619**
	(0.0118)	(0.0148)	(0.0149)	(0.0257)	(0.0295)	(0.0260)
Other	-0.0444	-0.0716***	-0.0259	-0.0274	0.126	-0.107***
	(0.0285)	(0.0265)	(0.0402)	(0.0724)	(0.164)	(0.0350)
Wage head	-0.00984***	-0.00936***	-0.0125***	0.0101***	0.0141***	-0.00201
	(0.00274)	(0.00293)	(0.00469)	(0.00220)	(0.00249)	(0.00308)
Number employed	0.0119***	0.00882	0.0156***	0.0230***	0.0354***	0.0189***
	(0.00362)	(0.00637)	(0.00460)	(0.00490)	(0.00976)	(0.00537)
Age adults	0.00401***	0.00307***	0.00441***	0.00265***	-0.000514	0.00469***
	(0.000528)	(0.00102)	(0.000629)	(0.000712)	(0.00139)	(0.000762)
No of children under 5	0.00470	0.0114	0.00104	0.00567	0.000842	0.00558
	(0.00467)	(0.00837)	(0.00547)	(0.00548)	(0.0105)	(0.00611)
No. of children over 15	-0.0144**	-0.0190	-0.0102	-0.00654	-0.0325	-0.00672
	(0.00721)	(0.0119)	(0.00926)	(0.00911)	(0.0198)	(0.00999)
Age head	-0.00175***	-0.000206	-0.00267***	-0.00137**	0.00184	-0.00336***
	(0.000506)	(0.000947)	(0.000598)	(0.000639)	(0.00114)	(0.000748)
Urban	-0.00423			-0.000186		
	(0.00686)			(0.00962)		
Protestant	-0.0329***	-0.0241**	-0.0421***	-0.0651***	-0.0594***	-0.0696***
	(0.00775)	(0.0114)	(0.00987)	(0.0119)	(0.0197)	(0.0121)
Other Christians	-0.0371***	-0.0362**	-0.0343***	-0.0937***	-0.109***	-0.0791***
	(0.0102)	(0.0145)	(0.0132)	(0.0140)	(0.0218)	(0.0160)
Muslim	0.0272	0.0326	-0.00446	-0.138***	-0.159***	-0.0400
	(0.0267)	(0.0299)	(0.0315)	(0.0174)	(0.0195)	(0.0418)
Other religion	0.0562***	0.0585**	0.0381	0.0518**	0.0258	0.0507
	(0.0210)	(0.0287)	(0.0285)	(0.0263)	(0.0417)	(0.0334)
Month FE	chi2=16.40	chi2=27.75***	chi2=6.90	chi2=14.26	chi2=20.78**	chi2=15.82
County FE	chi2=888.60***	chi2=231.89***	chi2 =750.24***	chi2=294.26***	chi2=125.52***	chi2 =293.90***
Sample size	**16,075**	**7,019**	**8,999**	**15, 963**	**6,986**	**8,924**

Notes: The table shows the results from estimating a probit model for the tobacco (alcohol) consumption status of a household. The dependent variable in the probit is a tobacco (alcohol) dummy (assigned a value 1 if the household consumes tobacco (alcohol) and zero otherwise). In all data specifications, adult sex ratio was a strong predictor of whether the household consumed tobacco (alcohol). The omitted religion is Catholic. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

2.6.1 3SLS estimation of difference in household expenditure shares

The results from the Three Stage Least Square estimation of the difference in expenditure shares between households that consumed tobacco (alcohol) and those that did not during the 2005-2006 KIHBS are presented in Table 2.8. The 3SLS results were corrected for endogeneity in the estimation of the difference in expenditure shares. The 3SLS used the adult sex ratio, specified as the ratio of adult males to total adults and as the ratio of adult females to total adults. Both specifications of the instrumental variable yielded the same results.

To avoid what is referred to as *the forbidden regression*, which occurs when the dependent variable in the first stage regression is a dummy variable, the predicted values from the first stage regression were included as instruments in the 3SLS estimation (Wooldridge, 2002; Chelwa, 2015). The reported standard errors for all the 3SLS regressions were the bootstrapped standard errors. Owing to limitations associated with the reg3 (reg3 is a command used for analysis in the STATA statistical software) command used for 3SLS regression in STATA, the 3SLS regression could not be run with cluster fixed effects[12]. Therefore, the analysis was done with district/county fixed effects and month fixed effects.

The conclusions from the results, whether run with or without district/county fixed effects and month fixed effects, were similar. The only difference was the magnitude of the variables of interest. The magnitude was smaller when the district/county fixed effects and month fixed effects were included. Therefore, this study assumes that even with the inclusion of cluster fixed effects, the conclusions from the results discussed below would be unchanged. Further, Section 2.6.2 provides a possible range for the magnitude of the difference in expenditure shares.

The results from KIHBS 2005-2006, indicate that households that consumed tobacco had lower expenditure shares on education, healthcare, energy, and food items such as seafood, vegetables, milk and eggs. The types of expenditure that were negatively associated with tobacco consumption differed between urban and rural households. Rural tobacco-consuming households had lower expenditure shares only on education, healthcare, bread and cereals. Lower expenditure on rent, energy, vegetables, milk and eggs was only evident among urban tobacco-consuming households.

Chelwa and Van Walbeek (2014) and Paraje and Araya (2017) also found that tobacco consuming households spent less on healthcare, education, housing, food, and energy. The estimation of a short-run model may explain why tobacco-consuming households had lower healthcare expenditures. The effect of tobacco consumption on healthcare expenditure in the long run may be different.

Energy and rent were the most negatively affected expenditure categories among urban tobacco-consuming households. Among rural tobacco-consuming households, healthcare and

[12] The maximum *matsize* in STATA 15 was 11,000. The reg3 command doesn't have an option of absorbing clusters in the same way as the areg command or the possibility of using xt. Therefore, with over 2,000 clusters in KIHBS 2005-2006 and 19 equations in the system of equations, STATA 15 was unable to run reg3 with cluster fixed effects. matsize required for just the clusters in the 2005-2006 reg3 estimation was at least 38,000. A similar matsize related error message also came up for the KIHBS 2015-2016 when the model was estimated with cluster fixed effects.

education were the most affected categories. The budget share for education among rural tobacco-consuming households was 0.3 percentage points lower than for non-consuming households.

Alcohol consumption was associated with lower expenditure on education, healthcare and food items such as cereals, bread, vegetables, tubers, milk, and eggs. The most negatively affected expenditure categories among rural alcohol-consuming households were education and cereals. For urban alcohol consuming households, the three most traded off expenditures were energy, vegetables, milk, and eggs.

Alcohol consumption had a negative effect on more commodities than tobacco consumption. This is likely to be the result of the relatively higher expenditures on alcohol. The average monthly expenditure on tobacco, among tobacco-consuming households in the 2005-2006 KIHBS, was USD 4.55 while the average alcohol expenditure among alcohol-consuming households was USD 16.12. Tobacco (alcohol) consumption was associated with higher alcohol (tobacco) expenditure among all groups.

Table 2.8 Three Stage Least Square (3SLS) estimates for the coefficient on the tobacco and alcohol dummies d *(2005-2006 KIHBS)*

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				4.877***	4.804***	5.008***
				(0.668)	(0.775)	(0.826)
Alcohol	7.321***	13.49***	6.186***			
	(1.179)	(2.493)	(1.353)			
Education	-0.759	2.765	-2.820**	-2.744***	-0.917	-4.191***
	(1.017)	(2.077)	(1.219)	(1.063)	(1.296)	(1.561)
Energy	-2.231***	-6.714***	0.856	-2.021*	-5.896***	1.012
	(0.796)	(1.527)	(0.927)	(1.126)	(1.510)	(1.314)
Bread and cereals	-2.786	-1.829	-3.614*	-5.027***	-1.516	-5.778**
	(1.756)	(2.023)	(2.164)	(1.632)	(1.720)	(2.540)
Banana and tubers	-1.286	-3.482***	-1.589	-2.293***	-2.579***	-1.851
	(0.995)	(0.888)	(1.137)	(0.855)	(0.740)	(1.196)
Poultry	-0.838	-0.965	0.0885	-0.983	-1.303*	-0.152
	(0.585)	(0.655)	(0.926)	(0.651)	(0.680)	(1.173)
Meats	0.555	-0.451	1.075	2.198**	1.140	3.075*
	(1.071)	(1.661)	(1.071)	(0.939)	(1.334)	(1.854)
Fish and seafood	-1.254***	-0.800	-0.284	0.232	-0.00771	0.883
	(0.383)	(0.658)	(0.432)	(0.484)	(0.531)	(0.800)
Milk and eggs	-2.240**	-5.044***	-1.513	-2.770***	-4.447***	-1.059
	(1.043)	(1.323)	(1.402)	(0.976)	(1.192)	(1.324)
Fruits	-1.165*	-1.928**	-0.667	-0.698	-1.892***	-0.194
	(0.661)	(0.854)	(0.799)	(0.594)	(0.701)	(1.131)
Vegetables	-2.201***	-4.838***	-0.729	-1.741**	-4.176***	0.756
	(0.767)	(1.176)	(-0.955)	(0.796)	(0.852)	(1.378)
Other foods	15.34***	23.31***	7.123***	11.53***	18.33***	6.233**
	(2.066)	(4.146)	(2.059)	(1.610)	(3.947)	(2.429)
Healthcare	-0.879**	-0.141	-1.130***	-1.030***	-0.284	-1.396***
	(0.346	(0.554)	(0.421)	(0.264)	(0.459)	(0.478)
Clothing and	0.0811	2.371	-0.542	2.038	3.059	1.332
footwear	(1.800)	(3.108)	(2.178)	(1.872)	(2.798)	(2.414)
Water	-0.538	-1.222*	-0.634	-0.680*	-1.186**	-0.182
	(0.422)	(0.654)	(0.509)	(0.365)	(0.499)	(0.450)
Transport	1.859*	4.148*	0.561	4.055***	6.711***	0.157
	(1.024)	(2.144)	(1.057)	(1.299)	(1.930)	(0.995)
Furnishings	-1.049	-1.033	-1.117	-0.377	0.147	0.242
	(0.923)	(1.239)	(1.232)	(0.811)	(0.694)	(1.660)
Rent	-2.732***	-9.869***		-0.0804	-2.803	
	(0.944)	(2.467)		(1.044)	(1.852)	
Communication	0.954	-0.772	1.669***	2.309***	1.899*	1.629**
	(0.586)	(1.278)	(0.558)	(0.717)	(1.130)	(0.678)
Sample Size	**8,644**	**3,457**	**5,104**	**8,580**	**3,436**	**5,062**

The results are the coefficients on d from the 3SL estimation of equation (2.5). They are the estimated differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage point difference. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets. Full regression results are included in the appendix.

The results from the KIHBS 2015-2016 are presented in Table 2.9. Some of the expenditure categories that were negatively affected by the consumption of the two goods were similar to those in the 2005-2006 KIHBS. Both urban and rural tobacco-consuming households had lower expenditure shares on energy and on food items such as bread, cereals, tubers, milk and eggs. Expenditure on rent and cereals was about 0.8 percentage points lower for urban tobacco-consuming households than for non-consuming ones. Rural tobacco consuming

households spent 0.6 percentage points less on energy than non-consuming households. The expenditure shares that were negatively affected among alcohol-consuming households were similar to those of tobacco-consuming households. Spending on education was lower among rural tobacco- and alcohol-consuming households, but not among urban households.

Table 2.9 Three Stage Least Square (3SLS) estimates for the coefficient on tobacco and alcohol dummies d *(2015-2016 KIHBS)*

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				4.912***	4.419***	4.894***
				(0.377)	(0.449)	(0.392)
Alcohol	9.061***	10.59***	8.437***			
	(0.610)	(1.092)	(0.744)			
Education	-1.523*	1.869	-3.435***	-4.649***	2.610	-6.167***
	(0.827)	(1.383)	(1.095)	(1.097)	(1.786)	(1.428)
Energy	-4.937***	-4.608***	-5.908***	-4.087***	-3.745***	-6.658***
	(0.665)	(1.046)	(0.814)	(0.841)	(1.215)	(0.862)
Bread and cereals	-5.410***	-7.800***	-2.844**	-8.786***	-9.654***	-4.567***
	(0.954)	(1.489)	(1.188)	(1.188)	(1.774)	(1.343)
Roots and tubers	-2.028***	-2.416***	-1.854***	-2.693***	-2.649***	-2.075***
	(0.335)	(0.434)	(0.449)	(0.361)	(0.429)	(0.469)
Meat	-0.706	-1.663	-0.629	1.003	0.764	1.255
	(0.708)	(1.074)	(0.966)	(0.847)	(1.134)	(1.022)
Fish and seafood	0.205	0.418	0.477	0.0745	-0.261	0.672
	(0.355)	(0.609)	(0.414)	(0.426)	(0.603)	(0.561)
Milk and eggs	-3.854***	-3.442***	-4.037***	-5.019***	-3.628***	-5.085***
	(0.589)	(0.877)	(0.770)	(0.763)	(1.003)	(1.013)
Fruits	-0.129	-0.383	0.274	-0.836	-2.198***	0.531
	(0.480)	(0.673)	(0.658)	(0.522)	(0.684)	(0.685)
Vegetables	-5.944***	-6.787***	-5.291***	-7.861***	-7.043***	-6.805***
	(0.501)	(0.817)	(0.613)	(0.689)	(0.828)	(0.805)
Other foods	30.03***	39.67***	24.58***	45.01***	52.05***	34.28***
	(1.235)	(2.519)	(1.451)	(2.220)	(3.150)	(1.662)
Rent	-2.629***	-8.724***		-2.278**	-8.558***	
	(0.628)	(1.522)		(0.914)	(1.869)	
Sample size	**16,073**	**7,051**	**8,998**	**15,961**	**6,985**	**8,923**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). They are the estimated differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage point difference. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets. Full regression results are included in the appendix.

2.6.2 3SLS estimates of the crowding out effects associated with the amount spent on tobacco and alcohol

The results for the coefficients on $p_t t, p_a a \; and \; (p_t t + p_a a)$ from a 3SLS estimation of equation (2.6) (with bootstrapped standard errors), using data from KIHBS 2005-2006 are presented Table 2.10, Table 2.11, and Table 2.12 respectively. Equation 2.6 was estimated for the KIHBS 2005-2006 because consumers were not separable for more than half of the expenditure categories that were considered (see Table A1). The coefficients on $p_t t, p_a a \; and \; (p_t t + p_a a)$ show the commodities that were crowded out by expenditures on

tobacco, alcohol, and both combined. The coefficients were multiplied by 1,000 for convenience in reporting. They are interpreted as the effect of a 1,000 Kenya shilling (10 USD) change in monthly expenditure on alcohol, tobacco, or both alcohol and tobacco, on the budget share of other goods consumed by Kenyan households. In 2005-2006 Ksh. 1,000 could purchase fifteen packets of Sportsman cigarettes or fifteen 500ml bottles of Tusker beer. Ksh. 1,000 could purchase nine packets of Sportsman cigarettes or seven 500ml bottles of Tusker beer in 2015-2016.

Table 2.10 Three Stage-Least Square (3SLS) Regression (Tobacco expenditure) (2005-2006 KIHBS)

VARIABLES	$p_t t$	lnM	$(lnM)^2$	ln Household size	No. children under 5 years	Sample Size
Education	-0.125***	-0.0196	0.00174	0.0355***	-0.0180***	8,666
	(0.0343)	(0.0279)	(0.00147)	(0.00317)	(0.000935)	
Energy	-0.0593**	0.0444**	-0.00239**	-0.00816***	0.000839	8,666
	(0.0242)	(0.0193)	(0.00100)	(0.00225)	(0.000739)	
Bread and cereals	-0.0562	-0.549***	0.0244***	0.0611***	-0.00183	8,666
	(0.0396)	(0.0398)	(0.00201)	(0.00344)	(0.00145)	
Banana and tubers	-0.0679***	-0.0166	0.000356	0.00878***	0.000299	8,666
	(0.0240)	(0.0160)	(0.000782)	(0.00237)	(0.000780)	
Poultry	-0.0357**	0.0357**	-0.00168**	-0.00171	0.00104	8,666
	(0.0152)	(0.0166)	(0.000827)	(0.00163)	(0.000653)	
Meats	0.0505*	0.137***	-0.00701***	-0.00553***	0.00252***	8,666
	(0.0288)	(0.0280)	(0.00142)	(0.00203)	(0.000930)	
Fish and seafood	-0.00904	0.0112	-0.000678	-0.000581	0.000880**	8,666
	(0.0110)	(0.0134)	(0.000671)	(0.000986)	(0.000398)	
Milk and eggs	-0.0768***	0.123***	-0.00668***	0.00178	0.00389***	8,666
	(0.0256)	(0.0218)	(0.00111)	(0.00269)	(0.000807)	
Fruits	-0.0289	0.0305*	-0.00182**	-0.00274*	0.000309	8,666
	(0.0187)	(0.0167)	(0.000826)	(0.00160)	(0.000609)	
Vegetables	-0.0601***	-0.0169	-0.000123	0.00885***	-0.000816	8,666
	(0.0187)	(0.0194)	(0.000978)	(0.00164)	(0.000729)	
Other foods	0.367***	0.00610	-0.00304	-0.00494	0.00632***	8,666
	(0.0611)	(0.0612)	(0.00321)	(0.00684)	(0.00186)	
Alcohol	0.253***	0.00858	-0.000888	-0.00735*	0.000977	8,666
	(0.0286)	(0.0440)	(0.00232)	(0.00390)	(0.00103)	
Healthcare	-0.0272***	-0.00295	0.000155	-0.000338	0.000854***	8,666
	(0.00916)	(0.00751)	(0.000382)	(0.000831)	(0.000295)	
Clothing and footwear	0.0533	0.289***	-0.0134***	-0.0339***	0.00663***	8,666
	(0.0453)	(0.0418)	(0.00212)	(0.00367)	(0.00149)	
Water	-0.0157*	-0.00765	0.000339	-0.000161	0.000131	8,666
	(0.00938)	(0.00881)	(0.000452)	(0.00100)	(0.000251)	
Transport	0.133***	-0.126***	0.00843***	-0.0219***	0.00237**	8,666
	(0.0394)	(0.0465)	(0.00254)	(0.00312)	(0.00105)	
Furnishings	-0.0273	0.0180	-0.000648	-0.00608***	0.000987	8,666
	(0.0209)	(0.0228)	(0.00117)	(0.00223)	(0.000737)	
Rent	-0.0424	0.0642**	-0.00304*	-0.0119***	0.00237***	8,666
	(0.0322)	(0.0326)	(0.00175)	(0.00229)	(0.000643)	
Communication	0.0612**	0.106***	-0.00442***	-0.0166***	0.00247***	8,666
	(0.0245)	(0.0156)	(0.000813)	(0.00140)	(0.000546)	

The results are the 3SLS estimation of equation (2.6). Coefficients on $p_t t$ is the change in expenditure shares associated with a Ksh. 1,000 increase in monthly expenditure on tobacco. In 2005-2006 Ksh. 1,000 purchased 15 packets of Sportsman cigarettes. Negative coefficient on $p_t t$ indicates that tobacco expenditure crowds out the budget share of that commodity. For brevity, other household characteristics included in the regression are not reported. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table 2.11 Three Stage-Least Squares (3SLS) Regression (Alcohol expenditure) (2005-2006 KIHBS)

VARIABLES	$p_a a$	lnM	$(lnM)^2$	ln Household size	No. children under 5 years	Sample Size
Education	-0.0431***	-0.0150	0.00165	0.0291***	-0.0170***	8,666
	(0.0131)	(0.0270)	(0.00141)	(0.00346)	(0.00113)	
Energy	-0.0195**	0.0474**	-0.00248**	-0.0114***	0.00136*	8,666
	(0.00836)	(0.0224)	(0.00117)	(0.00212)	(0.000701)	
Bread and cereals	-0.0237	-0.550***	0.0246***	0.0588***	-0.00150	8,666
	(0.0152)	(0.0412)	(0.00206)	(0.00371)	(0.00153)	
Banana and tubers	-0.0243***	-0.0171	0.000459	0.00524**	0.000938	8,666
	(0.00892)	(0.0196)	(0.000992)	(0.00250)	(0.000823)	
Poultry	-0.0118**	0.0375**	-0.00174**	-0.00345**	0.00133**	8,666
	(0.00579)	(0.0162)	(0.000803)	(0.00175)	(0.000679)	
Meats	0.0231**	0.137***	-0.00709***	-0.00294	0.00203**	8,666
	(0.0101)	(0.0295)	(0.00150)	(0.00211)	(0.000942)	
Fish and seafood	-0.00278	0.0114	-0.000679	-0.00100	0.000943**	8,666
	(0.00403)	(0.0135)	(0.000676)	(0.00116)	(0.000405)	
Milk and eggs	-0.0252***	0.127***	-0.00682***	-0.00214	0.00451***	8,666
	(0.00951)	(0.0207)	(0.00108)	(0.00257)	(0.000896)	
Fruits	-0.00928	0.0287*	-0.00170**	-0.00405**	0.000490	8,666
	(0.00631)	(0.0169)	(0.000838)	(0.00191)	(0.000615)	
Vegetables	-0.0207***	-0.0153	-0.000142	0.00579***	-0.000299	8,666
	(0.00694)	(0.0198)	(0.000998)	(0.00203)	(0.000810)	
Other foods	0.139***	-0.00439	-0.00299	0.0137**	0.00315	8,666
	(0.0262)	(0.0724)	(0.00376)	(0.00683)	(0.00234)	
Tobacco	0.0462***	-0.0115	0.000163	0.00654***	-0.000964*	8,666
	(0.00762)	(0.0218)	(0.00113)	(0.00195)	(0.000586)	
Healthcare	-0.00970***	-0.00258	0.000165	-0.00175*	0.00109***	8,666
	(0.00333)	(0.00728)	(0.000378)	(0.000971)	(0.000310)	
Clothing & footwear	0.0255	0.294***	-0.0137***	-0.0316***	0.00619***	8,666
	(0.0175)	(0.0406)	(0.00205)	(0.00421)	(0.00155)	
Water	-0.00602*	-0.00758	0.000355	-0.00110	0.000301	8,666
	(0.00363)	(0.00965)	(0.000502)	(0.00104)	(0.000269)	
Transport	0.0518***	-0.130***	0.00848***	-0.0151***	0.00118	8,666
	(0.0156)	(0.0440)	(0.00245)	(0.00374)	(0.00145)	
Furnishings	-0.00833	0.0198	-0.000723	-0.00754***	0.00119	8,666
	(0.00731)	(0.0223)	(0.00116)	(0.00260)	(0.000746)	
Rent	-0.0105	0.0687*	-0.00326*	-0.0140***	0.00278***	8,666
	(0.0120)	(0.0351)	(0.00188)	(0.00255)	(0.000682)	
Communication	0.0251**	0.105***	-0.00449***	-0.0136***	0.00199***	8,666
	(0.00992)	(0.0202)	(0.00107)	(0.00205)	(0.000681)	

The results are the 3SLS estimation of equation (2.6). Coefficients on $p_a a$ is the change in expenditure shares associated with a Ksh. 1,000 increase in monthly expenditure on alcohol. In 2005-2006 Ksh. 1,000 purchased 15 500ml bottles of Tusker beer. Negative coefficient on $p_a a$ indicates that alcohol expenditures crowds out that commodity. For brevity household characteristics included in the regression are not reported. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table 2.12 Three Stage-Least Squares (3SLS) Regression (Alcohol plus Tobacco expenditure) (2005-2006 KIHBS)

VARIABLES	$(p_t t + p_a a)$	lnM	$(lnM)^2$	ln Household size	No. children under 5 years	Sample Size
Education	-0.0486***	-0.0410	0.00290	0.0346***	-0.0180***	7,251
	(0.0118)	(0.0432)	(0.00231)	(0.00293)	(0.00121)	
Energy	-0.0108	0.0453**	-0.00248**	-0.00889***	0.00113*	7,251
	(0.0117)	(0.0204)	(0.00106)	(0.00174)	(0.000618)	
Bread and cereals	-0.0314*	-0.591***	0.0266***	0.0603***	-0.000785	7,251
	(0.0164)	(0.0605)	(0.00307)	(0.00454)	(0.00145)	
Banana and tubers	-0.0295***	-0.0311	0.00104	0.00939***	0.00104	7,251
	(0.00833)	(0.0295)	(0.00154)	(0.00275)	(0.00107)	
Poultry	-0.0157**	0.0425**	-0.00207**	-0.00190	0.00115*	7,251
	(0.00630)	(0.0166)	(0.000860)	(0.00185)	(0.000610)	
Meats	0.0289***	0.152***	-0.00786***	-0.00360*	0.00272***	7,251
	(0.0100)	(0.0285)	(0.00149)	(0.00212)	(0.000965)	
Fish and seafood	-0.00209	0.0150	-0.000878	-0.00141	0.00128**	7,251
	(0.00515)	(0.0158)	(0.000812)	(0.00106)	(0.000508)	
Milk and eggs	-0.0263*	0.122***	-0.00678***	0.000378	0.00399***	7,251
	(0.0139)	(0.0307)	(0.00160)	(0.00271)	(0.00113)	
Fruits	-0.00512	0.0273*	-0.00170**	-0.00346**	0.000613	7,251
	(0.00728)	(0.0165)	(0.000844)	(0.00151)	(0.000672)	
Vegetables	-0.0176**	-0.0211	2.91e-05	0.00812***	-0.000450	7,251
	(0.00889)	(0.0242)	(0.00125)	(0.00186)	(0.000625)	
Other foods	0.141***	0.0329	-0.00446	9.56e-05	0.00453**	7,251
	(0.0313)	(0.0989)	(0.00522)	(0.00638)	(0.00189)	
Healthcare	-0.00680**	-0.00113	5.33e-05	-0.000672	0.000756***	7,251
	(0.00299)	(0.00940)	(0.000478)	(0.000922)	(0.000226)	
Clothing and footwear	0.0448**	0.334***	-0.0156***	-0.0374***	0.00689***	7,251
	(0.0210)	(0.0656)	(0.00346)	(0.00508)	(0.00185)	
Water	-0.00222	-0.00726	0.000309	-0.000412	0.000249	7,251
	(0.00440)	(0.00996)	(0.000498)	(0.00111)	(0.000389)	
Transport	0.0606***	-0.141***	0.00920***	-0.0203***	0.00150	7,251
	(0.0161)	(0.0529)	(0.00283)	(0.00364)	(0.00124)	
Furnishings	-0.00717	0.0189	-0.000736	-0.00730***	0.000613	7,251
	(0.00796)	(0.0253)	(0.00132)	(0.00199)	(0.000837)	
Rent	-0.00886	0.0540	-0.00258	-0.0118***	0.00220***	7,251
	(0.0118)	(0.0353)	(0.00193)	(0.00232)	(0.000792)	
Communication	0.0332***	0.124***	-0.00535***	-0.0169***	0.00217***	7,251
	(0.00931)	(0.0293)	(0.00158)	(0.00182)	(0.000639)	

The results are the 3SLS estimation of equation (2.6). Coefficients on $(p_t t + p_a a)$ is the change in expenditure shares associated with a Ksh. 1,000 increase in the monthly expenditure on both tobacco and alcohol. In 2005-2006 Ksh. 1,000 could purchase 15 packets of Sportsman cigarettes or 15 500ml bottles of Tusker beer. Negative coefficient on $(p_t t + p_a a)$ indicates that combined alcohol and tobacco expenditures crowds out that commodity. For brevity other household characteristics included in the regression are not reported *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Tobacco expenditure crowded out expenditures on education, energy, healthcare and food items such as tubers, vegetables milk and eggs. The crowding-out effect of tobacco expenditure was highest for education, milk and eggs. An increase of 1,000 Kenya shillings in monthly expenditure on tobacco is predicted to reduce the budget share of education by about 0.1 percentage points.

Education, energy, healthcare and food items such as tubers, vegetables, milk and eggs were crowded out by alcohol expenditures. The effect of alcohol expenditure on education, healthcare and energy was similar to what Jumrani and Birthal (2017) and Pu *et al.*(2008) found for India and Taiwan respectively. An increase in monthly expenditure on alcohol by 1,000 Kenya shillings reduced the budget share of education around 0.04 percentage points.

Tobacco and alcohol combined crowded out expenditures on education, healthcare, and food items such as tubers, vegetables and poultry. For every additional 1,000 Kenya shillings spent on both tobacco and alcohol in a month, the budget share of education decreased by 0.1 percentage points and that of tubers decreased by 0.03 percentage points.

The crowding-out effect of a 1,000 Kenya shilling increase in monthly tobacco expenditure was higher than a similar increase in alcohol expenditure. This result was similar to what Jumrani and Birthal (2017) found among rural households in India. They concluded that, in rural India, the crowding-out effects of a 100 rupee increase in tobacco expenditure was larger than a similar increase in alcohol expenditure. Even though the crowding-out effect of tobacco was larger in both cases, increasing the monthly expenditure on alcohol by 100 Kenya shillings in 2005-2006 would have increased the average monthly expenditure on alcohol by 8.5%. A 100 Kenya Shilling increase in the monthly tobacco expenditure in 2005-2006 would have resulted in a 30% increase in the average monthly expenditure on tobacco.

The results for the coefficients on $p_t t, p_a a \; and \; (p_t t + p_a a)$ from a 3SLS estimation of equation (2.4) (with bootstrapped standard errors), using data from KIHBS 2015-2016 are presented in Table 2.13 , Table 2.14 and Table 2.15 respectively. Equation (2.4) was estimated for the 2015-2016 survey because consumers were separable for most of the expenditure categories that were considered (see Table A2). For the most part, the goods that were crowded out by tobacco and alcohol in both surveys were similar. The results from the 2015-2016 survey, showed that a 1,000 Kenya shilling increase in the monthly expenditure on tobacco reduced the budget share of cereals and energy by 0.6 percentage points and 0.3 percentage points respectively. A similar increase in alcohol expenditure was associated with a 0.1 percentage point decrease in expenditures on cereals and vegetables.

The results from both surveys showed that, in Kenya, alcohol and tobacco were complementary goods. Across all data specifications, expenditure on alcohol (tobacco) crowded *in* tobacco (alcohol). A 1,000 Kenya Shilling increase in the monthly expenditure on tobacco was associated with a 0.3 percentage point (2005-2006) and 0.7 percentage point (2015-2016) increase in the budget share of alcohol. A similar increase in expenditure on alcohol was associated with a 0.1 percentage point (2005-2006) and 0.1 percentage point (2015-2016) increase in the tobacco budget share. The positive effect of tobacco (alcohol) expenditure on alcohol (tobacco) was also reported by Wang *et al.* (2006) Önder and Yürekli (2014) and Jumrani and Birthal (2017).

Table 2.13 Three Stage-Least Squares (3SLS) Regression (Tobacco expenditure) (2015-2016 KIHBS)

VARIABLES	$p_t t$	d	lnM	$(lnM)^2$	$d * lnM$	$d * (lnM)^2$	Sample Size
Education	-0.249**	2.894	-0.0818***	0.00538***	-0.648	0.0376	16,073
	(0.125)	(1.911)	(0.0209)	(0.00111)	(0.426)	(0.0243)	
Energy	-0.328***	3.253	-0.191***	0.00943***	-0.762*	0.0461*	16,073
	(0.115)	(2.086)	(0.0430)	(0.00225)	(0.461)	(0.0259)	
Bread and cereals	-0.603***	6.730*	0.123***	-0.00887***	-1.556**	0.0930**	16,073
	(0.177)	(3.553)	(0.0337)	(0.00172)	(0.783)	(0.0437)	
Roots and tubers	-0.172***	2.103**	0.0417***	-0.00201***	-0.483**	0.0286**	16,073
	(0.0554)	(1.023)	(0.00619)	(0.000328)	(0.226)	(0.0127)	
Meat	0.108	-1.090	0.112***	-0.00424***	0.248	-0.0149	16,073
	(0.0757)	(1.143)	(0.0191)	(0.000991)	(0.256)	(0.0147)	
Fish and seafood	0.000599	0.123	0.0248***	-0.00127***	-0.0259	0.00135	16,073
	(0.0366)	(0.507)	(0.00639)	(0.000331)	(0.115)	(0.00667)	
Milk and eggs	-0.275***	3.408*	0.153***	-0.00775***	-0.785**	0.0465**	16,073
	(0.0943)	(1.756)	(0.0163)	(0.000828)	(0.389)	(0.0219)	
Fruits	-0.0338	0.348	-0.0153	0.00105	-0.0807	0.00484	16,073
	(0.0449)	(0.642)	(0.0195)	(0.000991)	(0.143)	(0.00824)	
Vegetables	-0.552***	6.743**	0.0609***	-0.00353***	-1.549**	0.0918**	16,073
	(0.153)	(3.164)	(0.0158)	(0.000839)	(0.696)	(0.0388)	
Other foods	2.486***	-29.39**	-0.107*	0.00278	6.774**	-0.402**	16,073
	(0.667)	(14.02)	(0.0649)	(0.00356)	(3.086)	(0.172)	
Alcohol	0.705***	-8.981**	-0.0427**	0.00263**	2.039**	-0.119**	16,073
	(0.203)	(4.217)	(0.0212)	(0.00118)	(0.928)	(0.0517)	
Rent	-0.195**	2.875*	0.134***	-0.00707***	-0.652*	0.0378*	16,073
	(0.0959)	(1.532)	(0.0227)	(0.00115)	(0.342)	(0.0194)	

The results are the 3SLS estimation of equation (2.4). Coefficients on $p_t t$ is the change in expenditure shares associated with a Ksh. 1,000 increase in monthly expenditure on tobacco. In 2015-2016 Ksh. 1,000 purchased 9 packets of Sportsman cigarettes. Negative coefficient on $p_t t$ indicates that tobacco expenditure crowds out that commodity. For brevity household characteristics included in the regression are not reported. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table 2.14 Three Stage-Least Squares (3SLS) Regression (Alcohol expenditure) (2015-2016 KIHBS)

VARIABLES	$p_t t$	d	lnM	$(lnM)^2$	$d * lnM$	$d * (lnM)^2$	Sample Size
Education	-0.0382*	4.060**	-0.0975***	0.00653***	-0.906**	0.0509**	16,073
	(0.0208)	(1.850)	(0.0259)	(0.00134)	(0.419)	(0.0239)	
Energy	-0.0554**	5.150***	-0.187***	0.00957***	-1.180***	0.0680***	16,073
	(0.0227)	(1.951)	(0.0483)	(0.00254)	(0.439)	(0.0250)	
Bread and cereals	-0.0956**	10.10***	0.192***	-0.0120***	-2.298***	0.131***	16,073
	(0.0408)	(3.345)	(0.0440)	(0.00224)	(0.752)	(0.0428)	
Roots and tubers	-0.0304**	2.956***	0.0481***	-0.00217***	-0.674***	0.0387***	16,073
	(0.0128)	(1.062)	(0.0119)	(0.000644)	(0.239)	(0.0136)	
Meat	0.0255	-2.407*	0.0894***	-0.00298***	0.551*	-0.0319*	16,073
	(0.0164)	(1.385)	(0.0215)	(0.00111)	(0.313)	(0.0179)	
Fish and seafood	0.00139	-0.0490	0.0196***	-0.000964***	0.0159	-0.00115	16,073
	(0.00774)	(0.663)	(0.00694)	(0.000361)	(0.151)	(0.00872)	
Milk and eggs	-0.0443**	4.033**	0.161***	-0.00782***	-0.934**	0.0542***	16,073
	(0.0194)	(1.635)	(0.0224)	(0.00115)	(0.367)	(0.0209)	
Fruits	0.000737	-0.434	-0.0269	0.00169	0.0891	-0.00462	16,073
	(0.00859)	(0.834)	(0.0213)	(0.00108)	(0.189)	(0.0108)	
Vegetables	-0.0992***	9.677***	0.0846**	-0.00425**	-2.208***	0.127***	16,073
	(0.0368)	(3.060)	(0.0349)	(0.00184)	(0.684)	(0.0387)	
Other foods	0.447***	-41.73***	-0.111	0.000276	9.575***	-0.552***	16,073
	(0.160)	(13.14)	(0.142)	(0.00755)	(2.937)	(0.166)	
Tobacco	0.0584***	-5.598***	-0.0202	0.000458	1.280***	-0.0737***	16,073
	(0.0226)	(1.866)	(0.0197)	(0.00104)	(0.418)	(0.0237)	
Rent	-0.0332*	2.842*	0.116***	-0.00586***	-0.658*	0.0382*	16,073
	(0.0184)	(1.608)	(0.0240)	(0.00123)	(0.364)	(0.0208)	

The results are the 3SLS estimation of equation (2.4). Coefficients on $p_a a$ is the change in expenditure shares associated with a Ksh. 1,000 increase in the monthly expenditure on alcohol. In 2015-2016 Ksh. 1,000 purchased 7 500ml bottles of Tusker beer. Negative coefficient on $p_a a$ indicates that alcohol expenditures crowds out that commodity. For brevity household characteristics included in the regression are not reported. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table 2.15 Three Stage-Least Squares (3SLS) Regression (Alcohol plus Tobacco expenditure) (2015-2016 KIHBS)

VARIABLES	$p_t t + p_a a$	d	lnM	$(lnM)^2$	$d * lnM$	$d * (lnM)^2$	Sample Size
Education	-0.0651	5.291	-0.100***	0.00665***	-1.217	0.0711	13,475
	(0.0438)	(3.959)	(0.0261)	(0.00135)	(0.910)	(0.0530)	
Energy	-0.0773**	6.553*	-0.198***	0.00997***	-1.529**	0.0902**	13,475
	(0.0323)	(3.368)	(0.0407)	(0.00213)	(0.761)	(0.0436)	
Bread and cereals	-0.159***	12.89***	0.193***	-0.0123***	-3.034***	0.180***	13,475
	(0.0486)	(4.978)	(0.0381)	(0.00194)	(1.116)	(0.0633)	
Roots and tubers	-0.0474***	3.755**	0.0532***	-0.00253***	-0.885**	0.0528**	13,475
	(0.0162)	(1.719)	(0.00802)	(0.000400)	(0.388)	(0.0221)	
Meat	0.0831**	-6.345*	0.0795***	-0.00260**	1.487*	-0.0886*	13,475
	(0.0370)	(3.764)	(0.0224)	(0.00114)	(0.854)	(0.0490)	
Fish	0.00699	-0.366	0.0206**	-0.00104**	0.0935	-0.00597	13,475
	(0.0129)	(1.194)	(0.00811)	(0.000405)	(0.275)	(0.0160)	
Milk and eggs	-0.0415*	2.989	0.163***	-0.00822***	-0.723	0.0438	13,475
	(0.0228)	(2.214)	(0.0178)	(0.000913)	(0.507)	(0.0294)	
Fruits	0.00136	-0.785	-0.0237	0.00155	0.163	-0.00846	13,475
	(0.0152)	(1.394)	(0.0216)	(0.00108)	(0.322)	(0.0188)	
Vegetables	-0.178***	14.81**	0.102***	-0.00536***	-3.468***	0.206***	13,475
	(0.0524)	(5.995)	(0.0188)	(0.000967)	(1.341)	(0.0757)	
Other foods	0.710***	-57.07**	-0.175**	0.00474	13.44**	-0.799***	13,475
	(0.200)	(23.46)	(0.0814)	(0.00411)	(5.239)	(0.295)	
Rent	-0.0381	3.455	0.129***	-0.00666***	-0.807	0.0475	13,475
	(0.0315)	(2.792)	(0.0228)	(0.00113)	(0.643)	(0.0375)	

The results are the 3SLS estimation of equation (2.4). Coefficients on $(p_t t + p_a a)$ is the change in expenditure shares associated with a Ksh. 1,000 increase in the monthly expenditure on tobacco and alcohol. In 2015-2016 Ksh. 1,000 purchased 9 packets of Sportsman cigarettes or 7 500ml bottles of Tusker beer. Negative coefficient on $(p_t t + p_a a)$ indicates that combined alcohol and tobacco expenditures crowds out that commodity. For brevity household characteristics included in the regression are not reported. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

2.6.3 Relaxing the exclusion restriction

The adult sex ratio was used as an instrumental variable for the tobacco- or alcohol-consuming status of a household. However, the instrument may not have met the exclusion restriction. The assumption that the instrumental variable should be uncorrelated with the error term may not have held for some of the expenditure categories that were considered. This is because the adult sex ratio may have directly determined some of the expenditure shares.

Nevo and Rosen (2012) provided a way of calculating the bounds for parameters when researchers are faced with imperfect instrumental variables (IIVs). IIVs are instrumental variables that may be correlated with the error term. Let Z be an IIV, variable Y be a function of an endogenous covariate X, other covariates W and error term U. The bounds for the IIV are calculated based on assumptions about the IIV, the endogenous variable, and the error term.

The correlation between the endogenous regressor and the error term (ρ_{xu}) is assumed to have the same direction as the correlation between the IIV and the error term (ρ_{zu}). The instrumental variable is also assumed to be less correlated with the error term than the endogenous regressor is correlated with the error term. The process of estimating the bounds is presented below using a simple linear model with one imperfect instrument. If the instrumental variable and the endogenous variable are positively correlated, only one bound is estimated. The bound is given by; $\beta \leq min\{\beta^{IV}_{v(1)}, \beta^{IV}_{z}\}\ if\ \sigma_{xu,}\ \sigma_{zu,} \geq 0$ or $\beta \geq$

$max\{\beta_{v(1)}^{IV}, \beta_z^{IV}\}\ if\ \sigma_{xu,}\ \sigma_{zu,} \leq 0$ where, σ_{ab} is the covariance between any two random variables A and B, σ_a is the standard deviation of A, $\beta_z^{IV} = {}^{\sigma_{zy}}/_{\sigma_{xz}}$ and $\beta_{v(1)}^{IV} = \frac{\sigma_x\sigma_{zy} - \sigma_z\sigma_{xy}}{\sigma_x(\sigma_{xz} - \sigma_z\sigma_x)}$ (Nevo and Rosen, 2012).

However, if the instrumental variable and the endogenous variable are negatively correlated, an upper and lower bound for the parameter of interest can be estimated. The bounds are given by $\beta_z^{IV} \leq \beta \leq \beta_{v(1)}^{IV}\ if\ \sigma_{xu,}\ \sigma_{zu,} \geq 0$ and $\beta_{v(1)}^{IV} \leq \beta \leq \beta_z^{IV}\ if\ \sigma_{xu,}\ \sigma_{zu,} \leq 0$ (Nevo and Rosen, 2012). The possibility of the upper and lower bounds crossing provides a specification test for the assumptions made. According to Nevo and Rosen (2012), crossing of the upper and lower bounds of the confidence set is an indication that the IIV assumptions that are imposed by the researcher are not mutually consistent. Therefore, when the bounds do not cross, the conclusion is that, based on the empirical evidence, the maintained assumptions cannot be rejected.

Chelwa and Van Walbeek, (2014) calculated the upper confidence bounds for the estimates of d (tobacco dummy). They used differences in time preferences as a possible reason for why the adult sex ratio may have been less correlated to the error term when compared to the correlation between the tobacco dummy and the error term. They pointed out that one of the possible variables in the error term that may have influenced both the decision on whether to consume tobacco or not, and budgeting decisions was time preference. Time preference has been found to differ between smokers and non-smokers, alcohol consumers and non-consumers, but not between men and women (Bishai, 2001; Chelwa, 2015).

In this section, the adult sex ratio, calculated as the proportion of *female* adults in a household, was used as the IIV. The specification of the adult sex ratio as the ratio of female adults to total adults in the household was also used by San and Chaloupka (2016). The 3SLS estimation using the adult sex ratio, whether specified as the ratio of adult males to total number of adults and the ratio of adult females to total number of adults, yielded the same results. However, by using the ratio of adult females divided by total number of adults, the correlation between the IIV and endogenous regressor becomes negative. This provided the opportunity to generate both the upper and lower confidence bounds. The bounds were estimated separately for each equation. Therefore, the assumptions on the sign of the correlation between the endogenous variable and the error term for each expenditure category were partly based on the use of crossing of the confidence bounds as a specification test.

The Nevo and Rosen (2012) upper and lower confidence bounds for the estimates of tobacco (alcohol) dummy d in equation (2.5) are presented in Table A32 and Table A33. The

interpretation of the bounds was similar to that of Chelwa and Van Walbeek (2014). The coefficient of an expenditure category was considered insignificant if the estimated bounds crossed zero. This is because, if zero was part of the confidence bound, the possibility of the estimated coefficient being zero could not be ruled out.

The conclusions from the results of the estimated bounds for both household surveys were similar to the 3SLS results for the tobacco and alcohol consumption dummies. However, the bounds provided additional information that may be useful for policy implementation. For most of the expenditure categories for which tobacco- and alcohol-consuming households had lower budget shares, the 3SLS estimates were closer to the upper bounds. For instance, the results from 3SLS estimation (both surveys) indicated that rural tobacco-consuming households spent around 0.3 percentage points less on education. That is, the coefficient was approximately -0.3. The confidence bounds (in percentage points) for rural tobacco-consuming household was [-1.04, -0.10] for the 2005-2006 KIHBS and [-1.37, -0.20] for the 2015-2016 KIHBS.

The results on the confidence bounds showed that tobacco- and alcohol-consuming households might have spent even less on categories such as education, healthcare, energy, and food items than was estimated using 3SLS. Chelwa and Van Walbeek (2014) concluded that the positive effect of tobacco on alcohol may not have been causal after relaxing the exclusion restriction. However, by changing the specification of the first stage regression, this study found that the positive correlation between tobacco and alcohol expenditure was still significant even after relaxing the exclusion restriction.

Generation of both the upper and lower bounds by changing the specification of the adult sex ratio and using of crossing of these bounds as specification test has some drawbacks. This study was not able to show explicitly that the direction of correlation between the IIV and the error term was the same as the correlation between the endogenous variable and the error term for each expenditure category. Further, this method did not correct for contemporaneous correlation in the error terms. Therefore, the confidence bounds are presented in this section subject to criticism based on these limitations.

2.6.4 Impact of a change in tobacco and alcohol taxes on household expenditure patterns

A new excise duty act on tobacco and alcohol was introduced during the 2015-2016 KIHBS data collection process. This provided an opportunity to estimate the impact of an increase in tobacco and alcohol taxes on household expenditure patterns in a natural

experiment. The first step involves the comparison of the average tobacco (alcohol) expenditure shares for the tobacco (alcohol) consuming households that were surveyed before and after the implementation of the new taxes. The households that were surveyed after the implementation of the taxes experienced on average higher real prices for cigarettes and for some alcohol products. Therefore, there is a possibility that the budget shares on alcohol and tobacco were higher for those households that were interviewed after the tax was increased.

Table 2.16 provides the results of an OLS regression for the coefficient on the tax dummy (τ) from equation (2.7). The results are the differences in tobacco (alcohol) budget shares for tobacco-consuming (alcohol-consuming) households that were interviewed before and immediately after the tax increase. After controlling for household characteristics, tobacco and alcohol budget shares were found to be higher among households that were interviewed after the tax increase.

The budget share of tobacco, for tobacco-consuming households interviewed immediately after the tax increase was on average 0.16 percentage points higher than for those interviewed before the implementation of the tax. Comparison of alcohol-consuming households showed a similar increase, with the budget share on alcohol around 0.18 percentage points higher after the tax increase. This means that the increase in the prices of tobacco and alcohol products as a result of the tax increase contributed to an increase in the household budget shares of the two goods.

Table 2.16 Effect of tobacco (alcohol) tax increase on tobacco (alcohol) budget shares (KIHBS 2015-2016)

VARIABLES	Budget share (Tobacco)	Budget share (Alcohol)
$\boldsymbol{Tax\ dummy\ (\tau)}$	15.57**	17.84*
	(6.558)	(10.70)
$\boldsymbol{lnM}$	-0.888**	1.812**
	(0.405)	(0.708)
$\boldsymbol{\tau * lnM}$	-1.257**	-1.479*
	(0.529)	(0.863)
Adult prop	-0.915	-0.362
	(1.130)	(2.153)
$\boldsymbol{lnHHsize}$	-2.000***	-4.941***
	(0.540)	(1.023)
Post primary vocational	3.569***	-3.283**
	(1.036)	(1.446)
Secondary	0.310	0.0123
	(0.312)	(0.664)
College	-0.910**	0.829
	(0.442)	(1.003)
University	-0.593	-2.778*
	(1.320)	(1.505)
Other	-0.760	-1.049
	(1.027)	(2.061)
Head Wage	-0.126	1.896**
	(0.170)	(0.786)
Number employed	-0.364**	0.295
	(0.149)	(0.311)
Age Adults	-0.0784***	-0.0832
	(0.0265)	(0.0527)
No. of children under 5 years	0.462**	0.833**
	(0.200)	(0.362)
No. of children over 15 years	0.667*	-0.951*
	(0.378)	(0.538)
Age of household head	0.0449*	0.0610
	(0.0245)	(0.0420)
Protestant	0.0109	0.611
	(0.359)	(0.683)
Other Christians	-0.0432	-0.837
	(0.582)	(0.924)
Muslim	-1.286*	-3.159**
	(0.725)	(1.523)
Other religions	0.358	-0.799
	(0.664)	(1.129)
Urban	0.298	0.524
	(0.348)	(0.717)
Constant	18.90***	-12.05
	(5.223)	(8.389)
County fixed effects	Yes	Yes
Sample size	**942**	**1,318**

Notes: These are the results from a simple OLS regression, comparing the budget shares of tobacco (alcohol) consuming households that were surveyed three months prior to and three months after the implementation of a new excise tax on tobacco and alcohol. The two groups of households consisted of nationally representative samples. T$ax\ dummy\ (\tau)$ was assigned value of one if the household was surveyed after the implementation of the new excise tax and zero otherwise. Catholic was the omitted religion. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

The larger budget shares of tobacco and alcohol after the tax increase may have led to a decrease in the budget share of other household expenditures. Equation (2.7) was used to test this hypothesis. Seemingly Unrelated Regression (SURE) was used to compare the expenditure shares of different items for the two nationally representative samples that were interviewed in the three months before and three months after the implementation of the tax increase. The comparison was done for tobacco-consuming households and alcohol-consuming households. SURE, was selected because of the existence of contemporaneous correlation among the error terms.

The results for the coefficient on the tax dummy (τ) from the SURE estimation are presented in Table 2.17. Tobacco-consuming households that were surveyed immediately after the tax increase had a lower budget share on energy and other non-food expenditures compared to tobacco-consuming households that were interviewed before the tax increase. A comparison of the alcohol-consuming households indicated that those interviewed after the tax increase spent less on fruit, seafood, and some non-food items. The other expenditure categories were similar for tobacco (alcohol) consuming households interviewed immediately pre- and post-tax increase.

Table 2.17 Seemingly Unrelated Regression (SURE) estimates for the coefficient on the tax dummy (KIHBS 2015-2016)

Commodity	Tobacco consuming households	Alcohol consuming households
Education	0.0282	0.170
	(0.403)	(0.415)
Energy	-0.721**	-0.0837
	(0.360)	(0.283)
Bread and cereals	0.717	0.679
	(0.596)	(0.450)
Roots and tubers	0.0724	0.130
	(0.168)	(0.126)
Meats	0.627	0.537
	(0.410)	(0.360)
Fish and seafood	-0.283	-0.286*
	(0.242)	(0.165)
Milk and eggs	0.356	0.430
	(0.358)	(0.287)
Fruits	0.344	-0.677***
	(0.317)	(0.224)
Vegetables	-0.0594	-0.234
	(0.266)	(0.234)
Other foods	0.323	-0.0107
	(0.721)	(0.724)
Other non-food expenditures	-1.504**	-0.926*
	(0.693)	(0.548)
Rent	0.209	0.0939
	(0.226)	(0.252)
Sample size	**967**	**1,264**

Notes: These are the results for the coefficient on the t*ax dummy* (τ) from Seemingly Unrelated Regression (SURE). T*ax dummy* (τ) was assigned value of one if the household was surveyed after the implementation of the new excise tax and zero otherwise. Coefficient on the tax dummy is the difference in percentage points on expenditures between tobacco (alcohol) consuming households that were interviewed before the tax increase and tobacco (alcohol) consuming households interviewed after the tax increase. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets. Full regression results included in the appendix.

The results from the SURE estimation do not account for changes in the budget shares of other expenditure items that may have resulted from macroeconomic and seasonal changes over the two periods. The KIHBS data provided an opportunity to control for both unobservable factors that are constant over time and other macroeconomic shocks that the households faced. Since there were nationally representative samples from the same population, matched difference-in-differences was used to estimate the effect of the tobacco and alcohol taxes on the budget shares of other goods.

The main assumption in this section was that the evolution of the unobserved determinants, given the observables, was independent of the tobacco-consuming (alcohol-consuming) status of the households. Since the relevant households were interviewed within a nine-month period, the assumption that most selection unobservable variables remained unchanged over time is likely to hold. Therefore, using matched difference-in-differences provided a means of controlling for selection bias that was due to time-invariant unobservable variables.

The natural experiment resulted in four categories of households. Tobacco (alcohol) consuming households interviewed after the tax increase (category A), households that did not consume tobacco (alcohol) that were interviewed after the tax increase (category B), tobacco (alcohol) consuming households interviewed before the tax increase (category C), and households that did not consume tobacco (alcohol) interviewed before the tax increase (category D).

Kernel matching with enforcement of common support was used to match tobacco (alcohol) consuming households that were surveyed after the tax increase to similar households in the other three categories. That is, households in category A were matched to similar households in categories B, C and D based on observable household characteristics. The observable household characteristics used, are similar to those used in the previous sections. Following the condition on the selection of covariates to use in the matching process outlined by Stuart *et al.* (2014) the household characteristics used are believed not to have been affected by the anticipation or imposition of the higher tobacco and alcohol taxes.

As a result of matching, a pseudo-panel of households was created. The created pseudo-panel of households was used to compare expenditure shares. The balanced t-tests for post-matching household characteristics are presented in Table A36, Table A37, Table A38 Table A39 and Table A40. The p-values from the t-tests indicate that after matching, all the household characteristics for households that consumed tobacco (alcohol) and those that did not consume tobacco (alcohol) balanced.

The matched difference-in-differences results are presented in Table 2.18 and Table 2.19. The results contain the differences in expenditure shares between tobacco (alcohol) consuming households and those households that did not consume tobacco (alcohol) both before and immediately (one to three months) after higher taxes on tobacco (alcohol) were implemented. Similar to what was observed from the 3SLS results, tobacco- and alcohol-consuming households spent less on education, energy, rent, and food items such as milk and

eggs, both before and after the tax increase. Therefore, the 3SLS results were upheld even after limiting the comparison of expenditure shares to similar/matched households.

Table 2.18 Matched difference in differences results for household expenditure patterns of tobacco and non-tobacco consuming households that were surveyed before and 1 to 3 months after an increase in tobacco taxes

	Before implementation of the new tax			**After implementation of the new tax**				
	Tobacco consumption			**Tobacco consumption**				
Commodity	Consumers	Non-consumers	Difference	Consumers	Non-consumers	Difference	Difference in Differences	Sample Size
Education	3.640	5.504	-1.865***	4.200	5.934	-1.733***	0.131	7,720
			(0.401)			(0.442)	(0.597)	
Energy	6.754	8.019	-1.265***	6.211	7.550	-1.339***	-0.075	7,720
			(0.352)			(0.308)	(0.468)	
Bread & cereals	18.609	19.609	-1.001	19.241	19.848	-0.607	0.393	7,720
			(0.615)			(0.605)	(0.862)	
Roots & tubers	1.672	2.010	-0.338**	1.825	1.994	-0.169	0.169	7,720
			(0.153)			(0.154)	(0.217)	
Meats	4.472	5.587	-1.115***	5.057	6.031	-0.974**	0.141	7,720
			(0.370)			(0.404)	(0.548)	
Fish & seafood	1.903	1.669	0.234	1.409	1.366	0.043	-0.191	7,720
			(0.264)			(0.193)	(0.327)	
Milk & eggs	5.974	6.975	-1.001***	6.261	7.524	-1.263***	-0.262	7,720
			(0.310)			(0.344)	(0.463)	
Fruits	3.247	3.462	-0.217	3.566	3.324	0.241	0.458	7,720
			(0.245)			(0.290)	(0.380)	
Vegetables	5.771	6.136	-0.365	5.558	5.971	-0.413*	-0.048	7,720
			(0.252)			(0.234)	(0.334)	
Other foods	22.690	14.148	8.542***	22.455	14.338	8.116***	-0.425	7,720
			(0.741)			(0.718)	(1.032)	
Other non-food expenditures	17.345	21.690	-4.344***	16.433	21.172	-4.740***	-0.395	7,720
			(0.663)			(0.587)	(0.885)	
Rent	2.024	3.222	-1.198***	2.007	3.101	-1.093	0.105	7,720
			(0.297)			(0.272)	(0.403)	

Notes: These are the matched difference in differences estimation results that compared households that consumed tobacco and those that did not consume tobacco. Data used, was from two nationally representative samples surveyed before and (one to three months) after an increase in tobacco taxes. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

Table 2.19 Matched difference in differences results for household expenditure of alcohol and non-alcohol consuming households that were surveyed before and 1 to 3 months after an increase in alcohol taxes

	Before implementation of the new tax			After implementation of the new tax				
	Alcohol consumption			Alcohol consumption				
Commodity	Consumers	Non-consumers	Difference	Consumers	Non-consumers	Difference	Difference in Differences	Sample Size
Education	4.618	6.322	-1.704***	4.892	6.835	-1.942***	-0.238	7,875
			(0.434)			(0.441)	(0.619)	
Energy	6.383	8.485	-2.102***	6.288	7.871	-1.583***	0.519	7,875
			(0.406)			(0.309)	(0.510)	
Bread & cereals	16.352	18.691	-2.338***	17.097	18.719	-1.621***	0.717	7,875
			(0.503)			(0.471)	(0.689)	
Roots & tubers	1.368	1.713	-0.345***	1.539	1.748	-0.209*	0.136	7,875
			(0.116)			(0.109)	(0.159)	
Meats	5.155	5.777	-0.622**	5.704	6.332	-0.629*	-0.007	7,875
			(0.307)			(0.340)	(0.458)	
Fish & seafood	1.897	1.973	-0.094	1.421	1.553	-0.131	-0.038	7,875
			(0.193)			(0.137)	(0.337)	
Milk & eggs	5.896	7.342	-1.446***	6.399	7.808	-1.409***	0.037	7,875
			(0.255)			(0.277)	(0.376)	
Fruits	3.220	3.359	-0.139	2.688	3.426	-0.737***	-0.598**	7,875
			(0.214)			(0.195)	(0.290)	
Vegetables	5.696	6.149	-0.453*	5.440	6.014	-0.574***	-0.121	7,875
			(0.233)			(0.199)	(0.306)	
Other foods	26.538	12.688	13.850***	26.165	12.130	14.035***	0.185	7,875
			(0.684)			(0.656)	(0.948)	
Other non-food expenditures	18.278	22.857	-4.579***	17.778	23.267	-5.489***	-0.910	7,875
			(0.560)			(0.537)	(0.776)	
Rent	3.302	4.209	-0.907***	3.087	3.875	-0.788***	0.119	7,875
			(0.341)			(0.286)	(0.445)	

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 was from two nationally representative sample surveyed before and (one to three months) after an increase in alcohol taxes. Kernel matching was used to match the households. Differences are the differences in budget shares *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

The difference-in-differences results showed that among tobacco-consuming households, the increase in taxes/prices of cigarettes did not have an effect on other expenditure categories. This result was a refinement of the SURE estimates. Although the SURE result indicated that tobacco-consuming households interviewed after the tax increase had lower expenditure shares for energy and other non-food expenditures, the decline in the expenditure shares of the two categories also occurred among non-tobacco consuming household. This indicated that there might have been other macroeconomic shocks that were not controlled for by the SURE estimation.

A possible reason for the tax on tobacco not having an effect on other household expenditures may have been its relatively minimal effect on household budgets. The average monthly expenditure on tobacco was approximately 1.32 US$ (23.33%) higher for tobacco-consuming households that were interviewed after the tax increase.

The tax increase on alcohol which resulted in an increase in the average real price of most alcohol products, had an impact on household spending patterns. After the tax increase, spending on fruits decreased in alcohol-consuming households while other categories remained unchanged. This result was also a refinement of the SURE results. The SURE results indicated that alcohol consuming households that were interviewed after the tax increase had lower

expenditure shares for seafood, fruits, and other non-food expenditure. However, MDID results showed that the decrease in expenditure on seafood as well as other non-food expenditure also occurred in non-alcohol consuming households. Consequently, there might have been other macroeconomic shocks that affected the two items that were not controlled for in SURE.

After controlling for other macroeconomic shocks, expenditure on fruits by alcohol-consuming households were further crowded out after the tax increase. This means that some alcohol-consuming households may have reallocated expenditure from food items, when they were faced with higher alcohol prices. The tax on alcohol may have had an effect on other expenditure shares because, for some alcohol-consuming households, the average expenditure on alcohol was 5.40 US$ higher for those surveyed after the new tax was implemented.

It is possibility that some of the households that were interviewed immediately after the tax change were consuming tobacco and alcohol products that they had bought in bulk in anticipation of the tax increase. To address this concern, a matched difference-in-differences estimation was done for only those households that purchased tobacco and alcohol products during the interview period (this excluded households that consumed tobacco and alcohol products from their own stock i.e. bought at an earlier period) and households that did not consume tobacco or alcohol. Further, an MDID estimation was done for households interviewed before the tax increase and the nationally representative subsample that was interviewed four to six months after the tax increase.

The results presented in Table 2.20 and Table 2.21 which considered only tobacco and alcohol purchasing households, were similar to the matched difference-in-differences results discussed above. The balanced t-test for post-matching household characteristics are presented in Table A41, Table A42, Table A43 and Table A44. The p-values from the t-tests indicate that after matching, all the household characteristics for households that purchased tobacco (alcohol) and those that did not consume tobacco (alcohol) balanced.

Table 2.20 Matched difference in differences results for household expenditure patterns of tobacco purchasing and non-tobacco consuming households that were surveyed before and 1 to 3 months after an increase in tobacco taxes

	Before implementation of the new tax			After implementation of the new tax				
	Tobacco consumption			Tobacco consumption				
Commodity	Purchased	Non-consumers	Difference	Purchased	Non-consumers	Difference	Difference in Differences	Sample Size
Education	3.973	5.703	-1.730***	3.989	5.973	-1.947***	-0.217	7,790
			(0.422)			(0.421)	(0.596)	
Energy	7.065	8.050	-0.985***	6.466	7.556	-1.090***	-0.106	7,790
			(0.351)			(0.313)	(0.470)	
Bread & cereals	18.714	19.754	-1.040*	19.495	19.829	-0.334	0.707	7,790
			(0.599)			(0.618)	(0.861)	
Roots & tubers	1.673	2.015	-0.342**	1.807	1.974	-0.167	0.174	7,790
			(0.153)			(0.153)	(0.216)	
Meats	4.474	5.562	-1.088***	4.984	5.924	-0.940**	0.148	7,790
			(0.359)			(0.392)	(0.531)	
Fish & seafood	1.939	1.592	0.347	1.372	1.400	0.028	-0.319	7,790
			(0.256)			(0.191)	(0.319)	
Milk & eggs	5.945	7.064	-1.119***	6.302	7.480	-1.179***	-0.060	7,790
			(0.305)			(0.339)	(0.456)	
Fruits	3.264	3.420	-0.156	3.605	3.309	0.296	0.452	7,790
			(0.238)			(0.300)	(0.383)	
Vegetables	5.727	6.125	-0.398	5.638	5.982	-0.344	0.054	7,790
			(0.244)			(0.235)	(0.339)	
Other foods	22.011	13.950	8.061***	22.363	14.442	7.920***	-0.140	7,790
			(0.713)			(0.718)	(1.012)	
Other non-food expenditures	17.631	21.803	-4.172***	16.423	21.102	-4.679***	-0.577	7,790
			(0.649)			(0.576)	(0.868)	
Rent	1.962	3.155	-1.193***	2.076	3.218	-1.142***	0.051	
			(0.287)			(0.278)	(0.399)	

Notes: These are the matched difference in differences estimation results that compared households that purchased tobacco and those that did not consume tobacco. Data used, was from two nationally representative samples surveyed before and (one to three months) after an increase in tobacco taxes. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

Table 2.21 Matched difference in differences results for household expenditure patterns alcohol purchasing and non-alcohol consuming households that were surveyed before and 1 to 3 months after an increase in alcohol taxes

	Before implementation of the new tax			After implementation of the new tax				
	Alcohol consumption			Alcohol consumption				
Commodity	Purchased	Non-consumers	Difference	Purchased	Non-consumers	Difference	Difference in Differences	Sample Size
Education	4.670	6.301	-1.631***	4.808	6.878	-2.070***	-0.439	7,612
			(0.437)			(0.445)	(0.624)	
Energy	6.327	8.378	-2.052***	6.188	8.066	-1.878***	0.174	7,612
			(0.364)			(0.438)	(0.570)	
Bread & cereals	16.477	18.750	-2.273***	16.850	18.610	-1.760***	0.513	7,612
			(0.508)			(0.478)	(0.698)	
Roots & tubers	1.364	1.730	-0.366***	1.522	1.740	-0.218**	0.148	7,612
			(0.117)			(0.111)	(0.161)	
Meats	5.127	5.756	-0.630**	5.772	6.287	-0.515	0.114	7,612
			(0.308)			(0.344)	(0.462)	
Fish & seafood	1.922	1.945	-0.023	1.382	1.578	-0.196	-0.173	7,612
			(0.194)			(0.137)	(0.237)	
Milk & eggs	5.910	7.380	-1.469***	6.422	7.885	-1.433***	0.036	7,612
			(0.257)			(0.284)	(0.383)	
Fruits	3.250	3.367	-0.117	2.601	3.425	-0.825***	-0.708**	7,612
			(0.217)			(0.179)	(0.281)	
Vegetables	5.720	6.171	-0.451*	5.387	6.005	-0.618***	-0.167	7,612
			(0.236)			(0.199)	(0.309)	
Other foods	26.422	12.937	13.485***	26.488	12.237	14.251***	0.676	7,612
			(0.694)			(0.682)	(0.973)	
Other non-food expenditures	18.274	22.722	-4.448***	17.877	22.939	-5.061***	-0.613	7,612
			(0.559)			(0.529)	(0.770)	
Rent	3.222	4.118	-0.896***	3.171	3.951	-0.780	0.115	7,612
			(0.343)			(0.292)	(0.450)	

Notes: These are the matched difference in differences estimation results that compared households that purchased alcohol and those that did not consume alcohol. Data used, was from two nationally representative samples surveyed before and (one to three months) after an increase in alcohol taxes. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

The results presented in Table 2.22 and Table 2.23 are the MDID results comparing households that were surveyed before the tobacco (alcohol) tax increase to the nationally representative sample that was surveyed four to six months after the tobacco (alcohol) tax increase. The results on the impact of tobacco tax increase are similar to those discussed above. As was observed in the earlier results, the increase in alcohol taxes contributed to further crowding-out of expenditure on fruits among alcohol-consuming households. However, there was less crowding-out of energy expenditure for alcohol-consuming households that were interviewed four to six months after the increase in alcohol taxes. The balanced t-test for post-matching household characteristics are presented in Table A45, Table A46, Table A47 and Table A48. The p-values from the t-tests indicate that after matching, all the household characteristics for households that purchased tobacco (alcohol) and those that did not consume tobacco (alcohol) balanced.

Table 2.22 Matched difference in differences results for household expenditure patterns of tobacco purchasing and non-tobacco consuming households that were surveyed before and 4 to 6 months after an increase in tobacco taxes

	Before implementation of the new tax			**After implementation of the new tax**				
	Tobacco consumption			**Tobacco consumption**				
Commodity	Purchased	Non-consumers	Difference	Purchased	Non-consumers	Difference	Difference in Differences	Sample Size
Education	3.971	5.689	-1.727***	3.920	6.043	-2.123***	-0.396	7,087
			(0.423)			(0.416)	(0.593)	
Energy	7.071	8.039	-0.968***	6.317	7.179	-0.862***	0.106	7,087
			(0.351)			(0.293)	(0.457)	
Bread & cereals	18.693	19.753	-1.060*	17.682	18.865	-1.183**	-0.122	7,087
			(0.600)			(0.595)	(0.845)	
Roots & tubers	1.674	2.021	-0.346**	1.657	2.046	-0.389***	-0.043	7,087
			(0.153)			(0.145)	(0.211)	
Meats	4.480	5.575	-1.096***	4.554	5.526	-0.972**	0.124	7,087
			(0.359)			(0.461)	(0.584)	
Fish & seafood	1.895	1.591	0.305	1.336	1.526	-0.189	-0.494	7,087
			(0.253)			(0.188)	(0.315)	
Milk & eggs	5.956	7.054	-1.097***	5.594	7.377	-1.782***	-0.685	7,087
			(0.305)			(0.314)	(0.437)	
Fruits	3.271	3.427	-0.157	3.276	3.706	-0.430*	-0.273	7,087
			(0.238)			(0.234)	(0.334)	
Vegetables	5.762	6.132	-0.406*	5.925	5.949	-0.024	0.382	7,087
			(0.245)			(0.267)	(0.362)	
Other foods	22.023	13.949	8.073***	23.193	15.376	8.537***	0.464	7,087
			(0.714)			(0.807)	(1.078)	
Other non-food expenditures	17.650	21.798	-4.148***	17.810	20.548	-2.738***	1.410	7,087
			(0.650)			(0.649)	(0.919)	
Rent	1.959	3.149	-1.191***	2.152	3.815	-1.663	-0.473	7,087
			(0.288)			(0.300)	(0.415)	

Notes: These are the matched difference in differences estimation results that compared households that purchased tobacco and those that did not consume tobacco. Data used, was from two nationally representative samples surveyed before and (four to six months) after an increase in tobacco taxes. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

Table 2.23Matched difference in differences results for household expenditure patterns alcohol purchasing and non-alcohol consuming households that were surveyed before and 4 to 6 months after an increase in alcohol taxes

	Before implementation of the new tax			After implementation of the new tax				
	Alcohol consumption			Alcohol consumption				
Commodity	Purchased	Non-consumers	Difference	Purchased	Non-consumers	Difference	Difference in Differences	Sample Size
Education	6.305	4.666	-1.638***	4.966	7.161	-2.195***	-0.557	7,638
			(0.437)			(0.438)	(0.619)	
Energy	6.322	8.380	-2.058***	6.179	7.294	-1.114***	0.943**	7,638
			(0.363)			(0.269)	(0.452)	
Bread & cereals	16.451	18.761	-2.310***	15.155	18.076	-2.921***	0.611	7,638
			(0.508)			(0.460)	(0.685)	
Roots & tubers	1.361	1.728	-0.368***	1.464	1.822	-0.358***	0.010	7,638
			(0.117)			(0.112)	(0.162)	
Meats	5.130	5.748	-0.618**	5.080	5.857	-0.777	-0.159	7,638
			(0.308)			(0.378)	(0.487)	
Fish & seafood	1.917	1.945	-0.028	2.159	1.942	0.217	0.245	7,638
			(0.194)			(0.230)	(0.300)	
Milk & eggs	5.902	7.379	-1.477***	6.075	7.996	-1.922***	0.445	7,638
			(0.256)			(0.261)	(0.366)	
Fruits	3.245	3.364	-0.119	2.834	3.527	-0.693***	-0.574**	7,638
			(0.216)			(0.162)	(0.270)	
Vegetables	5.712	6.173	-0.462*	5.559	6.177	-0.618***	-0.156	7,638
			(0.236)			(0.223)	(0.309)	
Other foods	26.480	12.938	13.542***	27.439	13.302	14.137***	0.595	7,638
			(0.696)			(0.738)	(1.014)	
Other non-food expenditures	18.264	22.716	-4.452***	18.090	21.821	-3.730***	0.722	7,638
			(0.558)			(0.574)	(0.801)	
Rent	3.238	4.120	-0.881**	3.691	4.502	-0.811**	0.071	7,638
			(0.342)			(0.321)	(0.469)	

Notes: These are the matched difference in differences estimation results that compared households that purchased alcohol and those that did not consume alcohol. Data used, was from two nationally representative samples surveyed before and (four to six months) after an increase in alcohol taxes. Kernel matching was used to match the households. Differences are the differences in budget shares. *p<0.1, **p<0.05, ***p<0.01. Robust standard errors are in brackets.

2.6.5 Limitations

This chapter used cross-sectional data to estimate the impact of tobacco and alcohol consumption and taxation on household spending patterns in Kenya. Panel data analysis would have provided evidence as to whether tobacco and alcohol consumption had a negative causal effect on expenditures necessary for human capital development. Further, a panel data set would have provided a better estimation of the impact of tobacco and alcohol taxes on household spending patterns. Unfortunately, Kenya does not have an appropriate panel data set.

The adult sex ratio was used as an instrumental variable for both the tobacco and alcohol consumption status of households. As was pointed out in section 2.6.3, the main drawback of this approach is that the adult sex ratio may not meet the exclusion restriction. Conclusions from the point estimates resulting from the use of an imperfect instrumental variable may be biased. Unfortunately, a better instrumental variable could not be found in the data that used in this chapter.

2.7 Summary and conclusion

The purpose of this chapter was to estimate the impact of consumption and taxation of tobacco and alcohol on household spending patterns in Kenya. This was done by considering both the consumption status of households (i.e. whether they consumed the two products or not) and the amounts they spent on the two products.

Tobacco-control policies that were implemented between 2005 and 2016 resulted in a decline in prevalence of tobacco use among Kenyan households. The overall prevalence of tobacco use decreased by six percentage points between 2005-2006 and 2015-2016. The decrease in the proportion of tobacco-consuming households was slightly larger for rural households. Alcohol-control policies implemented over the same period did not contribute to a reduction in the proportion of alcohol-consuming households. The share of alcohol-consuming households increased by half a percentage point over the ten-year period.

Tobacco- and alcohol-consuming households were found to spend less on education, healthcare, energy, rent and food items. The most affected expenditure categories in tobacco-consuming households were food items and energy. The household expenditure categories that were most adversely affected among alcohol-consuming households, were food items and education. Some of the categories negatively affected by the two goods, differed between urban and rural households.

Alcohol- and tobacco-consuming households in urban areas consistently had lower expenditure shares for energy and rent. In rural areas, households that consumed both goods had lower expenditure shares for education and healthcare. More expenditure categories were negatively affected when the comparison was between alcohol-consuming households and households that did not consume alcohol. A likely reason for this is the size of alcohol's budget share. The average budget share of alcohol was more than double that of tobacco. Tobacco and alcohol crowded *in* each other, both among urban and rural households.

The adult sex ratio was used as an instrumental variable for the tobacco and alcohol consumption status in the Three Stage Least Square (3SLS) estimation, of the difference in expenditure shares. However, the adult sex ratio may not have met the exclusion restriction, for some of the expenditure categories that were considered. The method proposed by Nevo and Rosen (2012) was used to relax the exclusion restriction. As a result, the upper and lower bound confidence intervals for the difference in expenditure shares were generated. The results

on the impact of tobacco and alcohol consumption on household spending patterns were mostly unchanged even after the exclusion restriction was relaxed.

A new tax on tobacco and alcohol was implemented during the KIHBS 2015-2016 data collection period. After the new tax was implemented, the average real price of one of the most popular cigarette brands increased by around 21%. Similarly, the real price of the most popular brand of beer increased by 12%. This natural experiment was used to test the effect of tobacco and alcohol tax policy on household expenditure patterns.

Matched difference-in-differences (MDID) was used to estimate the impact of the tax increase on household budgets. Using MDID provided a new means of controlling for selection bias caused by time-invariant unobservable variables. Therefore, the pseudo-panel created for MDID estimation also provided a new method for estimating the difference in expenditure shares between households that consumed tobacco (alcohol) and those that did not consume tobacco (alcohol).

The MDID results on comparison of the expenditure shares were similar to the 3SLS results. Households that consumed tobacco and alcohol consistently spent less on education, food items, energy, and rent. The results of the estimation of the effect of the tax increase, indicate that, tax increase on tobacco did not have a significant impact on the household expenditure patterns of tobacco-consuming households. However, the increase in alcohol taxes resulted in further crowding-out of expenditure on fruits.

These results show that the full costs of consuming tobacco and alcohol transcend the costs associated with health effects and loss of productivity. This is because, at the household level, expenditure on the two goods was negatively correlated with expenditure on items such as education, healthcare, food items, and energy which are necessary for human capital development. Lower expenditure on items necessary for human capital development implied that consumption of tobacco and alcohol may be contributing to intergenerational poverty.

Taxation has been shown to be very effective in reducing the demand for tobacco. The results from this chapter indicate that modest increases in tobacco taxes may not have an adverse effect on the spending patterns of tobacco-consuming households. However, increasing tax on alcohol may lead to further crowding-out of expenditures on some food items. Further research is required on the impact of larger or sustained increases in tobacco and alcohol taxes on household expenditure patterns.

2.8 Appendix A

Table A1 Test for consumer separability (2005-2006 KIHBS)

	Tobacco	Alcohol
Commodity	**Full Sample**	**Full Sample**
Alcohol	**69.18**	
Tobacco		**10.84**
Education	**14.83**	**20.87**
Energy	**9.84**	7.32
Bread and Cereals	5.59	**29.35**
Banana and tubers	0.68	2.93
Poultry	6.16	**17.41**
Meat	**23.29**	**17.63**
Fish and Seafood	5.62	2.05
Milk and eggs	**9.29**	7.75
Fruits	**13.45**	0.61
Vegetables	2.14	7.23
Other foods	6.45	3.92
Healthcare	0.88	2.72
Clothing and Footwear	**8.06**	7.54
Water	1.89	2.62
Transport	1.24	**10.15**
Furnishings	**12.29**	6.69
Rent	1.67	**12.38**
Communication	**3.06**	**18.65**
Overall	**262.79**	**396.66**

Notes: The values are x^2 statistics from a Wald test on the joint significance of the parameters associated with d in equation (2.4) for our system of conditional demand equations. Bold numbers indicate significant statistics with p-values less than 0.05.

Table A2 Test for consumer separability (2015-2016 KIHBS)

	Tobacco	Alcohol
Commodity	**Full Sample**	**Full Sample**
Alcohol	**10.59**	
Tobacco		**15.43**
Education	4.39	5.31
Energy	**9.58**	**14.31**
Bread and Cereals	**12.07**	**17.25**
Roots and tubers	**10.49**	**10.24**
Meat	3.90	3.24
Fish and Seafood	0.58	3.08
Milk and eggs	**9.38**	**32.26**
Fruits	0.51	**10.00**
Vegetables	**14.14**	**21.98**
Other foods	**15.04**	**11.52**
Rent	4.65	**26.47**
Overall system of equations	**85.52**	**286.00**

Notes: The values are x^2 statistics from a wald test on the joint significance of the parameters associated with d in equation (2.4) for our system of conditional demand equations. Bold numbers indicate significant statistics with p-values less than 0.05.

*Table A3 Ordinary Least Square (OLS) estimates for the coefficient on tobacco (alcohol) dummies **d** (2005-2006 KIHBS)*

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				1.358***	1.540***	1.222***
				(0.0742)	(0.115)	(0.0989)
Alcohol	3.519***	4.167***	3.129***			
	(0.151)	(0.293)	(0.167)			
Education	-0.841***	-1.044***	-0.741***	-0.819***	-0.812***	-0.709***
	(0.201)	(0.320)	(0.255)	(0.196)	(0.287)	(0.263)
Energy	-0.543***	-0.531**	-0.439***	-0.662***	-0.902***	-0.306**
	(0.131)	(0.241)	(0.149)	(0.128)	(0.215)	(0.154)
Bread and cereals	0.266	0.619**	0.0324	-0.335	-0.221	-0.721*
	(0.264)	(0.304)	(0.376)	(0.257)	(0.272)	(0.388)
Banana and tubers	-0.021	-0.163	0.0294	0.013	-0.0866	0.103
	(0.158)	(0.156)	(0.233)	(0.155)	(0.140)	(0.243)
Poultry	-0.0343	-0.0318	-0.0668	0.226**	0.367***	0.0789
	(0.108)	(0.121)	(0.159)	(0.106)	(0.109)	(0.165)
Meats	-0.074	0.0273	-0.106	0.845***	1.412***	0.550**
	(0.160)	(0.242)	(0.211)	(0.159)	(0.223)	(0.220)
Fish and seafood	0.110	0.00401	0.199*	0.167**	0.00406	0.331***
	(0.0777)	(0.114)	(0.103)	(0.0762)	(0.102)	(0.107)
Milk and eggs	-0.519***	-0.416*	-0.610***	-0.243	-0.254	-0.377
	(0.167)	(0.217)	(0.232)	(0.163)	(0.194)	(0.239)
Fruits	0.0306	0.0824	-0.00132	0.0807	0.163	0.0668
	(0.117)	(0.128)	(0.173)	(0.115)	(0.115)	(0.179)
Vegetables	0.0632	-0.112	0.151	0.294**	0.0992	0.425**
	(0.123)	(0.160)	(0.173)	(0.121)	(0.144)	(0.179)
Other foods	0.848***	1.266***	0.516	1.248***	2.096***	0.540
	(0.288)	(0.487)	(0.355)	(0.283)	(0.440)	(0.367)
Healthcare	0.029	0.00889	0.0289	-0.124**	-0.161**	-0.115
	(0.0533)	(0.0837)	(0.0703)	(0.052)	(0.0747)	(0.0726)
Clothing and footwear	-0.590**	-0.674	-0.473	0.144	0.178	0.131
	(0.300)	(0.489)	(0.384)	(0.294)	(0.440)	(0.398)
Water	-0.0738	-0.162	-0.0153	-0.0384	-0.181*	0.0865
	(0.0636)	(0.106)	(0.0774)	(0.0621)	(0.095)	(0.0797)
Transport	-0.408**	-0.204	-0.521**	-0.625***	-0.905***	-0.473**
	(0.193)	(0.369)	(0.216)	(0.189)	(0.329)	(0.224)
Furnishings	0.074	0.0565	0.103	-0.0157	-0.139	0.159
	(0.148)	(0.220)	(0.198)	(0.144)	(0.196)	(0.206)
Rent	-0.583***	-1.638***		-0.431***	-1.026***	
	(0.152)	(0.382)		(0.148)	(0.341)	
Communication	-0.368***	-0.513**	-0.308***	0.0151	0.00967	-0.0323
	(0.107)	(0.217)	(0.110)	-0.106	(0.196)	(0.115)
Sample Size	**8,783**	**3,609**	**5,174**	**8,783**	**3,609**	**5,174**

The results are the coefficients on ***d*** from the estimation of equation (2.5). They are the differences in expenditure shares expressed as percentage points. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). The dependent variable has values between 0 and 100. For brevity household characteristics included in the regression were left out. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

*Table A4 Ordinary Least Square (OLS) estimates for the coefficient on tobacco (alcohol) dummies **d** (2015-2016 KIHBS)*

	Tobacco			**Alcohol**		
Commodity	Full Sample	Urban	Rural	Full Sample	Urban	Rural
Tobacco				0.973***	0.902***	1.051***
				(0.0428)	(0.0618)	(0.0592)
Alcohol	4.096***	4.407***	3.955***			
	(0.126)	(0.225)	(0.147)			
Education	-1.783***	-2.030***	-1.672***	-1.970***	-1.909***	-2.055***
	(0.239)	(0.389)	(0.304)	(0.204)	(0.311)	(0.272)
Energy	-1.344***	-1.577***	-1.271***	-1.434***	-1.693***	-1.334***
	(0.158)	(0.247)	(0.203)	(0.135)	(0.197)	(0.182)
Bread and cereals	-1.547***	-1.561***	-1.551***	-2.146***	-1.697***	-2.577***
	(0.226)	(0.337)	(0.300)	(0.192)	(0.268)	(0.267)
Roots and tubers	-0.344***	-0.301***	-0.382***	-0.384***	-0.257***	-0.434***
	(0.071)	(0.0847)	(0.103)	(0.0606)	(0.0678)	(0.0922)
Meats	-0.763***	-0.744***	-0.856***	-0.544***	-0.878***	-0.222
	(0.170)	(0.248)	(0.230)	-0.145)	(0.198)	(0.206)
Fish and seafood	0.00216	0.0987	-0.0653	-0.0357	-0.202*	0.0979
	(0.0856)	(0.135)	(0.110)	(0.0734)	(0.108)	(0.099)
Milk and eggs	-1.643***	-1.462***	-1.713***	-1.759***	-1.677***	-1.773***
	(0.150)	(0.208)	(0.206)	(0.128)	(0.165)	(0.184)
Fruits	-0.209*	-0.148	-0.276*	-0.482***	-0.446***	-0.457***
	(0.107)	(0.146)	(0.150)	(0.0914)	(0.117)	(0.134)
Vegetables	-0.691***	-0.667***	-0.682***	-0.781***	-0.879***	-0.644***
	(0.112)	(0.159)	(0.154)	(0.0961)	(0.127)	(0.138)
Other foods	9.594***	11.00***	8.949***	14.44***	16.71***	12.80***
	(0.244)	(0.440)	(0.278)	(0.214)	(0.361)	(0.254)
Rent	-1.194***	-3.062***		-1.108***	-2.908***	
	(0.151)	(0.345)		(0.129)	(0.276)	
Sample Size	**16,073**	**7,051**	**9,022**	**16.073**	**7,051**	**9,022**

The results are the coefficients on ***d*** from the estimation of equation (2.5). They are the differences in expenditure shares expressed as percentage points. Positive coefficient indicates that tobacco (alcohol) consuming households had a higher expenditure share than households that did not consume tobacco (alcohol). The dependent variable has values between 0 and 100. For brevity household characteristics included in the regression were left out. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table A5 Breusch-Pagan test for heteroscedasticity (2005-2006 KIHBS)

Tobacco			**Alcohol**		
Full Sample	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
20200	**12000**	**12900**	**24300**	**10500**	**13200**

The results are the Chi square statistics from the Breusch-Pagan test for heteroscedasticity in the system of equations Results in bold indicate that the null hypothesis (No overall system Heteroscedasticity) was rejected at 5% level of significance.

Table A6 C-statistic test for endogeneity of $\boldsymbol{lnM}, (\boldsymbol{lnM})^2$ and $\boldsymbol{p_t t}$ $(\boldsymbol{p_a a})$ (2005-2006 KIHBS)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Education	**61.44**	**32.30**	**30.50**	**64.71**	**33.54**	**33.49**
Energy	**77.86**	**39.02**	**59.79**	**70.71**	**33.75**	**57.70**
Food	**71.68**	**31.93**	**54.29**	**80.87**	**38.13**	**59.30**
Alcohol	**95.17**	**59.41**	**43.74**			
Tobacco				**87.92**	**49.70**	**43.40**
Healthcare	**11.27**	1.06	**16.09**	**11.06**	1.21	**16.11**
Clothing	**10.31**	**8.00**	**21.41**	**11.41**	**10.71**	**20.48**
Water	5.21	**12.47**	1.55	6.15	**11.10**	2.48
Transport	**67.84**	**37.56**	**37.56**	**67.23**	**40.13**	**31.45**
Furnishing	**12.28**	4.84	5.93	**11.04**	3.35	5.70
Rent	**85.73**	**120.82**		**83.04**	**117.10**	
Communication	**125.21**	**56.05**	**76.40**	**115.99**	**47.18**	**76.06**

The results are the Chi square statistics from C-statistic test for endogeneity of $lnM, (lnM)^2$ and $p_t t$ $(p_a a)$ in equation (2.6). Results in bold indicate that the null hypothesis (the variables were exogenous) was rejected at 5% level of significance.

Table A7 C-statistic test for endogeneity of $\boldsymbol{lnM}, (\boldsymbol{lnM})^2$ and $\boldsymbol{d}$ (2005-2006 KIHBS)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Education	**43.88**	**23.74**	**14.44**	**50.62**	**75.47**	**21.86**
Energy	**69.00**	**36.74**	**51.18**	**68.81**	**28.00**	**50.87**
Food	**71.17**	**22.43**	**55.22**	**75.59**	**34.50**	**55.51**
Alcohol	**47.65**	**54.03**	**22.58**			
Tobacco				**67.74**	**40.90**	**23.10**
Healthcare	7.37	0.80	**8.22**	**9.01**	0.78	**9.44**
Clothing	7.53	**8.58**	**20.38**	**9.28**	**10.64**	**17.74**
Water	3.95	**12.35**	1.82	6.45	**12.36**	1.52
Transport	**54.55**	**25.03**	**29.18**	**59.55**	**39.51**	**24.73**
Furnishing	**13.18**	5.88	6.34	**9.23**	2.61	3.92
Rent	**86.99**	**99.48**		**84.84**	**116.26**	
Communication	**117.42**	**32.62**	**69.38**	**104.27**	**44.38**	**62.18**

The results are the Chi square statistics from the C-statistic test for endogeneity of $lnM, (lnM)^2$ and d in equation (2.5). Results in bold indicate that the null hypothesis (the variables were exogenous) was rejected at 5% level of significance.

Table A8 Breusch-Pagan test for heteroscedasticity (2015-2016 KIHBS)

Tobacco			Alcohol		
Full Sample	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
9896.59	**4645.44**	**5802.74**	**16200.00**	**8937.00**	**9719.51**

The results are the Chi square statistics from the Breusch-Pagan test for heteroscedasticity in the system of equations Results in bold indicate that the null hypothesis (No overall system Heteroscedasticity) was rejected at 5% level of significance.

Table A9 C-statistic test for endogeneity test of $p_t t$ and $p_a a$ (2015-2016 KIHBS)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Education	**8.59**	1.71	**30.70**	**5.24**	2.97	**24.49**
Energy	**31.47**	**7.23**	**27.69**	**23.44**	**4.08**	**32.86**
Food	**47.49**	**29.83**	**24.81**	**54.69**	**28.56**	**33.20**
Alcohol	**175.34**	**68.69**	**115.44**			
Tobacco				**180.00**	**85.18**	**89.41**
Rent	**6.39**	**10.20**		**5.18**	**7.97**	

The results are the Chi square statistics from the C-statistic test for endogeneity of $p_t t$ and $p_a a$ in equation (2.4). Results in bold indicate that the null hypothesis (the variables were exogenous) was rejected at 5% level of significance.

Table A10 C-statistic test for endogeneity of d (2015-2016 KIHBS)

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Education	0.08	3.53	2.41	0.56	**6.47**	**9.67**
Energy	**30.11**	**7.61**	**29.58**	**24.96**	3.51	**29.84**
Food	**29.04**	**14.59**	**16.05**	**59.88**	**35.26**	**33.96**
Alcohol	**85.58**	**41.81**	**47.87**			
Tobacco				**176.85**	**76.80**	**77.24**
Rent	**3.85**	**7.76**		**5.85**	**8.14**	

The results are the Chi square statistics from C-statistic test for endogeneity of d in equation (2.5). Results in bold indicate that the null hypothesis (the variables were exogenous) was rejected at 5% level of significance.

Table A11 First stage regression on tobacco (alcohol) spending (2005-2006 KIHBS)

	Tobacco			Alcohol		
Coefficient on	**Full Sample**	**Urban**	**Rural**	**Full sample**	**Urban**	**Rural**
Adult sex ratio	89.53***	93.49***	91.61***	237.7***	350.3***	101.3***
	(10.42)	(14.84)	(17.14)	(34.52)	(63.13)	(34.64)
Adult proportion	26.23	59.10	-0.591	-26.70	61.34	-55.89
	(22.96)	(45.76)	(21.58)	(66.14)	(138.5)	(59.20)
lnHHsize	20.56*	40.17*	8.838	-70.45**	-84.14	-8.529
	(11.18)	(21.42)	(13.01)	(29.48)	(62.74)	(26.54)
Head schooling	-0.0704	-1.765	0.306	5.562	-6.709	9.142**
	(1.613)	(3.832)	(1.566)	(5.042)	(11.99)	(4.186)
Wage head	-0.630	-1.259	-3.908	14.65***	13.55**	-5.716
	(1.744)	(1.932)	(3.651)	(4.307)	(6.047)	(13.37)
Number employed	5.864	15.63**	1.005	20.10*	59.60**	2.976
	(3.604)	(7.809)	(3.643)	(11.02)	(26.49)	(9.079)
Age adults	1.502***	2.321*	0.974*	2.083	9.609**	-0.674
	(0.532)	(1.230)	(0.531)	(1.763)	(4.365)	(1.431)
No of children under 5	-2.978	-13.07	0.551	7.596	6.796	-6.853
	(3.651)	(7.948)	(4.010)	(13.34)	(32.30)	(10.89)
No. of children over 15	0.324	-6.588	2.662	21.65	46.33	-2.854
	(4.803)	(10.51)	(5.585)	(16.57)	(39.68)	(13.63)
Age head	-0.800*	-0.924	-0.622	-0.0893	-4.768	1.278
	(0.454)	(1.138)	(0.399)	(1.533)	(3.770)	(1.254)
Most educated	-2.665	-1.211	-3.573**	8.428	28.41**	-3.637
	(1.820)	(4.223)	(1.813)	(5.805)	(13.74)	(4.815)
Non-poor	35.51***	35.77***	33.83***	41.71**	68.06	32.51*
	(5.286)	(10.24)	-0.591	(20.82)	(46.84)	(17.60)
Urban	21.53**			67.11**		
	(9.282)			-26.70		
Protestant	-27.42***	-29.76**	-27.15***	-68.35***	-125.6***	-23.04
	(6.517)	(12.26)	(7.253)	(20.89)	(43.20)	(18.58)
Other Christians	-28.51***	-35.23**	-28.57**	-82.91***	-142.1**	-44.92
	(10.01)	(16.34)	(12.74)	(31.25)	(65.28)	(27.56)
Muslim	78.74**	74.47*	103.5	-119.5**	-111.6	-95.37
	(38.15)	(39.56)	(93.58)	(51.36)	(85.83)	(63.21)
Other religions	29.80*	32.47	23.21	-3.943	-226.2**	73.86**
	(15.88)	(36.38)	(17.48)	(42.53)	(96.30)	(36.12)
Month FE	F=0.81	F=1.03	F=0.64	F=1.90**	F=0.74	F=1.86**
District FE	F=4.44***	F=4.02***	F=3.44***	F=1.85***	F=1.86***	F=1.38**
Sample Size	**8,790**	**3,612**	**5,178**	**8,790**	**3,612**	**5,178**

Notes: The table shows the results from estimating an OLS regression for the tobacco (alcohol) smoking status of a household. The dependent variable is the monthly expenditure on tobacco (alcohol) in Kenya shillings. In all data specifications, adult sex ratio was a strong predictor of the amount spent on tobacco (alcohol) *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table A12 First stage regression on tobacco (alcohol) spending (2015-2016 KIHBS)

	Tobacco			Alcohol		
Coefficient on	**Full sample**	**Urban**	**Rural**	**Full sample**	**Urban**	**Rural**
Adult sex ratio	148.3***	134.1***	162.9***	482.5***	503.3***	459.4***
	(12.73)	(17.33)	(16.72)	(88.33)	(148.1)	(64.78)
Adult proportion	28.88	64.87	6.495	47.42	-291.2	303.6**
	(29.04)	(44.20)	(31.69)	(194.0)	(365.2)	(135.4)
lnHHsize	11.67	25.16	-1.421	-149.2	-375.6**	60.36
	(13.90)	(22.94)	(15.91)	(97.83)	(180.5)	(66.34)
Post primary vocational	50.24	156.7	-22.53	-103.6	-72.01	-89.47
	(60.14)	(136.6)	(28.01)	(139.6)	(329.2)	(73.86)
Secondary	-33.95***	-46.87***	-21.55**	18.57	34.16	50.21
	(7.648)	(11.85)	(9.234)	(48.33)	(83.18)	(46.83)
College	-39.97***	-34.57**	-49.11***	118.6	199.1	63.46
	(9.683)	(15.66)	(10.46)	(113.0)	(177.4)	(63.09)
University	-57.52***	-45.99**	-93.27***	256.2	273.6	97.56
	(14.33)	(20.22)	(11.98)	(191.9)	(241.7)	(224.2)
Other	73.17	-106.8*	174.5	140.9	504.2	-64.07
	(149.9)	(61.82)	(201.6)	(142.4)	(366.6)	(121.5)
Wage head	-2.932**	-4.322***	-2.008	107.3***	136.8***	14.81
	(1.154)	(1.545)	(2.126)	(24.91)	(31.18)	(11.88)
Number employed	12.43**	10.61	14.05**	74.99***	118.3*	56.14***
	(5.022)	(8.779)	(5.963)	(26.08)	(69.14)	(19.37)
Age adults	2.636***	3.752***	1.774**	2.852	2.527	4.669
	(0.708)	(1.448)	(0.773)	(4.223)	(10.71)	(3.163)
No of children under 5	1.741	7.358	-1.494	-5.267	-50.60	6.823
	(5.152)	(9.743)	(5.831)	(26.90)	(64.87)	(21.46)
No. of children over 15	3.551	-15.16	14.21	-26.88	-166.0*	0.970
	(9.829)	(15.68)	(12.60)	(36.51)	(90.21)	(33.85)
Age head	-1.241*	-0.938	-1.402*	0.984	7.111	-4.722
	(0.746)	(1.508)	(0.781)	(3.760)	(7.998)	(2.898)
Urban	13.14			144.3**		
	(9.287)			(58.14)		
Protestant	-16.79*	-13.64	-25.97**	-197.9***	-189.7	-200.5***
	(9.443)	(15.74)	(11.40)	(69.56)	(130.5)	(54.28)
Other Christians	-25.45**	-30.14*	-20.80	-358.2***	-506.7***	-230.6***
	(11.57)	(15.97)	(15.97)	(74.31)	(139.9)	(61.05)
Muslim	11.77	43.14*	-83.91**	-630.9***	-760.0***	-235.8*
	(20.98)	(24.77)	(42.68)	(117.7)	(169.8)	(142.8)
Other religion	69.80*	66.58	58.44	-122.6	-329.1	-5.626
	(36.29)	(51.90)	(52.24)	(130.6)	(264.9)	(111.5)
Month FE	F=0.55	F=0.81	F=0.82	F=1.11	F=2.02**	F=1.39
District FE	F=8.27***	F=4.02***	F=6.44***	F=2.20***	F=1.65***	F=2.68***
Observations	**16,075**	**7,052**	**9,023**	**16,073**	**7,051**	**9,022**

Notes: The table shows the results from estimating an OLS regression for the tobacco (alcohol) smoking status of a household. The dependent variable is the monthly expenditure on tobacco (alcohol) in Kenya shillings. In all data specifications, adult sex ratio was a strong predictor of the amount spent on tobacco (alcohol) *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table A13 First-stage ordinary least square (OLS) regression for $\boldsymbol{lnM}$ and $(\boldsymbol{lnM})^{\boldsymbol{2}}$ (2005-2006 KIHBS)

	$\boldsymbol{lnM}$			$(\boldsymbol{lnM})^{\boldsymbol{2}}$		
Coefficient on	**Full Sample**	**Urban**	**Rural**	**Full sample**	**Urban**	**Rural**
Log of Assets	0.204***	0.236***	0.169***	0.257***	0.292***	0.209***
	(0.00447)	(0.00668)	(0.00613)	(0.00513)	(0.00762)	(0.00718)
Adult proportion	0.355***	0.213***	0.455***	8.227***	4.911***	10.68***
	(0.0323)	(0.0533)	(0.0406)	(0.771)	(1.313)	(0.942)
$\boldsymbol{lnHHsize}$	0.592***	0.484***	0.677***	13.58***	11.20***	15.43***
	(0.0153)	(0.0255)	(0.0194)	(0.365)	(0.627)	(0.451)
Head schooling	0.00517**	0.0153***	0.000594	0.128**	0.383***	0.0120
	(0.00253)	(0.00469)	(0.00297)	(0.0604)	(0.116)	(0.0690)
Wage head	0.0402***	0.0317***	0.0757***	0.992***	0.777***	1.766***
	(0.00221)	(0.00244)	(0.00952)	(0.0534)	(0.0610)	(0.222)
Number employed	-0.000345	0.0235**	-0.0136**	0.00436	0.596**	-0.313**
	(0.00550)	(0.0103)	(0.00640)	(0.131)	(0.255)	(0.149)
Age adults	-0.00159*	-0.00144	-0.00206**	-0.0404*	-0.0526	-0.0471**
	(0.000885)	(0.00171)	(0.00101)	(0.0211)	(0.0422)	(0.0235)
No of children under 5	-0.0743***	-0.0796***	-0.0783***	-1.741***	-1.923***	-1.799***
	(0.00670)	(0.0126)	(0.00775)	(0.160)	(0.310)	(0.180)
No. of children over 15	0.0919***	0.0774***	0.0950***	2.141***	1.950***	2.197***
	(0.00826)	(0.0155)	(0.00963)	(0.197)	(0.381)	(0.224)
Age head	0.00253***	0.00606***	0.000847	0.0631***	0.153***	0.0216
	(0.000767)	(0.00147)	(0.000887)	(0.0183)	(0.0363)	(0.0206)
Most educated	0.0267***	0.0166***	0.0265***	0.593***	0.355***	0.606***
	(0.00294)	(0.00543)	(0.00345)	(0.0700)	(0.133)	(0.0799)
Non-poor	0.705***	0.647***	0.729***	16.02***	14.83***	16.57***
	(0.0110)	(0.0193)	(0.0131)	(0.261)	(0.474)	(0.304)
Urban	0.336***			7.535***		
	(0.0135)			(0.322)		
Protestant	-0.00257	0.00614	-0.00771	-0.0466	0.238	-0.213
	(0.0105)	(0.0169)	(0.0132)	(0.249)	(0.415)	(0.306)
Other Christians	-0.0272*	-0.0617**	-0.00781	-0.634*	-1.510**	-0.145
	(0.0156)	(0.0255)	(0.0195)	(0.373)	(0.629)	(0.453)
Muslim	0.0687***	0.0847**	0.0445	1.634***	2.066**	0.984
	(0.0258)	(0.0336)	(0.0450)	(0.616)	(0.828)	(1.044)
Other religions	0.0746***	0.129***	0.00512	1.714***	2.915***	0.0409
	(0.0213)	(0.0378)	(0.0255)	(0.507)	(0.931)	(0.593)
Constant	3.576***	3.525***	6.923***	-37.70*	-38.41	47.97**
	(0.807)	(1.014)	(0.887)	(19.26)	(24.96)	(20.59)
Month FE	F=4.53***	F=1.59*	F=3.60***	F=4.26***	F=1.49	F=3.68***
District FE	F=10.46***	F=6.65***	F=5.57***	F=10.81***	F=6.66***	F=5.42***
Sample size	**8,673**	**3,557**	**5,116**	**8,673**	**3,557**	**5,116**

Notes: The table shows results of estimating an OLS model for log of household total expenditure(lnM). And log of total household expenditure squared$(lnM)^2$. *p<0.1, **p<0.05, ***p<0.01. In all data specifications, the log of assets strongly explains variations in lnM F statistic for the instrumental variable (log of assets) for Full Sample, Urban and Rural are 2007.92, 1225.56 and 736 for lnM and 2455.10, 1457.71 and 832.62 in the case of $(\log of\ assets)^2$. Standard errors are in brackets.

Table A14 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Full Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	-0.759	-2.231***	-2.786	-1.286	-0.838	0.555	-1.254***	-2.240**	-1.165*	-2.201***
	(1.017)	(0.796)	(1.756)	(0.995)	(0.585)	(1.071)	(0.383)	(1.043)	(0.661)	(0.767)
lnM	-5.845**	2.096	-40.27***	0.660	5.799***	16.09***	0.622	12.87***	3.129***	-2.156
	(2.278)	(1.750)	(3.444)	(1.457)	(1.114)	(1.626)	(0.967)	(1.503)	(1.070)	(1.314)
$(lnM)^2$	0.307***	-0.0926	1.324***	-0.0658	-0.224***	-0.660***	-0.0346	-0.553***	-0.147***	0.00998
	(0.0961)	(0.0715)	(0.135)	(0.0565)	(0.0427)	(0.0640)	(0.0381)	(0.0589)	(0.0419)	(0.0513)
Adult prop	0.623	-0.208	-1.130*	-0.175	-0.252	1.150***	0.113	0.457	-0.945***	0.269
	(0.522)	(0.336)	(0.673)	(0.479)	(0.305)	(0.434)	(0.198)	(0.512)	(0.317)	(0.357)
$lnHHsize$	3.012***	-0.405**	5.002***	0.732***	-0.215	-0.539***	-0.0150	0.388*	-0.279**	0.938***
	(0.238)	(0.160)	(0.321)	(0.201)	(0.146)	(0.186)	(0.0900)	(0.232)	(0.136)	(0.157)
Head schooling	-0.169***	0.0153	-0.0382	0.00137	0.0378*	0.0879***	-0.00855	0.0364	-0.00776	0.0171
	(0.0486)	(0.0245)	(0.0539)	(0.0307)	(0.0198)	(0.0273)	(0.0173)	(0.0307)	(0.0241)	(0.0234)
Head Wage	-0.131**	-0.0174	0.0835**	0.0287**	0.00768	0.0251	-0.000664	0.0248	0.000546	0.00611
	(0.0622)	(0.0239)	(0.0347)	(0.0121)	(0.00752)	(0.0188)	(0.00816)	(0.0177)	(0.00964)	(0.0111)
Number employed	-0.553***	0.0622	-0.0898	-0.0901	0.0135	0.0818	0.0677**	0.00343	0.0913	-0.0159
	(0.0946)	(0.0468)	(0.120)	(0.0702)	(0.0486)	(0.0646)	(0.0284)	(0.0734)	(0.0638)	(0.0482)
Age Adults	-0.123***	0.00776	0.0467**	0.0325**	0.0178*	0.0369***	0.00110	0.0446***	0.00498	0.0232**
	(0.0134)	(0.00871)	(0.0214)	(0.0134)	(0.00997)	(0.0133)	(0.00501)	(0.0163)	(0.0118)	(0.00973)
No. of children under 5	-1.670***	0.0308	0.0383	0.0814	0.120*	0.242***	0.0981**	0.385***	0.0517	-0.0544
	(0.110)	(0.0604)	(0.145)	(0.0957)	(0.0649)	(0.0841)	(0.0408)	(0.0891)	(0.0634)	(0.0686)
No. of children over 15	1.714***	-0.266***	-0.136	-0.386***	-0.127*	-0.282***	-0.107**	-0.405***	-0.200***	-0.348***
	(0.149)	(0.0702)	(0.168)	(0.106)	(0.0702)	(0.0960)	(0.0507)	(0.112)	(0.0697)	(0.0722)
Age head	0.0974***	-0.00182	0.00795	-0.00209	0.00250	-0.0239**	-0.00262	-0.0261**	0.00190	-0.0142*
	(0.0124)	(0.00704)	(0.0180)	(0.0108)	(0.00814)	(0.00992)	(0.00436)	(0.0125)	(0.00912)	(0.00740)
Most educated	0.637***	-0.0645*	-0.184***	-0.148***	-0.0960***	-0.164***	-0.0801***	-0.138***	-0.0280	-0.118***
	(0.0587)	(0.0336)	(0.0710)	(0.0380)	(0.0247)	(0.0350)	(0.0210)	(0.0420)	(0.0291)	(0.0334)
Urban	-0.748***	1.758***	-2.371***	-1.293***	-0.723***	0.249*	-0.0671	-1.004***	-0.712***	-0.205*
	(0.199)	(0.146)	(0.271)	(0.137)	(0.0958)	(0.138)	(0.0703)	(0.147)	(0.0969)	(0.113)
Protestant	-0.152	0.000696	-0.333	-0.0718	0.0562	-0.212	-0.205***	0.255*	0.0782	-0.00487
	(0.180)	(0.109)	(0.225)	(0.127)	(0.0855)	(0.139)	(0.0672)	(0.144)	(0.0919)	(0.114)
Other Christians	-0.185	-0.00981	-0.212	-0.160	0.0357	-0.330*	-0.0588	0.0999	0.0824	-0.144
	(0.238)	(0.173)	(0.314)	(0.204)	(0.145)	(0.199)	(0.113)	(0.203)	(0.164)	(0.154)
Muslim	-1.319***	0.664***	-0.535	-0.0485	-0.0306	0.270	0.809***	-0.326	0.306	-0.166
	(0.372)	(0.236)	(0.461)	(0.210)	(0.223)	(0.339)	(0.242)	(0.287)	(0.240)	(0.219)
Other religions	-0.895***	0.768***	0.990*	-0.208	0.120	-0.187	-0.147	0.541	0.133	0.415*
	(0.322)	(0.259)	(0.533)	(0.267)	(0.195)	(0.370)	(0.123)	(0.339)	(0.170)	(0.227)
Constant	21.06	-6.767	296.5***	4.910	-33.74***	-91.59***	-0.213	-68.60***	-11.61*	29.50***
	(13.59)	(10.67)	(21.59)	(9.107)	(6.994)	(10.17)	(6.005)	(9.491)	(6.726)	(8.290)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,644	8,644	8,644	8,644	8,644	8,644	8,644	8,644	8,644	8,644

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A15 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Full Sample)

VARIABLES	Other foods	Alcohol	Healthcare	Clothing	Water	Transport	Furnishing	Rent	Communication
d	15.34***	7.321***	-0.879**	0.0811	-0.538	1.859*	-1.049	-2.732***	0.954
	(2.066)	(1.179)	(0.346)	(1.800)	(0.422)	(1.024)	(0.923)	(0.944)	(0.586)
lnM	-5.279*	-0.269	0.608	25.62***	0.384	-11.30***	-1.878	8.401***	7.880***
	(3.146)	(1.485)	(0.509)	(3.185)	(0.766)	(2.919)	(2.093)	(2.315)	(1.238)
$(lnM)^2$	0.00610	-0.0208	-0.0247	-0.930***	-0.0204	0.605***	0.103	-0.325***	-0.242***
	(0.125)	(0.0567)	(0.0201)	(0.129)	(0.0305)	(0.126)	(0.0897)	(0.0989)	(0.0517)
Adult prop	-0.853	-0.580	-0.222	-1.483*	0.235	0.511	-0.478	1.376***	0.636**
	(0.728)	(0.405)	(0.150)	(0.815)	(0.180)	(0.530)	(0.353)	(0.407)	(0.277)
$lnHHsize$	-1.024***	-1.158***	-0.0399	-3.191***	-0.0126	-1.577***	-0.518***	-0.611***	-1.174***
	(0.354)	(0.212)	(0.0619)	(0.361)	(0.0772)	(0.223)	(0.165)	(0.188)	(0.139)
Head schooling	0.0784	0.0695***	0.00344	-0.0835	-0.00113	0.000203	-0.0151	0.0433	0.0942***
	(0.0510)	(0.0233)	(0.0121)	(0.0596)	(0.0124)	(0.0421)	(0.0379)	(0.0271)	(0.0212)
Head Wage	0.163***	0.0336**	0.00214	-0.00612	0.00109	-0.149**	-0.0655*	0.263***	-0.0521**
	(0.0347)	(0.0148)	(0.0126)	(0.0425)	(0.00918)	(0.0657)	(0.0363)	(0.0945)	(0.0214)
Number employed	0.0385	0.0616	0.0219	0.279**	0.00389	0.111	0.0606	-0.0975*	0.139***
	(0.119)	(0.0682)	(0.0254)	(0.110)	(0.0248)	(0.0836)	(0.0627)	(0.0564)	(0.0376)
Age Adults	-0.0404**	-0.0136	0.000776	0.00774	1.28e-05	0.0201	0.0116	0.0461***	0.0113*
	(0.0189)	(0.0101)	(0.00395)	(0.0215)	(0.00431)	(0.0129)	(0.0131)	(0.0119)	(0.00679)
No. of children under 5	0.521***	0.0792	0.0993***	0.633***	0.0143	0.0680	0.105	0.163**	0.142***
	(0.147)	(0.0693)	(0.0331)	(0.166)	(0.0311)	(0.0933)	(0.0795)	(0.0683)	(0.0502)
No. of children over 15	0.0491	0.0909	-0.105***	-0.413**	-0.0390	-0.119	-0.159	0.0937	-0.0340
	(0.173)	(0.0745)	(0.0348)	(0.197)	(0.0374)	(0.109)	(0.100)	(0.0816)	(0.0581)
Age head	-0.00154	0.0264***	0.00596	-0.0941***	0.00220	0.00109	-0.0153	-0.00899	-0.0135**
	(0.0164)	(0.00839)	(0.00376)	(0.0165)	(0.00348)	(0.0104)	(0.0106)	(0.00965)	(0.00616)
Most educated	-0.0966	0.0339	-0.0257	-0.218***	-0.0293*	0.117**	-0.0352	0.0641*	0.0415*
	(0.0641)	(0.0336)	(0.0198)	(0.0757)	(0.0168)	(0.0529)	(0.0395)	(0.0352)	(0.0245)
Urban	0.327	0.395***	-0.126**	-1.889***	0.717***	-0.497**	-0.724***	8.569***	0.112
	(0.304)	(0.150)	(0.0523)	(0.298)	(0.0673)	(0.194)	(0.146)	(0.144)	(0.0988)
Protestant	1.262***	-0.309**	-0.0250	-0.402	0.0503	0.381**	0.0401	-0.201	0.228**
	(0.253)	(0.140)	(0.0477)	(0.266)	(0.0547)	(0.160)	(0.146)	(0.135)	(0.0895)
Other Christians	0.498	-0.172	-0.118*	0.549	0.0832	0.589**	-0.101	-0.203	0.368***
	(0.350)	(0.188)	(0.0615)	(0.404)	(0.0750)	(0.233)	(0.192)	(0.178)	(0.126)
Muslim	1.239**	-1.316***	-0.0577	-0.231	0.102	-0.0170	0.0537	0.835**	-0.163
	(0.537)	(0.330)	(0.108)	(0.546)	(0.200)	(0.422)	(0.269)	(0.420)	(0.205)
Other religions	-1.001*	-0.496	0.0263	-0.227	0.308***	-0.528	-0.461**	1.266***	-0.327*
	(0.595)	(0.352)	(0.0858)	(0.560)	(0.108)	(0.374)	(0.196)	(0.373)	(0.172)
Constant	77.65***	6.128	-2.676	-152.1***	-1.278	54.82***	12.19	-49.48***	-57.03***
	(19.61)	(9.468)	(3.190)	(19.68)	(4.742)	(17.03)	(12.06)	(13.56)	(7.391)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,644	8,644	8,644	8,644	8,644	8,644	8,644	8,644	8,644

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A16 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Urban Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	2.765	-6.714***	-1.829	-3.482***	-0.965	-0.451	-0.800	-5.044***	-1.928**	-4.838***
	(2.077)	(1.527)	(2.023)	(0.888)	(0.655)	(1.661)	(0.658)	(1.323)	(0.854)	(1.176)
lnM	-2.344	-5.295	-18.59***	1.212	5.543***	13.41***	0.508	9.170***	4.283***	-3.214**
	(3.422)	(3.232)	(3.111)	(1.276)	(0.999)	(2.265)	(0.980)	(1.859)	(0.862)	(1.551)
$(lnM)^2$	0.153	0.182	0.569***	-0.0747	-0.205***	-0.565***	-0.0313	-0.400***	-0.182***	0.0494
	(0.140)	(0.132)	(0.120)	(0.0481)	(0.0385)	(0.0872)	(0.0378)	(0.0708)	(0.0323)	(0.0581)
Adult prop	-2.422***	-0.112	-0.442	-0.156	0.0829	1.555***	0.00460	0.196	-0.656*	0.0569
	(0.749)	(0.539)	(0.783)	(0.344)	(0.305)	(0.586)	(0.236)	(0.519)	(0.339)	(0.458)
$lnHHsize$	3.005***	0.492*	3.560***	0.849***	-0.194	0.0279	0.203*	0.312	-0.341**	1.308***
	(0.357)	(0.261)	(0.365)	(0.177)	(0.138)	(0.246)	(0.122)	(0.251)	(0.171)	(0.215)
Head schooling	-0.0251	-0.00949	-0.0950	-0.0278	0.0338*	0.108***	0.0219	-0.0553	0.0135	-0.000281
	(0.0921)	(0.0457)	(0.0833)	(0.0298)	(0.0202)	(0.0388)	(0.0229)	(0.0424)	(0.0239)	(0.0362)
Head Wage	-0.0206	-0.0512	0.0508**	0.0111*	-0.00436	0.0322*	0.00630	0.0108	-0.0108	0.00258
	(0.0546)	(0.0348)	(0.0218)	(0.00666)	(0.00625)	(0.0181)	(0.00670)	(0.0137)	(0.00807)	(0.0116)
Number employed	-0.887***	0.0593	-0.260**	-0.0256	0.000914	-0.0728	0.000556	0.0559	0.0470	-0.0227
	(0.156)	(0.0908)	(0.122)	(0.0610)	(0.0465)	(0.100)	(0.0616)	(0.0839)	(0.0617)	(0.0768)
Age Adults	-0.202***	0.0147	0.0543*	0.0121	0.0191**	0.0320*	-0.00101	0.0253	-0.0128	0.0242*
	(0.0283)	(0.0191)	(0.0325)	(0.0120)	(0.00937)	(0.0166)	(0.00725)	(0.0176)	(0.0111)	(0.0138)
No. of children under 5	-2.337***	-0.0927	0.432**	0.0603	0.150*	0.446***	0.0920	0.532***	0.136*	-0.106
	(0.159)	(0.131)	(0.211)	(0.0816)	(0.0901)	(0.152)	(0.0748)	(0.101)	(0.0808)	(0.0947)
No. of children over 15	1.586***	-0.459***	0.0200	-0.247***	-0.137	-0.422***	-0.0115	-0.554***	-0.267***	-0.407***
	(0.293)	(0.138)	(0.281)	(0.0952)	(0.0947)	(0.141)	(0.0841)	(0.132)	(0.0728)	(0.113)
Age head	0.177***	-0.000685	0.00507	-0.00471	-0.00592	-0.0237**	-0.00500	-0.0312**	0.00807	-0.00596
	(0.0291)	(0.0159)	(0.0269)	(0.0101)	(0.00718)	(0.0109)	(0.00676)	(0.0139)	(0.00906)	(0.0114)
Most educated	0.353***	-0.116**	-0.165*	-0.106***	-0.0825***	-0.184***	-0.0967***	-0.0772	-0.0671*	-0.137***
	(0.101)	(0.0579)	(0.0872)	(0.0405)	(0.0302)	(0.0528)	(0.0235)	(0.0510)	(0.0368)	(0.0299)
Protestant	0.0619	-0.345	-0.280	-0.207	-0.0192	-0.381**	-0.235***	0.352**	0.102	-0.138
	(0.199)	(0.259)	(0.283)	(0.126)	(0.0819)	(0.182)	(0.0810)	(0.137)	(0.0811)	(0.132)
Other Christians	0.198	-0.486	-0.00826	-0.206	-0.176	-0.510*	0.103	0.0616	0.0466	-0.322**
	(0.316)	(0.315)	(0.432)	(0.228)	(0.129)	(0.297)	(0.153)	(0.194)	(0.181)	(0.154)
Muslim	-1.786***	0.262	-0.301	0.0845	-0.00134	0.288	0.286	-0.175	0.580**	-0.0542
	(0.498)	(0.321)	(0.513)	(0.180)	(0.211)	(0.343)	(0.193)	(0.265)	(0.260)	(0.215)
Other religions	-1.580***	1.682***	-0.299	0.160	-0.247	-0.669	-0.348**	0.662**	1.006***	0.411
	(0.542)	(0.464)	(0.480)	(0.284)	(0.183)	(0.478)	(0.174)	(0.281)	(0.277)	(0.376)
Constant	6.094	44.49**	145.2***	-1.647	-35.19***	-74.75***	0.167	-46.91***	-21.26***	36.49***
	(20.91)	(19.94)	(20.00)	(8.140)	(6.479)	(14.62)	(6.283)	(11.98)	(5.495)	(10.17)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,457	3,457	3,457	3,457	3,457	3,457	3,457	3,457	3,457	3,457

The results are the coefficients on d from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A17 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Urban Sample)

VARIABLES	Other foods	Alcohol	Healthcare	Clothing	Water	Transport	Furnishing	Rent	Communication
d	23.31***	13.49***	-0.141	2.371	-1.222*	4.148*	-1.033	-9.869***	-0.772
	(4.146)	(2.493)	(0.554)	(3.108)	(0.654)	(2.144)	(1.239)	(2.467)	(1.278)
lnM	-7.980	1.335	0.746	12.37***	-0.782	-11.26***	-6.623**	12.35***	14.09***
	(5.403)	(2.604)	(0.517)	(3.875)	(0.918)	(4.093)	(2.589)	(3.814)	(2.261)
$(lnM)^2$	0.101	-0.100	-0.0328*	-0.442***	0.0274	0.577***	0.287***	-0.470***	-0.490***
	(0.206)	(0.101)	(0.0197)	(0.155)	(0.0368)	(0.169)	(0.108)	(0.152)	(0.0903)
Adult prop	-0.553	0.220	-0.289	-1.204	0.224	1.233	-0.983*	3.545***	1.151***
	(1.122)	(0.637)	(0.204)	(1.244)	(0.249)	(1.146)	(0.520)	(1.197)	(0.419)
$lnHHsize$	-1.742***	-1.128***	0.0843	-3.128***	0.224**	-1.420***	-0.541**	-0.792	-1.378***
	(0.650)	(0.286)	(0.0993)	(0.535)	(0.114)	(0.520)	(0.225)	(0.524)	(0.248)
Head schooling	0.166**	0.0692	0.0151	-0.109	-0.0353*	-0.0137	0.0300	0.0820	0.0841
	(0.0783)	(0.0515)	(0.0163)	(0.113)	(0.0203)	(0.0695)	(0.0361)	(0.0804)	(0.0526)
Head Wage	0.129***	0.0572***	0.00886	0.00944	-0.00219	-0.157***	-0.0555*	0.206**	-0.0753***
	(0.0316)	(0.0194)	(0.0106)	(0.0444)	(0.00902)	(0.0573)	(0.0288)	(0.0877)	(0.0282)
Number employed	0.832***	0.227**	-0.0677*	0.556***	-0.0196	0.220	0.00488	-0.143	0.108
	(0.218)	(0.114)	(0.0389)	(0.190)	(0.0449)	(0.175)	(0.0946)	(0.191)	(0.0868)
Age Adults	-0.0552	0.0427**	0.000913	-0.0283	0.00399	0.0788**	-0.00772	0.137***	0.0305**
	(0.0367)	(0.0196)	(0.00571)	(0.0406)	(0.00835)	(0.0342)	(0.0174)	(0.0370)	(0.0134)
No. of children under 5	1.069***	0.257**	0.0696	0.884***	-0.0437	-0.0421	0.162	0.0919	0.150
	(0.250)	(0.127)	(0.0520)	(0.281)	(0.0556)	(0.181)	(0.162)	(0.163)	(0.105)
No. of children over 15	0.0224	0.272**	-0.0401	-0.123	-0.0110	-0.287	-0.161	0.0827	-0.0740
	(0.278)	(0.133)	(0.0572)	(0.412)	(0.0698)	(0.290)	(0.182)	(0.262)	(0.120)
Age head	-0.000372	0.000759	0.00468	-0.0715**	0.000329	-0.0321	-0.0131	-0.0294	-0.0214*
	(0.0286)	(0.0142)	(0.00377)	(0.0341)	(0.00691)	(0.0288)	(0.0163)	(0.0264)	(0.0127)
Most educated	-0.0570	0.105	-0.0170	-0.0948	-0.0267	0.172*	-0.0797	0.143	0.0905
	(0.119)	(0.0709)	(0.0216)	(0.139)	(0.0292)	(0.0889)	(0.0503)	(0.0956)	(0.0576)
Urban	1.520***	-0.466*	-0.0329	-0.127	-0.0582	0.489	0.159	-0.286	0.200
	(0.336)	(0.279)	(0.0679)	(0.407)	(0.0856)	(0.302)	(0.167)	(0.273)	(0.146)
Protestant	0.956**	-0.454*	-0.0326	-0.00450	-0.0728	1.192***	0.212	-0.717**	0.275
	(0.483)	(0.254)	(0.0916)	(0.574)	(0.112)	(0.390)	(0.218)	(0.316)	(0.236)
Other Christians	1.659**	-1.388***	-0.0504	-0.483	0.0438	-0.177	0.135	1.888***	-0.316
	(0.711)	(0.507)	(0.138)	(0.806)	(0.153)	(0.629)	(0.394)	(0.614)	(0.369)
Muslim	1.909*	-1.712***	-0.0696	-1.320	0.456***	-0.882	-0.267	2.072**	-0.495
	(1.058)	(0.516)	(0.125)	(0.873)	(0.158)	(0.566)	(0.243)	(0.921)	(0.321)
Other religions	1.520***	-0.466*	-0.0329	-0.127	-0.0582	0.489	0.159	-0.286	0.200
	(0.336)	(0.279)	(0.0679)	(0.407)	(0.0856)	(0.302)	(0.167)	(0.273)	(0.146)
Constant	95.52***	-4.067	-3.463	-66.40***	6.914	55.96**	42.66***	-72.77***	-96.23***
	(34.06)	(16.77)	(3.355)	(24.82)	(5.683)	(24.71)	(15.58)	(23.48)	(13.99)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,457	3,457	3,457	3,457	3,457	3,457	3,457	3,457	3,457

The results are the coefficients on d from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped Standard errors are in brackets.

Table A18 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Rural Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	-2.820**	0.856	-3.614*	-1.589	0.0885	1.075	-0.284	-1.513	-0.667	-0.729
	(1.219)	(0.927)	(2.164)	(1.137)	(0.926)	(1.071)	(0.432)	(1.402)	(0.799)	(0.955)
lnM	-30.26***	6.383**	-42.53***	6.318**	8.389***	18.06***	-0.581	28.87***	7.449***	2.850
	(5.347)	(3.078)	(9.396)	(3.036)	(2.691)	(3.622)	(1.807)	(3.618)	(2.837)	(2.793)
$(lnM)^2$	1.371***	-0.236*	1.259***	-0.348***	-0.345***	-0.734***	0.0181	-1.214***	-0.358***	-0.212*
	(0.236)	(0.132)	(0.392)	(0.126)	(0.109)	(0.149)	(0.0749)	(0.150)	(0.120)	(0.114)
Adult prop	2.518***	-0.800**	-0.136	0.389	-0.610	0.997	0.211	0.736	-1.236***	0.635
	(0.611)	(0.391)	(1.125)	(0.617)	(0.439)	(0.694)	(0.207)	(0.760)	(0.477)	(0.502)
$lnHHsize$	2.992***	-1.486***	5.997***	0.857***	-0.264	-1.004***	-0.0818	-0.0633	-0.267	0.544**
	(0.287)	(0.195)	(0.500)	(0.285)	(0.235)	(0.314)	(0.109)	(0.350)	(0.257)	(0.231)
Head schooling	-0.246***	0.0290	0.00674	0.0242	0.0405	0.0741**	-0.0266	0.0718*	-0.00601	0.0296
	(0.0577)	(0.0225)	(0.0745)	(0.0381)	(0.0324)	(0.0375)	(0.0251)	(0.0423)	(0.0365)	(0.0288)
Head Wage	-0.0312	0.318**	-0.0767	-0.123	-0.115	0.127	-0.0491	-0.473***	-0.0423	-0.0817
	(0.199)	(0.146)	(0.159)	(0.120)	(0.0760)	(0.112)	(0.0561)	(0.108)	(0.0743)	(0.0790)
Number employed	-0.419***	0.0136	-0.0752	-0.135	0.0262	0.132	0.0705*	0.000936	0.126	0.0232
	(0.104)	(0.0580)	(0.201)	(0.0923)	(0.0799)	(0.0819)	(0.0419)	(0.113)	(0.100)	(0.0748)
Age Adults	-0.0711***	-0.0106	0.0234	0.0429**	0.0104	0.0420**	0.00180	0.0500**	0.00573	0.0155
	(0.0155)	(0.0102)	(0.0310)	(0.0181)	(0.0111)	(0.0186)	(0.00705)	(0.0211)	(0.0172)	(0.0138)
No. of children under 5	-1.336***	0.128*	-0.202	0.111	0.0918	0.205**	0.119**	0.417***	0.00121	-0.00326
	(0.138)	(0.0667)	(0.173)	(0.129)	(0.0859)	(0.0987)	(0.0575)	(0.115)	(0.0694)	(0.0717)
No. of children over 15	1.711***	-0.0544	0.0195	-0.326**	-0.117	-0.121	-0.107*	-0.223*	-0.133	-0.211*
	(0.171)	(0.0738)	(0.223)	(0.131)	(0.0830)	(0.123)	(0.0596)	(0.127)	(0.107)	(0.113)
Age head	0.0480***	0.0102	0.0135	-0.00795	0.0111	-0.0208	-0.00511	-0.0237	0.00259	-0.0158
	(0.0136)	(0.00754)	(0.0267)	(0.0124)	(0.00971)	(0.0139)	(0.00573)	(0.0186)	(0.0126)	(0.0103)
Most educated	0.769***	0.00404	-0.171*	-0.161***	-0.0729*	-0.117**	-0.0451	-0.185***	-0.00314	-0.0874*
	(0.0757)	(0.0413)	(0.0975)	(0.0461)	(0.0389)	(0.0556)	(0.0294)	(0.0565)	(0.0357)	(0.0457)
Protestant	-0.357	0.276*	-0.437	-0.116	0.163	-0.0823	-0.165**	0.164	0.0851	0.0378
	(0.281)	(0.163)	(0.424)	(0.222)	(0.148)	(0.183)	(0.0816)	(0.256)	(0.134)	(0.158)
Other Christians	-0.390	0.253	-0.178	-0.176	0.227	-0.209	-0.181	0.130	0.138	-0.0529
	(0.349)	(0.183)	(0.494)	(0.324)	(0.232)	(0.279)	(0.121)	(0.343)	(0.245)	(0.232)
Muslim	-0.137	0.655	-1.014	-0.538	0.191	-0.574	1.854***	-0.392	-0.101	-0.636
	(0.652)	(0.415)	(1.058)	(0.484)	(0.711)	(0.621)	(0.624)	(0.588)	(0.583)	(0.492)
Other religion	0.225	0.0837	1.115	-0.284	0.0808	0.262	-0.153	0.240	-0.358	0.188
	(0.428)	(0.290)	(0.919)	(0.316)	(0.307)	(0.477)	(0.159)	(0.391)	(0.272)	(0.345)
Constant	158.0***	-34.80*	327.8***	-22.83	-47.76***	-103.2***	5.453	-165.4***	-33.30**	1.014
	(30.12)	(18.11)	(56.31)	(18.11)	(16.37)	(21.81)	(10.87)	(21.68)	(16.81)	(17.09)
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped Standard errors are in brackets.

Table A19 Three Stage-Least square (3SLS) Regression (Tobacco) (2005-2006 KIHBS Rural Sample)

VARIABLES	Other foods	Alcohol	Healthcare	Clothing	Water	Transport	Furnishing	Communication
d	7.123***	6.186***	-1.130***	-0.542	-0.634	0.561	-1.117	1.669***
	(2.059)	(1.353)	(0.421)	(2.178)	(0.509)	(1.057)	(1.232)	(0.558)
lnM	14.02**	-3.187	-0.418	43.34***	0.619	-22.98***	-0.424	4.157*
	(5.640)	(3.268)	(1.436)	(6.031)	(1.282)	(8.026)	(4.370)	(2.244)
$(lnM)^2$	-0.831***	0.113	0.0222	-1.614***	-0.0324	1.149***	0.0442	-0.0829
	(0.233)	(0.135)	(0.0611)	(0.256)	(0.0543)	(0.359)	(0.183)	(0.101)
Adult prop	-0.180	-1.074*	-0.177	-2.232**	0.195	-0.357	-0.490	0.220
	(0.898)	(0.574)	(0.164)	(1.110)	(0.202)	(0.490)	(0.606)	(0.326)
$lnHHsize$	-0.0849	-0.780***	-0.132*	-3.608***	-0.287***	-1.468***	-0.593**	-0.875***
	(0.458)	(0.290)	(0.0779)	(0.499)	(0.0960)	(0.188)	(0.236)	(0.189)
Head schooling	0.0911	0.0852***	-0.00412	-0.0471	0.0102	-0.0155	-0.0340	0.0567**
	(0.0651)	(0.0318)	(0.0171)	(0.0649)	(0.0118)	(0.0370)	(0.0393)	(0.0224)
Head Wage	0.437**	-0.0124	-0.0722*	-0.339	0.0482	0.390	-0.131	0.551***
	(0.194)	(0.0688)	(0.0423)	(0.275)	(0.0427)	(0.329)	(0.0886)	(0.147)
Number employed	-0.245*	0.00658	0.0710**	0.194	0.00463	0.0227	0.109	0.131***
	(0.143)	(0.0711)	(0.0320)	(0.158)	(0.0289)	(0.0931)	(0.0855)	(0.0408)
Age Adults	-0.00749	-0.0331***	0.00107	0.0258	-0.00122	0.00186	0.0201	0.00177
	(0.0262)	(0.0115)	(0.00465)	(0.0221)	(0.00493)	(0.0135)	(0.0182)	(0.00760)
No. of children under 5	0.430***	-0.0322	0.114***	0.586***	0.0366	0.0916	0.0779	0.0555
	(0.162)	(0.0749)	(0.0400)	(0.184)	(0.0362)	(0.0816)	(0.101)	(0.0538)
No. of children over 15	-0.226	-0.0993	-0.123***	-0.658***	-0.0250	-0.190	-0.164	-0.0502
	(0.168)	(0.0854)	(0.0402)	(0.225)	(0.0387)	(0.143)	(0.142)	(0.0558)
Age head	-0.00537	0.0361***	0.00502	-0.0928***	0.00346	0.0149	-0.0175	-0.00878
	(0.0227)	(0.00898)	(0.00501)	(0.0165)	(0.00401)	(0.0118)	(0.0127)	(0.00667)
Most educated	-0.294***	-0.00980	-0.0331	-0.323***	-0.0157	0.0782	-0.00448	0.0234
	(0.0811)	(0.0416)	(0.0272)	(0.0802)	(0.0161)	(0.0573)	(0.0570)	(0.0282)
Protestant	0.908***	-0.0380	-0.0441	-0.513	0.0869	0.237	-0.102	0.279***
	(0.280)	(0.151)	(0.0726)	(0.411)	(0.0632)	(0.208)	(0.239)	(0.0967)
Other Christians	0.0302	0.149	-0.208**	0.842	0.138*	0.184	-0.395	0.457***
	(0.431)	(0.221)	(0.0908)	(0.556)	(0.0812)	(0.258)	(0.291)	(0.150)
Muslim	-0.172	-1.379***	-0.217	0.395	0.633	0.610	-0.414	0.0793
	(1.085)	(0.345)	(0.138)	(1.232)	(0.594)	(0.830)	(0.321)	(0.242)
Other religion	-0.971*	0.214	0.0312	0.404	0.219	-0.213	-0.634**	-0.353**
	(0.571)	(0.500)	(0.0872)	(0.627)	(0.156)	(0.371)	(0.275)	(0.153)
Constant	-31.87	23.28	3.159	-262.3***	-1.480	119.5***	4.573	-34.68***
	(34.16)	(19.54)	(8.464)	(35.48)	(7.648)	(45.06)	(25.81)	(12.63)
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**	**5,104**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A20 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Full Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	-2.744***	-2.021*	-5.027***	-2.293***	-0.983	2.198**	0.232	-2.770***	-0.698	-1.741**
	(1.063)	(1.126)	(1.632)	(0.855)	(0.651)	(0.939)	(0.484)	(0.976)	(0.594)	(0.796)
lnM	-5.219**	1.556	-36.62***	0.599	5.860***	16.99***	0.188	12.43***	2.603**	-2.659*
	(2.183)	(1.723)	(3.223)	(1.433)	(1.213)	(1.413)	(0.923)	(1.503)	(1.074)	(1.508)
$(lnM)^2$	0.277***	-0.0722	1.182***	-0.0665	-0.228***	-0.693***	-0.0144	-0.537***	-0.127***	0.0289
	(0.0912)	(0.0715)	(0.127)	(0.0560)	(0.0464)	(0.0560)	(0.0364)	(0.0599)	(0.0421)	(0.0593)
Adult prop	0.753	-0.333	-1.189	-0.152	-0.233	0.976**	-0.114	0.412	-1.075***	0.0760
	(0.532)	(0.314)	(0.732)	(0.446)	(0.310)	(0.410)	(0.207)	(0.490)	(0.265)	(0.379)
lnHHsize	2.925***	-0.477***	4.627***	0.657***	-0.238*	-0.654***	-0.0512	0.316	-0.331**	0.865***
	(0.243)	(0.182)	(0.304)	(0.212)	(0.134)	(0.152)	(0.0776)	(0.223)	(0.152)	(0.167)
Head schooling	-0.150***	0.0236	-0.0109	0.0137	0.0446**	0.0773**	-0.00956	0.0465	-0.00131	0.0295
	(0.0493)	(0.0233)	(0.0566)	(0.0265)	(0.0186)	(0.0329)	(0.0196)	(0.0299)	(0.0221)	(0.0308)
Head Wage	-0.117**	-0.00183	0.106***	0.0423***	0.0150*	0.0196	-0.00369	0.0455***	0.00495	0.0198
	(0.0537)	(0.0272)	(0.0311)	(0.0113)	(0.00851)	(0.0177)	(0.00801)	(0.0161)	(0.00948)	(0.0135)
Number employed	-0.552***	0.0572	-0.119	-0.0810	0.0153	0.0885	0.0547*	0.00101	0.0917	-0.0170
	(0.115)	(0.0578)	(0.0781)	(0.0769)	(0.0519)	(0.0647)	(0.0295)	(0.0713)	(0.0659)	(0.0475)
Age Adults	-0.121***	0.00196	0.0403*	0.0293**	0.0171*	0.0375***	-0.00471	0.0412***	0.000279	0.0149
	(0.0121)	(0.00920)	(0.0232)	(0.0125)	(0.00893)	(0.0138)	(0.00568)	(0.0158)	(0.0107)	(0.00973)
No. of children under 5	-1.662***	0.0528	0.115	0.0985	0.128**	0.248***	0.0867***	0.390***	0.0438	-0.0619
	(0.104)	(0.0628)	(0.144)	(0.0833)	(0.0615)	(0.0755)	(0.0328)	(0.0972)	(0.0557)	(0.0590)
No. of children over 15	1.769***	-0.211***	-0.106	-0.370***	-0.109	-0.285***	-0.105**	-0.371***	-0.188**	-0.325***
	(0.176)	(0.0817)	(0.183)	(0.107)	(0.0752)	(0.101)	(0.0468)	(0.106)	(0.0764)	(0.0624)
Age head	0.101***	0.00607	0.0184	0.00357	0.00434	-0.0265***	0.000523	-0.0201	0.00630	-0.00615
	(0.0122)	(0.00928)	(0.0193)	(0.0105)	(0.00765)	(0.00963)	(0.00394)	(0.0127)	(0.00848)	(0.00772)
Most educated	0.623***	-0.0447	-0.233***	-0.150***	-0.0931***	-0.151***	-0.0653***	-0.119***	-0.0182	-0.103***
	(0.0531)	(0.0299)	(0.0642)	(0.0333)	(0.0283)	(0.0356)	(0.0217)	(0.0330)	(0.0256)	(0.0374)
Urban	-0.706***	1.935***	-2.576***	-1.293***	-0.694***	0.249*	-0.00964	-0.880***	-0.670***	-0.137
	(0.155)	(0.116)	(0.246)	(0.118)	(0.0949)	(0.147)	(0.0683)	(0.119)	(0.0923)	(0.0957)
Protestant	-0.344*	-0.0555	-0.527**	-0.198	0.0240	-0.130	-0.120*	0.155	0.0786	-0.0322
	(0.191)	(0.139)	(0.246)	(0.134)	(0.0965)	(0.148)	(0.0697)	(0.155)	(0.115)	(0.121)
Other Christians	-0.384	-0.0507	-0.420	-0.273	0.00869	-0.227	0.0447	0.0293	0.111	-0.157
	(0.240)	(0.212)	(0.361)	(0.227)	(0.152)	(0.202)	(0.108)	(0.254)	(0.165)	(0.187)
Muslim	-1.872***	0.190	-1.481***	-0.335	-0.198	0.638***	0.827***	-0.679**	0.211	-0.435*
	(0.359)	(0.283)	(0.519)	(0.224)	(0.276)	(0.244)	(0.206)	(0.276)	(0.230)	(0.245)
Other religions	-0.800**	0.535**	1.080**	-0.215	0.0789	-0.378	-0.320**	0.398	0.0482	0.258
	(0.353)	(0.243)	(0.464)	(0.280)	(0.196)	(0.310)	(0.126)	(0.362)	(0.178)	(0.202)
Constant	18.00	-3.463	274.3***	5.846	-34.00***	-97.55***	1.964	-65.62***	-8.292	32.69***
	(12.92)	(10.35)	(20.16)	(8.945)	(7.745)	(8.859)	(5.888)	(9.341)	(6.746)	(9.483)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A21 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Full Sample)

VARIABLES	Other foods	Tobacco	Healthcare	Clothing	Water	Transport	Furnishing	Rent	Communication
d	11.53***	4.877***	-1.030***	2.038	-0.680*	4.055***	-0.377	-0.0804	2.309***
	(1.610)	(0.668)	(0.264)	(1.872)	(0.365)	(1.299)	(0.811)	(1.044)	(0.717)
lnM	-1.907	-2.484***	0.483	26.01***	0.805	-11.77***	-1.402	6.566***	7.361***
	(3.549)	(0.930)	(0.521)	(2.486)	(0.589)	(2.391)	(2.018)	(2.029)	(1.332)
$(lnM)^2$	-0.133	0.0816**	-0.0205	-0.946***	-0.0362	0.631***	0.0755	-0.249***	-0.220***
	(0.141)	(0.0370)	(0.0205)	(0.102)	(0.0241)	(0.104)	(0.0828)	(0.0890)	(0.0570)
Adult prop	0.403	0.192*	-0.259*	-1.708**	0.266*	0.375	-0.678*	1.079**	0.546*
	(0.692)	(0.108)	(0.137)	(0.696)	(0.137)	(0.507)	(0.380)	(0.460)	(0.290)
$lnHHsize$	-0.727**	0.0167	-0.0724	-3.331***	-0.0387	-1.568***	-0.554***	-0.629***	-1.156***
	(0.369)	(0.0873)	(0.0676)	(0.387)	(0.0749)	(0.230)	(0.172)	(0.184)	(0.129)
Head schooling	0.0481	-0.00884	0.00887	-0.0946*	0.000256	-0.0206	-0.00535	0.0447	0.0857***
	(0.0555)	(0.0140)	(0.0143)	(0.0563)	(0.0119)	(0.0410)	(0.0346)	(0.0293)	(0.0193)
Head Wage	0.0937***	-0.0177**	0.00818	-0.00952	0.00451	-0.182***	-0.0388	0.258***	-0.0625***
	(0.0341)	(0.00792)	(0.0113)	(0.0414)	(0.0112)	(0.0627)	(0.0260)	(0.0750)	(0.0241)
Number employed	0.117	0.0422	0.0214	0.295***	-0.00134	0.103	0.0687	-0.128**	0.144***
	(0.119)	(0.0319)	(0.0298)	(0.108)	(0.0303)	(0.0837)	(0.0591)	(0.0544)	(0.0385)
Age Adults	0.00393	0.00817*	-0.00148	0.00561	0.000557	0.0240**	0.00207	0.0388***	0.0115*
	(0.0222)	(0.00433)	(0.00344)	(0.0195)	(0.00385)	(0.0116)	(0.0105)	(0.0132)	(0.00696)
No. of children under 5	0.577***	-0.0297	0.0984***	0.633***	0.0278	0.0592	0.0592	0.153**	0.131***
	(0.133)	(0.0320)	(0.0280)	(0.134)	(0.0305)	(0.0728)	(0.0720)	(0.0633)	(0.0506)
No. of children over 15	-0.190	-0.0506	-0.0940***	-0.419***	-0.0447	-0.169	-0.159	0.137**	-0.0484
	(0.201)	(0.0356)	(0.0317)	(0.156)	(0.0337)	(0.121)	(0.105)	(0.0609)	(0.0636)
Age head	-0.0425**	-0.0103***	0.00892**	-0.0937***	0.00312	-0.00598	-0.00609	-0.00414	-0.0156**
	(0.0171)	(0.00316)	(0.00404)	(0.0160)	(0.00336)	(0.00992)	(0.00781)	(0.0102)	(0.00668)
Most educated	-0.249***	0.000621	-0.0207	-0.209***	-0.0345***	0.126***	-0.0138	0.113***	0.0565***
	(0.0659)	(0.0171)	(0.0186)	(0.0681)	(0.0131)	(0.0464)	(0.0362)	(0.0385)	(0.0219)
Urban	-0.360	0.0121	-0.0928*	-1.887***	0.750***	-0.548**	-0.702***	8.810***	0.132
	(0.265)	(0.0692)	(0.0499)	(0.268)	(0.0611)	(0.248)	(0.131)	(0.160)	(0.0959)
Protestant	1.270***	0.0528	-0.0605	-0.307	0.0222	0.578***	0.0506	-0.0670	0.333***
	(0.259)	(0.0715)	(0.0496)	(0.270)	(0.0602)	(0.179)	(0.153)	(0.148)	(0.123)
Other Christians	0.429	0.0323	-0.145**	0.675	0.0534	0.789***	-0.0854	-0.0551	0.476***
	(0.361)	(0.0872)	(0.0591)	(0.451)	(0.0860)	(0.217)	(0.197)	(0.179)	(0.135)
Muslim	2.844***	0.869***	-0.232*	-0.101	-0.131	0.474	-0.0917	0.800	0.101
	(0.550)	(0.249)	(0.125)	(0.648)	(0.148)	(0.400)	(0.265)	(0.527)	(0.193)
Other religions	0.480	0.178	-0.0332	-0.342	0.288***	-0.517	-0.601***	0.848***	-0.380**
	(0.521)	(0.184)	(0.0913)	(0.471)	(0.0908)	(0.350)	(0.187)	(0.323)	(0.193)
Constant	58.55***	17.66***	-1.811	-154.4***	-3.978	56.64***	10.19	-39.15***	-54.20***
	(22.05)	(5.761)	(3.296)	(15.23)	(3.557)	(13.77)	(12.34)	(11.53)	(7.948)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**	**8,580**

The results are the coefficients on *d* from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A22 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Urban Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	-0.917	-5.896***	-1.516	-2.579***	-1.303*	1.140	-0.00771	-4.447***	-1.892***	-4.176***
	(1.296)	(1.510)	(1.720)	(0.740)	(0.680)	(1.334)	(0.531)	(1.192)	(0.701)	(0.852)
lnM	-2.912	-7.915**	-17.14***	0.971	4.920***	14.31***	0.611	7.471***	3.444***	-3.520**
	(2.981)	(3.102)	(2.525)	(1.139)	(0.870)	(2.007)	(0.858)	(1.859)	(0.987)	(1.696)
$(lnM)^2$	0.159	0.274**	0.513***	-0.0699	-0.186***	-0.602***	-0.0337	-0.343***	-0.153***	0.0549
	(0.126)	(0.126)	(0.0976)	(0.0442)	(0.0334)	(0.0785)	(0.0336)	(0.0725)	(0.0395)	(0.0661)
Adult prop	-2.132**	-0.173	-0.617	-0.205	0.255	1.493***	-0.108	0.0629	-0.727**	-0.0740
	(0.871)	(0.554)	(0.982)	(0.386)	(0.373)	(0.530)	(0.283)	(0.491)	(0.299)	(0.339)
$lnHHsize$	3.098***	0.254	3.364***	0.726***	-0.136	-0.0891	0.182	0.0900	-0.427***	1.099***
	(0.375)	(0.261)	(0.371)	(0.185)	(0.143)	(0.280)	(0.120)	(0.257)	(0.132)	(0.195)
Head schooling	-0.00609	0.0328	-0.0948	-0.0248	0.0425*	0.0968**	0.0224	-0.0170	0.0264	0.0206
	(0.0913)	(0.0401)	(0.0893)	(0.0331)	(0.0245)	(0.0479)	(0.0196)	(0.0442)	(0.0266)	(0.0348)
Head Wage	-0.0226	-0.0163	0.0575***	0.0263***	0.00646	0.0368**	0.00605	0.0393***	0.00256	0.0324***
	(0.0562)	(0.0334)	(0.0188)	(0.00777)	(0.00587)	(0.0168)	(0.00739)	(0.0150)	(0.00802)	(0.0122)
Number employed	-0.875***	0.184**	-0.281**	0.0109	0.0184	-0.0903	-0.00424	0.132	0.0976	0.0271
	(0.206)	(0.0936)	(0.138)	(0.0811)	(0.0601)	(0.114)	(0.0544)	(0.0928)	(0.0645)	(0.0828)
Age Adults	-0.182***	0.0222	0.0478	0.0123	0.0265**	0.0230	-0.00404	0.0272*	-0.0123	0.0219
	(0.0230)	(0.0184)	(0.0320)	(0.0112)	(0.0120)	(0.0189)	(0.00795)	(0.0142)	(0.0101)	(0.0144)
No. of children under 5	-2.393***	0.0972	0.397**	0.0614	0.147*	0.440***	0.102	0.664***	0.142**	-0.0473
	(0.176)	(0.120)	(0.198)	(0.0892)	(0.0771)	(0.121)	(0.0703)	(0.104)	(0.0700)	(0.102)
No. of children over 15	1.634***	-0.302**	0.0627	-0.137	-0.104	-0.435***	-0.0204	-0.436***	-0.231***	-0.293***
	(0.309)	(0.136)	(0.253)	(0.111)	(0.0658)	(0.140)	(0.0735)	(0.121)	(0.0884)	(0.0921)
Age head	0.165***	0.0146	0.00668	-0.000166	-0.00729	-0.0195	-0.00397	-0.0211*	0.0125	0.00529
	(0.0234)	(0.0128)	(0.0236)	(0.00949)	(0.00787)	(0.0145)	(0.00641)	(0.0120)	(0.00851)	(0.0118)
Most educated	0.357***	-0.0573	-0.173*	-0.0612*	-0.0664**	-0.171***	-0.0972***	-0.0386	-0.0454	-0.0924**
	(0.104)	(0.0516)	(0.0954)	(0.0367)	(0.0307)	(0.0638)	(0.0213)	(0.0486)	(0.0328)	(0.0392)
Protestant	-0.0974	-0.417**	-0.222	-0.163	-0.0657	-0.352*	-0.220***	0.306**	0.0342	-0.183
	(0.214)	(0.206)	(0.263)	(0.132)	(0.0933)	(0.212)	(0.0725)	(0.154)	(0.111)	(0.147)
Other Christians	-0.0920	-0.615*	-0.0164	-0.184	-0.221	-0.425	0.0887	-0.0487	-0.0170	-0.447**
	(0.344)	(0.345)	(0.386)	(0.222)	(0.142)	(0.344)	(0.168)	(0.234)	(0.185)	(0.180)
Muslim	-1.988***	-0.431	-0.551	-0.166	-0.145	0.371	0.304	-0.704**	0.400*	-0.577**
	(0.436)	(0.333)	(0.591)	(0.230)	(0.227)	(0.484)	(0.206)	(0.323)	(0.210)	(0.226)
Other religion	-1.566***	1.331***	-0.304	0.0946	-0.329*	-0.639	-0.384*	0.429	0.871***	0.211
	(0.592)	(0.432)	(0.454)	(0.255)	(0.169)	(0.490)	(0.209)	(0.298)	(0.320)	(0.397)
Constant	11.62	61.13***	136.4***	-0.0169	-30.94***	-80.12***	-0.628	-35.79***	-15.56**	38.66***
	(17.80)	(19.01)	(16.49)	(7.177)	(5.671)	(12.80)	(5.428)	(11.91)	(6.127)	(10.75)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A23 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Urban Sample)

VARIABLES	Other foods	Tobacco	Healthcare	Clothing	Water	Transport	Furnishing	Rent	Communication
d	18.33***	4.804***	-0.284	3.059	-1.186**	6.711***	0.147	-2.803	1.899*
	(3.947)	(0.775)	(0.459)	(2.798)	(0.499)	(1.930)	(0.694)	(1.852)	(1.130)
lnM	0.670	-1.256	0.877**	16.22***	-1.329	-9.097**	-4.847**	8.393**	14.44***
	(4.893)	(1.407)	(0.426)	(4.296)	(0.850)	(4.387)	(2.154)	(3.442)	(2.144)
$(lnM)^2$	-0.211	0.0341	-0.0383**	-0.584***	0.0481	0.511***	0.208**	-0.309**	-0.495***
	(0.193)	(0.0550)	(0.0170)	(0.170)	(0.0341)	(0.182)	(0.0900)	(0.142)	(0.0869)
Adult prop	0.648	0.463*	-0.273	-0.983	0.191	1.153	-1.388**	2.869***	0.907*
	(1.062)	(0.273)	(0.238)	(1.042)	(0.275)	(1.076)	(0.597)	(1.015)	(0.521)
$lnHHsize$	-1.264**	0.260*	0.0715	-3.367***	0.191	-1.349***	-0.594***	-0.917*	-1.513***
	(0.584)	(0.147)	(0.112)	(0.527)	(0.134)	(0.458)	(0.189)	(0.525)	(0.211)
Head schooling	0.0230	-0.00204	0.0146	-0.174*	-0.0270	-0.0470	0.0497	0.154**	0.0773
	(0.0930)	(0.0262)	(0.0170)	(0.103)	(0.0246)	(0.0881)	(0.0307)	(0.0758)	(0.0520)
Head Wage	0.0183	-0.00742	0.00993	-0.00153	0.00395	-0.203***	-0.0313	0.221**	-0.0826***
	(0.0435)	(0.00735)	(0.0103)	(0.0451)	(0.00911)	(0.0677)	(0.0247)	(0.0985)	(0.0285)
Number employed	0.600**	0.0263	-0.0657	0.468**	0.000117	0.108	0.0452	-0.0919	0.0938
	(0.260)	(0.0410)	(0.0480)	(0.194)	(0.0394)	(0.150)	(0.0997)	(0.202)	(0.0861)
Age Adults	-0.0428	0.00227	0.00239	-0.0263	0.00554	0.0804***	-0.0209	0.132***	0.0225
	(0.0340)	(0.00832)	(0.00621)	(0.0332)	(0.00652)	(0.0267)	(0.0128)	(0.0358)	(0.0146)
No. of children under 5	0.817***	-0.0351	0.0695	0.873***	-0.0162	-0.0428	0.0784	0.224	0.200*
	(0.295)	(0.0563)	(0.0528)	(0.284)	(0.0562)	(0.215)	(0.144)	(0.186)	(0.105)
No. of children over 15	-0.365*	-0.104	-0.0296	0.0342	0.00394	-0.410	-0.252	0.0631	-0.103
	(0.198)	(0.0647)	(0.0591)	(0.400)	(0.0550)	(0.289)	(0.177)	(0.260)	(0.117)
Age head	-0.0595**	-0.00196	0.00438	-0.0936***	0.00261	-0.0462*	0.00231	-0.00495	-0.0178
	(0.0288)	(0.00738)	(0.00458)	(0.0272)	(0.00638)	(0.0261)	(0.0102)	(0.0294)	(0.0124)
Most educated	-0.258**	-0.0583	-0.0132	-0.106	-0.0192	0.126	-0.0701	0.193**	0.0944
	(0.113)	(0.0386)	(0.0211)	(0.123)	(0.0287)	(0.107)	(0.0431)	(0.0954)	(0.0591)
Urban	1.401***	-0.117	-0.0454	-0.0449	-0.0873	0.660**	0.168	-0.136	0.267*
	(0.459)	(0.0818)	(0.0609)	(0.388)	(0.0746)	(0.278)	(0.146)	(0.301)	(0.158)
Protestant	1.104*	-0.00921	-0.0487	0.158	-0.146	1.423***	0.243	-0.567	0.440**
	(0.580)	(0.153)	(0.108)	(0.655)	(0.130)	(0.384)	(0.249)	(0.365)	(0.223)
Other Christians	4.036***	0.378*	-0.110	-0.237	-0.0834	0.435	0.0726	1.276*	-0.295
	(0.819)	(0.223)	(0.159)	(0.754)	(0.151)	(0.551)	(0.361)	(0.731)	(0.326)
Muslim	2.598***	0.340	-0.0966	-1.222*	0.369**	-1.002*	-0.263	1.428*	-0.676**
	(0.908)	(0.314)	(0.107)	(0.693)	(0.163)	(0.607)	(0.243)	(0.736)	(0.263)
Other religions	40.53	10.22	-4.268	-90.67***	10.34*	40.48	32.36**	-50.23**	-99.49***
	(30.82)	(8.823)	(2.745)	(27.11)	(5.278)	(26.60)	(13.25)	(21.05)	(13.33)
Constant	18.33***	4.804***	-0.284	3.059	-1.186**	6.711***	0.147	-2.803	1.899*
	(3.947)	(0.775)	(0.459)	(2.798)	(0.499)	(1.930)	(0.694)	(1.852)	(1.130)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**	**3,436**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A24 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Rural Sample)

VARIABLES	Education	Energy	Bread and cereals	Banana and tubers	Poultry	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables
d	-4.191***	1.012	-5.778**	-1.851	-0.152	3.075*	0.883	-1.059	-0.194	0.756
	(1.561)	(1.314)	(2.540)	(1.196)	(1.173)	(1.854)	(0.800)	(1.324)	(1.131)	(1.378)
lnM	-29.28***	6.851**	-41.42***	5.631	8.789***	17.77***	-1.594	28.41***	6.184**	1.251
	(4.815)	(2.729)	(7.632)	(3.967)	(3.220)	(3.212)	(1.872)	(4.526)	(2.603)	(2.542)
$(lnM)^2$	1.335***	-0.261**	1.218***	-0.321*	-0.362***	-0.717***	0.0628	-1.195***	-0.307***	-0.144
	(0.214)	(0.112)	(0.314)	(0.165)	(0.133)	(0.130)	(0.0779)	(0.186)	(0.106)	(0.106)
Adult prop	2.474***	-0.805	-0.216	0.277	-0.586	0.738	0.0543	0.581	-1.336***	0.399
	(0.929)	(0.552)	(1.112)	(0.627)	(0.480)	(0.858)	(0.240)	(0.681)	(0.408)	(0.600)
$lnHHsize$	2.919***	-1.488***	5.961***	0.851***	-0.266	-1.133***	-0.0934	-0.0881	-0.237	0.544**
	(0.337)	(0.272)	(0.517)	(0.282)	(0.190)	(0.335)	(0.107)	(0.343)	(0.225)	(0.262)
Head schooling	-0.220***	0.0245	0.0443	0.0385	0.0435	0.0601	-0.0298	0.0828**	0.00155	0.0316
	(0.0568)	(0.0283)	(0.0752)	(0.0433)	(0.0301)	(0.0383)	(0.0223)	(0.0375)	(0.0335)	(0.0313)
Head Wage	-0.0486	0.338**	-0.123	-0.127	-0.124	0.137	-0.0468	-0.445***	-0.0387	-0.0755
	(0.271)	(0.158)	(0.153)	(0.111)	(0.0930)	(0.108)	(0.0491)	(0.140)	(0.0902)	(0.0727)
Number employed	-0.440***	0.0210	-0.110	-0.141	0.0327	0.150*	0.0607*	-0.0179	0.116	0.0130
	(0.116)	(0.0581)	(0.172)	(0.0913)	(0.0651)	(0.0880)	(0.0322)	(0.0988)	(0.0835)	(0.0608)
Age Adults	-0.0822***	-0.00780	0.0142	0.0359**	0.0115	0.0455***	-0.00148	0.0415**	0.00209	0.00919
	(0.0132)	(0.00942)	(0.0229)	(0.0156)	(0.0119)	(0.0167)	(0.00552)	(0.0186)	(0.0160)	(0.0127)
No. of children under 5	-1.338***	0.133	-0.195	0.119	0.0940	0.214**	0.105*	0.400***	-0.0159	-0.0264
	(0.147)	(0.0894)	(0.148)	(0.118)	(0.0852)	(0.0938)	(0.0536)	(0.104)	(0.0851)	(0.0888)
No. of children over 15	1.725***	-0.0694	0.0479	-0.336***	-0.124	-0.0950	-0.113	-0.226	-0.136	-0.221**
	(0.168)	(0.0727)	(0.247)	(0.118)	(0.103)	(0.108)	(0.0740)	(0.147)	(0.105)	(0.0891)
Age head	0.0599***	0.00907	0.0271	-1.27e-05	0.0110	-0.0265*	-0.00412	-0.0163	0.00626	-0.0123
	(0.0127)	(0.00752)	(0.0232)	(0.0123)	(0.0103)	(0.0151)	(0.00587)	(0.0161)	(0.0126)	(0.0109)
Most educated	0.755***	0.00267	-0.199**	-0.162***	-0.0802**	-0.0936*	-0.0304	-0.169***	0.00598	-0.0704
	(0.0705)	(0.0398)	(0.0808)	(0.0447)	(0.0362)	(0.0531)	(0.0275)	(0.0601)	(0.0374)	(0.0465)
Protestant	-0.566*	0.288	-0.755*	-0.190	0.143	0.0982	-0.0440	0.165	0.130	0.186
	(0.289)	(0.187)	(0.390)	(0.246)	(0.170)	(0.234)	(0.105)	(0.239)	(0.185)	(0.206)
Other Christians	-0.553	0.252	-0.394	-0.212	0.211	-0.0453	-0.0650	0.196	0.216	0.0966
	(0.375)	(0.183)	(0.575)	(0.320)	(0.239)	(0.324)	(0.187)	(0.301)	(0.273)	(0.260)
Muslim	-1.050*	0.450	-2.332*	-0.897*	0.119	0.133	1.931***	-0.326	-0.173	-0.458
	(0.586)	(0.522)	(1.287)	(0.466)	(0.646)	(0.639)	(0.700)	(0.529)	(0.667)	(0.527)
Other religion	0.245	0.0917	1.135	-0.331	0.137	0.00363	-0.238	0.177	-0.370*	0.105
	(0.404)	(0.272)	(0.786)	(0.349)	(0.257)	(0.498)	(0.169)	(0.430)	(0.191)	(0.317)
Constant	151.8***	-36.89**	320.7***	-18.55	-50.03**	-102.0***	11.02	-162.7***	-25.69	10.22
	(27.22)	(16.55)	(46.56)	(23.51)	(19.52)	(19.53)	(11.16)	(27.29)	(16.01)	(15.11)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**	**5,062**

The results are the coefficients on d, from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A25 Three Stage-Least square (3SLS) Regression (Alcohol) (2005-2006 KIHBS Rural Sample)

VARIABLES	Other foods	Tobacco	Healthcare	Clothing	Water	Transport	Furnishing	Communication
d	6.233**	5.008***	-1.396***	1.332	-0.182	0.157	0.242	1.629**
	(2.429)	(0.826)	(0.478)	(2.414)	(0.450)	(0.995)	(1.660)	(0.678)
lnM	15.39**	-3.169**	-0.472	41.94***	1.283	-22.67***	-1.340	4.578
	(6.055)	(1.614)	(1.261)	(6.641)	(0.839)	(6.406)	(4.021)	(3.338)
$(lnM)^2$	-0.886***	0.105	0.0243	-1.561***	-0.0557	1.140***	0.0823	-0.103
	(0.250)	(0.0667)	(0.0532)	(0.286)	(0.0342)	(0.284)	(0.172)	(0.148)
Adult prop	0.115	0.0593	-0.217	-2.382**	0.141	-0.299	-0.712	0.285
	(1.036)	(0.220)	(0.201)	(1.163)	(0.197)	(0.452)	(0.630)	(0.340)
$lnHHsize$	-0.216	-0.175	-0.137	-3.626***	-0.294***	-1.532***	-0.593**	-0.910***
	(0.485)	(0.148)	(0.0861)	(0.528)	(0.105)	(0.274)	(0.296)	(0.154)
Head schooling	0.0692	-0.0135	0.00587	-0.0517	0.0129	-0.0179	-0.0329	0.0489**
	(0.0606)	(0.0181)	(0.0178)	(0.0785)	(0.0137)	(0.0444)	(0.0510)	(0.0232)
Head Wage	0.339*	0.0934**	-0.0709**	-0.306	0.0309	0.365	-0.110	0.556***
	(0.177)	(0.0436)	(0.0341)	(0.262)	(0.0539)	(0.380)	(0.0950)	(0.149)
Number employed	-0.193	0.0293	0.0654***	0.209	-0.00614	0.0303	0.0963	0.147***
	(0.135)	(0.0335)	(0.0253)	(0.152)	(0.0328)	(0.0799)	(0.0854)	(0.0465)
Age Adults	0.0122	0.00854	-0.00349	0.0208	-0.00210	0.00593	0.0141	0.00697
	(0.0278)	(0.00620)	(0.00438)	(0.0259)	(0.00563)	(0.0135)	(0.0165)	(0.00731)
No. of children under 5	0.480**	-0.0149	0.109***	0.571***	0.0379	0.105	0.0540	0.0653
	(0.211)	(0.0397)	(0.0418)	(0.181)	(0.0265)	(0.113)	(0.0927)	(0.0538)
No. of children over 15	-0.270	0.00351	-0.124***	-0.667***	-0.0472	-0.204	-0.169	-0.0590
	(0.233)	(0.0594)	(0.0424)	(0.236)	(0.0369)	(0.154)	(0.131)	(0.0834)
Age head	-0.0230	-0.0122**	0.00978**	-0.0892***	0.00481	0.0126	-0.0132	-0.0131**
	(0.0213)	(0.00488)	(0.00481)	(0.0261)	(0.00404)	(0.0113)	(0.0143)	(0.00660)
Most educated	-0.365***	0.0418**	-0.0314	-0.305***	-0.0213	0.0653	0.0197	0.0162
	(0.0824)	(0.0207)	(0.0292)	(0.0987)	(0.0137)	(0.0500)	(0.0670)	(0.0254)
Protestant	0.962**	0.189*	-0.0987	-0.369	0.0936	0.210	0.0113	0.297**
	(0.382)	(0.0971)	(0.103)	(0.369)	(0.0736)	(0.211)	(0.253)	(0.118)
Other Christians	0.0440	0.0953	-0.240**	0.996	0.150	0.152	-0.285	0.447***
	(0.490)	(0.128)	(0.110)	(0.702)	(0.0910)	(0.273)	(0.301)	(0.147)
Muslim	1.219	1.710*	-0.506***	0.178	-0.165	0.614	-0.532	0.279
	(1.336)	(1.009)	(0.193)	(1.333)	(0.366)	(0.714)	(0.402)	(0.298)
Other religion	-0.331	0.103	-0.00175	0.268	0.192*	-0.117	-0.802***	-0.279**
	(0.610)	(0.202)	(0.101)	(0.626)	(0.104)	(0.329)	(0.263)	(0.133)
Constant	-39.13	22.80**	3.463	-253.4***	-6.064	117.4***	9.777	-36.73**
	(36.54)	(9.762)	(7.459)	(38.62)	(5.156)	(36.11)	(23.35)	(18.73)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,062	5,062	5,062	5,062	5,062	5,062	5,062	5,062

The results are the coefficients on d from the 3SLS estimation of equation (2.5). $\boldsymbol{d}$ represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A26 Three Stage-Least square (3SLS) Regression (Tobacco) (2015-2016 KIHBS Full Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Alcohol	Rent
d	-1.523*	-4.937***	-5.410***	-2.028***	-0.706	0.205	-3.854***	-0.129	-5.944***	30.03***	9.061***	-2.629***
	(0.827)	(0.665)	(0.954)	(0.335)	(0.708)	(0.355)	(0.589)	(0.480)	(0.501)	(1.235)	(0.610)	(0.628)
lnM	-10.57***	-22.04***	18.08***	5.056***	12.72***	2.777***	18.88***	-1.888	7.519***	-13.18***	-4.161**	15.51***
	(2.498)	(4.483)	(4.023)	(0.623)	(2.291)	(0.829)	(1.635)	(2.257)	(1.513)	(4.559)	(1.790)	(2.368)
$(lnM)^2$	0.496***	0.839***	-0.998***	-0.212***	-0.388***	-0.113***	-0.786***	0.0951	-0.388***	0.544***	0.275***	-0.665***
	(0.105)	(0.187)	(0.163)	(0.0252)	(0.0940)	(0.0337)	(0.0663)	(0.0916)	(0.0611)	(0.185)	(0.0753)	(0.0960)
Adult prop	2.178***	0.0599	-3.051***	-0.184	0.656	-0.289	1.078***	-1.078***	1.260***	-2.643***	-0.842***	0.751**
	(0.665)	(0.439)	(0.568)	(0.191)	(0.440)	(0.217)	(0.379)	(0.261)	(0.282)	(0.554)	(0.296)	(0.372)
lnHHsize	6.180***	0.963***	5.125***	0.222***	-1.444***	-0.155	0.421**	-0.672***	1.556***	-7.209***	-2.568***	-1.581***
	(0.323)	(0.204)	(0.274)	(0.0826)	(0.205)	(0.104)	(0.183)	(0.122)	(0.135)	(0.294)	(0.166)	(0.179)
Post primary voc	0.360	-0.220	-1.388***	-0.163	-0.265	-0.125	0.232	0.131	-0.0921	-0.915	-0.690***	-0.863***
	(0.476)	(0.357)	(0.534)	(0.142)	(0.349)	(0.190)	(0.350)	(0.284)	(0.262)	(0.603)	(0.262)	(0.269)
Secondary	1.311***	-0.0992	-1.733***	-0.204***	-0.102	-0.232***	0.0162	0.0395	-0.429***	-0.455**	-0.476***	1.013***
	(0.176)	(0.120)	(0.166)	(0.0515)	(0.124)	(0.0585)	(0.109)	(0.0745)	(0.0804)	(0.179)	(0.0883)	(0.114)
College	2.820***	0.140	-2.406***	-0.421***	-0.612***	-0.399***	-0.257	-0.221**	-0.809***	-1.853***	-1.058***	2.026***
	(0.304)	(0.180)	(0.214)	(0.0659)	(0.180)	(0.0732)	(0.162)	(0.101)	(0.108)	(0.256)	(0.136)	(0.199)
University	5.888***	0.789**	-1.935***	-0.460***	-1.669***	-0.565***	-1.055***	-0.413***	-1.128***	-1.914***	-1.446***	2.674***
	(0.636)	(0.348)	(0.314)	(0.0874)	(0.284)	(0.117)	(0.213)	(0.145)	(0.145)	(0.439)	(0.236)	(0.374)
Head Wage	-0.526	0.878	-0.896	-0.491**	-0.193	-0.0802	-0.488	0.104	-1.489***	1.632	0.318	-0.836
	(0.776)	(0.680)	(0.904)	(0.219)	(0.556)	(0.518)	(0.521)	(0.403)	(0.309)	(1.088)	(0.356)	(0.545)
Number employed	-0.201***	0.200***	-0.148***	-0.0415***	-0.0184	-0.00462	-0.0149	-0.0498***	-0.0403**	0.0874**	-0.0484**	0.199***
	(0.0584)	(0.0402)	(0.0423)	(0.0103)	(0.0281)	(0.0106)	(0.0169)	(0.0192)	(0.0180)	(0.0426)	(0.0218)	(0.0506)
Age Adults	-1.853***	0.119*	0.274***	0.0731**	0.0285	-0.0267	0.102*	0.0633	0.0261	0.0787	-0.00965	0.0586
	(0.138)	(0.0630)	(0.0945)	(0.0297)	(0.0716)	(0.0391)	(0.0582)	(0.0482)	(0.0496)	(0.0773)	(0.0440)	(0.0508)
No. of children under 5	-0.293***	0.0810***	0.103***	0.0261***	0.0490***	0.00988*	0.0878***	0.00459	0.0676***	-0.103***	-0.00523	-0.00155
	(0.0172)	(0.0110)	(0.0161)	(0.00503)	(0.0112)	(0.00565)	(0.0106)	(0.00729)	(0.00756)	(0.0140)	(0.00762)	(0.00862)
No. of children over 15	-2.632***	-0.0262	0.194*	0.0122	0.246***	0.0168	0.508***	0.0346	0.129**	0.756***	0.268***	0.0207
	(0.112)	(0.0759)	(0.108)	(0.0338)	(0.0750)	(0.0405)	(0.0723)	(0.0500)	(0.0546)	(0.0849)	(0.0469)	(0.0557)
Age head	4.272***	-0.750***	-1.009***	-0.197***	-0.730***	0.0511	-0.504***	-0.129	-0.401***	0.705***	-0.0387	0.206**
	(0.228)	(0.116)	(0.182)	(0.0574)	(0.115)	(0.0713)	(0.109)	(0.0826)	(0.0853)	(0.138)	(0.0726)	(0.0910)
Urban	-0.0657	-0.363***	-3.028***	-0.502***	-1.080***	-0.0882	-1.246***	-0.437***	-0.218***	0.00746	-0.382***	-0.00438
	(0.168)	(0.118)	(0.161)	(0.0442)	(0.120)	(0.0562)	(0.107)	(0.0748)	(0.0792)	(0.179)	(0.0925)	(0.00704)
Protestant	0.288	0.102	-0.151	-0.0141	-0.224*	-0.0597	0.0164	0.136*	-0.0745	0.242	-0.500***	0.0107
	(0.181)	(0.119)	(0.175)	(0.0537)	(0.129)	(0.0603)	(0.118)	(0.0792)	(0.0849)	(0.178)	(0.100)	(0.116)
Other Christians	-0.302	0.129	-0.0926	-0.114	-0.155	0.268**	-0.409**	0.0870	0.0350	0.942***	-0.619***	0.191
	(0.245)	(0.156)	(0.247)	(0.0788)	(0.196)	(0.108)	(0.167)	(0.115)	(0.128)	(0.265)	(0.126)	(0.168)
Muslim	-0.979***	0.360	1.293***	0.133	-0.216	1.278***	0.493**	-0.107	-0.363**	-0.0700	-1.706***	0.592*
	(0.336)	(0.251)	(0.384)	(0.105)	(0.271)	(0.199)	(0.224)	(0.168)	(0.161)	(0.489)	(0.222)	(0.329)
Other religions	-1.042**	0.122	0.000148	0.0915	-0.100	-0.259**	0.267	-0.0534	0.288	1.066*	0.593*	0.283
	(0.441)	(0.293)	(0.440)	(0.183)	(0.376)	(0.122)	(0.306)	(0.209)	(0.238)	(0.565)	(0.309)	(0.288)
Constant	56.85***	146.0***	-57.37**	-28.99***	-91.09***	-15.35***	-108.2***	12.98	-30.39***	101.8***	14.30	-83.01***
	(14.84)	(26.87)	(24.85)	(3.866)	(14.00)	(5.114)	(10.10)	(13.93)	(9.349)	(28.10)	(10.72)	(14.64)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**	**16,073**

The results are the coefficients on ***d*** from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A27 Three Stage-Least square (3SLS) Regression (Tobacco) (2015-2016 KIHBS Urban Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Alcohol	Rent
d	1.869	-4.608***	-7.800***	-2.416***	-1.663	0.418	-3.442***	-0.383	-6.787***	39.67***	10.59***	-8.724***
	(1.383)	(1.046)	(1.489)	(0.434)	(1.074)	(0.609)	(0.877)	(0.673)	(0.817)	(2.519)	(1.092)	(1.522)
lnM	-10.83**	-26.20***	6.903	2.746***	18.31***	3.271**	17.86***	-0.0840	4.163*	-22.62***	-8.632***	10.21
	(4.361)	(7.612)	(5.066)	(0.942)	(2.301)	(1.388)	(2.327)	(2.605)	(2.252)	(6.519)	(3.207)	(6.548)
$(lnM)^2$	0.516***	1.015***	-0.505**	-0.120***	-0.639***	-0.132**	-0.739***	0.0130	-0.251***	0.951***	0.481***	-0.506*
	(0.180)	(0.316)	(0.202)	(0.0376)	(0.0938)	(0.0558)	(0.0938)	(0.104)	(0.0896)	(0.262)	(0.134)	(0.261)
Adult prop	-0.893	-0.552	-1.674**	-0.111	1.473***	-0.0341	0.701	-0.838**	1.487***	-3.052***	-1.539***	1.283
	(1.007)	(0.634)	(0.823)	(0.205)	(0.561)	(0.331)	(0.485)	(0.328)	(0.399)	(0.922)	(0.494)	(0.802)
$lnHHsize$	5.215***	0.527*	5.871***	0.331***	-0.445*	0.114	0.674***	-0.438***	2.119***	-8.356***	-3.244***	-2.308***
	(0.484)	(0.304)	(0.403)	(0.0874)	(0.261)	(0.161)	(0.228)	(0.150)	(0.180)	(0.476)	(0.266)	(0.355)
Post primary voc	0.974	-0.400	-0.198	-0.399***	-0.286	0.333	0.346	0.339	-0.326	-1.674*	-0.927**	-1.150*
	(0.799)	(0.452)	(0.814)	(0.150)	(0.540)	(0.375)	(0.478)	(0.352)	(0.343)	(0.855)	(0.417)	(0.610)
Secondary	1.250***	-0.0806	-1.558***	-0.222***	-0.159	-0.213**	-0.103	0.0617	-0.367***	-0.560*	-0.566***	2.290***
	(0.243)	(0.171)	(0.248)	(0.0579)	(0.173)	(0.0882)	(0.143)	(0.101)	(0.110)	(0.301)	(0.150)	(0.249)
College	2.818***	0.00214	-2.185***	-0.380***	-0.519**	-0.416***	-0.443**	0.0393	-0.774***	-2.313***	-1.393***	3.822***
	(0.406)	(0.242)	(0.281)	(0.0756)	(0.247)	(0.112)	(0.181)	(0.140)	(0.132)	(0.386)	(0.213)	(0.342)
University	6.646***	0.232	-2.030***	-0.387***	-1.430***	-0.679***	-1.034***	-0.135	-1.094***	-2.523***	-1.679***	4.476***
	(0.773)	(0.420)	(0.371)	(0.0860)	(0.334)	(0.164)	(0.235)	(0.171)	(0.173)	(0.547)	(0.313)	(0.504)
Head Wage	-0.813	1.933*	-0.984	0.150	0.752	-0.613	-0.803	-0.269	-0.613	-0.190	0.849	-0.559
	(1.202)	(1.012)	(1.288)	(0.323)	(0.939)	(0.587)	(0.753)	(0.450)	(0.480)	(1.114)	(0.667)	(1.265)
Number employed	-0.287***	0.210***	-0.190***	-0.0365***	-0.000840	-0.00711	-0.0128	-0.0555***	-0.0602***	0.0918*	-0.0769**	0.343***
	(0.0706)	(0.0530)	(0.0488)	(0.00844)	(0.0345)	(0.0147)	(0.0215)	(0.0180)	(0.0175)	(0.0535)	(0.0356)	(0.0706)
Age Adults	-1.949***	0.170	0.209	0.0338	-0.0330	0.0249	0.0515	0.152**	-0.0281	0.0610	-0.00429	-0.110
	(0.247)	(0.118)	(0.163)	(0.0363)	(0.107)	(0.0691)	(0.0862)	(0.0689)	(0.0729)	(0.142)	(0.0877)	(0.131)
No. of children under 5	-0.323***	0.0480**	0.110***	0.0216***	0.0671***	0.0200**	0.0731***	0.00307	0.0705***	-0.129***	-0.0166	0.0480**
	(0.0299)	(0.0194)	(0.0259)	(0.00572)	(0.0159)	(0.00887)	(0.0161)	(0.00989)	(0.0110)	(0.0262)	(0.0136)	(0.0210)
No. of children over 15	-2.783***	0.179	0.145	0.104**	0.257**	0.0705	0.688***	0.112*	0.0859	0.647***	0.270***	-0.256*
	(0.185)	(0.128)	(0.166)	(0.0426)	(0.119)	(0.0664)	(0.110)	(0.0678)	(0.0823)	(0.163)	(0.0879)	(0.144)
Age head	4.070***	-0.657***	-0.887***	-0.224***	-0.552***	0.0311	-0.440***	-0.271**	-0.241**	0.843***	-0.0752	-0.108
	(0.408)	(0.194)	(0.256)	(0.0673)	(0.184)	(0.115)	(0.159)	(0.106)	(0.113)	(0.226)	(0.128)	(0.219)
Protestant	0.446	0.142	-0.0989	-0.0980*	-0.299*	-0.0248	0.132	0.0934	-0.155	0.525*	-0.477***	0.251
	(0.282)	(0.173)	(0.231)	(0.0592)	(0.171)	(0.0911)	(0.146)	(0.0970)	(0.107)	(0.289)	(0.173)	(0.234)
Other Christians	-0.0965	0.193	-0.368	-0.0416	-0.0163	0.245	-0.230	0.109	-0.0395	1.419***	-0.756***	0.199
	(0.375)	(0.231)	(0.347)	(0.0957)	(0.272)	(0.151)	(0.226)	(0.149)	(0.174)	(0.494)	(0.210)	(0.363)
Muslim	-0.635	0.517*	1.579***	0.00457	0.0685	0.803***	0.172	0.273	-0.369**	-0.966	-1.857***	1.646***
	(0.447)	(0.306)	(0.442)	(0.117)	(0.324)	(0.219)	(0.261)	(0.183)	(0.187)	(0.662)	(0.312)	(0.496)
Other religions	-1.109	0.0295	0.0834	0.119	-0.754	-0.196	-0.164	-0.140	0.546	1.897*	-0.0853	1.042*
	(0.720)	(0.488)	(0.649)	(0.173)	(0.494)	(0.228)	(0.418)	(0.247)	(0.346)	(1.037)	(0.497)	(0.623)
Constant	60.16**	171.2***	0.986	-14.97**	-124.4***	-19.12**	-103.8***	2.462	-10.32	157.9***	38.59**	-35.86
	(26.50)	(46.02)	(31.78)	(5.919)	(14.24)	(8.647)	(14.52)	(16.34)	(14.15)	(40.65)	(19.43)	(41.07)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,051	7,051	7,051	7,051	7,051	7,051	7,051	7,051	7,051	7,051	7,051	7,051

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A28 Three Stage-Least square (3SLS) Regression (Tobacco) (2015-2016 KIHBS Rural Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Alcohol
d	-3.435***	-5.908***	-2.844**	-1.854***	-0.629	0.477	-4.037***	0.274	-5.291***	24.58***	8.437***
	(1.095)	(0.814)	(1.188)	(0.449)	(0.966)	(0.414)	(0.770)	(0.658)	(0.613)	(1.451)	(0.744)
lnM	-10.33***	-16.40***	39.67***	7.592***	8.688**	3.855***	24.55***	-3.496	13.33***	-12.97*	1.248
	(3.554)	(4.672)	(5.025)	(1.061)	(3.500)	(1.138)	(2.682)	(3.536)	(2.111)	(6.836)	(2.061)
$(lnM)^2$	0.478***	0.601***	-1.920***	-0.315***	-0.197	-0.157***	-1.022***	0.168	-0.630***	0.520*	0.0319
	(0.152)	(0.194)	(0.207)	(0.0439)	(0.145)	(0.0470)	(0.111)	(0.145)	(0.0864)	(0.280)	(0.0863)
Adult prop	4.828***	0.821	-4.217***	-0.214	0.108	-0.583**	1.356**	-1.319***	1.116***	-2.147***	-0.203
	(0.956)	(0.594)	(0.785)	(0.298)	(0.635)	(0.284)	(0.578)	(0.415)	(0.384)	(0.681)	(0.368)
$lnHHsize$	7.039***	1.096***	3.887***	0.0458	-2.380***	-0.486***	-0.0626	-0.922***	0.964***	-5.568***	-1.995***
	(0.452)	(0.270)	(0.373)	(0.132)	(0.316)	(0.136)	(0.276)	(0.194)	(0.197)	(0.358)	(0.213)
Post primary voc	-0.341	-0.343	-1.936***	-0.157	-0.509	-0.436**	-0.124	-0.136	-0.443	0.785	-0.144
	(0.559)	(0.461)	(0.743)	(0.214)	(0.494)	(0.178)	(0.508)	(0.396)	(0.383)	(0.833)	(0.351)
Secondary	1.438***	-0.172	-1.644***	-0.161*	-0.0393	-0.248***	0.134	-0.000500	-0.504***	-0.362*	-0.359***
	(0.260)	(0.158)	(0.224)	(0.0827)	(0.178)	(0.0759)	(0.161)	(0.117)	(0.113)	(0.209)	(0.110)
College	2.946***	0.282	-2.400***	-0.413***	-0.648**	-0.417***	-0.131	-0.501***	-0.870***	-1.005***	-0.636***
	(0.465)	(0.280)	(0.342)	(0.107)	(0.274)	(0.108)	(0.284)	(0.158)	(0.180)	(0.326)	(0.192)
University	4.938***	1.736**	-2.979***	-0.826***	-1.643***	-0.308	-1.190***	-0.780***	-1.493***	-0.728	-1.338***
	(1.254)	(0.692)	(0.625)	(0.182)	(0.531)	(0.199)	(0.438)	(0.293)	(0.292)	(0.790)	(0.397)
Head Wage	0.560	0.596	-0.748	-0.670**	-0.747	-0.0240	-0.406	0.355	-1.467***	0.638	-0.117
	(1.135)	(0.991)	(1.250)	(0.316)	(0.776)	(0.862)	(0.757)	(0.647)	(0.396)	(1.306)	(0.437)
Number employed	-0.0937	0.174**	-0.170*	-0.0541**	-0.00155	0.00458	-0.0196	-0.0303	-0.0307	0.0658	-0.0408*
	(0.0718)	(0.0674)	(0.0997)	(0.0260)	(0.0399)	(0.0156)	(0.0284)	(0.0333)	(0.0365)	(0.0734)	(0.0243)
Age Adults	-1.833***	0.174**	0.361***	0.116***	0.0696	-0.0219	0.142*	0.0233	0.0714	0.0649	0.00854
	(0.160)	(0.0779)	(0.124)	(0.0396)	(0.101)	(0.0462)	(0.0766)	(0.0636)	(0.0684)	(0.0891)	(0.0488)
No. of children under 5	-0.272***	0.0967***	0.0745***	0.0261***	0.0387***	0.00111	0.0893***	0.00121	0.0604***	-0.0664***	0.00445
	(0.0204)	(0.0131)	(0.0199)	(0.00682)	(0.0142)	(0.00688)	(0.0136)	(0.0101)	(0.00962)	(0.0153)	(0.00854)
No. of children over 15	-2.534***	-0.153*	0.272**	-0.0243	0.242**	-0.00523	0.434***	0.0154	0.187**	0.793***	0.270***
	(0.143)	(0.0915)	(0.138)	(0.0470)	(0.105)	(0.0531)	(0.0955)	(0.0679)	(0.0749)	(0.101)	(0.0563)
Age head	4.390***	-0.725***	-0.865***	-0.150*	-0.774***	0.113	-0.431***	-0.0327	-0.379***	0.334**	-0.0661
	(0.300)	(0.148)	(0.221)	(0.0828)	(0.155)	(0.0889)	(0.140)	(0.117)	(0.114)	(0.166)	(0.0885)
Protestant	0.156	-0.0252	-0.129	0.00926	-0.218	-0.0705	-0.187	0.144	-0.0896	0.215	-0.448***
	(0.264)	(0.166)	(0.245)	(0.0829)	(0.191)	(0.0824)	(0.186)	(0.117)	(0.130)	(0.212)	(0.129)
Other Christians	-0.383	0.123	-0.0539	-0.161	-0.320	0.227	-0.421*	0.00797	0.0468	0.639**	-0.528***
	(0.328)	(0.231)	(0.335)	(0.119)	(0.267)	(0.140)	(0.229)	(0.167)	(0.181)	(0.307)	(0.168)
Muslim	-1.544***	-0.395	0.579	0.327	-0.533	1.934***	0.552	-0.888**	-0.756**	2.146***	-1.248***
	(0.554)	(0.445)	(0.783)	(0.216)	(0.521)	(0.444)	(0.472)	(0.389)	(0.335)	(0.684)	(0.304)
Other religions	-1.053*	-0.136	-0.362	0.0944	0.311	-0.309**	0.444	0.0250	0.153	0.870	0.999**
	(0.550)	(0.361)	(0.602)	(0.276)	(0.512)	(0.142)	(0.435)	(0.297)	(0.320)	(0.612)	(0.414)
Constant	56.65***	117.2***	-182.3***	-41.98***	-67.54***	-22.69***	-141.2***	23.03	-64.04***	101.4**	-16.31
	(20.85)	(28.19)	(30.64)	(6.442)	(21.07)	(6.913)	(16.29)	(21.69)	(12.92)	(41.85)	(12.40)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**	**8,998**

The results are the coefficients on *d* from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that tobacco consuming households had a higher expenditure share than households that did not consume tobacco. Catholic was the omitted religion. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A29 Three Stage-Least square (3SLS) Regression (Alcohol) (2015-2016 KIHBS Full Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Tobacco	Rent
d	-4.649***	-4.087***	-8.786***	-2.693***	1.003	0.0745	-5.019***	-0.836	-7.861***	45.01***	4.912***	-2.278**
	(1.097)	(0.841)	(1.188)	(0.361)	(0.847)	(0.426)	(0.763)	(0.522)	(0.689)	(2.220)	(0.377)	(0.914)
lnM	-11.46***	-27.37***	20.04***	5.260***	11.61***	2.641***	19.62***	-1.688	7.327***	-2.649	-0.124	12.05***
	(2.671)	(4.183)	(4.088)	(0.660)	(2.327)	(0.854)	(1.555)	(2.360)	(1.625)	(4.360)	(0.800)	(2.268)
$(lnM)^2$	0.540***	1.082***	-1.067***	-0.219***	-0.330***	-0.105***	-0.804***	0.0922	-0.376***	0.0576	0.00611	-0.504***
	(0.113)	(0.174)	(0.165)	(0.0267)	(0.0950)	(0.0347)	(0.0631)	(0.0954)	(0.0657)	(0.176)	(0.0319)	(0.0914)
Adult prop	2.493***	-0.231	-2.734***	-0.147	0.340	-0.265	1.114***	-1.027***	1.398***	-3.579***	-0.197*	0.686*
	(0.681)	(0.425)	(0.587)	(0.181)	(0.422)	(0.223)	(0.375)	(0.271)	(0.277)	(0.566)	(0.111)	(0.362)
lnHHsize	5.958***	0.565***	4.746***	0.125	-1.701***	-0.191*	0.101	-0.791***	1.314***	-6.141***	-0.223***	-1.863***
	(0.322)	(0.197)	(0.275)	(0.0858)	(0.205)	(0.107)	(0.180)	(0.125)	(0.137)	(0.319)	(0.0604)	(0.170)
Post primary voc	0.282	-0.240	-1.547***	-0.217	-0.354	-0.130	0.115	0.0827	-0.233	-0.607	0.163	-0.882***
	(0.476)	(0.338)	(0.552)	(0.145)	(0.342)	(0.184)	(0.338)	(0.275)	(0.273)	(0.597)	(0.223)	(0.286)
Secondary	1.181***	-0.0219	-1.816***	-0.200***	-0.129	-0.252***	-0.00306	-0.0173	-0.403***	-0.432**	-0.186***	1.067***
	(0.172)	(0.120)	(0.167)	(0.0514)	(0.121)	(0.0587)	(0.108)	(0.0784)	(0.0834)	(0.197)	(0.0368)	(0.112)
College	2.470***	0.355*	-2.563***	-0.415***	-0.737***	-0.440***	-0.265*	-0.370***	-0.713***	-1.995***	-0.367***	2.198***
	(0.295)	(0.200)	(0.210)	(0.0638)	(0.178)	(0.0763)	(0.159)	(0.102)	(0.110)	(0.289)	(0.0476)	(0.193)
University	5.293***	1.624***	-2.090***	-0.416***	-2.009***	-0.671***	-0.990***	-0.704***	-0.710***	-3.757***	-0.691***	3.344***
	(0.620)	(0.383)	(0.315)	(0.0789)	(0.271)	(0.115)	(0.203)	(0.143)	(0.150)	(0.502)	(0.0585)	(0.342)
Head Wage	-0.597	0.798	-0.524	-0.162	0.0357	-0.0552	-0.396	0.233	-0.977***	0.679	-0.195	-1.074*
	(0.836)	(0.700)	(0.963)	(0.218)	(0.627)	(0.599)	(0.470)	(0.449)	(0.331)	(1.200)	(0.155)	(0.587)
Number employed	-0.0270	-0.429**	-2.114***	-0.105	0.303	-0.213**	0.119	-0.0966	-0.213*	0.725***	0.00716	0.152
	(0.269)	(0.170)	(0.247)	(0.0841)	(0.192)	(0.104)	(0.156)	(0.127)	(0.128)	(0.211)	(0.0516)	(0.138)
Age Adults	-1.783***	0.131*	0.431***	0.0899***	-0.0137	-0.0159	0.132**	0.0857*	0.0817	-0.192**	-0.0415***	0.0415
	(0.131)	(0.0680)	(0.0984)	(0.0287)	(0.0711)	(0.0374)	(0.0598)	(0.0478)	(0.0517)	(0.0855)	(0.0156)	(0.0522)
No. of children under 5	-0.293***	0.0761***	0.102***	0.0234***	0.0469***	0.0115**	0.0843***	0.00559	0.0598***	-0.0757***	0.00649**	-0.00398
	(0.0172)	(0.0101)	(0.0164)	(0.00496)	(0.0108)	(0.00575)	(0.0105)	(0.00695)	(0.00732)	(0.0141)	(0.00269)	(0.00797)
No. of children over 15	-2.614***	0.00757	0.234**	0.0212	0.279***	0.0264	0.526***	0.0478	0.149***	0.641***	0.0425**	0.0662
	(0.118)	(0.0746)	(0.106)	(0.0348)	(0.0825)	(0.0426)	(0.0737)	(0.0506)	(0.0566)	(0.0922)	(0.0184)	(0.0559)
Age head	4.330***	-0.773***	-0.960***	-0.181***	-0.749***	0.0456	-0.504***	-0.137	-0.367***	0.585***	0.0227	0.189**
	(0.233)	(0.119)	(0.180)	(0.0576)	(0.116)	(0.0729)	(0.113)	(0.0847)	(0.0853)	(0.144)	(0.0274)	(0.0888)
Urban	0.232***	-0.0125	-0.00760	0.00196	-0.0293***	-0.0114**	-0.0349***	0.000917	-0.0149**	-0.0167	-0.00336	-0.00476
	(0.0160)	(0.00886)	(0.0142)	(0.00419)	(0.00954)	(0.00509)	(0.00901)	(0.00610)	(0.00641)	(0.0112)	(0.00212)	(0.00669)
Protestant	0.0773	0.0556	-0.401**	-0.0697	-0.232*	-0.0706	-0.132	0.0646	-0.213**	1.093***	0.0402	-0.0201
	(0.195)	(0.119)	(0.178)	(0.0562)	(0.138)	(0.0632)	(0.122)	(0.0818)	(0.0882)	(0.211)	(0.0422)	(0.124)
Other Christians	-0.585**	0.0456	-0.436*	-0.199**	-0.165	0.258**	-0.599***	0.00821	-0.186	2.185***	0.103*	0.128
	(0.257)	(0.164)	(0.252)	(0.0822)	(0.200)	(0.108)	(0.167)	(0.118)	(0.132)	(0.286)	(0.0606)	(0.176)
Muslim	-1.620***	-0.229	0.384	-0.153	-0.320	1.283***	-0.237	-0.270	-1.162***	4.509***	0.401***	0.255
	(0.364)	(0.260)	(0.396)	(0.106)	(0.285)	(0.214)	(0.229)	(0.183)	(0.176)	(0.569)	(0.0905)	(0.350)
Other religion	-0.875*	0.0363	0.195	0.0814	-0.120	-0.246*	0.363	0.0171	0.267	1.063*	0.158	0.249
	(0.449)	(0.295)	(0.447)	(0.186)	(0.366)	(0.127)	(0.296)	(0.213)	(0.244)	(0.622)	(0.124)	(0.287)
Constant	61.48***	176.5***	-67.84***	-30.02***	-86.11***	-14.63***	-113.9***	11.29	-28.65***	40.04	0.635	-64.00***
	(15.85)	(25.11)	(25.31)	(4.103)	(14.27)	(5.290)	(9.623)	(14.60)	(10.06)	(26.98)	(4.965)	(14.05)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**	**15,961**

The results are the coefficients on ***d*** from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A30 Three Stage-Least square (3SLS) Regression (Alcohol) (2015-2016 KIHBS Urban Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Tobacco	Rent
d	2.610	-3.745***	-9.654***	-2.649***	0.764	-0.261	-3.628***	-2.198***	-7.043***	52.05***	4.419***	-8.558***
	(1.786)	(1.215)	(1.774)	(0.429)	(1.134)	(0.603)	(1.003)	(0.684)	(0.828)	(3.150)	(0.449)	(1.869)
lnM	-17.88***	-29.55***	7.455	2.740***	16.17***	2.829**	19.19***	-0.908	4.560**	-13.08**	-0.454	9.711
	(5.095)	(8.363)	(5.309)	(1.023)	(2.664)	(1.402)	(2.175)	(2.850)	(2.151)	(6.669)	(1.697)	(6.410)
$(lnM)^2$	0.828***	1.171***	-0.521**	-0.119***	-0.532***	-0.110*	-0.779***	0.0520	-0.264***	0.506*	0.0228	-0.462*
	(0.213)	(0.349)	(0.210)	(0.0411)	(0.109)	(0.0566)	(0.0878)	(0.115)	(0.0860)	(0.268)	(0.0674)	(0.257)
Adult prop	-1.163	-1.107*	-2.152**	-0.259	1.037*	0.0567	0.349	-0.756**	0.992***	-0.500	0.299*	0.563
	(1.064)	(0.655)	(0.864)	(0.184)	(0.549)	(0.377)	(0.534)	(0.316)	(0.370)	(0.910)	(0.175)	(0.725)
lnHHsize	4.992***	-0.0300	5.168***	0.137	-0.825***	0.0641	0.183	-0.653***	1.599***	-4.974***	0.0693	-3.305***
	(0.480)	(0.322)	(0.404)	(0.0868)	(0.276)	(0.174)	(0.260)	(0.160)	(0.192)	(0.567)	(0.0992)	(0.347)
Post primary voc	0.738	-0.421	-0.122	-0.349**	-0.496	0.338	0.254	0.341	-0.210	-2.479***	0.0165	-1.146*
	(0.800)	(0.524)	(0.892)	(0.160)	(0.553)	(0.343)	(0.444)	(0.336)	(0.364)	(0.835)	(0.223)	(0.656)
Secondary	1.167***	-0.0782	-1.529***	-0.185***	-0.175	-0.259***	-0.0980	0.00965	-0.280**	-0.850**	-0.246***	2.373***
	(0.225)	(0.161)	(0.249)	(0.0558)	(0.177)	(0.0780)	(0.123)	(0.0977)	(0.119)	(0.342)	(0.0549)	(0.244)
College	2.479***	-0.0918	-2.148***	-0.327***	-0.648***	-0.490***	-0.472***	-0.0687	-0.641***	-2.484***	-0.366***	3.845***
	(0.366)	(0.240)	(0.292)	(0.0704)	(0.250)	(0.109)	(0.171)	(0.138)	(0.150)	(0.491)	(0.0664)	(0.365)
University	6.227***	0.273	-1.729***	-0.257***	-1.700***	-0.806***	-1.057***	-0.237	-0.737***	-4.099***	-0.490***	4.751***
	(0.833)	(0.466)	(0.353)	(0.0827)	(0.329)	(0.159)	(0.229)	(0.163)	(0.172)	(0.603)	(0.0797)	(0.474)
Head Wage	-0.732	2.597**	-0.467	0.388	0.540	-0.651	-0.189	-0.149	0.0351	-3.783**	-0.534***	-0.00302
	(1.299)	(1.027)	(1.441)	(0.351)	(1.108)	(0.642)	(0.655)	(0.451)	(0.526)	(1.513)	(0.201)	(1.545)
Number employed	-0.391***	0.255***	-0.0592	0.00104	-0.0284	-0.0122	0.0118	-0.0362*	0.0402**	-0.508***	-0.0790***	0.463***
	(0.0788)	(0.0585)	(0.0579)	(0.00999)	(0.0405)	(0.0171)	(0.0240)	(0.0215)	(0.0196)	(0.0704)	(0.00982)	(0.0806)
Age Adults	-1.960***	0.182	0.290*	0.0504	-0.0691	0.0349	0.0915	0.206***	0.0255	-0.365**	-0.0644**	-0.0719
	(0.245)	(0.127)	(0.172)	(0.0349)	(0.103)	(0.0645)	(0.0873)	(0.0766)	(0.0849)	(0.161)	(0.0303)	(0.133)
No. of children under 5	-0.314***	0.0343*	0.0821***	0.0143***	0.0612***	0.0226**	0.0621***	0.00219	0.0476***	-0.00171	0.0200***	0.0189
	(0.0298)	(0.0188)	(0.0257)	(0.00527)	(0.0158)	(0.00889)	(0.0156)	(0.00983)	(0.0110)	(0.0273)	(0.00472)	(0.0219)
No. of children over 15	-2.810***	0.201	0.152	0.114***	0.332***	0.0973	0.717***	0.135**	0.100	0.584***	0.0745**	-0.186
	(0.202)	(0.139)	(0.175)	(0.0429)	(0.116)	(0.0760)	(0.103)	(0.0643)	(0.0820)	(0.160)	(0.0325)	(0.153)
Age head	4.064***	-0.710***	-0.890***	-0.225***	-0.515***	0.0237	-0.495***	-0.301**	-0.284**	1.256***	0.0668	-0.215
	(0.407)	(0.205)	(0.262)	(0.0643)	(0.187)	(0.122)	(0.155)	(0.119)	(0.120)	(0.239)	(0.0498)	(0.228)
Protestant	0.445	0.114	-0.239	-0.122*	-0.279	-0.0553	0.0539	-0.00937	-0.210*	1.101***	-0.0353	0.161
	(0.298)	(0.182)	(0.241)	(0.0666)	(0.171)	(0.0939)	(0.144)	(0.104)	(0.120)	(0.333)	(0.0552)	(0.264)
Other Christians	-0.0640	0.0687	-0.742**	-0.123	0.0171	0.219	-0.365	-0.0452	-0.251	2.983***	0.0158	-0.0867
	(0.427)	(0.220)	(0.367)	(0.0983)	(0.261)	(0.155)	(0.224)	(0.174)	(0.175)	(0.455)	(0.0762)	(0.378)
Muslim	-0.635	-0.0913	0.470	-0.304***	-0.0928	0.788***	-0.490*	0.0157	-1.225***	4.907***	0.399***	0.494
	(0.437)	(0.321)	(0.480)	(0.114)	(0.333)	(0.239)	(0.257)	(0.188)	(0.197)	(0.713)	(0.118)	(0.543)
Other religions	-0.988	-0.184	-0.163	0.0308	-0.822*	-0.132	-0.185	-0.0703	0.283	3.049***	0.183	0.728
	(0.723)	(0.437)	(0.668)	(0.180)	(0.481)	(0.231)	(0.408)	(0.257)	(0.342)	(1.068)	(0.178)	(0.638)
Constant	100.4***	190.0***	-1.585	-14.66**	-113.9***	-17.02*	-113.4***	6.893	-12.06	99.59**	1.620	-34.60
	(30.61)	(50.24)	(33.55)	(6.369)	(16.47)	(8.700)	(13.58)	(17.76)	(13.45)	(41.69)	(10.57)	(39.95)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**	**6,985**

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A31 Three Stage-Least square (3SLS) Regression (Alcohol) (2015-2016 KIHBS Rural Sample)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Tobacco
d	-6.167***	-6.658***	-4.567***	-2.075***	1.255	0.672	-5.085***	0.531	-6.805***	34.28***	4.894***
	(1.428)	(0.862)	(1.343)	(0.469)	(1.022)	(0.561)	(1.013)	(0.685)	(0.805)	(1.662)	(0.392)
lnM	-12.39***	-17.69***	40.47***	7.599***	7.639**	3.860***	25.33***	-3.497	13.77***	-8.589	-0.423
	(3.910)	(4.971)	(4.887)	(1.002)	(3.688)	(1.084)	(2.767)	(3.582)	(2.029)	(6.510)	(0.893)
$(lnM)^2$	0.576***	0.663***	-1.937***	-0.313***	-0.142	-0.156***	-1.041***	0.175	-0.646***	0.305	0.0204
	(0.167)	(0.207)	(0.201)	(0.0418)	(0.153)	(0.0447)	(0.115)	(0.147)	(0.0830)	(0.267)	(0.0366)
Adult prop	5.607***	1.059*	-3.680***	-0.0897	-0.180	-0.626**	1.682***	-1.403***	1.717***	-4.363***	-0.522***
	(1.067)	(0.577)	(0.825)	(0.296)	(0.648)	(0.304)	(0.607)	(0.429)	(0.409)	(0.656)	(0.154)
$lnHHsize$	7.089***	1.035***	3.864***	0.0575	-2.573***	-0.522***	-0.165	-1.052***	1.095***	-6.198***	-0.549***
	(0.459)	(0.251)	(0.403)	(0.125)	(0.339)	(0.144)	(0.273)	(0.197)	(0.207)	(0.370)	(0.0814)
Post primary voc	-0.392	-0.309	-1.999**	-0.171	-0.481	-0.448***	-0.164	-0.133	-0.497	0.564	0.285
	(0.572)	(0.489)	(0.782)	(0.227)	(0.460)	(0.166)	(0.502)	(0.393)	(0.369)	(0.900)	(0.359)
Secondary	1.350***	-0.191	-1.780***	-0.165**	-0.0367	-0.255***	0.105	-0.0190	-0.526***	-0.174	-0.118**
	(0.268)	(0.165)	(0.228)	(0.0753)	(0.186)	(0.0779)	(0.180)	(0.119)	(0.131)	(0.232)	(0.0473)
College	2.890***	0.404	-2.745***	-0.388***	-0.650**	-0.450***	-0.122	-0.586***	-0.808***	-1.067***	-0.275***
	(0.496)	(0.272)	(0.351)	(0.113)	(0.295)	(0.106)	(0.296)	(0.152)	(0.172)	(0.354)	(0.0694)
University	4.949***	1.871**	-3.437***	-0.810***	-1.619***	-0.359*	-1.286***	-0.917***	-1.493***	-0.847	-0.446***
	(1.169)	(0.737)	(0.640)	(0.196)	(0.559)	(0.195)	(0.435)	(0.292)	(0.280)	(0.785)	(0.0777)
Head Wage	0.107	-0.420	-0.631	-0.386	-0.391	-0.0166	-0.908	0.533	-1.457***	2.107	0.130
	(1.190)	(1.064)	(1.348)	(0.315)	(0.822)	(0.882)	(0.744)	(0.663)	(0.400)	(1.489)	(0.234)
Number employed	-0.0931	0.186**	-0.184*	-0.0518*	-0.0133	0.00103	-0.0156	-0.0391	-0.0186	0.0672	-0.0130
	(0.0703)	(0.0737)	(0.105)	(0.0273)	(0.0400)	(0.0158)	(0.0273)	(0.0349)	(0.0356)	(0.0704)	(0.00898)
Age Adults	-1.759***	0.215***	0.399***	0.120***	0.0274	-0.0247	0.179**	0.0193	0.123*	-0.122	-0.0395*
	(0.157)	(0.0780)	(0.124)	(0.0403)	(0.0956)	(0.0470)	(0.0768)	(0.0612)	(0.0666)	(0.0837)	(0.0202)
No. of children under 5	-0.262***	0.0974***	0.0849***	0.0269***	0.0388**	0.00138	0.0954***	0.00173	0.0663***	-0.0934***	-0.00528
	(0.0206)	(0.0122)	(0.0200)	(0.00764)	(0.0163)	(0.00757)	(0.0139)	(0.0109)	(0.0105)	(0.0156)	(0.00321)
No. of children over 15	-2.491***	-0.120	0.325***	-0.0100	0.239**	-0.00360	0.439***	0.0297	0.222***	0.687***	0.0463**
	(0.126)	(0.0925)	(0.125)	(0.0455)	(0.108)	(0.0533)	(0.0947)	(0.0664)	(0.0737)	(0.0964)	(0.0232)
Age head	4.446***	-0.742***	-0.887***	-0.155*	-0.807***	0.109	-0.427***	-0.0481	-0.374***	0.298*	0.0325
	(0.272)	(0.155)	(0.242)	(0.0860)	(0.178)	(0.0861)	(0.151)	(0.116)	(0.113)	(0.170)	(0.0369)
Protestant	-0.175	-0.211	-0.344	-0.0474	-0.193	-0.0591	-0.373**	0.129	-0.267**	1.159***	0.121**
	(0.254)	(0.176)	(0.240)	(0.0853)	(0.191)	(0.0901)	(0.182)	(0.124)	(0.136)	(0.236)	(0.0554)
Other Christians	-0.744**	-0.125	-0.306	-0.246**	-0.306	0.242	-0.636***	0.00883	-0.208	1.822***	0.181**
	(0.342)	(0.243)	(0.353)	(0.123)	(0.277)	(0.153)	(0.229)	(0.164)	(0.194)	(0.320)	(0.0795)
Muslim	-1.885***	-0.504	0.162	0.266	-0.586	1.987***	-0.0284	-1.062**	-0.971***	3.619***	0.113
	(0.610)	(0.453)	(0.758)	(0.234)	(0.581)	(0.526)	(0.448)	(0.430)	(0.352)	(0.792)	(0.142)
Other religions	-0.832	-0.0567	-0.0668	0.126	0.309	-0.341**	0.699	0.0621	0.330	0.500	0.158
	(0.604)	(0.358)	(0.598)	(0.291)	(0.569)	(0.147)	(0.440)	(0.292)	(0.320)	(0.637)	(0.164)
Constant	67.40***	124.1***	-189.7***	-42.32***	-62.70***	-22.85***	-147.8***	22.13	-67.23***	80.95**	3.283
	(22.95)	(29.82)	(29.70)	(5.999)	(22.33)	(6.657)	(16.82)	(21.92)	(12.44)	(39.83)	(5.475)
Month F E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,923	8,923	8,923	8,923	8,923	8,923	8,923	8,923	8,923	8,923	8,923

The results are the coefficients on d from the 3SLS estimation of equation (2.5). ***d*** represents the differences in expenditure shares expressed as percentage points. The coefficients were multiplied by ten. Therefore, 1.0 represents 0.1 percentage points. Positive coefficient indicates that alcohol consuming households had a higher expenditure share than households that did not consume alcohol. *p<0.1, **p<0.05, ***p<0.01. Bootstrapped standard errors are in brackets.

Table A32 Lower and upper bounds for the estimates of the tobacco and alcohol dummies d *(2005-2006 KIHBS)*

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				**[5.15, 12.89]**	**[3.82, 12.84]**	**[1.43, 10.28]**
Alcohol	**[6.65, 22.78]**	**[5.63, 38.22]**	**[2.78, 10.63]**			
Education	**[-14.58, -0.66]**	**[-11.26, -0.27]**	**[-10.37, -0.91]**	**[-14.46, -0.55]**	[-8.33, 0.44]	**[-12.64, -0.89]**
Energy	**[-8.23, -0.22]**	**[-25.31, -4.53]**	[-0.46, 5.33]	**[-7.41, -0.26]**	**[-18.30, -1.24]**	[-0.36, 6.40]
Bread and cereal	**[-17.68, -1.64]**	[-14.27, 0.28]	**[-9.66, -0.20]**	**[-15.49, -0.24]**	[-9.18, 0.79]	**[-14.69, -0.25]**
Banana and tubers	**[-9.71, -0.19]**	**[-11.93, -2.93]**	[-6.70, 0.52]	**[-9.32, -0.11]**	**[-9.12, -0.05]**	[-5.80, 0.60]
Poultry	[-4.95, 0.26]	[-7.78, 0.18]	[-2.58, 0.49]	[-5.12, 0.36]	[-6.42, 0.48]	[-3.78, 0.50]
Meats	[-0.29, 9.48]	[-1.28, 6.79]	[0.02, 7.21]	**[0.02, 9.29]**	[-0.22, 5.59]	[0.03, 9.99]
Fish and sea food	**[-2.66, -0.28]**	[-0.33, 2.18]	[-1.92, 0.41]	[-0.13, 1.25]	[-0.33, 1.79]	[-0.77, 0.58]
Milk and eggs	**[-9.38, -0.40]**	**[-20.33, -3.41]**	[-1.19, 3.08]	**[-8.47, -0.88]**	**[-14.63, -1.08]**	[-0.86, 3.98]
Fruits	[-5.21, 0.21]	[-9.20, 0.001]	[-3.56, 0.34]	[-4.80, 0.23]	**[-6.84, -0.33]**	[-4.27, 0.30]
Vegetables	**[-8.95, -1.21]**	**[-16.85, -4.64]**	[-4.36, 0.59]	**[-8.04, -0.17]**	**[-12.24, -1.98]**	[-3.14, 0.97]
Other foods	**[12.33, 38.04]**	**[14.84, 70.94]**	[-0.02, 19.96]	**[9.93, 39.98]**	**[14.27, 59.02]**	**[0.35, 16.85]**
Healthcare	**[-3.60, -0.04]**	[-2.65, 0.33]	**[0.00, 2.93]**	**[-3.48, -0.28]**	[-1.78, 0.13]	**[-3.66, -0.16]**
Clothing & footwear	[-0.63, 15.81]	[-1.85, 19.79]	[-0.77, 4.54]	[-0.36, 14.99]	[-1.41, 15.33]	[-0.53, 9.20]
Water	[-3.07, 0.02]	[-5.33, 0.08]	[-1.99, 0.16]	[-0.12, 0.21]	[-4.01, 0.09]	[-1.94, 0.29]
Transport	**[1.04, 16.16]**	[0.62, 29.72]	[-0.42, 4.40]	**[1.80, 16.46]**	**[4.46, 25.37]**	[-1.00, 5.99]
Furnishings	[-5.38, 0.74]	[-0.32, 4.32]	[-5.60, 0.72]	[-5.20, 0.58]	[-0.82, 3.73]	[-4.44, 0.88]
Rent	[-6.16, 0.30]	**[-17.60, -1.70]**		[-5.38, 0.41]	[-1.68, 4.15]	
Communication	**[0.56, 10.23]**	[-1.19, 12.76]	[-0.05, 4.50]	**[1.49, 9.60]**	[-0.64, 9.43]	**[0.20, 3.29]**
Sample Size	**8,651**	**3,459**	**5,108**	**8,587**	**3,438**	**5,066**

These are the 95% confidence Nevo & Rosen imperfect instruments lower and upper bounds estimates, of the tobacco (alcohol) dummy d in equation (2.5). They provide a possible range for the difference in percentage points (Estimates were multiplied by ten. Therefore, an estimate of 1.0 represents 0.1 percentage points). Positive values indicate tobacco (alcohol) consuming households have a higher budget share than households that do not consume tobacco (alcohol). Values in bold represent significant differences in expenditure shares.

Table A33 Lower and upper bounds for the estimates of the tobacco and alcohol dummies d *(2015-2016 KIHBS)*

	Tobacco			Alcohol		
Commodity	**Full Sample**	**Urban**	**Rural**	**Full Sample**	**Urban**	**Rural**
Tobacco				**[4.08, 6.69]**	**[1.94, 6.92]**	**[4.00, 7.08]**
Alcohol	**[7.89, 16.61]**	**[7.69, 19.70]**	**[6.51, 15.95]**			
Education	**[-7.97, -1.66]**	[-2.53, 5.37]	**[-13.74, -1.98]**	**[-5.83, -1.12]**	[-2.02, 6.19]	**[-10.50, -1.32]**
Energy	**[-8.33, -3.54]**	**[-8.14, -1.70]**	**[-9.90, -4.35]**	**[-7.94, -1.53]**	**[-6.94, -1.42]**	**[-9.31, -4.86]**
Bread and cereal	**[-13.66, -2.78]**	**[-20.00, -3.41]**	**[-9.42, -1.23]**	**[-14.20, -6.14]**	**[-20.49, -4.92]**	**[-10.53, -2.53]**
Roots and tubers	**[-3.89, -1.32]**	**[-4.81, -1.20]**	**[-3.90, -0.84]**	**[-4.02, -2.31]**	**[-4.94, -1.69]**	**[-4.02, -0.89]**
Meats	[-1.09, 2.78]	[-1.21, 3.48]	[-1.33, 3.52]	[-0.88, 3.21]	[-1.32, 4.15]	[-0.80, 3.76]
Fish and sea food	[-0.26, 1.00]	[-0.41, 1.49]	[-0.28, 1.76]	[-0.26, 1.09]	[-0.52, 1.50]	[-0.19, 1.92]
Milk and eggs	**[-7.69, -2.41]**	**[-7.87, -1.44]**	**[-8.45, -2.15]**	**[-7.63, -3.49]**	**[-7.67, -1.62]**	**[-8.24, -2.98]**
Fruits	[-2.00, 0.09]	[-3.44, 0.14]	**[-1.52, 0.04]**	[-5.05, 0.12]	**[-3.20, -2.34]**	[-0.78, 2.28]
Vegetables	**[-10.87, -5.35]**	**[-11.79, -4.32]**	**[-10.69, -4.13]**	**[-11.13, -7.23]**	**[-12.15, -5.00]**	**[-10.79, -5.24]**
Other foods	**[28.51, 53.58]**	**[30.98, 71.11]**	**[22.18, 42.84]**	**[12.23, 46.77]**	**[51.74, 74.64]**	**[30.93, 45.49]**
Rent	**[-6.51, -1.11]**	**[-16.38, -3.42]**		**[-5.57, -0.86]**	**[-13.85, -2.61]**	
Sample size	**16,075**	**7,019**	**8,999**	**15, 961**	**6,985**	**8,923**

These are the 95% confidence Nevo & Rosen imperfect instruments lower and upper bounds estimates, of the tobacco (alcohol) dummy d in equation (2.5). They provide a possible range for the difference in percentage points (Estimates were multiplied by ten. Therefore, an estimate of 1.0 represents 0.1 percentage points). Positive values indicate tobacco (alcohol) consuming households have a higher budget share than households that do not consume tobacco (alcohol). Values in bold represent significant differences in expenditure shares.

Table A34 Seemingly Unrelated Regression (SURE): Tobacco consuming households (2015-2016 KIHBS)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Other non-food	Rent
$Tax\ dummy\ \tau$	0.0282	-0.721**	0.717	0.0724	0.627	-0.283	0.356	0.344	-0.0594	0.323	-1.504**	0.209
	(0.403)	(0.360)	(0.596)	(0.168)	(0.410)	(0.242)	(0.358)	(0.317)	(0.266)	(0.721)	(0.693)	(0.226)
lnM	-6.850	-2.429	21.88*	9.178***	-6.374	2.344	13.82*	-5.714	1.193	-17.18	-18.82	0.719
	(8.028)	(7.176)	(11.88)	(3.344)	(8.176)	(4.833)	(7.135)	(6.320)	(5.298)	(14.38)	(13.81)	(4.497)
$(lnM)^2$	0.274	0.00106	-1.177**	-0.376***	0.422	-0.0816	-0.604**	0.260	-0.102	0.684	0.868	-0.0420
	(0.331)	(0.296)	(0.490)	(0.138)	(0.337)	(0.199)	(0.294)	(0.261)	(0.218)	(0.593)	(0.570)	(0.185)
Adult prop	5.223***	2.441	-6.005**	0.536	-0.794	-1.736*	4.252***	-0.0987	0.527	0.0634	-1.407	-0.845
	(1.731)	(1.547)	(2.560)	(0.721)	(1.763)	(1.042)	(1.538)	(1.363)	(1.142)	(3.101)	(2.978)	(0.970)
$lnHHsize$	6.206***	2.555***	4.853***	0.784**	-0.678	-0.775*	2.441***	-0.561	1.895***	-10.83***	1.171	-0.530
	(0.775)	(0.692)	(1.146)	(0.323)	(0.789)	(0.466)	(0.688)	(0.610)	(0.511)	(1.388)	(1.333)	(0.434)
Post primary voc	0.962	-3.354**	-5.679**	0.0825	2.823*	-0.826	0.785	-1.367	-0.753	10.19***	0.970	-1.318
	(1.639)	(1.465)	(2.424)	(0.683)	(1.669)	(0.987)	(1.456)	(1.290)	(1.081)	(2.936)	(2.819)	(0.918)
Secondary	1.141**	-0.503	-1.800**	0.0745	-0.205	-0.324	0.860*	-0.748*	-0.440	1.248	0.637	0.333
	(0.496)	(0.443)	(0.733)	(0.206)	(0.505)	(0.298)	(0.440)	(0.390)	(0.327)	(0.888)	(0.853)	(0.278)
College	4.040***	0.671	-2.983**	-0.00994	-1.375	-0.630	0.778	-0.515	-1.422**	-0.171	0.888	1.354**
	(0.956)	(0.854)	(1.414)	(0.398)	(0.973)	(0.575)	(0.849)	(0.752)	(0.631)	(1.712)	(1.644)	(0.535)
University	2.616	2.912*	-1.071	-0.136	-1.898	-0.323	1.192	-1.819	-1.508	-1.256	-0.530	1.490
	(1.842)	(1.646)	(2.725)	(0.767)	(1.876)	(1.109)	(1.637)	(1.450)	(1.216)	(3.300)	(3.169)	(1.032)
Head Wage	-0.837	0.247	-1.880*	-0.431	1.167*	-0.486	0.0358	-1.269**	-0.282	1.293	1.743	-0.278
	(0.667)	(0.596)	(0.986)	(0.278)	(0.679)	(0.401)	(0.592)	(0.525)	(0.440)	(1.194)	(1.147)	(0.373)
Number employed	-1.565***	-0.253	0.873**	-0.0990	-0.118	-0.0307	-0.0713	-0.443**	0.0152	0.992**	0.0520	-0.186
	(0.275)	(0.246)	(0.407)	(0.115)	(0.280)	(0.166)	(0.244)	(0.216)	(0.181)	(0.493)	(0.473)	(0.154)
Age Adults	-0.122***	0.0376	0.0307	0.0347**	0.110***	0.0235	0.124***	-0.0265	0.0472*	-0.105	-0.0923	-0.00672
	(0.0398)	(0.0356)	(0.0589)	(0.0166)	(0.0406)	(0.0240)	(0.0354)	(0.0313)	(0.0263)	(0.0713)	(0.0685)	(0.0223)
No. of children under 5	-1.577***	0.117	-0.449	-0.0773	-0.313	0.0606	0.109	-0.0157	0.0670	1.901***	-0.220	-0.232
	(0.318)	(0.284)	(0.471)	(0.133)	(0.324)	(0.192)	(0.283)	(0.251)	(0.210)	(0.570)	(0.548)	(0.178)
No. of children over 15	4.622***	-0.177	-2.219***	-0.141	-0.128	-0.196	-0.379	0.133	-0.221	0.837	-1.905**	-0.0828
	(0.551)	(0.492)	(0.815)	(0.229)	(0.561)	(0.332)	(0.489)	(0.434)	(0.363)	(0.987)	(0.948)	(0.308)
Age head	0.0815**	0.00153	0.0385	-0.0191	-0.0355	-0.0168	-0.0720**	0.0407	-0.0178	-0.0645	0.0322	0.0169
	(0.0358)	(0.0320)	(0.0529)	(0.0149)	(0.0364)	(0.0215)	(0.0318)	(0.0282)	(0.0236)	(0.0641)	(0.0616)	(0.0200)
Urban	0.0129	-0.261	-2.451***	-0.567***	-0.615	0.232	-1.200***	-0.347	-0.276	1.189	0.610	4.639***
	(0.457)	(0.409)	(0.676)	(0.190)	(0.465)	(0.275)	(0.406)	(0.360)	(0.302)	(0.819)	(0.786)	(0.256)
Protestant	0.686	0.428	-0.470	-0.137	0.127	-0.103	0.264	-0.458	-0.313	0.304	-0.351	0.426
	(0.501)	(0.448)	(0.741)	(0.209)	(0.510)	(0.302)	(0.445)	(0.394)	(0.331)	(0.897)	(0.862)	(0.281)
Other Christians	0.00199	0.0936	-1.193	-0.257	-1.058	0.296	-0.598	0.198	-0.333	1.620	1.852	0.0924
	(0.770)	(0.688)	(1.139)	(0.321)	(0.784)	(0.464)	(0.684)	(0.606)	(0.508)	(1.380)	(1.325)	(0.431)
Muslim	-0.174	0.963	2.273	-0.0823	-0.600	2.321***	0.913	-0.972	-0.547	-0.638	-0.445	0.900*
	(0.948)	(0.847)	(1.402)	(0.395)	(0.965)	(0.571)	(0.842)	(0.746)	(0.625)	(1.698)	(1.630)	(0.531)
Other religion	-0.997	0.829	-1.759	-0.715*	0.241	-0.472	0.147	-0.228	-0.563	4.428***	-2.445	0.764
	(0.888)	(0.794)	(1.313)	(0.370)	(0.904)	(0.535)	(0.789)	(0.699)	(0.586)	(1.591)	(1.527)	(0.497)
Constant	39.65	30.64	-72.50	-54.48***	16.92	-12.66	-77.80*	37.92	6.514	132.3	122.1	5.083
	(48.80)	(43.62)	(72.19)	(20.33)	(49.70)	(29.38)	(43.37)	(38.42)	(32.21)	(87.43)	(83.96)	(27.34)
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**967**	**967**	**967**	**967**	**967**	**967**	**967**	**967**	**967**	**967**	**967**	**967**

Notes: These are the results from Seemingly Unrelated Regression (SURE). τ was assigned value of one if the household was surveyed after the implementation of the new excise tax and zero otherwise. Coefficient on the tax dummy is the difference in percentage points on expenditures between tobacco consuming households that were interviewed before the tax increase and tobacco consuming households interviewed after the tax increase. Catholic is the omitted religion. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table A35 Seemingly Unrelated Regression (SURE): Alcohol consuming households (2015-2016 KIHBS)

VARIABLES	Education	Energy	Bread and cereals	Roots and tubers	Meats	Fish and seafood	Milk and eggs	fruits	Vegetables	Other foods	Other non-food	Rent
$Tax\ dummy\ (\tau)$	0.170	-0.0837	0.679	0.130	0.537	-0.286*	0.430	-0.677***	-0.234	-0.0107	-0.926*	0.0939
	(0.415)	(0.283)	(0.450)	(0.126)	(0.360)	(0.165)	(0.287)	(0.224)	(0.234)	(0.724)	(0.548)	(0.252)
lnM	-13.93*	-26.71***	11.01	3.611	2.648	-1.984	24.01***	7.533*	3.868	-5.273	-15.27	9.821**
	(7.825)	(5.330)	(8.479)	(2.380)	(6.796)	(3.114)	(5.412)	(4.216)	(4.406)	(13.66)	(10.34)	(4.758)
$(lnM)^2$	0.573*	1.027***	-0.657*	-0.148	0.0261	0.0843	-0.964***	-0.280	-0.217	0.149	0.840**	-0.412**
	(0.319)	(0.217)	(0.346)	(0.0971)	(0.277)	(0.127)	(0.221)	(0.172)	(0.180)	(0.557)	(0.422)	(0.194)
Adult prop	4.269**	0.887	-3.857*	0.416	0.160	-1.774**	1.588	-0.532	1.139	-1.297	-1.113	0.189
	(1.837)	(1.251)	(1.991)	(0.559)	(1.595)	(0.731)	(1.271)	(0.990)	(1.034)	(3.206)	(2.427)	(1.117)
$lnHHsize$	5.460***	1.515***	5.304***	0.597**	-0.465	-0.690**	0.479	-0.179	1.875***	-12.04***	0.0868	-0.990**
	(0.821)	(0.559)	(0.889)	(0.250)	(0.713)	(0.327)	(0.568)	(0.442)	(0.462)	(1.432)	(1.084)	(0.499)
Post primary voc	4.616**	0.423	0.309	-0.824	-1.021	-1.117	0.169	-0.585	-0.177	-3.166	0.434	1.175
	(1.819)	(1.239)	(1.971)	(0.553)	(1.580)	(0.724)	(1.258)	(0.980)	(1.024)	(3.175)	(2.404)	(1.106)
Secondary	1.183**	-0.254	-0.791	-0.513***	-0.204	-0.341*	0.307	-0.300	-0.287	0.833	-0.118	0.911***
	(0.508)	(0.346)	(0.550)	(0.154)	(0.441)	(0.202)	(0.351)	(0.274)	(0.286)	(0.886)	(0.671)	(0.309)
College	4.321***	1.342**	-2.585***	-0.765***	-1.853**	-0.264	-0.192	-0.758*	-0.995**	0.0621	-0.575	2.974***
	(0.852)	(0.580)	(0.923)	(0.259)	(0.740)	(0.339)	(0.589)	(0.459)	(0.480)	(1.487)	(1.126)	(0.518)
University	7.143***	2.232***	-2.353**	-0.800**	-3.216***	-1.159***	-1.027	-1.365**	-1.433**	-1.190	0.684	3.780***
	(1.075)	(0.732)	(1.165)	(0.327)	(0.933)	(0.428)	(0.743)	(0.579)	(0.605)	(1.875)	(1.420)	(0.653)
Head Wage	-0.356	0.126	-1.307*	0.0673	0.0806	-0.133	0.0644	-0.487	0.170	1.504	0.529	-0.524
	(0.733)	(0.499)	(0.794)	(0.223)	(0.636)	(0.292)	(0.507)	(0.395)	(0.413)	(1.279)	(0.968)	(0.446)
Number employed	-1.089***	0.0358	0.112	-0.0243	-0.292	0.154	-0.0281	-0.282*	0.144	1.005**	0.220	-0.0659
	(0.289)	(0.197)	(0.313)	(0.0879)	(0.251)	(0.115)	(0.200)	(0.156)	(0.163)	(0.505)	(0.382)	(0.176)
Age Adults	-0.117***	0.0322	0.0628	0.0267**	0.101***	0.00530	0.0712**	-0.00806	0.0346	-0.144**	-0.0871	0.00794
	(0.0418)	(0.0285)	(0.0453)	(0.0127)	(0.0363)	(0.0166)	(0.0289)	(0.0225)	(0.0236)	(0.0730)	(0.0553)	(0.0254)
No. of children under 5	-1.724***	0.197	-0.419	0.0481	-0.384	0.0228	0.382	-0.00304	-0.0726	1.533**	0.276	0.0110
	(0.354)	(0.241)	(0.384)	(0.108)	(0.308)	(0.141)	(0.245)	(0.191)	(0.199)	(0.618)	(0.468)	(0.215)
No. of children over 15	5.134***	-0.276	-0.783	-0.410**	-0.780	0.00482	-0.618	0.0271	-0.567*	-0.560	-0.994	-0.142
	(0.572)	(0.390)	(0.620)	(0.174)	(0.497)	(0.228)	(0.396)	(0.308)	(0.322)	(0.998)	(0.756)	(0.348)
Age head	0.0670*	0.00787	0.0243	-0.0124	-0.0666**	-0.00318	-0.0150	0.0162	0.00375	0.00490	-0.00301	-0.00918
	(0.0364)	(0.0248)	(0.0394)	(0.0111)	(0.0316)	(0.0145)	(0.0251)	(0.0196)	(0.0205)	(0.0634)	(0.0480)	(0.0221)
Urban	0.790	0.0501	-2.468***	-0.278*	-1.745***	-0.150	-1.365***	-0.514*	-0.408	0.904	0.0963	5.833***
	(0.501)	(0.341)	(0.542)	(0.152)	(0.435)	(0.199)	(0.346)	(0.270)	(0.282)	(0.874)	(0.661)	(0.304)
Protestant	0.915*	0.167	-0.508	-0.210	-0.0856	-0.0584	0.0328	-0.130	0.409	-0.216	-0.656	0.484*
	(0.483)	(0.329)	(0.524)	(0.147)	(0.420)	(0.192)	(0.334)	(0.260)	(0.272)	(0.843)	(0.638)	(0.294)
Other Christians	0.294	-0.296	-0.502	-0.354	0.195	0.672**	0.279	0.227	0.124	0.524	-0.850	-0.310
	(0.802)	(0.546)	(0.869)	(0.244)	(0.696)	(0.319)	(0.555)	(0.432)	(0.451)	(1.399)	(1.060)	(0.488)
Muslim	3.015**	-0.536	1.637	-0.145	0.983	2.265***	-1.308	-0.659	-0.590	-0.906	-2.605	-0.971
	(1.425)	(0.971)	(1.544)	(0.433)	(1.238)	(0.567)	(0.986)	(0.768)	(0.802)	(2.487)	(1.883)	(0.867)
Other religion	-1.645*	-0.668	-1.266	-0.180	0.538	-0.0506	0.647	0.339	0.0373	5.343***	-3.941***	-0.0603
	(0.963)	(0.656)	(1.044)	(0.293)	(0.836)	(0.383)	(0.666)	(0.519)	(0.542)	(1.681)	(1.273)	(0.586)
Constant	81.64*	174.4***	-21.26	-21.46	-28.94	14.85	-146.5***	-45.22*	-11.93	72.97	85.17	-50.94*
	(48.21)	(32.83)	(52.24)	(14.66)	(41.87)	(19.18)	(33.34)	(25.97)	(27.14)	(84.13)	(63.70)	(29.31)
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**	**1,264**

Notes: These are the results from Seemingly Unrelated Regression (SURE). τ was assigned value of one if the household was surveyed after the implementation of the new excise tax and zero otherwise. Coefficient on the tax dummy is the difference in percentage points on expenditures between alcohol consuming households that were interviewed before the tax increase and alcohol consuming households interviewed after the tax increase. Catholic is the omitted religion. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table A36 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco consumers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Consuming**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.019	7.020	-0.999	2.78	0.0055***
Adult sex ratio	0.650	0.660	0.010	0.74	0.4620
$\boldsymbol{lnM}$	12.230	12.212	-0.019	0.55	0.5824
$(\boldsymbol{lnM})^2$	149.966	149.518	-0.448	0.55	0.5839
Adult prop	0.673	0.678	0.005	0.33	0.7392
$\boldsymbol{lnHHsize}$	1.174	1.158	-0.016	0.37	0.7101
Post primary vocational	0.010	0.014	0.004	0.60	0.5495
Secondary	0.250	0.244	-0.006	0.24	0.8115
College	0.050	0.039	-0.012	1.14	0.2535
University	0.012	0.008	-0.004	0.86	0.3872
Other	0.010	0.012	0.002	0.28	0.7798
Head Wage	0.885	0.886	0.000	0.03	0.9779
Number employed	1.895	1.876	-0.019	0.33	0.7416
Age Adults	39.131	39.171	0.039	0.06	0.9495
No. of children under 5	0.530	0.517	-0.013	0.30	0.7610
No. of children over 15	0.190	0.188	-0.003	0.11	0.9108
Age head	44.894	44.863	-0.031	0.04	0.9680
Urban	0.376	0.363	-0.012	0.47	0.6349
Protestant	0.425	0.410	-0.014	0.54	0.5899
Other Christians	0.083	0.088	0.005	0.32	0.7505
Muslim	0.114	0.118	0.004	0.20	0.8434
Other religion	0.064	0.067	0.003	0.18	0.8602
Sample size	**4,717**	**666**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A37 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco consumers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Consuming**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	19.609	18.609	-1.001	1.63	0.1036
Adult sex ratio	0.650	0.660	0.010	0.74	0.4620
$\boldsymbol{lnM}$	12.230	12.212	-0.019	0.55	0.5824
$(\boldsymbol{lnM})^2$	149.966	149.518	-0.448	0.55	0.5839
Adult prop	0.673	0.678	0.005	0.33	0.7392
$\boldsymbol{lnHHsize}$	1.174	1.158	-0.016	0.37	0.7101
Post primary vocational	0.010	0.014	0.004	0.60	0.5495
Secondary	0.250	0.244	-0.006	0.24	0.8115
College	0.050	0.039	-0.012	1.14	0.2535
University	0.012	0.008	-0.004	0.86	0.3872
Other	0.010	0.012	0.002	0.28	0.7798
Head Wage	0.885	0.886	0.000	0.03	0.9779
Number employed	1.895	1.876	-0.019	0.33	0.7416
Age Adults	39.131	39.171	0.039	0.06	0.9495
No. of children under 5	0.530	0.517	-0.013	0.30	0.7610
No. of children over 15	0.190	0.188	-0.003	0.11	0.9108
Age head	44.894	44.863	-0.031	0.04	0.9680
Urban	0.376	0.363	-0.012	0.47	0.6349
Protestant	0.425	0.410	-0.014	0.54	0.5899
Other Christians	0.083	0.088	0.005	0.32	0.7505
Muslim	0.114	0.118	0.004	0.20	0.8434
Other religion	0.064	0.067	0.003	0.18	0.8602
Sample size	**4,717**	**666**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A38 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol consumers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Consuming**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.485	6.383	-2.102	5.18	0.0000***
Adult sex ratio	0.624	0.631	0.008	0.58	0.5632
$\boldsymbol{lnM}$	12.275	12.271	-0.004	0.12	0.9063
$(\boldsymbol{lnM})^2$	151.124	151.033	-0.091	0.11	0.9088
Adult prop	0.680	0.684	0.004	0.32	0.7454
$\boldsymbol{lnHHsize}$	1.122	1.110	-0.012	0.33	0.7446
Post primary vocational	0.011	0.013	0.002	0.35	0.7227
Secondary	0.277	0.269	-0.008	0.37	0.7125
College	0.078	0.074	-0.003	0.29	0.7736
University	0.059	0.062	0.003	0.29	0.7702
Other	0.004	0.005	0.001	0.38	0.7026
Head Wage	0.878	0.880	0.002	0.12	0.9039
Number employed	1.747	1.741	-0.006	0.13	0.8986
Age Adults	37.261	37.266	0.005	0.01	0.9925
No. of children under 5	0.553	0.545	-0.008	0.21	0.8321
No. of children over 15	0.177	0.172	-0.005	0.27	0.7890
Age head	42.661	42.615	-0.046	0.07	0.9463
Urban	0.422	0.413	-0.009	0.38	0.7063
Protestant	0.495	0.475	-0.020	0.84	0.4014
Other Christians	0.088	0.087	-0.001	0.07	0.9439
Muslim	0.034	0.034	-0.000	0.03	0.9724
Other religion	0.048	0.050	0.002	0.22	0.8245
Sample size	**4,613**	**769**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A39 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol consumers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Consuming**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	18.691	16.352	-2.338	4.65	0.0000***
Adult sex ratio	0.624	0.631	0.008	0.58	0.5632
$\boldsymbol{lnM}$	12.275	12.271	-0.004	0.12	0.9063
$(\boldsymbol{lnM})^2$	151.124	151.033	-0.091	0.11	0.9088
Adult prop	0.680	0.684	0.004	0.32	0.7454
$\boldsymbol{lnHHsize}$	1.122	1.110	-0.012	0.33	0.7446
Post primary vocational	0.011	0.013	0.002	0.35	0.7227
Secondary	0.277	0.269	-0.008	0.37	0.7125
College	0.078	0.074	-0.003	0.29	0.7736
University	0.059	0.062	0.003	0.29	0.7702
Other	0.004	0.005	0.001	0.38	0.7026
Head Wage	0.878	0.880	0.002	0.12	0.9039
Number employed	1.747	1.741	-0.006	0.13	0.8986
Age Adults	37.261	37.266	0.005	0.01	0.9925
No. of children under 5	0.553	0.545	-0.008	0.21	0.8321
No. of children over 15	0.177	0.172	-0.005	0.27	0.7890
Age head	42.661	42.615	-0.046	0.07	0.9463
Urban	0.422	0.413	-0.009	0.38	0.7063
Protestant	0.495	0.475	-0.020	0.84	0.4014
Other Christians	0.088	0.087	-0.001	0.07	0.9439
Muslim	0.034	0.034	-0.000	0.03	0.9724
Other religion	0.048	0.050	0.002	0.22	0.8245
Sample size	**4,613**	**769**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A40 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol consumers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Consuming**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Fruits	3.359	3.22	-0.139	0.65	0.514
Adult sex ratio	0.624	0.631	0.008	0.58	0.5632
$\boldsymbol{lnM}$	12.275	12.271	-0.004	0.12	0.9063
$(\boldsymbol{lnM})^2$	151.124	151.033	-0.091	0.11	0.9088
Adult prop	0.68	0.684	0.004	0.32	0.7454
$\boldsymbol{lnHHsize}$	1.122	1.11	-0.012	0.33	0.7446
Post primary vocational	0.011	0.013	0.002	0.35	0.7227
Secondary	0.277	0.269	-0.008	0.37	0.7125
College	0.078	0.074	-0.003	0.29	0.7736
University	0.059	0.062	0.003	0.29	0.7702
Other	0.004	0.005	0.001	0.38	0.7026
Head Wage	0.878	0.88	0.002	0.12	0.9039
Number employed	1.747	1.741	-0.006	0.13	0.8986
Age Adults	37.261	37.266	0.005	0.01	0.9925
No. of children under 5	0.553	0.545	-0.008	0.21	0.8321
No. of children over 15	0.177	0.172	-0.005	0.27	0.789
Age head	42.661	42.615	-0.046	0.07	0.9463
Urban	0.422	0.413	-0.009	0.38	0.7063
Protestant	0.495	0.475	-0.02	0.84	0.4014
Other Christians	0.088	0.087	-0.001	0.07	0.9439
Muslim	0.034	0.034	0	0.03	0.9724
Other religion	0.048	0.05	0.002	0.22	0.8245
Sample size	**4,613**	**769**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for fruits, the largest food and non-food expenditure items.

Table A41 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco purchasers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.05	7.065	-0.985	2.81	0.0050***
Adult sex ratio	0.648	0.655	0.007	0.54	0.5882
$\boldsymbol{lnM}$	12.232	12.222	-0.01	0.31	0.7591
$(\boldsymbol{lnM})^2$	150.004	149.761	-0.243	0.31	0.7588
Adult prop	0.665	0.669	0.004	0.25	0.8029
$\boldsymbol{lnHHsize}$	1.197	1.186	-0.01	0.25	0.8015
Post primary vocational	0.01	0.013	0.003	0.57	0.5679
Secondary	0.254	0.25	-0.004	0.18	0.8606
College	0.054	0.043	-0.011	1.06	0.2913
University	0.01	0.008	-0.003	0.67	0.5038
Other	0.01	0.011	0.001	0.15	0.8773
Head Wage	0.884	0.885	0.001	0.09	0.9293
Number employed	1.899	1.902	0.003	0.06	0.9543
Age Adults	39.032	39.036	0.004	0.01	0.9946
No. of children under 5	0.557	0.543	-0.014	0.34	0.7335
No. of children over 15	0.197	0.199	0.002	0.07	0.9423
Age head	44.807	44.754	-0.053	0.07	0.9422
Urban	0.365	0.364	-0.001	0.04	0.9698
Protestant	0.435	0.423	-0.012	0.46	0.6435
Other Christians	0.086	0.09	0.004	0.29	0.7681
Muslim	0.114	0.121	0.007	0.38	0.7032
Other religion	0.058	0.063	0.005	0.39	0.6956
Sample size	**4,708**	**675**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A42 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco purchasers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	19.754	18.714	-1.04	1.74	0.0826*
Adult sex ratio	0.648	0.655	0.007	0.54	0.5882
$\boldsymbol{lnM}$	12.232	12.222	-0.01	0.31	0.7591
$(\boldsymbol{lnM})^2$	150.004	149.761	-0.243	0.31	0.7588
Adult prop	0.665	0.669	0.004	0.25	0.8029
$\boldsymbol{lnHHsize}$	1.197	1.186	-0.01	0.25	0.8015
Post primary vocational	0.01	0.013	0.003	0.57	0.5679
Secondary	0.254	0.25	-0.004	0.18	0.8606
College	0.054	0.043	-0.011	1.06	0.2913
University	0.01	0.008	-0.003	0.67	0.5038
Other	0.01	0.011	0.001	0.15	0.8773
Head Wage	0.884	0.885	0.001	0.09	0.9293
Number employed	1.899	1.902	0.003	0.06	0.9543
Age Adults	39.032	39.036	0.004	0.01	0.9946
No. of children under 5	0.557	0.543	-0.014	0.34	0.7335
No. of children over 15	0.197	0.199	0.002	0.07	0.9423
Age head	44.807	44.754	-0.053	0.07	0.9422
Urban	0.365	0.364	-0.001	0.04	0.9698
Protestant	0.435	0.423	-0.012	0.46	0.6435
Other Christians	0.086	0.09	0.004	0.29	0.7681
Muslim	0.114	0.121	0.007	0.38	0.7032
Other religion	0.058	0.063	0.005	0.39	0.6956
Sample size	**4,708**	**675**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A43 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol purchasers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.378	6.327	-2.052	5.64	0.0000***
Adult sex ratio	0.63	0.637	0.008	0.56	0.5723
$\boldsymbol{lnM}$	12.269	12.26	-0.009	0.29	0.7696
$(\boldsymbol{lnM})^2$	150.98	150.751	-0.229	0.29	0.7725
Adult prop	0.679	0.683	0.003	0.26	0.7971
$\boldsymbol{lnHHsize}$	1.127	1.116	-0.011	0.3	0.766
Post primary vocational	0.011	0.014	0.002	0.4	0.6914
Secondary	0.281	0.27	-0.01	0.49	0.6244
College	0.076	0.072	-0.004	0.31	0.7531
University	0.059	0.061	0.002	0.21	0.8329
Other	0.004	0.005	0.001	0.35	0.7239
Head Wage	0.877	0.881	0.004	0.25	0.8012
Number employed	1.755	1.75	-0.005	0.1	0.9191
Age Adults	37.226	37.294	0.068	0.12	0.9033
No. of children under 5	0.554	0.548	-0.006	0.17	0.8684
No. of children over 15	0.175	0.17	-0.005	0.27	0.7894
Age head	42.704	42.742	0.037	0.05	0.9567
Urban	0.415	0.404	-0.011	0.47	0.641
Protestant	0.491	0.474	-0.017	0.71	0.4747
Other Christians	0.088	0.087	-0.001	0.06	0.9537
Muslim	0.034	0.034	0	0.01	0.9924
Other religion	0.048	0.051	0.003	0.32	0.7473
Sample size	**4,640**	**742**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A44 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol purchasers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	18.75	16.477	-2.273	4.47	0.0000***
Adult sex ratio	0.63	0.637	0.008	0.56	0.5723
$\boldsymbol{lnM}$	12.269	12.26	-0.009	0.29	0.7696
$(\boldsymbol{lnM})^2$	150.98	150.751	-0.229	0.29	0.7725
Adult prop	0.679	0.683	0.003	0.26	0.7971
$\boldsymbol{lnHHsize}$	1.127	1.116	-0.011	0.3	0.766
Post primary vocational	0.011	0.014	0.002	0.4	0.6914
Secondary	0.281	0.27	-0.01	0.49	0.6244
College	0.076	0.072	-0.004	0.31	0.7531
University	0.059	0.061	0.002	0.21	0.8329
Other	0.004	0.005	0.001	0.35	0.7239
Head Wage	0.877	0.881	0.004	0.25	0.8012
Number employed	1.755	1.75	-0.005	0.1	0.9191
Age Adults	37.226	37.294	0.068	0.12	0.9033
No. of children under 5	0.554	0.548	-0.006	0.17	0.8684
No. of children over 15	0.175	0.17	-0.005	0.27	0.7894
Age head	42.704	42.742	0.037	0.05	0.9567
Urban	0.415	0.404	-0.011	0.47	0.641
Protestant	0.491	0.474	-0.017	0.71	0.4747
Other Christians	0.088	0.087	-0.001	0.06	0.9537
Muslim	0.034	0.034	0	0.01	0.9924
Other religion	0.048	0.051	0.003	0.32	0.7473
Sample size	**4,640**	**742**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A45 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco purchasers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.039	7.071	-0.968	2.76	0.0059***
Adult sex ratio	0.649	0.656	0.007	0.5	0.6137
$\boldsymbol{lnM}$	12.233	12.221	-0.012	0.36	0.7156
$(\boldsymbol{lnM})^2$	150.033	149.745	-0.288	0.36	0.7162
Adult prop	0.666	0.669	0.004	0.25	0.8046
$\boldsymbol{lnHHsize}$	1.198	1.184	-0.014	0.35	0.7297
Post primary vocational	0.01	0.013	0.003	0.57	0.5656
Secondary	0.252	0.25	-0.002	0.08	0.9373
College	0.054	0.043	-0.011	1.03	0.3009
University	0.01	0.008	-0.002	0.53	0.5968
Other	0.01	0.011	0.001	0.15	0.8795
Head Wage	0.884	0.885	0.001	0.08	0.9333
Number employed	1.898	1.898	-0.001	0.01	0.9901
Age Adults	39.01	39.001	-0.009	0.02	0.9879
No. of children under 5	0.558	0.542	-0.017	0.4	0.6881
No. of children over 15	0.197	0.197	-0.001	0.02	0.9811
Age head	44.848	44.754	-0.094	0.13	0.8982
Urban	0.365	0.363	-0.002	0.09	0.9272
Protestant	0.436	0.422	-0.014	0.52	0.6001
Other Christians	0.086	0.091	0.004	0.28	0.776
Muslim	0.115	0.121	0.007	0.37	0.71
Other religion	0.058	0.064	0.005	0.38	0.7015
Sample size	**4,708**	**675**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A46 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Tobacco purchasers 2015-2016 KIHBS)

	Tobacco				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	19.753	18.693	-1.06	1.77	0.0775*
Adult sex ratio	0.649	0.656	0.007	0.5	0.6137
$\boldsymbol{lnM}$	12.233	12.221	-0.012	0.36	0.7156
$(\boldsymbol{lnM})^2$	150.033	149.745	-0.288	0.36	0.7162
Adult prop	0.666	0.669	0.004	0.25	0.8046
$\boldsymbol{lnHHsize}$	1.198	1.184	-0.014	0.35	0.7297
Post primary vocational	0.01	0.013	0.003	0.57	0.5656
Secondary	0.252	0.25	-0.002	0.08	0.9373
College	0.054	0.043	-0.011	1.03	0.3009
University	0.01	0.008	-0.002	0.53	0.5968
Other	0.01	0.011	0.001	0.15	0.8795
Head Wage	0.884	0.885	0.001	0.08	0.9333
Number employed	1.898	1.898	-0.001	0.01	0.9901
Age Adults	39.01	39.001	-0.009	0.02	0.9879
No. of children under 5	0.558	0.542	-0.017	0.4	0.6881
No. of children over 15	0.197	0.197	-0.001	0.02	0.9811
Age head	44.848	44.754	-0.094	0.13	0.8982
Urban	0.365	0.363	-0.002	0.09	0.9272
Protestant	0.436	0.422	-0.014	0.52	0.6001
Other Christians	0.086	0.091	0.004	0.28	0.776
Muslim	0.115	0.121	0.007	0.37	0.71
Other religion	0.058	0.064	0.005	0.38	0.7015
Sample size	**4,708**	**675**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A47 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol purchasers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Energy	8.38	6.322	-2.058	5.66	0.0000***
Adult sex ratio	0.628	0.637	0.009	0.65	0.5159
$\boldsymbol{lnM}$	12.268	12.262	-0.006	0.19	0.8505
$(\boldsymbol{lnM})^2$	150.947	150.801	-0.146	0.18	0.854
Adult prop	0.679	0.683	0.004	0.31	0.7583
$\boldsymbol{lnHHsize}$	1.126	1.114	-0.013	0.34	0.732
Post primary vocational	0.011	0.013	0.002	0.39	0.6948
Secondary	0.281	0.272	-0.009	0.4	0.6872
College	0.076	0.072	-0.004	0.34	0.7306
University	0.059	0.061	0.002	0.21	0.8361
Other	0.004	0.005	0.001	0.36	0.7205
Head Wage	0.877	0.881	0.004	0.28	0.7779
Number employed	1.753	1.748	-0.005	0.11	0.9151
Age Adults	37.221	37.323	0.102	0.18	0.8557
No. of children under 5	0.555	0.547	-0.008	0.2	0.8378
No. of children over 15	0.175	0.17	-0.005	0.29	0.7728
Age head	42.69	42.758	0.068	0.1	0.9213
Urban	0.415	0.406	-0.01	0.41	0.6839
Protestant	0.491	0.474	-0.017	0.73	0.4636
Other Christians	0.088	0.087	-0.001	0.1	0.9209
Muslim	0.035	0.034	0	0.03	0.9782
Other religion	0.048	0.051	0.003	0.31	0.7542
Sample size	**4,640**	**742**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

Table A48 Two-Sample T Test for household characteristics post propensity score matching (PSM) (Alcohol purchasers 2015-2016 KIHBS)

	Alcohol				
Weighted Variable(s)	**Mean Non-consuming**	**Mean Purchasing**	**Difference**	**|t|**	**Pr (|T|>|t|)**
Bread and Cereals	18.761	16.451	-2.31	4.55	0.0000***
Adult sex ratio	0.628	0.637	0.009	0.65	0.5159
$\boldsymbol{lnM}$	12.268	12.262	-0.006	0.19	0.8505
$(\boldsymbol{lnM})^{\mathbf{2}}$	150.947	150.801	-0.146	0.18	0.854
Adult prop	0.679	0.683	0.004	0.31	0.7583
$\boldsymbol{lnHHsize}$	1.126	1.114	-0.013	0.34	0.732
Post primary vocational	0.011	0.013	0.002	0.39	0.6948
Secondary	0.281	0.272	-0.009	0.4	0.6872
College	0.076	0.072	-0.004	0.34	0.7306
University	0.059	0.061	0.002	0.21	0.8361
Other	0.004	0.005	0.001	0.36	0.7205
Head Wage	0.877	0.881	0.004	0.28	0.7779
Number employed	1.753	1.748	-0.005	0.11	0.9151
Age Adults	37.221	37.323	0.102	0.18	0.8557
No. of children under 5	0.555	0.547	-0.008	0.2	0.8378
No. of children over 15	0.175	0.17	-0.005	0.29	0.7728
Age head	42.69	42.758	0.068	0.1	0.9213
Urban	0.415	0.406	-0.01	0.41	0.6839
Protestant	0.491	0.474	-0.017	0.73	0.4637
Other Christians	0.088	0.087	-0.001	0.1	0.9209
Muslim	0.035	0.034	0	0.03	0.9782
Other religion	0.048	0.051	0.003	0.31	0.7542
Sample size	**4,640**	**742**			

Notes: These are the results of the two-sample t-test for the matched households in period zero. *p<0.1, **p<0.05, ***p<0.01. For brevity, I only report results for the largest food and non-food expenditure items.

CHAPTER 3: THE RISK OF CHILD MALNUTRITION AMONG ALCOHOL AND TOBACCO CONSUMING HOUSEHOLDS IN RURAL KENYA

3.1 Introduction

There is an opportunity cost associated with expenditures on tobacco and alcohol. The opportunity cost at the household level is more pronounced in low and middle-income countries (LMICs), where the proportion of poor households is relatively large. Studies have shown that household expenditures that are crowded out by tobacco and alcohol consumption include expenditures on education, clean energy, food, and medical care (John, 2008a; Chelwa and Van Walbeek, 2014; Do and Bautista, 2015; Jumrani and Birthal, 2017).

In some countries such as India, similar expenditures are crowded out by tobacco and alcohol (Jumrani and Birthal, 2017). The previous chapter found that, in Kenya, tobacco and alcohol crowded out expenditure on education, healthcare, energy, rent, and food items. Healthcare expenditure shares were lower only among rural tobacco- and alcohol-consuming households. The prevalence of tobacco consumption among rural households was found to be around five percentage points higher than among urban households. The proportion of households that consumed both tobacco and alcohol was also three percentage points higher in rural Kenya.

A lower expenditure on food and healthcare is likely to have adverse effects on child nutrition. The two immediate causes of childhood malnutrition are low calorie intake and disease. Therefore, the risk of childhood malnutrition may be higher for those children living in households that consume tobacco and alcohol (UNICEF, 1991; Efroymson *et al.* 2001; John, 2008a). This was the motivation behind studies by Semba *et al*. (2007) and Best *et al.* (2007, 2008). The three studies focused on the effect of parental tobacco consumption on child nutrition. They found that children whose parents consumed tobacco were at a higher risk of both short-term and long-term malnutrition.

Data on calorie intake is not usually available. As a result, child anthropometric measurements are usually used in studies on child nutrition outcomes. The height for age z-score (HAZ) and weight for age z-score (WAZ) are used to establish whether a child is stunted or underweight. HAZ is a measure of long-term nutritional status and WAZ of short-term nutritional status (Charmarbagwala *et al.*, 2004).

There are two types of growth standards used to calculate the z-scores: The National Centre for Health Statistics (NCHS) growth reference (referred to as NCHS growth standards) and the 2006 World Health Organization (WHO) growth standards (subsequently referred to

as the WHO growth standards). The NCHS growth standards were developed in 1977 using a predominantly white sample of US infants and children. The WHO growth standards were calculated based on a longitudinal study of children in Brazil, Ghana, India, Norway, Oman, and the USA. The prevalence of malnutrition varies with the growth standards that are used. This is partly because of the different compositions of children included in the reference groups (Griffiths *et al.*, 2004; De Onis *et al*., 2006).

Kenya, like other developing countries, has relatively high levels of both short-term and long-term childhood malnutrition. The WHO (2012) estimated that in 2005-2006, 18.4% of children in Kenya were underweight while 40.9% were stunted. Using WHO growth standards and data from 2008-2009, WHO (2012) concluded that 16.4% of children below the age of five were underweight while 35.2% were stunted. The rate of childhood malnutrition in Kenya was higher in rural areas, where more than 60% of children under the age of five lived.

This chapter uses household survey data from rural Kenyan households to extend the literature on the risk of childhood malnutrition in tobacco-consuming households. Earlier studies on the risk of malnutrition in tobacco-consuming households used the anthropometric measurements of the youngest child in each household and did not explicitly address the observed/unobserved cluster/village level determinants of child nutrition. This study addresses the correlation of nutritional outcomes among children in the same cluster/village that are caused by unobserved environmental and cultural factors. Possible estimates for the availability and use of health facilities in a village, as well as village sanitation are also included.

In 2005-2006, the odds of long-term malnutrition were higher for children living in households that consumed tobacco and alcohol. The prevalence of both long-term and short-term malnutrition among children in rural Kenya declined between 2005-2006 and 2015-2016. Over the same period, tobacco- and alcohol-control policies implemented in Kenya reduced the share of tobacco- and alcohol-consuming households in the bottom quartile. As a result, there was a greater decline in the prevalence of malnutrition among households that consumed tobacco and alcohol. These results provide evidence that tobacco- and alcohol-control policies can be effective in reducing consumption of the two goods among the most vulnerable households.

The rest of this chapter is organised as follows: the relevant literature is reviewed in section 3.2 and, section 3.3 discusses the conceptual framework. Sections 3.4 and 3.5 present the empirical strategy and a description of the data. The results and conclusions are presented in Sections 3.6 and 3.7.

3.2 Relevant literature

Malnutrition among children is most frequently and most immediately caused by insufficient food or disease. In many cases malnutrition is a result of both. A high prevalence of diseases among children may be the result of a lack of sanitary facilities, clean water, adequate child care, and health facilities. Failure to use health facilities regularly and poor food hygiene may also contribute to children getting sick. These underlying causes, which are usually interlinked, can be grouped into three main categories: healthy environment and basic healthcare services, household food security and child care (UNICEF, 1991).

Higher incomes give households the leeway to spend more on food and healthcare. Wealthier households are also able to provide a relatively healthier environment for their children (Charmarbagwala *et al.,* 2004). The positive effect of *per capita* income on child nutrition has been found in studies done on Africa, Asia, Europe and South America. Most studies used *per capita* expenditure or wealth indices as proxies for *per capita* income (Behrman and Wolfe, 1984; Deolalikar, 1996; Webb and Block, 2004; Fedorov and Sahn, 2005). The magnitude of the positive effect of income on nutrition may vary with the source of income. Kirk *et al.* (2017) found that, in rural Uganda, self-employment income had a higher correlation with positive nutritional outcomes for children than income from other sources.

The effect of income on child nutrition may be determined partly by who controls resource allocation in a household. In a comparison of caloric intake among pre-school children in Kenya and Malawi, Kennedy and Peters (1992) found that a larger share of the household budget was allocated to alcoholic drinks in male-headed households. On the other hand, in poorer female-headed households, higher proportions of calories were directed to young children.

Kennedy and Cogill (1987) and Rogers (1996) concluded that children in female-headed households had better nutritional outcomes. However, some studies on sub-Saharan African countries have concluded that female headship did not independently influence child nutrition. In some of the studies that included *per capita* income and household size as explanatory variables, the coefficient for female headship was found to be insignificant. (Charmarbagwala *et al.*, 2004).

In West Africa, the insignificance of household headship could be explained by the prevailing norms that allowed women to have some control over resource allocation and decision-making in male-headed households. Thus, the distinction between male- and female-

headed households in terms of resource allocation becomes blurred, compared to a social structure where women have no say in the allocation of resources when the household is headed by a man. Female-headed households tend to have a different composition of household members. Therefore, to determine the effect of female headship, household composition should also be considered (Staten *et al.,* 1998; Charmarbagwala *et al*., 2004).

The composition of households may determine the effect of household size on child nutrition. Larger households, where most members are children, tend to have a higher prevalence of malnutrition among the children, because of competition for resources. The effect of household size on child nutrition tends to be positive in households where many of the members are able-bodied and of working age (Charmarbagwala *et al.,* 2004; Kismul *et al.,* 2015; Liu et *al.,* 2015). However, by considering wealth status and nucleation, Annim *et al.* (2015) concluded that in Ghana, a high dependency ratio did not translate into adverse health outcomes for children under the age of five.

The characteristics of the adults in a household may determine their effect on child nutrition. The ability of the adults to earn income and to use available information to offer better childcare may be influenced by factors such as their educational attainment (White and Masset, 2004). The educational attainment of the extended family members or community may also influence child nutrition. After controlling for paternal and maternal educational levels, Moestue and Huttly (2008) found that community-level maternal education had a positive effect on child nutrition in Vietnam. In India, where households are made up of extended family members, the educational levels of grandmothers had a positive effect on child nutrition.

In some countries the educational level of both parents has been found to affect child nutrition independently. Some studies that consider paternal education have found that it had a positive effect on child nutrition (Webb and Block, 2004; Aslam and Kingdon, 2012). The positive effect of maternal education on child nutrition was greater than that of the father in most studies. The effect of maternal education may have been greater because mothers were the primary care givers for young children in most countries (Charmarbagwala *et al.,* 2004; Jeong *et al.,* 2018).

Some studies have concluded that literacy or primary education was enough for improved child nutrition. However, others have argued that at least post-primary education was necessary for improved nutritional outcomes. The level of education necessary for improved child nutrition may vary between countries, based on the prevailing quality and nature of the education system (Charmarbagwala *et al*., 2004; Burchi, 2010; Hasan *et al.,* 2016).

The mother's age or experience has also been found to influence child nutrition. Children cared for by relatively older mothers were less likely to be malnourished. Most authors, including Deolalikar (1996) and Kabubo-Mariara *et al.* (2008), found that mother's age was negatively correlated with malnutrition.

Malnutrition among children has also been linked to the environment in which they are raised. Some of the underlying causes of malnutrition were exacerbated by poor sanitation and the lack of a clean water supply. The type of toilet and source of drinking water have been found to be significant determinants of child nutritional outcomes (Grace *et al.*, 2012; Masibo and Makoka, 2012; Imai *et al.*, 2014). However, some studies have found that household level water and sanitation indicators were not significant determinants of child nutritional status. Through the 1980s and 1990s the effect of sanitation on nutritional outcomes was greater than access to clean water (Charmarbagwala *et al.*, 2004; Silva, 2005).

There may be spill-over effects associated with sanitation and access to clean water. Poor sanitation in a household may not only affect the health of the children within that household but also of other children in the village or neighbourhood. The inclusion of cluster-level variables on sanitation, water source, and other determinants of child nutrition may be used to account for some spill-over effects. The significance of community-level measures for access to clean water and sanitation varies between countries and regions. Whereas Silva (2005) found that they were significant, Kabubo-Mariara *et al.* (2008) concluded that they were insignificant.

The availability and use of health care facilities in a community may also influence child nutrition. Past studies have used immunization, the type of birth attendant, the estimated distance to a health facility, and where the child was delivered as some of the measures for availability and use of health facilities. The significance of these measures on child nutrition varies across studies (Charmarbagwala *et al.*, 2004; Webb and Block, 2004; Kabubo-Mariara *et al.*, 2008).

Community-level determinants of child nutrition may be captured by the inclusion of cluster fixed effects in the estimation equation. However, some studies have used multilevel linear or logistic regressions to account for the hierarchical nature of the data. Individual children of interest are nested within households, which are nested within clusters or neighbourhoods, which may also be nested within regions. Multilevel regression accounts for the possible correlation of nutrition outcomes between children in a family, cluster or region. Unlike the fixed effects regressions, the effect of cluster-level determinants of child nutritional

outcomes can also be estimated *(*Griffiths *et al., 2004;* Moestue and Huttly, *2008;* Kanjilal *et al.,* 2010). In addition to village/neighbourhood factors and household characteristics, the individual attributes of a child may also affect his/her nutritional outcomes.

A Child's sex is one of the child specific characteristics that is included in most studies on child nutrition. The significance of the child's sex in studies on nutrition varies across regions. Whereas, sex was found to be insignificant in most studies done on Latin America, it was found to be significant in most of the studies done on countries in East and Southern Africa (ESA) (Charmarbagwala *et al.,* 2004).

Contrary to *a priori* expectations, many studies in ESA found that boys were less well-nourished than girls. A possible explanation for this finding, is the female resilience hypothesis, which suggests that girls fare better in adverse living conditions (Charmarbagwala *et al.,* 2004; Burchi, 2010). Another child characteristic that influences nutritional outcomes is the child's age. Most studies done on Asia and Africa have found that the odds of being malnourished increased at a decreasing rate with the infant's age (Deolalikar, 1996; Griffiths *et al.,* 2004; Kabubo-Mariara *et al.,* 2008; Kanjilal *et al.,* 2010).

The conclusions drawn from the determinants of childhood malnutrition discussed above have been confirmed by the (relatively fewer) studies that used panel data. Apart from confirming causality, panel data studies have been able to explain the lagged effects of some of the causes of childhood malnutrition. Panel data studies have also provided information on the long-term effects of malnutrition in a child's life. Some studies have found that malnourished children partially catch up over time. This means that their height and weight deficit was partially, but not fully, reduced over time. In the long run, better-nourished children had better learning productivity per year and performed better in school (Senauer and Garcia, 1991; Glewwe *et al.,* 2001; Fedorov and Sahn, 2005; Burchi, 2010; Kirk *et al.,* 2017).

In some countries, tobacco-consuming households spend less on food and healthcare. This led to studies on whether parental tobacco consumption had an adverse effect on childhood nutrition in Bangladesh and Indonesia. These studies used the anthropometric measurements of the youngest child in each household to construct the dependent variable. They found that parental tobacco consumption increased the odds of malnutrition by between 3% and 17% (Semba *et al.,* 2007; Best *et al.,* 2007, 2008). Similarly, Block and Webb, (2009) using three structural equations and data from Indonesia, concluded that tobacco use indirectly contributed to reduced nutritional status for children.

3.2.1 Contribution to the literature

The research on the effect of tobacco on household spending patterns has evolved over the last decade. Based on the consumption patterns of tobacco and alcohol, some recent studies have established that the two goods crowd out expenditures on basic needs. Chapter 2 of the present study found that, in rural Kenya, tobacco- and alcohol-consuming households had lower expenditure on education, food items and healthcare.

A lower share of household expenditure on food and healthcare may be linked to a higher risk of childhood malnutrition. This chapter seeks to extend the literature on the risk of child malnutrition among tobacco consuming households. Household survey data is used to establish whether tobacco and alcohol consumption adversely affected child nutritional outcomes in rural Kenya.

The few studies done on effect of tobacco use on child nutritional outcomes were done on relatively more developed countries in Asia. Further, they focused on the youngest child in each household and did not explicitly control for observed and unobserved cluster/neighbourhood effects. This chapter includes all the children between the age of six months and five years in each household. Multilevel logit regression is used to account for the possibility of correlation in nutritional outcomes between children living in the same cluster/village. The use of the multilevel model accommodates the inclusion of contextual effects in the estimated model.

Contextual effects refer to the effects of cluster-level variables on a child's nutritional outcomes. The inclusion of cluster-level variables on sanitation, access to water, and access to healthcare facilities may provide information on public health interventions that could improve child nutritional outcomes in rural Kenya. To check robustness, logit with cluster fixed effects and General Estimation Equations logit models are also estimated. Two household surveys that are ten years apart are used to investigate whether tobacco- and alcohol-control policies, reduced prevalence of the consumption of tobacco and alcohol among households that are more likely to have malnourished children.

3.3 Conceptual Framework

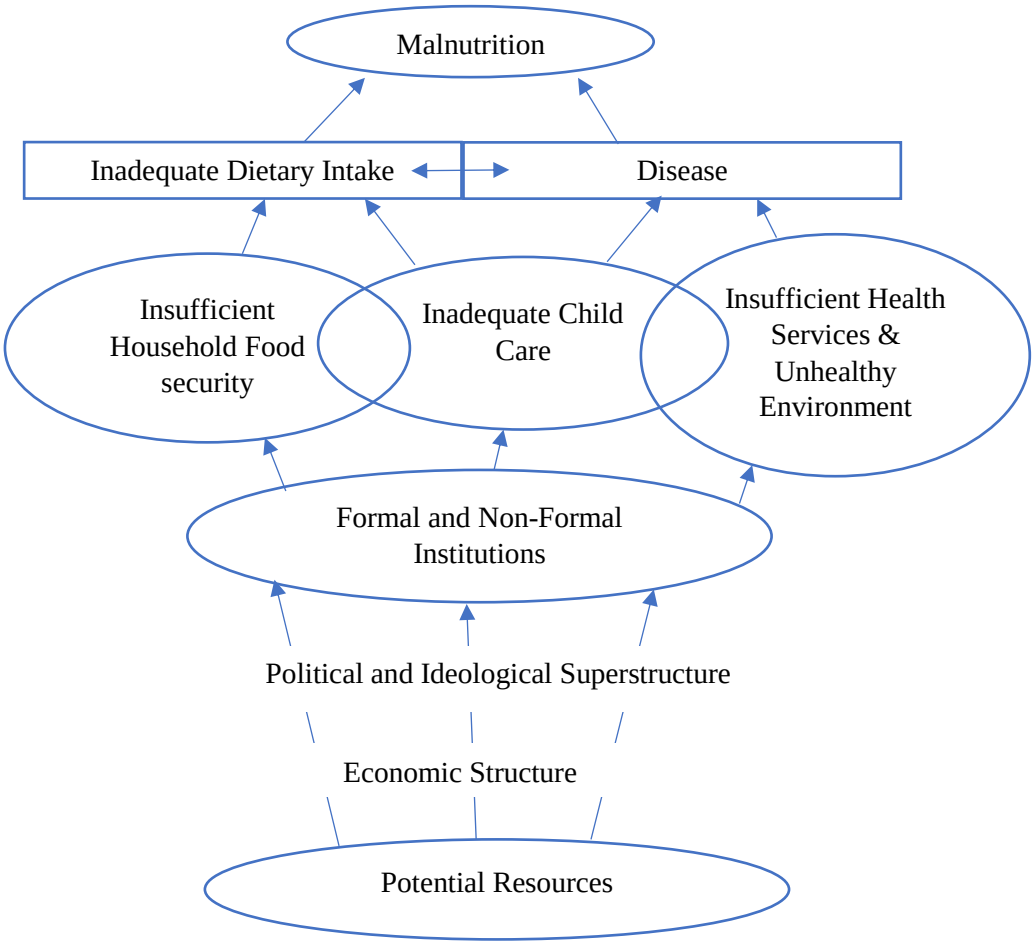
Figure 3.1 presents a summary of the United Nations International Children's Fund (UNICEF) framework for the causes of malnutrition in children (UNICEF, 1991). The immediate cause of child malnutrition is usually a combination of disease and insufficient food. The capacity of households to produce or acquire food influences the caloric intake of children

that have been weaned. The dietary intake of younger children is linked to the adequacy of breastfeeding.

The quality of child care influences both the dietary intake and disease prevalence among children. The availability and use of healthcare services reduces the likelihood of children suffering from diseases. Disease prevalence is also linked to the child's environment. The type and quality of water and sanitation services that a household uses influences both the quality of food consumed and the health status of children.

The underlying causes of malnutrition are linked to wider societal and systemic factors that may be described as the basic causes of malnutrition. These factors include the economic and political structures in each jurisdiction, which determine what is produced and how it is distributed. Formal institutions, such as governments, and informal institutions such as extended families or households, are the interface between the immediate causes and the underlying causes of malnutrition.

Figure 3.1 Causes of malnutrition



The model which formally presents the possible causes of malnutrition has its roots in the analysis by Becker (1981). In this model, time and goods are classified as inputs. These inputs are used to produce commodities which provide utility for household members. The commodities are produced and consumed using own time, purchases from the market, and environmental inputs. The commodities include such things as health, status, pleasures of the senses, and prestige. Utility can be written as:

$$U = U(Z_1, Z_2, \dots Z_m) \quad (3.1)$$

Z_i, represents the various commodities consumed in a household. Each commodity is self-produced as follows:

$$Z_i = f\left(g_i, t_{h_i}; E_i\right) \qquad i = 1,2, \dots m \quad (3.2)$$

Where, $g_i \; and \; t_{h_i}$ are the goods and time used to produce commodity i. Time t is the total time available in a period e.g. 24 hours in a day. Time is split into t_w , time spent working in the market place, for which income is received, and t_h , time spent on other activities, such as sleeping, eating, recreation etc. The utility function above can be generalized to distinguish consumption at different ages:

$$U = U(Z_1, Z_2, \dots Z_n) \quad (3.3)$$

Where Z_n is the aggregate consumption at age n. The evolution of the stock of human capital is presented in equation (3.4).

$$H_j = H_{j-1}(1 - d) + Q_{j-1} \quad (3.4)$$

Where H_j, is the stock at age j, d is the depreciation rate and Q_{j-1} is the gross investment at age $j - 1$. Equation (3.5) shows how the gross investment in period $j - 1$ is produced, $g_q \; and \; t_q$ are the goods and time spent on investment.

$$Q_{j-1} = Q\left(g_{q_{j-1}}, t_{q_{j-1}}; \; H_{j-1}\right) \quad (3.5)$$

The model by Becker (1981) has been adapted for the analysis of childhood nutrition. The adaptation provided below is from Charmarbagwala *et al.* (2004). The household's utility maximization function can be presented as follows;

$$U = U\{NF_{it}, L_{it}, H_{it}[N(F_{it}, \dots), HEXP_{it}, HTIME_{it} \dots]\} \quad (3.6)$$

NF represents the consumption of non-health and non-food items by person i at time t. The time subscript can be dropped with no loss in generality. L is leisure, H is the health status, N is the nutrition status and F is the food consumption. $HEXP$ is the amount spent on healthcare for individual i and $HTIME$ is the time other household members devote to the healthcare of

individual i. The determinants of a child's health status are presented in equation (3.7) and equation (3.8).

$$H = H[(H_{t-1}, N, HEXP(Y, PH, C, ACESS), HTIME(C, PED), ENV, PED \dots] \quad (3.7)$$

$$N = H[F(Y, PF, \dots), N_{t-1}, H, C, PED \dots] \quad (3.8)$$

H_{t-1} is health status in the previous period, Y is the household income *per capita*, PH is the price of health services and products, PF is the price of food and C is a vector of each child's characteristics. $ACESS$ is a measure of availability of health services, PED is parental education and ENV is a vector of environmental risk factors such as pollution and availability of clean drinking water. From equation (3.7) and equation (3.8), the determinants of the health and nutritional status of children can be presented as follows:

$$H \; and \; N = F(H_{t-1}, N_{t-1}, Y, PH, PF, C, ACESS, PED, ENV) \quad (3.9)$$

3.4 Empirical Strategy

Data on caloric intake is not usually available, as a result, anthropometric measurements are used instead in most studies on child malnutrition. The measures that are commonly used include height for age, weight for age, and height for weight. The height and weight measures for children under five years are first converted into z-scores. Z-scores are used to measure how many standard deviations a child's measurements are away from the mean. Those children who have a z-score of less than -2 for their height for age, weight for age, and height for weight are classified as stunted, underweight and wasted respectively (Charmarbagwala *et al.*, 2004).

After calculation of the z-scores, children are grouped by the tobacco and alcohol consumption status of their parents or guardians. Households are classified as tobacco-consuming, alcohol-consuming or both tobacco- and alcohol-consuming households based on budget and consumption data from the household survey diaries. The t-test for difference in means is used to determine whether there is a difference in the proportion of underweight and stunted children between consuming and non-consuming households.

The difference in the prevalence of malnutrition may be the result of other factors, as discussed earlier. Logistic regressions are used to estimate whether the odds of a child being malnourished differed with the tobacco/alcohol consumption status of a household. Three different logistic models are estimated.

The first model, equation (3.10) is a logistic regression with child, household characteristics, and cluster fixed effects. The cluster fixed effects term is used to control for the village-level factors that may affect child nutritional outcomes. y_{ijk} is the nutrition status of

child i in household j in cluster k. y_{ijk} is assigned a value of one if the child is underweight or stunted and zero otherwise. $\boldsymbol{x}$ represents the observed characteristics of the child and the household in which a child lives. e_{ijk} is the error term and f_k is the cluster specific fixed effects.

$$y_{ijk} = \beta_0 + \beta' \boldsymbol{x}_{ijk} + \beta' \boldsymbol{x}_{jk} + f_k + e_{ijk} \quad (3.10)$$

The second model is a multilevel logit model. The multilevel model allows for correlation of nutritional outcomes for children living in the same cluster/village. The model also includes contextual (cluster level averages) variables for sanitation/environmental factors as well as availability and use of healthcare facilities. The estimated multilevel logit model which is adapted from Steele, (2009) is presented below:

$$y_{ijk} = \beta_0 + \beta' \boldsymbol{x}_{ijk} + \beta' \boldsymbol{x}_{jk} + \beta' \boldsymbol{x}_k + v_k + u_{jk} + e_{ijk} \quad (3.11)$$

y_{ijk} is the nutrition status of child i in household j in cluster k. y_{ijk} is assigned a value of one if the child is underweight or stunted and zero otherwise. $\boldsymbol{x}$ represents the observed characteristics of the child, the household and the cluster/village in which a child lives. The model can have three levels: level one (individual), level two (household) and level three (cluster). $v_k, u_{jk}, and\ e_{ijk}$ are the level three, level two and level one residuals respectively. The residuals are assumed to have a mean of zero and a variance of δ_v^2 , $\delta_u^2, and\ \delta_e^2$. The model can be expressed in terms of expected value:

$$E\left[y_{ijk} \mid x, v_k, u_{jk} \right] = \pi_{ijk} \quad (3.12)$$

π_{ijk} is the probability that y is equal to one. The generalized linear random intercept model is presented in equation (3.13). In a logit model which is presented in equation (3.14) $F^{-1}\left(\pi_{ijk} \right)$ is the log odds that $y = 1$.

$$F^{-1}\left(\pi_{ijk}\right) = \beta_0 + \beta' x_{ijk} + \beta' x_{jk} + \beta' x_k + v_k + u_{jk} \quad (3.13)$$

$$\log\left(\frac{\pi_{ijk}}{1 - \pi_{ijk}}\right) = \beta_0 + \beta' x_{ijk} + \beta' x_{jk} + \beta' x_k + v_k + u_{jk} \quad (3.14)$$

A Generalized Estimation Equations (GEE) logit model (model 3) is also estimated. GEE focuses on the within-cluster similarity of residuals. It uses the estimated correlation within a cluster to estimate parameters and standard errors. GEE models are better than multilevel models when there are many clusters with few individuals, because computational complexity is a function of the largest cluster. GEE provides unbiased parameter estimates and their standard errors even when the number per cluster is as low as two, if there are many clusters (Hanley *et al.,* 2003; McNeish, 2014). GEE is therefore used as a robustness check,

because multilevel models tend to overestimate between cluster variance components when there are few observations per cluster.

3.5 Description of the Data

The data for the study was obtained from the two most recent Kenya Integrated Budget and Household Budget Surveys (KIHBS). The KIHBSs were national surveys carried out in 2005-2006 and 2015-2016 by the Kenya National Bureau of Statistics (KNBS). One objective of the surveys was to obtain data that could be used to monitor the implementation of development initiatives in Kenya.

The 2005-2006 KIHBS consisted of 13,158 households drawn from urban and rural areas in each of Kenya's 69 districts. The sampling design used by KNBS ensured that both rural and urban subsamples were representative. The total number of rural households in the survey was 8,475. As part of the two surveys, anthropometric measurements for all children who were aged between six months and five years were collected.

This chapter focuses on rural households that had children aged between six months and five years old. A summary of the household descriptive statistics is presented in Table 3.1. 73% of children in this age range resided in rural households. This study categorized children according to the tobacco/alcohol consumption status of the household in which they lived. 19.3% of the 4,290 households that had children between six months and five years, consumed tobacco, and 12.9% consumed alcohol. 13.0% of households consumed only tobacco, 6.7% consumed only alcohol and 6.3% consumed both alcohol and tobacco.

Table 3.1 Characteristics of rural households with children aged between six months and five years (2005-2006 KIHBS)

		Tobacco only		Alcohol only		Alcohol & Tobacco	
Statistic	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Number of households	4,290	3,464	826	3,735	555	3,177	268
Percentage of tobacco consuming households	19.25%	0.00%	100%	14.94%	48.29%	0.00%	100%
Percentage of alcohol consuming households	12.94%	8.29%	32.45%	0.00%	100%	0.00%	100%
Average monthly tobacco expenditure (in USD)[13]	0.63	0.00	3.26	3.10	3.58	0.00	3.59
Average monthly alcohol expenditure (in USD)	1.39	10.74	10.72	0.00	10.73	0.00	10.72
Average monthly household expenditure[14] (in USD)	129.46	131.78	119.75	127.58	142.12	130.59	139.13
Average household size	6.68	6.58	7.11	6.61	7.17	6.55	7.37
Share where most educated member has at least 5 years of education	87.44%	88.87%	81.09%	86.88%	91.12%	88.50%	89.29%
Average number of employed HH members	1.09	1.06	1.21	1.07	1.19	1.06	1.29
Average number of children below 15 years	3.54	3.51	3.66	3.50	3.76	3.49	3.81
Average number of children below 5 years	1.54	1.54	1.57	1.54	1.61	1.53	1.62
Share of male headed households	74.48%	72.81%	81.48%	72.29%	88.19%	71.55%	91.79%
Average distance to water source[15] (minutes)	19.01	18.17	22.48	19.02	18.89	17.95	18.03
Share of households with pit latrine or flush toilet	67.33%	70.25%	55.16%	67.39%	66.91%	70.29%	63.91%

Note: Data from the 2005/2006 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these sample statistics.

The 2015-2016 KIHBS contained 21,773 households. The households were sampled from the urban and rural areas of each of Kenya's 47 counties. The total number of rural households was 13,092. The descriptive statistics of rural households with children between six months and five years in the 2015-2016 KIHBS are presented in Table 3.2. There were 5,717 households with children in the relevant age range. 11.5% of the 5,717 households consumed tobacco while, 13.4% consumed alcohol. 7.1% consumed only tobacco, 8.9% consumed only alcohol and 4.5% consumed both tobacco and alcohol.

[13] Converted to USD using end of period exchange rate (December 2005) reported by the Central Bank of Kenya. Exchange rate was 72.36 KSH to 1 USD.

[14] Generated by adding up relevant household expenditures.

[15] Distance measured in average time in minutes it took to walk (one way) to the main water source from the dwelling. For those with piped water the distance is zero.

Table 3.2 Characteristics of rural households with children aged between six months and five years (2015-2016 KIHBS)

		Tobacco only		Alcohol only		Alcohol & Tobacco	
Statistic	**Full Sample**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**	**Non-Consumers**	**Consumers**
Number of households	5,717	5,057	660	4,949	768	4,545	257
Percentage of tobacco consuming households	11.54%	0.00%	100%	8.14%	33.46%	0.00%	100%
Percentage of alcohol consuming households	13.43%	10.10%	38.94%	0.00%	100%	0.00%	100%
Average monthly tobacco expenditure (in USD)[16]	0.57	0.00	4.90	4.89	4.92	0.00	4.92
Average monthly alcohol expenditure (in USD)	2.39	17.65	18.11	0.00	17.80	0.00	18.11
Average monthly household expenditure[17] (in USD)	176.48	174.78	189.46	172.51	202.02	167.28	216.27
Average household size	5.91	5.86	6.25	5.87	6.14	5.84	6.31
Share where most educated member has at least 5 years of education	86.66%	87.62%	79.03	86.46%	87.91%	87.36%	84.33%
Average number of employed HH members	1.77	1.73	2.01	1.73	1.98	1.71	2.11
Average number of children below 15 years	3.30	3.29	3.44	3.29	3.38	3.23	3.47
Average number of children below 5 years	1.67	1.65	1.76	1.67	1.65	1.66	1.70
Share of male headed households	70.18%	69.17%	77.88%	68.07%	83.72%	67.55%	84.05%
Average distance to water source[18] (minutes)	29.87	29.44	33.17	29.55	31.96	29.23	33.25
Share of households with pit latrine or flush toilet	72.57%	74.37%	58.73%	72.25%	74.58%	73.95%	67.70%

Note: Data from the 2015/2016 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these sample statistics.

The prevalence of tobacco use among rural households declined between 2005-2006 and 2015-2016. Over the ten-year period the proportion of tobacco-consuming households in rural Kenya declined from 18.0% to 12.7%. The proportion of households that consumed both tobacco and alcohol also decreased, from 6.8% to 5.6%. However, the proportion of alcohol-consuming households increased from 13.6% to 14.8%.

Tobacco-control policies, such as periodic increases in the real tax on cigarettes, particularly in the first half of the decade under review, may have contributed to a reduction in the prevalence of tobacco consumption. Another major tobacco-control initiative during that period was the implementation of the Tobacco Control Act (2007). Tobacco-control policies were most effective in reducing consumption among the poorest rural households. Similarly, the implementation of Alcohol Control Act (2010), as well as periodic increases in real alcohol

[16] Converted to USD using end of period exchange rate (December 2015) reported by the Central Bank of Kenya. Exchange rate was 102.31 KSH to 1 USD.

[17] Differs from what is reported by KNBS. KNBS total household expenditure only included categories necessary for calculation of poverty rates.

[18] Distance measured in average time in minutes it took to walk (both ways) to the main water source from the dwelling. For those with piped water the distance is zero.

taxes, may have contributed to a decline in the proportion of poorest rural households that consumed alcohol.

Table 3.3 presents the share of tobacco/alcohol-consuming rural households in each quartile. The quartiles were based on the *per capita* household expenditures. The share of tobacco-consuming households among the bottom 25% of rural households, reduced from 21.2% in 2005-2006 to 10.9% in 2015-2016. Over the same period, the share of tobacco-consuming households in the top quartile remained constant at around 16%. Among the bottom 25% of rural households, those that consumed both tobacco and alcohol reduced from 6.6% to 3.3%.

Table 3.3 Shares of rural tobacco/alcohol consuming households in each quartile

	2005-2006 KIHBS			2015-2016 KIHBS		
	Tobacco	**Alcohol**	**Alcohol & Tobacco**	**Tobacco**	**Alcohol**	**Alcohol & Tobacco**
Quartile 4	15.72%	15.59%	7.45%	16.11%	20.97%	8.53%
Quartile 3	17..86%	12.36%	6.31%	12.34%	14.84%	6.20%
Quartile 2	17.76%	13.15%	6.63%	10.97%	11.61%	3.72%
Quartile 1	21.20%	12.91%	6.58%	10.87%	10.56%	3.33%
Full Sample	17.95%	13.58%	6.77%	12.71%	14.77%	5.59%
Sample Size	**1,693**	**1,161**	**586**	**1,774**	**1,883**	**730**

Notes: These statistics were generated from the Kenya Integrated Household and Budget Surveys (KIHBS). They are the shares of households that consumed tobacco/alcohol in rural Kenya. 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.

The summary of the characteristics of the children, aged between six months and five years, living in rural households in 2005-2006 is presented in Table 3.4. The total number of children in this age range from the 2005-2006 KIHBS was 6,300. 19.5% of these children lived in tobacco consuming households, while 13.4% lived in alcohol consuming households. 6.4% of these children lived in households that consumed both alcohol and tobacco.

The 2006 WHO growth standards were used to calculate the z-scores for height for age (HAZ), weight for age (WAZ) and weight for height (WHZ). Those children whose HAZ, WAZ, and WHZ were less than -2 were classified as stunted, underweight and wasted respectively. 22% of the children were underweight, while 43% were classified as stunted. The prevalence of both short-term and long-term malnutrition was higher for households that consumed tobacco or alcohol.

The prevalence of malnutrition reported in this chapter is higher than was reported by some of the earlier studies. Studies that used the NCHS growth reference developed in 1977, reported lower rates of malnutrition. Other studies such as De Onis *et al.* (2006) and Best *et al*. (2007) have found that when the NCHS and the WHO growth standards were applied to the same sample, the prevalence of malnutrition was higher for the later growth standards.

The estimates on the prevalence of malnutrition are therefore more comparable to studies that used the WHO growth standards. WHO (2012) estimated that in 2005-2006 about 41% of children in Kenya were stunted and 18% were underweight. They subsequently used the WHO growth standards on data from Kenya, which was collected in 2008-2009. They found that the share of underweight children in rural Kenya was 17.6% while the share of stunted children was 37.1%. The prevalence of malnutrition in urban Kenya was significantly lower. In 2008-2009, 11% of children in urban areas were underweight while 26% were stunted.

Table 3.4 Characteristics of children aged between six months and five years living in rural households (2005-2006 KIHBS)

		Tobacco only		**Alcohol only**		**Alcohol & Tobacco**	
Statistics	Full Sample	Non-Consumers	Consumers	Non-Consumers	Consumers	Non-Consumers	Consumers
Number of Children	6,300	5,074	1,226	5,456	844	4,632	402
Boys	50.35%	50.71%	48.86%	50.62%	48.58%	50.56%	44.53%
Girls	49.65%	49.29%	51.14%	49.38%	51.42%	49.44%	55.47%
Age in Months							
6 to 12	5.89%	6.21%	4.57%	5.85%	6.16%	6.07%	4.48%
13 to 24	24.16%	23.87%	25.37%	23.88%	25.92%	23.64%	25.62%
25 to 36	22.40%	22.53%	21.86%	22.75%	20.14%	22.86%	21.39%
37 to 48	24.83%	24.64%	25.61%	24.73%	25.47%	24.74%	27.61%
49 to 60	22.73%	22.76%	22.59%	22.80%	22.27%	22.69%	20.90%
No. of children per HH	1.5	1.5	1.5	1.5	1.5	1.5	1.5
No. children per cluster	7.4	6.0	2.8	6.4	2.4	5.5	1.9
Average number of months breastfed	16.74	16.59	17.35	16.70	17.01	16.56	17.12
Share delivered in health facility	30.28%	32.29%	22.07%	30.92%	26.02%	32.81%	25.27%
Share with vaccination cards	90.52%	90.79%	89.42%	90.36%	91.59%	90.62%	90.48%
Share with BCG scar	85.34%	85.28%	85.58%	85.15%	86.57%	84.95%	84.13%
Child Malnutrition[19]							
Underweight	21.47%	20.42%	25.78%	21.50%	21.28%	20.54%	23.49%
Stunted	43.02%	42.70%	44.32%	42.69%	45.28%	42.79%	48.88%
Wasted	8.39%	8.24%	9.00%	8.79%	5.75%	8.39%	5.05%
Average age of mothers at birth							
Below 18	2.43%	2.25%	3.17%	2.47%	2.16%	2.30%	2.66%
19 to 24	25.00%	25.21%	24.12%	25.21%	23.66%	25.36%	23.67%
25 to 30	32.36%	33.06%	29.49%	32.47%	31.68%	32.70%	26.06%
31 and above	40.21%	39.47%	43.22%	39.85%	42.49%	39.63%	47.61%

Notes: Data from the 2005/2006 Kenya Integrated Household and Budget Survey was used to generate these statistics. A child was considered stunted, underweight or wasted if their height for age, weight for age and weight for height z-score was less than negative two.

The descriptive statistics from the 2015-2016 KIHBS for children between the age of six months and five years are presented in Table 3.5. 11.8% of the 7,804 children in this age range lived in tobacco consuming households while 13.4% lived in alcohol-consuming

[19] Based on the World Health Organization (WHO) 2006 growth standards.

households. 4.5% lived in households that consumed both tobacco and alcohol. In 2015-2016, over 60% of the children in this age group resided in rural areas.

There was a significant decline in the percentage of malnourished children between 2005-2006 and 2015-2016. In the KIHBS 2015-2016, 18% of children (aged between six months and five years) in rural households were underweight and 30.8% were stunted. After accounting for the sampling design, it was evident that, over the ten-year period, the proportion of underweight children had declined by around 5 percentage points, while the proportion of stunted children declined by around 14 percentage points.

Table 3.5 Characteristics of children aged between six months and five years living in rural households (2015-2016 KIHBS)

		Tobacco only		**Alcohol only**		**Alcohol & Tobacco**	
Statistics	Full Sample	Non-Consumers	Consumers	Non-Consumers	Consumers	Non-Consumers	Consumers
Number of Children	7,804	6,881	923	6,758	1,046	6,185	351
Boys	51.32%	51.56%	49.51%	51.51%	50.10%	51.59%	47.58%
Girls	48.68%	48.44%	50.49%	48.49%	49.90%	48.41%	52.42%
Age in Months							
6 to 12	12.61%	12.67%	12.13%	12.65%	12.33%	12.72%	12.54%
13 to 24	21.89%	21.81%	22.43%	22.20%	19.89%	22.05%	20.23%
25 to 36	23.35%	23.41%	22.86%	23.53%	22.18%	23.46%	20.51%
37 to 48	22.80%	22.71%	23.40%	22.61%	24.00%	22.55%	25.64%
49 to 60	19.36%	19.39%	19.19%	19.01%	21.61%	19.11%	21.08%
No. of children per HH	1.4	1.4	1.4	1.4	1.4	1.4	1.4
No. children per cluster	5.7	5.1	2.2	5.0	2.0	4.7	1.7
Av. number of months breastfed	18.72	18.69	19.00	18.82	18.06	18.78	18.52
Av. number of months breastfed[20]	5.10	5.08	5.24	5.14	4.86	5.11	4.95
Share delivered in health facility	51.06%	52.04	43.74	51.05	51.12	52.06%	49.71%
Share with vaccination cards	90.64%	90.77%	89.67%	90.54%	91.30%	90.75%	91.91%
Share with diarrhoea in the past weeks	8.00%	7.53%	11.53%	7.41%	11.80%	7.15%	13.95%
Child Malnutrition[21]							
Underweight	17.95%	17.69%	19.93%	18.14%	16.75%	17.92%	18.79%
Stunted	30.78%	30.60%	32.09%	30.42%	32.78%	30.45%	44.65%
Wasted	9.53%	8.87%	14.41%	9.69%	8.53%	9.11%	11.91%
Average age of mothers at birth							
Below 18	2.46%	2.46%	2.46%	2.39%	2.89%	2.34%	1.65%
19 to 24	23.13%	23.54%	19.93%	223.05%	23.66%	23.38%	20.79%
25 to 30	34.05%	34.49%	30.63%	34.47%	31.26%	34.74%	29.37%
31 and above	40.36%	39.51%	46.99%	40.09%	42.18%	39.54%	48.18%

Notes: Data from the 2015/2016 Kenya Integrated Household and Budget Survey was used to generate these sample statistics. A child was considered stunted, underweight or wasted if their height for age, weight for age and weight for height z-score was less than negative two.

[20] Average number of months the children were exclusively breastfed.

[21] Based on the World Health Organization (WHO) 2006 growth standards.

3.6 Empirical results

The empirical analysis focuses on stunting and weight for age as indicators of malnutrition. Stunting is a measure of the long-term nutritional status of children while weight for age is a short-term measure. The proportions of stunted and underweight children are presented in Table 3.6 and Table 3.7. In 2005/2006, the prevalence of short-term malnutrition was significantly higher among tobacco-consuming households, while the prevalence of long-term malnutrition was significantly higher in households that consumed both tobacco and alcohol.

Between 2005-2006 and 2015-2016, the prevalence of both short-term and long-term malnutrition declined significantly among all households. Tobacco- and alcohol-control policies implemented in Kenya were most effective in reducing tobacco and alcohol consumption prevalence among the poorest households. This may explain why there was a larger decline in malnutrition rates for households that consumed tobacco and alcohol. By 2015-2016, the difference in malnutrition rates between alcohol/tobacco consuming households and those that did not consume the two goods was statistically insignificant. These results do not account for the other determinants of childhood malnutrition discussed in the previous sections.

Table 3.6 Share of underweight and stunted children grouped by tobacco (alcohol) consumption status of households (2005-2006 KIHBS)

		Underweight (%)	Stunted (%)
Tobacco			
	Consumers	25.78	44.32
	Non-consumers	20.42	42.70
	Difference	5.36***	1.62
		(1.505)	(1.786)
Alcohol			
	Consumers	21.28	45.28
	Non-consumers	21.50	42.69
	Difference	-0.22	2.59
		(1.698)	(2.134)
Alcohol & tobacco			
	Consumers	23.49	48.88
	Non-consumers	20.54	42.79
	Difference	2.95	6.09**
		(2.321)	(2.949)

Notes: The statistics are the share of children that are underweight (stunted) in households where parent/guardian consumed tobacco/alcohol and those households where parent/guardian did not consume the two goods. Positive difference indicated that the share of underweighted (stunted) children was higher in tobacco/alcohol consuming households. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Table 3.7 Share of underweight and stunted children grouped by tobacco (alcohol) consumption status of households (2015-2016 KIHBS)

		Underweight (%)	Stunted (%)
Tobacco			
	Consumers	19.93	32.09
	Non-consumers	17.69	30.60
	Difference	2.24	1.49
		(1.450)	(1.680)
Alcohol			
	Consumers	16.75	32.78
	Non-consumers	18.14	30.47
	Difference	-1.39	2.32
		(1.323)	(1.593)
Alcohol & tobacco			
	Consumers	18.79	34.65
	Non-consumers	17.92	30.45
	Difference	0.87	4.20
		(2.173)	(2.614)

Notes: The statistics are the share of children that are underweight (stunted) in households where parent/guardian consumed tobacco/alcohol and those households where parent/guardian did not consume the two goods. Positive difference indicated that the share of underweighted (stunted) children was higher in tobacco/alcohol consuming households. *p<0.1, **p<0.05, ***p<0.01. Standard errors are in brackets.

Logistic regressions were used to account for other factors that may have influenced child malnutrition. The first model (model 1) was a logit with cluster fixed effects. The fixed effects estimation controlled for, among other things, the availability and use of health facilities, as well as other environmental factors that may have affected child health. The accessibility of clean water and sewerage facilities was proxied by access to water and ownership of toilets by ***other*** households in a cluster, after excluding the household the child lived in.

A multilevel logistic regression (model 2) was used to account for the hierarchical nature of the data. Model 2 allowed the nutritional outcomes of children residing in the same cluster/village to be correlated. Model 2 also included cluster-level contextual variables, such as cluster averages on access to water, the availability of toilets, and the availability and use of healthcare facilities. The proportion of (other) children in a cluster that were vaccinated, and the proportion delivered in a health facility were used as estimates of the availability and use of healthcare facilities. Owing to the limited number of children in some clusters, the Generalised Estimation Equations (GEE) method (model 3) was also used to account for the correlation of child nutritional outcomes among children in the same cluster. The results for the three models are presented in Table 3.8, Table 3.9, Table 3.10, and Table 3.11

Table 3.8 Risk of long-term malnutrition among tobacco and alcohol consuming households in rural Kenya (KIHBS 2005-2006)

Variables	Logit with cluster fixed effects	Mixed effects logit	GEE population averaged logit model	GEE population averaged[#]
Consumed tobacco & alcohol	1.437**	1.333**	1.296**	1.357**
	(0.263)	(0.191)	(0.166)	(0.204)
Log of *per capita* expenditure	0.776***	0.755***	0.777***	0.718***
	(0.0722)	(0.0535)	(0.0498)	(0.0593)
Female household head	0.734**	0.842	0.858	0.814
	(0.0974)	(0.0968)	(0.0890)	(0.110)
Log of household size	0.596**	0.716	0.746	0.693
	(0.153)	(0.158)	(0.149)	(0.177)
Girl	0.671***	0.657***	0.684***	0.620***
	(0.0589)	(0.0513)	(0.0481)	(0.0567)
Child age in months	1.073***	1.072***	1.064***	1.062***
	(0.0176)	(0.0163)	(0.0145)	(0.0185)
(Child age in months)^2	0.999***	0.999***	0.999***	0.999***
	(0.000223)	(0.000207)	(0.000186)	(0.000236)
Number of months breastfed	0.999	0.997	0.998	0.997
	(0.00729)	(0.00646)	(0.00580)	(0.00728)
Share in cluster born at health facility		0.831	0.847	0.880
		(0.145)	(0.134)	(0.150)
Share of vaccinated children in a cluster		0.791	0.796	0.885
		(0.222)	(0.199)	(0.260)
Mother's age when child was born	0.989	0.992	0.993	1.001
	(0.00685)	(0.00596)	(0.00539)	(0.00691)
Mother living with partner	0.886	0.930	0.938	0.846
	(0.131)	(0.118)	(0.108)	(0.128)
Parent Education				
Upper primary	0.908	0.974	0.980	0.990
	(0.166)	(0.161)	(0.147)	(0.194)
High school and above	0.787	0.809	0.830	0.783
	(0.160)	(0.143)	(0.132)	(0.163)
Number employed	0.969	0.993	0.993	0.959
	(0.0483)	(0.0386)	(0.0347)	(0.0409)
Number of children below 15 years	1.188***	1.115***	1.102***	1.109**
	(0.0574)	(0.0446)	(0.0395)	(0.0515)
Av. distance to water source in a cluster[22]	1.034	1.003	1.003	1.001
	(0.0268)	(0.00285)	(0.00260)	(0.00291)
Share of households with a toilet in a cluster	0.225	0.855	0.873	1.013
	(0.313)	(0.118)	(0.108)	(0.135)
Constant		2.575	2.345	3.057*
		(1.502)	(1.231)	(1.997)
Number of Clusters	516	792	792	516
Average number of children per cluster	5.1	4.2	4.2	5.1
Sample Size	**2,636**	**3,326**	**3,326**	**2,636**

Notes: The dependent variable took the value of 1 if a child was stunted and 0 otherwise. *p<0.1, **p<0.05, ***p<0.01. For models with cluster fixed effects, cluster shares referred to the share of ***other*** households in the cluster, excluding the household where the child resided. **#** GEE model with same children as those used in the Logit with cluster fixed effects. The reference group for parental education was less than four years of formal education. Models without cluster fixed effects included regional fixed effects. Robust standard errors are in brackets.

[22] For models with cluster fixed effects, cluster shares referred to the share of ***other*** households in the cluster, excluding the household where the child lived.

Table 3.9 Risk of short-term malnutrition among tobacco and alcohol consuming households in rural Kenya (KIHBS 2005-2006)

Variables	Logit with cluster fixed effects	Mixed effects logit	GEE population averaged logit model
Consumed tobacco & alcohol	1.283	1.069	1.106
	(0.281)	(0.198)	(0.213)
Log of *per capita* expenditure	0.728***	0.724***	0.689***
	(0.0804)	(0.0576)	(0.0681)
Female household head	0.900	0.970	0.855
	(0.143)	(0.141)	(0.148)
Log of household size	0.798	0.796	0.828
	(0.246)	(0.210)	(0.267)
Girl	0.723***	0.748***	0.729***
	(0.0747)	(0.0680)	(0.0730)
Child age in months	1.070***	1.061***	1.041**
	(0.0211)	(0.0185)	(0.0194)
(Child age in months)^2	0.999***	0.999***	1.000*
	(0.000264)	(0.000233)	(0.000258)
Number of months breastfed	0.996	1.001	1.001
	(0.00841)	(0.00776)	(0.0225)
Share in cluster delivered at health facility		0.927	1.133
		(0.201)	(0.333)
Share of vaccinated children in a cluster		0.591*	0.547
		(0.164)	(0.222)
Mother's age when child was born	0.983**	0.989	0.987
	(0.00822)	(0.00730)	(0.00914)
Mother living with partner	0.777	0.863	0.824
	(0.135)	(0.137)	(0.167)
Parent Education			
Upper primary	0.958	0.871	1.010
	(0.184)	(0.134)	(0.193)
High school and above	1.026	0.851	0.961
	(0.220)	(0.150)	(0.206)
Number employed	0.896*	0.938	0.887**
	(0.0511)	(0.0408)	(0.0507)
Number of children below 15 years	1.184***	1.154***	1.128**
	(0.0650)	(0.0562)	(0.0600)
Average distance to water source in a cluster[23]	1.037	1.008***	1.005
	(0.0304)	(0.00220)	(0.00350)
Share of households with a toilet in the cluster	0.0640*	0.657***	0.647**
	(0.0919)	(0.105)	(0.126)
Constant		0.714	1.347
		(0.476)	(1.130)
Number of Clusters	377	809	770
Average number of children per cluster	5.6	4.4	4.1
Sample Size	**2,102**	**3,548**	**3,189**

Notes: The dependent variable took the value of 1 if a child was underweight and 0 otherwise. *p<0.1, **p<0.05, ***p<0.01. For models with cluster fixed effects, cluster shares referred to the share of ***other*** households in the cluster, excluding the household where the child resided. The reference group for parental education was less than four years of formal education. Models without cluster fixed effects included regional fixed effects. Robust standard errors are in brackets.

[23] For models with cluster fixed effects, cluster shares referred to the share of ***other*** households in the cluster, excluding the household where the child lived.

Table 3.10 Risk of long-term malnutrition among tobacco and alcohol consuming households in rural Kenya (KIHBS 2015-2016)

Variables	Logit with cluster fixed effects	Mixed effects logit	GEE population averaged logit model
Consumed tobacco & alcohol	1.210	1.104	1.339
	(0.253)	(0.181)	(0.248)
Log of *per capita* expenditure	0.637***	0.681***	0.618***
	(0.0663)	(0.0533)	(0.0532)
Female household head	0.897	0.841*	0.773**
	(0.102)	(0.0772)	(0.0823)
Log of household size	0.718	0.673*	0.797
	(0.198)	(0.160)	(0.210)
Girl	0.672***	0.681***	0.698***
	(0.0518)	(0.0455)	(0.0547)
Child age in months	1.068***	1.065***	1.059***
	(0.0129)	(0.0112)	(0.0136)
(Child age in months)^2	0.999***	0.999***	0.999***
	(0.000185)	(0.000162)	(0.000198)
Number of months breastfed	0.974	0.960***	0.968**
	(0.0187)	(0.0141)	(0.0158)
Share in cluster delivered at health facility		0.825	0.788
		(0.115)	(0.120)
Share of children in a cluster with diarrhoea		1.337	1.238
		(0.351)	(0.343)
Mother's age when child was born	0.986**	0.984***	0.984**
	(0.00688)	(0.00607)	(0.00658)
Mother living with partner	1.086	0.980	0.968
	(0.153)	(0.114)	(0.131)
Parent Education			
Other	0.701	0.716	1.127
	(0.419)	(0.490)	(0.809)
Upper primary	0.816	1.016	1.135
	(0.127)	(0.131)	(0.179)
High school and above	0.710**	0.769*	0.821
	(0.124)	(0.110)	(0.149)
Number employed	0.994	0.960	0.933*
	(0.0459)	(0.0358)	(0.0383)
Number of children below 15 years	1.113**	1.147***	1.117**
	(0.0587)	(0.0554)	(0.0610)
Average distance to water source in a cluster	1.006	1.001	0.999
	(0.0120)	(0.00129)	(0.00171)
Share of households with a toilet in the cluster	0.835	0.415	0.480
	(1.109)	(0.237)	(0.321)
Constant	0.701	3.942***	5.040***
	(0.419)	(1.765)	(2.369)
Number of Clusters	698	1,290	1,290
Average number of children per cluster	5.0	3.9	3.9
Sample Size	**3,517**	**5,023**	**5,023**

Notes: The dependent variable took the value of 1 if a child was stunted and 0 otherwise. *p<0.1, **p<0.05, ***p<0.01. For models with cluster fixed effects, cluster shares referred to the share of other households in the cluster, excluding the household where the child resided. The reference group for parental education was less than four years of formal education. Models without cluster fixed effects included regional fixed effects. Robust standard errors are in brackets.

Table 3.11 Risk of short-term malnutrition among tobacco and alcohol consuming households in rural Kenya (KIHBS 2015-2016)

Variables	Logit with cluster fixed effects	Mixed effects logit	GEE population averaged logit model
Consumed tobacco & alcohol	1.455	1.060	0.961
	(0.436)	(0.219)	(0.198)
Log of *per capita* expenditure	0.689***	0.605***	0.602***
	(0.0970)	(0.0641)	(0.0674)
Female household head	0.912	0.843	0.896
	(0.138)	(0.101)	(0.113)
Log of household size	0.781	0.984	1.147
	(0.294)	(0.320)	(0.451)
Girl	0.852	0.838**	0.893
	(0.0848)	(0.0751)	(0.102)
Child age in months	1.082***	1.065***	1.049***
	(0.0179)	(0.0154)	(0.0176)
(Child age in months)^2	0.999***	0.999***	0.999**
	(0.000247)	(0.000215)	(0.000247)
Number of months breastfed	0.960	0.988	0.977
	(0.0252)	(0.0198)	(0.0194)
Share in cluster delivered at health facility		0.386***	0.590**
		(0.0775)	(0.122)
Share of children in a cluster with diarrhoea		0.857	0.561
		(0.384)	(0.291)
Mother's age when child was born	0.998	0.994	0.990
	(0.00911)	(0.00807)	(0.00894)
Mother living with partner	0.821	0.811	0.899
	(0.157)	(0.127)	(0.149)
Parent Education			
Other	0.560	0.471	0.959
	(0.459)	(0.436)	(0.969)
Upper primary	0.705**	0.789	0.975
	(0.122)	(0.118)	(0.164)
High school and above	0.600**	0.561***	0.596**
	(0.121)	(0.100)	(0.121)
Number employed	0.910	0.857***	0.885**
	(0.0573)	(0.0442)	(0.0491)
Number of children below 15 years	1.151**	1.111*	1.075
	(0.0824)	(0.0691)	(0.0778)
Average distance to water source in a cluster	1.019	1.001	1.001
	(0.0150)	(0.00170)	(0.00186)
Share of households with a toilet in the cluster	5.311	0.586***	0.566***
	(8.536)	(0.111)	(0.108)
Constant	0.560	1.255	1.290
	(0.459)	(0.796)	(0.915)
Number of Clusters	419	1,291	1,291
Average number of children per cluster	5.4	3.9	3.8
Sample Size	**2,247**	**5,040**	**5,040**

Notes: The dependent variable took the value of 1 if a child was underweight and 0 otherwise. *p<0.1, **p<0.05, ***p<0.01. For models with cluster fixed effects, cluster shares referred to the share of other households in the cluster, excluding the household where the child resided. The reference group for parental education was less than four years of formal education. Models without cluster fixed effects included regional fixed effects. Robust standard errors are in brackets.

Children living in households where parents or guardians consumed both tobacco and alcohol in 2005-2006 had a higher risk of being malnourished than those living in households that did not consume the two goods. The results from the logit regression with cluster fixed effects indicated that the odds of long-term malnutrition were 44% higher for children living in tobacco and alcohol consuming households. However, after accounting for the hierarchical nature of the data and contextual variables using a multilevel logistic regression, the odds of malnutrition were only 33% higher.

The GEE logit regression was expected to provide unbiased estimates of and their standard errors if the number of children per cluster was low. The average number of children per cluster in the 2005-2006 data used in the regression analysis was four. The results from the GEE estimation show that the odds of malnutrition were 30% higher for children living in households that consumed tobacco and alcohol.

In 2015-2016, there was no difference in the risk of malnutrition between children living in tobacco/alcohol consuming households and those living in households that did not consume the two goods. This result was similar across all the models that were estimated. Over the ten-year period, the tobacco- and alcohol-control policies implemented in Kenya were most effective in reducing consumption among the poorest rural households. Whereas tobacco use prevalence increased among households in the top quartile, it decreased by around ten percentage points among the poorest households.

A similar trend was observed among rural households that consumed alcohol, as well as those consuming both tobacco and alcohol. The proportion of households that consumed alcohol/tobacco also increased among households in the top quartile. Among rural households in the bottom quartile, alcohol consumption prevalence decreased by around two percentage points while the consumption prevalence of both alcohol and tobacco decreased by around three percentage points.

The effectiveness in tobacco- and alcohol-control policies in reducing consumption among the poorest households may be one of the factors that contributing factors to the greater decline in child malnutrition prevalence among tobacco- and alcohol-consuming households. This is because poorer households were able to invest resources that might otherwise have been used on tobacco and alcohol in human capital development.

Other factors that influenced child nutritional outcomes included *per capita* expenditure, child characteristics, the composition of the household, and sanitation. For most of the factors, the results were consistent across the three models. Further, for most factors the

estimated odds from GEE and the mixed effects logit were more conservative than the logit with cluster fixed effects.

Children living in households with higher *per capita* expenditure were less likely to be underweight or stunted. Wealthier households have more money to spend on food and healthcare, thus reducing the risk of their children being malnourished. The odds of children being malnourished increased at a decreasing rate with the age of the child. The odds of both short-term and long-term malnutrition were higher for boys. This result was similar to what most studies on child malnutrition in East and Southern Africa have found.

The composition of the household also had an effect on the child nutritional outcomes. Children living in households with many children under the age of fifteen were more likely to be malnourished. This may have been a result of competition for resources within the household. Conversely, children in households in which more members were employed, were less likely to be malnourished. Having many employed household members was an indicator of diversification in sources of income and other resources in a household.

The results from models with community-level variables indicated that the availability of healthcare facilities and cluster/village level sanitation influenced the risk of short-term malnutrition. In the later survey, children living in clusters/villages where a larger share of children were born in a health facility also had a lower risk of being underweight.

In both surveys, children in clusters where more households had toilets, had lower odds of being underweight. Therefore, public health initiatives focusing on increasing the ownership of toilets and the availability and use of healthcare facilities may further improve child nutritional outcomes in rural Kenya.

3.6.1 Limitations

The main limitation of this chapter is the use of cross-sectional data. The use of a panel data set, collected at relatively short intervals, would have provided a better estimate of the effects of the different tobacco/alcohol control policies on consumption of the two goods. Such a data set would have made possible the comparison of child nutrition outcomes, between children in poor households whose parents continued consuming tobacco/alcohol and those whose parents stopped consuming tobacco/alcohol. Unfortunately, I did not have access to a relevant panel data set on Kenya.

3.7 Summary and conclusion

The costs associated with tobacco and alcohol consumption are not limited to their effects on health and productivity. At the household level, consumption of the two goods has been associated with lower expenditure on goods that are essential for human capital development. In Kenya, rural tobacco- and alcohol-consuming households spend less on items such as education, healthcare, and food. Owing to the nature of the expenditures that are crowded out, this chapter investigated whether malnutrition was more prevalent among children living in households that consumed tobacco and alcohol. The chapter also investigated whether malnutrition patterns in tobacco/alcohol consuming households changed over time.

To achieve the two objectives, the anthropometric measurements of all the children in a household that were aged between six months and five years were used. There are also many unobserved household and community level factors that may influence child nutrition. As a result, the nutritional outcomes of children living in the same household or cluster/village may be correlated.

Three models were used to estimate the risk of child malnutrition: a logit with cluster fixed effects, a Multilevel/mixed effects logit, and a General Equations Estimation logit model. The two latter models allowed for within-cluster correlation of nutritional outcomes. They also included cluster-level indicators of sanitation and the availability and use of healthcare facilities.

The risk of malnutrition was found to be higher for children living in tobacco- and alcohol-consuming households in 2005-2006. From 2005-2006 to 2015-2016, tobacco- and alcohol-control policies implemented in Kenya, succeeded in reducing the level of tobacco and alcohol consumption among the poorest households.

The consumption prevalence of tobacco/alcohol increased among rural households in the top quartile between 2005-2006 and 2015-2016. Over the same period, the prevalence of tobacco consumption among rural households in the bottom quartile decreased by around ten percentage points. The proportion of rural households that consumed both tobacco and alcohol also decreased in the bottom quartile. The decrease in the prevalence of both short-term and long-term malnutrition was greater among households that consumed tobacco/alcohol. In 2015-2016, the risk of child malnutrition in tobacco/alcohol-consuming households was similar to that of non-consuming households.

The results from this chapter indicate that tobacco- and alcohol-control policies that were implemented in Kenya over the period 2005 to 2016 reduced consumption prevalence of the two goods among the poorest rural households. This meant that very poor households were able to reallocate resources that would otherwise would have been used for tobacco and alcohol, to human capital development. These results provide further justification for continued implementation of tobacco and alcohol control policies in LMICs.

CHAPTER 4: EXPENDITURE BURDENS AND PRICE ELASTICITIES OF DEMAND FOR TOBACCO AND ALCOHOL IN KENYA

4.1 Introduction

Tax-induced price increases is one of the most effective policy tool for reducing the demand for tobacco and alcohol. Many of the earlier studies that estimated the effect of prices on the demand for alcohol and tobacco products were conducted on developed countries using time series data. The use of household/individual survey data in subsequent studies resulted in the estimation of changes in demand by different categories of consumers. Young individuals and low-income individuals/households were found to be more responsive to price changes for both alcohol and tobacco (IARC, 2011; WHO, 2007, 2015).

Many developing countries lack reliable aggregate data on prices and the consumption of tobacco and alcohol products. The use of household/individual survey data has aided the estimation of own and cross-price elasticities of demand for different tobacco and alcohol products consumed in developing countries (John, 2005, 2008b; Selvaraj *et al.*, 2015). However, studies on the price elasticity of demand for tobacco and alcohol in sub-Saharan Africa are still relatively few. Moreover, the few that have been done deal mostly with South Africa and have focused on formally produced alcohol and cigarettes.

The implementation of tobacco- and alcohol-control policies in Africa is affected by the continent's demographics and governance. These, together with Africa's actual and potential economic growth, have made the continent a target for aggressive marketing by the tobacco industry, which is facing decreasing demand in developed countries. Rising *per capita* incomes across Africa mean that alcohol consumption is also expected to continue to increase (Sornpaisarn *et al.*, 2013; Ahluwalia *et al.*, 2016).

Sub-Saharan African countries also have a limited capacity to prevent smuggling and the illegal production of alcohol and tobacco products. As a result, they tend to have higher rates of consumption of relatively cheaper informally-produced alcohol and non-cigarette/smokeless tobacco products (Sornpaisarn *et al.*, 2013; Jawad *et al.*, 2018). As in other sub-Saharan African countries, the consumption of informally produced alcohol in Kenya is widespread. Between 2008 and 2010, the average *per capita* consumption of pure alcohol in Kenya was 4.3 litres, of which, 2.5 litres was unrecorded[24] alcohol (WHO, 2014a).

[24] Unrecorded consumption refers to alcohol which is not taxed and is outside the usual system of governmental control. This includes homebrewed or informally produced alcohol (legal or illegal), smuggled alcohol, surrogate alcohol or alcohol, obtained through cross-border shopping.

Informally produced alcohol in Kenya includes traditional beers such as *busaa* and *muratina* as well as spirits such as c*hang'aa*. *Chang'aa* is mostly made from millet, maize or sorghum. In some instances, *chang'aa* 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 drinking of *chang'aa* (WHO, 2004; Carey *et al.*, 2015).

There is also substantial use of smokeless tobacco products in Kenya. The Global Adult Tobacco Survey done in 2014 estimated that the overall prevalence of tobacco use in Kenya was 11.6%. This was broken down to an overall smoking prevalence of 7.5% and an overall smokeless tobacco use prevalence of 4.5%. The relatively high rates of consumption for non-cigarette tobacco products and informally produced alcohol may affect the effectiveness of tax policy in controlling tobacco and alcohol consumption in Kenya.

The effectiveness of tobacco and alcohol taxes in controlling demand for the two goods in Kenya may also be influenced by the consumption of other stimulants such as *khat*. *Khat* or *miraa* refers to the twigs and leaves of the *Catha edulis* tree. The twigs and leaves are chewed for their stimulant and euphoriant effect. *Khat* is mostly consumed in the Arabian peninsula and East Africa (Hodgkinson, 1962; Kalix, 1988). *Khat* has been identified as one of the possible contributing factors to initiation, continuance, and relapse among tobacco smokers (Kassim *et al.*, 2014). Some studies have also found a positive correlation between *khat* chewing and alcohol use in some regions of Kenya (Omolo and Dhadphale, 1987).

Cigarettes and formally produced alcohol have been the main focuses of taxation in Kenya, but, although cigarette taxes have been found to be an effective tool for reducing demand, there has also been concern that they may be regressive (Koch, 2018). Alcohol taxes have also been found to be regressive in some African countries (Ataguba, 2012). This concern about the regressive nature of such taxes has led to studies on the equity impact of various tobacco and alcohol control policies (Hill *et al.*, 2014; Bosdriesz *et al.*, 2015; Vandenberg and Sharma, 2016; Koch, 2018).

The regressive nature of tobacco and alcohol taxes has also been an issue in Kenya. Members of the Kenyan parliament have argued for a tax system favourable to poor smokers. To this end, a tiered tax on cigarettes was implemented between 2003 and 2010, and an attempt was made to reintroduce it in 2015 (Nargis *et al.*, 2015). Similarly, beers made from millet and sorghum such as Senator Keg, which are mostly consumed by the poor, have also received preferential tax treatment.

This chapter uses household survey data from Kenya and the method developed by Deaton (1987, 1988, 1990, 1997) to estimate own- and cross-price elasticities of demand for cigarettes, snuff tobacco, unprocessed tobacco, traditional brews, *chang'aa*, beers, and *khat*. The results show that the demand for cigarettes was price inelastic while that of unprocessed tobacco was unitary elastic. The demand for beers was found to be price elastic. The cross-price elasticity estimates indicate that *chang'aa* was a substitute for formally produced beers. Snuff tobacco and *khat* were found to be complements for cigarettes.

These results suggest that taxing cigarettes is an effective policy tool for reducing the demand for cigarettes in Kenya. The taxation of cigarettes may also be effective in reducing demand for other harmful substances, such as snuff tobacco and *khat.* The taxation of beers and other formally produced alcohol products should be done in conjunction with policies aimed at controlling the production and consumption of informally produced alcohol. This would reduce the likelihood of the substitution to cheaper and more harmful informally produced alcohol products.

This chapter also uses the method developed by Kakwani (1977) to analyse the equity impact of price and non-price tobacco and alcohol control policies that were implemented between 2005/6 and 2015/6. It finds that tobacco control policies succeeded in reducing the regressivity of household tobacco burdens (budget shares). Similarly, alcohol control policies contributed to a reduction in the regressivity of overall alcohol burden.

The rest of this chapter is organised as follows: the relevant literature is reviewed in section 4.2. Sections 4.3 and 4.4 present the empirical strategy and a description of the data. The results and conclusions are presented in sections 4.5 and 4.6.

4.2 Relevant literature

4.2.1 Income and price elasticity of demand for tobacco

Price and income elasticities of demand for tobacco have mostly been estimated using either time series or household survey data. Time series data was used in many of the earlier studies. Owing to the unavailability of reliable data, studies on developing countries have been relatively few (Chelwa, 2015).

The availability of aggregate data on categories of tobacco products that are consumed in a country varies between developed and low- and middle-income counties (LMICs). Whereas time series aggregate data on multiple tobacco products has been available for developed countries, studies on developing countries were limited to categories such as

cigarettes and non-cigarette tobacco products (Chapman and Richardson, 1990) or filter and non-filter cigarettes (Okello, 2001; Kiringai *et al.*, 2002).

One advantage of having price and consumption data for different categories of tobacco products is the ability to compare own-price elasticities, as well as to estimate cross-price elasticities of demand. In some countries, smokeless tobacco products were found to be substitutes for cigarettes, while in others they were complements. Other possible substitutes for conventional cigarettes include roll-your-own tobacco, pipe tobacco, little cigars, little cigarettes, e-cigarettes, heat-not-burn products and filter-less cigarettes (Chaloupka, 1999; Kiringai e*t al.*, 2002; Huang *et al.*, 2018).

Through the years, the types of available tobacco products and consumption patterns across countries have changed. In countries such as the United Kingdom (UK), Ireland, and the United States of America (USA), the price elasticity of demand for cigarettes fell over time as a result of rising incomes (Townsend, 1996). Some authors, such as Tarantilis *et al.* (2015), who used data on Greece, also found that the income elasticity of demand for tobacco had changed over time.

The time span of the analysis is also important, because the short-run effect of a change in the price of a tobacco product may differ from the long-run effect. Tobacco products tend to be addictive, and as a result the effect of a permanent increase in price takes effect over time, as demand slowly adjusts. The long-run price elasticity of demand for tobacco may be up to twice that of short-run elasticity (Chaloupka, 1999).

Most of the studies that found a higher long-term price elasticity of demand for tobacco used time series data. However, the estimation of elasticity using aggregated country- or state-level data has some drawbacks. Aggregate consumption of tobacco products does not account for smuggling, which may occur as a result of cross-border price differentials. Because they do not account for smuggling, the resulting elasticity estimates tend to be biased (Chaloupka, 1999; Osoro *et al.*, 2001; Kiringai *et al.*, 2002; Chelwa, 2015).

There is also simultaneity associated with the aggregate price and aggregate consumption of tobacco products. Some studies have used exogenous tobacco taxes as a proxy for tobacco prices. However, using changes in tax as a proxy for price may introduce measurement error. In jurisdictions where opportunities for tax evasion exist, using tobacco taxes may result in an overestimation of elasticities. Studies that measure the dependent variable at a country level also tend to have higher price elasticity estimates (Chaloupka, 1999; Gallet and List, 2003; Chelwa, 2015; Jawad *et al.*, 2018).

Price is usually not endogenous when the price elasticity of demand is estimated using household survey data. This is because an individual's or a household's consumption rarely influences the prices of the products they buy (Fuchs and Meneses, 2018). The use of cross-sectional data to estimate the price and income elasticity of demand for tobacco is also popular in LMICs because of the lack of adequate time series data. Aggregate level data for many non-cigarette tobacco products is seldom available in LMICs (Chelwa, 2015; Jawad *et al.*, 2018).

Jawad *et al.* (2018) identified ten non-cigarette tobacco products whose price elasticity of demand had been estimated over the years. They defined non-cigarette tobacco products as products other than manufactured cigarettes that contained tobacco or nicotine. Studies from LMICs were able to estimate the cross-price elasticity of demand for cigarettes and non-cigarette tobacco products using survey data. Some studies found that cigarette and non-cigarette tobacco products were substitutes. Therefore, they proposed that price and tax increases needed to be concurrent and comparable across the different types of tobacco products consumed in such countries.

Most cross-sectional data sets used in the estimation of elasticity have a large sample of households. This has enabled researchers to estimate price and income elasticities for different types of tobacco-consuming households. The estimated price elasticity of demand for tobacco products has been found to be higher among poorer households and among rural households (Townsend, 1996; John, 2008b; Selvaraj *et al.*, 2015).

Measurement error is one of the drawbacks of using survey data collected from individuals or households. The method developed by Deaton (1987, 1988, 1990)[25] has been used by some of the studies that estimated the price elasticity of demand for tobacco products using cross-sectional data. Most surveys done in LMICs do not contain complete or accurate income data, and for this reason the expenditure elasticity of demand for tobacco is estimated in place of the income elasticity.

The Deaton method relies on the variability of prices across geographical regions in LMICs. In this way, it avoids the possible endogeneity problem associated with aggregate data. The Deaton method also corrects for measurement error and quality heterogeneity. Individual/household level data may also be subject to underreporting. However, if the underreporting is systemic then it may not affect the estimated elasticities (Chelwa, 2015; Fuchs and Meneses, 2018; Jawad e*t al.*, 2018).

[25] Subsequently referred to as the Deaton method.

Consumers of tobacco products may respond to price increases either by reducing the quantity consumed or by quitting. Using a two-part estimation procedure and individual level data, some studies have estimated both the participation and quantity elasticity of demand for tobacco. In the USA, increases in the prices of cigarettes reduced both participation in smoking and quantity of cigarettes smoked among women, while men only reduced daily consumption, not participation. Young adults, poorer adults, women, and African Americans have been found to be more price responsive (Townsend et al., 1994; Chaloupka, 1999; Farrelly *et al.,* 2001; Tauras, 2006).

Studies on developed countries that have used individual, household and aggregate data have consistently concluded that the demand for tobacco was price inelastic. The estimated average price elasticity of demand for tobacco in high-income countries is -0.4. In both developed and developing countries, tobacco was found to be a normal good. Most studies have found a positive income elasticity that lies between zero and one. Although there is more variability in the estimated price elasticity of demand for tobacco in developing countries, there is consensus that cigarette demand is relatively more price elastic in developing countries (IARC, 2011).

The price elasticity of demand for tobacco in developing countries varies between -0.2 and -1.0. Most of the few studies done on sub-Saharan African countries have been on South Africa. The estimated long-run elasticity of demand for tobacco in South Africa ranged between -0.16 to -1.52 while short run estimates were between -0.32 and -0.99. Income elasticity estimates were between 0.37 and 1.70 (Reekie, 1994; Van Walbeek, 1996; Boshoff, 2008; IARC, 2011; Chelwa, 2015).

Some recent studies on sub-Saharan African countries have used cross-sectional data. Chelwa (2015) concluded that the price elasticity of demand for cigarettes in Uganda ranged from -0.3 to -0.4, while the expenditure elasticity was between 0.16 and 0.20. Owing to data limitations, the study did not estimate the price elasticities of demand for different tobacco products and income groups.

Fuchs Tarlovsky *et al.* (2018) estimated the price elasticity of demand for tobacco for different income groups in South Africa. They concluded that the average price elasticity of demand was -0.25. The price elasticity estimate for the poorest decile was -0.36 while that for the richest decile was -0.22. Stoklosa *et al.* (2018) focused on both factory-made (FM) and roll-your-own (RYO) cigarettes. They found that in Zambia, FM cigarettes and RYO cigarettes were substitutes.

The focus of this chapter is the estimation of price and expenditure elasticities of demand for tobacco and alcohol in Kenya. Two non-peer-reviewed studies have estimated the price and income elasticity of demand for cigarettes in Kenya. Okello (2001) concluded that the price elasticity of demand for filter was -0.4 while that of plain cigarettes was -0.35. The income elasticity of demand in the long run was 0.47 for filter cigarettes and -1.92 for plain cigarettes. The study used monthly data from Ministry of Finance received from cigarette manufacturers.

Kiringai *et al.* (2002) advanced the findings of the earlier study by estimating the cross-price elasticity between filter and non-filter cigarettes. They used monthly time series data from British American Tobacco (BAT) Kenya. The estimated cross-price elasticity was 0.26, which meant that when the price of filter cigarettes increased in Kenya, smokers switched to lower quality cigarettes. Their estimated long-run price elasticity of demand for all cigarettes was -1.78 and the short-run elasticity was -0.49.

4.2.2 Income and price elasticity of demand for alcohol

There is an extensive literature from high income countries on the price and income elasticity of demand for alcohol (Kumar, 2017). Many of the earlier studies used aggregate state- or country-level data to estimate elasticities. The estimated range of the price elasticity of demand for all types of alcoholic beverages by these studies was between -0.5 and -1.6 (Manning *et al.*, 1995).

The relative share of ethanol in an alcoholic beverages has been found to be one of the factors that explained differences in response by consumers to variations in the price of alcohol (Fogarty, 2006). Earlier studies that used aggregate data to estimate the price elasticity of demand grouped alcohol into three broad categories: beers, wines, and spirits. The estimated price elasticity of demand ranged between -0.64 and -1.0 for wine and -0.82 and -2.0 for spirits (Manning *et al.*, 1995; Wagenaar *et al.*, 2009).

Aggregate data has also been used to estimate the cross-price elasticity between the different types of alcoholic drinks. Gruenewald *et al.* (2006) grouped beers, wines and spirits into different qualities. The quality was based on the relative average price over a ten-year period. They concluded that in Sweden, consumers switched to lower quality alcoholic drinks when the price of high-quality beverages increased. Specifically, an increase in the price of higher quality beer and wine was associated with increased sales of lower quality spirits.

Elasticity estimates from aggregate data may be biased if the studies do not account for simultaneity in the aggregate consumption and price of alcohol. Aggregate consumption data may also fail to account for cross-border shopping to take advantage of tax differences across countries or states. There may also be precision issues resulting from a limited number of observations when aggregate data is used (Manning *et al.*, 1995). In addition to being sensitive to the choice of functional form in the demand model specification, elasticity estimates from aggregate data tend to be relatively smaller in absolute terms (Wagenaar *et al.*, 2009).

Household and individual level survey data has been used as an alternative to aggregate data in the estimation of the price and income elasticity of demand for alcohol. Some advantages of household/individual survey data are the avoidance of the possible simultaneity associated with aggregate price and consumption data and the ability to estimate the elasticity of demand for unrecorded alcohol. Unrecorded alcohol includes home-distilled spirits that are illegal in some countries. For example, Goryakin *et al.* (2015) found that in Russia moonshine (*samogon*) was a substitute for fortified wine and cheap vodka.

Kumar (2017) used the survey of unrecorded alcohol in India to estimate the price elasticity of demand. The study concluded that the price elasticity of demand for country liquor was -0.46 while that for beer was -0.33. Further, the price elasticity of demand was higher in rural areas. As with other studies that used survey data, measurement errors associated with the self-reporting of quantity, frequency, and price could not be ruled out.

The possibility of unrecorded alcohol such as moonshine or other self-produced alcohol, serving as substitutes to formally produced alcohol is an important policy issue. In countries with high levels of production and consumption of unrecorded alcohol or where unrecorded alcohol is a substitute for formally-produced alcohol, increasing the proportion of alcohol that is taxed could be a more effective alcohol-control policy (Anderson *et al.*, 2009).

Per capita alcohol consumption and income level are some of the other factors that may explain the differences in response by consumers to variations in alcohol prices (Fogarty, 2006). Heavy drinkers have been found to have relatively more price inelastic demand for alcohol than moderate or light drinkers (Manning *et al.*, 1995; Wagenaar *et al.*, 2009; Van Walbeek and Blecher, 2014). A similar conclusion was arrived at by Aepli (2014) who used household level data from Switzerland. The study found that heavy-drinking households were less responsive to changes in the prices of beer and wine.

An increase in price of alcohol has been found to reduce alcohol consumption among young people. This includes a reduction in underage drinking, per occasion binge drinking

among young adults, and the proportion of young people that were heavy drinkers (WHO, 2007; Anderson *et al.*, 2009). Taxation has also been found to be effective in preventing drinking initiation among the youth in countries with high rates of abstainers such as Thailand (Sornpaisarn *et al.*, 2015). However, Nelson (2016) pointed out that heavy drinking among young adults may not be easily discouraged by higher prices.

Low-income drinkers have also been found to be more price responsive in some countries. Jiang *et al.* (2016) found that, in Australia, the absolute values of own-price elasticity of demand for beer, wine, and spirits were higher among low income drinkers. They also found that demand for off-premise consumption, e.g. alcohol purchased in supermarkets and liquor stores, was affected more by own-price, than alcohol that was consumed on premise e.g. in restaurants and bars.

Demand for off-premise beer and cider was also found to be relatively more price elastic in the United Kingdom (UK). Studies on the UK also suggested that setting a minimum unit price for alcohol may influence consumption. Minimum unit price of alcohol was expected to be especially effective in reducing consumption among harmful drinkers (Purshouse et al., 2010; Holmes et al., 2014).

The time-frame of the analysis may also influence the elasticity estimates. The majority of studies have estimated the short-run elasticity of demand for alcohol. Short-run price and income elasticity of demand estimates tend to be smaller in absolute terms than long-run estimates. In a meta-analysis of 132 studies Gallet (2007) found that, at the median, short-run price elasticity of demand was -0.52, long-run price elasticity of demand was -0.82, short-run income elasticity was 0.68, and long-run income elasticity was 0.86.

The majority of alcohol consumers reside in high-income countries. This may be another reason why many of the studies on price and income elasticity of demand for alcohol have focused on high-income countries. Middle- and low-income countries tend to have a relatively larger proportion of abstainers, this may be one of the reasons why alcohol consumption has been found to increase at a decreasing rate with a country's income level (Sornpaisarn *et al.*, 2013; Cook *et al.*, 2014).

Consumers of alcohol in low-income countries are mostly male. Although the proportion and aggregate consumption of alcohol may be lower in LMICs, the adverse effect associated with every litre of consumption is significantly higher. This is because there is a higher risk of alcohol-related morbidity and mortality in LMICs (Cook *et al.*, 2014).

Sornpaisarn *et al.* (2013), in a review of twelve studies on LMICs, found that the estimated elasticity of demand was -0.5 for beer, -0.79 for other alcoholic beverages, and -0.64 for total consumption of alcohol. They pointed out that LMICs had limited capacity to deter illegal production. Therefore, they proposed that further research on the relationship between the taxation of alcohol and smuggling or informal production was needed in LMICs.

Kenya, like other low-income countries, has high consumption rates of informally produced alcohol. The majority of consumers of informally produced alcohol live in urban slums and poor rural areas and cannot afford conventional legal alcohol. The most common surrogate alcohol in Kenya is *chang'aa*. *Chang'aa* is made from millet, maize or sorghum and may contain methanol and other hazardous additives (WHO, 2004; Carey *et al.*, 2015). Other informally produced alcoholic beverages are traditional beers such as *muratina* and *busaa*.

One non-peer reviewed study has estimated the price and income elasticity of demand for alcohol in Kenya. Okello (2001) used monthly data from manufacturers to estimate the price and income elasticity of demand for Guinness and other beers. The estimated long-run price elasticity of demand was -5.49 for Guinness and -1.11 for other beers. The short-run price elasticity of demand for Guinness was -1.13 while that for other beers was -0.74. The estimated short-run income elasticity of demand for Guinness was 1.00 and for other beers 0.17.

4.2.3 Regressivity/progressivity of tobacco and alcohol expenditures and tax burden

Tobacco taxes have been used successfully to reduce demand for tobacco products. However, as tobacco taxes are considered to be regressive, tobacco control efforts may have adverse effects on the poor (Koch, 2018). Similarly, there is concern about the equity implications of alcohol control policies (Blas and Kurup, 2010; Vandenberg and Sharma, 2016).

The majority of the studies on the implications of tobacco- and alcohol-control policies for relatively poor consumers have focused on tax policies. Studies on the effect of increases of tax/price of tobacco products on equity have arrived at mixed conclusions. Some studies have concluded that price increases via taxation had a positive effect on equity. This is because, poorer tobacco consumers have been found to be more responsive to changes in price (Warner, 2000; Siahpush *et al.*, 2009; Hill *et al.*, 2014; Koch, 2018).

Other studies have disputed the assertion that poorer tobacco consumers were more price responsive. Colman and Remler (2008) found that in the United States, there was a very small difference in the price elasticity of demand across different income groups. They

concluded that increases in cigarette taxes were not progressive. Other studies have also found that income-related smoking inequality increased with increases in prices. In some cases, an increase in excise taxes resulted in relatively larger increases in income spent on cigarettes by smokers in the lowest income category (Franks e*t al.,* 2007; Farrelly *et al.,* 2012).

The impact of alcohol taxes on equity is also mixed. In some countries, such as Guinea, Ghana, Tanzania, and Uganda taxes on alcohol have been found to be progressive whereas in countries such as South Africa they have been found to be regressive (Gemmell and Morrissey, 2005; Ataguba, 2012). The impact of an increase in alcohol taxes has been found to vary according to the type of drinker. An increase in alcohol taxes resulted in a net gain to low-risk/moderate drinkers from disadvantaged socioeconomic groups but were potentially regressive for relatively poor heavy drinkers (Daley *et al.,* 2012; Holmes *et al.,* 2014; Vandenberg and Sharma, 2016).

There is little evidence on the equity impact of population-level tobacco and alcohol control measures. In particular, there are few studies that focus on multidimensional tobacco-control approaches and those targeting disadvantaged communities (Hill *et al.,* 2014). The impact of smoke-free legislation and other interventions such as pharmacological, behavioural, and mass media campaigns, on socioeconomic inequalities related to tobacco consumption has been mixed (Brown e*t al.,* 2014; Hill *et al.,* 2014). Bosdriesz *et al.* (2015) considered both price and non-price tobacco-control polices implemented in 11 European countries. They concluded that tobacco-control policies that were implemented in the 2000s were not effective in reducing socioeconomic inequality among smokers.

Ross *et al.* (2017) is one of the few studies on a sub-Saharan African country (Mauritius) that considers the effect of tobacco-control polies on different socioeconomic groups. They compare household tobacco budget shares from two cross-sectional household surveys. They find that between 2006/7 and 2012 the largest increase in tobacco budget shares occurred among middle-income households in Mauritius. Therefore, even though tobacco expenditures continued to be regressive, they were less regressive in the later survey.

Koch (2018) also used two South African Income and Expenditure Surveys that were carried out in 2005/6 and 2010/11. The study used quintile regression and the method developed by Kakwani (1977) to determine whether tobacco control policies had an impact on the regressivity of the household tobacco burden. The study concluded that tobacco-control policies contributed to a decrease in the regressivity of tobacco budget shares and taxes. Ataguba (2012) also used the method developed by Kakwani (1977) and data from the 2005/6

South African Income and Expenditure Survey to evaluate alcohol taxes. The study found that alcohol taxes in South Africa were regressive.

4.2.4 Contribution to the literature

This chapter uses household survey data to estimate the own- and cross-price elasticities of demand for alcohol and tobacco products in Kenya. The focus is on a sub-Saharan African country, where there is significant consumption of informally produced alcohol and non-cigarette tobacco products, such as snuff tobacco and unprocessed tobacco. The first contribution is to the limited but growing literature on the price elasticity of demand for tobacco and alcohol products in sub-Saharan Africa.

The second contribution is on how changes in the price of formally produced alcohol/tobacco affect demand for non-formally produced alcohol/tobacco and stimulants such as *khat*. Specifically, this chapter seeks to establish whether other tobacco/alcohol products and *khat* (a stimulant mostly consumed in the Horn of Africa region), are consumed as substitutes or complements to formally produced tobacco/alcohol products. Formally produced alcohol and tobacco products are usually the focus of tax policy in Kenya.

This chapter also seeks to contribute to the literature on the equity impact of tobacco and alcohol control polies. Household survey data that was collected before and after the implementation of major tobacco- and alcohol-control policies is used. The focus is on the impact of tobacco- and alcohol-control policies on the tobacco and alcohol burden (tobacco and alcohol budget shares) for households in different socioeconomic groups.

4.3 Methods and Empirical Strategy

4.3.1 Estimation of expenditure and price elasticity of demand

This chapter uses the method developed by Deaton (1987, 1988, 1990, 1997) (subsequently referred to as the Deaton method) to estimate the own- and cross-price elasticities of demand for different tobacco and alcohol products consumed in Kenya. The Deaton method was developed for estimating elasticities in developing countries where reliable time series data is seldom available. The method makes use of household survey data which is available in many developing countries.

There is a possibility of spatial variation in prices in developing countries because of, among other things, relatively high transport costs. Household surveys often do not collect data on prices, but they do collect data on the quantity and value of purchases. The ratio of amount

spent to quantity can be used to calculate unit values, which give an indication of the price. Unit values are not a precise measure of prices because they are affected by the type or quality of a commodity that is purchased by a household.

Household surveys usually group households into clusters. An assumption is made that the market price of a good does not vary within each cluster. Therefore, the within-cluster estimators of the unit value and quantity equations can identify quality and Engel effects without contamination by the unobservable variations in market price. The within-cluster estimators can also be used to calculate the effect of measurement errors, because only spurious covariances and variances will exist within clusters. The demand system is estimated for inter-cluster variation in corrected unit values and quantities. For cross-price effects, the price of each good is allowed to influence the quantities chosen of every other good consumed by the households.

Since wealthier households will tend to buy higher-quality tobacco and alcohol products, the unit value of these goods will tend to be positively correlated with household income. Quality choice may also depend on both own- and cross-price effects. For instance, consumers may buy lower-quality cigarettes when the price of cigarettes increases, or they may buy lower-quality cigarettes because the prices of other goods have increased.

The rest of this section provides a more detailed account of the underlying model and estimation procedure of the Deaton method (the model is from Deaton (1997)). Let G denote groups of goods that are consumed by the households, p_G the price vector of the goods in the group and q_G the quantity vector so that $E_G = p_G . q_G . Q_G$ refers to the group quantity.

$$unit\ \ value\ (UV_G) = \frac{Expenditure\ on\ good\ G\ (E_G)}{Quantity\ of\ good\ G\ purchased\ (Q_G)} \qquad (4.1)$$

The budget share equation (equation (4.2)) and the unit value equation (equation (4.3)) are estimated in the first stage. Equation (4.2), presented below, is a standard double logarithmic demand function for the different goods that a household consumes. BS_{Ghc} is the budget share of the good, in the budget of household h, living in cluster c. x is household expenditure, $\boldsymbol{z}$ is a vector of household demographic characteristics and p_H represents the unobservable prices of the different commodities. f is the cluster-specific fixed effects, which represents among other things shared preferences, distance and weather. u^0_{Ghc} represents the household specific error term.

$$BS_{Ghc} = \alpha^0_G + \beta^0_G ln x_{hc} + \gamma^0_G . \boldsymbol{z}_{hc} + \sum_{H=1}^{M} \theta_{GH} \ln P_{Hc} + (f_{Gc} + u^0_{Ghc}) \qquad (4.2)$$

$$lnUV_{Ghc} = \alpha_G^1 + \beta_G^1 lnx_{hc} + \gamma_G^1 . \boldsymbol{z}_{hc} + \sum_{H=1}^{M} \psi_{GH} \ln P_{Hc} + u_{Ghc}^1 \quad (4.3)$$

Equation (4.3) is the unit value equation. $lnUV$ is the logarithm of the unit values, which is essentially the logarithm of quality plus the logarithm of price. Therefore, if there were no quality effects, unit values would move proportionately with prices. The cluster fixed effects term is not included in the unit value equation, because adding cluster fixed effects would break the direct link between prices and unit values.

Prices are assumed to be the same for all households in a cluster. $x \; and \; \boldsymbol{z}$ reflect respectively the effect of the household's living standards and demographics on choice of quality. Among other things, u_{Gic}^1 reflects measurement error. $u^0 \; and \; u^1$ are allowed to be correlated because measurement errors in the two equations are correlated. That is, prices and quantities are recalled imperfectly by respondents.

Equation (4.2) and equation (4.3) are estimated using OLS. The estimated $\beta \; and \; \gamma$ from the first stage are the estimates for these parameters. β_G^0, is the expenditure elasticity of quantity and β_G^1 the expenditure elasticity of quality. The residuals from each equation provide an indication of the pattern of the measurement error. In the second stage, the estimated $\beta \; and \; \gamma$ are used to define the corrected budget share and unit values. That is, the first stage estimates are used to calculate the village averages.

$$\tilde{y}_{Gc}^0 = n_c^{-1} \sum_{h \in c} (BS_{Ghc} - \tilde{\beta}_G^0 lnx_{hc} + \tilde{\gamma}_G^0 . \boldsymbol{z}_{hc}) \quad (4.4)$$

$$\tilde{y}_{Gc}^1 = n_c^{-1} \sum_{h \in c} (lnUV_{Ghc} - \tilde{\beta}_G^1 lnx_{hc} + \tilde{\gamma}_G^1 . \boldsymbol{z}_{hc}) \quad (4.5)$$

Cluster means are subtracted from all variables. As a result, the fixed effects and price effects are annihilated while allowing the consistent estimation of demographic and income effects. Subtracting the cluster mean (mean over all households in a cluster) from the variables leads to the dropping of price and cluster fixed effects which were measured at cluster level. n_c the number of households in cluster c, is used in the calculation of the cluster means. n_{cG}^+ is the number of households that have positive observations on both the budget share and unit value of good G.

Subsequently, I describe how the first and second stage estimates are used to construct a matrix $\boldsymbol{B}$ and generate the elasticity estimates. Let $\boldsymbol{S}$ be the between-village variance covariance matrix of y_G^1, $\boldsymbol{R}$ the covariance matrix of y_G^0 with y_G^1, $\boldsymbol{\Omega}$ the $cov(u_{Ghc}^1, u_{Hhc}^1)$, $\boldsymbol{\Gamma}$ the

$cov(u^1_{Ghc}, u^0_{Hhc})$ and $\boldsymbol{M}$ the variance covariance matrix of the unobservable logarithm of prices.

$$\boldsymbol{S} = \boldsymbol{\psi M \psi'} + \boldsymbol{N_+^{-1}\Omega} \quad (4.6)$$

$$\boldsymbol{R} = \boldsymbol{\psi M \Theta'} + \boldsymbol{N^{-1}\Gamma} \quad (4.7)$$

$\tilde{y}^0_{Gc}$ *and* $\tilde{y}^1_{Gc}$ can be used to provide consistent estimators for $\boldsymbol{R}$ *and* $\boldsymbol{S}$. $\boldsymbol{N_+^{-1}} = \text{plim}\, \boldsymbol{C^{-1}} \sum_{\boldsymbol{c}} \boldsymbol{D}(\boldsymbol{n_c^+})^{-1}$. $\boldsymbol{D}(.)$ converts vector arguments into a diagonal matrix such that $\boldsymbol{D}(\boldsymbol{n_c^+})$ is a diagonal matrix formed from elements of n^+_{cG}. $\widetilde{\boldsymbol{N}}_+^{-1} = \boldsymbol{C^{-1}} \sum_{\boldsymbol{c}} \{\boldsymbol{D}(\boldsymbol{n_c^+})\}^{-1}$ and $\widetilde{\boldsymbol{N}}_{\boldsymbol{A}}^{-1} = \boldsymbol{C^{-1}} \sum_{\boldsymbol{c}} \{\boldsymbol{D}(\boldsymbol{n_c})\}^{-1}$. From equation (4.6) and equation (4.7), it is evident that $\tilde{\boldsymbol{S}} - \widetilde{\boldsymbol{N}}_+^{-1}\widetilde{\boldsymbol{\Omega}}$ is a consistent estimator of $\boldsymbol{\psi M \psi'}$ and $\widetilde{\boldsymbol{R}} - \widetilde{\boldsymbol{N}}_{\boldsymbol{A}}^{-1}\widetilde{\boldsymbol{\Gamma}}$ a consistent estimator of $\boldsymbol{\psi M \Theta'}$.

$$\widetilde{\boldsymbol{B}} = (\tilde{\boldsymbol{S}} - \widetilde{\boldsymbol{N}}_+^{-1}\widetilde{\boldsymbol{\Omega}})^{-1} (\widetilde{\boldsymbol{R}} - \widetilde{\boldsymbol{N}}_{\boldsymbol{A}}^{-1}\widetilde{\boldsymbol{\Gamma}}) \quad (4.8)$$

$$\operatorname*{plim}_{\boldsymbol{C}\to\infty} \widetilde{\boldsymbol{B}} = (\boldsymbol{\psi'})^{-1}\boldsymbol{\Theta'} \quad (4.9)$$

$$\boldsymbol{\psi} = \boldsymbol{I} + \boldsymbol{D}(\boldsymbol{\beta^1})\boldsymbol{D}(\boldsymbol{e})^{-1}\boldsymbol{E} \quad (4.10)$$

$\boldsymbol{B}$ *and* $\boldsymbol{D}$ are asymptotically independent since the former uses between-cluster variation while the latter uses within-cluster variation in the data. $\boldsymbol{E}$, is the matrix of price elasticities and $\boldsymbol{e}$ is a vector of total expenditure elasticities. Equation (4.11) corrects $\widetilde{\boldsymbol{B}}$ using first-stage estimates and the result is a matrix $\boldsymbol{E}$, which contains estimates of own- and cross-price elasticities of demand. The expenditure elasticity of demand vector $\boldsymbol{e}$ is estimated by equation (4.13).

$$\boldsymbol{E} = \left[\boldsymbol{D}(\overline{\boldsymbol{BS}})^{-1}\boldsymbol{B'} - \boldsymbol{I}\right]\boldsymbol{\psi} = \left[\boldsymbol{D}(\overline{\boldsymbol{BS}})^{-1}\boldsymbol{B'} - \boldsymbol{I}\right][\boldsymbol{I} - \boldsymbol{D}(\varsigma)\boldsymbol{B'} + \boldsymbol{D}(\varsigma)\boldsymbol{D}(\overline{\boldsymbol{BS}})]^{-1} \quad (4.11)$$

$$where\ \varsigma_{\boldsymbol{G}} = [(\boldsymbol{1} - \boldsymbol{\beta_G^1})\overline{\boldsymbol{BS}}_{\boldsymbol{G}} + \boldsymbol{\beta_G^0}]^{-1}\boldsymbol{\beta_G^1} \quad (4.12)$$

$$\boldsymbol{e} = \boldsymbol{\iota} - \boldsymbol{\beta^1} + \boldsymbol{\beta^0}\boldsymbol{D}(\overline{\boldsymbol{BS}})^{-1} \quad (4.13)$$

In summary, the estimation procedure involves a first-stage estimation of the parameters of the budget share and unit value equations. In the second stage, the first-stage parameters are used to estimate part of the mean unit values and cluster shares that were not accounted for in the first stage. The parameters from the first and second stage are then used to estimate $\widetilde{\boldsymbol{B}}$ which is then corrected using the first stage estimates, to come up with estimates of the price elasticities of demand. The variance covariance matrix for estimated elasticities is then obtained through bootstrapping.

4.3.2 Regressivity/progressivity of household tobacco and alcohol budget shares

The concentration curves/index and the Lorenz curve and Gini coefficient are used to estimate the change in the progressivity/regressivity of household tobacco and alcohol burdens. This method of estimating progressivity/regressivity is based on Kakwani (1977) and has been used by studies such as Koch (2018) to evaluate the impact of tobacco control policies on household tobacco burdens. The procedure provided here is from O'Donnell *et al.* (2008). The Lorenz curve and Gini coefficient are first estimated using *per capita* household expenditure. *Per capita* household expenditure is used as a measure of the household's ability to pay.

Once the households are ranked according to their ability to pay, the concentration curves are then plotted. The concentration curves display the budget shares accounted for by the cumulative proportions of households that are ranked from the poorest to the richest. If the concentration curve dominates (lies above) the Lorenz curve, then the budget share of that product is regressive. That means that the expenditure burden of that product is higher for poorer households.

Visual dominance may not always be established, because in some instances the concentration curve may cross that Lorenz curve. In such cases, the Kakwani index (see Kakwani (1977)) can be used to determine progressivity/regressivity. The Kakwani index (KI) is twice the area between a concentration curve and the Lorenz curve. It can be calculated as the difference between the concentration index (CI) and the Gini coefficient (GC) that is $KI = CI - GC$. The Kakwani index ranges from -2 to 1. A negative index implies regressivity, zero implies proportionality, and a positive index implies progressivity. The Kakwani index is useful for the comparison of regressivity/progressivity across time and countries.

4.4 Description of the Data

The data for the study was obtained from the two most recent household budget surveys conducted by KNBS, the Kenya Integrated Household and Budget Surveys (KIHBs) of 2005-2006 and 2015-2016.

The 2005-2006 KIHBS set out to collect data from 13,430 (1,343) households (clusters) in both urban and rural sections for each of Kenya's 69 districts. Inaccessibility and insecurity meant that only 1,339 clusters were visited during the data collection period. This resulted in a final sample of 13,158 households. 16.1% of the sampled households purchased tobacco products while 12.6% purchased alcohol. Based on the sample design, it was estimated that

15.8% of Kenyan households purchased tobacco products and 12.2% purchased alcohol in 2005-2006.

The sampled households, in both KIHBSs, were issued with diaries in which they recorded their consumption of and expenditure on food and non-food items. Each household recorded the quantity obtained and amount paid for the items that they purchased. The Deaton method relies on unit values, which are the expenditures per unit on each product, in the estimation of price elasticity of demand. Therefore, this chapter focused on the households that purchased the relevant products when estimating the price elasticity of demand.

Table 4.1 provides the descriptive statistics of those households in the 2005-2006 KIHBS that purchased tobacco and alcohol products. In the 2005-2006 KIHBS, tobacco products were classified into cigarettes, unprocessed tobacco, processed tobacco, cigars, and snuff while alcohol was classified into spirits, wine, beer, traditional brews and ciders. This chapter used the 2005-2006 KIHBS data on cigarettes, unprocessed tobacco, snuff tobacco, and traditional brews. Traditional brews referred to *chang'aa* and other traditional beers such as *busaa* and *muratina*.

8% of the households purchased traditional brews, 9% purchased cigarettes and over 3% purchased snuff and unprocessed tobacco. Traditional brews, snuff and unprocessed tobacco were mostly purchased by rural households. The share of rural and urban households that purchased cigarettes was between 9% and 10%. 22.46% of households that purchased cigarettes also purchased traditional brews while 26% of households that purchased traditional brews also purchased cigarettes. In addition, 11.29% of households that purchased unprocessed tobacco also purchased cigarettes.

Table 4.1 Characteristics of households that purchased relevant tobacco and alcohol products (2005-2006 KIHBS)

Statistic	Cigarettes	Unprocessed Tobacco	Snuff Tobacco	Traditional Brews
Number of households that purchased the product	1,242	425	400	1,061
Percentage of households that purchased the product	9.44%	3.23%	3.04%	8.06%
Percentage of households in rural areas that purchased the product	9.03%	4.70%	4.39%	10.25%
Percentage of households in Urban areas that purchased the product	10.19%	0.58%	0.60%	4.10%
Average Monthly household expenditure[26] (in USD)[27]	209.23	106.27	108.39	125.12
Average monthly expenditure on product among purchasing households (in USD)	7.21	1.08	1.30	6.74
Average expenditure share on product in total household expenditure[28]	4.96%	1.46%	1.72%	6.45%
Average household size	4.76	5.72	6.05	5.64
Percentage of adults in the household	64.21%	54.95%	55.30%	56.08%
Percentage of male adults in the household[29]	59.80%	50.25%	45.26%	53.78%
Average age of adults	36.50	42.65	44.38	38.83
Average number of children below 15 years	1.90	2.40	2.74	2.46
Average age of household head	43.47	52.05	54.02	47.38
Share of male headed households	89.05%	73.65%	70.50%	83.60%
Number of people employed	1.22	1.09	1.06	1.09
Share of households where most educated person has post primary education	41.73%	17.43%	19.25%	32.53%
Share of households where most educated person has at least 5 years of education	91.81%	71.66%	72.67%	87.07%
Number of clusters	720	219	198	542
Average number of households per cluster	1.7	1.9	2.0	2.0
Maximum number of households per cluster	7	9	8	9

Note: Data from the 2005/2006 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these statistics.

The 2015-2016 KIHBS targeted 2,400 clusters in the rural and urban areas of each of Kenya's 47 Counties[30]. The targeted number of households was 24,000, but, due to insecurity and inaccessibility, the final number of households surveyed was 21,773. Tobacco products were purchased by 11.5% of the sampled households while 13.3% of households purchased alcohol. This was extrapolated, based on the sample design, to an estimate that 10.7% of Kenyan households purchased tobacco products while 14.0% purchased alcohol in 2015-2016. Although, the proportion of alcohol-purchasing households had increased slightly over ten

[26] Differs from what was reported by KNBS. KNBS only included expenditure categories they deemed necessary for poverty calculation.
[27] Converted 2005/2006 KSH using end of period exchange rate (December 2005) reported by the Central Bank of Kenya. Exchange rate was 72.36 KSH to 1 USD.
[28] Includes only households that purchased the relevant alcohol or tobacco product.
[29] Calculated as the number of male adults/number of adults multiplied by 100.
[30] A new constitution in 2010 created 47 devolved units called Counties.

years, the share of tobacco purchasing households had declined by around five percentage points.

The 2015-2016 KIHBS had only two classifications for tobacco products. Household purchases of tobacco were recorded as either cigarettes and cigars or unprocessed/pipe/snuff tobacco. Alcohol was classified into beers (lagers and stouts), other beers, traditional beers, vodka, whisky, rum, brandy, other spirits, *chang'aa*, wine, sparkling wines and fortified wines. The analysis in this chapter focused on cigarettes, *chang'aa*, beers, traditional beers, and *khat.*

The statistics on tobacco use from the 2015-2016 KIHBS are similar to the Global Adult Tobacco Survey on Kenya done in 2014 (GATS 2014). GATS 2014, which surveyed individuals, found an overall tobacco-use prevalence of 11.6%. The prevalence of smoking tobacco was 7.5% and that of smokeless tobacco was 4.5%. The proportion of households that purchased tobacco in KIHBS 2015-2016 was 11.5%, and 7.9% of the sampled households purchased cigarettes and cigars.

The descriptive statistics of the households that purchased the relevant tobacco and alcohol products, as well as those who purchased *khat*, are presented in Table 4.2. 7.9% of households purchased cigarettes, 4.5% purchased beer, 4.2% purchased traditional beers, 3.8% purchased *chang'aa*, and 2.8% purchased *khat*. 23% of households that purchased *chang'aa* also purchased traditional beers while 21% of households that purchased traditional beers also purchased *chang'aa*. 10% of households that purchased *khat* purchased beer and 37% of households that purchased *khat* also purchased cigarettes. Further, 13% of households that purchased cigarettes also purchased *khat.*

Table 4.2 Characteristics of households that purchased relevant tobacco and alcohol products as well as Khat (2015-2016 KIHBS)

Statistic	Cigarettes	*Chang'aa*	Beers	Traditional Beers	*Khat*
Number of households that purchased the product	1,719	831	985	915	601
Percentage of households that purchased the product	7.90%	3.82%	4.52%	4.20%	2.76%
Percentage of households in rural areas that purchased the product	7.97%	4.69%	3.30%	5.31%	2.55%
Percentage of households in Urban areas that purchased the product	7.78%	2.50%	6.37%	2.53%	3.08%
Average Monthly household expenditure[31] (in USD)[32]	214.49	200.41	339.70	176.19	228.84
Average monthly expenditure on product among purchasing households (in USD)	8.93	12.26	38.44	10.13	22.09
Average expenditure share on product in total household expenditure[33]	4.71%	8.58%	12.03%	5.93%	10.30%
Average household size	4.02	4.75	3.40	4.72	4.46
Percentage of adults in the household	68.15%	60.14%	73.07%	60.26%	62.49%
Percentage of male adults in the household	65.43%	58.11%	64.15%	56.76%	62.15%
Average age of adults	39.69	40.17	37.41	40.52	34.53
Average number of children below 15 years	1.56	2.04	1.17	2.05	2.04
Average age of household head	45.62	47.44	42.23	47.97	39.89
Share of male headed households	90.52%	83.27%	89.24%	80.44%	85.69%
Number of people employed	1.78	1.87	1.71	1.81	1.49
Share of households where most educated person has post primary education	48.56%	41.65%	66.26%	39.91%	42.62%
Number of clusters	1,034	506	657	511	404
Average number of households per cluster	1.7	1.6	1.5	1.8	1.8
Maximum number of households in a cluster	6	7	7	8	9

Note: Data from the 2015/2016 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these statistics.

The proportion of households that consumed tobacco and alcohol in each quartile is presented in Table 4.3 and Table 4.4. The households are grouped into quartiles based on *per capita* household expenditure. Between 2005-2006 and 2015-2016, there was a decline in the share of households that consumed tobacco. The largest decline occurred among households in the bottom quartile. There was an overall increase in the share of households that consumed alcohol over the same period. The increase in the share of alcohol-consuming households was driven by increase in consumption among households in the top quartile.

[31] Generated by author.

[32] Converted 2015/2016 KSH using end of period exchange rate (December 2015) reported by the Central Bank of Kenya. Exchange rate was 102.31 KSH to 1 USD.

[33] Includes only households that purchased the relevant alcohol or tobacco product.

Table 4.3 Share of tobacco/alcohol consuming households in each quartile (2005-2006 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco	Snuff	Alcohol	Traditional brews	Beers	Spirits	*Khat*
Quartile 4	13.22%	12.23%	0.71%	0.46%	16.09%	4.03%	11.10%	3.00%	1.83%
Quartile 3	15.86%	11.94%	2.39%	1.74%	13.12%	8.68%	4.20%	0.94%	1.90%
Quartile 2	16.06%	9.36%	3.64%	3.47%	11.33%	10.09%	1.09%	0.33%	1.27%
Quartile 1	20.21%	7.28%	4.91%	5.88%	12.78%	12.19%	0.37%	0.16%	1.04%
Full Sample	16.37%	10.19%	2.95%	2.91%	13.25%	8.84%	4.02%	1.08%	1.51%
Sample Size	**2,237**	**1,253**	**478**	**427**	**1,804**	**1,172**	**568**	**170**	**297**

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.

Table 4.4 Share of tobacco/alcohol consuming households in each quartile (2015-2016 KIHBS)

	Tobacco	Cigarettes	Other tobacco[#]	Alcohol	Traditiona l beers	*Chang'aa*	Beers	Spirits	*Khat*
Quartile 4	10.18%	9.71%	1.19%	21.68%	2.91%	2.09%	12.08%	7.31%	2.97%
Quartile 3	10.76%	8.70%	2.51%	12.46%	3.45%	4.28%	4.35%	2.20%	2.50%
Quartile 2	10.99%	7.32%	3.78%	11.52%	4.77%	4.41%	2.36%	1.52%	2.83%
Quartile 1	10.70%	3.87%	6.55%	9.95%	5.09%	5.14%	0.39%	0.36%	1.38%
Full Sample	10.68%	7.73%	3.19%	14.72%	3.90%	3.78%	5.60%	3.33%	2.50%
Sample Size	**2,551**	**1,645**	**985**	**3,081**	**1,031**	**875**	**1,016**	**576**	**747**

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. # Refers to unprocessed, snuff and pipe tobacco.

The average budget shares of the different tobacco and alcohol products, by quartiles are presented in Table 4.5 and Table 4.6. The budget shares presented below are only for those households that reported a positive consumption of the respective tobacco/alcohol products. The value of consumption of each good was used to generate the budget shares. There was a slight decline in the average budget share of cigarettes between 2005-2006 and 2015-2016. However, whereas the budget share of cigarettes declined among the poorest smoking households, it increased among some richer smoking households. The budget share of alcohol also decreased among the poorest alcohol-consuming households and increased among relatively wealthier alcohol-consuming households. The alcohol product that had the largest increase in household budget share over the ten-year period was spirits.

Table 4.5 Weighted Average household budget shares of tobacco/alcohol products by quartile (2005-2006 KIHBS)

	Tobacco	Cigarettes	Unprocessed tobacco	Snuff	Alcohol	Traditional brews	Beers	Spirits	Khat
Quartile 4	4.64%	4.86%	1.55%	1.35%	11.04%	7.05%	11.23%	6.39%	12.23%
Quartile 3	3.78%	4.49%	1.12%	1.63%	8.91%	6.57%	11.92%	7.17%	11.20%
Quartile 2	3.83%	5.47%	1.18%	1.44%	6.77%	6.31%	10.11%	4.28%	12.00%
Quartile 1	3.50%	5.62%	2.14%	1.74%	7.78%	7.54%	15.58%	7.96%	14.56%
Full Sample	3.87%	5.02%	1.58%	1.61%	8.76%	6.87%	11.44%	6.46%	12.23%
Sample Size	**2,237**	**1,253**	**478**	**427**	**1,804**	**1,172**	**568**	**170**	**297**

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.

Table 4.6 Weighted Average household budget share of different tobacco/alcohol products by quartile (2015-2016 KIHBS)

	Tobacco	Cigarettes	Other tobacco#	Alcohol	Traditional beers	*Chang'aa*	Beers	Spirits	*Khat*
Quartile 4	4.41%	4.71%	1.31%	13.10%	7.29%	9.43%	12.60%	10.56%	8.99%
Quartile 3	4.59%	5.32%	1.67%	9.61%	5.63%	8.70%	9.39%	9.01%	9.17%
Quartile 2	3.38%	4.31%	1.27%	8.61%	5.59%	8.42%	9.41%	8.38%	10.20%
Quartile 1	3.29%	4.99%	2.16%	6.99%	4.72%	7.88%	7.33%	5.95%	8.15%
Full Sample	4.01%	4.82%	1.73%	10.74%	5.78%	8.53%	11.60%	9.98%	9.25%
Sample Size	**2,551**	**1,645**	**985**	**3,081**	**1,031**	**875**	**1,016**	**576**	**747**

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. **#** Refers to unprocessed, snuff and pipe tobacco.

4.4.1 Unit Values

The surveyed households in the KIHBSs used different units of measurement for the different products they purchased. The unit values for this study were calculated for households that provided information on the purchased quantity of cigarette as sticks/pack, other tobacco products and *khat* in gram and kilogram equivalent and alcohol products in millilitre and litre equivalent. The raw unit values were then inspected for possible outliers. Following Cox and Wohlgenant (1986), Gibson and Rozelle (2005) and Selvaraj *et al.* (2015) the few unit values that were more than five standard deviations from their respective means were dropped.

The breakdown of the outliers among the unit values of the different products calculated from the 2005-2006 KIHBS were as follows: there were two outliers among the calculated unprocessed tobacco unit values, two for snuff, three for traditional brews, and fourteen for cigarettes. The summary statistics for the remaining unit values, calculated from the 2005-2006 KIHBS, are presented in Table 4.7.

Table 4.7 Unit Values for tobacco and alcohol products (2005-2006 KIHBS)

Statistic	Cigarettes	Unprocessed Tobacco	Snuff Tobacco	Traditional Brews
Average quantity purchased in a week	41.24 sticks	83.82 grams	39.23 grams	5.46 litres
	(2.077)	(19.420)	(6.885)	(0.448)
Median quantity purchased in a week	28 sticks	50 grams	20 grams	3 litres
Average weekly expenditure in KSH	115.41	15.01	19.89	125.66
	(7.502)	(1.300)	(1.479)	(10.064)
Median weekly expenditure in KSH	70.00	10.00	15.00	70.00
Average unit value	3.74 per stick	0.50 per gram	0.84 per gram	31..74 per litre
	(0.324)	(0.051)	(0.050)	(1.666)
Median unit value	2.50 per stick	0.222 per gram	1.00 per gram	20.00 per litre
Number of households	1,133	229	232	696
Number of clusters	671	108	122	367
Average number of households per cluster	1.7	2.1	1.9	1.9
Maximum number of households per cluster	7	9	8	9
Number of districts	69	38	34	59
Average number of households per district	16.4	6.0	6.8	11.8

Notes: Data from the 2005-2006 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these statistics. Clustered Standard errors are in brackets. For comparison, the average price of a pack of Sportsman cigarettes in 2005 and 2006 was Ksh. 63.37 and Ksh 67.90 respectively. This translated to an average price per stick of Ksh. 3.17 and Ksh. 3.40 respectively

The unit values from the 2015-2016 KIHBS are presented in Table 4.8. The outliers in the 2015-2016 KIHBS unit values were: two for beers, three for traditional beers, three for *chang'aa*, five for *khat*, and eighteen for cigarettes. The average number of cigarettes smoked per week declined from 41 to 37 between 2005-2006 and 2015-2016. In both surveys, the median number of cigarettes smoked was 28 sticks per week. The average volume of traditional brews consumed per household also declined over the ten-year period. Among households that consumed traditional brews, the median consumption per week decreased from 3 litres to 2 litres.

The average and median unit value per litre of beer from the 2015-2016 KIHBS was around Ksh. 300. The unit values were deemed plausible because the average price of Tusker (a commonly consumed formally-produced beer in Kenya) in 2015 and 2016 was Ksh. 276 per litre and Ksh. 312 per litre respectively. Similarly, the unit values for cigarettes, calculated from the 2015-2016 survey, matched the prevailing prices of cigarettes at the time of the survey. The average and median unit values for cigarettes were Ksh. 6.63 and Ksh. 5.00 respectively, while the average price of a stick of Sportsman cigarettes was Ksh. 4.98 in 2015 and Ksh. 6.07 2016.

Table 4.8 Unit Values for cigarettes, khat and alcohol products (2015-2016 KIHBS)

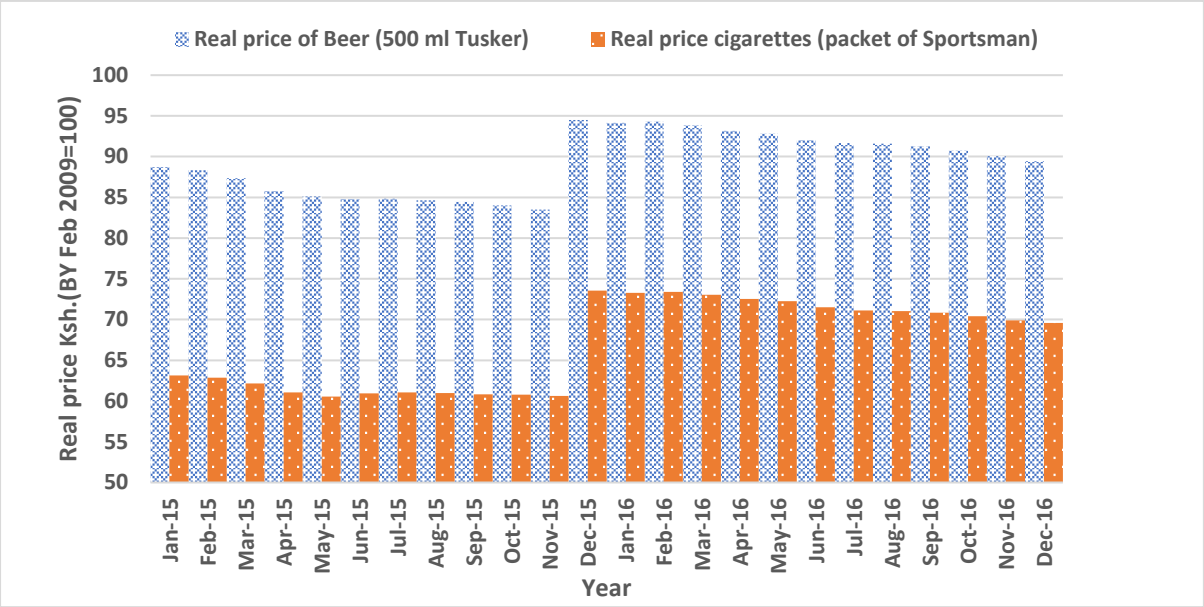
Statistic	Cigarettes	*Chang'aa*	Beers	Traditional Beers	*Khat*
Average quantity purchased in a week	36.82 sticks (1.344)	1.73 litres (0.119)	3.41litres (0.198)	3.95 litres (0.200)	0.90 Kgs (0.072)
Median quantity purchased in a week	28 sticks	1 litre	2 litres	2.5 litres	0.60 Kgs
Average weekly expenditure in KSH	208.56 (7.860)	304.53 (14.458)	929.77 (50.115)	240.47 (15.597)	449.29 (36.771)
Median weekly expenditure in KSH	140.00	200.00	600.00	120.00	300.00
Average unit value	6.63per sick (0.263)	237.37 per litre (9.200)	313.94 per litre (9.983)	71.16 per litre (3.237)	752.16 per Kg (49.200)
Median unit value	5.00 per stick	194.44 per litre	300.00 per litre	50.00 per litre	500.00 per Kg
Number of households	1,100	814	941	885	574
Number of clusters	684	500	631	497	343
Average number of households per cluster	1.6	1.6	1.5	1.8	1.7
Maximum number of households per cluster	6	7	7	8	8
Number of Counties	44	35	44	40	35
Average number of households per County	25.0	23.3	21.4	22.1	16.4

Notes: Data from the 2015-2016 Kenya Integrated Household and Budget Survey (KIHBS) was used to generate these statistics. Clustered standard errors are in brackets. For comparison, the average price of a pack of sportsman cigarettes in 2015 and 2016 was Ksh. 99.58 and Ksh 121.42 respectively. This translated to an average price per stick of Ksh 4.98 and 6.07 respectively. The average price of 500ml Tusker in 2015 and 2016 was Ksh. 137.78 and Ksh. 156.19. This translated to an average price of Ksh. 275.56 and Ksh. 312.38 per litre respectively.

A new excise duty Act (Excise Duty Act 2015) came into operation on 1st December 2015. This coincided with the 2015-2016 KIHBS data collection period. The increase in the excise duty on cigarettes and some alcohol products resulted in an increase in the real price of some of the popular cigarette and beer brands. The real price of Sportsman cigarettes was significantly higher in the twelve months after the tax increase, and, as a result, the cigarette unit values for households interviewed after the tax increase were expected to be higher.

The real price of Tusker beer increased slightly after the tax, but within twelve months after the tax increase it had declined to pre-tax levels. The changes in real prices was expected to have an effect on the unit values reported by households that were interviewed after November 2015. Therefore, the change in excise tax laws was included in subsequent analysis. The monthly real prices of a pack of Sportsman cigarettes and a bottle of Tusker beer are presented in Figure 4.1.

Figure 4.1 Monthly real prices of cigarettes and beer 2015-2016



Notes: Generated using data from the Kenya National Bureau of Statistics

4.5 Empirical results

4.5.1 Expenditure and price elasticity of demand for tobacco and alcohol

The Deaton method uses spatial variation of prices in the estimation of the price elasticity of demand. Analysis of variance (ANOVA) was used to test whether unit values of *khat*, tobacco, and alcohol products varied geographically across Kenya. The ANOVA results are presented in Table 4.9 and Table 4.10. The results for cigarettes indicate that between 70% and 80% of price variation in unit values could be explained by cluster effects. This was similar to what John (2008b) and Chelwa (2015) found. The two studies found that around 70% of variation in unit values in India and Uganda were explained by cluster effects.

There was also spatial variation in unit values of *khat* and some of the other tobacco and alcohol products The ANOVA results presented below indicate that between 66% and 87% of variation in unit values of most products was due to cluster effects.

Table 4.9 Testing for spatial variation in unit values (2005-2006 KIHBS)

	Cigarettes	Unprocessed Tobacco	Snuff Tobacco	Traditional Brews
Variation Across Clusters				
F Statistic	2.23	3.59	2.58	3.28
P Value	0.0000	0.0000	0.0000	0.0000
R-Squared	0.764	0.761	0.740	0.785
Variation Across Districts				
F Statistic	4.16	3.34	3.70	5.84
P Value	0.0000	0.0000	0.0000	0.0000
R-Squared	0.210	0.393	0.381	0.347
Sample Size	1,133	229	232	696

Notes: These results are from the analysis of variance in unit values that test for the presence of spatial variation across clusters and districts. The null hypothesis of no spatial variation in unit values is rejected at p<0.01 for all products.

Table 4.10 Testing for spatial variation in unit values (2015-2016 KIHBS)

	Cigarettes	*Chang'aa*	Beers	Traditional Beers	*Khat*
Variation Across Clusters					
F Statistic	4.37	1.23	2.94	5.62	3.58
P Value	0.0000	0.0241	0.0000	0.0000	0.0000
R-Squared	0.878	0.661	0.857	0.878	0.841
Variation Across Counties					
F Statistic	4.46	3.91	4.40	10.24	4.97
P Value	0.0000	0.0000	0.0000	0.0000	0.0000
R-Squared	0.152	0.146	0.174	0.321	0.239
Sample Size	1,100	814	941	885	574

Notes: These results are from the analysis of variance in unit values that test for the presence of spatial variation across clusters and districts. The null hypothesis of no spatial variation in unit values is rejected at p<0.05 for all products.

The next step in the Deaton method involves estimation of the within cluster budget share and unit value equations (equations (4.2) and (4.3)). The results for the unit value regression are presented in Table 4.11 and Table 4.12. There were quality effects for cigarettes, snuff tobacco, traditional brews, beers, and *khat*. Households with higher total household expenditures, had higher unit values for most of the products. The cigarette expenditure elasticity of quality for the two surveys was 0.17 and 0.10. This implied that the unit values increased by approximately 1.0% and 1.7% for every 10% increase in total household expenditure.

The cigarette expenditure elasticities of quality were in the range reported by previous studies. John (2005, 2008b) Chen and Xing (2011) Guindon *et al.* (2011) and Chelwa (2015) report quality elasticities of cigarettes between 0.11 and 0.34. The tax dummy in the regression results from the 2015-2016 KIHBS captures the effects of the excise duty act that came into effect in December 2015. There was a significant difference in unit values between households that were surveyed before the Act came into effect and those that were surveyed after.

The cigarette unit values were higher for households that were surveyed after the new excise tax on cigarettes was implemented. The introduction of a new, higher, specific tax that was applicable to all cigarette brands resulted in an increase in the prices of most cigarette brands. This may be the reason why, on average, the cigarette unit values reported by households surveyed after November 2015 were significantly higher.

The unit values for beers were lower after the implementation of the new excise duty act. The switching of beer consumers from premium brands to cheaper beers, made from sorghum, millet or cassava, may be a reason for the lower unit values. The new excise tax rate was applicable to wines, spirits, and beers made from barley (e.g. Tusker). Beers that were made from made from sorghum, millet or cassava that was grown in Kenya were exempt from the new excise tax rates.

East African Breweries Limited (2018) reported that, in 2016, sales from of Senator Keg, a popular beer made from sorghum, more than trebled. They reported a net alcohol sales growth of 16% in the financial year 2015/2016. The growth excluding Senator Keg was 4.5%, with net sales of Tusker beer and other premium brands decreasing by 6%.

The increase in consumption of the significantly cheaper Senator Keg, (the real price of Senator Keg in 2015/2016 was approximately Ksh. 48 to Ksh 60 per liter) may have been one of the factors that contributed to lower beer unit values for households surveyed after November 2015. The unit values for traditional beers was higher for households that were surveyed after the tax increase. This may have been a result of an increased demand for traditional beers by households that could no longer afford formally produced alcohol.

Table 4.11 Results from the unit value regressions (2005-2006 KIHBS)

VARIABLES	ln *UV* Cigarettes	ln *UV* Unprocessed Tobacco	ln *UV* Snuff#	ln *UV* Traditional Brews#
Log of total household expenditure	0.172***	-0.00689	0.212**	0.140*
	(0.0391)	(0.158)	(0.0973)	(0.0754)
Proportion of adults	-0.0741	0.412	-0.810	-0.0659
	(0.0634)	(0.770)	(0.556)	(0.358)
Log of household size	0.0850	0.180	-0.132	-0.444**
	(0.163)	(0.369)	(0.320)	(0.205)
Number of people employed	-0.0564**	-0.125	-0.0732	0.0362
	(0.0284)	(0.156)	(0.0501)	(0.0386)
Average age of adults	-0.00665**	0.00357	-0.0108	-0.0115
	(0.00320)	(0.0140)	(0.0101)	(0.00862)
Number of children below 15 years	0.0162	-0.0731	-0.0466	0.0517
	(0.0225)	(0.109)	(0.0636)	(0.0351)
Age of household head	-0.000140	-0.00909	0.0108	0.00552
	(0.00230)	(0.0123)	(0.00784)	(0.00737)
Education	0.0164*	-0.00411	-0.00266	-0.00151
	(0.00899)	(0.0551)	(0.0219)	(0.0136)
Female household head	-0.0837	-0.461	0.0609	-0.126
	(0.0600)	(0.316)	(0.151)	(0.112)
Percentage of male adults	0.000429	-0.0164***	0.00174	-0.00345
	(0.00119)	(0.00497)	(0.00385)	(0.00249)
Constant	-0.401	0.0342	-1.500*	2.908***
	(0.379)	(1.421)	(0.846)	(0.598)
Sample size	1,096	186	178	652
R-squared	0.063	0.092	0.071	0.046

Notes: Results for the regression of log of unit values on log of total household expenditure and other household characteristics. #The unit value regression was not significant. Education refers to years of education for most educated household member. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.12 Results from the unit value regressions (2015-2016 KIHBS)

VARIABLES	ln *UV* Cigarettes	ln *UV* Beer	ln *UV* Traditional beers	ln *UV* *Chang'aa*[#]	ln *UV* *Khat*
Log of household total expenditure	0.104**	0.281***	0.319***	0.00454	0.226***
	(0.0449)	(0.0441)	(0.0616)	(0.0519)	(0.0831)
Share of Adults in a household	0.110	-0.0191	0.127	-0.274	0.0106
	(0.159)	(0.258)	(0.308)	(0.374)	(0.473)
Log of household size	-0.0327	-0.139*	0.0256	-0.00295	0.243
	(0.0695)	(0.0765)	(0.145)	(0.102)	(0.198)
Number of people employed	-0.0165	-0.0233	-0.0583**	0.0293	-0.0282
	(0.0175)	(0.0239)	(0.0277)	(0.0376)	(0.0590)
Average age of adults	-0.000629	0.00569	0.00445	0.00545	-0.00951
	(0.00420)	(0.00370)	(0.00494)	(0.00534)	(0.0122)
Number of children below 15 years	0.0144	0.0476	-0.0216	-0.0329	-0.141**
	(0.0203)	(0.0386)	(0.0303)	(0.0469)	(0.0559)
Age of household head	-0.000992	-0.00715**	-0.000434	-0.00592	-0.00286
	(0.00356)	(0.00321)	(0.00428)	(0.00509)	(0.00831)
Education					
High school/post primary vocational	0.0468	0.0441	-0.00374	-0.0587	-0.0579
	(0.0447)	(0.0552)	(0.0787)	(0.0568)	(0.116)
Post high school	0.0418	0.0894	-0.112	-0.111	-0.374
	(0.0617)	(0.0643)	(0.108)	(0.129)	(0.246)
Female household head	-0.0217	0.0140	0.0978	-0.195**	-0.148
	(0.0706)	(0.0697)	(0.0888)	(0.0875)	(0.153)
Percentage of male adults	0.0000043	-0.00156	0.00243*	-0.00138	-0.00178
	(0.00123)	(0.00102)	(0.00146)	(0.00167)	(0.00304)
After tax increase	0.246***	-0.130**	0.186***	-0.0167	-0.191
	(0.0405)	(0.0508)	(0.0640)	(0.0685)	(0.127)
Constant	0.541	3.103***	0.507	5.632***	-2.073**
	(0.471)	(0.415)	(0.573)	(0.663)	(0.938)
Sample size	1,077	928	832	779	530
R-squared	0.081	0.169	0.099	0.033	0.098

Notes: results for the regression of log of unit values on log of total household expenditure and other household characteristics. **#** The unit value regression was not significant. Education refers to education level of most educated household member. Reference group for education was primary and below/other. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The results of the budget share regression are reported in Table 4.13 and Table 4.14. The budget shares of cigarettes, unprocessed tobacco, and *chang'aa* was lower for households with higher total household expenditures. Households with older adults spent more on snuff tobacco. Other factors that influenced the budget shares were the age of the household head, household size, and proportion of male adults. The results from the budget share regression also indicated that unobservable cluster-level factors which may include prices, tastes/preferences, and weather influenced the budget shares that households allocated to *khat* and to alcohol and tobacco products.

Table 4.13 Results from the budget share regressions (2005-2006 KIHBS)

VARIABLES	BS Cigarettes	BS Unprocessed Tobacco	BS Snuff	BS Traditional Brews
Log of household total expenditure	-2.983**	-0.611***	-0.379	-0.165
	(1.252)	(0.201)	(0.660)	(0.921)
Proportion of Adults	3.082	-0.248	1.792	2.669
	(3.504)	(1.044)	(1.102)	(4.103)
Log of household size	1.163	-0.597*	0.157	-3.181*
	(1.759)	(0.357)	(0.812)	(1.855)
Number of people employed	-0.712	0.0480	-0.746	0.128
	(0.480)	(0.130)	(0.545)	(0.557)
Average age of adults	0.0453	-0.00862	0.0521**	-0.0250
	(0.0787)	(0.0144)	(0.0234)	(0.0914)
Number of children below 15 years	0.170	0.0179	0.0471	0.600
	(0.383)	(0.110)	(0.144)	(0.472)
Age of household head	-0.0408	-0.00243	-0.0349*	0.00980
	(0.0496)	(0.0101)	(0.0210)	(0.0641)
Education	0.218	-0.00617	-0.0741	-0.347*
	(0.243)	(0.0405)	(0.0786)	(0.201)
Female household head	-0.389	-0.179	0.149	-1.741
	(1.367)	(0.256)	(0.314)	(1.096)
Percentage of male adults	0.0495*	0.000641	0.0143*	-0.0152
	(0.0275)	(0.00649)	(0.00823)	(0.0266)
Constant	24.92**	8.060***	3.821	14.15*
	(10.32)	(1.899)	(4.270)	(8.443)
Cluster Fixed Effects	Yes	Yes	Yes	Yes
Sample size	1,188	361	321	985
R-squared	0.634	0.788	0.626	0.688

Notes: Results for the regression of budget shares on log of total household expenditure and other household characteristics and cluster fixed effects. The coefficients were multiplied by 100 for convenience of reporting. Education refers to years of education for most educated household member. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.14 Results from the budget share regressions (2015-2016 KIHBS)

VARIABLES	BS Cigarettes	BS Beers	BS Traditional Beer	BS *Chang'aa*	BS *Khat*
Log of household total expenditure	-2.205***	3.122*	-0.922	-2.246**	0.570
	(0.550)	(1.627)	(0.880)	(1.116)	(0.813)
Proportion of adults	0.187	2.837	-1.920	0.906	-1.161
	(1.988)	(8.320)	(3.955)	(2.996)	(3.819)
Log of household size	-2.732***	-6.262*	-0.185	-1.575	-0.992
	(0.986)	(3.480)	(1.411)	(1.890)	(1.717)
Number employed	0.365	0.525	-0.118	0.239	0.0770
	(0.264)	(0.933)	(0.514)	(0.475)	(0.374)
Average age of adults	-0.0716	0.0868	0.0205	0.0736	-0.0348
	(0.0458)	(0.123)	(0.0486)	(0.0804)	(0.0555)
Number of children below 15 years	0.440*	0.898	-0.492	0.361	0.434
	(0.266)	(1.207)	(0.517)	(0.436)	(0.388)
Age of household head	0.0256	-0.0362	-0.0398	-0.0624	-0.0462
	(0.0349)	(0.109)	(0.0431)	(0.0589)	(0.0521)
Education					
High school/post primary vocational	-0.325	0.0636	-0.954	-0.276	-0.375
	(0.509)	(1.673)	(1.169)	(1.054)	(0.916)
Post high school	-0.683	-2.704	-2.445	-0.987	0.992
	(0.838)	(2.148)	(2.288)	(1.408)	(1.492)
Female household head	-0.383	0.294	0.916	0.187	-0.929
	(0.697)	(2.778)	(0.949)	(1.370)	(1.173)
Percentage of male adults	-0.000144	-0.0233	0.0219	0.0606**	0.0449**
	(0.0154)	(0.0359)	(0.0200)	(0.0255)	(0.0214)
Constant	30.16***	-18.11	17.37**	26.65***	0.581
	(5.960)	(17.18)	(8.606)	(9.580)	(8.625)
Cluster Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sample size	1,683	928	862	796	702
R-squared	0.789	0.794	0.782	0.743	0.780

Notes: Results for the regression of budget shares on log of total household expenditure and other household characteristics and cluster fixed effects. The coefficients were multiplied by 100 for convenience of reporting. Education refers to level of education for most educated household member. Reference group for education was primary and below/other. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The next stage in the estimation of price elasticities using the Deaton method involves using the between-cluster information to estimate the price elasticity of demand. The estimated effects of the household characteristics in the first stage were stripped from the budget shares and unit values. The stripped-down unit values and budget shares were then averaged by cluster to create cluster-level observations.

Next, the cluster-level observations were stripped of seasonal and regional effects (in this case region refers to the eight provinces that existed prior to 2010). The inter-cluster variance and covariance matrices (matrix $\boldsymbol{S}$ and matrix $\boldsymbol{R}$) were then generated, corrected for measurement error using residuals from the first stage regressions, and used to estimate the relevant price elasticities of demand.

The own- and cross-price elasticities of demand, estimated from the 2005-2006 KIHBS, are presented in Table 4.15 and Table 4.16. The diagonal elements in Table 4.16 are the

estimated own-price elasticities of demand, when the price of and demand for other products were considered. The element in the i^{th} column and the j^{th} row represents change in demand for good j when the price of good i changes.

The symmetry constrained estimates are the basis of the conclusions on cross-price elasticities of demand. Symmetry restriction guaranteed a unique complimentary/substitution relationship. It ruled out the possibility of good j being a complement of i, when good i was a substitute of good j. The results on the own-price elasticity of demand remain relatively unchanged with or without symmetry restriction.

The results on own-price elasticity of demand indicate that demand for cigarettes was price inelastic while demand for unprocessed tobacco had unity elasticity. The estimated own-price elasticity of demand for cigarettes in 2005-2006 was -0.63, while that of unprocessed tobacco was -1.00. These estimates are comparable to a study done on India using a similar method. John (2005) found that the own price elasticity of demand for *bidiis* in rural india was -1.01, leaf tobacco was -0.85 and cigarettes was -0.60.

The cross-price elasticity estimates indicate that other tobacco products and traditional brews were complements of cigarettes. This confirms the results from chapter 2 which found that tobacco expenditures crowded in expenditure on alcohol. However, only the cross-price elasticities of other tobacco products were significant.

An increase in the price of cigarettes was associated with a decline in the demand for snuff tobacco and unprocessed tobacco. Some past studies have also found complementarity between cigarettes and other tobacco products. John (2005, 2008b) and Selvaraj *et al.* (2015) found that *bidiis* and cigarettes were complements in India. Huang *et al.* (2018) also concluded that cigarettes and smokeless tobacco products were complements in the United States.

Table 4.15 Own price elasticities of demand for tobacco and beers

2005-2006 KIHBS		2015-2016 KIHBS	
Cigarettes	**Unprocessed Tobacco**	**Cigarettes**	**Beers**
-0.631***	-1.000***	-0.418	-1.126***
(0.178)	(0.142)	(0.373)	(0.037)

Notes: These are the estimated own elasticities estimated from the Kenya Integrated Budget and Household Survey (KIHBS). Each was estimated independently without considering the other tobacco/alcohol products. The bootstrapped standard errors from 1000 replications are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.16 Own and cross-price elasticities of demand (2005-2006 KIHBS)

	Cigarettes	Unprocessed Tobacco	Composite
Cigarettes	**-0.700**	0.000	0.871
	(7.233)	(0.003)	(13.630)
Unprocessed Tobacco	0.909	**-1.000*** **	-0.766
	(1.782)	(0.006)	(3.782)
Snuff	0.185	0.000	-0.389
	(0.653)	(0.009)	(1.770)
Traditional Brews	0.261	0.000	-0.230
	(1.003)	(0.004)	(1.939)
Composite	0.017	0.000	**-0.298**
	(0.118)	(0.0001)	(0.225)
Symmetry constrained			
Cigarettes	**-0.659**	0.000	0.487
	(0.513)	(0.00001)	(0.489)
Unprocessed Tobacco	-0.009***	**-1.000*** **	0.414***
	(0.0001)	(0.004)	(0.005)
Snuff	-0.711***	0.000	0.625
	(0.169)	(0.003)	(0.392)
Traditional Brews	-0.028	0.000	0.056
	(0.081)	(0.00002)	(0.502)
Composite	0.001	0.000	**-0.285*** **
	(0.009)	(0.00003)	(0.015)

Notes: These are the estimated own and cross-price elasticities estimated from the 2005-2006 KIHBS. The columns represent the good whose price is changing while the row represents the good whose demand is changing. The price of the goods whose unit value regressions were not significant were excluded from the output table. The bold figures represent the own price elasticities of demand. The bootstrapped standard errors from 1000 replications are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

The own- and cross-price elasticities of demand, estimated using the 2015-2016 KIHBS, are presented in Table 4.15 and Table 4.17. The estimated own-price elasticity of demand for cigarettes was -0.42. This estimate was also within the range reported by other studies done on developing countries (IARC, 2011). The price elasticity of demand for cigarettes had increased slightly over ten years.

The two estimated own-price elasticities of demand for cigarettes were also comparable studies done on Kenya using time series data. Kiringai *et al.* (2002) found that the short-run price elasticity of demand for all cigarettes and filter cigarettes in Kenya was -0.49 and -0.86 respectively while Okello (2001) found that the short-run price elasticity of demand for filter and plain cigarettes was -0.40 and -0.35 respectively.

The results for the cross-price elasticities of demand indicate that traditional beers, *chang'aa* and *khat* were complements for cigarettes. However, only the cross-price elasticities of demand for c*hang'aa* and *khat* were significant. An increase in the price of cigarettes was associated with a decline in the demand for *khat*. On the other hand, an increase in the price of beer was associated with an increase in demand for *chang'aa* and *khat*. This indicated that beer and *chang'aa* were consumed as substitutes.

The estimated own-price elasticity of demand for beer was -1.13. This estimate was comparable to that of a previous study done on Kenya using time series data. Okello (2001) found that the short-run price elasticity of demand for other beers (excluding Guinness) was -0.74 while the long-run price elasticity of demand was -1.11.

Table 4.17 Own and cross-price elasticities of demand (2015-2016 KIHBS)

	Cigarettes	**Beers**	**Traditional Beers**	**Composite**
Cigarettes	**-0.420*** **	-0.015	0.000	-0.118
	(0.091)	(0.088)	(0.130)	(0.157)
Beers	0.255***	**-1.098*** **	0.000	-0.359
	(0.073)	(0.079)	(0.352)	(0.414)
Chang'aa	0.179**	-0.358***	0.000	0.316
	(0.090)	(0.105)	(0.251)	(0.316)
Khat	-0.262	0.420***	0.000	-0.237
	(0.170)	(0.120)	(0.475)	(0.414)
Traditional Beers	0.676***	0.035	**-0.994*** **	-0.557
	(0.172)	(0.174)	(0.358)	(0.489)
Composite	0.082***	0.033**	0.000	**-0.492*** **
	(0.016)	(0.016)	(0.043)	(0.042)
		Symmetry constrained		
Cigarettes	**-0380*** **	0.365***	0.000	-0.538***
	(0.078)	(0.057)	(0.0001)	(0.094)
Beers	0.118***	**-1.112*** **	0.000	-0.207***
	(0.024)	(0.038)	(0.040)	(0.041)
Chang'aa	-0.004***	0.030***	0.000	0.110***
	(0.00004)	(0.0003)	(0.00005)	(0.0003)
Khat	-0.025***	0.020*	0.000	-0.074
	(0.008)	(0.012)	(0.002)	(0.046)
Traditional Beers	-0.014	0.048	**-0.994*** **	0.121
	(0.058)	(0.083)	(0.271)	(0.182)
Composite	0.031***	0.006	0.000	**-0.480*** **
	(0.004)	(0.004)	(0.008)	(0.009)

Notes: These are the estimated own and cross-price elasticities estimated from the 2015-2016 KIHBS. The columns represent the good whose price is changing while the row represents the good whose demand is changing. The price (demand) of the goods whose unit value (budget share) regressions were not significant were excluded from the output table. The bold figures represent the own price elasticities of demand. The bootstrapped standard errors from 1000 replications are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

The estimated expenditure elasticities of demand are presented in Table 4.18. The results show that all the products considered were normal goods. An increase in household expenditure (income) was associated with an increase in demand for tobacco and alcohol products. The results were in line with previous studies, which have concluded that the income elasticity of demand for tobacco was between zero and one (IARC, 2011). Similarly Gallet, (2007) in a meta-analysis reported a median of 0.69 for the income elasticity of demand for alcohol from 1,014 income elasticity estimates.

Table 4.18 Estimates of expenditure elasticities of demand

Expenditure elasticities of demand			
2005-2006 KIHBS		**2015-2016 KIHBS**	
Cigarettes	0.238	**Cigarettes**	0.455
Unprocessed tobacco	0.598	**Beers**	0.981
Snuff	0.569	***Chang'aa***	0.717
Traditional brews	0.835	***Khat***	0.854
		Traditional Beers	0.525

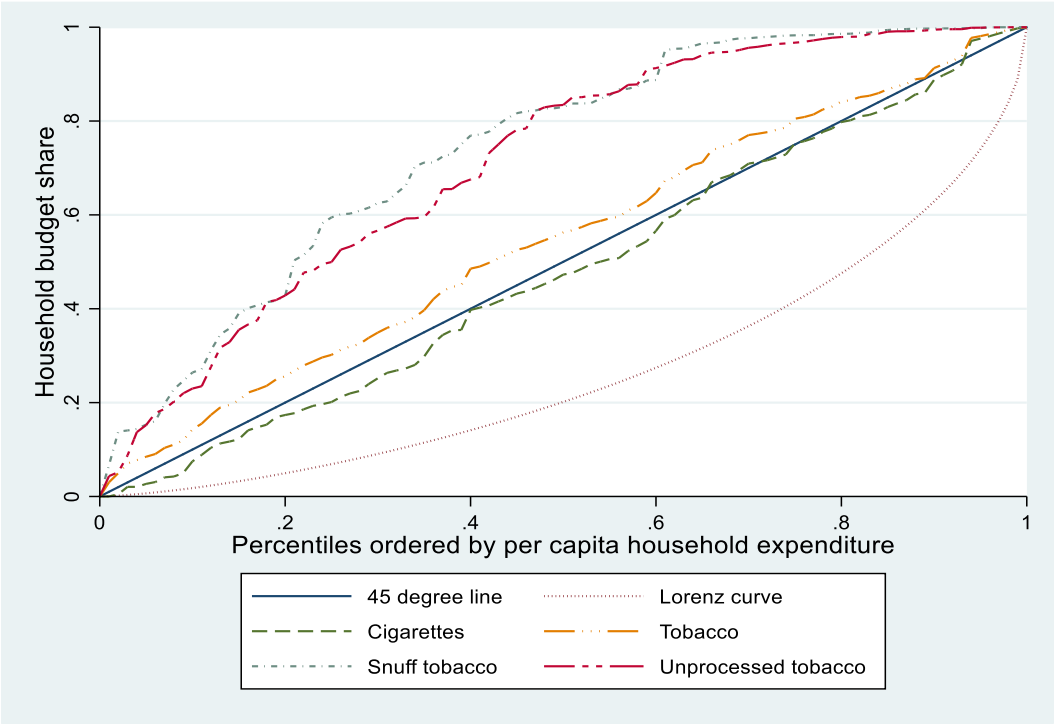
Notes: These are the results of the estimated expenditure elasticities of demand from the 2005-2006 and the 2015-2016 Kenya Integrated Household and Budget Surveys (KIHBS)

4.5.2 Regressivity/progressivity of household tobacco and alcohol budget shares

As seen in the earlier description of the data it is evident that there was a more rapid decline in the proportion of poor households that consumed tobacco. Further, the budget shares of some tobacco and alcohol products were relatively smaller among poorer households in the later KIHBS. Concentration curves/indices and the Lorenz curve and Gini coefficient were used to establish whether the progressivity/regressivity of tobacco and alcohol budget shares had changed over the ten-year period. The Gini coefficient, based on *per capita* household expenditure, declined from 0.466 in 2005-2006 to 0.404 in 2015-2016. This decline in inequality is similar to what was reported by World Bank (2018b) based on the same household survey data.

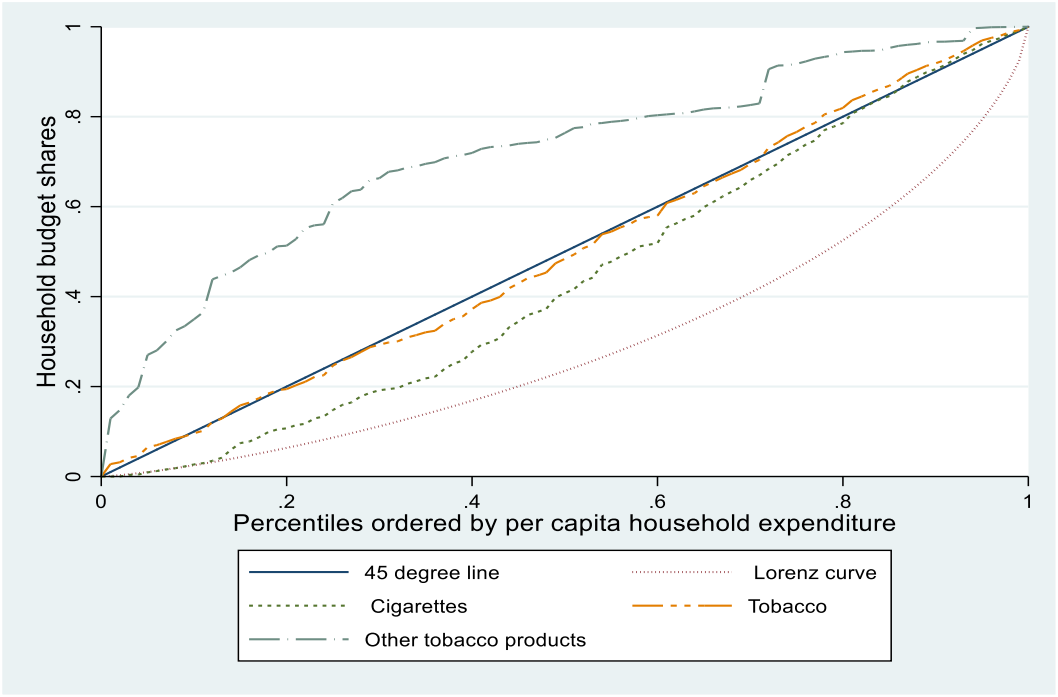
Figure 4.2 and Figure 4.3 present the concentration curves for tobacco products. The concentration curves for snuff tobacco, unprocessed tobacco, and other tobacco products (snuff, unprocessed tobacco and pipe tobacco) were above the 45-degree line. This indicates that the budget share for these products were relatively higher among poorer households. Total tobacco budget shares were also higher among poorer households in 2005-2006.

Figure 4.2 Lorenz and concentration curves for tobacco products (2005-2006 KIHBS)



Notes: Generated using data from 2005-2006 Kenya Integrated Household and Budget Survey (KIHBS). Tobacco refers to all tobacco products combined.

Figure 4.3 Lorenz and concentration curves for tobacco products (2015-2016 KIHBS)



Notes: Generated using data from 2015-2016 Kenya Integrated Household and Budget Survey (KIHBS). Tobacco refers to all tobacco products combined.

The concentration and Kakwani indices presented in Table 4.19 were used to determine whether the regressivity of household tobacco burdens had changed over the ten-year period. The results show that there was a decline in the regressivity of budget shares of cigarettes and other tobacco products. That is, even though poorer household still had larger budget shares, the relative burden of tobacco spending among poorer households had decreased over the ten-year period.

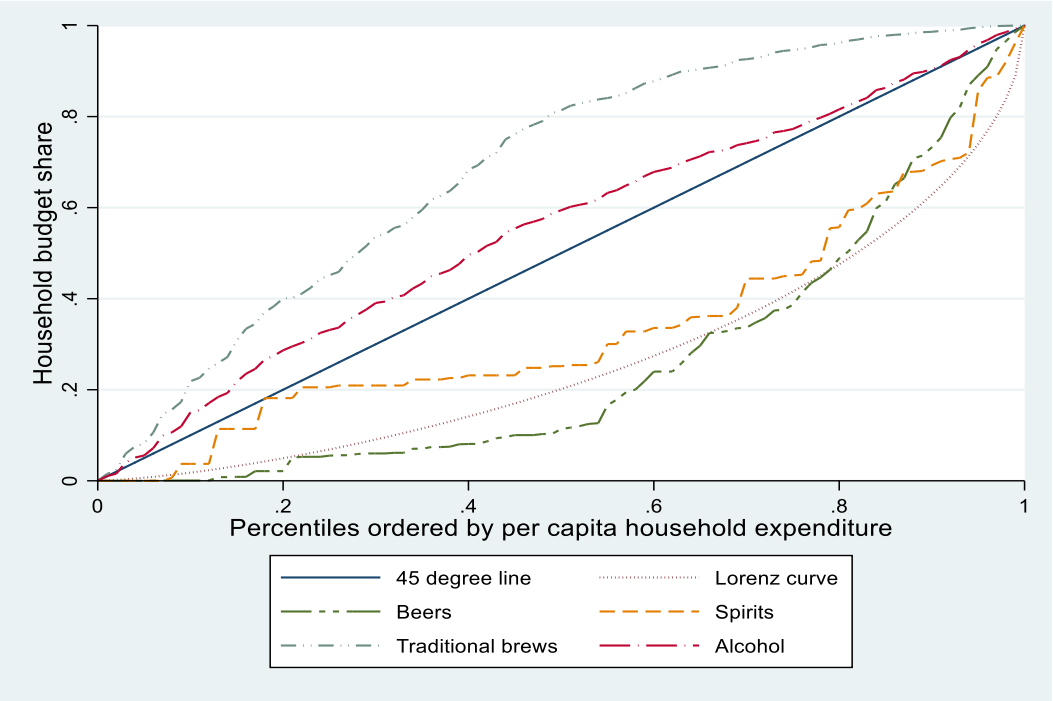
Table 4.19 Concentration and Kakwani indices for tobacco budget shares

	2005-2006 KIHBS				2015-2016 KIHBS		
	Cigarettes	Snuff tobacco	Unprocessed tobacco	Tobacco	Cigarettes	Other tobacco#	Tobacco
Concentration Index	0.042	-0.477***	-0.426***	-0.093**	0.122***	-0.435***	0.002
	(0.044)	(0.059)	(0.039)	(0.038)	(0.026)	(0.088)	(0.030)
Gini coefficient	0.466	0.466	0.466	0.466	0.404	0.404	0.404
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Kakwani Index	-0.424***	-0.944***	-0.892***	-0.559***	-0.282***	-0.893**	-0.401***
	(0.046)	(0.060)	(0.040)	(0.040)	(0.026)	(0.089)	(0.032)

Notes: The indices were calculated using data from the Kenya Integrated Budget and Household surveys (KIHBS). The budget shares of all the households (consumers and non-consumers were included). **#** includes snuff, unprocessed and pipe tobacco. Kawkwani index ranges from -2 to 1. Negative index implied expenditures were regressive while positive index implied, they were progressive. Standard errors are in brackets. ***P<0.01, **P<0.05, *P<0.1.

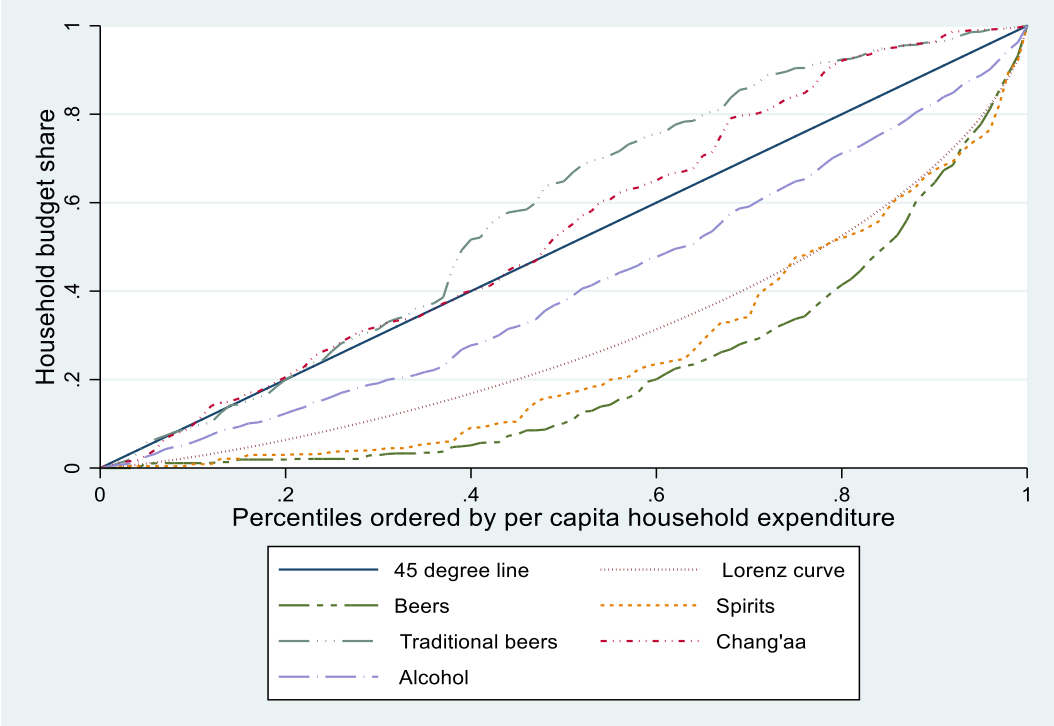
The concentration curves for alcohol products are presented in Figure 4.4 and Figure 4.5. The budget shares for traditional brews were above the 45-degree line. This implies that poor households had relatively higher budget shares on traditional brews. The concentration curves for the budget shares of beer and spirits were below the 45-deree line.

Figure 4.4 Lorenz and concentration curves for alcohol products (2005-2006 KIHBS)



Notes: Generated using data from 2005-2006 Kenya Integrated Household and Budget Survey (KIHBS). Alcohol refers to all alcohol products combined.

Figure 4.5 Lorenz and concentration curves for alcohol products (2015-2016 KIHBS)



Notes: Generated using data from 2015-2016 Kenya Integrated Household and Budget Survey (KIHBS). Alcohol refers to all alcohol products combined.

The concentration and Kakwani indices presented in Table 4.20 were used to determine whether the regressivity/progressivity of alcohol budget shares had changed over time. The budget shares of beer and spirits went from being proportional in 2005-2006 to being progressive in 2015-2016. Over the ten-year period, the budget shares of traditional brews became less regressive. These results indicate that alcohol and tobacco control policies implemented over the ten-year period may have contributed to a reduction in the burden of the two goods among poorer households.

Table 4.20 Concentration and Kakwani indices for alcohol budget shares

	2005-2006 KIHBS				2015-2016 KIHBS				
	Beers	Spirits	Traditional Brews	Alcohol	Beers	Spirits	Traditional beers	*Chang'aa*	Alcohol
Concentration Index	0.484***	0.329**	-0.374***	-0.107***	0.560***	0.489***	-0.153***	-0.076*	0.181***
	(0.045)	(0.139)	(0.028)	(0.033)	(0.028)	(0.035)	(0.032)	(0.0390	(0.021)
Gini coefficient	0.466	0.466	0.466	0.466	0.404	0.404	0.404	0.404	0.404
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Kakwani Index	0.018	-0.137	-0.841***	-0.573***	0.156***	0.086**	-0.556***	-0.480***	-0.223***
	(0.046)	(0.139)	(0.030)	(0.035)	(0.301)	(0.036)	(0.034)	(0.041)	(0.023)

Notes: The indices were calculated using data from the Kenya Integrated Budget and Household surveys (KIHBS). The budget shares of all the households (consumers and non-consumers were included). Kawkwani index ranges from -2 to 1. Negative index implied expenditures were regressive while positive index implied, they were progressive. Standard errors are in brackets. ***P<0.01, **P<0.05, *P<0.1.

4.5.3 Discussion of results

The price elasticity of demand for cigarettes has been found to be higher among poorer individuals and households. Similarly, within and across countries, the price elasticity of demand has been found to decrease as *per capita* incomes increased (Townsend, 1996; IARC, 2011; Fuchs Tarlovsky *et al.*, 2018).

The average annual growth of Kenya's GPD *per capita* between 2005 and 2016 was 2.6%. Over the same period, the share of tobacco-consuming households in the bottom quartile declined by around ten percentage points whereas, the share of tobacco consuming households in the top quartile decreased by two percentage points. Economic growth and the changing profile of tobacco consuming households may be the reasons why the estimated price elasticity of demand for cigarettes in Kenya increased from -0.63 in 2005-2006 to -0.42 in 2015-2016.

The average price elasticity of demand for cigarettes in Kenya for the two periods was -0.53. This meant that the demand for cigarettes declined by around 5% when the price rose by 10%. Therefore, in the long-run a sustained, increase in the real price of cigarettes was expected to lead to a reduction in the demand for cigarettes. Further, if the price increases were a result of increased excise taxes on cigarettes, the excise revenue from cigarettes was expected to

increase, because the decrease in demand was less than the increase in price. However, in the past, policy makers in Kenya have also considered the regressive nature of cigarette taxation.

This concern about the regressive nature of taxes on cigarette was evident in the excise tax systems that the country has implemented. Between 2003 and 2010, the country had a tiered tax system based on the retail selling price. This was changed to a mixed specific and *ad valorem* tax system between 2011 and 2014. In 2015, the country implemented a single specific excise tax of Ksh. 2500 per mille that was applicable to all cigarettes. This specific tax was to be adjusted for inflation every year. However, in 2017 it was revised to a specific tax of Ksh. 2,500 per mille for filter cigarettes and Ksh. 1,800 per mille for unfiltered cigarettes. The creation of a tax system that was favourable for poor smokers was one of the reasons Kenyan parliamentarians cited when they attempted to reintroduce the tiered tax system in 2015 (Nargis et al., 2015).

The upward revision of specific taxes in all the tiers between 2006 and 2008 resulted in an increase in the real price of cigarettes, including Sportsman cigarettes. The Sportsman brand was estimated to have a market share of 51.23% in 2012 (Nargis *et al.,* 2015). The annual average increase in the real price of Sportsman cigarettes between 2006 and 2008 was 3.4%. The average annual increase in real price between 2006 and 2010 was 0.5%.

Increase in real the prices of cigarettes between 2005 and 2010, as well as the other tobacco control initiatives that were implemented following to the adoption of the Tobacco Control Act of 2007, contributed to household tobacco burdens becoming less regressive. Therefore, the implementation of an increasing (real increase) specific tax, will make cigarettes less affordable and result in decreased demand, especially among poorer households. Taxes on cigarettes may also be effective in reducing demand for other products, such as snuff tobacco and *khat*, which are consumed as complements. Taxes on cigarettes may also be expected to be less regressive in the medium term.

Demand for beer was found to be price elastic. The estimated own price elasticity of demand for beer was -1.13. The formally produced beers that were considered in the estimation of own-price elasticity included beers not made from malt, such as Senator Keg, which catered to the low-end market. In the past, policies that have resulted in a price increase of Senator Keg have resulted in large decreases in consumption of formally produced beers.

In 2013 the Minister for Finance reduced the remission granted to beers not made from malt from 100% to 50% (Mailu and Mulinge, 2016). The increase in taxes on beers not made from malt which included Senator Keg, resulted in a 12% decrease in aggregate consumption

of all formally produced beer in 2013 and a 22% decrease in 2014. East African Breweries Limited (2018) reported that the net sales of Senator Keg dropped by 75%, post implementation of the of the 2013 directive.

The switching by poorer consumers to informally produced brews was one of the possible explanations for the substantial decline in the consumption of formally produced beers. The results from this chapter confirm that demand for informally produced brews increases with an increase in the price of formally produced beers.

Measures that were aimed at reducing or regulating the consumption of informally produced beers were included in the Alcohol Control Act of 2010. However, these measures have not been successful in curbing the informal production and the sale of *chang'aa* and other informally produced traditional brews (Carey *et al.,* 2015). There was a slight decline in the consumption of traditional brews between 2005 and 2016. The share of households that consumed traditional brews decreased from 8.9% to 7.8%.

The alcohol control policies implemented between 2005 and 2010 were successful in reducing the regressivity associated with overall household alcohol burden (alcohol budget share). Over the same period household burden on formally produced beers and spirits became more progressive.

Data from the two surveys, also revealed that there was an increase in consumption of spirits among Kenyan households. There was a two-percentage point increase in the proportion of households that consumed spirits and a four-percentage point increase in the average household budget share spent on spirits (among households that consumed spirits). This pattern is similar to what was observed in the aggregate excise tax revenue data. Between 2008 and 2016 there was a 28% average annual increase in the real excise revenues from wines and spirits.

Taxation of alcohol must contend with both the changing consumption patterns of formally produced alcohol products and the continued consumption of informally produced alcohol. Due to the possibility of substitution between formally and informally produced alcohol products, the taxation of alcohol should be implemented in tandem with policies that control the production and consumption of informally produced alcohol.

4.5.4 Limitations

The number of households reporting a positive expenditure on the relevant products in the two surveys was quite low. Consequently, the elasticity estimates are likely to suffer from two sources of bias: possible endogeneity of unit values and measurement errors that may not

have been adequately dealt with because of the small number of households per cluster (Chelwa, 2015). The price elasticities of demand for some tobacco and alcohol products, such as cigars, processed tobacco, ciders, and wines were not estimated because they were purchased by relatively few households. Pooling the data would have slightly increased the sample size. However, pooling the data would not have solved the problems associated with having few households per cluster.

The Deaton method relies on the spatial variability of prices in the estimation of elasticity. Therefore, I did not estimate the elasticity of the alcohol and tobacco products whose unit values did not have significant spatial variation. Consequently, this chapter does not provide a comprehensive analysis on the substitution/complementarity between all the tobacco and alcohol products that were purchased by Kenyan households.

4.6 Summary and Conclusion

Tax-induced price increases are one of the most effective policy tools for those seeking to reduce the demand for tobacco and alcohol. The reduction in demand has been found to be greater among the youth, and for low-income individuals and households. Tax policy has been used to influence the prices of alcohol and tobacco products in both developed countries and LMICs. However, there have been some concerns about the regressive nature of tobacco/alcohol taxes. Taxation of alcohol and tobacco in developing countries usually focuses on commercially produced alcohol and tobacco products. This leaves out informally produced alcohol and tobacco products, which are mostly consumed by poor household.

The possibility of consumers using informally produced alcohol and tobacco products, as well other stimulants, as substitutes or complements may affect the effectiveness of a tax policy. This chapter sought to estimate the responsiveness to price changes of consumers of both formally and informally produced tobacco and alcohol products. This chapter focused on Kenya, a sub-Saharan African country that has significant consumption of informally produced alcohol and non-cigarette tobacco products.

Household survey data from 2005-2006 and 2015-2016 was used in the estimation of own- and cross-price elasticities of demand. The results show that the demand for cigarettes was price inelastic, while the demand unprocessed tobacco was unitary elastic. The demand for beer was found to be price elastic. The cross-price elasticity estimates indicate that *chang'aa* (an informally produced alcoholic beverage) was a substitute for formally produced beers. Snuff tobacco and *khat* were found to be complements for cigarettes.

Tobacco and alcohol control policies implemented between 2005-2006 and 2015-2016, resulted in the decrease in the regressivity of the household tobacco burden (tobacco budget share) and traditional brews burden. Over the same period, household beer and spirits burden (budget share) became more progressive. The results from this chapter provide information on the possible effectiveness of using tax policy in the control of tobacco and alcohol consumption in Kenya.

Taxation of cigarettes may be useful for reducing the demand of cigarettes and for other tobacco products and stimulants such as *khat*. Taxes on cigarettes are also expected to be less regressive in the long run. Moreover, as the demand for cigarettes is price inelastic the government can increase excise revenue at the same time as reducing demand.

The possible substitution to informally produced alcoholic beverages when there is an increase in the prices of formally produced beers implies that focusing only on tax policy may not be an effective way of controlling alcohol consumption. Taxation of alcohol in Kenya should be done in tandem with programmes aimed at curbing the production and consumption of informally produced alcohol.

CHAPTER 5: CONCLUSION

The objective of this thesis was to contribute to the literature on the economics of tobacco- and alcohol-control policy, in low- and middle-income countries in general and Kenya in particular. Specifically, it set out to analyse some of the effects of the tobacco and alcohol control policies that were implemented in Kenya between 2005 and 2016.

The study had four related themes: the implication of tobacco and alcohol consumption and taxation on household spending patterns, the risk of child malnutrition among tobacco and alcohol consuming households, the impact of tobacco- and alcohol-control policies on household tobacco and alcohol burdens and the estimation of own- and cross-price elasticities of demand for tobacco and alcohol products. This section summarises the key findings and contributions of this thesis and discusses possible future areas of research.

5.1 Main findings and contributions of this thesis

Chapter 2 sought to contribute to the growing literature on the impact of tobacco and alcohol consumption on household spending patterns. At present, there are three studies that have been done on sub-Saharan African countries, all focusing on household tobacco consumption (Koch and Tshiswaka-Kashalala, 2008; Chelwa and Van Walbeek, 2014; Ross et al., 2017). This thesis's first contribution, therefore, has been the investigation of the impact of alcohol consumption on household spending patterns in a sub-Saharan Africa context.

The second contribution was methodological. The adult sex ratio was used in this, and in some of the other previous studies, as an instrumental variable for the tobacco (alcohol) consumption status of households. However, the adult sex ratio may not meet the exclusion restriction, because it may directly influence some of the other household expenditures that were considered. Chelwa and Van Walbeek (2014) used the method developed by Nevo and Rosen (2012) to relax the exclusion restriction, by allowing the instrumental variable to be correlated with the error term. They subsequently, generated the upper bounds for the difference in household expenditure shares between smoking and non-smoking households in Zambia.

This thesis also used the method developed by Nevo and Rosen (2012) to relax the exclusion restriction. However, by adopting the specification of the adult sex ratio that was used by San and Chaloupka (2016), both the upper and lower bounds of the difference in household's expenditure shares, between tobacco-consuming (alcohol-consuming) households and households that did not consume tobacco (alcohol) were estimated.

The third contribution was also methodological. There was a change in tobacco and alcohol taxes during the collection of 2015-2016 KIHBS data. The change in taxes, coupled with the data collection process that resulted in nationally representative subsamples both before and after the tax change, created a natural experiment. This provided an opportunity for the use of matched difference-in-differences (MDID) to estimate the impact of a change in tobacco and alcohol taxes on household spending patterns.

The pseudo-panel generated during the MDID estimation, also provided a new method for controlling for selection bias caused by time-invariant unobservable variables, when estimating the difference in expenditure shares between households that consumed tobacco (alcohol) and those that did not consume tobacco (alcohol).

The findings from chapter 2 indicated that price and non-price tobacco control policies that were implemented in Kenya between 2006 and 2015 contributed to a decrease in the prevalence of household tobacco use in Kenya. The overall prevalence of tobacco use decreased by six percentage points between 2006 and 2015. The decrease in the proportion of tobacco-consuming households was slightly larger for rural households. Alcohol-control policies implemented over the same period did not successfully reduce the overall prevalence of alcohol consumption among Kenyan households. The share of alcohol-consuming households increased by half a percentage point over the ten-year period.

Tobacco- and alcohol-consuming households spent less on education, energy, and some food items. Alcohol- and tobacco-consuming households in urban areas consistently had significantly lower expenditure on some food items, energy, and rent. In rural areas, households that consumed tobacco (alcohol) had lower expenditure shares for food items, education and healthcare.

These findings remained unchanged even after relaxing the exclusion restriction. The bounds generated for the percentage point differences in households' expenditure shares, using the method, developed by Nevo and Rosen (2012) also indicated that the 3SLS estimates for the items on which tobacco and alcohol consuming households had lower budget shares, were closer to the upper bounds.

MDID results confirmed that tobacco- and alcohol-consuming households had lower expenditure shares for items necessary for human capital development. An increase in tobacco taxes, did not affect household spending patterns among tobacco-consuming households. However, an increase in taxes on alcohol led to further crowding-out of expenditures on fruits among alcohol consuming-households.

One of the findings in chapter 2 was that rural tobacco- and alcohol-consuming households spent less on food items and healthcare. This finding was one of the contributors to the analysis done in chapter 3, which explored the risk of child malnutrition in tobacco and alcohol consuming households. Chapter 3 also sought to use prevalence of child malnutrition to investigate whether tobacco and alcohol control polices implemented in Kenya had been effective in reducing tobacco/alcohol consumption prevalence among the most vulnerable households.

Past studies on the risk of child malnutrition in tobacco consuming households were done on Asian countries. The present study considers a developing country in sub-Saharan Africa where the prevalence of malnutrition was relatively high. To the best of my knowledge, there are no similar studies that have been done on a sub-Saharan African country.

The second contribution of chapter 3 was methodological. Previous studies did not explicitly control for cluster/village level factors that might affect child nutrition. Owing to a possible correlation in nutritional outcomes for children in the same household, they focused on the youngest child in tobacco-consuming and non-tobacco consuming households. A multilevel/mixed effects logit and and General Equations Estimation logit model were used to to account for the possible correlation in nutritional outcomes for children living in the same village/cluster. The two methods also allowed for the inclusion of village level health and sanitation variables that could inform public health policy in Kenya.

The findings from chapter 3 show that in 2005-2006 the odds of long-term child malnutrition were about 30% higher for children living in tobacco and alcohol consuming households in rural Kenya. The tobacco and alcohol control policies implemented in Kenya between 2005 and 2016 were effective in reducing tobacco and alcohol consumption prevalence among the poorest rural households.

The share of rural tobacco-consuming households in the bottom quartile reduced by ten percentage points between 2005-2006 and 2015-2016. Over this period, the share of rural households in the bottom quartile that consumed alcohol decreased by two percentage points, while those that consumed both alcohol and tobacco decreased by three percentage points. On the other hand, among rural households in the top quartile, there was an increase in tobacco/alcohol consumption prevalence over the ten-year period. As a result, the decrease in both short-term and long-term malnutrition prevalence was greater among households that consumed tobacco/alcohol. As at 2015-2016, the risk of child malnutrition in tobacco/alcohol-consuming households was similar to that of non-consuming households.

The results from chapter 3 indicate that tobacco- and alcohol-control policies that were implemented in Kenya over the period 2005 to 2016 contributed to the reduction in consumption of the two goods among the most vulnerable rural households. As a result, very poor households, could invest resources that would otherwise have been used in tobacco/alcohol consumption, on human capital development. These results provide further justification for the continued implementation of tobacco- and alcohol-control policies in LMICs.

Chapter 2 and 3 provided evidence on some of the costs of tobacco/alcohol consumption, as well as the potential benefits that might arise from controlling consumption of both goods. Chapter 4 focused on the price of tobacco and alcohol products, because tax-induced price increases are known to be an effective policy tool for controlling demand for the two goods. The effectiveness of price is supported by studies on the elasticity of demand for tobacco and alcohol that have mostly been done on developed countries. More localised studies on the elasticity of demand for the two goods are needed, because the context in which they are consumed differs across regions and countries.

The effectiveness of price policy in controlling demand for tobacco and alcohol may be reduced by, among other things, the consumption of informally produced alcohol and non-cigarette tobacco products, as well as other stimulants. This is especially a concern for African countries south of the Sahara, such as Kenya, where the consumption of informally produced alcohol and non-cigarette tobacco products is widespread. The relatively few studies done on African countries have focused on South Africa and most of them only estimated the price elasticity of demand for cigarettes and formally produced alcohol products. There appear to be no peer-reviewed studies that estimated the price elasticity of demand for alcohol and tobacco products in Kenya.

Chapter 4 sought to contribute to the literature by estimating the price elasticity of demand for tobacco and alcohol for Kenya. The chapter used the method developed by Deaton (1987, 1988, 1990, 1997) to estimate the own-price and expenditure elasticities of demand for tobacco and alcohol products.

The second contribution of chapter 4 was the estimation of responsiveness of demand for informally produced alcohol and non-cigarette tobacco products to changes in the prices of cigarettes and formally produced beers. It also estimated the responsiveness of the demand for *khat* to changes in the price of cigarettes and formally produced beers. *Khat* is a stimulant mostly consumed in Arabia and the Horn of Africa and therefore data from these regions is

suitable for investigating the nexus between its consumption and the consumption of alcohol/tobacco.

Finally, to address the concerns about the equity impact of price and non-price tobacco- and alcohol-control policies, chapter 4 also examined the evolution of the regressivity/progressivity of household tobacco and alcohol burden (tobacco and alcohol budget shares). The method developed by Kakwani (1977) was used to determine whether price and non-price tobacco and alcohol control policies that were implemented between 2005/6 and 2015/6 had an impact on the regressivity/progressivity of household tobacco and alcohol burdens.

The findings from this chapter indicate that the tobacco control policies contributed to a reduction in the regressivity of household tobacco burden. The implementation of measures outlined in the Tobacco Control Act (2007) and increases in the real price of cigarettes in the first half of the ten-year span, contributed to a reduction in the proportion of households that consumed tobacco. The share of tobacco-consuming households in the bottom quartile decreased by around ten percentage points while the share of tobacco-consuming households in the top quartile decreased by about three percentage points.

The changing profile of tobacco-consuming households, as well as economic growth over the period, may also have contributed to the slight increase in the estimated price elasticity of demand for cigarettes. The estimated price elasticity of demand for cigarettes from the 2005-2006 KIHBS was -0.63, while that from the 2015-2016 KIHBS was -0.42. *Khat* and snuff tobacco were found to be complements for cigarettes. Therefore, an increase in the real price of cigarettes was expected to reduce demand for cigarettes in the long-run. Taxing cigarettes was expected to both increase excise revenues and contribute to the decrease in demand for other tobacco products and *khat*.

Khat and *chang'aa* were found to be substitutes for formally produced beers. The demand for formally produced beers was found to be price elastic. Therefore, to avoid substitution to informally produced alcohol, taxation of formally produced beers should be carried out in conjunction with measures that curb the production and consumption of informally produced alcohol.

The alcohol-control policies that were implemented over the ten-year period including the implementation of the Alcohol Control Act of 2010, were not very effective at reducing consumption of informally produced alcohol. The share of households that consumed

informally produced alcohol over the ten-year period decreased by only two percentage point. In the later KIHBSs approximately 7% of households consumed traditional brews.

The alcohol-control policies contributed to a reduction in the regressivity associated with overall household alcohol burden. Whereas the share of alcohol consuming households in the top quartile increased by around six percentage points, the share of alcohol consuming households in the bottom quartile decreased by three percentage points between 2005-2006 and 2015-2016.

The household beers and spirits burden (budget share) became more progressive between the two surveys. There was also an increase in the proportion of households that consumed spirits as well as the household budget share of expenditure on spirits. Among households that consumed spirits, the budget share on spirits increased by around four percentage points over the ten-year period. Increased demand for spirits was also evident in excise tax revenues. Between 2008 and 2016, the average annual increase in real excise taxes from wines and spirits was 28%. Therefore, policy makers involved in alcohol control initiatives, should also take cognizance of the changing patterns of demand for formally produced alcohol.

5.2 Ideas for future research

There is a need for more in-depth analysis of the political economy of tobacco- and alcohol-control policy in Kenya. This analysis can be done through key informant interviews and an analysis of existing polices. The focus could include both the process of policy formulation and legislation and outlining the successes/failures in the implementation of existing policies. Lessons could be drawn from the comparison of the success/failure in the implementation of policies that are common for the two goods.

Chapter 2 used a pseudo-panel to analyse the short-run effect of tobacco/alcohol tax policy on household spending patterns. Subject to data availability, future research could estimate the effect of larger tobacco/alcohol tax increases, as well as the long-run effects of sustained tobacco/alcohol tax increases on household spending patterns in LMICs.

Household surveys, which are available in most sub-Saharan African countries, can be used to estimate the price elasticity of demand for other non-formally produced tobacco and alcohol products. The cross-price elasticity of demand for tobacco/alcohol products, and other stimulants/addictive substances that may be unique to different regions of Africa, could provide

a more comprehensive analysis of the effectiveness of tobacco and alcohol tax policy in sub-Saharan Africa.

There is a growing concern about the illicit trade in cigarettes. Illicit trade is likely to influence the effectiveness of tobacco taxation. Estimation of the size of illicit trade, as well as the nexus between tobacco taxation and the size of illicit trade in sub-Saharan Africa in general and Kenya in particular, is another possible area for future research.

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