



Research Report

The Impact of Tobacco Use on Household Consumption Patterns in Pakistan

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The Impact of Tobacco Use on Household Consumption Patterns in Pakistan

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Social Policy and Development Centre

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The University of Illinois at Chicago's (UIC) Institute for Health Research and Policy is funding a group of economists to develop evidence-based policy support for effective tobacco tax policies in low- and middle-income countries with the highest rates of tobacco consumption. The global collaboration on the economics of tobacco is facilitated through [Tobacconomics](#), a web-based platform. UIC is a partner of the Bloomberg Initiative to Reduce Tobacco Use.

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Executive Summary

Pakistan has comparably high rates of tobacco consumption and tobacco-related illness and disease. In addition, consumption of tobacco constitutes a sizable portion of household expenditure. High tobacco expenditure leads to reduced spending on other basic needs and thus has direct bearing on household welfare. Analysis of household spending patterns is therefore important for understanding the opportunity cost of tobacco use.

This study is the first attempt to estimate the impact of tobacco use on consumption patterns of households in Pakistan and complements existing work on the crowding out effect of tobacco expenditures in developing economies. It also explores how reductions in tobacco expenditure affect intra-household resource allocation. The study is based on quantitative methods by using data from the Pakistan Household Integrated Economic Survey 2015–16.

The key findings of this analysis are the following:

- In Pakistan, tobacco-spending households spend nearly three percent of their monthly budget on tobacco, and poor households devote more of their budget to tobacco relative to rich households.
- The study finds strong evidence of a crowding out effect in Pakistan, in which a reduction in tobacco expenditure leads to an increase in household spending on basic food items, health, education, housing, household durables, leisure, and other commodities.
- The crowding out effect is more prominent in education and basic food among lower-income households, while education and housing are more affected among higher-income households.
- The simulation analysis suggests that a reduction in tobacco expenditures by 50 percent would increase aggregate expenditures on the abovementioned commodity groups by about 18 percent. For lower-income households, the major share of this increase would be devoted to education (35 percent) and basic food (25 percent).

The findings of this study highlight the importance of tobacco control policies in Pakistan to reducing tobacco consumption and freeing up household resources for other spending such as food and education. Moreover, given the tobacco-poverty link, the study also recommends that tobacco control measures be integrated into the poverty reduction policies and programs.

1 Introduction

Tobacco use is responsible for more than seven million deaths worldwide each year (WHO, 2019) and the toll is expected to reach eight million annually by 2030 (WHO, 2011). Tobacco use is higher in developing countries than in developed ones (de Beyer et al., 2001; Wang et al., 2006). In addition to its harmful impact on health, tobacco use also affects the economic and social well-being of households and individuals (NIH, 2016). Considering the resource constraints of most households, tobacco spending has an opportunity cost as it can lead to reduced expenditure on other goods and services, including basic needs such as education, health, food, housing, etc. This phenomenon is referred to as the “crowding out effect” and is evidenced by many studies (e.g., John, 2008; Wang, 2006; Efrogmson et al., 2001; San and Chaloupka, 2016; Hussain et al., 2018). The literature also confirms a strong link between tobacco use and poverty whereby tobacco use not only contributes to poverty in the short run, by reducing consumption of other commodities, but also has long-term implications due to lower productivity and high expenditure on tobacco-related illness (Owusu-Dabo et al., 2009; John et al., 2011).

Pakistan has comparably high rates of tobacco consumption and tobacco-related illness and disease. According to GATS (2014), 31.8 percent of adult men and 5.8 percent of adult women use tobacco in some form.¹ Estimates² based on Pakistan’s Household Integrated Economic Survey (HIES) 2015–16 indicate that tobacco is consumed in 45 percent of households in the country. HIES data also reveal that poor households spend more of their budget on tobacco compared to rich households. On average, tobacco-using households devote 2.9 percent of their monthly budget to consumption of tobacco. It is important to note that food is the single largest category of expenditure in Pakistani households, accounting for more than 40 percent of the total household budget. Hence, the share of tobacco expenditure is not trivial in relation to other categories.

In Pakistan, very little research has been conducted on the consumption patterns of households in relation to tobacco spending. To the best of the

Poor households spend more of their budget on tobacco compared to rich households.

¹ Consequently, prevalence of tobacco-related diseases is also high, and tobacco use is associated with more than 160,000 deaths every year in the country (<https://tobaccoatlas.org/country/pakistan/>; accessed February 20, 2020).

² Authors’ estimates based on data from the Household Integrated Economic Survey, Pakistan Bureau of Statistics, Government of Pakistan (2004–05 and 2015–16).

authors' knowledge, this is the first work that examines the impact of tobacco use on household consumption patterns and also explores how reductions in tobacco expenditure affect intra-household resource allocation. This study is based on quantitative methods and relies mainly on HIES 2015–16 data. The report is organized into five sections. A literature review is presented in Section 2, while Section 3 provides methodology and data sources. Research findings are discussed in Section 4, and the last section draws conclusions and makes policy recommendations.

2 Review of Literature

Given the dearth of research on tobacco use in Pakistan, particularly on consumption patterns, the literature review mostly focuses on studies that have been conducted in a similar context in countries such as India, Bangladesh, and China. India, Bangladesh, and Pakistan, being developing countries of South Asia, share common developmental problems such as poverty and poor public health. Though China belongs to the group of upper-middle income countries, it has a high prevalence of tobacco use. Some other studies are also reviewed for identifying a suitable methodology of analysis.

Efroymson et al. (2001) analyzed the economic impact of tobacco consumption in Bangladesh and showed that expenditure on tobacco, particularly cigarettes, represents a major burden on impoverished people. They found that the poorest households are twice as likely to smoke as the wealthiest households; and a male smoker spends more than twice as much on cigarettes per capita than his expenditure on clothing, housing, health, and education combined. Further, the study suggested that tobacco expenditures exacerbate the effects of poverty and cause significant deterioration in the living standards of the poor—an aspect of tobacco use that has been largely neglected by those working in poverty and tobacco control.

Another study conducted by Wang et al. (2006) investigated the crowding out effect of tobacco expenditures on households in rural China and found that spending on tobacco affects human capital investment (such as education and health), future farming productivity (such as farming equipment and seeds), and financial security (such as savings and insurance). The study also showed that smoking can have important intra-family distributional impacts, as smoking expenses can affect other family members by reducing expenditures on the basic needs of all members.

John (2008) estimated the crowding out effect of tobacco use in India and examined how spending on tobacco crowds out expenditure on basic needs, along with the associated implications on nutritional intake and intra-household resource allocation. He found that tobacco-spending households had lower consumption of certain commodities such as milk, education, clean fuels, and entertainment. Tobacco spending also had a negative effect on per capita nutritional intake. Moreover, the nature of crowding out was similar among low- and high-income households.

The review of literature shows that tobacco expenditure has a significant impact on household consumption patterns.

Following the theoretical framework developed by John (2008), Pu et al. (2008) estimated the crowding out effect of tobacco and alcohol use in Taiwan. The study found that, even though the lower-income households were the most vulnerable to the crowding out effect of tobacco and alcohol expenditures, higher-income households may also suffer a lower standard of living.

A study conducted on Turkey by San and Chaloupka (2016) found that the expenditures of nonsmoking households on food, utilities, and housing average nine percent more than those of smoking households. The study found a crowding out effect whereby smoking expenditure results in decreased household expenditure on food, housing, durable/nondurable goods, and education.

Paraje and Araya (2018) estimated the degree to which tobacco consumption is associated with spending on a set of goods and services in Chile (especially on health and education). The study found that tobacco consumption was associated with lower budget shares allocated to healthcare, education, and housing expenses, especially for poorer households. In the case of health and education, not consuming tobacco was associated with up-to-32-percent- and up-to-16-percent-higher expenditures, respectively. The study concluded that a strong statistical relationship between tobacco consumption and resources allocated for healthcare and education might be indicative of the existence of a crowding out effect of tobacco.

In summary, the review of literature shows that tobacco expenditure has a significant impact on household consumption patterns. Moreover, the crowding out effect is higher among poor households—especially its impact on food- and education-related expenditures.

3 The Data and Descriptive Analysis

This section discusses the data source and descriptive statistical analysis of the variables used for estimating the crowding out effect of tobacco use. The research methodology, including the theoretical framework of the study and estimation of the regression model, is presented in Appendix A.

The data are drawn from the Household Integrated Economic Survey (HIES) 2015–16, conducted by the Pakistan Bureau of Statistics. HIES is a nationally representative survey consisting of 24,238 households and provides information on consumption expenditure of more than 300 commodities at the household level. For the sake of analysis, expenditures are divided into the following 13 commodity groups, which mostly correspond to the HIES categories (see Appendix B). The food group is subdivided into basic food and other food where the former includes all food items except for food eaten in restaurants.

-
- | | |
|--------------|----------------------|
| • Basic food | • Transport |
| • Other food | • Communication |
| • Tobacco | • Energy |
| • Clothing | • Housing |
| • Health | • Household durables |
| • Education | • Leisure |
| | • Others |
-

If a household reported any expenditure on any tobacco product, it is categorized as a tobacco-user household, whether the expenditure was incurred by a single person or by multiple persons. In terms of income, households are divided into two groups: the bottom 60 percent are categorized as lower-income while the top 40 percent are higher-income. A comparative analysis of tobacco-user and tobacco non-user households is presented in Table 1.

Overall, nearly 40 percent of the household budget is allocated to basic food, reflecting the low income level of households in Pakistan. Other expenditure groups absorbing larger budget shares include housing, energy, and clothing. Altogether, these groups account for nearly 70 percent of the household budget. Education and health, which have direct bearing on household welfare, receive low priority due to resource constraints.

Nearly 40 percent of the household budget is allocated to basic food, reflecting the low income level of households in Pakistan.

Table 1: Descriptive statistics on expenditure pattern, socioeconomic and demographic variables (averages)

	Tobacco non-user households	Tobacco-user households						
		Overall	Lower income	Higher income	Rural	Urban	Female-headed	Male-headed
Number of observations	13,403	10,835	7,627	3,208	4,123	6,712	305	10,530
Monthly expenditure (Rs)	34,289	32,522	26,318	50,878	28,940	39,862	32,676	32,517
Expenditure allocation to major consumption categories (%)								
Basic food items	38.10	40.51	43.49	31.68	43.52	34.34	35.20	41.07
Other food items	3.90	3.82	1.78	3.43	1.39	3.83	3.90	3.75
Tobacco	-	2.90	3.02	2.55	3.03	2.63	2.50	2.91
Clothing	9.29	8.29	9.60	7.91	9.55	8.41	9.15	8.01
Health	3.12	3.01	2.96	3.17	3.28	2.46	3.35	3.00
Education	3.98	2.61	2.19	3.85	2.03	3.80	2.37	2.62
Transportation	4.50	3.98	3.60	6.06	4.26	4.14	5.75	3.89
Communication	2.00	1.68	1.86	2.30	1.91	2.08	1.96	1.65
Energy	8.60	8.47	9.03	7.65	9.54	6.92	8.57	8.43
Housing	13.45	11.99	10.40	16.69	8.77	18.59	14.14	11.93
Household durables	3.94	3.93	3.72	4.58	3.75	4.32	3.98	3.93
Leisure	0.63	0.56	0.53	0.65	0.48	0.72	0.91	0.55
Others	8.50	8.24	7.83	9.47	8.49	7.75	8.22	8.25
Household size	5.9	6.7	7.3	5.2	6.9	6.4	5.7	6.8
Number of adults/HH	3.0	3.4	3.5	3.4	3.4	3.5	3.2	3.5
Number of male adults/HH	1.4	1.7	1.7	1.7	1.7	1.8	1.3	1.7

Source: HIES, 2015–16

On average, tobacco-user households spend 2.9 percent of their monthly budget on tobacco products, while the ratio for lower-income and higher-income households is 3.0 percent and 2.6 percent, respectively. Similarly, rural households allocate more of their budget (3.0 percent) to tobacco than urban households (2.6 percent). The analysis also indicates that female-headed households spend a lesser share of their budget on tobacco than male-headed households. This finding also corresponds with the difference in the average number of male adults per household, since the prevalence of tobacco use in Pakistan is much higher among men than women—about 85 percent of adult tobacco users in the country are males (GATS, 2014).

The results show that, as compared to tobacco non-user households, tobacco-user households allocate a significantly lower budget share to all

commodity groups except for basic food. Particularly, the differences in budget shares for clothing, education, and housing are more sizeable: tobacco non-user households outspend tobacco-user households the most in these categories. This differential indicates that tobacco use may have an influence on intra-household resource allocation. In other words, tobacco-user households might have spent more on other goods and services in the absence of their tobacco spending.

To estimate how tobacco spending crowds out spending on other goods, this research involves an econometric analysis of household spending patterns, which controls for socioeconomic and demographic characteristics of households to determine whether the spending preferences of tobacco-user and non-user households are different.

The research uses the theoretical framework developed by John (2008), which assumes that each household wants to maximize utility given a set of socioeconomic characteristics. Decisions about the consumption of each commodity are taken in consideration of the prices of commodities and income of the household. This study used an econometric model for conditional demand functions, which assumes that a household's expenditure on tobacco is predetermined, implying that a household has already decided the level of tobacco expenditure, and the household has to maximize utility subject to the expenditure in excess of the pre-allocated tobacco expenditure—that is, within the reduced income level (see Appendix A for detailed methodology).

Tobacco-user households allocate a significantly lower budget share to all commodity groups except for basic food.

4 Results and Discussion

Table 2 provides a summary of the estimated coefficients of the regression model. A negative and significant coefficient of total amount of tobacco spending (A_i) against a specific commodity group indicates that tobacco-user households allocate a lower budget share relative to tobacco non-user households for this commodity group. The results show that in all commodity groups consumption decisions are affected by tobacco expenditures. An increase in the total amount of tobacco spending would lead to a decrease in the budget shares of basic food, health, education, housing, household durables, leisure, and other commodities.

The regression analysis was also carried out separately for lower-income and higher-income households, which provides further insight on how the crowding out effect of tobacco expenditure differs between the two income groups. One major difference appeared in the basic food category, where the coefficient for the higher-income group turned out to be insignificant. This finding suggests that the crowding out in the aggregate analysis is driven by the lower-income group. This coefficient for the lower-income group is not only negative but is also higher in magnitude relative to aggregate estimates. On the other hand, there is no crowding out of housing expenditure in the lower-income group, as the coefficient is statistically insignificant. It is also important to observe that the impact of tobacco expenditure on health, education, and leisure is more pronounced in the lower-income group. The results may also indicate that lower-income households have less control over housing expenditure due to the mandatory nature of expenses such as house rentals. On the other hand, expenditure on health and education may be compromised, for example, by visiting free government health facilities or not sending children to school. The latter, for instance, is evident in the primary enrollment rates by income quintile provided in the Pakistan Living Standards Measurement Survey (PSLM, 2013–14). According to the estimates, average net enrollment rate in the 1st and 5th consumption quintiles are 54 and 80 percent, respectively. Interestingly, crowding out in expenditures for leisure is also statistically significant only in the lower-income group.

The impact of tobacco expenditure on health, education, and leisure is more pronounced in the lower-income group.

Table 2: Crowding out effects of tobacco expenditure – regression results

Independent Variables	Total tobacco spending (Ai)		
	All households	Lower-income	Higher-income
Basic food	-0.005 ***	-0.011 **	0.0004
Other food	0.011 *	0.011 *	0.001 *
Clothing	0.008 *	0.009 *	0.005 *
Health	-0.005 *	-0.043 **	-0.114 **
Education	-0.009 *	-0.013 *	-0.007 **
Transport	0.012 *	0.012 *	0.01 *
Communication	0.005 *	0.006 *	0.0004 *
Housing	-0.008 *	-0.001	-0.01 *
Household durables	-0.004 *	-0.004 *	-0.003 **
Leisure	-0.001 **	-0.002 **	-0.00007
Other	-0.004 **	-0.005 **	-0.003

Note: The main purpose of this study is to focus on the effect of tobacco expenditure on spending for other commodities, so the coefficients of household characteristics are not reported (see Appendix A for detailed results. All commodity groups are considered as dependent variables.

*Significant at the 1% level | **Significant at the 5% level | ***Significant at the 10% level.

Simulated effect of a reduction in tobacco expenditure

The next step of the analysis is to estimate what would happen if households spent less on tobacco. In order to estimate the impact of a reduction in tobacco expenditures on household budget allocation, a simulation is carried out that assumes that household expenditure on tobacco is reduced by 50 percent. Table 3 provides the values used for the simulation analysis. On average, tobacco expenditure is reduced from Rs 943 per month to Rs 472 per month, which reduces total monthly expenditures of tobacco-user households by 1.5 percent.

The new household expenditure (after reduction of Rs 472) is then multiplied with the coefficients of (Ai) given in Table 2 for each commodity group, which shows the impact on intra-household budget allocation for each commodity group. The same exercise is done for lower-income and higher-income groups.

Table 3: Value used for simulation analysis – monthly expenditures of tobacco-user households (Rs/month)

Heads	Average values		
	All households	Lower-income	Higher-income
Total expenditure	32,522	26,318	50,878
Tobacco expenditures	943	795	1,300
Tobacco expenditures as % of total expenditures	2.9	3.0	2.6
Tobacco expenditures after 50% reduction	472	397	650
50% reduction in tobacco expenditures as % of total expenditures	1.45	1.5	1.3
Total expenditures after adjusting for new tobacco expenditures	32,050	25,921	50,229

Source: Household Integrated Economic Survey, Government of Pakistan, 2015–16

Table 4: Actual and simulated budget shares (%)

Commodity groups*	All households			Lower-income			Higher-income		
	Actual	Simulated	Difference	Actual	Simulated	Difference	Actual	Simulated	Difference
Basic food	40.5	42.3	1.8	43.5	47.3	3.9	-	-	-
Health	3.0	4.8	1.8	3.0	4.5	1.5	3.2	5.5	2.3
Education	2.6	6.2	3.6	2.2	6.8	4.6	3.8	7.5	3.7
Housing	12.0	15.4	3.4	10.4	10.8	0.4	16.7	23.3	6.7
Household durables	3.9	5.4	1.4	3.7	5.1	1.4	4.6	6.3	1.8
Leisure	0.6	0.9	0.3	0.5	1.1	0.6	-	-	-
Others	8.2	9.7	1.5	7.8	9.5	1.7	-	-	-

* Analysis is presented for selected commodity groups where an increase is expected due to reduction in tobacco spending.

Source: Household Integrated Economic Survey, Government of Pakistan, 2015–16

Table 4 gives the actual and simulated budget shares by commodity groups where an increase is expected due to a 50-percent reduction in tobacco expenditure. The aggregated results show that the share of expenditure on education and housing is expected to increase substantially. The budget share of education increases from 2.6 to 6.2 percent, while that of housing rises from 12.0 to 15.4 percent. As far as the lower-income group is concerned, the impact is more prominent in basic food and education. On the other hand, the budget share allocated to housing is expected to increase massively by 6.7 percentage points in the higher-income group.

The changes in the pattern of household expenditure in absolute rupee terms are presented in Table 5, which shows that due to a 50-percent reduction in tobacco spending overall household expenditures on basic food, health, education, housing, household durables, leisure, and miscellaneous

commodities together increase by 17.8 percent—from Rs 23,045 to Rs 27,140 per month. A relatively higher increase is observed in education and housing.

For lower-income households, the expected increase in total expenditure on these commodity groups is 18.2 percent (from Rs 18,718 to Rs 22,125) with the major share of increase devoted to education (35 percent) and basic food (25 percent). As far as the higher-income group is concerned, housing and education receive 46 and 26 percent of the increased expenditure, respectively.

Table 5: Simulated impact on intra-household expenditures (tobacco-user households)

Commodity groups*	Rupees per month			% distribution of increased expenditure
	Current expenditure	Simulated expenditure	Increase in expenditure	
All household				
Basic food	13,175	13,560	385	9.4
Health	979	1,551	572	14.0
Education	849	1,975	1,126	27.5
Housing	3,900	4,924	1,024	25.0
Household durables	1,279	1,725	446	10.9
Leisure	182	289	107	2.6
Others	2,681	3,116	435	10.6
Total	23,045	27,140	4,095	100.0
Lower income				
Basic food	11,447	12,292	845	24.8
Health	778	1,164	386	11.3
Education	577	1,763	1,186	34.8
Housing	2,738	2,810	72	2.1
Household durables	978	1,333	355	10.4
Leisure	139	292	153	4.5
Others	2,061	2,471	410	12.0
Total	18,718	22,125	3,407	100.0
Higher income				
Health	1,612	2,738	1,126	16.0
Education	1,957	3,783	1,826	25.9
Housing	8,491	11,724	3,233	45.9
Household durables	2,330	3,186	857	12.2
Total	14,390	21,431	7,041	100.0

* Analysis is presented for selected commodity groups where an increase is expected due to reduction in tobacco expenditure.

Source: Household Integrated Economic Survey, Government of Pakistan, 2015–16

5

Conclusion and Policy Implications

This study is the first attempt to estimate the impact of tobacco use on consumption patterns of households in Pakistan and complements existing work on the crowding out effect of tobacco expenditures in developing economies. The findings are consistent with previous studies conducted on countries like India, Bangladesh, and Turkey. In Pakistan, tobacco-spending households spend nearly three percent of their monthly budget on tobacco, and poor households devote more of their budget to tobacco as compared to rich households. As far as household spending patterns are concerned, the analysis shows that tobacco-user households allocate a significantly lower budget share to all commodity groups (except for basic food) than tobacco non-user households. The study finds strong evidence of a crowding out effect, in which a reduction in tobacco expenditure leads to an increase in household spending on basic food items, health, education, housing, household durables, leisure, and other commodities. The simulation analysis suggests that a reduction in tobacco expenditures by 50 percent would increase the aggregate expenditures on the abovementioned commodity groups by about 18 percent. The crowding out effect is more prominent in education and basic food among lower-income households, while education and housing are more affected among higher-income households.

Considering household welfare, the findings of this study underscore the importance of tobacco control policies. For a developing country like Pakistan where income levels are low for a large proportion of households³, policies aimed at reducing the demand for tobacco products would enhance the economic well-being of people, particularly the poor, as it would free up more resources for basic needs such as food and education. Given the tobacco-poverty link highlighted in the study, it is also recommended that tobacco control measures be integrated into the poverty reduction policies and programs.

³ The incidence of poverty in Pakistan was estimated to be 38 percent in 2013–14 (Jamal, 2016).

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ACRONYMS

CDF	Conditional Demand Function
GATS	Global Adult Tobacco Survey
HIES	Household Integrated Economic Survey
PIDE	Pakistan Institute of Development Economics
PSLM	Pakistan Living Standards Measurement Survey
QUAIDS	Quadratic Almost Ideal Demand System
SPDC	Social Policy and Development Centre
UMP	Utility Maximization Problem
WHO	World Health Organization

APPENDIX A: METHODOLOGY

Theoretical Framework

The study uses the theoretical framework developed by John (2008). The model assumes that each household wants to maximize its utility given a vector of socioeconomic characteristics (v). According to the model, the household decides the consumption of each commodity given the prices and income of the household. Then, the utility maximization problem (UMP) can be written in the following equation,

$$\begin{aligned} \text{Max } U &= U(x_i; v) \\ \text{S. t } \sum_{i=1}^n p_i x_i &= I \end{aligned}$$

where x_i denotes the consumption of commodity i , p_i is the price of commodity i , and I denotes total expenditure by household. The solution of this UMP gives us the unconditional demand functions.

John (2008) developed the model by using the Pollak (1969) model for conditional demand functions, which assumes that a household's expenditure on tobacco is predetermined, implying that the household has already decided the level of expenditure on tobacco independently. This means that the household now has to maximize its utility subject to the expenditure in excess of the pre-allocated expenditure for tobacco, which reduces the income level of the consumer. Assuming that tobacco is the n th commodity and all other commodities except tobacco are available in the market at given prices, then the total expenditure on all other commodities except tobacco is given as follows,

$$\sum_{i=1}^{n-1} p_i x_i = M$$

where $M = I - p_t x_t$ where $p_t x_t$ is the expenditure on tobacco product. Now the utility maximization problem can be rewritten as

$$\text{Max } U = U(x_i; v)$$

subject to

$$\begin{aligned} \sum_{i=1}^{n-1} p_i x_i &= M \\ x_n &= \bar{x}_t \end{aligned}$$

where \bar{x}_t is the consumption of tobacco.

The solution of the above UMP will give the demand function for $n-1$ goods and is known as the conditional demand function (CDF).

$$x_i = f_{i,n}(p_i, M, x_n; v) (\forall i \neq n)$$

The $f_{i,n}$ above is the CDF for the i th commodity on the consumption of n th commodity (tobacco). The demand function of a commodity i is the function of its own price, the price of other commodities, the total expenditure excess of expenditures on tobacco, and the quantities of the conditional goods. It is useful to apply conditional demand functions when dealing with a commodity that is not consumed by many households—tobacco, in this case.

The CDF can be used to test whether zero expenditure on any product is due to corner solutions or to nonparticipation by any household. In the data a large number of households report no expenditure on tobacco products, and this could be due to the fact that they do not want to consume any tobacco. However, theoretically, when one observes a large proportion of zeros for the consumption of tobacco in a cross-sectional consumer expenditure survey, it cannot be concluded that all of them resulted from pure abstention. Ignoring the possibility of infrequent purchases, a zero consumption of tobacco can appear either due to corner solutions, resulting from budget constraints, or sheer abstention. From the point of view of demand functions corner solutions mean purchases are not made because prices are at unaffordable levels, and if the prices actually decrease there may be purchases by the same consumers who had not purchased previously. But if abstention is the actual cause of zeros, it typically means tobacco users and nonusers have different preferences (John, 2008).

Estimation of Demand Functions

Studies by John (2008), Pu et al. (2008), Paraje and Araya (2018), Husain et al. (2018), and San and Chaloupka (2016) have used the Quadratic Almost Ideal Demand System (QUAIDS) to estimate the crowding out impact of tobacco consumption. This technique, developed by Banks, Blundell, and Lewbel (1997), estimated the Engel curve using QUAIDS. QUAIDS allows us to treat a commodity as a luxury at a certain income level and normal at another income level (John, 2008).

We estimated the Engel curve equation for each commodity group controlling for household characteristics and quadratic income term by using the following equation,

$$S_{ij} = (\alpha_{1j} + \alpha_{2j}dt_i + \alpha_{3j}T_i + \gamma_{5j}A_i) + (\beta_{1j} + \beta_{2j}dt_i)\ln M_i + (\theta_{1j} + \theta_{2j}dt_i)(\ln M_i)^2 \dots (A)$$

where S_{ij} is the share of j th commodity group in total household expenditure of household i , and a_i is a vector of household characteristics. We used household size, gender of household head, provincial dummies (to control for regional variations), and a dummy for urban location of the households. T_i is the dummy variable and equal to 1 if the household was observed with tobacco use. A_i and M_i are the actual level of tobacco-related expenditures for household i , respectively. $\ln M_i$ is the natural log of total expenditure minus tobacco expenditures by household i . We also carried out the Durbin-Wu-Hausmann test for exogeneity of M_i and A_i , and they were found to be endogenous.

$$H_0 = \alpha_{2j} = \beta_{2j} = \theta_{2j} = 0 \dots(B)$$

If this null hypothesis in equation (B) is not rejected, it means that there is no difference between the spending patterns of smoking and nonsmoking households. If this hypothesis is rejected, it is surmised that tobacco expenditures have an effect on the consumption decisions of other goods in smoking household budgets.

APPENDIX B

HIES commodity groups	Commodity groups used in the study
Food & Beverages	Basic food items Other food items (readymade food eaten out of home/ public places/offices)
Tobacco	Tobacco
Clothing and footwear	Clothing (including footwear)
Health	Health
Education	Education
Transport	Transportation
Communication	Communication
Housing, water, electricity, gas and other fuels	Housing (actual rentals, imputed rentals, maintenance) Energy (water, electricity, gas and other fuels)
Furnishing, household equipment and maintenance	Household durables
Recreation & culture	Leisure
Restaurants and hotels (includes expenditure on hotels, motels, summer cottages, holiday villages etc. It does not include food expenses)	Others
Miscellaneous goods and services (personal effects, personal care, insurance, marriages, religious ceremonies, etc.)	

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