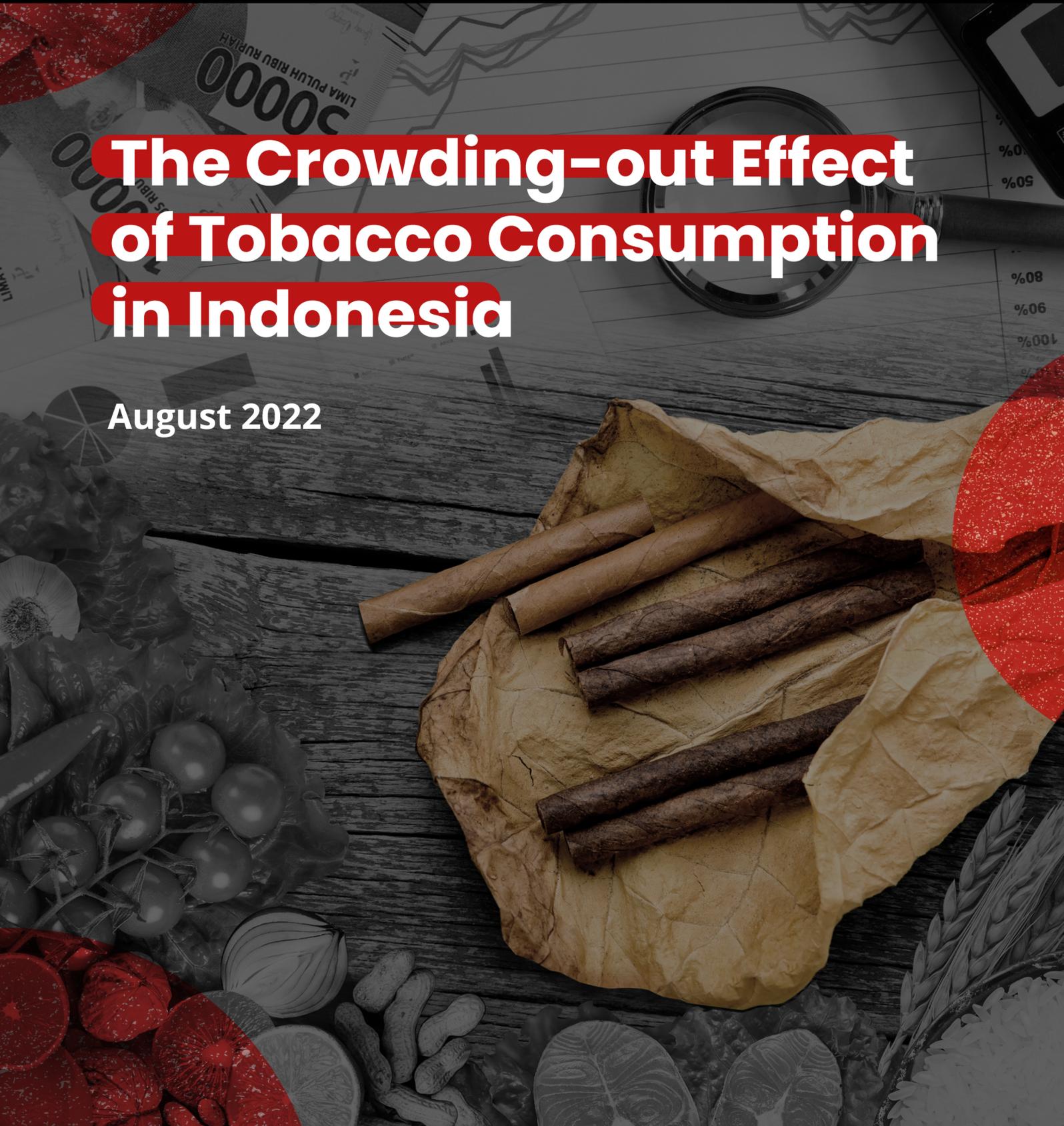


The Crowding-out Effect of Tobacco Consumption in Indonesia

August 2022





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2022

Suggested citation:

Center for Indonesia's Strategic Development Initiatives. (2022). *The Crowding-out Effect of Tobacco Consumption in Indonesia*. Jakarta: CISDI.



Acknowledgment

CISDI is funded by the University of Illinois Chicago's (UIC) Institute for Health Research and Policy to conduct economic research to support tobacco tax reform in Indonesia. UIC is a partner of the Bloomberg Initiative to Reduce Tobacco Use. The views expressed in this document cannot be attributed to, nor do they represent, the views of UIC, the Institute for Health Research and Policy, or Bloomberg Philanthropies.



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Executive Summary

Tobacco consumption is pervasive in Indonesia, with six out of ten households reported spending on tobacco products. Smoking households divert a significant share of their budget on tobacco, where they typically spend around 11 percent of monthly expenditure on cigarettes, higher than spending on staples, meat, or vegetables. High tobacco spending potentially crowds out budget shares allocated for other commodities such as food, clothing, housing, and education. Adult males who are more likely to smoke typically hold significant power to pre-allocate their income for tobacco purchases before sharing the rest of it for the household budget.

This study aims to estimate the crowding-out effects of tobacco spending on the consumption of other goods and services using Indonesian data. Following the latest generation of crowding-out analysis, the research estimates the conditional Engel curve with 3SLS, where the instrumental variable technique is applied to address the simultaneity of tobacco and total non-tobacco spending. The research uses a large-scale household budget survey from the Indonesian socio-economic survey (Susenas) from 2017 to 2019, comprising over 900,000 households.

The results of the study indicate that smoking households in Indonesia, on average, allocate a lower portion of their spending on non-tobacco commodities than non-smoking households, where the gap is more prominent among the low-income earners. The crowding-out analysis confirms that additional tobacco spending reduces the percentage of expenditure allocated for food, such as staples, meat, dairy, vegetables, fruit, and spending on other food (spices and oils). Tobacco spending also crowds out the share of expenditure spent on non-food commodities such as clothing, housing, utilities, durable and non-durable goods, education, health care, and entertainment, although its effect is not as large as the crowding-out on food. Moreover, the results show that the crowding-out effect persists across income groups.

These findings provide empirical evidence that tobacco spending crowds out household resources allocated to food and non-food commodities, and thus, contributes to nutritional inadequacy among smoking households documented in previous studies.



Moreover, the results show that tobacco spending is associated with increased spending on beverages (including caffeine and sweetened drinks) and ready-made food, contributing to poor dietary quality among smoking households. As a result, the crowding-out effect of tobacco on food and other essential commodities essential for human capital investment potentially brings long-term adverse consequences.

Given that high tobacco spending in Indonesia adversely crowds out expenditure on basic commodities, this study highlights the need for a more effective tobacco control policy to significantly reduce tobacco consumption in the country. Reduced tobacco spending would improve the well-being of smoking households as it would free up resources for essential needs such as food, housing, education, and health care. Moreover, the revenues from the tobacco tax can be allocated toward smoking cessation and prevention programs to help people quit smoking and to prevent young people from starting. In addition, a specific allocation from tobacco tax revenues can be made for health and education programs, particularly for low-income populations, to help with the human capital deficit attributed to tobacco consumption.



Introduction

1.1 Background

Despite reduced cigarette affordability in recent years, tobacco consumption in Indonesia has yet to show any substantial cutback. According to the Global Adult Tobacco Survey (2021), adult smoking prevalence only dropped by 1.6 percentage points in ten years, from 36.1 percent in 2011 to 34.5 percent in 2021. After accounting for the population growth, it is estimated that there are over 8.8 million more adult smokers in 2021 than in 2011. At the same time, smoking in Indonesia is significantly more prevalent among males, with over 65.5 percent of adult males consuming tobacco products compared to only 3.3 percent adult females (WHO, 2021)¹.

Because of the high smoking prevalence, most households in Indonesia have at least one smoker, where six out of ten households report some expenditure on tobacco products. Smoking households divert a significant share of their budget to tobacco. On average, they spend 11 percent of the monthly budget buying cigarettes, which is higher than the allocation for staples (9.7%) and meat (6.5%). Moreover, low-and middle-income households tend to have a higher smoking prevalence, consequently spending a larger percentage of their budget for cigarettes compared to high-income households.

Although smoking is only pervasive among adult males, it also adversely affects the well-being of the entire household, including non-smoking family members who live and share resources with the smoker. This is because individuals often pool their income into a single household budget and share the resources for daily consumption, such as spending on food, groceries, and utilities. Therefore, the higher tobacco consumption, the less budget left allocated for other commodities. This is particularly the case when smokers in the household hold significant power in determining budget allocation, e.g., the household head or the breadwinner. Studies have shown that male household heads

¹ It is worth noting that Indonesia's smoking prevalence based on WHO estimate is typically higher than statistics derived from the National Socioeconomic Survey (Susenas). For instance, Susenas showed that smoking prevalence in 2019 was 57.1% for adult males and 1.1% for adult females, which was lower than the GATS' estimate of 65.5% (adult males) and 3.3% (adult females)



in Indonesia have complete autonomy to spend household income on cigarettes before passing it on to wives, who are typically responsible for allocating the household budget for daily shopping (Arif et al., 2013).

The reduction of household expenditure allocated for goods and services due to tobacco spending is known as the crowding-out effect, which has been documented in India (John, 2008; Jumrani & Birthal, 2017), Pakistan (Saleem & Asif Iqbal, 2021), Cambodia (John et al., 2012), Bangladesh (Husain et al., 2018), Turkey (San & Chaloupka, 2016), South Africa (Koch & Tshiswaka-Kashalala, 2008), Zambia (Chelwa & van Walbeek, 2014), Serbia (IES, 2021), and Vietnam (Nguyen & Nguyen, 2020). The studies show that tobacco expenditure crowds out spending on food and non-food commodities, such as clothing, housing, durable goods, education, and health care. The crowding-out effect has been found more serious among resource-constrained low-income households (IES, 2021; Nguyen & Nguyen, 2020; Pu et al., 2008). On the other hand, other studies have also suggested that the crowding-out effect of tobacco is similar in low- and high-income households (John, 2008).

Since smoking households in Indonesia divert a significant share of their budget for tobacco consumption, one would ask whether it crowds out spending on food and other non-tobacco commodities. Studies have indicated that poor households in Indonesia, with at least one smoker, divert a substantial portion of an already limited resource to tobacco, reducing dietary quantity and quality (Block & Webb, 2009). Moreover, Djutaharta et al. (2022) finds that Indonesians living in a smoking household, on average, had lower protein intake than those from non-smoking families. In addition, a host of studies also has shown that smoking households in the country have inferior child health outcomes compared to non-smoking households. Dartanto et al. (2018) finds that children living with smoking parents have a 5.5. percent higher probability of stunting compared to children whose parents are non-smokers. Moreover, Girik Allo et al. (2018) finds that children growing up in smoking families have lower cognitive scores than those from non-smoking families.



This study aims to estimate the crowding-out effect of tobacco expenditure using Indonesian data. Following the latest literature, the research estimates unbiased estimators by addressing the endogeneity issue using the instrumental variable (IV) technique. The finding of this study adds to the literature on the adverse impact of smoking on household welfare, particularly providing credible evidence on how tobacco expenditures affect resource allocation to other commodities, which helps explain nutritional inadequacy and worse health outcomes experienced by smoking households.

The report is organized as follows. Chapter 2 presents the country's context, specifically discussing the extent of smoking among Indonesia's households. Chapter 3 outlines the theoretical framework and the estimation approach. Chapter 4 discusses the analysis result, and Chapter 5 provides a discussion, conclusion, and policy recommendations.

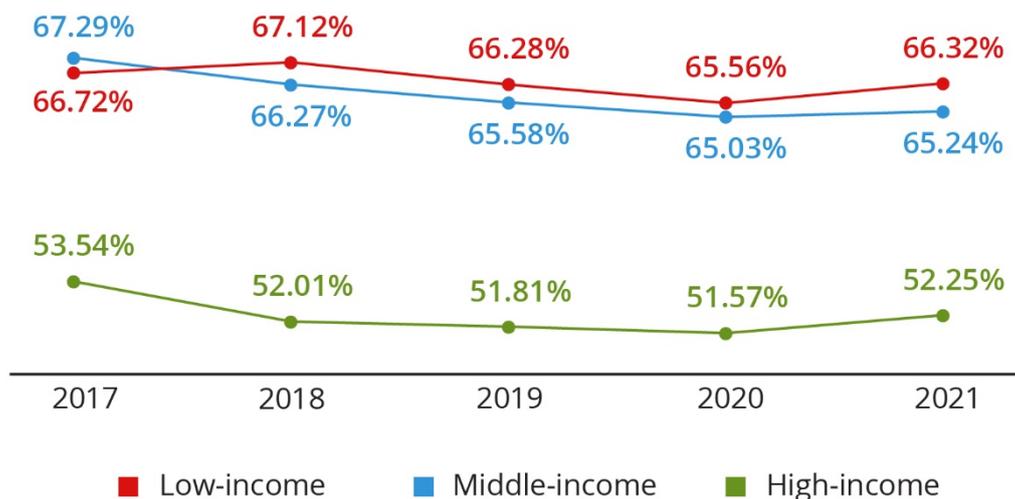


Country context

2.1 Tobacco consumption among Indonesian households

Most Indonesian households are smoking households, with at least one of their members consuming tobacco. Figure 1 shows that around 65 to 66 percent of low- and middle-income families consume tobacco products. At the same time, the prevalence of tobacco consumption among high-income households is relatively lower at 51 to 53 percent. The figures show unremarkable changes over the past five years, suggesting a relatively limited effect of the country's tobacco control policies on the prevalence of tobacco use. In 2017, 67.3 percent of low-income households (bottom 40 percent) and 66.7 percent of middle-income households consumed tobacco. Meanwhile, around half (53.3 percent) of high-income families (top 20 percent) consumed tobacco products. Over the next three years, the percentage of smoking households dropped slightly by 1 to 2 percentage points. However, the declining trend was reversed in 2021, when the share of smoking households was higher than the previous year.

Figure 1. Share of households with tobacco spending (2017 – 2021)



Source: Susenas 2017-2021



Table 1 presents tobacco spending statistics in 2019, the latest year for which the data are used for crowding-out estimation. Smoking households, on average, spend Rp418,235 on tobacco products monthly which accounts for 10.7 percent of the total household expenditure. Further analysis not shown in the table reveals that out of total tobacco expenditures, 91 percent is spent on *kretek* (clove cigarettes), 6 percent is spent on white cigarettes, and the remaining 3 percent is allocated to other tobacco products. Table 1 also shows that the average number of smokers in smoking households is 1.26, about one-third of the average household size, which illustrates that tobacco spending disproportionately favors a small number of household members at the expense of a higher number of non-smokers in the household.

Table 1. Indonesia's smoking-related statistics in 2019

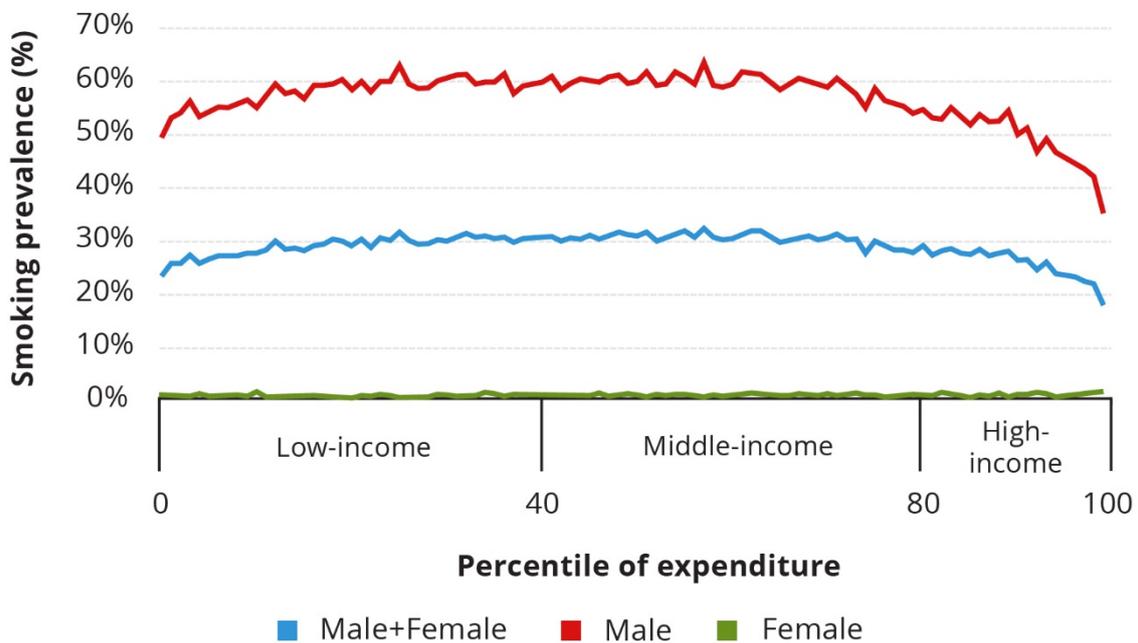
Statistics	Overall	Low income	Middle income	High income
Share of households reported tobacco spending	63.11%	66.28%	65.58%	51.81%
Average tobacco expenditures (Rp)	418,235	270,448	485,470	626,179
Share of tobacco expenditures out of total spending among smoking households	10.69%	10.73%	11.30%	9.04%
The average number of smokers in smoking households	1.26	1.28	1.26	1.21
The average size of smoking households	4.04	4.54	3.87	3.23

Source: Susenas (2019)

Notes: Survey weight is applied. Income groups are determined based on the distribution of households' per capita expenditures: Low income (<41%), Middle income (41%-80%), and High income (>80%). The complete statistics for 2017 to 2021 are available in Table A1 in the Appendix.



Figure 2. Smoking prevalence among Indonesia's adult population in 2019



Source: Susenas 2019

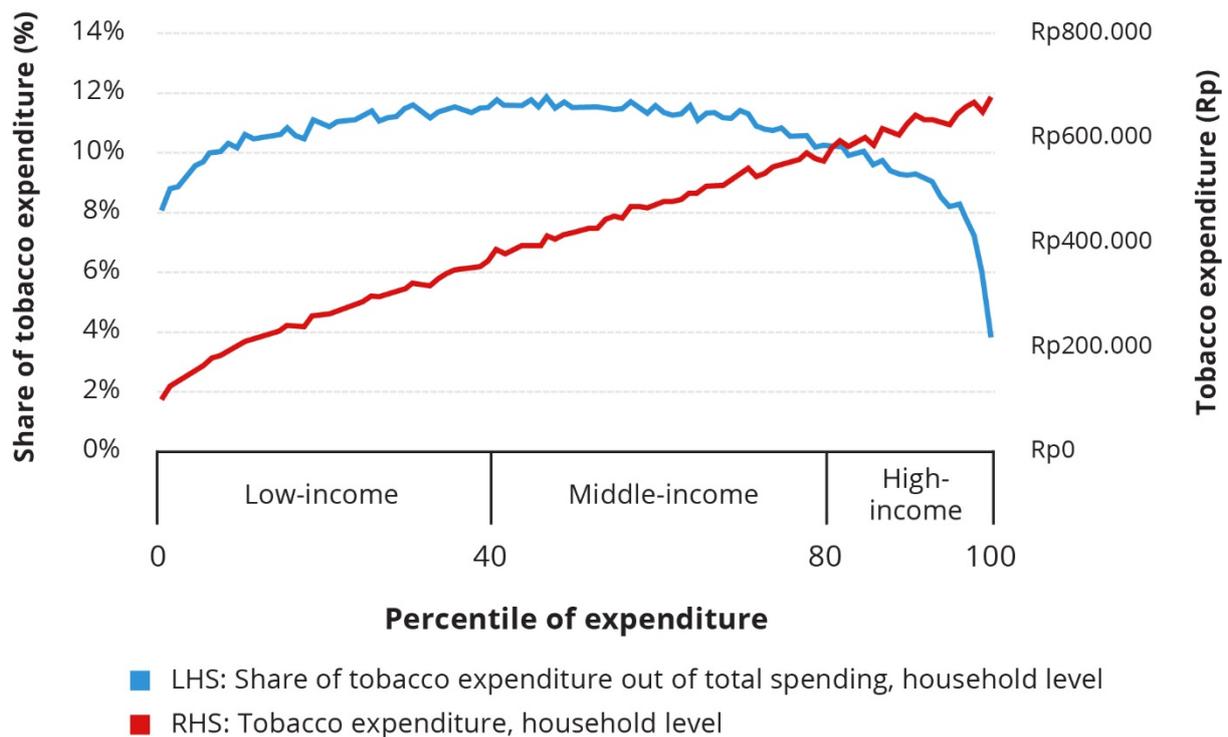
Figure 2 illustrates the smoking rate of the adult population disaggregated by household income level as proxied by their expenditure percentile. Overall, smoking prevalence is steadily high across the income groups, where the smoking rate among low-income (28.9 percent) and middle-income populations (30.5 percent) are relatively higher compared to the high-income populations (25.9 percent). Figure 3 presents household tobacco spending across income groups, both in absolute terms and as a share of total household spending. The figure shows that the amount of money spent on tobacco goes hand in hand with income level. Low-income households, on average, spend Rp258,071 on tobacco per month. Meanwhile, middle- and high-income households respectively allocate Rp473,111 and Rp620,493 to buy tobacco products.

Relative to their total spending, households, on average, allocate a significant share of their monthly budget on tobacco (11.06 percent). Middle-income households typically spend 11.29 percent of their budget on tobacco, slightly higher than that of low-income smokers (10.7 percent). Among the top earners, the share of household budget diverted for tobacco is also relatively high. On average, the top 20-percent wealthiest group



spends 8.95 percent of the monthly budget on tobacco. The share of tobacco spending is 7.25 percent for the 98th income percentile, 5.90 percent for the 99th percentile, and 3.89 percent for the top 1-percent earners. This indicates that smoking in Indonesia takes up a significant share of the household budget not only among low- and middle-income groups, but also among top earners.

Figure 3. Share of tobacco expenditure out of total household spending



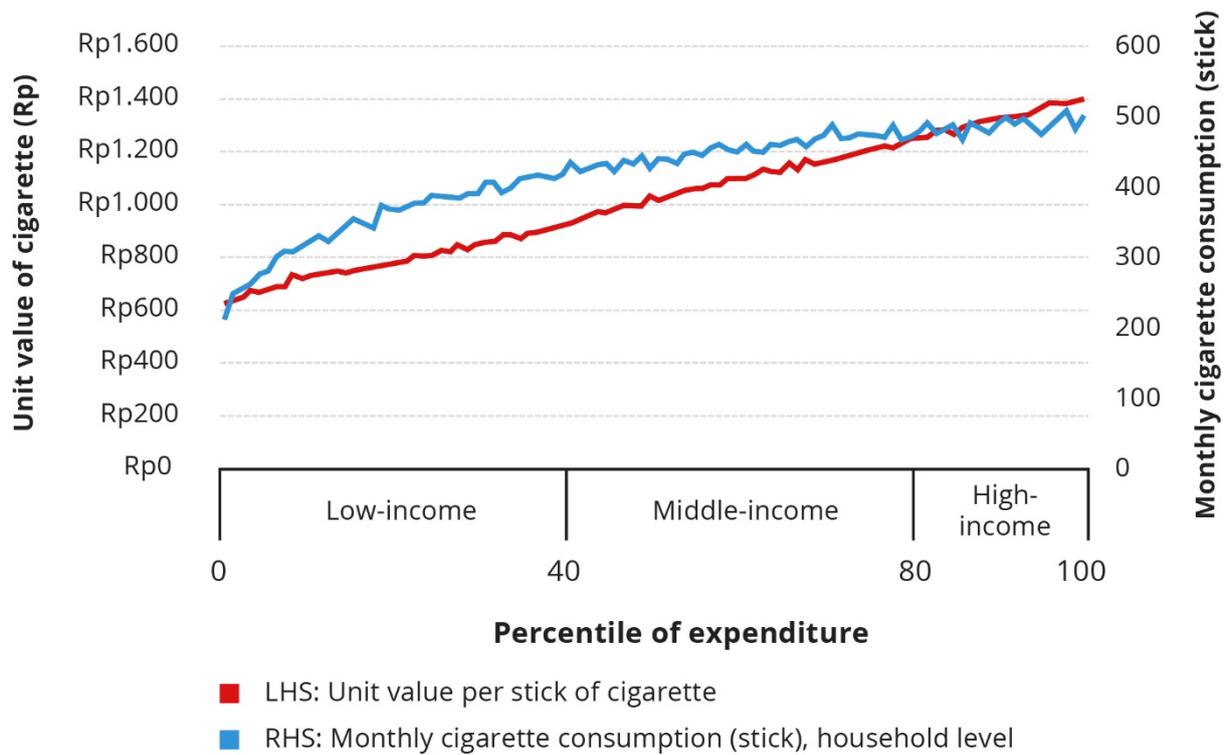
Source: Susenas 2017 – 2019

Figure 4. below shows that high-income households tend to consume more cigarettes and tend to opt for more expensive brands. On average, low-income households consume 358 sticks of cigarettes monthly. The number is significantly higher for the middle-income group (453 sticks), and the top earners (486 sticks). In addition to consuming more cigarettes, higher-income households also tend to buy higher-priced cigarettes compared to lower income families. The left-vertical axis of Figure 4 shows the unit value, which reveals the average price per cigarette stick paid by smokers. Low-income households on average spend Rp791 for each cigarette stick consumed, while



middle- and high-income households spend Rp1,094 and Rp1,322 per cigarette stick, respectively. This implies that lower-income smokers opt for cheaper cigarette brands, which is made possible by the wide range of cigarette price variability in Indonesia.

Figure 4. Intensity of cigarette consumption among tobacco-consuming households



Source: Susenas 2017 - 2019



Method and Data

3.1 Theoretical framework

Following the theoretical framework laid out by John et al. (2019), the estimation of the crowding-out effect stems from the underlying assumption that households determine their consumption to maximize a single utilities function. This assumption is relevant as households often pool resources from family members and then make spending decisions based on the needs of their members (Arif et al., 2013). Moreover, a household expenditure survey typically reports spending for the whole family as a single unit. Therefore, the unit analysis in this study is expenditure at the household level.²

Household consumption is modelled by a demand function in which the quantity of goods consumed (q_i) is determined by the price of all goods (p_i) in the commodities basket, the available budget (Y), and the household characteristics (h), as illustrated in Equation 1. Pollak (1969) pointed out that if households predetermine consumption of one good, for example, consumption of tobacco, then they will maximize a utilities function presented in Equation 2, where \bar{q}_n is the predetermined quantity of tobacco consumption, and M is the remaining budget after being deducted by the tobacco spending. Solving Equation 2 for $n-1$ goods returns a conditional demand function shown in Equation 3.

$$q_i = f^i(p_1, p_2, \dots, p_n; Y; h), \quad i = 1, 2, \dots, n \quad \text{Equation 1}$$

$$\text{Max } U = U(q_1, q_2, \dots, \bar{q}_n; a), \quad \text{subject to } \sum_{i=1}^{n-1} p_i q_i = M \quad \text{Equation 2}$$

$$q_i = g^i(p_1, p_2, \dots, p_{n-1}, \bar{q}_n; M; h), \quad i = 1, 2, \dots, n - 1 \quad \text{Equation 3}$$

² One of the limitations of aggregating the unit of analysis at the household level is that we cannot look at the intra-household resource allocation due to the crowding-out. For example, the reduced budget share allocated to certain commodities (crowding-out) might disproportionately affect specific family members. Nevertheless, due to data availability, analysis of the individual level is not possible, and thus, is a limitation of this study.



3.2 Econometric model

As the information on commodity price is unavailable, this study estimates the Engel Curve—which allows use of expenditure data—using the Quadratic Almost Ideal System (QUAIDS) developed by Banks et al. (1997). Conditioning on tobacco expenditures, the Engel curves are estimated as follows:

$$w_{ij} = (a_{1i} + a_{2i}d_j + a_{3ij}p_{nj}\bar{q}_{nj} + \delta'_i h_j) + (\beta_{1i} + \beta_{2i}d_j)\ln M_j + (\gamma_{1i} + \gamma_{2i}d_j)(\ln M_j)^2 + u_{1i}$$

Equation 4

w_{ij} denotes the share of expenditure of product i out of total non-tobacco expenditure for household j . Meanwhile, d_j is a binary indicator with a value of 1 if the households have a non-zero tobacco expenditure; in other words, d_j refers to a smoking household. $p_{nj}\bar{q}_{nj}$ is the predetermined tobacco expenditures and h_j is a vector for household characteristics. $\ln M_j$ is the log of total non-tobacco expenditures and $\ln M_j^2$ is the square of $\ln M_j$.

Tobacco spending ($p_{nj}\bar{q}_{nj}$) and the total non-tobacco spending ($\ln M_j$) in Equation 4 are likely to be endogenous due to simultaneity; therefore, an OLS estimation would result in a biased parameter. The latest generation of crowding-out study addresses this issue with an instrumental variable (IV) (Chelwa & van Walbeek, 2014; Husain et al., 2018; IES, 2021; John, 2008; Jumrani & Birthal, 2017; Koch & Tshiswaka-Kashalala, 2008; Nguyen & Nguyen, 2020; Pu et al., 2008; San & Chaloupka, 2016).



The IV provides consistent estimators if the exogenous instrument is partially correlated with the endogenous regressors ($Cov[z_i, x_i] \neq 0$) and the instrument z_i only affects the dependent variables w_i through the endogenous regressors, or z_i does not correlate with the error terms, $E(u_i|z_i)=0$. As each commodity (w_i) has the same set of regressors, the study estimates Equation 4 by Seemingly Unrelated Regression (SUR) with the addition of an IV which is effectively a three-stage least square (3SLS) method (Zellner & Theil, 1962)³.

3.3 Variable and statistical tests

The study includes 15 groups of commodities as the dependent variables, which include seven food items (staples, meat and fish, dairy products, fruit and vegetables, beverages, ready-made food, and other food) and eight non-food items (clothing, housing, utilities and fuel, durable and non-durable goods, education, health care, transportation, and entertainment). Alcohol expenditure is arbitrarily excluded from the 3SLS regression to satisfy the adding-up restriction. Alcohol is dropped due to its negligible share, which only accounts for 0.04 percent of the total non-tobacco expenditure. Descriptive statistics of the variables used in the analysis are presented in Table A3 in the Appendix.

The endogenous regressors in Equation 4 are tobacco expenditure, log of non-tobacco spending, and its square. The endogeneity test (C-Statistics) presented in Table A4 in the Appendix shows that those variables are indeed endogenous for all commodities; therefore, the use of IV is justifiable. Following previous literature, the study employs the log of total expenditures ($\ln X$) and its square ($\ln X^2$) as an instrument for the endogenous log of non-tobacco spending ($\ln M$ and $\ln M^2$). The idea is that households' economic affluence, as proxied by their total expenditure, only affects their spending structure through expenditure for non-tobacco commodities.

³ Wooldridge (2010) pointed out that GMM 3SLS is more efficient than the traditional 3SLS in the presence of heteroskedastic error. Unfortunately, the attempt to use GMM 3SLS in this study was unsuccessful as it failed to converge. John et al. (2019) also advocate reporting 3SLS with bootstrapped standard errors to account for heteroskedasticity. This analysis shows that applying the bootstrap procedure with 1000 replications has an insignificant effect on the standard errors and the significance of the estimated parameters. Moreover, the bootstrap replication cannot accommodate sample weight in the regression, which is the preferred specification of this study. Therefore, Equation 4 is estimated by the traditional 3SLS regression without bootstrapped standard errors.



Meanwhile, the study employs the share of adult males out of the total adults in the household as the instrument for tobacco expenditure. As presented in Figure 2, smoking among the adult population in Indonesia is significantly more prevalent among males than females. Therefore, the share of the adult male in the household is highly correlated with tobacco spending. Table A5 in the Appendix highlights that proposed instruments are significantly associated with endogenous variables even after controlling for household characteristics. The under-identification test presented in Table A4 also reveals a rejection of the null hypothesis, suggesting the instruments are relevant or correlated with the endogenous variables⁴.

The study also includes a robustness check using alternative instruments for tobacco expenditure. The first alternative uses a ratio of adult males to adult females in the household, frequently used in previous tobacco crowding-out analyses (Chelwa & van Walbeek, 2014; John, 2008; Nguyen & Nguyen, 2020; San & Chaloupka, 2016). The second alternative uses a composite measure of smoking prevalence, which has been used in some studies (IES, 2021; Koch & Tshiswaka-Kashalala, 2008). Individual smoking determinants are estimated based on individual and household characteristics using the 2020 Susenas and the 2017 Indonesia Demographic Health Survey (DHS). The study then applies the estimated parameters to the sample characteristics to obtain a predicted probability of smoking and then averages them out to generate predicted smoking prevalence at the household level. The result of the crowding-out analysis using the alternative instruments is presented in the Appendix (Table A11).

In addition to adding year-fixed effects in the regression, the study also controls for household characteristics. They include average years of education of adult household members, the share of employed adult members, household composition: number of

⁴ Previous crowding-out studies have acknowledged the challenge of finding instrument variables that satisfy exclusion restrictions, i.e., do not correlate with error terms. For example, the share of male adults out of total adults in the household might be associated with other explanatory variables, such as household size. The study addresses this concern by conducting a robustness check by employing various alternative instrument variables, such as a composite measure of household smoking prevalence. Overall, the crowding-out effects using the alternative instruments are consistent with the main analysis.



infants, productive-aged persons, number of seniors in the household, and whether the family lives in a rural or urban area.

Table A4 presents the result of the Wald test for the joint significance of parameters $\alpha_{2i}, \beta_{2i}, \gamma_{2i}$. The rejection of the null hypothesis, meaning the parameters are jointly different from zero, suggests heterogeneity in smoking and non-smoking household preference. In other words, non-smoking households report zero spending on tobacco products because tobacco is not on their utilities function. Therefore, Equation 4 is the correct specification as it accounts for preference heterogeneity (John et al., 2019). The other statistical test performed is the heteroskedasticity test which reports heteroscedastic error terms; therefore, a heteroscedastic-consistent standard error should be employed throughout the analysis.

3.4 Data

The study utilizes three rounds of Indonesia's National Socioeconomic Survey (Susenas) from 2017 to 2019. Susenas is a nationally-representative survey on household social and economic activities conducted semi-annually in March and September. The study uses data from the March survey as it consists of larger respondents compared to the September survey. Overall, 908,103 households pooled from Susenas 2017 to 2019 are used for the analysis. Before pooling the surveys, expenditure data have been adjusted for inflation using monthly consumer price index where all expenditures are presented at March 2019 price level.

3.5 Simulation

The study includes a simulation to illustrate the change of household's expenditure spent on a specific commodity if tobacco spending decreases by 50 percent. The simulation is calculated based on the following formula:

$$\Delta E_i = (S_i^1 \times M^1) - (S_i^0 \times M^0) \quad \text{Equation 5}$$

where $S_i^1 = S_i^0 + (a_{3i} \times \Delta \text{TobExp})$ and $M^1 = M^0 - \Delta \text{TobExp}$

ΔE_i denotes a change in expenditure for commodity i . M^0 is the initial non-tobacco expenditure, while S_i^0 is the share of M^0 (initial non-tobacco expenditure) spent on commodity i . On the other hand, S_i^1 is the share of expenditure spent on commodity i



after reduced tobacco spending. ΔTobExp is a negative value as it represents a reduction of tobacco spending by 50 percent from the initial level. Parameter a_{3i} is crowding-out coefficient from Equation 4. In the case of the crowding-out effect, a_{3i} is negative, hence the product of a_{3i} and ΔTobExp is a positive value which represents the increase in budget share spent on commodity i (in percentage points) after a reduction in tobacco expenditure. Therefore, S_i^1 is greater than S_i^0 . Lastly, M^1 refers to the total household's budget for non-tobacco expenditure after a 50 percent reduction in tobacco spending. Since ΔTobExp is negative, then M^1 is greater than M^0 .



Results

4.1 Expenditure patterns of smoking and non-smoking households

The preliminary approach to analyzing the effect of tobacco consumption on household spending patterns is to compare the share of expenditures for non-tobacco commodities between smoking and non-smoking households. Table 2 presents the percentage of spending from total household expenditures on key commodity groups, such as food, clothing, housing, utilities and fuel, durable and non-durable goods, education, health care, transportation, entertainment, and alcohol. Food expenditure is also disaggregated into several subgroups to better explain the structure of household spending patterns. Food expenditure is disaggregated into spending on staples, meat and fish, dairy, fruit and vegetables, beverages, ready-made food, and other food, such as spices and oil.

Although smoking households overall spend a smaller share of their expenditure on food, disaggregation of food spending shows that they tend to allocate more to staples and beverages, suggesting heterogeneity in food expenditure patterns between smoking and non-smoking households. Further analysis based on income level indicates that the lower the income level, the larger the gap in resources allocated to food between smoking and non-smoking households. Low-income smoking households spend less on food by 4.9 percentage points (pp) than their non-smoking counterparts. The difference is smaller for the middle-income group (2.8 pp.) and top earners (1.2 pp.). This pattern is observed in all food categories, except for beverages, suggesting that smoking households allocate fewer resources to food than non-smoking families, where the gap is more prominent among the low earners.



Table 2. Comparison of share of expenditures between smoking and non-smoking households

Share of total household's expenditures	Overall			Diff. Low-income	Diff. Middle-income	Diff. High-income
	Smoking household	Non-smoking household	Diff.			
Food	49.30	50.48	-1.18	-4.86	-2.76	1.19
Staple	10.39	9.74	0.64	-0.60	0.04	0.43
Meat and fish	6.16	6.51	-0.35	-0.72	-0.58	0.11
Dairy	2.72	3.04	-0.31	-0.45	-0.40	-0.14
Fruit and vegetables	6.74	7.42	-0.68	-1.31	-0.98	-0.17
Beverages	5.19	4.63	0.56	0.32	0.49	0.60
Ready-made food	14.17	15.15	-0.98	-1.43	-1.14	0.13
Other food (spices, oils)	3.92	3.98	-0.06	-0.67	-0.19	0.24
Clothing	2.76	2.93	-0.17	-0.14	-0.18	-0.13
Housing	10.03	14.00	-3.97	-2.74	-3.97	-4.10
Utilities and fuel	8.12	10.23	-2.10	-1.70	-1.91	-2.08
Durable and non-durable goods	6.23	7.07	-0.84	-0.50	-0.57	-0.03
Education	2.33	3.15	-0.83	-0.24	-0.65	-1.81
Health care	3.33	4.30	-0.97	-0.53	-1.06	-1.26
Transportation	6.08	6.32	-0.24	0.03	-0.11	-0.29
Entertainment	1.12	1.50	-0.39	-0.06	-0.12	-0.49
Alcohol	0.05	0.01	0.04	0.03	0.04	0.05
Observations	571,975	336,128		370,685	374,321	163,097

Source: Pooled Susenas (2017-2019)

Notes: Survey weight is applied. All T-tests for share differences are statistically significant at a 1% level. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%). See Table A2 in the Appendix for the extended version of the table.



Smoking households also allocate a smaller share of expenditure for non-food commodities. Contrary to food spending patterns, the gap in the share of non-food expenditures between smoking and non-smoking households is larger among the high earners. For instance, smoking families in the top income group spend 4.1 percentage points less on housing than their non-smoking counterparts. Meanwhile, the gap is lower among the middle-income group (3.97 pp.) and low earners (2.74 pp.). The same patterns are also observed in spending on utilities, education, health care, transportation, and entertainment.

Overall, the descriptive analysis presented in Table 2 shows that smoking households, which spend a significant portion of their budget (10.7 percent) on tobacco products, tend to allocate a smaller share of their budget for spending on food and non-food commodities than non-smoking households. This pattern is consistent across income groups, which suggests the crowding-out effect of tobacco spending on other items.

The study also analyzes the correlation of tobacco expenditure with spending on other commodities among smoking households. Table 3 demonstrates a negative correlation between the share of tobacco spending and the share of the spending on other goods and services, except for spending on alcohol. This suggests that the higher the spending on tobacco products among the smoking household, the lower the expenditure allocated to other goods such as food, housing, utilities, etc. Note that these descriptive and correlation analyses do not control for household-specific characteristics and other confounders that might explain households' spending decisions. Failing to do so might lead to biased estimates where researchers inadvertently attribute households' expenditure allocation to their tobacco spending habit. Therefore, the following section discusses the result of the 3SLS regression, which provides more credible estimates of the crowding-out effects of tobacco expenditure.



Table 3. Correlation between tobacco spending and expenditure on other commodities

	Overall	Low income	Middle income	High income
Food				
Staple	-0.068	-0.173	-0.012	0.085
Meat and fish	-0.071	-0.091	-0.085	-0.030
Dairy	-0.104	-0.082	-0.127	-0.118
Fruit and vegetables	-0.127	-0.201	-0.121	-0.018
Beverages	-0.013	-0.076	-0.014	0.139
Ready-made food	-0.094	-0.122	-0.134	0.048
Other food (spices, oils)	-0.033	-0.113	-0.025	0.108
Clothing	-0.060	-0.034	-0.078	-0.094
Housing	-0.123	-0.131	-0.148	-0.076
Utilities and fuel	-0.131	-0.095	-0.134	-0.160
Durable and non-durable goods	-0.164	-0.119	-0.180	-0.222
Education	-0.178	-0.154	-0.195	-0.194
Health care	-0.127	-0.104	-0.133	-0.145
Transportation	-0.076	-0.057	-0.084	-0.084
Entertainment	-0.093	-0.051	-0.089	-0.142
Alcohol	0.015	-0.007	0.020	0.046

Source: Authors' estimation based on Susenas 2017-2019

Notes: The table above presents the correlation between the share of the household's expenditure on tobacco and the percentage of spending on other commodities among the smoking household. All parameters are statistically significant at a 1% level. Survey weight is applied in the analysis. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%).



4.2 The crowding-out effect of smoking expenditures

Table 4 presents the coefficients of tobacco expenditure from the 3SLS regression, which shows the change in the share of the remaining budget spent on commodity groups if the tobacco expenditures are increased by Rp10,000. For the most part, the coefficients show a negative sign and are statistically significant, highlighting that an additional tobacco expenditure reduces the budget share spent on other non-tobacco commodities. For instance, increasing tobacco spending by Rp10,000 (equivalent to buying six sticks of the most-sold cigarette brand)⁵ will crowd out the share of the remaining budget allotted for staples by 0.00048 percentage points. Among the food categories, spending on fruit and vegetables is the most negatively impacted as the budget spent on this commodity will decrease by 0.00137 percentage points for every Rp10,000 addition in tobacco purchase.

Among the non-food commodities, spending on entertainment and durable and non-durable goods are the most adversely affected by tobacco consumption as an additional pre-allocated budget for tobacco by Rp100,000 (equivalent to buying four packs of the most-sold cigarette brand) will reduce the share of expenditure for entertainment (movies, concerts, hotels, religious and social events) by 0.0049 percentage points and will decrease the share of spending for durable and non-durable goods by 0.0071 percentage points. At the same time, increasing tobacco spending by the same amount will crowd out the share of expenditure on clothing (0.0026 pp.), housing (0.0045 pp.), utilities and fuel (0.0018 pp.), education (0.0031 pp.), and health care (0.0008 pp.).

On the other hand, additional tobacco expenditure increases the expenditure share for some commodities, such as spending on beverages, ready-made food, and transportation. The estimation shows that increasing the pre-allocated spending for cigarettes by Rp10,000 will increase the share of expenditures for beverages (tea, coffee, sugar, bottled drinks) by 0.00102 percentage points, ready-made food (0.00364 pp.), and transportation (0.00145 pp.)

⁵ According to Tan & Dorotheo (2021), Indonesia's most-sold cigarette brand is A Mild (16 sticks), with a retail price of Rp25,000 or Rp1,594 per stick. Single-stick cigarette sales are typical in the country, particularly among informal small-scale vendors.

**Table 4. The crowding-out coefficients**

	Overall	Low income	Middle income	High income
Food				
Staple	-0.00048***	-0.00077***	-0.0001***	-0.00144***
Meat and fish	-0.00094***	0.00007	-0.00029***	-0.00204***
Dairy	-0.00044***	-0.00013***	-0.00016***	-0.00087***
Vegetable and fruit	-0.00137***	-0.00042***	-0.0007***	-0.00234***
Beverages	0.00102***	0.00081***	0.00058***	0.00132***
Ready-made food	0.00364***	0.00132***	0.00109***	0.00742***
Other food (spices, oils)	-0.00043***	-0.00013***	-0.00018***	-0.00078***
Clothing	-0.00026***	-0.00008***	-0.00016***	-0.00038***
Housing	-0.00045***	0.00035***	-0.00010**	-0.00104***
Utilities and fuels	-0.00018***	-0.00013***	0.00002	-0.00025***
Durable and non-durable goods	-0.00071***	-0.00029***	-0.00045***	-0.00131***
Education	-0.00031***	-0.00042***	-0.00029***	0.00043***
Health care	-0.00008***	0.00024***	0.00011***	-0.00011***
Transportation	0.00145***	-0.00036***	0.00083***	0.00248***
Entertainment	-0.00049***	-0.0001***	-0.00021***	-0.00118***

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: The table above presents parameters *exptob*, multiplied by 10,000. *** and ** denote significance at 1% and 5% levels, respectively. Survey weight is applied in the regression. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%). The complete regression results are reported in the Appendix (Table A7 to A10).

The crowding-out analysis disaggregated by household expenditure level reveals that the crowding-out effects of tobacco expenditure persist across income groups, where the effects are higher among the top earners than in the lower-income group. These results could be attributed to smokers from higher-income households consuming more cigarettes and preferring higher-priced brands compared to lower-income households. Therefore, given that high-income smokers prefer more expensive cigarettes, additional tobacco consumption would crowd out more resources relative to those in the lower-income group.



Tobacco spending consistently reduces the budget share spent on staples, meat (except for the low-income group), dairy products, vegetables, and other food across the income groups. In addition, tobacco spending is also consistently associated with an increased household budget share allotted for beverages and ready-made food for the low-, middle-, and high-income earners. Tobacco spending also crowds out the budget share allotted for durable and non-durable goods, clothing, and entertainment across income levels. In addition, the analysis finds that an increased budget allocated to tobacco reduces the budget share spent on housing among middle- and high-income groups, while the crowding out on utilities spending only occurs among low- and high-income households. On the other hand, the crowding-out effect of tobacco spending on education only occurs among low- and middle-income families, while the same effect on health care spending is only found among top-income households.

As discussed in section 3.3, the study also includes a robustness check using alternative variables as an instrument for tobacco expenditures. The analysis results using the proposed alternative instruments are presented in the Appendix (Table A11), which shows that crowding-out effects are consistent across all instruments, except for a deviation in some of the spending groups (staples, other food, and housing). Moreover, the robustness check also confirms the main finding that tobacco expenditure is positively associated with spending on beverages, ready-made food, and transportation.

4.3 Simulation of the crowding-out effect

The study simulates changes in the household's expenditure if tobacco spending is reduced by 50 percent. The formula for the simulation is explained in section 3.5 which assumes that saving from reduced tobacco spending is fully reallocated to other non-tobacco commodities. The other key information is that the average monthly expenditure among smoking households is Rp4,259,947, of which Rp407,283 is spent on tobacco and Rp3,852,662 is allocated to other non-tobacco commodities. A 50-percent reduction means that tobacco spending decreases by Rp203,643 which increases the budget available for non-tobacco commodities by the same amount from Rp3,852,662 to Rp4,056,305.



Table 5. Simulation of the impact of a 50-percent tobacco spending reduction on household's expenditure

[1] Total household expenditure (Rp)			4,259,947
[2] Total non-tobacco expenditure (Rp)			3,852,662
[3] Tobacco expenditure (Rp)			407,285
[4] A decrease in tobacco expenditure by 50% (Rp)			-203,643
	Initial expenditure (Rp)	Additional expenditure due to reduction in tobacco spending (Rp)	Percentage increase from the initial expenditure
Food			
Staple	450,806	63,065	14.0%
Meat and fish	266,099	92,043	34.6%
Dairy	116,997	42,447	36.3%
Vegetable and fruit	291,185	128,558	44.2%
Beverage	225,390	-72,342	-32.1%
Ready-made food	612,019	-268,327	-43.8%
Other foods (spices, oils)	170,199	44,681	26.3%
Clothing	119,263	27,864	23.4%
Housing	432,458	60,278	13.9%
Utilities and fuels	350,322	33,138	9.5%
Durable and non-durable goods	266,056	73,042	27.5%
Education	98,610	30,654	31.1%
Health care	142,068	14,184	10.0%
Transportation	262,047	-105,924	-40.4%
Entertainment	46,917	43,286	92.3%

Source: Authors' estimation based on Equation 5

Notes: The average expenditures presented in rows [1] to [4] are statistics among the smoking households derived from Susenas 2017-2019 (survey weight is applied). The expenditures have been adjusted for inflation and are presented in the 2019 price level.



The simulation shows that reducing tobacco spending, and assuming everything else is constant, will increase spending on food items, except for beverages and ready-made food. Reducing tobacco expenditure by 50 percent from the current level will increase spending on staples by Rp63,065 or 14 percent higher than the current expenditure. In addition, it also increases spending on fruit and vegetables (44.2%), dairy products (36.3%), meat and fish (34.6%), and other food (26.3%). On the other hand, spending less on tobacco by the same amount will reduce expenditure on ready-made food by 43.8 percent and reduces beverages spending by 32.1 percent. Cutting cigarette spending by half also increases expenditure on education (31.1%), durable and non-durable goods (27.5%), housing (13.9%), health care (10%), and utilities (9.5%). On the contrary, it will reduce the budget allocated for transportation by 40.4 percent.



Discussion and conclusions

Tobacco consumption is pervasive in Indonesia, with six out of ten households reported spending on tobacco products. Smoking households divert a significant share of their budget on tobacco, where they typically spend around 11 percent of monthly expenditure on cigarettes and other tobacco products. This study aims to estimate the crowding-out effects of tobacco spending on the consumption of other goods and services. Using the annual Indonesia socio-economic survey (Susenas) from 2017 to 2019, comprising over 908,103 households, this study analyzes the crowding-out effect by estimating the conditional Engel curve with SUR and IV to account for the endogeneity of tobacco expenditure.

The descriptive analysis suggests that smoking households, on average, allocate a lower portion of their spending on non-tobacco commodities compared to non-smoking households (except for spending on alcohol), and the gap is more prominent among the low-income earners. The crowding-out analysis confirms that additional tobacco spending reduces the percentage of expenditure allocated for food, such as staples, meat, dairy, fruit and vegetables, and spending on other food (spices and oils). This finding is consistent with evidence from other countries such as India, Cambodia, Turkey, and Serbia, suggesting that tobacco spending crowds out expenditure on food items (IES, 2021; John et al., 2012; Jumrani & Birthal, 2017; San & Chaloupka, 2016). In addition to diverting spending on food, the research also finds that tobacco spending crowds out the share of expenditure spent on non-food commodities, although its effect is not as large as the crowding-out on food. The estimate shows that additional tobacco spending would reduce resources allocated to clothing, housing, utilities, durable and non-durable goods, education, health care, and entertainment.

The study findings on tobacco's crowding-out effect on food consumption provides compelling evidence which helps to explain nutritional inadequacy among the smoking families documented in previous studies. Djutaharta et al. (2022) finds that individuals living in a smoking household in Indonesia have lower protein intake than those living in non-smoking families, where the gap in nutritional adequacy is more significant among



low-income smokers. Block & Webb (2009) suggested that poor smokers diverted a substantial portion of an already limited resource to tobacco, reducing dietary quantity and quality. Therefore, this study's findings serve as credible evidence that tobacco spending crowds out resources allocated to food, and directly contributes to poor diets and nutrition inadequacy among the smoking families in Indonesia.

The study's findings also demonstrate that tobacco spending is positively associated with the budget share allocated to beverages and ready-made food. Past research has demonstrated that smoking is linked to higher coffee and sweetened beverages intake (Bjørngaard et al., 2017; Lee et al., 2017). Therefore, concerning the household's dietary quality, this study's findings show that tobacco spending not only diverts expenditure for nutritious food such as staples, meat, and fruit and vegetables, but also increases caffeine and sugary drinks consumption, which might contribute to nutritional imbalance and nutritional inadequacy.

Reduced spending on food and other essential commodities such as housing, utilities, durable goods, and education among smoking families detrimentally affects human capital investment, particularly for children. A recent estimate shows that children with smoking parents in Indonesia have increased odds of stunting and lower growth indices (Dartanto et al., 2018; Wijaya-Erhardt, 2019). Moreover, Girik Allo et al. (2018) find that Indonesian children growing up in smoking households have lower cognitive scores than those living in non-smoking families. This indicates that the crowding-out effect of tobacco potentially brings a long-term and inter-generational adverse impact as it reduces children's productivity and earnings in adulthood (Dewey & Begum, 2011; Seema Nasser et al., 2022).

In conclusion, this research demonstrates that tobacco spending in Indonesia reduces the budget allocated to food and non-food commodities, where the crowding-out effect is higher for food items than the non-food items. Moreover, the analysis suggests that the crowding-out effect persists across the income groups. Given that more than half of Indonesian families are smoking households, the crowding-out effect of tobacco affects a significant share of the population, including those who do not smoke. To provide some context, in 2021, there were 47.7 million smoking households in Indonesia housing 184.5



million individuals, of which 78 percent did not consume tobacco but lived and shared resources with smoking family members. Around 33.7 percent of the smoking households had at least one child aged 5 years old and under, and 45.5 percent of them had children currently enrolled in school. These statistics illustrate the specific vulnerable groups that are affected by the crowding-out effect of tobacco consumption.

As high tobacco spending in Indonesia adversely crowds out expenditure on basic commodities, this study highlights the need for a more effective tobacco control policy to significantly reduce tobacco consumption in the country. Reduced tobacco spending would improve the well-being of smoking households as it would free up resources for essential needs such as food, housing, education, and health care. Moreover, the revenues from the tobacco tax can be allocated toward smoking cessation and prevention programs to help people quit smoking and to prevent young people from starting. In addition, tobacco tax revenues also can be allocated toward health and education programs, particularly for low-income populations, to help with the human capital deficit attributed to tobacco consumption.



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Appendix

Table A1. Indonesia's smoking-related statistics in 2017-2021

Income group	Statistics	2017	2018	2019	2020	2021
Overall	Share of households reported tobacco spending	64.31%	63.76%	63.11%	62.55%	63.07%
	Average tobacco expenditure (2019-price, Rp)	407,066.30	396,458.00	418,235.00	422,710.00	417,074.40
	Share of tobacco expenditures out of total expenditures	11.12%	10.18%	10.69%	10.60%	10.64%
Low-income	Share of households reported tobacco spending	66.72%	67.12%	66.28%	65.56%	66.32%
	Average tobacco expenditure (2019-price, Rp)	259,371.10	244,993.50	270,447.90	270,344.00	265,681.80
	Share of tobacco expenditures out of total expenditures	11.33%	10.08%	10.73%	10.56%	10.53%
Middle-income	Share of households reported tobacco spending	67.29%	66.27%	65.58%	65.03%	65.24%
	Average tobacco expenditure (2019-price, Rp)	471,366.00	462,314.20	485,470.20	489,035.60	476,078.20
	Share of tobacco expenditures out of total expenditures	11.72%	10.86%	11.30%	11.22%	11.20%
High-income	Share of households reported tobacco spending	53.54%	52.01%	51.81%	51.57%	52.25%
	Average tobacco expenditure (2019-price, Rp)	613,512.30	619,583.00	626,179.30	642,871.20	654,057.80
	Share of tobacco expenditures out of total expenditures	9.10%	8.70%	9.04%	9.12%	9.49%

Source: Susenas (2017-2021)

Notes: Survey weight is applied in the analysis. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%)



Table A2. Comparison of share of expenditures between smoking and non-smoking households

Share out of total household's expenditures	All sample				Low-income				Middle-income				High-income			
	Smoking household	Non-smoking household	Diff	t-stat	Smoking household	Non-smoking household	Diff	t-stat	Smoking household	Non-smoking household	Diff	t-stat	Smoking household	Non-smoking household	Diff	t-stat
Food	49.30	50.48	-1.18	-606.41	55.03	59.88	-4.86	-2067.58	47.91	50.67	-2.76	-1100.75	38.23	37.04	1.19	305.32
Staple	10.39	9.74	0.64	663.41	14.64	15.24	-0.60	-377.40	8.55	8.51	0.04	41.31	4.23	3.79	0.43	477.60
Meat and fish	6.16	6.51	-0.35	-500.66	6.12	6.83	-0.72	-623.83	6.55	7.14	-0.58	-521.31	5.26	5.15	0.11	79.09
Dairy	2.72	3.04	-0.31	-691.15	2.76	3.21	-0.45	-648.85	2.81	3.21	-0.40	-518.43	2.41	2.55	-0.14	-147.29
Fruit and vegetables	6.74	7.42	-0.68	-1164.27	7.46	8.77	-1.31	-1394.34	6.72	7.70	-0.98	-1086.17	4.96	5.13	-0.17	-154.38
Beverages	5.19	4.63	0.56	1388.23	5.63	5.31	0.32	476.72	5.09	4.60	0.49	790.83	4.33	3.73	0.60	742.17
Ready-made food	14.17	15.15	-0.98	-702.42	13.66	15.08	-1.43	-658.14	14.45	15.59	-1.14	-498.78	14.76	14.64	0.13	39.24
Other food (spices, oils)	3.92	3.98	-0.06	-172.98	4.76	5.43	-0.67	-1194.61	3.73	3.92	-0.19	-402.15	2.29	2.05	0.24	487.66
Clothing	2.76	2.93	-0.17	-624.16	2.50	2.64	-0.14	-356.43	2.94	3.12	-0.18	-390.12	2.96	3.09	-0.13	-182.67
Housing	10.03	14.00	-3.97	-3235.95	8.09	10.83	-2.74	-1881.26	10.59	14.56	-3.97	-2145.40	13.55	17.65	-4.10	-1245.40
Utilities and fuels	8.12	10.23	-2.10	-2885.37	7.55	9.25	-1.70	-1896.58	7.95	9.86	-1.91	-1876.60	10.03	12.12	-2.08	-969.88
Durable and non-durable goods	6.23	7.07	-0.84	-771.10	4.51	5.01	-0.50	-582.61	6.50	7.08	-0.57	-382.84	9.92	9.95	-0.03	-8.28
Education	2.33	3.15	-0.83	-1202.91	2.31	2.55	-0.24	-325.48	2.25	2.90	-0.65	-658.07	2.55	4.36	-1.81	-873.46
Health care	3.33	4.30	-0.97	-1159.36	3.19	3.72	-0.53	-545.15	3.27	4.33	-1.06	-793.35	3.80	5.06	-1.26	-527.00
Transportation	6.08	6.32	-0.24	-331.33	5.55	5.53	0.03	24.19	6.15	6.26	-0.11	-101.60	7.21	7.51	-0.29	-161.63
Entertainment	1.12	1.50	-0.39	-511.92	0.51	0.58	-0.06	-132.66	1.09	1.20	-0.12	-126.82	2.72	3.22	-0.49	-181.02
Alcohol	0.05	0.01	0.04	643.89	0.05	0.01	0.03	406.05	0.05	0.01	0.04	421.22	0.06	0.01	0.05	274.67
Observation	571,975	336,128			243,968	126,717			243,168	131,153			84,839	78,258		

Source: Pooled Susenas (2017-2019)

Notes: Survey weight is applied in the analysis. All t-tests for expenditure share differences are statistically significant at a 1% level. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%).



Table A3. Descriptive statistics of variables included in the crowding-out estimation

Variables	Label Variable	All sample (n=908,103)		Low income (n=370,685)		Middle income (n=374,321)		High income (n=163,097)	
		Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Dependent variables									
Staple	Share of staple food exp. out of total non-tobacco expenditures	0.1099	0.0714	0.1603	0.0713	0.0931	0.0456	0.0427	0.0320
Meat and fish	Share of meat and fish exp. out of total non-tobacco expenditures	0.0676	0.0500	0.0685	0.0506	0.0731	0.0497	0.0548	0.0472
Dairy	Share of dairy food exp. out of total non-tobacco expenditures	0.0304	0.0321	0.0313	0.0302	0.0317	0.0334	0.0259	0.0327
Fruit and vegetables	Share of vegetable and fruit exp. out of total non-tobacco expenditures	0.07509	0.04085	0.08485	0.04009	0.07632	0.03905	0.05308	0.03743
Beverages	Share of beverages exp. out of total non-tobacco expenditures	0.0541	0.0306	0.0599	0.0308	0.0538	0.0295	0.0431	0.0291
Ready-made food	Share of ready-made food exp. out of total non-tobacco expenditures	0.1562	0.0992	0.1521	0.0918	0.1605	0.0996	0.1557	0.1116
Other food	Share of other food (spices, oils) exp. out of total non-tobacco expenditures	0.0426	0.0243	0.0537	0.0238	0.0412	0.0209	0.0231	0.0174
Clothing	Share of clothing exp. out of total non-tobacco expenditures	0.0304	0.0201	0.0275	0.0170	0.0325	0.0204	0.0317	0.0240
Housing	Share of housing exp. out of total non-tobacco expenditures	0.1223	0.0832	0.0966	0.0611	0.1282	0.0777	0.1622	0.1099
Utilities and fuels	Share of utilities exp. out of total non-tobacco expenditures	0.0951	0.0498	0.0873	0.0387	0.0927	0.0436	0.1152	0.0713
Durable and non-durable goods	Share of durable & non-durable goods exp. out of total non-tobacco expenditures	0.0697	0.0764	0.0503	0.0384	0.0721	0.0671	0.1037	0.1238
Education	Share of education exp. out of total non-tobacco expenditures	0.0278	0.0443	0.0256	0.0317	0.0263	0.0401	0.0350	0.0674
Health care	Share of health care exp. out of total non-tobacco expenditures	0.0391	0.0563	0.0361	0.0414	0.0388	0.0557	0.0456	0.0785
Transportation	Share of transportation exp. out of total non-tobacco expenditures	0.0663	0.0520	0.0599	0.0496	0.0671	0.0484	0.0773	0.0611
Entertainment	Share of entertainment exp. out of total non-tobacco expenditures	0.0132	0.0510	0.0057	0.0212	0.0120	0.0425	0.0306	0.0901
Alcohol	Share of alcohol exp. out of total non-tobacco expenditures	0.0004	0.0057	0.0004	0.0048	0.0004	0.0057	0.0004	0.0073
Endogenous variables									
exptob	Total amount of tobacco expenditure	259,522	342,563	172,289	212,150	313,999	359,550	325,034	461,235
lnM	Log of total non-tobacco expenditure	14.92	0.72	14.41	0.51	15.05	0.49	15.71	0.66
lnM ²	Square of (log) total non-tobacco expenditure	223.25	21.74	207.82	14.43	226.63	14.65	247.39	20.89
Preference heterogeneity variables									
tob	Dummy variable for tobacco spender	0.64	0.48	0.67	0.47	0.66	0.47	0.52	0.50
tob x lnM	Interaction term	9.51	7.20	9.65	6.83	10.01	7.13	8.24	7.86
(tob x lnM) ²	Interaction term	142.30	108.52	139.87	99.37	151.10	108.10	129.58	124.22



Variables	Label Variable	All sample (n=908,103)		Low income (n=370,685)		Middle income (n=374,321)		High income (n=163,097)	
		Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Instrument variables									
lnX	Total household expenditure (log)	14.9981	0.7177	14.4846	0.5181	15.1278	0.4870	15.7655	0.6436
lnX ²	Total household expenditure (log, squared)	225.4570	21.5977	210.0719	14.8176	229.0887	14.6020	248.9647	20.3562
madultshare	Share of male adult out of total household member	0.4883	0.2112	0.4742	0.1853	0.4912	0.2027	0.5108	0.2670
Alternative instrument variables									
madultratio	Ratio of male adult to female adult household member	1.0803	0.7084	1.0792	0.7053	1.1055	0.7129	1.0319	0.7029
predictsmoke_dhs17	Predicted probability of smoking (household member average) based on smoking determinant parameters obtained from DHS17	0.3606	0.1511	0.3773	0.1381	0.3577	0.1450	0.3329	0.1807
predictsmoke_sus20	Predicted probability of smoking (household member average) based on smoking determinant parameters obtained from Susenas 2020	0.2904	0.2319	0.2846	0.2093	0.3023	0.2285	0.2779	0.2761
Control variables									
yeduc	Average years of education of adult household members	7.8510	3.3347	7.0345	2.8532	8.0716	3.1336	9.0427	4.1024
hhsiz	Number of household members	3.7592	1.6516	4.2176	1.7028	3.6489	1.5065	3.0628	1.5400
nchild05	Number of children 0 to 5 years old in the household	0.4028	0.6129	0.5230	0.6692	0.3641	0.5768	0.2395	0.5084
nchild15	Number of children 6 to 14 years old in the household	0.6033	0.7681	0.7731	0.8410	0.5548	0.7135	0.3606	0.6295
nsenior65	Number of seniors >65 years old in the household	0.1961	0.4693	0.2580	0.5322	0.1650	0.4275	0.1343	0.3947
sworking	Share of adult household member who work	0.5860	0.2884	0.5571	0.2699	0.5962	0.2819	0.6231	0.3285
urban	1 if household live in urban area	0.5462	0.4979	0.4279	0.4948	0.5293	0.4991	0.8166	0.3870
y17	=1 if year=2017 (base)	0.3287	0.4697	0.3287	0.4697	0.3287	0.4698	0.3287	0.4697
y18	=1 if year=2018	0.3325	0.4711	0.3325	0.4711	0.3325	0.4711	0.3325	0.4711
y19	=1 if year=2019	0.3388	0.4733	0.3388	0.4733	0.3388	0.4733	0.3388	0.4733

Source: Pooled Susenas (2017-2019)

Notes: Survey weight is applied in the analysis. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%).



Table A4. Statistical Test

Overall	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food	Clothing	Housing	Utilities and fuels	Durable & non-durable goods	Education	Health-care	Transportation	Entertainment
Heteroskedasticity test (Pagan-Hall general test statistic, -p-value)	31286.01 (0.0000)	1809.58 (0.0000)	18752.75 (0.0000)	163.57 (0.0000)	489.23 (0.0000)	734.20 (0.0000)	1558.57 (0.0000)	2137.63 (0.0000)	19708.59 (0.0000)	19685.56 (0.0000)	68816.97 (0.0000)	9469.33 (0.0000)	7334.00 (0.0000)	1437.80 (0.0000)	20572.26 (0.0000)
Under identification test (Kleibergen-Paap rk LM-test, p-value)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)	4609.09 (0.0000)
Weak identification test (Kleibergen-Paap rk Wald F statistic)	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87	1580.87
Endogeneity test (GMM-C-Statistics, p-value)	408.74 (0.0000)	1187.66 (0.0000)	748.56 (0.0000)	3256.49 (0.0000)	2440.81 (0.0000)	1856.51 (0.0000)	976.09 (0.0000)	843.48 (0.0000)	292.13 (0.0000)	257.75 (0.0000)	295.81 (0.0000)	142.02 (0.0000)	30.40 (0.0000)	2195.41 (0.0000)	292.61 (0.0000)
Household preference test (Chi-square, p-value)	4604.45 (0.0000)	1302.70 (0.0000)	856.45 (0.0000)	2193.69 (0.0000)	3485.66 (0.0000)	1858.62 (0.0000)	1105.92 (0.0000)	534.70 (0.0000)	550.07 (0.0000)	168.38 (0.0000)	433.09 (0.0000)	117.62 (0.0000)	35.24 (0.0000)	2328.25 (0.0000)	258.92 (0.0000)
Low-income	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Heteroskedasticity test (Pagan-Hall general test statistic, -p-value)	21121.58 (0.0000)	186.91 (0.0000)	6442.39 (0.0000)	232.49 (0.0000)	258.68 (0.0000)	1804.61 (0.0000)	610.66 (0.0000)	456.71 (0.0000)	5279.63 (0.0000)	171.60 (0.0000)	1315.66 (0.0000)	3535.06 (0.0000)	787.06 (0.0000)	356.85 (0.0000)	924.69 (0.0000)
Under identification test (Kleibergen-Paap rk LM-test, p-value)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)	1179.54 (0.0000)
Weak identification test (Kleibergen-Paap rk Wald F statistic)	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23	389.23
Endogeneity test (GMM-C-Statistics, p-value)	99.14 (0.0000)	112.65 (0.0000)	100.70 (0.0000)	400.78 (0.0000)	447.44 (0.0000)	63.44 (0.0000)	102.19 (0.0000)	313.70 (0.0000)	32.07 (0.0000)	152.60 (0.0000)	330.19 (0.0000)	215.79 (0.0000)	23.97 (0.0000)	604.44 (0.0000)	52.43 (0.0000)
Household preference test (Chi-square, p-value)	348.48 (0.0000)	46.06 (0.0000)	72.19 (0.0000)	243.19 (0.0000)	489.34 (0.0000)	164.63 (0.0000)	93.01 (0.0000)	241.30 (0.0000)	153.33 (0.0000)	148.53 (0.0000)	240.04 (0.0000)	245.09 (0.0000)	30.60 (0.0000)	420.44 (0.0000)	66.10 (0.0000)



Table A4. Statistical Test (Continued)

Middle-income	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food	Clothing	Housing	Utilities and fuels	Durable & non-durable goods	Education	Health-care	Transportation	Entertainment
Heteroskedasticity test (Pagan-Hall general test statistic) p-value in parentheses	7122.06 (0.0000)	628.46 (0.0000)	10142.19 (0.0000)	49.37 (0.0000)	478.22 (0.0000)	437.38 (0.0000)	595.31 (0.0000)	591.13 (0.0000)	2668.77 (0.0000)	957.76 (0.0000)	2907.56 (0.0000)	4277.85 (0.0000)	2714.04 (0.0000)	332.81 (0.0000)	2522.61 (0.0000)
Under identification test (Kleibergen-Paap rk LM-test) p-value in parentheses	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)	1782.99 (0.0000)
Weak identification test (Kleibergen-Paap rk Wald F statistic)	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46	595.46
Endogeneity test (GMM-C-Statistics) p-value in parentheses	315.52 (0.0000)	350.38 (0.0000)	147.82 (0.0000)	1145.92 (0.0000)	921.04 (0.0000)	795.02 (0.0000)	359.91 (0.0000)	462.12 (0.0000)	160.48 (0.0000)	255.76 (0.0000)	318.45 (0.0000)	80.67 (0.0000)	27.85 (0.0000)	733.33 (0.0000)	
Household preference test (Chi-square) p-value in parentheses	628.67 (0.0000)	272.69 (0.0000)	124.26 (0.0000)	779.21 (0.0000)	1124.90 (0.0000)	561.66 (0.0000)	392.79 (0.0000)	305.80 (0.0000)	353.71 (0.0000)	358.70 (0.0000)	347.09 (0.0000)	124.37 (0.0000)	69.31 (0.0000)	1071.62 (0.0000)	182.27 (0.0000)
High-income	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Heteroskedasticity test (Pagan-Hall general test statistic) p-value in parentheses	351.18 (0.0000)	97.23 (0.0000)	884.42 (0.0000)	1.16 (0.0000)	130.92 (0.0000)	7.08 (0.0000)	208.73 (0.0000)	67.35 (0.0000)	98.00 (0.0000)	1797.25 (0.0000)	5131.49 (0.0000)	5491.62 (0.0000)	1997.35 (0.0000)	117.05 (0.0000)	2536.80 (0.0000)
Under identification test (Kleibergen-Paap rk LM-test) p-value in parentheses	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)	355.07 (0.0000)
Weak identification test (Kleibergen-Paap rk Wald F statistic)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92
Endogeneity test (GMM-C-Statistics) p-value in parentheses	1020.87 (0.0000)	887.17 (0.0000)	415.19 (0.0000)	1350.32 (0.0000)	667.54 (0.0000)	1103.19 (0.0000)	791.77 (0.0000)	107.04 (0.0000)	37.22 (0.0000)	36.15 (0.0000)	60.21 (0.0000)	24.71 (0.0000)	20.99 (0.0000)	624.87 (0.0000)	223.42 (0.0000)
Household preference test (Chi-square) p-value in parentheses	389.52 (0.0000)	323.24 (0.0000)	210.42 (0.0000)	427.31 (0.0000)	640.60 (0.0000)	363.42 (0.0000)	349.94 (0.0000)	104.39 (0.0000)	65.58 (0.0000)	135.37 (0.0000)	347.85 (0.0000)	64.44 (0.0000)	15.97 (0.0000)	411.58 (0.0000)	110.18 (0.0000)



Table A5. Correlation of endogenous variables and instrument variables

Endogenous variables	Instrument variables					
	Share of adult males out of total adults	Ratio of adult males to adult females	Predicted household smoking prevalence (DHS 2017)	Predicted household smoking prevalence (Susenas 2020)	Log of total expenditure (lnX)	Square of log total expenditure (lnX ²)
Correlation coefficient						
Tobacco expenditure (exptob)	0.232***	0.273***	0.238***	0.474***	0.370***	0.369***
Log of non-tobacco expenditure (lnM)	0.099***	0.147***	-0.051***	-0.044***	0.992***	0.992***
Square of log of non-tobacco expenditure (lnM ²)	0.095***	0.143***	-0.056***	-0.048***	0.991***	0.992***
OLS coefficient						
Tobacco expenditure (exptob)	296,911.1*** (F=10,342.97)	94,307.58*** (F= 7,124.14)	439,024.3*** (F= 10,793.62)	713,640.2*** (F= 25,449.12)	171,011.5 *** (F= 10,408.61)	5,660.578 *** (F= 9,984.05)
Log of non-tobacco expenditure (lnM)	0.0620 *** (F=33,338.26)	0.014 *** (F= 33,304.08)	-0.458 *** (F= 34,492.11)	-0.149 *** (F= 33,526.39)	-0.149 *** (F= 99,999.00)	0.033 *** (F= 99,999.00)
Square of log of non-tobacco expenditure (lnM ²)	1.547 *** (F=33,024.31)	0.345 *** (F= 33,002.17)	-14.352 *** (F= 34,041.41)	-4.783 *** (F= 33,165.80)	30.069 *** (F= 99,999.00)	0.999 *** (F= 99,999.00)

Notes: Survey weight is applied in the analysis. *** indicates statistical significance at 1% level. The OLS coefficients have controlled for year-fixed effects and household characteristics which include whether they lived in a rural/urban area, average years of education of adult household members, the share of adult members who work, household composition: number of infants, productive age persons, and seniors in the household.



Table A6. First-stage regression

	Overall			Low-income			Middle-income			High-income		
	exptob	lnM	lnM2	exptob	lnM	lnM2	exptob	lnM	lnM2	exptob	lnM	lnM2
Log of total household expenditure <i>(lnX)</i>	-484,112*** (-15526)	0.919*** (-0.00312)	-1.964*** (-0.0925)	-4,282,000*** (-61237)	2.310*** (-0.0181)	39.35*** (-0.54)	-6,820,000*** (-110738)	1.952*** (-0.0208)	30.46*** (-0.633)	-475,654*** (-60435)	0.808*** (-0.0114)	-5.353*** (-0.337)
Squared log of total household expenditure <i>(lnX²)</i>	17,738*** (-523.3)	0.00213*** (-0.000103)	1.049*** (-0.00305)	154,771*** (-2182)	-0.0480*** (-0.000647)	-0.439*** (-0.0193)	232,675*** (-3766)	-0.0331*** (-0.000705)	-0.0563*** (-0.0215)	14,766*** (-1858)	0.00592*** (-0.000353)	1.165*** (-0.0104)
Share of male adults out of total household members <i>(madulratio)</i>	52,285*** (-1038)	-0.0117*** (-0.000182)	-0.353*** (-0.00552)	24,889*** (-843.8)	-0.00959*** (-0.000293)	-0.282*** (-0.00865)	60,264*** (-1459)	-0.0132*** (-0.000281)	-0.403*** (-0.00861)	79,460*** (-3757)	-0.00873*** (-0.000356)	-0.279*** (-0.0114)
Dummy variable for tobacco spender <i>(tob)</i>	-8,489,000*** (-298665)	0.973*** (-0.0629)	48.94*** (-1.795)	-19,900,000*** (-550756)	9.576*** (-0.234)	297.4*** (-6.59)	-36,830,000*** (-1,010,000)	2.403*** (-0.287)	114.9*** (-8.266)	-4,490,000*** (-1,005,000)	-7.986*** (-0.22)	-211.9*** (-6.372)
Interaction term <i>(tob x lnM)</i>	1,001,000*** (-40523)	-0.189*** (-0.00826)	-8.102*** (-0.237)	2,804,000*** (-78392)	-1.437*** (-0.0328)	-44.21*** (-0.924)	5,005,000*** (-137324)	-0.448*** (-0.0382)	-18.94*** (-1.104)	581,281*** (-128511)	0.927*** (-0.0275)	24.38*** (-0.796)
Interaction term <i>[(tob x lnM)²]</i>	-27,177*** (-1373)	0.00777*** (-0.000271)	0.308*** (-0.00778)	-97,629*** (-2787)	0.0530*** (-0.00114)	1.620*** (-0.0324)	-167,953*** (-4663)	0.0186*** (-0.00127)	0.736*** (-0.0369)	-16,467*** (-4108)	-0.0270*** (-0.000857)	-0.704*** (-0.0248)
Average years of education of adult household member <i>(yeduc)</i>	-2,911*** (-124.7)	0.000930*** (-0.00003)	0.0276*** (-0.000845)	-3,608*** (-134.2)	0.00146*** (-0.00006)	0.0427*** (-0.00163)	-3,216*** (-194.4)	0.000867*** (-0.00005)	0.0261*** (-0.00141)	-539.5** (-268.3)	0.000165*** (-0.00004)	0.00492*** (-0.00126)
Number of household member <i>(hsize)</i>	12,691*** (-541.3)	-0.00016 (-0.000102)	-0.0102*** (-0.0031)	4,854*** (-547.3)	0.00114*** (-0.000185)	0.0281*** (-0.00542)	29,407*** (-1338)	-0.00365*** (-0.000229)	-0.117*** (-0.00704)	40,680*** (-2190)	-0.00298*** (-0.000189)	-0.0957*** (-0.00601)
Number of children 0 to 5 years old in the household <i>(nchild05)</i>	-24,116*** (-852)	0.00449*** (-0.000175)	0.138*** (-0.00527)	-8,644*** (-742.3)	0.00229*** (-0.000265)	0.0695*** (-0.00777)	-31,533*** (-1459)	0.00582*** (-0.000273)	0.180*** (-0.00837)	-37,799*** (-3242)	0.00400*** (-0.000311)	0.128*** (-0.00991)
Number of children 6 to 14 years old in the household <i>(nchild15)</i>	-37,443*** (-750.5)	0.00815*** (-0.00015)	0.247*** (-0.00453)	-22,946*** (-696)	0.00774*** (-0.000228)	0.229*** (-0.00674)	-45,381*** (-1259)	0.00866*** (-0.00023)	0.267*** (-0.00708)	-38,425*** (-2813)	0.00373*** (-0.00026)	0.121*** (-0.00831)
Number of seniors >65 years old in the household <i>(nsenior65)</i>	-8,853*** (-841.2)	0.00260*** (-0.00023)	0.0766*** (-0.00676)	-8,678*** (-785)	0.00337*** (-0.000338)	0.0981*** (-0.00973)	-12,252*** (-1619)	0.00254*** (-0.00038)	0.0768*** (-0.0114)	-11,510*** (-2801)	0.00126*** (-0.000408)	0.0406*** (-0.0126)



	Overall			Low-income			Middle-income			High-income		
	exptob	InM	InM2	exptob	InM	InM2	exptob	InM	InM2	exptob	InM	InM2
Share of adult household members who work (working)	33,268*** (-1205)	-0.00816*** (-0.000308)	-0.245*** (-0.00911)	14,310*** (-1154)	-0.00335*** (-0.000516)	-0.102*** (-0.0149)	33,355*** (-1887)	-0.00645*** (-0.000488)	-0.198*** (-0.0146)	31,472*** (-3259)	-0.00493*** (-0.00053)	-0.152*** (-0.0162)
=1 if household live in urban area (urban)	-32,847*** (-777.8)	0.00811*** (-0.000207)	0.246*** (-0.00614)	-15,438*** (-776.4)	0.00505*** (-0.000318)	0.150*** (-0.00923)	-49,779*** (-1245)	0.0107*** (-0.000297)	0.327*** (-0.00894)	-46,354*** (-2834)	0.00681*** (-0.000447)	0.214*** (-0.0138)
=1 if year=2018 (y18)	-19,458*** (-937.3)	0.00737*** (-0.000234)	0.216*** (-0.00695)	-20,603*** (-883.3)	0.0100*** (-0.000369)	0.290*** (-0.0107)	-17,314*** (-1483)	0.00529*** (-0.00035)	0.158*** (-0.0106)	-593 (-3038)	0.000661 (-0.000448)	0.0197 (-0.0138)
=1 if year=2019 (y19)	-7,875*** (-957.5)	0.00356*** (-0.000235)	0.104*** (-0.007)	-10,935*** (-884.6)	0.00580*** (-0.000366)	0.167*** (-0.0106)	-3,543** (-1516)	0.00162*** (-0.000356)	0.0480*** (-0.0107)	6,210** (-3126)	-0.00032 (-0.000461)	-0.0105 (-0.0142)
Constant	3,240,000*** (-114278)	0.720*** (-0.0236)	18.16*** (-0.697)	29,550,000*** (-428451)	-8.930*** (-0.126)	-268.6*** (-3.761)	49,810,000*** (-812700)	-6.822*** (-0.153)	-218.8*** (-4.652)	3,688,000*** (-486127)	1.558*** (-0.091)	43.59*** (-2.702)
F- test of excluded instruments	3269.25 ***	1.6e+07 ***	1.7e+07 ***	2513.35 ***	1.3e+06 ***	1.2e+06 ***	1590.03 ***	1.1e+06 ***	1.0e+06 ***	158.21 ***	4.0e+06 ***	4.4e+06 ***
Sanderson-windmeijer multivariate F test of excluded instruments	2646.95***	2.7e+05***	2.0e+05***	907.65***	1204.05 ***	1194.25***	1720.74***	3521.65***	3451.20***	483.53***	1.2e+06***	1.2e+06***
Observations	908,103	908,103	908,103	370,685	370,685	370,685	374,321	374,321	374,321	163,097	163,097	163,097

Notes: Survey weight is applied in the analysis. *** indicates statistical significance at 1% level



Table A7. Result of 3SLS regression for all households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
All group	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food (spices, oils)	Clothing	Housing	Utilities and fuels	Durable and non-durable goods	Education	Health care	Transportation	Entertainment
Dummy variable for tobacco spender (<i>tob</i>)	0.712*** (0.0331)	-1.335*** (0.0371)	-0.407*** (0.0217)	-1.499*** (0.0344)	0.786*** (0.0250)	0.901*** (0.0878)	-0.495*** (0.0158)	-0.262*** (0.0142)	-0.835*** (0.0516)	0.247*** (0.0322)	0.585*** (0.0491)	-0.00525 (0.0274)	0.235*** (0.0373)	1.440*** (0.0415)	-0.0918*** (0.0343)
Total amount of tobacco spending (<i>exptob</i>)	-0.00048*** (0.00002)	-0.00094*** (0.00002)	-0.00044*** (0.00001)	-0.00137*** (0.00002)	0.00102*** (0.00002)	0.00364*** (0.00005)	-0.00043*** (0.00001)	-0.00026*** (0.00001)	-0.00045*** (0.00003)	-0.00018*** (0.00002)	-0.00071*** (0.00003)	-0.00031*** (0.00002)	-0.00008*** (0.00002)	0.00145*** (0.00003)	-0.00049*** (0.00002)
Log of total non-tobacco expenditure (<i>lnM</i>)	-0.279*** (0.00265)	0.144*** (0.00297)	0.0284*** (0.00173)	-0.00943*** (0.00276)	0.0866*** (0.00200)	0.343*** (0.00703)	-0.0334*** (0.00126)	0.0396*** (0.00114)	-0.0339*** (0.00413)	-0.209*** (0.00258)	-0.214*** (0.00393)	0.00244 (0.00219)	0.0201*** (0.00299)	0.217*** (0.00333)	-0.105*** (0.00274)
Square of (log) total non-tob expenditure (<i>lnM</i>) ²	0.00742*** (0.00009)	-0.00465*** (0.0001)	-0.0009*** (0.00006)	-0.00001 (0.00009)	-0.00335*** (0.00007)	-0.0127*** (0.00024)	0.000639*** (0.00004)	-0.00114*** (0.00004)	0.00183*** (0.00014)	0.00745*** (0.00009)	0.00843*** (0.00013)	0.000227*** (0.00007)	-0.000305*** (0.0001)	-0.00701*** (0.00011)	0.00414*** (0.00009)
Interaction term (<i>tob x lnM</i>)	-0.0864*** (0.00429)	0.163*** (0.00481)	0.0471*** (0.00281)	0.180*** (0.00446)	-0.0874*** (0.00324)	-0.0881*** (0.0114)	0.0613*** (0.00204)	0.0310*** (0.00184)	0.101*** (0.00668)	-0.0303*** (0.00417)	-0.0936*** (0.00636)	0.000242 (0.00355)	-0.0324*** (0.00484)	-0.168*** (0.00538)	0.00545 (0.00444)
Interaction term [(<i>tob x lnM</i>) ²]	0.00270*** (0.000137)	-0.00475*** (0.000154)	-0.00125*** (0.00009)	-0.00506*** (0.000143)	0.00218*** (0.000104)	0.00124*** (0.000365)	-0.00180*** (0.00007)	-0.000851*** (0.00006)	-0.00296*** (0.000214)	0.000921*** (0.000134)	0.00378*** (0.000204)	0.00003 (0.000114)	0.00111*** (0.000155)	0.00452*** (0.000173)	0.000132 (0.000142)
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103	908,103
R-squared	0.529	-0.211	-0.002	-0.562	-0.469	-0.725	0.072	-0.103	0.155	0.081	0.093	0.160	0.034	-0.402	0.010

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: Standard error is reported in parentheses. Parameters *exptob* are multiplied by 10,000. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Parameters of household characteristics and year dummy are not reported in this table. The household's characteristics include whether they lived in a rural/urban area, average years of education of adult household members, the share of adult members who work, household composition: number of infants, productive age persons, and seniors in the household. Survey weight is applied in the regression. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (41%), Middle-income (41%-80%), and High-income (>80%).



Table A8. Result of 3SLS regression for low-income households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Low income	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food (spices, oils)	Clothing	Housing	Utilities and fuels	Durable and non-durable goods	Education	Health care	Transportation	Entertainment
Dummy variable for tobacco spender (<i>tob</i>)	-1.459*** (0.0860)	0.310* (0.180)	-0.171 (0.111)	-0.0734 (0.144)	1.620*** (0.131)	0.677*** (0.131)	-0.0193 (0.0859)	-0.255*** (0.0653)	2.098*** (0.209)	0.0262 (0.138)	0.180 (0.143)	-1.091*** (0.109)	1.099*** (0.157)	-3.073*** (0.0807)	0.0640 (0.0805)
Total amount of tobacco spending (<i>exptob</i>)	-0.00077*** (-0.00002)	0.00007 (-0.00006)	-0.00013*** (-0.00004)	-0.00042*** (-0.00005)	0.00081*** (-0.00004)	0.00132*** (-0.00004)	-0.00013*** (-0.00003)	-0.00008*** (-0.00002)	0.00035*** (-0.00007)	-0.00013*** (-0.00005)	-0.00029*** (-0.00005)	-0.00042*** (-0.00004)	0.00024*** (-0.00005)	-0.00036*** (-0.00002)	-0.0001*** (-0.00003)
Log of total non-tobacco expenditure (<i>lnM</i>)	0.0935*** (0.000428)	0.0719** (0.0299)	-0.0226 (0.0186)	-0.0488** (0.0238)	0.323*** (0.0218)	0.0255*** (0.000650)	0.0608*** (0.0143)	-0.0758*** (0.0109)	-0.0920*** (0.0349)	-0.191*** (0.0230)	-0.169*** (0.0238)	-0.0475*** (0.0183)	0.144*** (0.0265)	-0.0261*** (0.000401)	-0.0565*** (0.0135)
Square of (log) total non-tob expenditure (<i>lnM</i>) ²	-0.00608*** (0.00003)	-0.00179* (0.00108)	0.000988 (0.00067)	0.00167* (0.00086)	-0.0117*** (0.00079)	-0.00104*** (0.00005)	-0.00248*** (0.00052)	0.00301*** (0.00039)	0.00325*** (0.00126)	0.00668*** (0.00083)	0.00673*** (0.00086)	0.00201*** (0.00066)	-0.00504*** (0.00096)	0.00201*** (0.00003)	0.00216*** (0.00049)
Interaction term (<i>tob x lnM</i>)	0.219*** (0.0120)	-0.0451* (0.0252)	0.0237 (0.0156)	0.00595 (0.0203)	-0.220*** (0.0184)	-0.109*** (0.0182)	0.00222 (0.0121)	0.0368*** (0.00918)	-0.303*** (0.0294)	0.000914 (0.0194)	-0.0266 (0.0201)	0.152*** (0.0153)	-0.156*** (0.0220)	0.438*** (0.0113)	-0.00997 (0.0113)
Interaction term [<i>tob x lnM</i>] ²	-0.00805*** (0.000419)	0.00161* (0.000880)	-0.000815 (0.000542)	-0.00002 (0.000707)	0.00743*** (0.000641)	0.00417*** (0.000636)	-0.00004 (0.000420)	-0.00131*** (0.000320)	0.0108*** (0.00102)	-0.000202 (0.000675)	0.00101 (0.000701)	-0.00528*** (0.000534)	0.00548*** (0.000768)	-0.0155*** (0.000393)	0.000392 (0.000394)
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685	370,685
R-squared	0.302	0.036	0.070	0.037	-0.103	0.013	0.066	0.037	0.112	0.056	0.039	0.230	0.007	0.102	0.007

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: Standard error is reported in parentheses. Parameters *exptob* are multiplied by 10,000. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Parameters of household characteristics and year dummy are not reported in this table. The household's characteristics include whether they lived in a rural/urban area, average years of education of adult household members, the share of adult members who work, household composition: number of infants, productive age persons, and seniors in the household. Survey weight is applied in the regression. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%).



Table A9. Result of 3SLS regression for middle-income households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Middle income	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food (spices, oils)	Clothing	Housing	Utilities and fuels	Durable and non-durable goods	Education	Health care	Transportation	Entertainment
Dummy variable for tobacco spender (<i>to</i> b)	-0.0447 (0.141)	-0.790*** (0.183)	-0.441*** (0.121)	-2.922*** (0.154)	2.369*** (0.120)		-0.581*** (0.0744)	-0.679*** (0.0816)	-0.937*** (0.274)	0.0972 (0.162)	-0.00275 (0.256)	-1.623*** (0.143)	1.319*** (0.216)	4.224*** (0.209)	-0.124 (0.165)
Total amount of tobacco spending (<i>exptob</i>)	-0.0001*** (-0.00003)	-0.00029*** (-0.00003)	-0.00016*** (-0.00002)	-0.0007*** (-0.00003)	0.00058*** (-0.00002)	0.00109*** (-0.00005)	-0.00018*** (-0.00001)	-0.00016*** (-0.00001)	-0.0001** (-0.00005)	0.00002 (-0.00003)	-0.00045*** (-0.00005)	-0.00029*** (-0.00003)	0.00011*** (-0.00004)	0.00083*** (-0.00004)	-0.00021*** (-0.00003)
Log of total non-tobacco expenditure (<i>lnM</i>)	0.279*** (0.0197)	0.0648** (0.0257)	-0.0428** (0.0166)	-0.274*** (0.0222)	0.381*** (0.0170)	0.171*** (0.0285)	0.0125 (0.0104)	-0.0675*** (0.0112)	-0.894*** (0.0376)	-0.242*** (0.0222)	-0.191*** (0.0352)	-0.130*** (0.0195)	0.170*** (0.0294)	0.950*** (0.0287)	-0.199*** (0.0226)
Square of (log) total non-tob expenditure (<i>lnM</i>) ²	-0.0109*** (0.000674)	-0.00197** (0.000876)	0.00165*** (0.000567)	0.00901*** (0.000759)	-0.0132*** (0.000580)	-0.00690*** (0.000979)	-0.000824** (0.000357)	0.00251*** (0.000383)	0.0297*** (0.00128)	0.00859*** (0.000758)	0.00785*** (0.00120)	0.00479*** (0.000667)	-0.00541*** (0.00100)	-0.0316*** (0.000981)	0.00715*** (0.000770)
Interaction term (<i>to</i> b x <i>lnM</i>)	0.0166 (0.0191)	0.109*** (0.0247)	0.0601*** (0.0163)	0.391*** (0.0208)	-0.310*** (0.0162)	-0.0150*** (0.00104)	0.0806*** (0.0100)	0.0935*** (0.0110)	0.110*** (0.0370)	-0.00502 (0.0218)	-0.00530 (0.0346)	0.221*** (0.0193)	-0.182*** (0.0291)	-0.559*** (0.0282)	0.0130 (0.0222)
Interaction term [(<i>to</i> b x <i>lnM</i>) ²]	-0.000861 (0.000639)	-0.00367*** (0.000827)	-0.00202*** (0.000546)	-0.0129*** (0.000697)	0.0101*** (0.000542)	0.000824*** (0.00007)	-0.00274*** (0.000336)	-0.00317*** (0.000368)	-0.00320*** (0.00124)	-0.000130 (0.000730)	0.000462 (0.00116)	-0.00747*** (0.000645)	0.00623*** (0.000975)	0.0183*** (0.000943)	-0.000275 (0.000745)
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321	374,321
R-squared	0.262	-0.015	0.127	-0.153	-0.134	-0.044	0.078	-0.024	0.156	0.060	0.031	0.178	0.027	-0.133	0.012

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: Standard error is reported in parentheses. Parameters *exptob* are multiplied by 10,000. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Parameters of household characteristics and year dummy are not reported in this table. The household's characteristics include whether they lived in a rural/urban area, average years of education of adult household members, the share of adult members who work, household composition: number of infants, productive age persons, and seniors in the household. Survey weight is applied in the regression. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income (>80%)



Table A10. Result of 3SLS regression for high-income households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
High income	Staple	Meat and fish	Dairy	Fruit and vegetables	Beverages	Ready-made food	Other food (spices, oils)	Clothing	Housing	Utilities and fuels	Durable and non-durable goods	Education	Health care	Transportation	Entertainment
Dummy variable for tobacco spender (<i>tob</i>)	-1.220*** (0.109)	-1.225*** (0.160)	-0.428*** (0.0799)	-2.142*** (0.167)	1.339*** (0.0955)	2.902*** (0.511)	-0.600*** (0.0598)	-0.299*** (0.0531)	-1.727*** (0.210)	1.372*** (0.136)	-0.201 (0.240)	-0.113 (0.123)	0.302** (0.150)	2.271*** (0.196)	-0.288 (0.186)
Total amount of tobacco spending (<i>exptob</i>)	-0.00144*** (-0.00007)	-0.00204*** (-0.0001)	-0.00087*** (-0.00005)	-0.00234*** (-0.0001)	0.00132*** (-0.00006)	0.00742*** (-0.00031)	-0.00078*** (-0.00004)	-0.00038*** (-0.00003)	-0.00104*** (-0.00013)	-0.00025*** (-0.00008)	-0.00131*** (-0.00014)	0.00043*** (-0.00007)	-0.00011 (-0.00009)	0.00248*** (-0.00012)	-0.00118*** (-0.00011)
Log of total non-tobacco expenditure (<i>lnM</i>)	0.0369*** (0.00975)	0.290*** (0.0143)	0.146*** (0.00713)	0.134*** (0.0149)	0.0299*** (0.00852)	-0.216*** (0.0456)	0.0170*** (0.00534)	0.0732*** (0.00474)	-0.565*** (0.0187)	0.0640*** (0.0121)	-0.432*** (0.0214)	-0.105*** (0.0110)	0.179*** (0.0134)	0.263*** (0.0175)	0.0841*** (0.0166)
Square of (log) total non-tob expenditure (<i>lnM</i>) ²	-0.00188*** (0.000308)	-0.00949*** (0.000450)	-0.00476*** (0.000225)	-0.00478*** (0.000470)	-0.00140*** (0.000269)	0.00468*** (0.00144)	-0.000869*** (0.000169)	-0.00237*** (0.000150)	0.0178*** (0.000591)	-0.00125*** (0.000382)	0.0158*** (0.000675)	0.00329*** (0.000347)	-0.00526*** (0.000422)	-0.00788*** (0.000553)	-0.00162*** (0.000523)
Interaction term (<i>tob x lnM</i>)	0.164*** (0.0139)	0.165*** (0.0203)	0.0570*** (0.0102)	0.277*** (0.0212)	-0.164*** (0.0122)	-0.378*** (0.0650)	0.0810*** (0.00762)	0.0376*** (0.00676)	0.216*** (0.0267)	-0.169*** (0.0172)	0.00712 (0.0305)	0.00827 (0.0157)	-0.0419** (0.0191)	-0.286*** (0.0250)	0.0339 (0.0236)
Interaction term [<i>(tob x lnM)</i> ²]	-0.00509*** (0.000439)	-0.00502*** (0.000642)	-0.00169*** (0.000321)	-0.00839*** (0.000670)	0.00471*** (0.000384)	0.0106*** (0.00205)	-0.00252*** (0.000240)	-0.00109*** (0.000214)	-0.00653*** (0.000843)	0.00520*** (0.000545)	0.000724 (0.000963)	-0.000222 (0.000496)	0.00144** (0.000602)	0.00842*** (0.000789)	-0.000707 (0.000746)
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097	163,097
R-squared	-2.067	-2.024	-0.575	-4.235	-1.832	-4.524	-2.120	-0.296	0.039	0.047	0.013	0.115	0.038	-1.721	-0.120

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: Standard error is reported in parentheses. Parameters *exptob* are multiplied by 10,000. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Parameters of household characteristics and year dummy are not reported in this table. The household's characteristics include whether they lived in a rural/urban area, average years of education of adult household members, the share of adult members who work, household composition: number of infants, productive age persons, and seniors in the household. Survey weight is applied in the regression. Income groups are determined based on the distribution of households' per capita expenditures: Low-income (<41%), Middle-income (41%-80%), and High-income



Table A11. The crowding-out effect of tobacco expenditures using alternative instruments

Instrument	Coefficients			
	Main instrument	Instrument alternative A	Instrument alternative B	Instrument alternative C
	male adult share lnX, lnX ²	male adult ratio, lnX, lnX ²	predicted smoke from DHS17, lnX, lnX ²	predicted smoke from Susenas20, lnX, lnX ²
Food				
Staple	-0.00048***	0.00071***	-0.00015***	-0.00034***
Meat and fish	-0.00094***	-0.00002*	-0.0007***	-0.00029***
Dairy	-0.00044***	-0.00014***	-0.00037***	-0.00012***
Fruit and vegetables	-0.00137***	-0.00019***	-0.00086***	-0.00034***
Beverages	0.00102***	0.00051***	0.00088***	0.00034***
Ready-made food	0.00364***	0.00058***	0.00294***	0.00123***
Other food (spices, oils)	-0.00043***	0.00007***	-0.00022***	-0.0001***
Clothing	-0.00026***	-0.00014***	-0.00025***	-0.00003***
Housing	-0.00045***	-0.00076***	-0.00048***	0.00012***
Utilities and fuels	-0.00018***	-0.00003*	-0.00049***	-0.00015***
Durable and non-durable goods	-0.00071***	-0.00045***	-0.00019***	-0.00001
Education	-0.00031***	-0.00029***	-0.00076***	-0.00037***
Health care	-0.00008***	-0.00002	-0.00012***	-0.00011***
Transportation	0.00145***	0.00065***	0.001***	0.00022***
Entertainment	-0.00049***	-0.00049***	-0.00027***	-0.00007***

Source: Authors' estimation based on Susenas 2017-2019 using Equation 4

Notes: The table above presents parameters exptob , multiplied by 10,000. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Survey weight is applied in the regression. There are different instrument variables used in each alternative. Main instrument: share of adult males out of adult household members (madultshare), log of total expenditure ($\ln X$) and its square ($\ln X^2$). Alternative A: Ratio of adult males to adult females in the household (madulratio), ($\ln X$), and ($\ln X^2$). Alternative B: Predicted probability of smoking using parameters from Demographic Health Survey 2017 ($\text{predictedsmoke_dhs17}$), ($\ln X$), and ($\ln X^2$). Alternative C: Predicted probability of smoking using parameters from Susenas 2020 ($\text{predictedsmoke_sus20}$), ($\ln X$), and ($\ln X^2$).



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