

# The dynamics of inequality of the crowding-out effect of tobacco expenditure in an emerging country

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## **Abstract**

In recent decades, policy initiatives involving increases in the taxes of tobacco products have increased pressure on budget allocations in poor households. In particular, the crowding-out effect concerning human capital accumulation is an important concern in developing countries. In this study, we examine this issue in the context of the expansion of the social welfare state that has taken place over the last two decades in several emerging economies. This study explores the case of Colombia between 1997 and 2011. In this period, the budget share of the poorest expenditure quintile devoted to tobacco products of smoker's households doubled. We analyse the differences between the poorest and richest quintiles in relation to the changes in budget shares, fixing a reference population over time to avoid demographic composition confounders. We find no evidence of crowding-out of education, or health expenditures. This is likely to be the result of free universal access to health insurance and basic education for the poor. For higher income households, tobacco crowd-out expenditures on entertainment, leisure activities, and luxury expenditures. This finding should reassure policy-makers who are keen to impose tobacco taxes as an element of their public health policy.

**Keywords:** Tobacco expenditure; Poverty; Crowding out; Household expenditure; Health Inequalities

### **Highlights:**

- We analyse whether increases in the share of the household budget allocated to tobacco over a 14-year period in Columbia is related to differential variations in the budget share of other goods
- We find no evidence of a crowding-out effect in relation to household expenditure on health or education
- The lack of a crowding-out effect is likely to be the result of advances in Colombia's welfare policies.

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### **Conflict of interest statement**

The authors declare no conflict of interest and have nothing to disclose.

# 1. Introduction

The tobacco epidemic disproportionately affects low socioeconomic status (SES) households (Pierce et al., 1989; De Vries, 1995; Cavelaars et al., 2000; Fernández et al., 2003; Huisman et al., 2005; Kalter-Leibovici et al., 2016). Global efforts such as the *World Health Organization Framework Convention on Tobacco Control* (WHO FCTC) have decades of promoting policies aimed at reducing smoking prevalence, specially tax increases, which have proved to be effective (Farrelly et al., 2001; Franks et al., 2007; Siahpush et al., 2009; Chaloupka et al., 2011; Thomas et al., 2008; James et al., 2017). Yet, evidence shows that the demand for cigarettes is inelastic and households try to sustain their habits even if they have to reallocate their expenditures (Townsend et al., 1994; Agthe and Billings, 1987; Wakefield and Inman, 2003). For low SES households that have continued to smoke, an important concern is the implications of the greater fiscal burden that they face as a result of tax modifications (Hill et al., 2005; Thomas et al., 2008; Zapata et al., 2012).

To compensate the increase on the prices, households need to decide where to draw resources from. One option available for households is to use income that they previously devoted to education and health expenditures. There is evidence of this crowding-out effect that impacts human capital accumulation (food intake, education, and health) and productive household investment in Bangladesh, rural China, India, and Indonesia (Efroymson et al., 2001; Wang et al., 2006; John, 2008; Block and Webb, 2009).<sup>2</sup> Yet, in middle-income countries, an alternative is to use the resources that are

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<sup>2</sup> This is not only an issue in developing countries, but there is also evidence of a reduced standard of living in high-income countries such as Taiwan and Australia (Siahpush et al., 2004; Pu et al., 2008).

saved by the expansion of social policy efforts. These policies involve transfers, that can be in cash or in kind, that provide an additional income to households that they might devote to the consumption of temptation goods. Evidence on the magnitude of this reallocation from the evaluation of cash-transfers programs is inconclusive (Evans and Popova, 2017).

In this paper, we explore the progression of the crowding-out effect of tobacco, along the income distribution, in a context of growing tobacco prices and social security expansion.

We consider the case of Colombia, a middle-income country. We analyse the changes in household budgets, across the income distribution, for smokers in comparison with non-smokers with similar observed characteristics. We use a repeated cross-section of the Colombian Quality of Life Survey (ECV, the acronym in Spanish) from 1997 to 2011. It includes household expenditure data during a period that saw increasing tobacco prices because of tighter tobacco control policies, and as result, there is a notable increase in financial pressure on the lowest SES households of smokers. Alongside, access to health insurance and basic education increased notoriously in the study period and drastically reduced out-of-pocket expenditures in those areas. We present an overview of these two characteristics below in section 2.

To determine differences overtime on how budget-pressure of smoking affects the poorest households, we undertake two empirical steps. First, to establish a comparable group of smoking and non-smoking households in each year, we use a genetic matching algorithm. Second, we contrast budget shares differences over total expenditures quintiles, between smokers and non-smokers. Alongside describing the dataset,

section 3 presents the matching strategy of the empirical step 1. It also presents the statistical model required to obtain the estimates described in step 2. Results are presented in section 4, and section 5 presents the discussion and conclusions.

## 2. Context

### 2.1 Tobacco control policies

In an attempt to curb the tobacco epidemic, Colombia has implemented a diverse range of control mechanisms that have played an important role in the decrease in cigarette consumption. As part of the adoption of the WHO FCTC, in 2009, an anti-tobacco law (Law 1335 of 2009) was introduced that restricted smokers from consuming cigarettes in public areas, a measure that has been broadly accepted among the population. Then, in 2011, the government implemented the marketing restrictions included in Law 1335 of 2009. Nevertheless, taxation is known to be the most cost-efficient policy, and thus several tax-based reforms were introduced between 1997 and 2011. Since 1995, several low-powered tax increases took place under different figures such as specific contributions to sports, custom tariffs, and other consumption taxes. A major reform took place in 2010 (Law 1393 of 2010) when the tax was applied uniformly to both local and imported products and was transformed into a combination of a lump-sum tax and an excise tax. During the study period, there was an increase of nearly 60% in the real average price per cigarette over the study period, as shown in Figure 1.

The policy initiatives outlined above and a general downward trend in tobacco consumption resulted in a substantial reduction in the prevalence of smoking. In 1997, 25% of households reported consuming tobacco during the previous week, while this figure was down to around 10% by 2011. Concerning SES differentials, Panel A of Figure 2 shows prevalence by total expenditure quintiles from 1997 to 2011. In the initial year, while prevalence is larger for the first quintile to the fifth. By 2011, there is almost no difference across quintiles. This is in line with several studies have found that initial differences in smoking prevalence across different characteristics have narrowed over time (Macías et al., 2013; Pardo and Piñeros, 2010; Rodríguez et al., 2009; Storr et al., 2008). Concerning expenditures, Panel B of Figure 2 presents a notorious SES gradient observed for the budget share allocated to tobacco by smoking households: while it remained the same for the richest quintile (less than 1%), it doubled for the poorest quintile, jumping from 3.1% to 6.2%. These average budget allocations are similar to the range of average international allocations, which vary from 1% in Mexico and Hong Kong to 10% in Zimbabwe and China (John, 2008).

These statistics indicate that a significant proportion of households did not respond to the policy interventions by reducing smoking and that instead, the amount of money available for tobacco purchases might be growing. This observation confirms the importance of examining whether smoking households reallocate their budgets in response to increased financial pressure, and if so, whether it is at the expense of human capital accumulation.

## 2.2 Social policies

It is important to realise that during the study period, several middle-income countries introduce policies to reduce poverty and inequality, which might compensate for the potential financial pressures of tobacco tax increases. In particular, Colombia introduced a range of aggressive social policies aimed at reducing poverty such as universal health insurance and basic education. One of the most relevant improvements in the context of this study was the expansion of health insurance. Figure 3 shows health insurance coverage and self-reported health for smokers and non-smokers in quintiles 1 and 5 in the sample selected by the analysis (see below). These figures reflect the dramatic improvement in access to health insurance.<sup>3</sup> In 1997, approximately 80% of people in quintile 5 had insurance, but the figure was only 50% in quintile 1. In contrast, by 2011, nearly 90% of people had insurance regardless of their SES. As a result, Colombia has the second-lowest out-of-pocket health expenditures in Latin America (Chang et al., 2019). A similar scenario is observed for education, and in our data we observe a drastic reduction in both education and health expenditures for all households along the income distribution, as shown in Panel C of Figure 2.

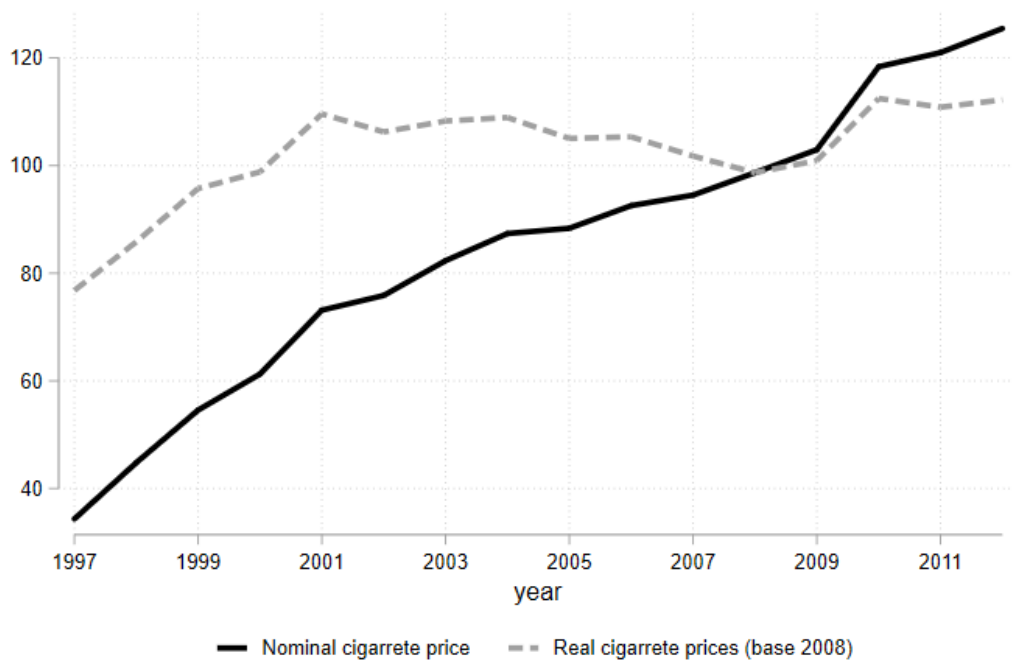
The universal health insurance policy is reflected in people's health status, whereby in 1997 60% of respondents in quintile 1 reported that their health was bad, whereas by 2011 this figure had fallen to 37%, while in quintile 5, the proportion was close to 25% in both 1997 and 2011. These substantial improvements in quintile 1 are

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<sup>3</sup> See Ministerio de Salud y Protección Social (2019) for further details.

irrespective of smoking status, which might be related to the fact that the insurance premiums and co-payments are tied to earnings and not to risk variables. Besides, individuals are free to move between insurers, limiting the ability of insurers to screen based on risk.

Figure 1: Tobacco Price Evolution in Colombia

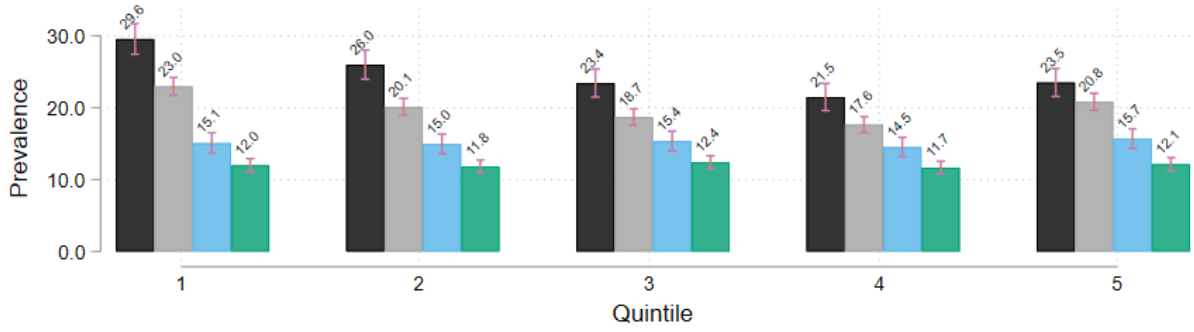


Source: Authors' calculations based on Consumer Price Index data. Base year: 2008.

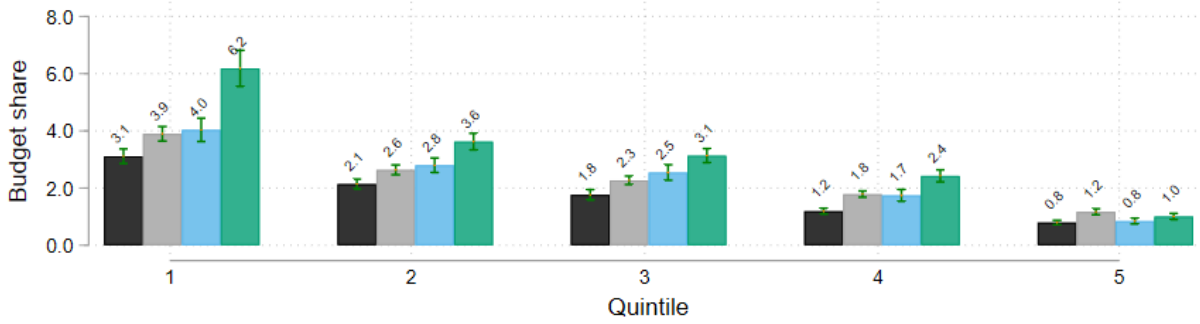
Figure 2: Smoking Prevalence and Tobacco Budget Share by Total Expenditures

Quintile

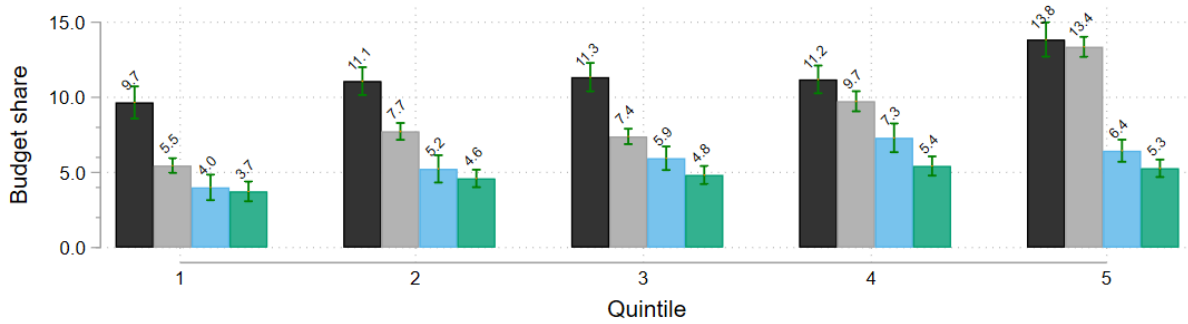
Panel A. Smoking Prevalence



Panel B. Budget Share Devoted to Tobacco Purchases



Panel C. Budget Share Devoted to Health and Education



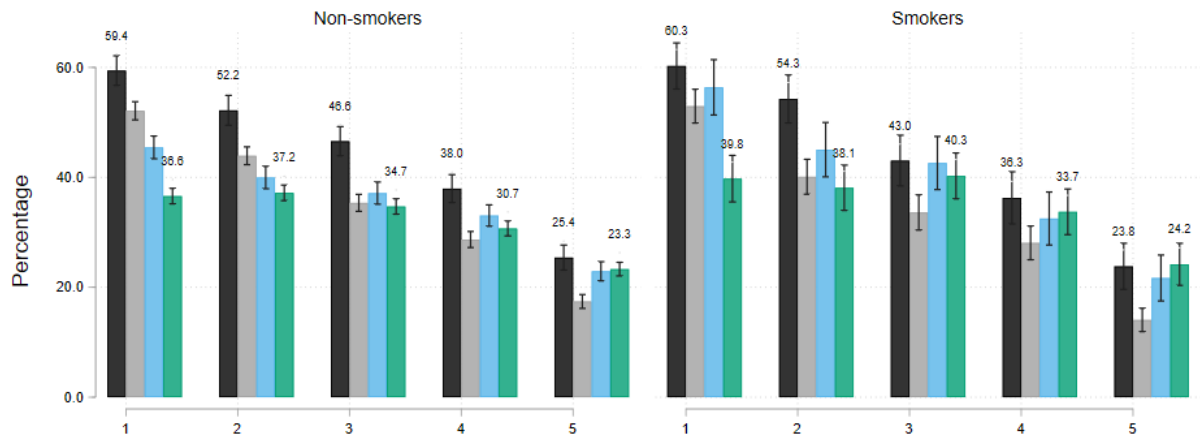
■ 1997    ■ 2003    ■ 2008    ■ 2011

Source: Authors' calculations.

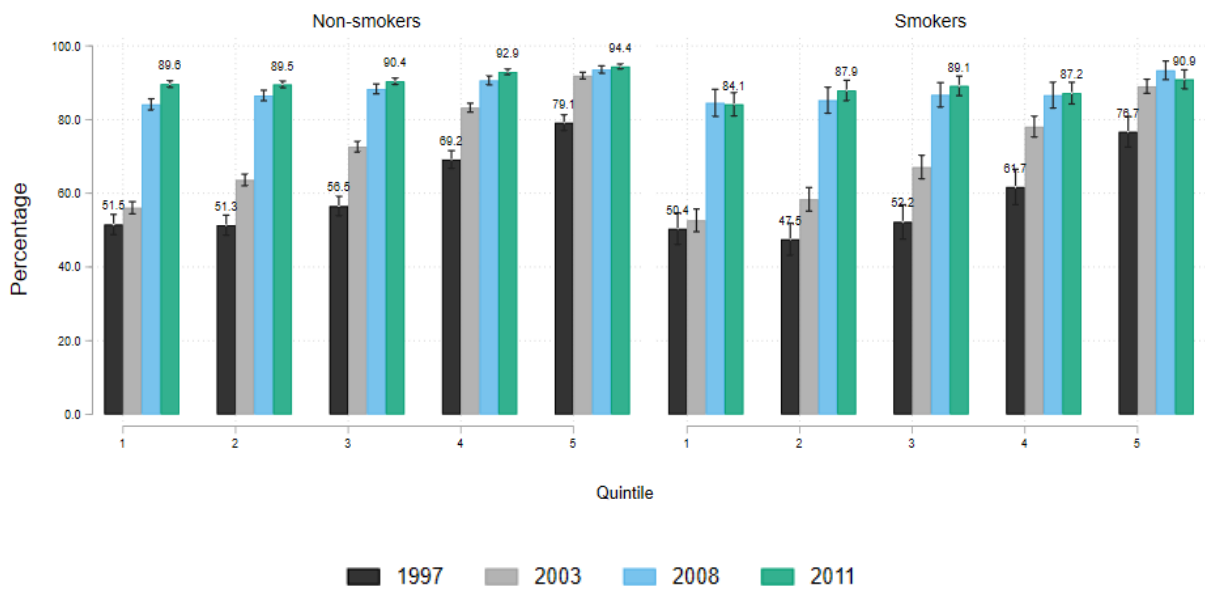


Figure 3: Self-reported Health Status and Affiliation with the Health System

Panel A. Self-reported health status: bad



Panel B. Affiliation to the Health System



Source: Authors' calculations.

## 3. Methods

### 3.1 Data and matching

To obtain tobacco consumption data that reflect changes through time, we used household consumption data that were collected as a part of the ECV for 1997, 2003, 2008 and 2011. These surveys include detailed household consumption records for the previous seven days. Using this information, we constructed monthly equivalent household expenditures<sup>4</sup>. As described above, these data allow us to determine (i) whether there is a tobacco user in the household (prevalence)<sup>5</sup> and (ii) the share of budget expenditure on the following categories: tobacco, food, alcohol, clothing, household services, health, education, transport, and other items. Online appendix [A](#) describes how these categories were constructed. The shares are calculated based on total expenditure including tobacco.

One important concern when comparing households of smokers across time is the composition differences: apart from time, the notorious reduction on smoking prevalence is not random. Thus, different budget shares might be the result of different

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<sup>4</sup> It is constructed using the OECD method, i.e., measuring the amount of final consumption expenditure made by resident households to meet their everyday needs. It includes the actual individual consumption aggregated at the household level, i.e., households' consumption expenditure plus those expenditures of the general government and non-profit institutions serving households that directly benefit them, such as, health care and education.

<sup>5</sup> Although expenditure data are used instead of consumption data, our estimates of prevalence obtained from ECV are similar to those based on individual-level data collected by specialized tobacco surveys. The prevalence of tobacco consumption in 2008 was around 17% for individuals aged 12 to 65 years of age. A household prevalence of 16.5% is estimated for the same year using the ECV 2008. The latter figure is expected to be lower as a result of the effect of aggregating several smokers into a single household unit.

needs of the households. Our goal with the matching is to replicate the characteristics of smokers of 2011 with those of smokers and non-smokers from the previous years. For this, we implement a genetic matching algorithm (Diamond & Sekhon, 2013). The method uses the genetic optimization to choose a group of  $M$  control units per treatment unit, which are as closely as possible in a vector of characteristics. The method chooses the metric that is used to measure the distance between the vectors, where the objective is to minimise the bias between treatment and the conformed comparison group (i.e. maximise the balance). Typically, the propensity score matching is added as an additional covariate. In our implementation, we search for one smoker, and for one non-smoker, per each 2011 smoker household – treatment group - ( $M = 1$ ), each year, in each expenditure quintile. The method as implement with the package *Matching* in R (Sekhon, 2011).

Table 1 compares non-smoker households and smoker households per year. For each variable -all of them considered in the matching algorithm -, we observe the mean for both groups per year. In the first row before matching and in the second after it. The asterisks reflect the level of significance of a comparison of the means of smokers with non-smokers. The goal of matching is to ensure similar distributions of the covariates, not only that the mean of each covariates is the same.

Overall, in all years, we observe that relative to earlier cohorts, 2017 households which bought cigarettes had household heads who were older, more likely to be female, more educated, and live in smaller households with fewer children. These trends also apply for the non-smoker population. The matching strategy reduce those

differences, but as differences are not completely gone, the econometric model below includes these variables as controls. Therefore, our study is based on the expenditure's composition for smoker households similar to the ones observed in 2011, change over time.

Table 1: Matching Sample Balance

Variable	Sample	1997		2003		2008		2011	
		Smoker	Non-Smoker	Smoker	Non-Smoker	Smoker	Non-Smoker	Smoker	Non-Smoker
Age	NM	47.690***	46.467***	46.616***	46.927***	49.271	47.342***	49.939	48.001***
	M	49.241	48.363	48.613	47.267	49.946	49.094		48.705
Gender (Female=1)	NM	0.205***	0.258	0.272	0.328***	0.228***	0.323***	0.270	0.323***
	M	0.229**	0.222	0.225	0.206	0.257	0.220		0.191
Primary school	NM	0.842**	0.793	0.634***	0.616***	0.830**	0.752***	0.811	0.700***
	M	0.824	0.823	0.781	0.742	0.817	0.817		0.812
Secondary school	NM	0.077	0.100	0.130***	0.154***	0.093	0.147***	0.089	0.153***
	M	0.090	0.079	0.077	0.078	0.083	0.077		0.067
Tertiary school	NM	0.081*	0.107	0.236***	0.230***	0.078***	0.101	0.099	0.147***
	M	0.086	0.098	0.142	0.180	0.101	0.106		0.121
Zone (Urban=1)	NM	0.540	0.609***	0.773***	0.814***	0.537	0.604***	0.539	0.584***
	M	0.531	0.516	0.560	0.625	0.523	0.516		0.487
Ratio children-under-5/adults	NM	0.801***	0.782***	0.580***	0.637***	0.590***	0.685***	0.515	0.652***
	M	0.516	0.553	0.478**	0.510	0.501	0.500		0.492
Total individuals	NM	4.612***	4.106***	3.922	3.665***	4.226***	3.978	3.919	3.876
	M	3.750**	3.777	3.753	3.543	3.825	3.620		3.477

Notes: Per variable, the first row corresponds to the sample without matching (NM), and the second to the matched sample (M). Genetic matching with the propensity score, with five neighbors, population size of the optimizer of 10000. Significance of t-test between smokers of each year, and smokers of 2011: \* 10%, \*\* 5%, \*\*\* 1%.

## 3.2 Empirical Strategy

Our goal is to determine differences overtime (1997 to 2011) on how budget-pressure of smoking affects the poorest households, relative to the richest ones. In order to compare conditional means, we use a linear model over a sample of individuals that is comparable. As exposed above, with our matching strategy, we ensure that the observed characteristics, which determine household expenditures, are comparable. However, it is important to bear in mind that the goal of this study is not to estimate the causal effect of tobacco control policies.

Here we compare, in a cross-section analysis, budget shares between smokers and non-smokers. For each year, we estimate the regression

$$b_i^{(j)} = \alpha_0^{(j,s)} \cdot s_i + \alpha_0^{(j,ns)} \cdot ns_i + \sum_{l=2}^5 [\alpha_l^{(j,s)} Q_i^{(l)} \cdot s_i + \alpha_l^{(j,ns)} Q_i^{(l)} \cdot ns_i] + \gamma^{(j)} X_i + e_i^{(j)} \quad (2)$$

where  $s_i$  and  $ns_i$  are dummy variables indicating whether the household has a smoker. Then, the parameter  $\alpha_l^{(j,s)}$  presents, for smokers, the difference between budget-share for item  $j$  of households in quintile  $l$  relative to quintile 1. For non-smokers, parameter  $\alpha_l^{(j,ns)}$  does the same. Crowding-in/out for quintile 1 can be tested with the null  $\alpha_0^{(j,s)} = \alpha_0^{(j,ns)}$ . Whether the smoking status of the household is relevant for budget-share inequalities can be tested with the null  $\alpha_l^{(j,s)} = \alpha_l^{(j,ns)}$ .

For each year, we estimate a Seemingly Unrelated Regression model (SUR), in which unobserved terms  $e_i^{(j)}$  are correlated with each spending category, since households simultaneously decide the proportion of income spent in each good group and are constrained by a single budget constraint.

## 4. Results

From 1997 to 2011 in Colombia, incomes grew and there was an important decline in poverty levels, for instance, extreme poverty fell from 16.9% to 6.6% (Banco Mundial, 2018). Household budget allocations reflect those changes. Rows A of Table 2 shows the average budget share for each expenditure category after matching for smokers in expenditure quintile 1. Rows C do the same for non-smokers. Some expenditure categories, such as transport, grew over time, while there were reductions

in expenditure on health, education, and clothing. This pattern is likely to be the result of substantial reductions in the costs of health and education services due to the roll-out of social policies. During the study period, full coverage was achieved in relation to health insurance and basic education, mainly because of efforts in the public sector.

What we are interested in is the difference in trends between smokers and non-smokers over time. Rows E in the table present the p-value of a Wald test between the budget shares per item is the same for smokers and non-smokers in the poorest quintile. Smokers' households tend to spend more in alcohol and less in transport and housing most years. There is no evidence of crowding-out in health (negative but non-significant coefficients, but there is for education in 1997 and 2011. For food smoker's household devoted less resources in 2008, it is also negative for 1997 and 2011, but not significant at the 90% level.

Next, we consider how different are households of the fifth quintile with those of the first in terms of budget shares. Rows B (smokers) and D (non-smokers) present such differences. As usual, richer households devote a smaller proportion to food consumption, and more to clothing, and other expenditures. However, how different are those gradients between smokers' and non-smokers' households? Rows F test how different are those gradients. First, the alcohol crowding-in seems larger for richer households only in 2003. Second, we observe that for richer households the observed smaller share of expenditures of food of smokers' households occurs is a smaller magnitude than for non-smokers; for "others", the extra share is small for smokers. Third, there are no significant differences across smokers and non-smokers, for the gap on the shares for health and education between quintiles 5 and 1.

Table 2: SUR Estimates for variation on shares between smokers and non-smokers

Variable	Alcohol				Others			
	1997	2003	2008	2011	1997	2003	2008	2011
A: Q1 Smokers Share	0.012 ( 0.002)	0.009 ( 0.001)	0.008 ( 0.001)	0.016 ( 0.002)	0.087 ( 0.004)	0.071 ( 0.004)	0.091 ( 0.004)	0.092 ( 0.003)
B: Q5 vs Q1 smokers share: $Q_5^{(l)} \cdot s_{it}$	0.023 ( 0.006)	0.017 ( 0.007)	0.017 ( 0.006)	0.021 ( 0.006)	0.079 ( 0.018)	0.039 ( 0.017)	0.156 ( 0.019)	0.175 ( 0.019)
C: Q1 Non-smokers Share	0.006 ( 0.002)	0.006 ( 0.001)	0.002 ( 0.001)	0.005 ( 0.002)	0.078 ( 0.004)	0.078 ( 0.004)	0.101 ( 0.004)	0.098 ( 0.003)
D: Q5 vs Q1 non-smokers share: $Q_5^{(l)} \cdot ns_{it}$	0.017 ( 0.006)	0.005 ( 0.007)	0.015 ( 0.005)	0.021 ( 0.006)	0.137 ( 0.019)	0.076 ( 0.017)	0.167 ( 0.020)	0.138 ( 0.019)
E: Share difference smok. vs non-smok. Q1 p-val	0.006 0.010	0.003 0.177	0.006 0.002	0.012 0.000	0.007 0.233	-0.006 0.328	-0.013 0.044	-0.009 0.124
F: Gradient difference smok. vs non-smok. Q1 p-val	0.005 0.213	0.012 0.001	0.002 0.550	-0.000 0.982	-0.058 0.000	-0.037 0.002	-0.011 0.444	0.037 0.009
Variable	Transport				Housing			
	1997	2003	2008	2011	1997	2003	2008	2011
A: Q1 Smokers Share	0.031 ( 0.002)	0.041 ( 0.003)	0.039 ( 0.003)	0.054 ( 0.002)	0.160 ( 0.007)	0.252 ( 0.006)	0.293 ( 0.007)	0.203 ( 0.006)
B: Q5 vs Q1 smokers share: $Q_5^{(l)} \cdot s_{it}$	0.000 ( 0.007)	0.000 ( 0.009)	0.025 ( 0.008)	0.019 ( 0.008)	0.045 ( 0.020)	-0.015 ( 0.018)	0.067 ( 0.018)	-0.033 ( 0.018)
C: Q1 Non-smokers Share	0.034 ( 0.002)	0.051 ( 0.003)	0.051 ( 0.003)	0.050 ( 0.002)	0.190 ( 0.007)	0.282 ( 0.006)	0.298 ( 0.007)	0.247 ( 0.006)
D: Q5 vs Q1 non-smokers share: $Q_5^{(l)} \cdot ns_{it}$	-0.003 ( 0.007)	-0.013 ( 0.009)	0.016 ( 0.008)	0.027 ( 0.008)	0.011 ( 0.020)	-0.012 ( 0.017)	0.069 ( 0.017)	-0.060 ( 0.018)
E: Share difference smok. vs non-smok. Q1 p-val	-0.002 0.649	-0.010 0.016	-0.013 0.000	0.005 0.179	-0.035 0.000	-0.028 0.000	0.008 0.356	-0.045 0.000
F: Gradient difference smok. vs non-smok. Q1 p-val	0.002 0.647	0.012 0.042	0.009 0.074	-0.008 0.161	0.034 0.016	-0.003 0.824	-0.002 0.852	0.027 0.059
Variable	Food				Clothing			
	1997	2003	2008	2011	1997	2003	2008	2011
A: Q1 Smokers Share	0.502 ( 0.008)	0.455 ( 0.006)	0.474 ( 0.008)	0.526 ( 0.007)	0.131 ( 0.009)	0.106 ( 0.006)	0.053 ( 0.004)	0.057 ( 0.003)
B: Q5 vs Q1 smokers share: $Q_5^{(l)} \cdot s_{it}$	-0.099 ( 0.019)	-0.045 ( 0.018)	-0.294 ( 0.022)	-0.205 ( 0.020)	0.019 ( 0.021)	0.017 ( 0.014)	0.037 ( 0.012)	0.030 ( 0.007)
C: Q1 Non-smokers Share	0.518 ( 0.008)	0.445 ( 0.006)	0.486 ( 0.008)	0.548 ( 0.007)	0.113 ( 0.009)	0.095 ( 0.005)	0.065 ( 0.004)	0.059 ( 0.004)
D: Q5 vs Q1 non-smokers share: $Q_5^{(l)} \cdot ns_{it}$	-0.128 ( 0.018)	-0.071 ( 0.018)	-0.321 ( 0.023)	-0.209 ( 0.021)	0.023 ( 0.018)	0.025 ( 0.013)	0.025 ( 0.010)	0.025 ( 0.009)
E: Share difference smok. vs non-smok. Q1 p-val	-0.015 0.134	0.008 0.379	-0.023 0.049	-0.018 0.118	0.016 0.212	0.009 0.316	-0.009 0.138	-0.002 0.721
F: Gradient difference smok. vs non-smok. Q1 p-val	0.029 0.018	0.025 0.052	0.027 0.062	0.004 0.792	-0.004 0.748	-0.008 0.401	0.012 0.072	0.005 0.471
Variable	Health				Education			
	1997	2003	2008	2011	1997	2003	2008	2011
A: Q1 Smokers Share	0.050 ( 0.003)	0.030 ( 0.002)	0.027 ( 0.003)	0.034 ( 0.002)	0.027 ( 0.003)	0.033 ( 0.002)	0.001 ( 0.001)	0.000 ( 0.001)
B: Q5 vs Q1 smokers share: $Q_5^{(l)} \cdot s_{it}$	-0.024 ( 0.011)	-0.004 ( 0.008)	0.008 ( 0.009)	0.010 ( 0.009)	0.013 ( 0.008)	-0.012 ( 0.008)	0.002 ( 0.002)	0.005 ( 0.002)
C: Q1 Non-smokers Share	0.054 ( 0.003)	0.035 ( 0.002)	0.033 ( 0.003)	0.034 ( 0.002)	0.037 ( 0.003)	0.032 ( 0.002)	0.001 ( 0.001)	0.002 ( 0.001)
D: Q5 vs Q1 non-smokers share: $Q_5^{(l)} \cdot ns_{it}$	-0.003 ( 0.012)	-0.010 ( 0.010)	0.009 ( 0.010)	0.026 ( 0.010)	-0.011 ( 0.008)	-0.013 ( 0.007)	0.004 ( 0.002)	0.005 ( 0.003)
E: Share difference smok. vs non-smok. Q1 p-val	-0.003 0.466	-0.006 0.137	-0.005 0.317	-0.002 0.705	-0.008 0.026	0.000 0.969	0.000 0.746	-0.002 0.047
F: Gradient difference smok. vs non-smok. Q1 p-val	-0.021 0.006	0.006 0.338	-0.001 0.916	-0.015 0.018	0.024 0.000	0.000 0.980	-0.002 0.139	-0.001 0.680

Notes: Robust standard errors in parentheses. This table summarises the main results with total expenditure net of expenditure on tobacco. Each set of columns correspond to a category of spending per year. In each year, the unconditional shares for smokers and non-smokers from quintile 1 are presented (rows A and C), as well as the difference of these shares for quintile 5 which correspond to equation 1 estimated coefficients conditional on controls (rows B and D). Below them, there are two tests that compare the previous numbers between smokers and non-smokers (A - C, B - D), both of them computed with the estimates of equation 1. Controls include log-expenditures, squared log-expenditures, log-age, female dummy, education level, living in a urban area, ratio dis under 5 per adult, household size, and log-income.

## 5. Discussion and conclusions

As shown in previous studies, financial pressure due to tax increases may affect human capital accumulation (Wang et al., 2006; John, 2008; Block and Webb, 2009). The objective of this article is to determine if this is the case for low-SES households, on a period where tobacco framework policies were introduced and at the same time, publicly provided health and education services were expanded.

Crowding-out of human capital accumulation among low SES households was a possibility of the tobacco control policies. Price increase might have induced a compositional change on smokers, as occasional consumers are more likely to cease consuming tobacco in response to tax hikes than frequent smokers are. Thus, a larger percentage of households that continue to consume tobacco under a higher-price regime will be composed of frequent/heavy consumers (Pierce et al., 1989; De Vries, 1995; Cavelaars et al., 2000; Fernández et al., 2003; Huisman et al., 2005; Kalter-Leibovici et al., 2016). As a result, the remaining smokers are less sensitive to price and would be more likely to substitute other goods to maintain their habit (Townsend et al., 1994; Agthe and Billings, 1987; Wakefield and Inman, 2003).

Between 1997 and 2011 there was a notorious increase in the budget share allocated to smoking on comparable low-SES households of smokers, and a reduction in the budget share allocated to health and education. Therefore, while financial pressure on smokers was growing via taxes, their disposable income was growing due to the income effect of the social policies. The results presented above shows almost no evidence of crowding-out in health and in food expenditures, on quintiles neither 1



nor 5. We also observe crowding-in of alcohol most years, which is typically associated to tobacco consumption in the literature. Such differences were not present for highest income households, aside from a larger crowding-in for alcohol. The only difference is that the extra share on clothing and other expenditures of the highest quintile is smaller for the smokers than for the non-smokers. Therefore the growth on tobacco expenditures is mostly affecting leisure, entertainment, and luxury expenses of households.

We conclude that part of the disposable income generated by the expansion of the social policies resulted in a higher capability of smoking households to sustain the growing prices of tobacco. The good news is that given that the expansion of social security protects the human capital accumulation, it is possible to exert further financial pressure on low-income households to reduce smoking prevalence. In the case of Colombia, tobacco prices are still some of the lowest on the continent despite recent tax hikes in 2017 and further efforts are required (PAHO, 2016; James et al., 2017). In general, any country that has undertaken considerable efforts on social security programs, do not need to worry about the household budget consequences of taxing temptation goods.

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# Appendices

## Appendix A. Data

### Quality of Life Survey

Our analysis uses household data from ECV 1997, 2003, 2008 and 2011. While these surveys do not include individual cigarette consumption, they measure total household expenditure on tobacco products during the previous seven days. Because this is a cross-sectional survey, we constructed a pseudo-panel using matching techniques for the purposes of this study.

### Sample Selection

- As data are collected from households, we used the sociodemographic characteristics of the household heads, such as education, gender, and age, to construct a pseudo-panel to assess smoking inequalities.

### Imputation of expenditure data

- For missing values, both at the individual and household levels, we used mean values based on a household socio-economic classification at the national level, which is used for assigning taxes and subsidies for public utilities (*Estrato*)

### Definitions of variables

- *Tobacco prices*: Although other tobacco products are available, tobacco expenditure in Colombia is mainly on cigarettes. A price per cigarette series was constructed using the annual cigarette-specific CPI index, and a reference price of COP 121 per cigarette in 2011 was derived from the average cigarette pack prices published by the Colombian Department of Statistics (DANE).
- *Consumption intensity*: We created a smoking-intensity variable based on household tobacco expenditure and the average cigarette price for each year of the analysis. This variable accounts for the number of cigarettes consumed by the household during the previous 30 days as a derived (noisy) measure of household smoking intensity that overestimates (underestimates) consumption by those in the highest (lowest) socioeconomic level.



- *Total and specific expenses*: All goods and services, which are classified by the Quality of Life Survey (ECV, the acronym for the Spanish title) into four groups, weekly, monthly, quarterly, and annually, were adjusted to a monthly basis. Weekly expenses consisted of actual or estimated (in cases of free acquisition) spending on food and personal items. Monthly spending covered aggregated, actual, or estimated expenditure on household items such as light bulbs, cleaning items, rent, administration fees, and other items. Quarterly and annual spending involved expenditure on clothing and repairs, improvements to housing, furnishings, and culture and entertainment.
- *Tobacco budget share*: Tobacco expenses were included in the personal spending account, and for the purposes of this study, we constructed a new variable that separated this item from other personal items. Finally, we calculated the share of the budget allocated to expenditure on tobacco using total household expenditure.
- *Annual household income (adjusted for household composition)*: Total annual household income is the aggregate of income derived from wages and salaries, capital income (business income, dividend and interest income, and income from other assets), pensions, and expenditure by the government and non-profit institutions serving households that directly benefit households such as health care, childcare, and education. We used the OECD modified equivalent scale to adjust household income. This scale, first proposed by Hagenaars et al. (1994), assigns a value of 1 to the household head, 0.5 to each additional adult member of the household, and 0.3 to each child in the household. Finally, we expressed these figures in log form.

### **Expenditure categories**

- **Food and beverages**: This category includes all bread and cereals, milk and its derivatives, eggs, beef, pork and mutton, goose flesh and chicken meat, fish and other seafood, jam and sausages, potatoes, rice, beans and other grains, ripe and green bananas, vegetables, and fruits, and other forms of nourishment, except expenditure on eating out, which is included in the “Others” category.
- **Tobacco**: Tobacco products, matches, and lighters are included in this category.
- **Alcohol**: This category includes all alcoholic beverages.
- **Clothing**: This category includes veiled stockings for women, clothes, footwear, and all goods/services related to clothing maintenance and repair.

- **Household services:** This category includes a huge variety of services and goods related to the maintenance and functioning of the household, such as house cleaning service per day, electrical goods, administration fees, fuel for cooking, sewerage payments, rent, property tax payments, television, and phone and Internet service payments.
- **Health:** This category includes out-of-pocket expenses for health services, such as affiliation payments or discounts, additional health insurance programs, hospitalization, dentistry, outpatient surgery, medication, and vaccines.
- **Education:** This category includes out-of-pocket expenses for education, such as school fees, uniforms, books and school supplies, transport to and from school, school meals, scholarships, subsidies, and student loans.
- **Transport:** This category includes both private and public transport costs, including maintenance, and communication services and goods. This includes the purchase, maintenance, and repair of vehicles for private use, mailing services, fuel and parking costs, bus tickets, and taxi fares.
- **Culture and recreational services:** This category includes newspapers and magazines, entertainment, and books and CDs. It also includes expenditure on trips, such as hotel accommodation and fares.
- **Others:** This category includes a wide variety of goods and services that cannot be classified in any of the previous categories, such as lotteries and other forms of gambling, eating out, toiletries, laundry services outside the home, haircuts and manicures, credit card payments, transfers to other households, home improvements, acquisition of real estate, vehicle tax payments, jewelry, and paintings and other works of art.

### **Final remarks on data construction and use**

To assess variations among similar households, we used propensity score matching, which involved selecting and weighting 2011 non-smokers and 1997 smokers and non-smokers to enable comparison with 2011 smokers. This enabled characteristics such as age, household composition, income, and education level of the household head to remain constant across the four groups.