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Research Report

CIGARETTE BRAND-SWITCHING BEHAVIOR AND TOBACCO TAXATION IN VIETNAM

Development and Policies Research Center
Address: No. 1B, Ly Thuong Kiet Lane, Hoan Kiem, Ha Noi, Vietnam
Phone: + 84 4 3935 1419 | Fax: +84 4 3935 1418
Website: http://www.depocen.org/
Email: depocen@depocen.org

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Cigarette Brand-Switching Behavior and Tobacco Taxation in Vietnam

Anh Ngoc Nguyen

Hoang Nguyen The

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Contents

Key Messages on Policy

The Government of Vietnam should establish a clear roadmap to raising the tobacco excise tax to reach 70 percent of retail price as recommended by the World Health Organization.

- Faced with price increases, smokers generally switch to close substitutes – higher-priced domestic brand smokers switch to other lower-priced domestic brands, and high-priced, foreign brand smokers switch to both low-priced domestic brands and other foreign brands. Upgrading from domestic brands to foreign brands is not prominent.
- Because the simulated effect of a specific tax increase on low-priced brands is greater than on high-priced brands, switching to the mixed system is likely to affect lower-income smokers more and therefore can make the tobacco excise tax more progressive.
- To maximize the effect of a specific excise tax on quitting, the Government of Vietnam should maintain and strengthen effective market surveillance and border control led by national and provincial 389 Steering Committees to fight against smuggling since 2016.

Executive Summary

Smoking is one of the most alarming public health issues in Vietnam. The country is ranked among those with the highest smoking prevalence worldwide. About 15.6 million Vietnamese adults consume tobacco, and among them, 12.6 million smoke cigarettes, accounting for approximately 22.5 percent and 18.2 percent of adult population in the country in 2015, respectively [1]. Over 90 percent of smokers are male and the overall smoking prevalence of males is 45.3 percent [1]. Furthermore, about 40,000 people are dying in Vietnam each year due to tobacco-related illnesses, and without proper measures, this is estimated to reach 70,000 deaths per year by 2030 [2]. Such high prevalence has been largely attributed to the ineffective taxation against tobacco, and as a result of which cigarettes have become more affordable in the country during the period of 2008-2016 [3].

Raising taxes on tobacco has proven to be the most effective measure to reduce smoking in many countries around the world. In 2013, the Government of Vietnam set a target of reducing smoking prevalence among males by over six percentage points to 39 percent by 2020 in the "National Strategy on Tobacco Control through 2020". To achieve the goal, the Ministry of Finance of Vietnam (MoF) is proposing to switch from the current purely ad valorem structure of tobacco excise tax to a mixed system in which a specific rate will be imposed on every 20-cigarette pack on top of the ad valorem tax. In the amendment drafted in 2017, the proposed specific component amounted to VND 1,000 and would be added to the tobacco excise in 2020. According to the World Health Organization and other international organizations, however, VND 1,000 is too modest, and the rate should be at least VND 2,000 to bring significant change, and VND 5,000 to achieve the set target [4].

In response to these proposals, there have been concerns that switching to a mixed scheme is unfair for domestic companies. It is argued that the increase in prices induced by adding the specific tax component may shift consumption away from cheaper, domestic brands to more expensive, foreign brands and to illicit cigarettes. This then adversely affects the domestic industry without effectively reducing overall cigarette consumption. Unfortunately, previous studies in Vietnam have not been able to address this issue due mostly to the unavailability of relevant micro market data with detailed information on brand choice. This research attempts to bridge this gap and measure the potential effect of three proposed specific tax amounts on cigarette brand choice, using the state-of-art combination of choice experiment data and real market data.

The results of the research show that smokers of low-priced, domestic brands are generally more price sensitive than smokers of high-priced, foreign brands. In addition, brand substitution is more prominent among domestic brands than among foreign brands or between the two brand segments. When cigarette prices increase, smokers of domestic brands are more likely to not buy any of the studied cigarette brands (accounting for over 80% of total market share) than smokers of the foreign brands. This provides suggestive evidence that the domestic brand smokers are more

likely to quit smoking. Jet and Hero, the two most popular illicit brands, which are exclusively concentrated in the South, are most sensitive to a change in the price of a domestic brand and a foreign brand in the region.

The impact of a tax increase on brand-level market share, which represents the percentage of current smokers who would choose to smoke a cigarette brand, varies across cigarette price segments. A uniform increase in specific excise tax induces a number of current smokers to give up on both (low-priced) domestic brands and (high-priced) foreign brands, with the estimated market share reduction being larger for domestic than for foreign brands. A large share of smokers substituting away from domestic brands would also refuse to purchase any of the studied cigarette brands, rather than up-trade to foreign or illicit brands, suggesting their likely intention to quit smoking. Meanwhile, in response to the tax increase, some (but not all) smokers of domestic and foreign brands may switch to illicit brands, mainly Jet and Hero in the South, resulting in a higher market share of illicit cigarettes. Yet, this market share gain is inversely related to how prices of illicit cigarettes respond to the tax increase. The more the prices of illicit cigarettes rise, the smaller the market share gain. Finally, the effect of the tax increase also depends on the extent to which the tax is shifted by the tobacco industry to consumers.

In light of these results, and to effectively reduce tobacco consumption in Vietnam, two policy recommendations are proposed. First, the Government of Vietnam should switch from a purely ad valorem tobacco excise tax scheme to a mixed system by imposing a specific excise tax on tobacco products, including cigarettes. Less reliance on the ad valorem component and more on the specific component can raise average cigarette price, reduce price variability, and thus leave less room for possible strategic brand-switching. Furthermore, as the cheap, domestic brands are the most affected by the price increase, the specific excise tax can make tobacco taxation more progressive. Since smokers of low-priced brands are typically low-income earners and more likely to quit smoking than the smokers of high-priced brands in response to a given price increase, adding a specific component is likely to benefit the poor more than the rich.

Second, the Government of Vietnam should maintain and strengthen intensive and effective market surveillance and border control led by national and provincial 389 Steering Committees to fight against smuggling since 2016. By raising the cost of sourcing, distributing, and purchasing illicit cigarettes, these activities will help raise their prices as they seem to have done since 2016. The rising prices not only encourage current smokers of illicit cigarettes to quit, but also disincentivize substitution from the legal cigarettes to the illicit cigarettes. Market monitoring also helps understand the extent to which the tax increase is passed through to retail prices, which determines the impact of the tax increases.

1. Introduction

According to the World Health Organization (WHO) [7], tobacco is one of the global leading causes of death, especially in low- and middle-income countries (LMICs). Smoking is one of the most alarming public health issues in Vietnam. The country is ranked among those with the highest smoking prevalence worldwide. About 15.6 million Vietnamese adults consume tobacco, and among them, 12.6 million smoke cigarettes, accounting for approximately 22.5 percent and 18.2 percent of adult population in the country in 2015, respectively [1]. Over 90 percent of smokers are male. Indeed, the overall smoking prevalence of males is 45.3 percent [1]. Furthermore, about 40,000 people are dying in Vietnam each year due to tobacco-related illnesses, and without proper measures, this is estimated to reach 70,000 deaths per year by 2030 [2]. Such high prevalence has been attributed to the ineffective taxation against tobacco, and as a result of which cigarettes have become more affordable in the country during the period of 2008-2016 [3].

Cigarettes made in Vietnam[1] are currently subject to three different taxes[2]. The first is an ad valorem excise tax which is levied on ex-factory price.[3] The ad valorem rate has been increased on a number of occasions, to 55 percent in 2006, 65 percent in 2008, 70 percent in 2016, and most recently to 75 percent in 2019.[4] The second tax is a compulsory contribution to the Tobacco Control Fund (TCF), which was established in 2012 by the Vietnam Tobacco Control Law[5]. The contribution rate started from 1.0 percent of the taxable price of all cigarette packs[6] in 2013, and increased to 1.5 percent in 2016, and most recently to 2.0 percent in 2019. The third is the Value Added Tax (VAT), which is applied to all goods in the country. The VAT currently amounts to 10.0 percent of the sum of taxable price, excise tax, and TCF contribution. Thus, the total tax imposed on domestically made cigarettes is equal to 84.7 percent of the ex-factory price[7]. The total tax rate seems to be high at first glance. However, cigarettes remain affordable, even for the poor. WHO estimates that the tobacco tax accounts for only about 36.7 percent of the retail price of the most popular cigarette brand in Vietnam in 2018, less than half of its recommended minimum level of 75.0 percent. [8] In addition, the practice of using the ex-factory price as the base makes the tobacco tax susceptible to tax avoidance[9]. By having affiliates acting as intermediaries between production and retail, for example, the tobacco industry can easily undervalue the ex-factory price to reduce their tax duties.

[1] Legally imported cigarettes are quite rare in Vietnam perhaps due to the extremely high import tariff of 135% imposed on them. Therefore, this research does not consider this marginal market segment.
[2] This analysis is drawn heavily from Marquez, Krasovsky, Andreeva, & Isenman [45]. See the original article for a more detailed analysis of current tobacco taxation and related policies in Vietnam.
[3] The ex-factory price is the price at the factory and does not include any costs or tax imposed at any delivery and distribution stage.
[4] This is commonly referred to as a special consumption tax. The country initially imposed different tax rates on different types of tobacco products, but changed to a uniform system in 2006.
[5] The TCF serves as a source of funding for the implementation of the WHO FCTC to which Vietnam became a party in 2005.
[6] produced locally or imported for local consumption
[7] = (75 percent + 2 percent)*110 percent

Raising tax imposed on tobacco is the most effective measure to reduce smoking. In 2013, the Government of Vietnam set a target of reducing smoking prevalence among males by over six percentage points to 39 percent by 2020 in the "National Strategy on Tobacco Control through 2020". To achieve this goal, the Ministry of Finance of Vietnam (MoF) is proposing to switch to a mixed excise tax system in which a specific rate will be imposed on every 20-cigarette pack on top of the ad valorem tax. In the draft proposal in 2017, a specific tax of VND 1,000 was proposed and would be added to the tobacco excise in 2020. According to WHO and other international organizations, VND 1,000 is too modest, and the rate should be at least VND 2,000 to bring about significant change, and VND 5,000 to achieve the set target [4].[8]

In response to these proposals, there have been concerns that switching to a mixed scheme is unfair for domestic companies. It is argued that the increase in prices induced by adding the specific tax component may shift consumption away from cheaper, domestic brands to more expensive, foreign brands and to illicit cigarettes. This then adversely affects the domestic industry without effectively reducing overall cigarette consumption. Evidence from other countries has shown that specific excises tend to result in higher reductions in cigarette consumption than ad valorem excises even though low-priced cigarettes can be more affected than high-priced brands [6]. Thus, there is a need for local evidence to respond to these concerns and to inform ongoing policy discussion in the country.

This research attempts to quantify the potential effect of three proposed tax rates on cigarette brand choice, using the combination of choice experiment data and real market data. Specifically, a discrete choice experiment (DCE) with smokers is conducted to collect data on their stated preferences of cigarette brands. Along with this experiment, data is also collected on smokers' actual cigarette brand choice and cigarette consumption. These rich micro-level data allow estimation of brand-level cigarette demand, calculation of price elasticities and semi-elasticities, and simulation of the impact of different tax reform scenarios on brand-level market share, taking brand-switching behavior into account. Finally, analyses are disaggregated by region (North, Central, and South) to account for regional heterogeneity in terms of brand selection and smoking behavior.

This study is related to an extensive literature on behavioral responses of cigarette smokers to higher cigarette prices. The literature has documented several possible strategic mechanisms that smokers may adopt to mute the impact of a price increase instead of quitting. They include smoking habit modification [10–12], substitution between cigarette brands [13], substitution from cigarettes to other, more affordable, tobacco products [14,15], and downsizing of the quantity bought in each purchase [14]. This research is mainly concerned with the price-based brand-switching possibility because it is the most likely reaction in the context of developing countries

[8] As of August 2019, anecdotal information suggests that MoF is revising their proposal with two options under consideration: i) increase the ad valorem rate to 80 percent, and add a specific rate of VND 1,000 per pack; and ii) keep the ad valorem rate of 75 percent, but impose a specific rate of VND 2,000 on every cigarette pack. On average, the latter is believed to create a higher tax increase than the former.

[14,16–18]. While it is essential to account for this behavioral response when assessing the potential impact of a tax increase, previous studies in Vietnam have not been able to address this issue due mostly to the unavailability of relevant micro market data with detailed information on brand choice.

2. The Cigarette Market in Vietnam

The tobacco industry in Vietnam is dominated by state-owned companies[9]. There are about 30 companies organized under six state-owned corporations, with the leading role played by the Government-owned Vietnam National Tobacco Corporation (Vinataba). To gain access to Vietnam's market, foreign companies are required by law to form joint ventures with Vinataba as British American Tobacco (BAT), Phillip Morris International (PMI) and Japan Tobacco International (JTI), three leading transnational tobacco companies (TTCs) have done.[10] Vinataba is also the only company that is licensed to import cigarettes and distribute them in the country.

There are many different cigarette brands traded in the market. Cigarette prices range from as low as VND 6,000 ($0.26) to over VND 40,000 ($1.74). Domestic producers dominate lower-priced segments while TTCs focus on more expensive products. As discussed later, brands from all price tiers and both domestic and foreign brands are included in the choice experiment to take these market characteristics into consideration. Domestic brands are those produced solely by domestic companies, while foreign brands are made by joint venture between TTCs and Vinataba.

Vietnam has three regions with relatively different natural, socio-economic and cultural characteristics, namely North, Central, and South. These differences are likely to affect smoking behavior and cigarette consumption. Furthermore, the set of the most popular cigarette brands varies between regions. Some brands are popular in one region, but at the same time are hardly found or account for a very modest market share in the other two. Thus, in the experiment described in the next section, the set of available (alternative) brands slightly varies across regions even though their statistical designs are the same.

The threat of illicit cigarette trade is the biggest obstacle to tax reform in Vietnam[11]. Without rigorous evidence, the tobacco industry claims that an increase in the tobacco excise tax will encourage smokers to buy illicit cigarettes with lower prices, rather than reduce their cigarette consumption, thereby undermining the tax policy objective. However, by estimating illicit cigarette consumption as the percentage of total cigarette consumption after the increase of the ad valorem rate in 2016, and comparing it with the ex-ante estimate of M. T. Nguyen, Dao, Nguyen, Bowling, & Ross [19] with a similar methodology, A. Nguyen & Nguyen [20] show that this is not necessarily the case. They found that the illicit consumption as the percentage of the total cigarette consumption in 2017 was significantly lower than that in 2012. A. Nguyen & Nguyen [20] do not

[9] The analysis is drawn from Department of Tax Policy - Ministry of Finance Vietnam, HealthBridge Foundation of Canada, & Southeast Asia Tobacco Control Alliance [46]. See the original report for more detailed discussion
[10] https://healthbridge.ca/news/entry/tobacco-taxes-must-rise-in-vietnam
[11] The analysis is drawn from A. Nguyen & Nguyen [20].

make a causality claim since the decline in the illicit brand market share may be primarily attributed to an extensive effort against smuggling, especially in the Southern provinces by the Government of Vietnam since 2016. Thus, the extent to which smokers may switch from licit to illicit brands, holding other factors unchanged, remains uncertain.

Illicit cigarettes possess other distinct characteristics that should be taken into consideration. First, the price of illicit cigarettes is on average higher than the price of licit cigarettes as found consistently by both the studies mentioned above. Second, according to the tobacco control law, licit products must have a tax stamp, health warning texts in Vietnamese, and pictorial health warning labels printed on packs. However, illicit cigarettes typically have none of these requirements. Thus, it is relatively easy to determine whether a cigarette pack is illicit simply by inspecting the pack. Third, some illegal brands have their legal versions while other do not. For example, Jet and Hero are the two most popular illicit-only brands, with over 80 percent of the illicit market share [20]. The two are smuggled cross border from Cambodia, and thus, mostly sold and consumed in the South [19]. However, another popular cigarette brand, SE555, which can be found nationwide, particularly in big cities like Hanoi, Da Nang, and Ho Chi Minh City, has both a legal and illicit version. The legal one is manufactured locally by the joint venture between Vinataba and BAT. Compared to Jet and Hero, the illicit version of SE555 accounts for a smaller market share, perhaps due to its extremely high price. As shown below, these three most popular illicit brands are included in the experiment.

3. Methodology

The study uses the combination of choice experiment data and real market data to study the brand-switching behavior of smokers in response to a price increase, and estimates the potential impact of different tobacco tax reform proposals under consideration by the Government of Vietnam. The choice experiment allows exogenous variation of the price of cigarette brands while a variety of discrete choice models allows estimation of differentiated cigarette demand. In particular, the random parameter logit model is capable of capturing flexible brand substitution patterns, which is essential to forecasting the impact of a tax increase.

Choice experiments are stated preference methods and have gained popularity in health economics [21]. There is also a small, but expanding literature that employs the method to study smoking behavior and the effect of tobacco control policies on tobacco use, mainly in the United States and other high-income countries [22]. Recent contributions include Kotnowski, Fong, Gallopel-Morvan, Islam, & Hammond [23] on cigarette packaging, and Marti, Buckell, Maclean, & Sindelar [24], Kenkel, Peng, Pesko, & Wang [25] and Shang, Huang, Chaloupka, & Emery [26] on e-cigarettes.

In stated preference data, choices are made by considering hypothetical situations. Since stated preference data are collected through an experiment, price and other attributes can be manipulated so as to have a sufficient degree of variation for the estimation purpose, which may not be available in the actual market data [27,28]. This advantage makes stated preference data

attractive and sometimes even the only available option in a number of market settings [24]. This is particularly relevant to the context of the cigarette market in Vietnam where smoker-level data on brand choice are scant, and price-based policy changes have not taken place until recently.

While the models based on stated preference data allows estimation of the effect of price on cigarette brand choice, it typically does not correctly reproduce the status quo in terms of brand market share, which is necessary before making predictions. There are unobserved brand-specific characteristics which smokers may encounter in an actual market situation, but not in the experiment. To overcome this shortcoming, this research follows common practice in the literature [29] and calibrates the alternative-specific constants and their interaction with demographics on actual brand choice data. The calibrated models then are used to calculate price elasticities and semi-elasticities, and to simulate the impact of specific tax increases on brand-level market share. The actual market data are also served as a baseline for the numerical impact simulation.

3.1 Experiment Design

A choice experiment is a survey in which each respondent is presented with a number of scenarios designed by researchers and asked a "what if" question. A sample of choice scenarios in this experiment is given in **Figure *1***. Each scenario or choice set contains multiple alternatives, which are cigarette products in this study. Each alternative then is described by a number of characteristics or attributes, which, as shown later, are cigarette brand and price in this experiment. Given this information, the respondent is asked which alternative s/he would choose if those alternatives with their given characteristics were actually available in the market. That is, which of those cigarette brands with their described prices s/he would choose to smoke.

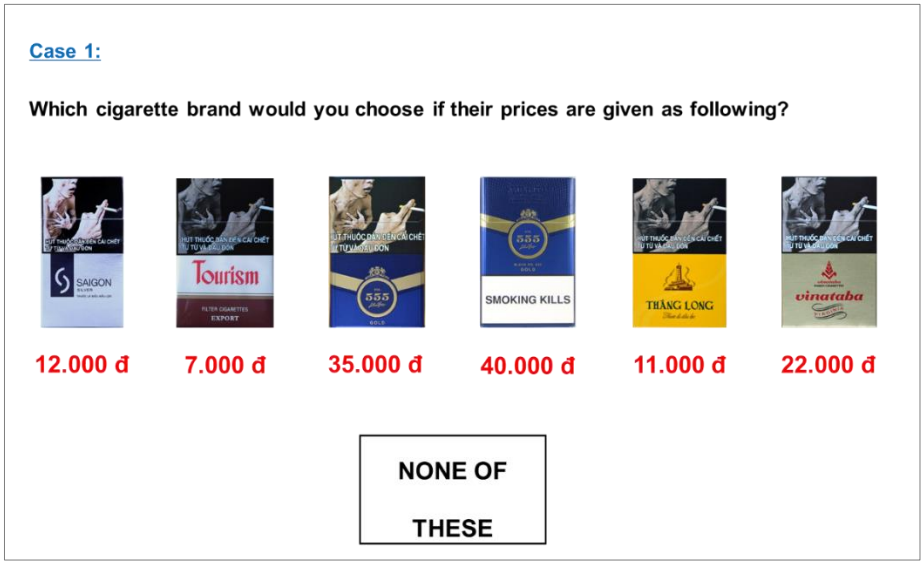
A discrete choice experiment can be generic or labelled. In the former, each alternative itself conveys virtually no information other than its characteristics or attributes included. In the latter, however, the name or label of each alternative conveys information that is not captured by the alternative's observed characteristics and may influence individual choice. Since the objective of this research is to examine brand-switching behavior and make accurate predictions of brand-level cigarette demand, this study uses the labelled choice experiment, with cigarette brand as the label of alternatives as suggested by Hensher, Rose, & Greene [30].

As shown in **Figure *1***, each cigarette brand serves as one alternative in the experiment. Currently, over 20 cigarette brands are available in the national market. However, it is practically infeasible to include all of them in each individual choice set. Certain trade-offs between coverage and feasibility thus have to be made. Fortunately, based on data collected from a smoker survey in 2018[12] , smokers in the three regions are likely to face three different sets of cigarette brands. Thang Long, for example, is the most popular brand in the North, but can be hardly found in the Central and South regions. These region-specific sets are much smaller than the nationwide one. Thus, by tailoring this experiment to take this feature into account, the number of cigarette brands

[12] See A. Nguyen & Nguyen [20] for a brief description of the survey design

included in the experiment is maximized, the statistical design is simplified, and the experiment is more realistic.

Figure 1: A Sample of Choice Scenarios



Once brands are grouped by region, four criteria are used to guide the selection of the set of brands in each region. First, selected brands must represent the price spectrum, from very cheap to premium products. Second, they must include both domestic and foreign brands. Third, both licit and illicit cigarette brands must be included. Finally, the most popular brands in each category are considered so that the selected brands cover a sufficiently large share of the market.

Based on these considerations and data collected from the tobacco consumption household survey in 2018, fifteen brands were selected and sub-divided into three regions: five licit brands and one illicit brand in the North; five licit brands and one illicit brand in the Central; and five licit brands and three illicit brands in the South. In each region, the selected brands account for over 80 percent of the market share[13]. The "none of these" optout is also included to allow smokers to choose not to buy any of the included brands. Changes in the number of smokers, who would opt out can provide suggestive evidence of smokers' intention to quit smoking in response to higher cigarette prices induced by tax increases. Obtained evidence, if any, is suggestive because "opting out" or refusing to purchase any brand could indicate that a smoker intends to quit or that s/he delays the purchase to seek a brand not included in the design. The latter however is less likely because the included brands already cover over 80% of total cigarette market. Furthermore, surveyed smokers are specifically instructed to imagine that only the experimented brands are sold, and there is no cigarette brand other than them available in the market.[14] The inclusion of the optout also makes the experiment more realistic.

[13] The market share of a brand in a given region is defined as the number of surveyed smokers consuming the brand as the percentage of the total number of smokers surveyed in the region.
[14] The detailed construction of the experiment instruments is shown in Appendix A.

Table 1: Attributes and Tentative Levels in the Experiment

Region	No.	Brand	Producer	Price Tiers	Legality	Es. Cur. Price (VND)	Specific Tax Rate (VND)				Experimental Prices (VND)			
North	1	Thang Long	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	2	Du Lich	Local	Very Cheap	Licit	7,000	0	1,000	2,000	5,000	7,000	8,000	9,000	12,000
	3	Vinataba	Local	Medium	Licit	20,000	0	1,000	2,000	5,000	20,000	21,000	22,000	25,000
	4	Sai Gon	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	5	SE 555	TTC	Premium	Licit	30,000	0	1,000	2,000	5,000	30,000	31,000	32,000	35,000
	6	Illicit SE 555	Smuggled	Premium	Illicit	40,000	0	0	0	0	40,000	40,000	40,000	40,000
Central	1	White Horse	TTC	Medium	Licit	23,000	0	1,000	2,000	5,000	23,000	24,000	25,000	28,000
	2	Bastos	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	3	Prince	Local	Very Cheap	Licit	8,000	0	1,000	2,000	5,000	8,000	9,000	10,000	13,000
	4	Sai Gon	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	5	SE 555	TTC	Premium	Licit	30,000	0	1,000	2,000	5,000	30,000	31,000	32,000	35,000
	6	Illicit SE 555	Smuggled	Premium	Illicit	40,000	0	0	0	0	40,000	40,000	40,000	40,000
South	1	Sai Gon	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	2	Craven A	TTC	Medium	Licit	20,000	0	1,000	2,000	5,000	20,000	21,000	22,000	25,000
	3	Hoa Binh	Local	Economy	Licit	11,000	0	1,000	2,000	5,000	11,000	12,000	13,000	16,000
	4	SE 555	TTC	Premium	Licit	30,000	0	1,000	2,000	5,000	30,000	31,000	32,000	35,000
	5	Khanh Hoi	Local	Very Cheap	Licit	8,000	0	1,000	2,000	5,000	8,000	9,000	10,000	13,000
	6	Jet	Smuggled	Medium	Illicit	20,000	0	0	0	0	20,000	20,000	20,000	20,000
	7	Hero	Smuggled	Medium	Illicit	17,000	0	0	0	0	17,000	17,000	17,000	17,000
	8	Illicit SE 555	Smuggled	Premium	Illicit	40,000	0	0	0	0	40,000	40,000	40,000	40,000
Code											***1***	***2***	***3***	***4***

Note: Current prices are median prices calculated from data from a retailer survey conducted in April 2019 by DEPOCEN.

In addition to the cigarette brand, price is the only attribute in the design[15] **(Table 1)**. Each licit brand has four price levels, reflecting four different values of specific tobacco excise tax: i) no change; ii) VND 1,000; iii) VND 2,000; and iv) VND 5,000. The price levels of each legal cigarette brand are determined by adding specific tax rates on top of its current, median retail price, obtained from a retailer survey conducted in April 2019 by DEPOCEN. Since different brands have different current prices, the price levels vary across the brands. For simplicity, the price of the illicit cigarette brands throughout the experiment is fixed as they are not subject to the excise tax. As discussed later, the possibility that the price of the illicit cigarettes might change after imposing the specific excise taxes and its influence on the impact of the tax reform on brand choice is considered in the numerical impact simulation. Once the cigarette brands and prices are selected, they are combined into a list of choice sets or scenarios that are presented to smokers. The detailed construction of the statistical design and experiment instruments is shown in Appendix A.

3.2 Sampling and Actual Market Data

The choice experiment is complemented by a household survey with a sample of more than 1,200 smokers (400 smokers in each of the three socio-economic regions, North, Central, and South). The target participant pool was comprised of males and females aged 18 or older who smoke cigarettes at least once per week, and within the last three months at the time of the survey. Multi-stage clustered and stratified sampling was used to randomly select participants. In the first stage, two provinces in each of the country's three socio-economic regions were selected, namely Hanoi and Hai Duong in the North, Da Nang and Quang Nam in the Central, and Ho Chi Minh City and Dong Thap in the South. According to Global Adult Tobacco Survey (GATS) 2015 data, these provinces together account for roughly 18 percent of the total number of smokers in the country. Then two districts (one urban and one rural) in each province, and three communes in each district were randomly selected for the survey implementation. In each selected commune, households of eligible smokers were identified and listed as a sampling frame. From this list, about 35 households were selected for interviews. For households with more than one eligible smoker, one among them was randomly selected.

In addition to the stated preference data, the survey collects data on smokers' actual cigarette consumption and demographic characteristics. Cigarette consumption data includes primary cigarette brand choice and cigarette price, which supplements the discrete choice experiment data. Demographic characteristics include age, educational attainment, and income are used to allow for heterogeneity in smoker preferences.

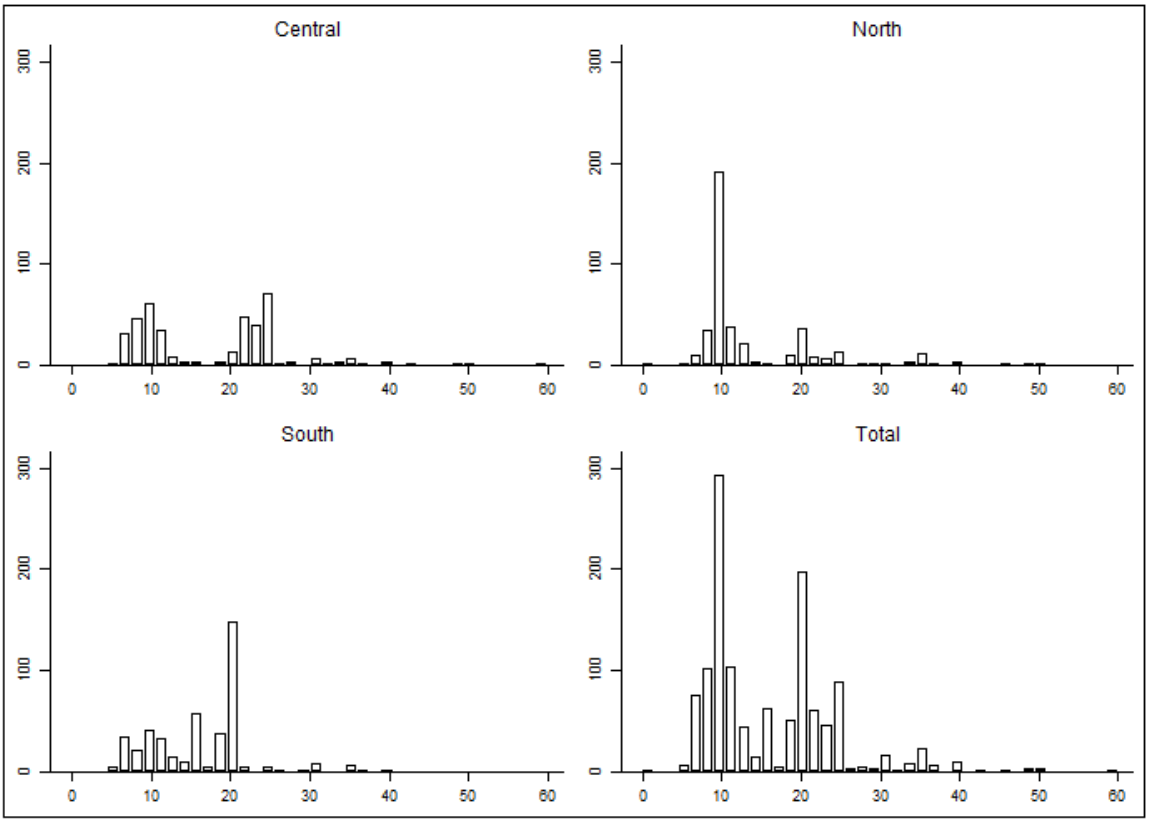
The final sample used in the analysis consists of 1,151 smokers after accounting for missing data. Table *2* reports the summary of sample demographics. Similar to the GATS 2015, a majority (96.5 percent) of surveyed smokers are male with an average age of over 45. The average income is about VND 7.34 million per month.

[15] Instead of the price, tax rate can be interpreted as the only attribute. This however does not affect the statistical design of the experiment. Only the attribute's number of levels does. Furthermore, strictly speaking, there are actually two attributes, namely cigarette brand and cigarette price.

Table 2: Descriptive Statistics

VARIABLES	(1) Mean	(2) sd	(3) min	(4) max
Male	0.965		0	1
Age	45.39	12.79	18	79
Education				
Primary School or Less	0.315		0	1
Lower-Secondary School	0.298		0	1
High School	0.214		0	1
Tertiary Education	0.173		0	1
Average monthly income (VND mil)	7.342	10.34	0	270
N	1,151			

Figure 2: Frequency Distribution of Self-reported Cigarette Price



Throughout the report, the market share of a brand in a given region is defined as the number of surveyed smokers choosing the brand as the percentage of the total number of smokers surveyed in the region. This definition of market share is utilized to be consistent with the discrete choice experiment, in which smokers are asked to choose cigarette brands, but not the number of

cigarettes. In other words, this study focuses only on the extensive margin, not smoking intensity or intensive margin. Following this definition, the considered brands account for an over 80 percent market share in the actual market as shown in ***Table 3***.

Figure 2 shows the frequency distribution of self-reported cigarette price while brand-level average price is shown in ***Table 3***. The cigarette price varies across a relatively wide range, from about 6,000 VND to over 40,000 VND. However, three distinct, major price segments are evident in all three regions: one around 10,000 VND or less, one around 20,000 VND to 25,000 VND, and one greater than 25,000 VND. In the South, there is one noticeable market segment around 15,000 VND, dominated by Hero. Since main brands in all of these segments are included in the experiment, the actual market is well represented in the research. Furthermore, the average prices are virtually identical to the ones used as the baseline levels in the experiment. To facilitate the discussion, the considered brands are artificially categorized into two price-based segments: low-priced segment with price less than 15,000 VND (that is, very cheap and economy brands in Table *1*); and ii) high-priced segment with price equal to 15,000 VND or more (medium and premium brands in Table *1*). In other words, the low-priced brands consist of Sai Gon, Thang Long and Tourism in the North, Batos, Sai Gon and Prince in the Central, and Sai Gon, Hoa Binh and Khanh Hoi in the South while the high-priced brands comprise of Vinataba and SE555 in the North, White Horse and SE555 in the Central, and Craven A and SE555 in the South.

Important results emerge from comparing prices across cigarette brands. As expected, most of the main domestic brands are much less expensive compared to foreign brands. The only exception is Vinataba, whose price is more comparable with White Horse and Craven A, two popular foreign brands. The illicit version of SE555 is more expensive than its legal counterpart. Jet and Hero, the two dominant illicit cigarette brands, cost far more than the main domestic brands across the country in general, and in the South in particular. This is consistent with findings by A. Nguyen & Nguyen [20]. Furthermore, the price of these two illegal cigarette brands is on average more similar to that of Craven A, the most popular foreign brand in the South. This finding contradicts the claim of the tobacco industry [31] that the illicit brands belong to the same price segment as the domestic brands, and thus directly compete with the domestic brands.

Across regions, there are significant differences between the prices of cigarette brands that are not considered in this experiment. In the North, the average price of this outside group is equal to nearly VND 20,000, which exceeds the average price of a majority of the brands considered in the experiment. This is because it is dominated by high-price cigarettes made by TTCs. They however account for only a relatively small market share in the region. The outside group in the Central region is somewhat less expensive with an average price of VND 15,000. Both low- and high-price brands are available. Finally, the average price of the outside group in the South is lowest, only less than VND 10,000 as it is dominated by low-priced, domestic brands. This provides additional evidence that the domestic brands not included in the experiment do not compete directly with the illicit brands as they fall in differing price segments.

Table 3: Mean Prices and Market Shares of Experimental Brands[16]

	North				Central				South			
	Price (VND '000)		Market Share (%)		Price (VND '000)		Market Share (%)		Price (VND '000)		Market Share (%)	
Low Price												
Tourism	6.8	(0.12)	1.3	(0.01)								
Prince					7.8	(0.14)	18.3	(0.36)				
Khanh_Hoi									8.3	(0.44)	1.6	(0.01)
Batos					10.1	(0.35)	4.2	(0.04)				
Thang_Long	10.0	(0.14)	64.7	(1.58)								
Sai_Gon	10.8	(0.16)	7.8	(0.11)	10.6	(0.09)	12.2	(0.20)	10.8	(0.17)	11.7	(0.19)
Hoa_Binh									10.9	(0.12)	3.9	(0.04)
High Price												
Craven_A									18.1	(0.69)	8.6	(0.12)
Vinataba	19.9	(0.67)	11.4	(0.19)								
White_Horse					23.6	(0.33)	43.7	(1.11)				
Legal_SE555	32.4	(2.83)	2.1	(0.02)	29.0	(1.09)	1.9	(0.01)	29.8	(0.63)	3.1	(0.03)
Illicit												
Hero									16.0	(0.21)	16.6	(0.32)
Jet									19.6	(0.10)	35.6	(0.87)
Illicit_SE555	38.4	(1.28)	4.2	(0.04)	40.1	(1.94)	1.9	(0.01)	36.8	(1.18)	1.0	(0.01)
Other brands	21.9	(1.37)	8.6	(0.12)	14.9	(1.00)	18.0	(0.36)	9.7	(0.67)	17.9	(0.35)
N	385		385		378		378		385		385	

Standard errors in parentheses

[16] Unweighted results

3.3 Estimation

To analyze data collected from the choice experiment, standard Multinomial Logit (MNL) and Random Parameter Logit (RPL)[17] are considered. MNL has a closed form, and thus, easy to implement. It however relies on a relatively strong assumption of homogeneous preferences across individuals, resulting in a rather restricted structure on substitution patterns. To overcome this limitation, RPL is considered as it allows for a more flexible substitution pattern. The RPL captures unobserved individual-specific taste heterogeneity by allowing different smokers to have different price coefficients, which are randomly distributed with a parametric density function. To ensure that the price coefficient is always negative, it is assumed to follow a log-normal distribution[18]. Given its flexibility, the RPL will be the main model.

Three specifications are considered. The first uses three tax dummies, one for each proposed specific tax rate in the MNL. This approach allows for potentially non-linear effects of tax increase on smokers' indirect utility. In the second, instead of the tax dummies, cigarette prices faced by smokers are used, and it is assumed that the marginal disutility of price and tobacco tax is linear. The last specification also uses cigarette price as an explanatory variable, but with the RPL. The second and third approaches enable estimation of price elasticity of demand for each cigarette brand, and thus, explicitly allow observation of the brand-level substitution pattern, which is particularly important for the simulation of the potential impact of tax reforms on cigarette brand choice. It also makes the results more easily replicable as well as comparable with future studies in other countries. Finally, as shown later, estimation results from the first specification suggest that it is reasonable to make this linearity assumption. Therefore, the impact simulation exercises are based on these two specifications.

Recall that the market share of a brand in a given region refers to the number of smokers consuming the brand as the percentage of the total number of current smokers in the region. The price elasticity in this report is defined as the percentage change in smoker selection probabilities of a brand with respect to a one percentage change in its own price in case of own-price elasticity, and in the price of another brand in case of cross-price elasticity, holding the prices of other brands constant. In other words, it measures the percentage change in the number of smokers (or equivalently in market share defined above) when the price of a cigarette brand increases by one percent. Thus, price elasticity represents the extensive margin, rather than the intensive margin of cigarette consumption.

To study the substitution pattern, in addition to cross-price elasticity as defined above, cross-price semi-elasticity is also used. A cross-price semi-elasticity indicates the percentage change in a brand's market share with respect to a VND 1,000 increase in the price of another brand, holding the prices of other brands unchanged. Since the absolute price change is identical across the brands, this indicator is particularly appropriate to study how differently one brand is sensitive to a change in the price of different brands when their price dispersion is large as in this context.

[17] The research also considers latent class models with two latent classes and using tax dummies. See Appendix C.
[18] See Appendix B for more detail on our model specifications.

Furthermore, this is also in line with the interest in simulating the impact of specific excise tax on brand choice.

3.4 Calibration

The models estimated on the stated preference data are not directly used to calculate the price elasticity and price semi-elasticity or to simulate the tax impacts. Instead, the constants and their interaction with demographics are calibrated on the actual choice (revealed preferences) data. The calibration allows correct reproduction of the actual current market shares for the cigarette brands, which serves as the baseline for simulating the potential effects of specific tax increases. To do so, the models are re-estimated using the actual market data, constraining the price coefficients in case of the MNL and the price coefficient distribution parameters in case of the RPL equal to those obtained from the stated preferences data. The calibrated models then are used to undertake the price elasticity and price semi-elasticity computation, and the impact forecasting. As explained, the calibration is not undertaken for the models using tax dummies, which are not used to conduct impact simulation exercises.

As the calibration involves re-estimating the models on the actual data, choice sets faced by smokers in reality must be recovered. Unfortunately, for each smoker, only the price of the chosen brand is observed. The actual price of cigarette brands that s/he does not choose to consume are not observed. Thus, several assumptions have to be made. First, it is assumed that the choice set contains all of the brands considered in the experiment. Second, the price of unchosen brands can be approximated by the median brand-level price observed from other smokers in the region. Third, the price of the experimented illicit brands equals their fixed price in the experiment. Finally, all cigarette brands other than those considered in the experiment are treated as the optout.

3.5 Simulation and Aggregation

In addition to smoker behavior, the impact of a tax increase on consumption depends on strategic responses of tobacco companies. Empirical results in the United States supports both under-shifting [32,33], complete pass-through [34,35] and over-shifting [36,37], with the estimated pass-through rate varying from 80 percent to 120 percent. Across brands, some find similar estimates across price classes [33,34,36] while other show that the pass-through rate for discount brands is 10 percentage points higher than that for premium brands [32]. Among LMICs, Cevik [38] finds in Pakistan, on average, about 80 percent of the tax increase are transmitted to retail price over the period of 2004-2015. The pass-through rate however varies across price segment with complete pass-through for premium, and only about 73 percent for low-price brands. Thus, following these results, three pass-through scenarios of adding a specific component to the current excise tobacco tax are considered: i) uniform complete pass-through; ii) heterogenous pass-through with an 80 percent pass-through rate for the low-priced brands, and a 100 percent pass-through rate for the high-priced brands; and iii) uniform under-shifting with 80% of the tax hike passed through to smokers.

For illicit cigarettes, two cases are considered. First, their prices are unaffected by the tax increases as they are not taxed. This is the assumption underlying the design of the choice experiment. However, it is possible that their price may respond (likely increase) to higher prices of licit brands induced by a higher tax. Therefore, the analysis also includes scenarios that the price of the illicit brands would go up by 50 percent of the specific excise tax increase. To this end, it is implicitly assumed that smokers are equally sensitive to a change in the prices of the illicit and licit brands since the latter are held constant in the experiment. Furthermore, this implies that the analysis is predicting outside the observed price range, which may raise concern about the accuracy of prediction. Nevertheless, it produces a useful comparison as illicit trade is often cited by the tobacco industry as an obstacle to tax increases.

In both of the cases, it is assumed that while their price may change, illicit cigarette brands are widely available and equally accessible to smokers as licit brands. This appears to be a strong assumption since selling and buying these cigarettes are prohibited by law in Vietnam. However, it is hardly possible to anticipate the trend of the illicit cigarette supply since it depends to large extent on strategic responses of smugglers, the enforcement effort of the government, production costs in origin countries, as well as policy changes in neighboring countries.

With all the assumptions made above, the simulation procedure is carried out as follows: For each tax proposal and pass-through scenario, the corresponding new price of each brand in the choice sets available for the smokers is calculated. Due to the tax structure in Vietnam, an increase in the excise tobacco tax, regardless of whether through the specific or ad valorem component, will necessarily increase the base on which the VAT of 10% is levied. The price calculation takes this into account. Then, the calibrated model is used to predict the market share of each brand (including the optout) after the tax increases, and the predicted value is compared with the current market share.

Since the models are estimated at regional level, aggregation must be undertaken to derive national-level results. To do so, data on the shares of cigarette smokers by each region from GATS 2015 is used. The national change in brand-level share is the weighted sum of brand-level share in regional markets, with weights as the regional share of smokers in the national market.

4. Results

4.1 Cigarette Demand based on the Multinomial Logit with Tax Dummies

Table *4* reports the results of the tax dummies specification, using the standard MNLs. The reference group is no tax change. Columns (1), (3) and (5) present the generic tax effects. In general, all coefficients have expected, negative sign, except for the case of a VND 1,000 tax increase in the South whose coefficient is positive, though statistically insignificant. Although the estimated coefficients do not indicate the magnitude of the marginal effect of tax rates on selection probability or market share, these findings still stress the importance of higher levels of tax increases to make tax policy effective. Second, the effect of tax rate is monotonic in the North and the South but turns

out to be non-monotonic in the Central. Third, across all of the three regions, only the estimated coefficients for the VND 5,000 tax dummy consistently show a high level of statistical significance. Finally, the VND 5,000 tax increase tends to have disproportionately larger impact on the brand selection probability than the two other options. However, statistical evidence supporting this non-linearity is not strong[19], implying that it is reasonable to assume that the effect of tax increase (and of corresponding price increase) on the indirect utility is linear.

Columns (2), (4) and (6) present results from price segment-specific tax effect models in the North, Central, and South, respectively. These models allow the effect of a tax increase on brand choice to differ between low-priced and high-priced cigarette brands. The results are essentially similar to those in the one without interaction terms. Only the VND 5,000 tax increase consistently shows negative, and there is a statistically significant impact on smokers' cigarette brand selection probability in all the three regions. The sign of the coefficients for the interaction terms are mixed, and almost all of these coefficients are not statistically significant. This implies that the effect of tax increase on brand choice varies very little across price segments if any. The only exceptions are that the VND 5,000 tax increase clearly affects low-price brands more than it affects the high-price ones in the South. To this end, it is not unreasonable to treat the effect of the tax increase (and corresponding price increase) as homogeneous across cigarette brands.

[19] At 5 percent significance level, the null hypotheses that the coefficient for the VND 5,000 tax increase is five times as much as the coefficient for the VND 1,000 in all regions is not rejected. However, the following null hypothesis is rejected: the coefficient for the VND 5,000 tax increase is equal to the coefficient for the VND 2,000 multiplied by 2.5 in the Central, and the null hypothesis that the coefficient for the VND 2,000 tax increase is exactly twice as much as the coefficient for the VND 1,000 in the South.

Table 4: Results from the Multinomial Logit Model with Tax Dummies

	North		Central		South	
	(1)	(2)	(3)	(4)	(5)	(6)
Reference is no tax						
VND 1,000 specific tax	-0.031	-0.034	-0.074**	-0.055	0.003	0.017
	(0.041)	(0.066)	(0.037)	(0.047)	(0.062)	(0.082)
VND 2,000 specific tax	-0.068*	-0.044	-0.036	-0.012	-0.227***	-0.248***
	(0.038)	(0.039)	(0.046)	(0.077)	(0.060)	(0.066)
VND 5,000 specific tax	-0.293***	-0.281***	-0.374***	-0.382***	-0.457***	-0.563***
	(0.075)	(0.093)	(0.066)	(0.068)	(0.089)	(0.112)
High Price x VND 1,000 specific tax		0.011		-0.043		-0.048
		(0.116)		(0.121)		(0.122)
High Price x VND 2,000 specific tax		-0.078		-0.057		0.070
		(0.101)		(0.084)		(0.152)
High Price x VND 5,000 specific tax		-0.041		0.015		0.335**
		(0.114)		(0.111)		(0.169)
ASCs	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-4479	-4479	-4673	-4673	-5756	-5754
Number of choice tasks	3088	3088	3040	3040	3080	3080
Number of participants	386	386	380	380	385	385

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Cigarette Demand based on the Multinomial Logit Model with Cigarette Prices

Table 5 reports the result from the standard MNL. Cigarette price is interacted with the income of smokers to examine whether price sensitivity varies with income. The price coefficients are negative and highly significant as expected. The coefficients for the interaction between price and income are positive, and the ones for price and squared income are negative. Both of them are statistically significant, except for the North whether the latter is insignificant. In general, these imply that smokers with lower income are more sensitive to price, which is consistent with a previous study in Vietnam [39] as well as in many other countries [5]. However, the effect of each additional VND million of income on price sensitivity diminishes as income increases.

Table 5: Results from the Multinomial Logit Model with Cigarette Prices

	(1)	(2)	(3)
	North	Central	South
VARIABLES	Brand choice	Brand choice	Brand choice
Price	-0.102***	-0.124***	-0.149***
	(0.016)	(0.016)	(0.020)
Price x Income	0.005***	0.007***	0.009***
	(0.001)	(0.002)	(0.002)
Price x Squared Income/100	-0.001	-0.008***	-0.008***
	(0.001)	(0.003)	(0.002)
ASCs	Yes	Yes	Yes
Age x ASCs	Yes	Yes	Yes
Log likelihood	-4199	-4229	-5467
Number of choice tasks	3088	3040	3080
Number of participants	386	380	385

Notes: (1) Robust standard errors in parentheses.

(2) *** p<0.01, ** p<0.05, * p<0.1.

Table 6 reports own- and cross-price elasticities calculated from the (calibrated) MNL. Price elasticity measures the percentage change in a brand's market share with respect to one percentage increase in the price of its price (own-price elasticity) or in the price of another brand (cross-price elasticity). Note that all elasticities are not constant, but rather depend on both the price and market share of all brands. The reported estimates are those evaluated at the current market conditions.

In general, high-priced brands have higher own-price elasticities than low-priced ones. This can be explained by the combination of market structure and the property of the MNL. More specifically, the high-priced brands are more expensive by definition and typically account for small market shares. Since a priori, the own-price elasticity of a brand is positively related to its price and negatively correlated with its market share in the MNL, it is also no surprise that their

estimated elasticities based on the MNL are larger. To this end, it is hard to tell whether this result accurately reflects the actual behavior of smokers or it merely stems from the restriction imposed by the MNL. However, since this appears to differ from the ones obtained from the RPLs, which are more flexible, the latter is more likely.

Some brand-level own-price elasticities appear to be greater than one. This does not necessarily contradict to the addictive nature of smoking. Instead, it may reflect the fact that smokers are able to switch from one brand to another, and that brand-switching is more likely to take place than quitting. Finally, as expected, the assumption of homogeneous tastes among smokers implies symmetric cross-price elasticities. For example, one percentage increase in the price of Thang Long results in the same 0.412 percent increase in the demand for each and every other cigarette brand.

Finally, the brand-level own-price elasticity appears to be higher in the South than in the two other regions. This may be in part attributable to the fact that more cigarette brands are included in the choice experiment in the South than in other two regions. Previous studies have found that analyses that have involved more distinct brands tend to produce higher brand-level own-price elasticity [40].

Table 6: Estimated Price Elasticities based on the Calibrated Multinomial Logit Model

Region	Experimental Brand	Price segment	Brand-level own-price elasticities	Average own-price elasticities	Brand-level cross-price elasticities
North	Sai_Gon	Low	-0.592	-0.220	0.053
	Thang_Long	Low	-0.171		0.412
	Tourism	Low	-0.404		0.006
	Legal_SE555	High	-1.857	-1.180	0.023
	Vinataba	High	-1.057		0.118
Central	Batos	Low	-0.785	-0.647	0.039
	Sai_Gon	Low	-0.786		0.115
	Prince	Low	-0.522		0.134
	Legal_SE555	High	-2.433	-1.222	0.038
	White_Horse	High	-1.171		0.736
South	Sai_Gon	Low	-0.940	-0.945	0.134
	Hoa_Binh	Low	-1.030		0.046
	Khanh_Hoi	Low	-0.769		0.014
	Legal_SE555	High	-2.872	-2.073	0.062
	Craven_A	High	-1.782		0.157

Note: Each entry in the third last column represents the average own-price elasticity of cigarette brands within each price segment weighted by brand-level market shares.

4.3 Cigarette Demand based on the Random Coefficient Logit Model

To relax the restriction imposed in the standard MNL, the RPL is used to allow for more flexible substitution pattern. The simulated maximum likelihood method is used to estimate this model [29]. The results on the stated preferences data are presented in Table 7. All brand-specific dummies are interacted with smokers' income and age. The standard deviation of the log of the price coefficient is highly significant, suggesting the existence of heterogeneous price disutility among smokers.

Table 7: Results from the Random Parameter Logit Model

		(1)	(2)	(3)	(4)	(5)	(6)
		North		Central		South	
VARIABLES		Parameter estimates	Mean price coefficient	Parameter estimates	Mean price coefficient	Parameter estimates	Mean price coefficient
Price	*b*	-1.226	-0.486	-1.373	-0.441	-1.230	-0.565
		(0.0610)		(0.0878)		(0.110)	
	s	1.005		1.052		1.148	
		(0.0560)		(0.0772)		(0.0827)	
ASCs		Yes		Yes		Yes	
Demographics x ASCs		Yes		Yes		Yes	
Log likelihood		-3088		-3009		-4136	
Number of choice tasks		3088		3040		3080	
Number of participants		386		380		385	

Notes: (1) Robust standard errors in parentheses.

(2) *** p<0.01, ** p<0.05, * p<0.1.

Table 9 reports a matrix of semi-elasticities based on the calibrated RPL model. Each semi-elasticity represents the percentage change in the market share of the row brand with respect to a VND 1,000 increase in the price of the column brand. For example, an increase of VND 1,000 in the price of Sai Gon increases the market share of Thang Long by 2.82 percent in the North, Prince by 7.42 percent in the Central, and Hoa Binh by 15.28 percent in the South, but has a very modest effect on the market share of both licit and illicit SE 555 (by at most one percent).

Table 8 presents own-price elasticities computed from the RPL after calibration. At brand-levels, the results based on the RPL are different from those produced by the MNL in at least two ways. First, the estimates of brand-level own-price elasticity generated by the RPL are considerably higher. Indeed, the estimated own-price elasticities for some low-priced brands based on the RPL are five to ten times as much as those based on the MNL. Second, except for Thang Long in the North, low-priced cigarette brands are estimated to have higher elasticities than high-

priced ones under the RPL. Similar to the case of the MNL, however, the brand-level own-price elasticity tends to be higher in the South.

Table *9* reports a matrix of semi-elasticities based on the calibrated RPL model. Each semi-elasticity represents the percentage change in the market share of the row brand with respect to a VND 1,000 increase in the price of the column brand. For example, an increase of VND 1,000 in the price of Sai Gon increases the market share of Thang Long by 2.82 percent in the North, Prince by 7.42 percent in the Central, and Hoa Binh by 15.28 percent in the South, but has a very modest effect on the market share of both licit and illicit SE 555 (by at most one percent).[20]

Table 8: Estimated Own-Price Elasticities based on the Calibrated Random Parameter Logit Model

Region	Experimental Brand	Price segment	Brand-level own-price elasticities	Average own-price elasticities
North	Sai_Gon	Low	-3.261	-1.158
	Thang_Long	Low	-0.823	
	Tourism	Low	-4.665	
	Legal_SE555	High	-3.046	-2.428
	Vinataba	High	-2.322	
Central	Batos	Low	-2.876	-2.326
	Sai_Gon	Low	-2.810	
	Prince	Low	-1.878	
	Legal_SE555	High	-3.216	-1.165
	White_Horse	High	-1.082	
South	Sai_Gon	Low	-3.909	-4.185
	Hoa_Binh	Low	-4.871	
	Khanh_Hoi	Low	-4.459	
	Legal_SE555	High	-2.976	-3.386
	Craven_A	High	-3.519	

Note: Each entry in the second last column represents the average own-price elasticity of cigarette brands within each price segment weighted by brand-level market shares.

Comparing across columns demonstrates how the sensitivity of a row cigarette brand varies with respect to a VND 1,000 increase in the price of different column brands. Clearly, low-priced cigarette brands are most sensitive to a change in the price of other low-priced brands.[21] For example, Sai Gon, a low-priced brand, is most sensitive to a change in the price of Thang Long in the North, Prince in the Central, and Hoa Binh in the South, three other low-priced brands.

[20] As noted by Nevo, using price semi-elasticity allows for comparing the price sensitivity across columns since the absolute price change is identical in all columns aside from intra-column comparison.[47]
[21] Note that if brand A is the closest substitute to brand B, it is not necessary that brand A is also most sensitive to a change in the price of brand B. For example, the licit SE 555 is the closest substitute to Vinataba, but is most sensitive to a change in the price of Thang Long in the North.

Meanwhile, it is negligibly affected by a change in the price of the licit SE 555, a foreign brand, whose price is more than twice higher than its price. Nevertheless, low-priced brands are relatively sensitive to the price of three other high-priced brands (Vinataba, White Horse, and Craven A), which are less expensive than the SE555.

Table 9: Estimated Semi-Elasticities based on the Calibrated Random Parameter Logit Model

Region	Brand	Sai_Gon	Thang_Long	Tourism	Legal SE555	Vinataba
North	Sai_Gon	-29.696	23.726	1.497	0.228	2.305
	Thang_Long	2.816	-8.225	0.960	0.129	1.493
	Tourism	7.320	39.542	-66.664	0.037	0.627
	Legal_SE555	0.922	4.403	0.030	-9.517	2.845
	Vinataba	1.597	8.715	0.089	0.487	-11.619
	Illicit_SE555	0.545	2.648	0.016	0.668	2.123
	Optout	1.240	16.652	2.883	0.006	0.036

		Batos	Sai_Gon	Prince	Legal SE555	White_Horse
Central	Batos	-28.751	6.851	11.888	0.130	4.586
	Sai_Gon	2.363	-25.673	11.139	0.145	7.052
	Prince	2.732	7.421	-23.565	0.089	3.559
	Legal_SE555	0.314	1.017	0.937	-10.725	8.060
	White_Horse	0.449	2.001	1.515	0.327	-4.648
	Illicit_SE555	0.261	0.605	0.730	0.375	5.235
	Optout	1.099	3.001	8.933	0.003	0.331

		Sai_Gon	Hoa_Binh	Khanh_Hoi	Legal SE555	Craven_A
South	Sai_Gon	-35.601	5.254	2.649	0.089	1.764
	Hoa_Binh	15.279	-44.289	2.851	0.104	1.766
	Khanh_Hoi	18.167	6.724	-55.706	0.054	1.316
	Legal_SE555	0.360	0.145	0.032	-9.920	2.246
	Craven_A	2.334	0.804	0.254	0.731	-17.738
	Hero	6.871	2.152	0.670	0.245	2.121
	Jet	2.370	0.673	0.152	0.426	2.236
	Illicit_SE555	0.115	0.043	0.006	0.733	0.809
	Optout	4.263	1.574	1.430	0.001	0.078

Note: Each entry represents the mean of the percentage change in the market share of row brand with respect to a VND 1,000 increase in the price of column brand.

High-priced brands exhibit less consistent substitution pattern. Unlike in the low-priced segment, a high-price brand is not necessarily most sensitive to a change in the price of other high-priced brands. More specifically, the licit SE 555 is most sensitive to a change in the price of Vinataba (and Thang Long) in the North, White Horse in the Central, and Craven A in the South,

three other high-priced brands.[22] These three high-price brands, however, are most sensitive to a change in the price of low-priced brands, but much less sensitive to a change in the price of the licit SE555[23].

Comparing within a column shows how close each row cigarette brand is as a substitute to the column cigarette brand[24]. As expected, cross-price semi-elasticities are in general large for brands with comparable prices, but small for those with wide price gaps. For example, the closest substitutes to Sai Gon, a low-priced brand are other low-priced brands, including Tourism and Thang Long in the North, Prince and Batos in the Central, and Khanh Hoi and Hoa Binh in the South. Vinataba, White Horse, and Craven A, three high-priced cigarette brands are among the closest substitutes to the legal SE555, another high-priced cigarette brand, which in turn is one of the closest substitutes to them.

For the illicit products, within columns, Jet and Hero are the closest substitutes to Craven A in the South. The illicit SE 555 is the closest substitute to its licit counterpart and almost unaffected by a change in the price of lower priced brands. Across columns, Hero is most sensitive to a change in the price of Sai Gon while Jet is most sensitive to a change in the price of Craven A. The illicit SE555 is most sensitive to a change in the price of Thang Long and Vinataba in the North, of White Horse in the Central, and of Craven A in the South.

The optout is one of the closest substitutes to low-priced brands, and also most sensitive to a change in their prices. The number of smokers who switch from each of the studied cigarette brands (accounting for over 80% of total market share) to the optout is computed as a percentage of the total number of smokers who substitute away from that brand in response to a VND 1,000 increase in its price, keeping the prices of other brands unchanged. The results are reported in Table *10*. For example, for every 100 smokers who substitute away from Thang Long in response to a VND 1,000 increase in its price, roughly over 32 of them optout (i.e., not buy any of the studied cigarette brands). In general, the substitution pattern is heterogeneous across brands, with the computed percentage ranging from 0.11 percent to 41.15 percent. However, faced with price increases, the smokers of the lower priced cigarette brands are more likely to choose none of the studied brands (i.e., switch to the optout), suggesting that they are also more likely to intend to quit smoking[25].

Table 10: Substitution to the Optout based on the Calibrated Random Parameter Logit Model

Region	Brand	Proportion (%)
North	Vinataba	0.29
	Legal_SE555	0.35

[22] The licit SE 555 are most sensitive to Thang Long perhaps because of the dominant market share accounted by the latter in the North.
[23] The similar result also holds when using price elasticity as the measure.
[24] It is however important to note that the large gaps in term of market shares may make within-column comparison inappropriate. For example, one percentage change in Thang Long's market share can be ten times as much as one percentage change in SE555's market share.
[25] Sai Gon in the North seems to be the only exception in which less than 6.00 percent of smokers who exhibit brand-switching stay with the optout when its price rises. This percentage is substantially lower than those of Sai Gon itself in the Central and the South, as well as of other brands with comparable prices. This anomaly may reflect region-specific taste of smokers in the North. Indeed, a majority of smokers who substitute away from Sai Gon choose to smoke Thang Long.

	Sai_Gon	5.66
	Tourism	28.65
	Thang_Long	32.56
Central	Legal_SE555	0.35
	White_Horse	3.29
	Batos	18.06
	Sai_Gon	19.05
	Prince	41.15
South	Legal_SE555	0.11
	Craven_A	1.16
	Hoa_Binh	20.62
	Sai_Gon	23.90
	Khanh_Hoi	35.13

Note: Given a price increase of a row brand, each entry gives the number of smokers who switch to the optout as a percentage of all smokers substitute away from the row brand.

4.4 Simulated Impacts of Tax Increases on Market Share

Four scenarios are considered: As a benchmark, the tax is completely passed through to consumer price while the price of the illicit cigarettes is not affected in the first scenario. In the second, the pass-through rate is also 100 percent, but the price of the illicit cigarettes increases by 50 percent of the tax increase. In the third, the taxes are under-shifted with a pass-through rate of 80 percent for the low-priced brands, and completely passed through for the high-priced brands, keeping the price of the illicit cigarettes unchanged. In the fourth, the taxes are under-shifted with a pass-through rate of 80 percent for both the low- and high-priced brands while the price of the illicit cigarettes increases by 50 percent of the specific tax rates

Table *11* reports the simulated impacts based on the MNLs. Each number indicates a change (in percentage points) in market share for a corresponding cigarette brand segment, and one percentage point amounts to one percent of total number of current smokers. Consistent with the discrete choice framework, legal brands, which are subject to the tax are estimated to experience a decrease in their market share. The change however varies across price segments with low-priced brands being more affected than high-priced brands. For example, under the complete pass-through assumption (Scenario 1), the MNL model predicts that adding a VND 5,000 specific tax to the current tax scheme would lead to a decrease of 4.81 percentage points in the low-priced brands market share, compared to only 2.68 percentage points in high-priced brands market share. In other words, 4.81 percent and 2.68 percent of current smokers would no longer smoke low-priced, and high-priced cigarette brands, respectively. In response to higher tax, among smokers, who would not stay with legal cigarettes, some may switch to illicit cigarettes while some other may not choose any of other included brands either. As a result, the share accounted for by illicit cigarettes and the optout increases. In the above scenario, for instance, the illicit brands market

share would increase by 2.97 percentage points while about 4.51 percent of current smokers choose to optout.

The impact of the tax increase on illicit consumption is particularly sensitive to the assumed changes in their prices. For example, should their price increases by 50 percent of the VND 5,000 specific tax (Scenario 2), their market share increases by only 0.44 percentage points, which amounts to only one sixth of the increase in the Scenario 1. Meanwhile, as illicit cigarettes become more expensive, more smokers would opt out, implying that more smokers might intend to quit smoking.

In the third scenario where the pass-through rate is assumed to be heterogeneous across brands, the results change slightly, compared to those in the Scenario 1. The low-priced brands are less impacted due to their lower after-tax prices. The high-priced brands lose more, but the additional decrease in their market share is less than the amount saved for the low-priced brands, thereby resulting in a smaller total decrease in the market share of the taxed brands. The improvement in the market shares of the illicit brands and optout are slightly smaller.

When the excise taxes are under-shifted and the prices of illicit cigarettes rise, it is possible for the illicit trade to actually contract as exemplified in the Scenario 4. The VND 5,000 specific tax could result in an about 0.1 percentage point fall in their market share. Compared to the Scenario 2, the legal brands, both low- and high-priced, exhibit smaller reduction in their market share while the market share gain accruing to the optout also decreases. These results highlight the complicated nature of brand-switching behavior and their influences on the impact of tobacco tax policies on brand choice, which must be taken into consideration when evaluating any tax reform.

Table 11: Simulated Impacts based on the Calibrated Multinomial Logit Model

Scenario	Price segment	1,000 VND specific tax	2,000 VND specific tax	5,000 VND specific tax
1	Low	-0.99	-1.96	-4.81
	High	-0.55	-1.09	-2.68
	Illicit SE555	0.05	0.10	0.27
	Jet and Hero	0.61	1.18	2.70
	Optout	0.87	1.76	4.51
2	Low	-0.80	-1.60	-4.05
	High	-0.45	-0.90	-2.27
	Illicit SE555	0.02	0.04	0.10
	Jet and Hero	0.13	0.23	0.34
	Optout	1.09	2.23	5.89
3	Low	-0.68	-1.36	-3.43
	High	-0.66	-1.30	-3.11
	Illicit SE555	0.04	0.08	0.22

	Jet and Hero	0.53	1.04	2.40
	Optout	0.76	1.53	3.91
4	Low	-0.60	-1.20	-3.07
	High	-0.33	-0.68	-1.72
	Illicit SE555	0.01	0.02	0.05
	Jet and Hero	0.01	0.00	-0.14
	Optout	0.91	1.86	4.89

Note: Jet and Hero are exclusively concentrated in the South. Each number indicates a change (in percentage points) in market share in the country. One percentage point represents one percent of total number of current smokers.

Next, simulation results based on the RPL, the main model, are considered (

Table 12). Overall, the prediction made by the RPL model is similar to that by the MNL in terms of the high-priced segment, whose market share declines by 1.3-4.0 percentage points in response to a VND 5,000 excise tax increase. Nevertheless, changes in market share corresponding to the low-priced brands, the two most popular illicit brands, and the optout are significantly larger in terms of magnitude. For example, under the first scenario, adding a VND 5,000 excise tax would result in a 11.9 percentage point decrease in the low-priced brands' total market share, a 7.9 percentage point increase in the optout, and an over 7.0 percentage point increase in the illicit brands. These figures are about three times as those predicted by the MNL.

As in the MNL, the impact of the tax increase on the illicit consumption is particularly sensitive to the assumption of their prices. For example, should their prices increase by 50 percent of the VND 5,000 specific tax (Scenario 2), then their market share would increase by 3.65 percentage points, over 50 percent less than in Scenario 1.

In the third scenario where the pass-through rate is assumed to be heterogeneous across brands, compared to those in the Scenario 1, it also holds that the low-priced brands are less impacted due to their lower after-tax prices while the high-priced brands lose more. In the fourth scenario, although the market share of the illicit cigarettes does not decrease as predicted by the MNL, the extent to which it increases is smaller than in the second scenario. Similar to the MNL, the legal brands' market share reduction is smaller in the fourth scenario than those in the second one.

Table 12: Simulated Impacts based on the Calibrated Random Parameter Logit Model

Scenario	Price segment	1,000 VND specific tax	2,000 VND specific tax	5,000 VND specific tax
1	Low	-3.31	-6.10	-11.90
	High	-0.69	-1.35	-3.03
	Illicit SE555	0.12	0.25	0.72
	Jet and Hero	1.82	3.43	6.35
	Optout	2.06	3.78	7.86

2	Low	-2.75	-5.14	-10.80
	High	-0.40	-0.80	-1.99
	Illicit SE555	0.06	0.13	0.35
	Jet and Hero	0.92	1.73	3.30
	Optout	2.17	4.09	9.15
3	Low	-2.48	-4.68	-9.49
	High	-0.89	-1.72	-3.79
	Illicit SE555	0.11	0.22	0.64
	Jet and Hero	1.58	3.03	5.98
	Optout	1.69	3.15	6.66
4	Low	-2.11	-4.01	-8.78
	High	-0.26	-0.52	-1.34
	Illicit SE555	0.04	0.08	0.21
	Jet and Hero	0.56	1.07	2.18
	Optout	1.77	3.39	7.73

Note: Jet and Hero are exclusively concentrated in the South. Each number indicates a change (in percentage points) in market share in the country. One percentage point represents one percent of total number of current smokers.

5. Discussion and Limitations

This study investigates the effect of cigarette price on cigarette brand-switching behavior of smokers and quantifies the potential impact of different specific excise tax rates on brand choice in Vietnam. The results show that most of low-priced cigarette brands are estimated to have higher elasticities than high-priced brands. Furthermore, substitution effects are more prominent within low-priced brands, than within high-priced brands and between the two brand segments. Since the low-priced segment consists of only domestic brands while most of brands in the high-priced class are foreign brands, this implies that smokers of cheaper, domestic brands are generally more price sensitive than smokers of more expensive, foreign brands. Additionally, demand for domestic cigarette brands is more responsive to a change in the price of other domestic brands than a change in the price of foreign brands.

The substitution pattern can be attributed to the fact that price and brand are relatively more homogeneous in the (low-priced) domestic segment so that it is easier for smokers to switch from one brand to another when the price of the former increases. In contrast, the (high-priced) foreign brands exhibit a larger extent of heterogeneity in the real market. Additionally, the average price of high-priced brands is about twice as much as that of low-priced brands. This significant price gap implies a non-price distinction between them. Both price and non-price differences together impede substitution across the brand segments.

Smokers of the domestic brands are more likely to not buy any of the studied brands (accounting for over 80% of total market share) when cigarette prices increase. One of the main reasons why smokers choose to smoke the domestic brands has to do with their limited budgets.

When cigarette prices increase, smokers of the more expensive, foreign brands can trade down to the more affordable, domestic brands to maintain their consumption and mitigate rising smoking expenses. Smokers of domestic brands however cannot do this. With tighter budget constraints, many of them therefore may not be able to afford higher cigarette expenditures, and consequently have no choice but to opt for other more affordable tobacco products (particularly, bamboo waterpipe tobacco and hand-rolled cigarettes) [15] or strive to quit smoking.

Jet and Hero, the two most popular illicit brands, which are exclusively concentrated in the South are particularly sensitive to a change in the price of Sai Gon (a domestic brand) and Craven A (a foreign brand), which are the two most popular legal brands in the region. In other words, not only smokers of the domestic brands, but also those of the foreign brands may switch to illicit cigarettes-One possible explanation is that the price of Craven A is comparable to the price of these two illicit brands on average. Therefore, once Craven A becomes more expensive, its smokers are more likely to substitute it with these two illicit brands than smokers of other legal brands. In addition, Vietnamese consumers usually perceive imported products to be superior and associated with a higher social status than those produced domestically, and the same perception can also be applied to buying illicit cigarettes. This can in part explain why the illicit cigarettes are widely used in the region even though they are much more expensive than most of the legal brands in the first place. Once the price gap between the legal brands and smuggled brands is reduced, some smokers may find it compelling to switch from the former to the latter. In any case, these three highlight the importance of making the sale and purchase of illicit brands more costly.

The numerical simulation indicates that imposing a specific tax reduces the market share for both low-and high-priced cigarette brands. Furthermore, the estimated market share reduction is larger for low-priced brands than for high-priced brands. This is consistent with findings by Sobel & Garret [41] in the U.S. and by Liu et al. [18] in China. The main reason is that the introduction of a uniform specific tax results in a higher percentage change in price for low-priced cigarette brands than for high-priced cigarette brands. Furthermore, in the main model, smokers of low-priced cigarette brands are more price sensitive than smokers of high-priced cigarette brands. Therefore, the market share for low-priced brands will be more impacted. As suggested by the brand substitution pattern, it is important to note that the reduction in low-priced brands market share can be attributed to large extent to smokers switching to the optout (i.e., choosing not to smoke any cigarette brands studied).

These findings have several implications. First, raising the specific tax imposed on tobacco would not only improve the public health of the country as a whole, but also contribute to making tobacco tax policy more progressive. Although the introduction of the specific tax component is estimated to reduce the market share of domestic brands significantly more than that of the foreign brands, a large share of smokers substituting away from domestic, low-priced brands refused to purchase any of the studied cigarette brands, suggesting that they are more likely to quit smoking than smokers of high-priced brands. Since smokers of low-priced brands are typically low-income

earners, this implies that low-income smokers are more likely to quit smoking than the high-income smokers. Thus, introducing a specific tax tends to benefit the poor more than the rich.

The impact of the specific excise tax on brand choice varies with different pass-through scenarios. The low-priced cigarette brands are more affected under the uniform complete pass through than under the heterogeneous pass-through while the opposite is true for the high-priced cigarette brands. This is because the pass-through rate will determine the extent to which the retail price faced by smokers will change as a consequence of a tax increase, and it is the retail price that influences the choice made by smokers. Therefore, this stresses the importance of understanding the structure of the cigarette market and monitoring the tobacco industry's strategic responses, including tax pass-through rate when designing, implementing, and evaluating the tax reform. In the case of observing low pass-through rates, it is important for the government to raise the tax even higher to ensure that the resultant increase in retail price is adequate to incentivise smokers to stop smoking. Furthermore, the pass-through rate is found to be higher in the case of specific taxes than in ad valorem taxes, making the former more effective in reducing cigarette consumption [42].

As discussed above, some smokers of legal brands may switch to the two illicit brands in the South (Jet and Hero) as one way to mitigate the impact of higher tax on their smoking expenses. However, as the price of the illicit cigarettes rises, an increasing number of smokers, who could previously afford illicit cigarettes would no longer do so. Consequently, the gain of illicit cigarettes in market share decreases. The VND 5,000 excise tax rate, for example, may cause their market share to rise over six percentage points, given that their prices remain unchanged ex post. However, should their prices increase by about 50 percent of the tax rate, then the improvement in their market share is estimated at only over three percentage points. Furthermore, because those who find them unaffordable may choose either to purchase more affordable licit cigarettes or even none of the studied cigarette brands, the decline of the legal cigarettes market share is less, and more smokers choose the optout.

There are at least three reasons that prices of illicit cigarettes may increase. First, higher illicit prices are simply a consequence of strategic, profit-maximizing response from smugglers and retailers. Once prices of legal cigarettes increase due to higher excise tax, they may find it more profitable to raise prices of smuggled products even though this would mean that their market shares would be lower than if their prices remain unchanged. Second, the Government's effective measures against smuggling can inflate the cost and risk of sourcing and distributing illicit cigarettes in the domestic market, and consequently lead to their higher prices. Indeed, between 2016 and 2017, there was intensive market surveillance and border control led by national and provincial 389 Steering Committees, government agencies specializing in fighting against smuggling. Numerous cases of illegal trading of cigarette brands were successfully uncovered and stopped. This may have contributed to the rising price of the illicit brands, even at higher rate than that of the legal brands [20]. Finally, production and trading costs, which incur before the illicit cigarettes reach the Vietnamese border can rise.

This research is subject to several limitations. First, the experiment design assumes that illicit brands are easily accessible to smokers and their prices are unchanged. As discussed above, in reality, both their price and availability depend on a number of factors, including strategic response of illicit traders, the efforts expended by the Government of Vietnam to combat against smuggling in the South, and policy changes in neighboring countries. While scenarios in which the price of the illicit brands would rise by 50 percent of the specific excise tax rate are included in the impact simulation, they rest on the assumption that smokers' price sensitivity does not vary between the illicit and licit brands. Furthermore, this implies that the analysis is predicting outside the observed price range, which may raise concern about the accuracy of prediction. Allowing the illicit cigarettes' prices to vary can be an important extension for future research.

Second, some brands have multiple varieties, whose prices, packaging and intensity may be different. Since all varieties under each brand are treated as a homogenous product, this approach does not capture within-brand substitution effect, which may well be possible.[26] Future study however could take this issue into account by including in the experiment design other product attributes, which may affect brand choice of the smokers. However, it is important to also note that the inclusion of additional product attributes will necessarily increase the design complication, particularly the number of choice sets to be completed by each respondent and/or the sample size.

Third, while the model allows for tax pass-through heterogeneity across differentiated cigarette brands, the pass-through is passive in the sense that the pass-through rates are imposed exogenously, rather than determined by the actual market supply-demand conditions. It would be interesting to learn how firms would react to a tax increase from market supply and demand condition. To accomplish this, a supply model must be specified, and firms' cost function must be estimated. This would be a fruitful venue for future research.

Forth, the probability of quitting is not explicitly considered in the model. An optout option "None of these" is included only to provide some suggestive evidence of quitting. Apart from smoking cessation, smokers may choose not to buy any of the considered brands because, for example, they may delay their purchases or choose to switch to other more affordable tobacco products other than cigarettes. Incorporating the addictive nature of smoking and quitting behavior into the discrete choice framework may be an interesting extension in the future research.

Finally, one popular concern about analysis based on choice experiment is hypothetical bias, which may arise when participants lack market experience with hypothetical alternatives provided in the experiment. Morwitz, Steckel, & Gupta [43] shows that familiarity with products can help increase the accuracy of the stated choices as the prediction of the actual purchases. While almost all smokers participating in this survey have consumed at least one of the considered brands at least once, only about a half of them reported to have used all of the considered brands in the North

[26] Particularly, when the price effects vary with some unobserved variety-specific characteristics

and Central (i.e., six brands), and a quarter in the South (i.e., eight brands). Therefore, the hypothetical bias may not be eliminated entirely.

6. Conclusion and Policy Recommendations

Smoking is one of the most alarming public health issues in Vietnam. The Government of Vietnam has been undertaking a wide range of tobacco control policies to fight against the epidemic. In particularly, since 2014, initiatives to increase the tobacco excise tax have been carried out. This is marked by the increase of ad valorem rate on ex-factory price to 70 percent in 2016 from 65 percent, the level that was set in 2008, and recently to 75 percent in 2019. Despite these progressive movement, cigarettes remain widely affordable.

In attempt to make cigarette less affordable, the Government of Vietnam is proposing to substitute its purely ad valorem excise tax with a mixed system by adding a specific excise component. However, there is concern that adding the specific tax component may encourage smokers to switch consumption away from cheaper, domestic brands to more expensive, foreign brands and to illicit cigarettes. This then might adversely impact the domestic industry without reducing cigarette consumption. This study aims to address this concern, and thus provide locally relevant evidence to inform ongoing policy discussion in the country.

The study uses the state-of-art combination of choice experiment data and real market data to study the brand-switching behavior of smokers in response to a price increase, and estimate the potential impact of different tobacco tax reform proposals under consideration on brand-level market share. The choice experiment allows exogenous variation of the price of cigarette brands, and through using the random coefficient logit model, estimation of the differentiated cigarette demand and observation of the substitution pattern, which is essential to forecast the impact of a tax increase. Data on brand choice actually made by smokers in the real market enables calibration and accurate reproduction of current brand composition, as well as numerical simulation of the impact of adding a specific component to the current tobacco excise tax on brand choice in Vietnam.

The results show that smokers of low-priced, domestic brands are generally more price sensitive than smokers of high-priced, foreign brands. In addition, brand substitution is more prominent within the domestic brands than within the foreign brands or between the two segments. When cigarette prices increase, smokers of the domestic brands are more likely to not buy any of the studied cigarette brands than smokers of the foreign brands. This suggests that the domestic brand smokers seem more likely to quit smoking. Jet and Hero, the two most popular illicit brands, which are exclusively concentrated in the South, are particularly sensitive to a change in the price of the two most popular legal brands (one domestic brand and one foreign brand) in the region.

The impact of a tax increase on brand-level market share varies across cigarette price segments. A uniform increase in specific excise tax reduces the market share of both (low-priced) domestic brands and (high-priced) foreign brands with the estimated market share reduction being

larger for domestic brands than for foreign brands. A large share of smokers substituting away from domestic brands refused to purchase any of the studied cigarette brands (accounting for over 80% of total market share), rather than up-trade to the foreign brands or to illicit brands. Meanwhile, in response to the tax increase, some (but not all) smokers of the domestic and foreign brands may switch to the illicit brands, mainly Jet and Hero in the South, resulting in a higher market share of illicit cigarettes. Yet, this market share gain is relatively sensitive to how the prices of the illicit cigarettes respond to the tax increase. The more their prices rise, the smaller the gain is. Finally, the effect of the tax increase also depends on the extent to which the tax is shifted by the tobacco industry to smokers.

The results have two policy implications. First, the Government of Vietnam should switch from a purely ad valorem tobacco excise tax scheme to a mixed system by imposing a specific excise tax on tobacco products, including cigarettes. Less reliance on the ad valorem component and more on the specific component can raise average cigarette price, reduce price variability, and thus leave less room for possible strategic brand-switching. Although cheap, domestic brands can be more affected, the specific excise tax can make tobacco taxation more progressive. Since the smokers of low-priced brands are typically low-income earners and more likely to quit smoking than the smokers of high-priced brands in response to a given price increase, adding a specific component is likely to benefit the poor more than the rich.

Second, the Government of Vietnam should maintain and strengthen intensive and effective market surveillance and border control led by national and provincial 389 Steering Committees to fight against smuggling. By raising the cost of sourcing, distributing and purchasing illicit cigarettes in the South and economic centers, these activities will help raise their prices as they seem to have done since 2016. The rising prices not only encourage current smokers of illicit cigarettes to quit, but also obstruct substitution from licit to illicit cigarettes. Market monitoring also helps understand the extent to which the tax increase is passed through to retail prices, which determines the impact of the tax increases.

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Appendix A. Choice Experiment Design and Implementation

A1. Statistical Design

For the statistical design of the experiment, we adopt the process in [28] and [30]. First, in each region, the four-level price attribute is combined with the five legal brands to obtain a total of five four-level factors[27] **(Table 2).** The resultant full factorial design has $4^5 = 1{,}024$ possible choice situations, which are impractically large to undertake. Thus, we opt for the smallest main-effects only orthogonal fractional factorial design, which comprises of only 16 choice sets. The SPSS software then is used to generate these choice sets **(Table 3)**.

Each choice set (that is, each row in **Table 3**) is equivalent to one question that each respondent has to answer. It is burdensome for each respondent to make decision for all the 16 questions. Thus, the design is randomly partitioned into smaller, mutually exclusive blocks. Each respondent is required to answer only questions in one block which is randomly assigned to him or her. Theoretically speaking, the design can be divided into two, four or eight blocks, each of which contains eight, four or two questions, respectively. However, there is trade-off between statistical efficiency and response efficiency when determining the number of blocks. With a given sample size, the larger number of blocks (implying the smaller number of choice sets in each block) increase the latter at the cost of the former. As explained later, given our sample size, pre-testing results suggest that the two-block specification is optimal. In other words, in our design, the fractional factorial design is further split into two blocks, each of which has eight choice sets so that each respondent has to answer eight questions.[28]

Table 13 Set of Factors Obtained by Combining Brands with the Price Attribute (Design Matrix)

Factor	Brands	Attribute	Level
NORTH			
x1	Thang Long	Price	1, 2, 3, 4
x2	Du Lich	Price	1, 2, 3, 4
x3	VINATABA	Price	1, 2, 3, 4
x4	Sai Gon	Price	1, 2, 3, 4
x5	SE 555	Price	1, 2, 3, 4
x6	Illicit SE 555	Price	1
CENTRAL			
x1	White Horse	Price	1, 2, 3, 4
x2	Bastos	Price	1, 2, 3, 4
x3	Prince	Price	1, 2, 3, 4
x4	Sai Gon	Price	1, 2, 3, 4
x5	SE 555	Price	1, 2, 3, 4
x6	Illicit SE 555	Price	1
SOUTH			

[27] Each illicit brand has only one price level, and thus, does not affect our experiment design.
[28] There are several different ways to block the 16 choice sets, including one single block case. We varied the number of choice sets assigned to smokers when pre-testing the experiment, and found that eight is the most appropriate.

Factor	Brands	Attribute	Level
x1	Sai Gon	Price	1, 2, 3, 4
x2	Craven A	Price	1, 2, 3, 4
x3	Hoa Binh	Price	1, 2, 3, 4
x4	SE 555	Price	1, 2, 3, 4
x5	Khanh Hoi	Price	1, 2, 3, 4
x6	Jet	Price	1
x7	Hero	Price	1
x8	Illicit SE 555	Price	1

Table 14 Statistical Design of the Experiment

Choice set	x1	x2	x3	x4	x5
1	1	2	2	3	4
2	4	3	2	2	1
3	2	4	3	3	1
4	3	3	1	3	3
5	4	2	3	1	3
6	2	2	1	2	2
7	2	1	2	4	3
8	4	1	4	3	2
9	3	4	2	1	2
10	3	2	4	4	1
11	1	1	1	1	1
12	4	4	1	4	4
13	2	3	4	1	4
14	3	1	3	2	4
15	1	4	4	2	3
16	1	3	3	4	2

A2. Instrument Design

Once the (statistical) experiment design is determined, experiment instruments are created to translate the design in **Table 3** into conceivable choice situations so that smokers can evaluate available alternatives and make choice[29]. In general, the instrument comprises two main components. First is the general description of a hypothetical situation on which all smokers are asked to condition their brand consideration. Second is a set of scenarios which visually illustrate the choice sets (i.e. rows) in the statistical design. [30]

One common concern with the analyses based on the stated preferences is hypothetical bias (Harrison, 2014). Hypothetical bias refers to situations in which the willingness-to-pay that a

[29] see [48] for best practices
[30] The description of the hypothetical context, and an example of the choice task from the questionnaire are provided in Appendix

respondent states in hypothetical choice scenarios does not match (typically exceeds) what they would actually pay if those scenarios faced them in reality. The bias may arise simply due to the respondent's lack of real market experience (Hausman, 2012). This hypothetical bias raises concern about the accuracy and reliability of market prediction based on results from choice experiments and other stated preference methods. However, previous studies show that the familiarity with the products can help increase the accuracy of the stated choices as the prediction of the actual purchases (Morwitz, Steckel, & Gupta, 2007). We also use color-printed showcards to present choice tasks to smokers to make the choice more realistic and thus mitigate the potential hypothetical bias.

More precisely, the general description provides smokers with a brief explanation of the experiment's purpose, the hypothetical choice-making context, and what they are expected to do. In particular, it specifically instructs them to imagine that only the experimented brands are sold, and there is no cigarette brand other than them available in the market. It also indicates the number of scenarios that they are expected to respond, as well as emphasize the variation of cigarette prices across those scenarios. Then, smokers are asked which brand they would be most likely to buy in each hypothetical scenario, given their current incomes.[31] It also stresses that they are free to choose not to buy any of the available cigarette brands by selecting the optout option. To mitigate potential hypothetical bias, a short cheap talk is included to encourage them to make choice as if they would have to pay for what they chose. Finally, to minimize human errors, the description is refined carefully to be as much concise, but self-explained as possible.

Both text and pictures are used to visualize the choice sets and make them more realistic, thereby minimizing hypothetical bias and maximizing response efficiency. Particularly, to represent a cigarette brand, we use the picture of the front cover of its pack. Two important characteristics however must be taken into account. First, some brands have multiple varieties with slightly different packaging. Second, every legally traded cigarette pack is mandated to possess a health warning label, which consists of a warning message in Vietnamese and a warning image. Currently, there are six different, valid sets of the label, and a cigarette pack is allowed to have any of them. To prevent the packaging and health warning label from confounding the effect of the price, we select the most popular product of each brand, and assign the most commonly found label to all the licit brands.[32] It is also important to note that all illicit products have either only English text warning message or no health warning at all as widely observed in the market. In addition to the pack picture, the price of each alternative is highlighted in red to ensure that smokers are well-informed of it. Finally, the positions of the cigarette brands are randomized across choice sets to avoid order bias.

[31] This question is constantly repeated in each choice set

[32] To identify the most popular varieties and health warning label, we conducted brief interviews with a selection of cigarette wholesalers and retailers

A3. Pretest

The experiment is implemented as a part of a household survey. Before officially launching the survey in field, we consecutively conduct multiple rounds of pilot interviews with a selection of smokers to test how well our experimental design, questionnaire and other instruments work in reality. Particularly, the piloting helps us determine whether: i) the set of brands included is sufficiently representative; ii) the number of choice sets assigned to each respondent is reasonable; iii) the general experiment description is clear to smokers; iv) the graphic design of the choice sets is intuitive and easy to navigate, and thus captures smokers' attention; and v) the length of the interviews is reasonable. Feedback from each round is used to revise the experiment instruments, and the revised version is tested in next round until all avoidable issues identified are resolved and no additional one arises.

Overall, three main results are obtained from the pre-test. First, their length is fairly reasonable. Each interview lasts for approximately 30 minutes. It takes a typical smoker about 40 seconds to make decision in each choice question. The younger the smokers, the less time is needed. Second, the general design of the experiment is realistic and comprehensible. The respondents understood the hypothetical choice context and requirement. The brands that they are currently smoking the most are among six brands included in the DCE. The show-cards work quite well in illustrating the brands and facilitating the decision-making process. Finally, eight choice sets for each smoker are the most appropriate although additional effort is necessary to fully have their attention in the very last choice questions. We observed that all of the smokers carefully evaluate alternatives in the very first choice sets before selecting. Some however start to show somewhat bored of answering choice tasks when reaching the 6^{th} or 7^{th} question, and ultimately lose most of their attention on the choice sets from the 10^{th} questions onward.

A4. Training Enumerators and Manual Design

In each region, we provided three days of training, including one day in the field. In general, our training follows the standard format of a training for a household survey, since the discrete choice experiment is relatively similar to a traditional survey. Nevertheless, the discrete choice experiment is completely new to all enumerators, even though they do have experience with household surveys. Thus, we thoroughly explain our experiment's purpose, conceptual framework and requirement, as well as compare it with a traditional household survey (i.e. the rest of this survey) to highlight its hypothetical nature. The experiment instruments are introduced, and a step-by-step procedure to implement the experiment is illustrated, including how the showcards should be handled. Hypothetical bias concern, potential sources and mitigation measures, as well as all of the issues arisen in the pre-test and their corresponding solutions are also discussed extensively. In addition to role plays and mocking interviews in the class, the enumerators are sent to the field to practice conducting actual experiments and interviews with randomly selected smokers. Our selection of the enumerators is based on their overall participation and performance both during the in-class training and during the field practice.

Apart from the face-to-face training, we also provide the enumerators with a manual which documents the key contents of the training and can be used as a reference in the field. In particular, the manual summarizes key, general principles that the enumerators have to follow when conducting interviews with smokers. It also demonstrates the step-by-step procedure of the experiment implementation as well as highlight key anticipated issues that must be taken with particular care and their corresponding solutions.

A5. Implementation

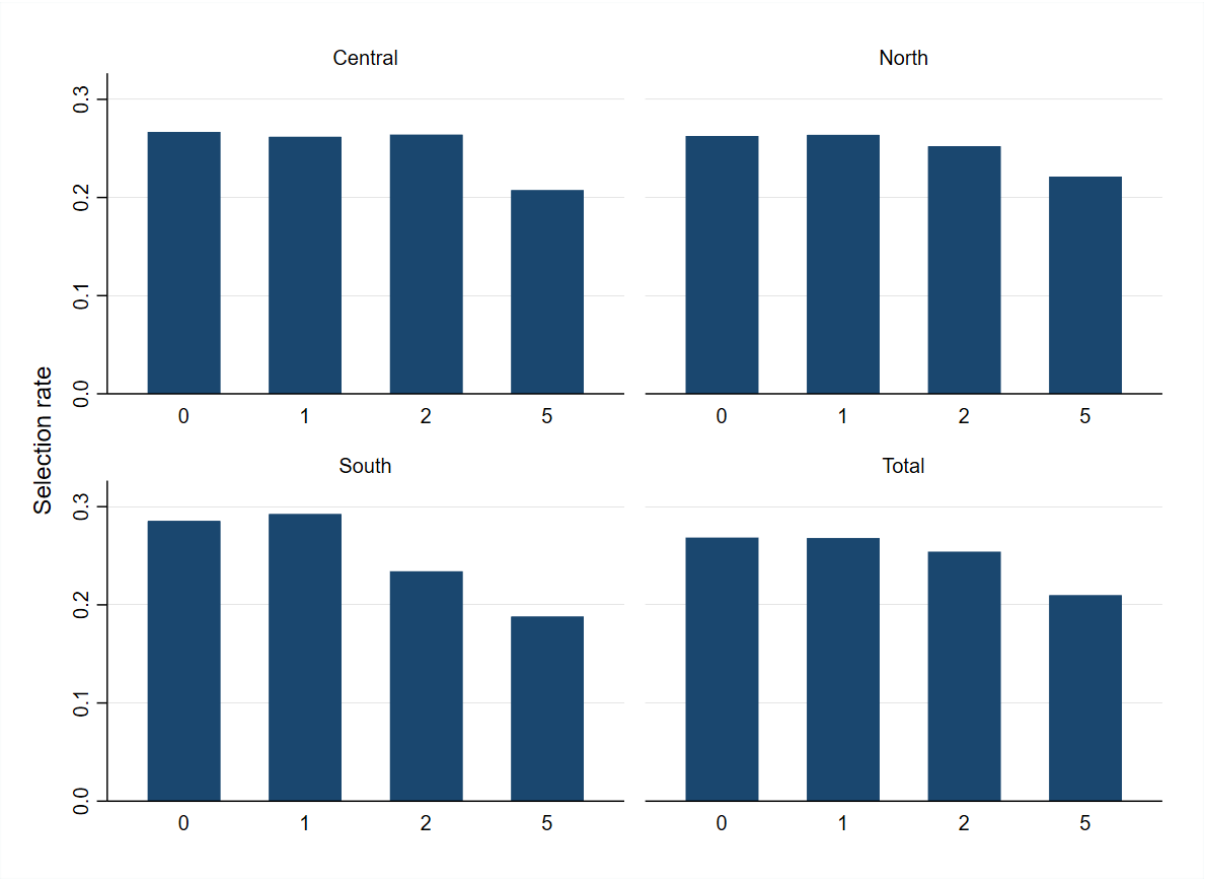
The experiment is implemented as a part of a face-to-face household survey in August – September 2019 by the Development and Policies Research Central (DEPOCEN). Its experiment instruments are arranged at the very beginning of the questionnaire, only after a few questions about current consumption. The interviews are assisted by tablets. Using the tablets has many advantages over the traditional paper-based method, and has become our standard survey method. In particular, it allows us to automatically perform the random assignment of the two blocks to respondents in the experiment.

The experiment is conducted as follow. First, enumerators describe the experiment's purpose, the hypothetical context, and other information as provided in the general description. Then, enumerators consecutively present showcards to smokers, ask which brand they would choose, and record their answers. During this process, the enumerators constantly remind respondents of the price variation across the choice sets as well as the importance of taking their time to consider alternatives carefully, and making the choice as if they have to pay for it even though they do not actually have to pay for their chosen brands.

A6. Selection Percentage by Tax Rates

Figure *3* presents the selection rate of different tax levels in choice sets where smokers did not choose either the fixed price illicit brands or the optout. In general, as the tax rate increases, the probability of choosing a cigarette brand increases. Nevertheless, the change in selection rate appears to be modest at the lowest tax rate of VND 1,000. This pattern suggests that tax increase must be sufficiently high to be effective in reducing cigarette smoking rate.

Figure 3 Selection Rate of Different Tax Levels in the Choice Experiment



Note: These figures are restricted to choice sets where smokers did not choose the (fixed price) illicit cigarettes and optout

Appendix B. Econometric Model Specification

B1. Model Specification

In general, discrete choice models assume that the indirect utility function for smoker n choosing cigarette brand j in choice set t is linear and given by:

$$V_{njt} = X_{njt}\beta_n + \varepsilon_{njt}$$

where X_{njt} is a K-dimensional vector of cigarette product characteristics of brand j in choice set t, and ε_{njt} is an unobserved error term, which is independently and identically distributed extreme value. Finally, β_n is a K-dimension vector of individual-specific coefficients with the distribution density function $f(\beta_n)$.

The smoker is assumed to purchase the brand that gives him or her the highest indirect utility.[33] With the utility of the optout option being normalized to zero, the selection probability (or market share) of brand j can be written as:

[33] About 30 percent of respondents reported to smoke more than one cigarette brand at least once a week during the past month. By this assumption, we consider only their primary cigarette brand. As noted by (Nevo, 2001), it can be viewed as an approximation to the true choice model.

$$s_{njt} = \int \frac{\exp(X_{njt}\beta_n)}{1 + \sum_{k=1}^{J_t} \exp(X_{nkt}\beta_n)} f(\beta_n) d\beta_n$$

B2. Tax Dummies

Specifically, in the first type of specifications, we consider three models: i) MNL with generic tax effect; ii) MNL with price segment-specific tax effect; and iii) LCM with two hidden classes. First, we use the MNL with generic tax effect. In other words, the effect of tax increase on the indirect utility is identical across smokers. The indirect utility function can be simplified as follow:

$$V_{njt} = \alpha_{nj} + \beta_1 Tax1_{njt} + \beta_2 Tax2_{njt} + \beta_3 Tax5_{njt} + \varepsilon_{njt}$$

where $Tax1_{njt}$, $Tax1_{njt}$, $Tax1_{njt}$ are dummies for specific tax rate equal to VND 1,000, VND 2,000 and VND 5,000 imposed on alternative j that smoker n is faced in choice set t, respectively. The reference category is no tax increase.

The selection probability or market share of product j in choice set t can be written as following:

$$s_{njt} = \frac{\exp(\alpha_{nj} + \beta_1 Tax1_{njt} + \beta_2 Tax2_{njt} + \beta_3 Tax5_{njt})}{1 + \sum_{k=1}^{J_t} \exp(\alpha_{nj} + \beta_1 Tax1_{njt} + \beta_2 Tax2_{njt} + \beta_3 Tax5_{njt})}$$

Then, we augment the first specification by allowing the effect of tax increase to differ between low-price and high-price cigarette brands. To do so, we interact tax dummies with a segment dummy when estimating the MNLs.

Finally, to incorporate heterogeneous tastes across smokers, we use LCM. With K hidden classes, the (unconditional) probability of smoker n choosing cigarette brand j in choice set t can be written as:

$$s_{njt} = \sum_{k=1}^{K} \lambda_{nk} \frac{\exp(\alpha_{jk} + \beta_{1k} Tax1_{njt} + \beta_{2k} Tax2_{njt} + \beta_{3k} Tax5_{njt})}{\sum_i \exp(\alpha_{ik} + \beta_{1k} Tax1_{nit} + \beta_{2k} Tax2_{nit} + \beta_{3k} Tax5_{nit})}$$

The probability of class membership can be expressed as a function of individual characteristics, which allows to examine the composition of the classes. The probability that smoker n belongs to class k is given by:

$$\lambda_{nk} = \frac{\exp(D_n \Pi_k)}{\sum_{h=1}^{K} \exp(D_n \Pi_h)}$$

$$\lambda_{nk} \in [0,1] \text{ and } \sum_{k=1}^{K} \lambda_{nk} = 1$$

where D_n is a vector of individual characteristics, and Π_k is a vector of parameters for class k.

B3. Continuous Prices

In the second set of models, the indirect utility function for smoker n choosing cigarette brand j in choice set t can be re-written as:

$$V_{njt} = \alpha_j + \beta_n p_{njt} + \varepsilon_{njt}$$

where α_j is the mean valuation of the unobserved brand characteristics, p_{jt} is the price of brand j in choice set t, β_n is individual-specific price coefficient, and ε_{njt} is an unobserved error term, which is independently and identically distributed extreme value.

The selection probability or market share of product j in choice set t then can be written as following:

$$s_{njt} = \int \frac{\exp(\alpha_j + \beta_n p_{jt})}{1 + \sum_{k=1}^{J_t} \exp(\alpha_k + \beta_n p_{kt})} f(\beta_n) d\beta_n$$

The MNL assumes that the individual-specific price coefficients are rather the same for all smokers (i.e. $\beta_n = \beta \quad \forall n$). The selection probability then can be simplified to have a closed form as:

$$s_{njt} = \frac{\exp(\alpha_j + \beta\, p_{njt})}{1 + \sum_{k=1}^{J_t} \exp(\alpha_k + \beta p_{nkt})}$$

The MNL can incorporate observed heterogeneous tastes, which vary systematically with smokers' observed characteristics. In our model, therefore, we include interaction between cigarette price and smokers' monthly income to capture the possibility that smokers with lower income are more price sensitive. Brand-specific constants are also interacted with smokers' age to capture the heterogeneous brand valuation.

Nevertheless, The MNL does not allow for unobserved taste heterogeneity, and therefore, imposes *a priori* a restricted structure on substitution pattern across cigarette brands. The cross-price elasticity of demand for brand j with respect to price of brand k can be calculated as: $\frac{\partial s_{njt}}{\partial p_{nkt}} . \frac{p_{nkt}}{s_{njt}} = \beta p_{nkt} s_{nkt} \; (j \neq k)$, which does not depend on j. Clearly, one percentage increase in the price of a brand would result in the same percentage change in all other brands' market shares.

To overcome this limitation, we consider the RPL, which allows for more flexible substitution pattern. The RPL captures unobserved individual-specific taste heterogeneity by allowing different smokers to have different price coefficient β_n, which is randomly distributed with a parametric density function $f(\beta_n)$. To ensure that the price coefficient is always negative, we assume β_n has a log-normal distribution, and can be written as $\beta_n = \exp(b + s\mu_n)$ where μ_n is a standard normally distributed value[34], and the parameters b and s represent the mean and deviation of $\log(\beta_n)$, respectively.

[34] Some previous related studies assume β_n to be normally distributed value. This assumption unavoidably results in a certain share of consumers have positive price effect coefficients, which do not necessarily reflect their true preferences, but rather the implication of the normal distribution [29]. In our model, when we try the normal distribution assumption, the mean price coefficient even becomes implausibly positive.

One typical concern with the log-normal distribution is that it has a relatively long right-hand tail, which may result in unreasonably high price coefficients to some smokers. Following [44], we drop up to five highest percentiles in the distribution of the individual price coefficient, recalculate the price elasticity and compare the new estimates with the ones obtained from the full distribution. The two are essentially identical, implying that the long tail of the lognormal distribution is likely not to have significant influence on our results.

An alternative specification commonly used in demand estimation assumes that β_n is normally distributed value [40]. In our case, however, this assumption results in a sizable share of consumers having positive price effect coefficients (i.e. the estimated standard deviation is greater than the estimated mean). This seemingly counterintuitive results do not necessarily reflect their true preferences, but may rather be due to the nature of the normal distribution [29]. Therefore, we opt for the log-normal distribution.

Once the models are estimated, the price elasticity can be calculated as following:

$$\frac{\partial s_{jt}}{\partial p_{kt}}\frac{p_{kt}}{s_{jt}} = \begin{cases} \frac{p_{jt}}{s_{jt}}\int \beta_n s_{njt}(1-s_{njt})f(\beta_n)d\beta_n\,, & \text{if } j=k \\ -\frac{p_{kt}}{s_{jt}}\int \beta_n s_{njt}s_{nkt}f(\beta_n)d\beta_n\,, & \text{otherwise} \end{cases}$$

The price semi-elasticity is calculated as following:

$$\frac{\partial s_{njt}}{\partial p_{nkt}}\frac{1}{s_{njt}} = \begin{cases} \frac{1}{s_{njt}}\int \beta_n s_{njt}(1-s_{njt})f(\beta_n)d\beta_n\,, & \text{if } j=k \\ -\frac{1}{s_{njt}}\int \beta_n s_{njt}s_{nkt}f(\beta_n)d\beta_n\,, & \text{otherwise} \end{cases}$$

We compute the number of smokers who switch from a considered cigarette brand j to the optout, as a percentage of the total number of smokers who substitute away from brand j in response to a VND 1,000 increase in the price of brand j:

$$\frac{100 * \left(\frac{\partial s_0}{\partial p_j}\right)}{\left|\frac{\partial s_j}{\partial p_j}\right|}$$

Appendix C. Latent Classes Model

C1. Latent classes model with tax dummies

Table 15 reports the results from the Latent Class Model (LCM) with two classes[35]. The reference group is no tax change. Note that class 1 and class 2 do not refer to the same type across regions. Overall, sensitivity to tax increase appears to vary modestly across two classes. Almost all of their differences are not statistically significant, with the only exception being the case of the VND 5,000 tax increase in the South.

More specifically, in the North, the estimated coefficients for the tax dummies are negative and monotonic, although only the coefficient for the VND 5,000 tax rate is statistically significant. Comparing between two classes, smokers in class 1 (about 31.6 percent of smokers) are slightly less sensitive to low tax increases, but more sensitive to high tax increase than smokers in class 2. This seems to be consistent with the fact that the former place higher intrinsic values on the high-price brands than on the optout and the low-price brands while the latter prefers the low-price brands. Nevertheless, these differences are not statistically significant. As expected, smokers with higher income and lower age are more likely to belong to the class 1, whose members are less responsive to high tax change.

In the Central, the estimated coefficients for the tax dummies are also negative as expected. However, these coefficients are not monotonic for class 1, and only the coefficient for the VND 5,000 tax rate is statistically significant. Similar to the results in the North, smokers in class 1 (about 45.8 percent) appears to less tax sensitive than those in class 2 although their differences are not statistically significant either. Unlike in the North, smokers in the class 1 prefers low-price brands to the optout, and the optout to high-price brands while those in the class 2 prefers all cigarette brands to the optout option. Also, the higher income smokers earn and the younger they are, the less likely they belong to the class 1.

Finally, in the South, the estimated coefficients for the tax dummies are negative as expected, with the only exception being the estimated coefficient for the VND 1,000 tax dummy, which is positive. However, only the coefficients estimated for the VND 2,000 tax dummy and the VND 5,000 tax dummy in the class 1 are statistically significant, while all other are not. Older smokers are more likely to belong to class 1 (about 39.3 percent of smokers), whose members are more tax sensitive than those in class 2. Although income has a negative effect on the probability of belonging to the more tax sensitive class, the effect is not statistically significant. These results are consistent with the fact that smokers in the class 1 prefers low-price brands to the optout, and the optout to the high-price brands while those in the class 2 prefers all the cigarette brands to the optout option.[36]

[35] LCMs with more than two classes, and with two classes and segment-specific tax effects were not estimable.
[36] The estimates of brand-specific constants are not reported

Table 15 Results from latent class models

	North			Central			South		
VARIABLES	Class1	Class2	Prob. of Class1	Class1	Class2	Prob. of Class1	Class1	Class2	Prob. of Class1
Tax = VND 1,000	-0.067	-0.046		-0.096	-0.090		0.005	-0.012	
	(0.145)	(0.102)		(0.104)	(0.120)		(0.099)	(0.185)	
Tax = VND 2,000	-0.147	-0.078		-0.038	-0.154		-0.304***	-0.103	
	(0.145)	(0.103)		(0.103)	(0.120)		(0.105)	(0.191)	
Tax = VND 5,000	-0.409***	-0.465***		-0.491***	-0.577***		-0.626***	-0.159	
	(0.149)	(0.105)		(0.111)	(0.126)		(0.112)	(0.198)	
Membership_of_class1									
Income			0.100***			-0.070***			-0.001
			(0.022)			(0.027)			(0.015)
Age			-0.010			0.070***			0.040***
			(0.010)			(0.011)			(0.009)
ASCs	Yes			Yes			Yes		
Probability Class 1			0.316			0.458			0.393
Probability Class 2			0.684			0.542			0.607
Log likelihood	-3160			-3278			-4453		
Number of choice tasks	3088			3040			3080		
Number of participants	386			380			385		

Reference (omitted) category: No tax. Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1