

The impact of cigarette prices on smoking onset and cessation: evidence from Vietnam

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ABSTRACT

Background Vietnam is a country with very high smoking rates among men. According to a Global Adult Tobacco Survey (GATS) conducted in 2015, the daily smoking prevalence among Vietnamese men was 39%.

Methods We used data from the 2010 and 2015 Vietnamese GATSs and cigarette price data from General Statistics Office of Vietnam. Since smoking prevalence is low among women, we only considered men. Using discrete-time hazard models, we estimated the effect of cigarette prices on smoking onset and cessation. Sensitivity analyses are conducted using different model specifications.

Results We find that higher cigarette prices reduce the probability of smoking onset. A 1% increase in the cigarette price reduces the hazard of smoking onset by 1.2% (95% CI –2.12% to –0.28%). This suggests that increases in tobacco taxation, which translate to price increases, can reduce smoking onset. We did not find evidence that cigarette prices impact smoking cessation among men in Vietnam.

Conclusion Vietnam should continue to increase excise taxes on tobacco products to reduce smoking onset. Since smokers are resilient to excise tax increases, other tobacco control policies, such as smoke-free areas and tobacco advertisement bans, should be better enforced to encourage people to quit. Other policies not yet implemented, such as plain packaging of tobacco products, may also encourage smokers to quit.

INTRODUCTION

There is a broad consensus that higher tobacco taxes and prices reduce tobacco consumption and smoking prevalence.^{1–4} However, empirical studies are not consistent regarding the magnitude of the effect of cigarette price on tobacco demand.^{1 2 5} Moreover, several studies do not find a significant effect of increases in tobacco taxes or prices on smoking onset.^{6–9} Guindon conducted an extensive methodological review on smoking onset studies.¹⁰ Existing studies show a diversity in magnitude of the tobacco price effect, which calls for more empirical studies to better understand the effects of tobacco pricing on smoking behaviour.

In this study, we examine the effect of cigarette prices and other determinants on smoking onset and cessation among Vietnamese men using discrete-time hazard models. We do not consider women, as smoking prevalence (any tobacco) among women is very low, at 1.1% in 2015 according to the 2015 Global Adult Tobacco Survey (GATS). A main reason for the low smoking prevalence among women in Vietnam is a social norm that attributes female smoking to ‘inappropriateness’.¹¹

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ The negative effect of cigarette prices on smoking prevalence has been widely confirmed.
- ⇒ However, empirical studies show mixed results on the effect of cigarette prices on smoking onset.
- ⇒ There is less evidence on the effect of cigarette prices on smoking cessation in low-income and middle-income countries.

WHAT THIS STUDY ADDS

- ⇒ We estimate the effect of the cigarette price on smoking onset and cessation among men using the most recent nationally representative data on smoking in Vietnam.
- ⇒ We find that a 1% increase in cigarette price reduces the hazard of smoking onset of men by 1.2%.
- ⇒ We do not find evidence that cigarette prices impact smoking cessation among men in Vietnam.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Vietnam should continue to increase excise taxes on tobacco products, which reduces smoking onset.
- ⇒ Smokers in Vietnam are resilient to excise tax increases. Thus, other tobacco control policies, such as smoke-free areas and tobacco advertisement bans, should be better enforced to encourage people to stop smoking.

Tobacco is estimated to cause over 40 000 deaths each year in Vietnam.¹² Although Vietnam has made progress in tobacco control, such as issuing the Law on Prevention and Control of Tobacco Harms in 2013 (the law prohibiting (1) tobacco advertisement, (2) smoking in public places and (3) the sale of cigarettes to those under 18 years) and raising the excise tax to 65% in 2008 and to 70% of the pretax ex-factory price in 2016, the daily smoking prevalence among men remained unchanged from 2010 to 2015.

Several studies investigate the relationship between cigarette price and smoking in Vietnam.^{13–15} These studies find a negative association between cigarette prices and smoking intensity and participation. Using the Vietnam Living Standard Surveys in 1993 and 1998, Eozenou and Fishburn estimate the price elasticity for cigarette demand in Vietnam to be approximately –0.53.¹³ Recently, using Vietnam Household Living Standard Surveys 2010–2016, Viet Nguyen *et al* shows



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Table 1 Smoking statistics among men in Vietnam

Indicators	Year 2010	Year 2015
% of adults ≥ 15 years who currently smoke tobacco	47.4	45.3
% of adults ≥ 15 years who currently smoke tobacco daily	38.7	38.7
% of adults ≥ 15 years who currently smoke cigarettes	39.7	36.7
% of adults ≥ 15 years who currently smoke cigarettes daily	31.3	30.7
% of smoking cessation among ever-smokers daily	23.3	24.2
Average age of male respondents	37.7	38.4
Mean smoking onset age	19.9	19.7
Mean smoking cessation age	37.7	38.7
Total number of observations	5569	3983

Note: The sample includes male subjects from 15 years old.
Source: Estimation from GATSs 2010 and 2015.
GATS, Global Adult Tobacco Survey.

that the higher cigarette prices reduce the smoking participation and expenditure on tobacco products.¹⁵ A study of Guindon is closely related to our paper.¹⁶ Using the 2003/2004 Survey Assessment of Vietnamese Youth, Guindon investigates the effect of tobacco price on smoking onset in Vietnam. He finds that a 1% increase in the consumer price index of tobacco products reduces the hazard of smoking onset among male subjects aged 14–24 years by 1.6%.¹⁶

Our study is expected to contribute to the literature by providing recent empirical findings from Vietnam. Compared with previous studies on the effect of cigarette prices in Vietnam, our study differs in several aspects. First, we use more recent data (GATS 2010 and 2015). Second, we look at the effect of cigarette prices on the smoking onset of all adult men, while Guindon focuses on the smoking onset of young men.¹⁶ Third, we examine the effect of cigarette prices on not only the smoking onset but also the smoking cessation.

DATA AND DESCRIPTIVE STATISTICS

Smoking data

Data on smoking behaviours are obtained from GATS 2010 and 2015. These surveys were conducted by the General Statistics Office of Vietnam (GSO), with technical support and funding from the WHO in 2010 and 2015. The 2010 and 2015 GATS collected information on demographic characteristics and tobacco use of individuals in 2010 and 2015, respectively. These surveys are nationally representative of men and women aged 15 years and older. Specifically, 9925 individuals completed the questionnaires in 2010, and 8996 individuals in 2015.

The prevalence of smoking (any form of tobacco) among men over 15 years of age was 47.4% in 2010 and decreased slightly in 2015 to 45.3% (table 1). In 2010 and 2015, 38.7% were daily users (any form of tobacco). Manufactured cigarettes are the main tobacco product used in Vietnam. In 2015, 36.7% of men smoked cigarettes (compared with 39.7% in 2010), and 30.7% of men smoked cigarettes daily (compared with 31.3% in 2010). In the 2010 and 2015 GATS, the average ages of male respondents (aged 15 and over) are 37.7 and 38.4, respectively.

In the GATSs, the age of smoking onset was identified by the question 'At what age did you first start smoking tobacco daily?' For people who did not remember onset age, a second question was asked: 'For how many years have you been smoking daily?' Using these two questions, we can identify respondents' age to start smoking. In the 2015 GATS, the mean smoking onset age

is approximately 20 years. The smoking onset in the 2015 GATS age ranges from 5 to 45.

The proportion of men who ever smoked on a daily basis and subsequently quit smoking was 24.2% in 2015. Quit age is identified using the question 'How long has it been since you stopped smoking?' In the 2015 GATS, the cessation age among subjects ranges from 10 to 85 with a mean of 39.

Cigarette price data

We obtain annual prices of Vinataba cigarettes over the years 2001–2015 from the GSO. We use the real price (base year 2001) of Vinataba cigarettes in the regression analyses. Vinataba is the largest tobacco company in Vietnam. Vinataba cigarettes are the main product of the Vinataba company. The price of cigarettes is measured by the retail price of Vinataba cigarettes (per pack of 20 cigarettes) at the provincial level (63 provinces). The market share of the Vinataba company in the Vietnam cigarette market was around 60% in 2016.¹⁷ Vinataba cigarettes are a mid-priced cigarette brand (18 600 Vietnamese Dong (VND) per pack of 20 cigarettes in 2016, around US\$0.82 using 2016 exchange rate).

Figure 1 shows that the average nominal Vinataba cigarette price increased by 164%, from 8738 VND/pack in 2001 to 20 815 VND/pack in 2015 (US\$1 was approximately equivalent to 18 500 VND in January 2010 and 21 500 VND in January 2015). To get the real cigarette price, we adjust the nominal cigarette price using the overall consumer price index (CPI). Because of relatively high inflation in Vietnam, the real price increased at a much smaller rate, approximately 20% from 2001 to 2015. During this period, the real per capita GDP of Vietnam increased by 109%, indicating increasing cigarette affordability over time. In this study, we focus on the 2001–2015 period, since cigarette price data are only available from 2001, and the latest GATS survey data were collected in 2015.

Our identification of the effect of the cigarette price depends not only on its overtime increase but also on its variation across provinces. In 2001, the average nominal Vinataba cigarette price varied from 6283 VND/pack in Dak Lak province to 15 251 VND/pack in Bac Lieu province. In 2015, Hai Duong was the province with the lowest nominal Vinataba cigarette price at 14 404 VND/pack, while Bac Lieu was still the province with the lowest Vinataba cigarette price at 30 778 VND/pack. The online supplemental figure S1 in the online supplemental materials presents the geographical pattern of the nominal price of a Vinataba cigarette pack across provinces in 2015.

It should be noted that the GSO constructs the tobacco CPI in Vietnam based on the prices of three tobacco products including Vinataba cigarettes, 555 cigarettes and water pipe tobacco. Data on the tobacco CPI are available for only 30 provinces. In this study, we use the Vinataba cigarette price instead of the tobacco CPI for the main analysis since its data are available for all the 63 provinces of Vietnam. Moreover, using the cigarette price (instead of CPI), we computed the price elasticity of tobacco demand. However, we still use the tobacco CPI for robustness analysis (the results are reported in the online supplemental materials). Online supplemental figure S2 also shows a strong correlation between the tobacco CPI and the Vinataba cigarette prices with the correlation coefficient at 0.78.

ESTIMATION METHOD

Construction of pseudo panel dataset

We use discrete-time hazard models to estimate the effect of cigarette prices on smoking onset and cessation. We construct a pseudo panel to track male respondents over time. In the GATS

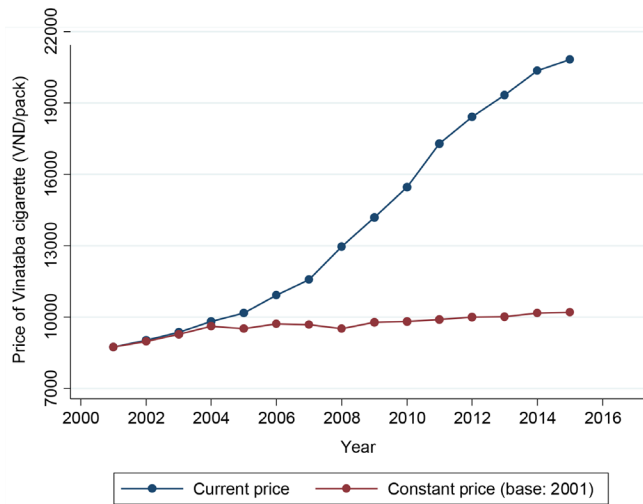


Figure 1 Current and constant (base: 2001) price of Vinataba cigarettes: 2001–2015. VND, Vietnamese Dong.

data, the proportion of people who started smoking from 5 to 9 years old is less than 0.1% in the sample. Thus, we expand the data on the smoking status of male respondents to the year of their age at 10. For the smoking onset, we create a dummy variable coded as 0 for respondents in all years they had not become a smoker. If a respondent started smoking in a given year, the dummy variable is coded as one in that year, and the respondent is dropped in the following years. For respondents who never start smoking, the dummy variable is equal to 0 in all the time periods. To estimate the impact of the cigarette price, we merge the cigarette price data with the pseudo panel dataset. The sample for onset analysis includes non-smokers and those who started smoking between 2001 and 2015. It should be noted that people who started smoking before 2001 are dropped from the sample because there is no price data to match these people to (data on the cigarette price is available from 2001). The final number of observations for the regression analysis is 33 939 (expanded from 3513 individuals), and the number of individuals who started smoking (also called events or failures in the duration model) is 831.

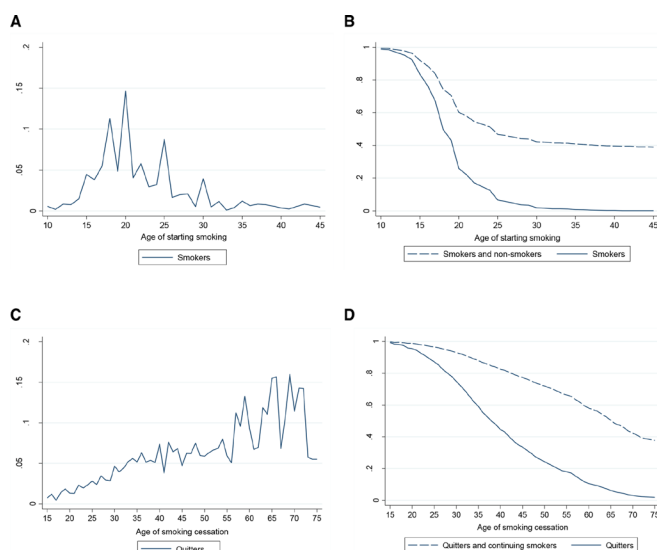


Figure 2 Hazard and survival functions of smoking onset and cessation.

Figure 2A,B present the hazards and survival functions of smoking onset, while figure 2C,D present the hazards and survival functions of smoking cessation. Figure 2A shows that the hazard of smoking initiation is substantially high for people around the age of 20. It also shows a heaping effect, with significantly higher risks of starting to smoke at ages 20, 25, 30 and 35. In figure 2B, the survival functions are plotted using the full sample and the sample of ever-smokers.

For the smoking cessation analysis, which considers ever-smokers (current smokers and quitters), we expand data using information on smoking onset age and cessation age. We create a dummy variable coded 0 for respondents in all years that they were smokers. In a year, if a respondent stops smoking, the dummy variable is coded as 1, after which the respondent is dropped from the sample. For current smokers, the smoking onset variable is equal to 0 from he started smoking until the current period. The final number of observations for the regression analysis is 44 106 (expanded from 4133 individuals), and the number of individuals who quit smoking (also called events or failures in the duration model) is 758. Figure 2C,D present the hazard and survival functions of smoking cessation across age. The probability of stopping smoking tend to increase over age, especially 55 years old.

It should be highlighted that the sample size for the smoking cessation analysis is larger than for smoking onset because we only have cigarette price data from 2001 to 2015. The beginning of time for the cessation analysis is not from when the person started smoking (if before 2001), but rather from 2001. This group accounts for nearly 60% of the sample of men. Almost all current smokers stay in the sample for the whole period 2001–2015.

Estimation model

Using discrete-time hazard models and pseudo panel data, we estimate the effect of cigarette prices on the hazard of smoking onset at time t (conditional on no prior smoking) as follows:

$$y_{i,p,t} = G \left[\beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3 + \beta_4 \text{Log}(\text{Price}_{p,t}) + X_{i,p} \beta_5 + P_{p,t} \beta_6 + U_{p,t} \beta_7 + \text{Year}_t \beta_8 \right] \quad (1)$$

The dependent variable, $y_{i,p,t}$, is the dummy variable indicating whether or not a respondent i in province p started smoking in year t . G denotes a function to model discrete-time hazard such as the complementary log–log (cloglog), logit or probit. In this study, different estimators produce very similar results. Although we also estimate logit, probit and linear probability models, we present the results from the cloglog model. Results from other estimators are presented in the online supplemental materials. cloglog has an asymmetrical response curve, and it is more widely used when the probability of an event is very small.^{18–20}

In equation (1), t indicates the number of years of individual i since age 10 or from 2001. Specifically, this time variable ranges from 1 when a respondent enters the dataset to $time$ when he exits from the dataset (time he started smoking or 2015 if he did not smoke). The maximum value of t is 15. To account for duration dependency, we use a third-order polynomial for time (ie, $time$, $time^2$ and $time^3$). We also test log of $time$, a fourth-order polynomial, and time dummies (the results are reported in the online supplemental materials).

$\text{Log}(\text{Price}_{p,t})$ is the natural logarithm of the real average price of a Vinataba cigarette pack in province p in year t . The cigarette prices are adjusted to the 2001 prices using provincial-level overall CPI. $X_{i,p}$ are time-invariant characteristics of respondents including a dummy variable of Kinh and an urban dummy.

In Vietnam, there are 54 ethnic groups, of which the Kinh group accounts for 85% of the total population. Urban and Kinh people have higher income than rural and ethnic minority people. We do not control for time-variant variables such as education and wealth, since data on these variables are available only in 2010 and 2015. We do not have data on these variables over time. $P_{p,t}$ denotes the provincial-level control variables: per capita income, and log of population of density. U_p are province dummies which capture time-invariant or fixed-effects of provinces. $Year_t$ is the set of calendar year dummies, which captures the effect of time events such as the implementation of Law on Prevention and Control of Tobacco Harms in 2013 or tax increases in 2006 and 2008. It should be noted that age of respondents is already controlled by year dummies and time t variables. The list of explanatory variables is presented in online supplemental table S1 in the supplementary materials.

The standard duration model assumes that all respondents will eventually start smoking. However, in reality, some people never smoke. To examine this issue, we use a split-population duration model, which estimates the hazard of smoking onset while explicitly taking into account that a proportion of the population never smoke (eg, ^{6, 19–24}). The probability of smoking during the analysis period, denoted by P_i , is first modelled using the explanatory variables for all people, then it is included in the log-likelihood function of smoking initiation as follows⁷:

$$L_i(\theta, \beta, X, t) = D_i P_i(\theta, X) f(\beta, X, t) + (1 - D_i) [(1 - P_i(\theta, X)) + P_i(\theta, X) S(\beta, X, t)] \quad (2)$$

where D_i is a dummy variable indicating whether or not the individual i eventually smoke in the analysis period. X denotes all the explanatory variables in equation (1). θ and β are the two vectors of parameters. $f()$ and $S()$ denotes the density and survival function at the year t , respectively. In this study, we use Stata command ‘spsurv’ from Jenkins to estimate the split-population duration model.²⁵ A problem with command ‘spsurv’ is that it does not allow sampling weights.

Another challenge in estimating the effect of cigarette prices is the endogeneity of the price. Provinces with different cigarette prices might be different among unobserved variables, which results in selection bias. To address this issue, we control for province fixed effects, which address selection bias caused by time-invariant variables. We expect the remaining bias to be negligible once we control for the provincial-level observed and time-invariant unobserved variables. However, we further examine the selection bias using two models. First, we use a frailty (random-effects) model, which allows for heterogeneity in the hazard of smoking onset across individuals. Under the assumption that the heterogeneity is normally distributed with zero mean, we can allow for this heterogeneity by using the cloglog estimator with frailty. Second, we use the instrumental variable (IV) regression, in which the instrument for cigarette price is the lagged cigarette price.^{26, 27} For additional robustness check, we use another type of IV based on the heteroscedasticity-based approach.^{28, 29} The IV methods are presented in detail in the online supplemental materials. Since our IV are not absolutely exogenous, the IV-based results are used as robustness analyses and presented in the online supplemental materials.

EMPIRICAL RESULTS

Impact of cigarette price on smoking onset

Table 2 presents estimates from three models: the standard discrete-time hazard, the split-population discrete-time hazard and the frailty discrete-time hazard models. The split-population

Table 2 Effect of cigarette prices on smoking onset

Explanatory variables	Dependent variable is ‘starting smoking (yes=1, no=0)’		
	cloglog (with sampling weights) (1)	cloglog (split population model) (without sampling weights) (2)	xtcloglog (without sampling weight) (3)
Log of the real cigarette price	−1.1962* (0.4698)	−0.8740* (0.4000)	−0.8768* (0.4013)
Kinh majority (Kinh=1, ethnic minorities=0)	0.0251 (0.1255)	−0.1281 (0.1035)	−0.1390 (0.1041)
Urban (urban=1, rural=0)	−0.0940 (0.0913)	−0.0779 (0.0777)	−0.0797 (0.0808)
Log of population density of provinces	1.3138 (1.0303)	1.1882 (0.7530)	1.1786 (0.7503)
Log of per capita income of provinces	0.4166 (0.5312)	0.6941 (0.4223)	0.6932 (0.4233)
Duration dependency (cubic function)	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
Constant	−8.461 (9.312)	−12.678† (7.333)	−12.711† (7.263)
Number of individuals	3513	3513	3513
Observations	33 939	33 939	33 939

Robust SEs in parentheses. SEs are corrected for sampling weights and cluster correlation at the individual level.
*P<0.05.
†P<0.1.
‡P<0.01.
cloglog, complementary log–log.

model relaxes the assumption that all respondents will eventually start smoking, but the command ‘spsurv’ (used to run it in Stata) does not allow the sampling weight. The frailty discrete-time hazard model allows individual heterogeneity in the hazard of smoking onset under the assumption of the distribution of this heterogeneity. Different models yield different point estimates of the cigarette price. However, all the estimates are negative and statistically significant at the 5% level.

Since the cigarette price is measured in natural logarithm, the coefficient on the log of price in the cloglog is interpreted as the elasticity of the hazard with respect to the real cigarette price. The coefficient of log of real cigarette price is estimated at −1.20 and significant at the 5% level (the 95% CI −2.12% to −0.28%) (table 2, column 1), indicating that a 1% increase in the cigarette price decreases the hazard of smoking onset by 1.2%. Column 2 reports estimates from the split-population duration model. The results are similar, though smaller, to the standard cloglog model: the effect of cigarette price on the hazard of smoking onset is estimated at −0.87. In column 3 of table 2, we estimate the effect of cigarette using a frailty (random-effects) model. This model is estimated using ‘xtcloglog’ command in Stata (sampling weights are not allowed). The estimate of the cigarette price is equal to −0.88, which is close to the estimates from the split-population duration model (also without sampling weights). Overall, the elasticity estimates in our study are slightly higher than the elasticity estimate for lower-income to middle-income countries (−0.74%) from the study of Kostova *et al.*³⁰ The difference might be due to the differences in countries and

sample size. Kostova *et al* used a pooled sample of six countries and included both men and women in the analysis, while we focused on the sample of men in Vietnam.³⁰

To compare with the study of Guindon, which finds a negative effect of the tobacco price on smoking onset of people aged 14–24 in Vietnam,¹⁶ we also limit our sample to people aged 24 and younger and estimate the effect of cigarette prices on the smoking onset using the same model as table 2. The results, which are reported in online supplemental table S2 in the supplementary materials, show a negative and significant effect of cigarette prices: a 1% increase in the cigarette price reduces the hazard of smoking onset of young people by 1.4%. This elasticity estimate is quite close to the estimate at –1.6% found in the study of Guindon.¹⁶

In all the models of smoking onset, the control variables, including ethnicity, urban/rural, population density and per capita income of provinces are not statistically significant.

We conduct a series of robustness checks, which are reported in the online supplemental materials. We estimate the effect of the tobacco CPI instead of smoking onset. Online supplemental table S3 in the supplementary materials also reports a negative and significant effect of the tobacco CPI on smoking onset. Our estimates are also robust to different samples of smokers (online supplemental tables S4 and S5) and different estimators including logit, probit and linear probability models (online supplemental table S6). We explore the endogeneity problem using the IV regression. The result also shows a negative and significant effect of the cigarette price on smoking onset (online supplemental tables S7 and S8). Our estimates are robust to different sets of control variables (online supplemental table S9) and the functional form of the baseline hazards (online supplemental table S10). We also examine whether the heaping problem and the assumption on proportional hazards affect our estimates and do not find evidence on these problems (online supplemental table S9). The estimates are also robust to different specifications of duration dependency such as log of time, fourth-order polynomial and time dummies (online supplemental table S11).

Impacts of cigarette price on smoking cessation

All models do not show statistically significant effects of cigarette prices on smoking cessation (table 3). We also conduct similar robustness analysis, which is presented in online supplemental tables S3, S8 and S12–S14 in the supplementary materials. In all these models, the real cigarette price does not have a significant effect on smoking cessation.

Thus, for daily smokers, higher prices have not encouraged them to quit smoking. In the GATSS, there is no information on reasons for smoking cessation. However, previous studies such as Pederson *et al* suggest that the main reason for smoking cessation is health problems.^{31 32} According to Gallus *et al*, only 3% of ex-smokers in Italy mentioned the economic cost as the main reason to stop smoking.³² Thus, a small or medium increase in the price might not be enough to cause smokers to stop smoking.

The results in table 3 indicate that the Kinh majority is positive and statistically significant at the 5% level, suggesting that Kinh are more likely to quit smoking than ethnic minorities. Urban/rural, population density and per capita income of provinces are not statistically significant.

DISCUSSION AND CONCLUSION

The prevalence of smoking in Vietnam remains high compared with other countries in the region.³³ To reduce smoking, the government has implemented comprehensive policies including

Table 3 Effect of cigarette prices on smoking cessation

Explanatory variables	Dependent variable is 'stopping smoking (yes=1, no=0)'		
	cloglog (with sampling weights)	cloglog (split population model) (without sampling weight)	xtcloglog (without sampling weight)
	(1)	(2)	(3)
Log of real cigarette price	–0.2961 (0.5034)	–0.3008 (0.3889)	–0.3181 (0.3961)
Kinh majority (Kinh=1, ethnic minorities=0)	0.3160* (0.1575)	0.3897† (0.1338)	0.4074† (0.1498)
Urban (urban=1, rural=0)	0.0001 (0.0004)	0.0003 (0.0003)	0.0002 (0.0003)
Log of population density of provinces	0.3360 (0.4760)	0.4096 (0.5579)	0.4612 (0.5811)
Log of per capita income of provinces	0.2843 (0.6168)	0.0266 (0.4708)	0.0175 (0.4766)
Duration dependency (cubic function)	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
Constant	–8.9018 (5.8366)	–7.3170 (5.9039)	–8.2706 (6.0981)
Number of individuals	4133	4133	4133
Observations	44 106	44 106	44 106
Robust SEs in parentheses. SEs are corrected for sampling weights and cluster correlation at the individual level.			
*P<0.05.			
†P<0.01.			
‡P<0.1.			

smoke-free areas, restrictions on tobacco advertisement, promotion and sponsorship, and taxation. Yet, the rate of smoking has only decreased slightly over time. Our findings are consistent with previous studies that also find a negative relation between prices and hazards of smoking onset in low-income and middle-income countries.^{14 15 20 24 28 30 34 35} Our study is also consistent with the studies of Laxminarayan *et al* and Guindon, who also find the negative effect of the tobacco prices on smoking onset in Vietnam.^{14 16} Regarding smoking cessation, we find no evidence that cigarette prices impact smoking cessation. This finding is similar to Laxminarayan and Deolalikar, which also use data from Vietnam,¹⁴ and Kostova *et al* who use pooled data from six lower-income and middle-income countries.³⁰

Findings from our study suggest that higher taxation on tobacco products can reduce smoking prevalence and smoking onset through increasing tobacco prices. The current tax rate in Vietnam is still low, accounting for roughly one-third of the retail price, whereas the WHO recommends that the tax share be at least 75% of the retail price.^{36 37} Our finding also suggests that cigarette smokers are less responsive to cigarette prices. Probably, cigarette prices should be increased enough to reduce cigarette consumption among existing smokers. In addition to tobacco taxation, policies to restrict smoking, such as smoke-free areas and tobacco advertisement, should be better enforced to encourage people to quit.

Finally, our study is subject to several limitations. First, there are a number of limitations in our dataset. Retrospective information on when to start and quit smoking is always associated with recall errors. In the pseudo-dataset, the number of time-variant control variables is very limited, and the endogeneity

bias caused by omitted variables is more likely to happen. Our data on cigarette prices also have the limitation that it does not cover a large number of cigarette brands for a long period of time. Second, cigarette prices are not absolutely exogenous, and the impact estimate can be associated with the endogeneity bias. Addressing these limitations is outside the scope of our study but certainly important for future ones.

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Contributors CVN: planning and conducting the data analysis and writing of the work described in the article, and being responsible for the overall content as guarantor; NV: commenting on and writing of the work described in the article; LTT and NHN: planning, commenting and writing of the work described in the article.

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