

**Projecting health benefits of raising  
Tobacco tax policy: An application of  
Abridged SimSmoke model to Vietnam**

**A Thesis Submitted to  
the Department of Cancer Control and Population Health  
in Partial Fulfillment of the Requirements  
for the Master's Degree of Public Health**

**Nguyen Thi Thuy Duyen**

**December 2020**

**National Cancer Center  
Graduate School of Cancer Science and Policy**

**Professor Jin Kyoung Oh**

**We hereby approve the M.S. thesis of  
Nguyen Thi Thuy Duyen.**

**December 2020**

**Min Kyung Lim**

 sign

---

**Chairman of Thesis Committee**

**Sung-il Cho**

 sign

---

**Thesis Committee Member**

**Jin-Kyoung Oh**

 sign

---

**Thesis Committee Member**

**NATIONAL CANCER CENTER  
GRADUATE SCHOOL OF CANCER SCIENCE AND POLICY**

## **ABSTRACT**

### **Projecting health benefits of raising tobacco tax policy: An application of Abridged SimSmoke model to Vietnam**

Since 2004, tobacco tax in Vietnam has been raised five times but remained insufficient for reducing tobacco use. To support the development of tobacco control strategy in 2020-2030, there is an urgent need for strengthening raising tobacco tax policy. This study aimed to describe the cigarette price and tax components and assessing health benefits of tobacco tax policy in Vietnam by using Abridged SimSmoke model.

Abridged SimSmoke model, a dynamic simulation model simplifying from SimSmoke for the comparative evaluation of tobacco control policies and interventions at country-level, was employed for tobacco tax intervention to project the reduction in number of smokers and smoking-attributable-deaths (SADs). The model assessed five proposed plans from Ministry of Finance and

Ministry of Health with two additional extreme scenarios for extended comparison. Demographic data and tobacco use data among adults aged 15+ were obtained from Vietnam General Statistic Office and GATS surveys. Policy effect sizes are based on previous SimSmoke models in many low and middle-income countries. The number of SADs was derived using the reduction in mortality rate at age of quitting with the assumption that half of current smokers will die prematurely.

Total tax share in retail price would vary from 38.1% - 50.9% among proposed plans while two extreme scenarios offered up to 52.5%-58.2% tax share with the retail margin set at 25%. After 5 years of policy implementation, the overall smoking prevalence would reduce to 21.8%-18.9% from the 2015 baseline rate of 22.7%. Male smoking rate would drop to 44.15 to 38.1% while female smoking rate will stay around 0.9%-1.0%. Total number of avoided SADs would be 109,175 – 511,991 with the highest contribution belongs to age group from 35-64.

Increasing ad valorem tax to 80% adding specific tax of 5,000VND/pack was deemed as the most suitable option among proposed plan at the current time. However, there is a huge vacant space for Vietnam government to raise tobacco tax to maximize the effectiveness of this intervention. Further budget impact analysis is needed to ascertain the study findings.

Copyright by  
Nguyen Thi Thuy Duyen  
2020



# Contents

<b>List of figures .....</b>	<b>i</b>
<b>List of tables.....</b>	<b>ii</b>
<b>1. Introduction.....</b>	<b>1</b>
1.1. Tobacco use & its burden.....	1
1.1.1. Epidemiology of tobacco use .....	1
1.1.2. Health and economic burden of tobacco use .....	3
1.2. Tobacco control in Vietnam .....	6
1.2.1. History of tobacco control in Vietnam (1975 – 2004).....	6
1.2.2. MPOWER implementation in Vietnam (2005 to now) .....	8
1.3. Tobacco industry in Vietnam .....	13
1.4. Tobacco tax and price .....	16
1.4.1. Tax structure for tobacco products .....	16
1.4.2. Price and tax share of cigarette in Vietnam .....	18
1.4.3. Road map of raising cigarette tax in Vietnam .....	20
1.5. Simulation models in tobacco control: SimSmoke & Abridged SimSmoke model.....	21
1.6. Rationale of study.....	22
1.7. Study objectives .....	23
<b>2. Methodology .....</b>	<b>24</b>
2.1. Model structure .....	24
2.2. Model inputs & assumptions.....	27

2.2.1. Population Module & Smoking Module .....	27
2.2.2. Policy Module .....	29
2.2.3. Smoking-Attributable Deaths Modules .....	33
2.3. Model validation & Sensitivity analysis .....	34
<b>3. Results .....</b>	<b>37</b>
3.1. Description of Cigarette Price and Tax in model scenarios .....	37
3.2. Effect of raising tobacco tax on adult smoking population .....	39
3.3. Effect of raising tobacco tax by age groups and sex .....	43
3.4. Sensitivity analysis .....	57
3.4.1. Sensitivity analysis for price elasticity .....	57
3.4.3. Sensitivity analysis for mortality rate .....	61
3.4.4. Sensitivity analysis for retail margin .....	64
<b>4. Discussion.....</b>	<b>68</b>
4.1. The gap between the suitable and desirable plan for raising cigarette taxes in Vietnam.....	68
4.2. Accelerating tobacco tax policy to strengthen the implementation of MPOWER package .....	71
4.3. Supporting the evidence of health impact of raising tobacco tax policy for Vietnam from other countries .....	74
4.4. Strengths & Limitations .....	81
4.5. Further steps .....	84
<b>5. Conclusion.....</b>	<b>85</b>

<b>Bibliography .....</b>	<b>86</b>
<b>Appendix .....</b>	<b>98</b>
Appendix 1: Consumer Price Index from 2010 to 2020 in Vietnam (Overall index and index for beverage and tobacco products) .....	98
Appendix 2: Projection of short-term smoking prevalence using price elasticity of -0.25 for low-income countries.....	100
Appendix 3: The projected reduction in number of smokers and SADs using price elasticity of -0.25 for low-income countries.....	102
Appendix 4: The projected number of smokers and SADs by age groups among male using retail margin at 10% .....	103
Appendix 5: Projection of number of smokers and SADs by age groups among females using retail margin at 10% .....	106
Appendix 6: Projection of number of smokers and SADs by age groups among males with retail margin at 30% .....	109
Appendix 7: Projection of number of smokers and SADs by age groups among females with retail margin at 30% .....	112

# List of figures

Figure 1: Timeline of tobacco control activities in Vietnam from 1990 to 2016...7	7
Figure 2: Manufacturing and shipment of tobacco products in 2010-2019 .....14	14
Figure 3: Structure of the Abridged SimSmoke model.....24	24
Figure 4: Smoking prevalence after 5 years of raising cigarette tax by gender .....42	42
Figure 5: Smoking prevalence after 5 years raising cigarette tax by residence ...43	43
Figure 6: Averted smoking-attributable deaths by age groups among males .....51	51
Figure 7: Changes in GDP per capita & cigarette price in Vietnam from 1994-2017 (unit:%) (75).....72	72
Figure 8: Smoking prevalence after 5 years raising cigarette tax by gender using the price elasticity for low-income country.....100	100
Figure 9: Smoking prevalence after 5 years raising cigarette tax by residence using the price elasticity for low-income country .....101	101

## List of tables

Table 1: Description of tax calculation on cigarettes in 2019 .....	17
Table 2: Data inputs & data sources.....	25
Table 3: Population size & Smoking prevalence .....	28
Table 4: Model scenarios on raising tobacco taxes in Vietnam .....	29
Table 5: Model validation with data from 2010 to 2015.....	35
Table 6: Sensitivity analysis on model’s main assumptions .....	36
Table 7: Cigarette tax and price components in seven model scenarios .....	38
Table 8: Estimation on Smoking prevalence and Reduction in number of smokers and SADs in adult population .....	40
Table 9: Short-term policy effect by age groups among males.....	46
Table 10: Short-term policy effect by age groups among females.....	54
Table 11: Lower limit & upper limit of smoking rate with price elasticity at -0.20 ..	58
Table 12: Lower limit & upper limit of smoking rate with price elasticity at -0.25 .....	60
Table 13: Reduction in number of SADs with cigarette mortality rate of 30% ...	61
Table 14: Reduction in number of SADs with cigarette mortality rate of 50% ...	63

Table 15: Projected smoking prevalence, reduction in number of smokers & SADs with retail margin of 10%.....	65
Table 16: Projected smoking prevalence, reduction in number of smokers & SADs with retail margin of 30%.....	67
Table 17: Comparison of health impacts of raising tobacco tax with previous SimSmoke and Abridged SimSmoke models .....	77
Table 18: Consumer Price Index (overall index) in Vietnam from 2010-2020....	98
Table 19: Consumer Price Index for beverage and tobacco products in Vietnam from 2010-2020 .....	99
Table 20: Estimation on Smoking prevalence and Reduction in number of smokers and smoking-attributable deaths in adult population .....	102
Table 21: Short-term policy effect by age groups among males using retail margin at 10%.....	103
Table 22: Short-term policy effect by age groups among females using retail margin at 10% .....	106
Table 23: Short-term policy effect by age groups among males using retail margin at 30%.....	109
Table 24: Short-term policy effect by age groups among females using retail margin at 30% .....	112

# **1. Introduction**

## **1.1. Tobacco use & its burden**

### **1.1.1. Epidemiology of tobacco use**

For ages, tobacco use has been common in human daily lives despite alarming health hazards. So far, a lot has been widely known about its enormous harmful effect on human health and society, but the tobacco industry is still extensively grown and remained a large chunk of the financial cake. Globally, more than 942 million men and 175 million women aged 15 are current smokers and about 80% of them resided in low- and middle-income countries (1). The majority proportion of current smokers used tobacco products on a daily basis (1). The highest male smoking prevalence was observed in East Asia, Southeast Asia, and Eastern Europe (2). The highest female smoking rates are mostly in European countries in contrast to the relatively low figure in Asia (2). China, USA, India and Brazil are known as the biggest tobacco growing and consuming countries (2). There is a noticeable drop of smoking rate in very high-income countries in recent years, however, smoking prevalence has remained at the same level or even continues to rise in many low- and middle-income countries (1, 2).

In Vietnam, tobacco has been a long-standing cultural material for traditional customs of hospitality and binding friendship. In 2015, Vietnam was in the top

25 countries with the highest smoking prevalence which made up to 22.5% for both sexes (3). Among males, the high profile of tobacco use was observed at 45.3% given that smoking remains socially acceptable for men in Vietnamese culture (3, 4). In contrast, the relatively low female smoking prevalence at 1.1% presented a disproportionate pattern of tobacco consumption by gender (3, 4). Tobacco usage among women is expected to remain stable at this level in the future with a wide cultural unacceptance for women to smoke. Cigarettes were identified to be the most popular tobacco product reported by approximately 80.6% of current tobacco smokers (4). Following cigarette, water-pipe tobacco was the second common tobacco products smoked by nearly one-third of the smoking population (3, 5). The use of water-pipe tobacco showed a higher rate in older age groups and rural areas (3). In recent years, a significant increase in smokeless products consumption was observed, especially among young adults and adolescents. Among the youth population, the overall smoking prevalence was found to slightly increase from 3.7% in 2003 (6) to 3.8% in 2007 (7) and reached 4.0% in 2014 (8). This smoking rate was much low compared to the next age group bracket of 15-24, which could be explained by the smoking initiation age at around 18-19 (4). From another viewpoint, there was evidence of the socio-economic disparities in tobacco use in Vietnam (9, 10). Low-price cigarette brands took a considerable share of total cigarette consumption, with the majority of its consumers having low income and living in rural areas or small towns (10).

### **1.1.2. Health and economic burden of tobacco use**

In the 19<sup>th</sup> century, several medical and epidemiologic observations had noticed the association between tobacco use and diseases such as lung cancer. In 1964, the first report of the Surgeon General's Advisory Committee on Smoking and Health released (11) providing concrete evidence on the harmful effect of smoking on human health. Since then, vast amount of scientific evidence has been accumulated to point out the detrimental effect of smoking.

Tobacco contains at least 43 carcinogens and affects almost every organ of human body (11). Anyone smoked would eventually develop nicotine dependence and leading to the accumulation of toxic chemicals for human body through time. For chronic diseases, smoking is the clearest damaging to health among all risk factors. For 109 countries, tobacco use was on the top five health risk factors (1). The annual estimation of 5 million deaths since 1990 was claimed to the use of tobacco (2). In the single year of 2016, over 7.1 million deaths worldwide were attributed to tobacco use with 6.3 million caused by cigarette use and the rest was due to secondhand smoke (2). Male was suffered over 75% of these smoking-related deaths (2). Among the working-age population, smoking-attributable diseases constituted 12% of total deaths worldwide (2). This percentage is highest in Europe and the Americas where tobacco use was reaching its peak while this proportion projected to rise in Africa and Asia when these countries enter the late stage of the tobacco epidemic. All the leading death causes including cancer, cardiovascular

diseases, chronic obstructive pulmonary disease, hypertension, and asthma are heavily tied to tobacco use. Approximately 40–45% of cancers have a causal association with tobacco use while lung cancer, the leading cancer type, has up to 90-95% linked to smoking (12). Chronic pulmonary obstructive disease (COPD) also has about 45% of its deaths attributed to smoking (2). Far beyond the well-known impact on chronic diseases, smoking also has negative impacts on major health challenges such as tuberculosis, HIV infection and other respiratory illness. Long-term exposure to smoking whether primary or secondhand is proven to be the profound background risk factor for several infectious diseases (13). Initial evidence from the COVID-19 pandemic would be a typical example of this consequence (14).

Since tobacco use has become a worldwide epidemic, it also places a huge economic burden at global, regional, and country level. It should be straightly admitted that tobacco product is an extraordinary economic fuel. Its powerful impact on economic growth is in pace and conflicted with the huge economic damage. The health and social implications on individuals and their surrounded communities were far exceeded the face value of tobacco purchases. The World Health Organization (WHO) estimated the annual economic loss of smoking would be half a trillion dollars (15, 16). The economic burden of tobacco use consists of two components: the direct cost of illness to individuals and the indirect cost to society and nonsmoking individuals (i.e. productivity loss, second-hand smoking, ...). Direct health expenditure related to smoking totaled US\$ 422 billion

in 2012 and made up to 5.7% of the world's total health expenditure (17). The indirect cost for illnesses related to smoking is included US\$657 billion for premature deaths and US\$357 billion for disability (17). In combined, the total economic loss for smoking is about 1.8% of the world's annual GDP by nearly reaching US\$ 1,500 billion (17). A substantial percentage of total economic burden at 40% occurred in developed countries (17).

Vietnam also witnessed the same situation since the late 1990s as the wave of health burden and economic burden from tobacco use started to increase following decades of a dominant smoking trend in population. The annual deaths related to smoking in Vietnam were approximately 75,000 people at least, equivalent to more than 200 deaths per day (3). Smoking also attributed to every one-in-five deaths among men (3). A clear upward trend of non-communicable diseases has taken the first ranking in the national burden, pulling smoking up to the top second leading risk factors in Vietnam's burden of disease. In 2011, the direct costs for smoking-related diseases in Vietnam were US\$470.4 million with around 80% constituted by inpatient care (US\$ 470.4 million) (18). The loss of productivity from sicked individuals made up US\$ 580.7 million, represented almost half of total economic loss for smoking (18). In total, the economic cost of smoking in 2011 was around US\$ 1.2 billion, equivalent to 5.76% of the government healthcare budget of the correspondence year (18). Most inpatients' expenses were allocated to treatment for COPD and lung cancer, followed by ischemic disease. This expenditure was

mainly financed by the government (51%) and the rest was placed on households' pockets (34%) and insurance agents (15%). (18)

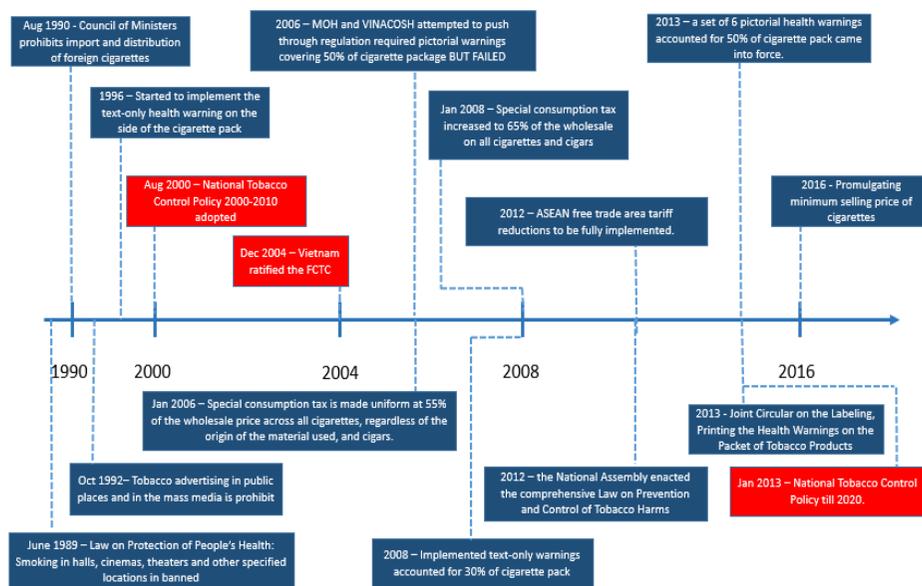
The time-lapse between change in tobacco use and change in its burden on health and economy could be counted by several decades. For very high income countries, positive movement in the burden of tobacco use could be seen later in the 1990s with the activation of the anti-smoking campaign since 1960s (19, 20). However, for developed countries like Vietnam, the aging population and rapid economic growth have put the situation into a tough spot, requiring immediate actions to hinder the rise of tobacco burden before it strikes.

## **1.2. Tobacco control in Vietnam**

### **1.2.1. History of tobacco control in Vietnam (1975 – 2004)**

With a high profile of tobacco use and manufacturing, the history of tobacco control of Vietnam has been recorded quite early. After the independence of Vietnam in 1975, the government's reform program, known as "Doi Moi", was applied in 1986 and revitalize the whole national economy. Much has been changed in tobacco control and manufacturing in Vietnam since then. The timeline of highlighted events in tobacco control from 1975 until now was summarized below in **Figure 1**. In 1989, for the first time, smoking was banned in public entertainment places including halls, theatres, cinemas (21). Also, in May 1989, the Vietnam Committee on Smoking and Health has been established under the supervision of Ministry of Health. In 1990, foreign

cigarette products are prohibited for importing by the Council of Ministers and remained in effect until 2007 when Vietnam officially joined the World Trade Organization. In October 1992, the prohibition of advertisement of tobacco products in public places and mass media was imposed. Since 1996, the text warning on health effect of tobacco use was implemented to print on tobacco packages but it was a small text on the side surface of tobacco packaging. In 2000, duty stamp on cigarette package was introduced on all local tobacco brands. In the same year, the National Tobacco Control Policy for 2000-2010 was adopted to move forward the government’s commitment to tobacco control, aiming to reduce the smoking prevalence among men from 50% to 20% (22). And in December 2004, Vietnam signed the FCTC taking the national actions on tobacco control to be aligned with the world’s standard.



**Figure 1: Timeline of tobacco control activities in Vietnam from 1990 to 2016**

### **1.2.2. MPOWER implementation in Vietnam (2005 to now)**

After being adopted in 2003 at the 56th World Health Assembly, WHO Framework Convention on Tobacco Control (FCTC) has redefined the global and country-level approach on tobacco control. The successful implementation of FCTC in many countries has shown a prominent reduction in tobacco use and Vietnam was not an exception. Starting with some existed activities on tobacco control before 2004, the MPOWER package in Vietnam has gradually implemented in Vietnam in both political and social settings.

#### **➤ *Monitoring tobacco use and prevention policies***

Since 1990s, tobacco use has been recorded in Vietnam in several national surveys including Vietnam Living Standards Survey (VLSS) 1992-93, 1997-98 (23, 24); Vietnam National Health Survey (VNHS) 2001-2002 (25); Vietnam Household Living Standard Survey 2006 (25). From 2005, the monitoring tobacco use and its prevention activities were comprehensively covered in Global Surveillance Surveys which includes Vietnam National Surveys on NCD Risk Factors (STEPS) 2005 (26) and Global Adults Tobacco Use survey (GATS, 3 rounds in 2010, 2015 and 2020) (3, 27, 28). The tobacco use among youth also tracked in all national surveys on adolescents such as Survey Assessment of Vietnamese Youth (SAVY, 2 rounds in 2003 and 2006) (29); Global Youth Tobacco Use survey (GYTS, 2 rounds in 2007 and 2014) (7, 8) and Global School-based Student Health survey (GSHS, 2 rounds in 2012 and 2019). Additionally, tobacco use is also recognized as an important predictor in

health research and documented in several large studies on non-communicable diseases across the country (4, 30, 31).

In term of prevention policies, following the enactment of the first comprehensive Law on Prevention and Control of Tobacco Harms in 2012, the Vietnam Tobacco Control Fund (VNTCF) has been established in 2013 using the earmarked tax from tobacco companies (32). The Vietnam Tobacco Control Fund was managed and also known as the Vietnam Committee on Smoking and Health (VINACOSH) (33). The establishment of Vietnam Tobacco Control Fund is to oversee the implementation of and mobilize financial resources for tobacco control activities. Hence, the implementation of prevention policies in Vietnam has been well rounded and improved with sustainable funding and regular monitoring from the Vietnam Tobacco Control Fund. Through the vertical approach, the Vietnam Tobacco Control Fund has been closely worked with the health system to monitoring the implementation of tobacco control at all levels while also extensively support the capacity of network of prevention of tobacco control nationwide.

➤ *Protecting people from secondhand smoke*

Following the partial bans of smoking at a few specific public places in 1989, the smoke-free model was implemented in a wide range of public places following the WHO's recommendation. Health facilities; indoor workplace; child care and entertainment areas; educational facilities; restaurants are subjected to smoke-free law with financial punishment for violations (32). After being in effect in 2013, the smoke-free model has been widely implemented in different settings but varied

in the compliance level (33). The compliance level at educational facilities, governmental facilities, healthcare facilities and indoor workplaces scored from 6-8 on a 10-point ranking. The worst compliance was recorded in restaurants (scored 1/10) with no smoke-law existing for cafés, pubs, bars and public transports. The overall compliance of this intervention was rated 3 out of 5 following the WHO report on MPOWER 2019 in Vietnam. (34)

➤ *Offer helps to quit tobacco use*

The cessation activities for tobacco use was initiated later than other interventions. Following the instruction of the 2012 Law on Tobacco Control, Vietnamese government had regulated the detailed implementation of cessation activities in the Decree number 77/2013/ND-CP (35). This decree indicated the establishment of tobacco cessation treatment and counseling services in health centers along with the guideline on delivering pharmacological therapy and the establishment of a quit line. Up to now, cessation services are set up in a toll-free Quitline in 2 national hospitals (Bach Mai hospital in Hanoi & Nhan Dan Gia Dinh Hospital in Ho Chi Minh city) and the specialized cessation counseling services in another 8 big hospitals across country (33, 36). Besides, the Vietnam Tobacco Control Fund has annual budget to strengthen the capacity of cessation services in health facilities from national level to district level (33).

➤ *Warn about the dangers of tobacco*

This intervention consists of two main components: (I) health education and communication on tobacco harm and (ii) health warning on tobacco packaging. Health

education was the leading prevention activity with a considerable budget allocation annually. With the stable and generous funding from Vietnam Tobacco Control Fund, health education and communication activities have been extensively carried out with a great population coverage through a wide range of channels and multiple sectors. There are 20 ministries and almost every health center receiving funds to conducting the awareness campaign every year (36). The annual survey on awareness campaigns in Vietnam from 2014-2018 (Vital Strategies) showed good coverage with more than 50% of respondents received messages on tobacco harms from at least one channel (36).

In the other hand, health warning has gone through a long fight to reach the WHO recommendation of pictorial warning covered 50% of tobacco packaging. Before 2005, tobacco packaging only has a small-size text warning on one side surface with a short message of “Smoking is harmful to health” or “Smoking causes lung cancer” (33). But after the FCTC took effect in 2005, only a text-warning on 30% of the principal surface was imprinted starting from March 2008 despite the effort of health advocacy and VINACOSH-MOH. It took another five years to gather evidence on the weak impact of these text-warnings so that the regulation of pictorial warning at 50% of both front and backside of cigarette package was indicated in the 2012 Law on Tobacco Control (32). Furthermore, from 2016 to now, Vietnam has successfully implemented the anti-smoking campaign on mass media which prohibited any image or material of smoking in all kinds of broadcasting programs (excepted for health education on tobacco harms). As a result, Vietnam has been classified for the highest

achievement on W intervention (Warn about the danger of tobacco use) in MPOWER report since 2015 (34, 37, 38).

➤ ***Enforce bans on tobacco advertisement, promotion and sponsoring***

The ban on advertisement, promotion and sponsoring was the first anti-smoking activity throughout the history of tobacco control in Vietnam as its consumption was not encouraged in Vietnam. In the National Tobacco Control Program in 2000, the comprehensive ban on tobacco advertising, promotion and sponsoring had been mentioned and implemented. The ban was well enforced on direct advertising channels such as national TV, radio, billboards with the compliance of 9 out of 10 (34). Anh et al 2010 found an average of about 90% of surveyed point-of-sales having at least one advertising or promotion activity (39). For promotion and sponsorship, the violation still occurred under the form of free distribution and promotional discounts. Serious violations at point-of-sales remained a huge issue for the comprehensive implementation of this intervention and required multisectoral cooperation for stronger actions. (33)

➤ ***Raising tobacco taxes***

Raising tobacco tax has been recognized as the most effective approach among MPOWER package in many countries. In Vietnam, tobacco is one of the commodities subjected to the special consumption tax. Before 2006, there are three different tax levels for 3 types of cigarettes including non-filtered (25%), filtered mainly made from domestic materials (45%) and filtered mainly made from imported materials (65%)

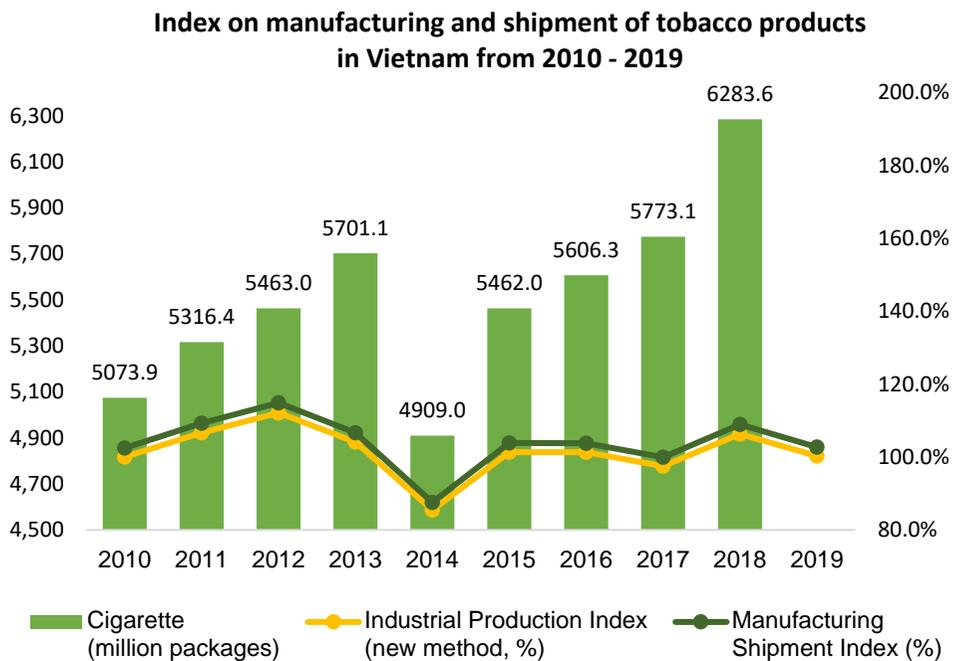
(40). After the ratification of FCTC, the special consumption tax was revised for cigarettes with four times of tax raise in 2006-2007 (55%); 2008-2015 (65%); 2016-2018 (70%) and in 2019 (75%) (41). However, the tax increase from 2006 up to now still falls short of WHO recommendation, only achieving a minimal level of MPOWER recommendation (42). Plan of raising tobacco tax in the next period is currently under review of Vietnam National Assembly. As the main topic of this study, raising tobacco tax and related issues would be fully described in section **1.4 Tobacco tax and price** below.

### **1.3. Tobacco industry in Vietnam**

Even though the health hazard of tobacco use is obvious, the tobacco industry in Vietnam is still growing and stayed at the second-rank of financial contribution after the petroleum industry (9). From 1961 to 2010, the farmland for tobacco growing has nearly triple increased from 11,000 hecta (1961) to more than 31,000 hecta (2010) and drop to about 14,000 hecta in 2017 (9, 43). This reflected a similar trend in tobacco production in which the raw tobacco production in 2010 is about 4-5 times higher than the annual production in 1960-1970s (56,530 tons in 2010 versus 10,000-15,000 tons in 1960-1970). This amount of raw tobacco production was dropped to more than 32,000 tons in 2017 but remained three times larger than the 1960s figure (9, 43).

**Figure 2** showed the market size of tobacco industry in Vietnam from 2010 to 2020 taken from the Vietnam General Statistics Office (GSO) (44, 45). The number of cigarette packages increased over time except for a decrease in 2014. In 2016, the total

market size of cigarette product has reached 683.6 million packages, equivalent to more than 136 billion sticks, almost double the market size in 2006-2007. Also, the table showed the increase of tobacco manufacturing and shipment over time through the Industrial Production Index and the Shipment Index of Manufacturing. Industrial Production Index characterizes the relative change of volume of tobacco products produced over one year (46). Manufacturing Shipment Index represented the relative change in shipment volume of tobacco products over one year (46). These indexes were both compared to the base year of 2010. Interestingly, there was a decline in both tobacco production and consumption in correspondence with highlighted events in tobacco control. Respectively, Vietnam has the establishment of Law on Tobacco Control in 2012; Vietnam Tobacco Control Fund in 2013 and the heaviest tax raise in 2017.



**Figure 2: Manufacturing and shipment of tobacco products in 2010-2019**

The tobacco industry in Vietnam includes 16 Vietnamese cigarette manufacturers with the government holds a monopoly on cigarette production (9). According to Euromonitor International 2016, Vinataba, as the most popular brand, dominates the cigarette market in Vietnam with about 60% share of the tobacco market (47). British American Tobacco (BAT) has 26% market share, followed by Phillip Morris Incorporation. (PMI) with 3% and Japan Tobacco Incorporation. with 1.5% (47). Other local tobacco companies have the rest of the market. Historically, Vinataba attempted to merge all players under its umbrella but failed due to strong objection from both local authorities and medium-sized enterprises. In the short term, it was projected to keep the dominant role in the tobacco industry development in Vietnam.

The tobacco industry in Vietnam mainly focused on domestic manufacturing with a small volume of annual imports (around 1.6 tons in 2019 (48)). However, Ministry of Industry and Trade reported that about half of tobacco leaves used in tobacco manufacturing are imported (49). The illicit trade of tobacco products was predicted to range from 0.5% to 10% of total market share due to its nature of difficulty to measure (9). The most recent study on illicit tobacco trade in Vietnam showed that from 2010-2016, the amount of tobacco products smuggled out was bigger than the amount of tobacco products smuggled into Vietnam, resulting in a net outflow of illicit trade (50).

## **1.4. Tobacco tax and price**

### **1.4.1. Tax structure for tobacco products**

In Vietnam, current taxes on tobacco products comprise (1) special consumption tax (or *excise tax*); (2) import tax and (3) value-added tax together with a compulsory contribution for Vietnam Tobacco Control Fund.

Firstly, the excise tax was imposed on the pre-tax, ex-factory price (hereinafter as *factory price*) which consists of *ad valorem tax* and/or *specific tax*. The ad valorem tax is charged as percentage of the factory price, hence, able to retain its impact on the actual value of tobacco products over time. The specific tax is charged based on the quantity or weight of tobacco products with a fixed value. The specific tax is easy to administer but the real value might decline over time due to inflation. With the case of high inflation in Vietnam, an adjustment of specific tax based on a price indicator (i.e. consumer price index) is highly recommended (51, 52). Currently, the excise tax has been made uniform for all types of cigarettes and cigars at 75% of factory price following the Law 70/2014/QH13 on amended Law on Special Consumption Tax.

The import tax is the second tax imposed on tobacco products after Vietnam joined the World Trade Organization in 2007. The tax rate of 140%, 125% and 30% was charged to the imported price of cigarettes, cigars and tobacco materials respectively (53). Thirdly, the value-added tax (VAT) is imposed on the pre-VAT retail price and remained at the same rate of 10% since 1999 (53).

Aside from product tax, the compulsory contribution of the factory price was imposed on all domestic and import products for the Vietnam Tobacco Control Fund. The rate was charged at 1% in 2013, raised to 1.5% in 2006 and reached 2% in 2019 (53).

In addition to product tax, the enterprise income tax (or *profit tax*) is imposed on tobacco companies. This tax rate has gradually declined since 1990 which hit 40% in 1993 and fall to 32% in 1999 and eventually dropped to 28% in 2004 (53). However, since the profit tax was not part of the product tax calculation, it will not be included in this study.

**Table 1: Description of tax calculation on cigarettes in 2019**

Tax types	Tax rates	Tax base	
		Domestic	Import
Import tax (import duties)	140%		Import price (included cost, insurance, freight)
Special consumption tax (excise tax)	75%	Factory price	Import price + Import tax
Tobacco Control Fund	2%	Factory price	Import price + Import tax
Value added tax (VAT)	10%	Factory price + Special consumption tax	Import price + Import tax + Special consumption tax

### **1.4.2. Price and tax share of cigarette in Vietnam**

The main objective of this section is to describe the current situation of cigarette price and tax in Vietnam. However, it is important to distinguish the price increases and tax increase as well as understand its role in the development and assessment of the new tobacco tax policy.

To measure the tax intervention, WHO uses total tax share as a standard indicator for country-level implementation due to the different characteristics in economic scale and measurement in each country. The total tax share was defined as the percentage of total consumption tax (special consumption tax and VAT) on the retail price. The optimal range of total tax share in retail price was from 65-80% with solid evidence from many countries (52). Usually, total tax share is used as a parameter of tax increase in multiple countries comparison.

On the other hand, to develop and assess the new tax policy, price increase is applied instead of tax increase. Because tobacco consumption is depended on the retail price since the demand curve of tobacco consumption would be directly affected when the retail price changes. Otherwise, the translation of tax increase to the increase in final consumer price depends on many other factors such as tax structure, inflation or the profit level of tobacco products. The cigarette affordability index is also used for assessing the compliance level of raising tobacco tax. In this study, both price increase and tax increase are reported.

The GATS 2015 reported that the average retail price of cigarette was 11,800 VND per pack (3). The study on tobacco market in 2016 also estimated the average retail price of cigarettes in Vietnam at 12,500 VND per pack with the factory price of 4,804 VND/pack (54). There is an increasing trend in the retail price of cigarette over time, however, it was also reported a decline in the real term after adjusting for inflation. Guindon et al 2010 found that the real price of tobacco products had declined by about 5% from 1995 to 2006 in contrast to the increase in the absolute value of more than 50% (9). It should be noted that the average price of the most popular brand was much higher than the estimated average price. The retail price of Vinataba, the most popular brand, is about 19,000 VND in 2015 (3, 37) and about 20,000 in 2018 (9). From 2006 to now, the tax rate has been increased several times, however, only cheap-price products observed the actual tax increase. It seems that the increase in tax rate could not keep in pace of inflation and did not raise the actual price of tobacco products as expected (9, 42, 54).

In term of tax share, the total tax proportion in retail price of cigarette was far below the recommended level. Assuming the retail margin at 10%, Guindon et al 2010 (52) estimated the tax share of tax-exclusive retail price was about 39% in 2007 and 43% in 2008. At a higher margin level of 20%, a tax share of 36% of retail price was reported in WHO report in 2017 (38). These contradictory trends suggested careful and comprehensive monitoring and assessment for developing new tax policy.

### **1.4.3. Road map of raising cigarette tax in Vietnam**

In 2013, the National Strategy on Tobacco Harm Prevention and Control until 2020 was approved with a target smoking prevalence of 39% among men in 2020 (55). In 2014, the amendment of special consumption tax was approved, declared an increase of excise tax on tobacco products to 70% (from 2016-2018) and continue to rise to 75% from January 2019. However, this plan was considered ineffective to achieve the set target. Hence, in August 2017, the Ministry of Finance has prepared and submitted the draft plan of raising tobacco taxes for 2020 onward. The draft law proposed amendment in some regulations of Special Consumption Tax, VAT as well as the Enterprise Income Tax. A mixed structure on excise tax along with the 2019 tax level was suggested. Ministry of Finance suggested a consecutive rise of ad valorem tax from 75% (2019) to 80% (2020) and 85% (2021); or adding a specific tax of 1,000 VND per 20-cigarette pack. Ministry of Health also supports the mixed excise tax but proposed a higher specific tax at 2,000 – 5,000 VND per pack.

Another point worth mentioned here is the technical issue on the excise tax structure. An impression of a high tax rate has been long argued (mainly by tobacco industry) but in fact, it is quite low after price transferring. The main reason is that the real tax based on tobacco products implicitly declared by tobacco companies. In 2016, Vietnam was in top three countries with lowest factory price in Western Pacific Region at the average cigarette producer price of US\$ 0.59 per pack (9).

The existing excise tax rate was based on percentage of factory price, leading to a small share in the actual consumer value of tobacco products. In the amendment of special consumption tax in 2014, the raising tobacco policy was framed by increasing the absolute value of excise rate from 65% to 75% and more.

## **1.5. Simulation models in tobacco control: SimSmoke & Abridged SimSmoke model**

Simulation models of tobacco use have been employed at least since the early 1980s (56). With early anti-smoking activities implemented since 1960s, there are several simulation models to assess impacts of implemented tobacco control policies in terms of health, economic and social impacts (57). To the best knowledge, the earliest simulation model in tobacco control belonged to Mendez and Warner's developed in 1998 (58, 59). Following that, there was some distinct simulation model on combined tobacco control policies such as HECOS model (Orme et al. 2001 (60)); Tobacco Policy Model (Tengs et al. (61, 62)) and SimSmoke models (Levy et al. (63)). Among these, the SimSmoke Model considered a broader array of public policies than the other models and have gained attention for application in more than 30 countries and states (63).

SimSmoke model is a dynamic simulation model that assessed both the impact of existing tobacco control policies and future trend of smoking prevalence. This model allowed the analysis of individual policies and the combined set of different policies. However, the full SimSmoke model requires a large-scale survey of

tobacco use which provides explicit data on smoking use, initiation rates and quitting rates by age and gender. Unfortunately, this requirement is not yet accomplished in many low and middle-income including Vietnam.

On the other hand, the Abridged SimSmoke model has been developed as a static model, simplifying from SimSmoke which allowed the comparative evaluation of policies and interventions at country-level (64, 65). Approaching through a static concept, the Abridged SimSmoke model has more flexible data requirements that are available with the biennial WHO Report on the Global Tobacco Epidemic in Vietnam. Another advantage of Abridged SimSmoke is the Excel-based programming which makes it user-friendly and transparent. Like the complete SimSmoke, the abridged version allowed the assessment of separated tobacco control policy. As such, the Abridged SimSmoke model is the most optimal option for this study topic in Vietnam's context.

## **1.6. Rationale of study**

Raising tobacco tax is the most effective approach to control tobacco harms. To support the policy planning of tobacco control in the next period of 2020-2030, there is an urgent need for strengthening the evidence of raising tobacco tax in Vietnam. Also, the findings of Vietnam Global Adults Tobacco Use 2020 would be available by the end of this year. Therefore, this study aimed to develop a transparent simulation model on raising tobacco tax which enables the excellent processing and analysis of updated information on tobacco use. Afterward, this

model is expected to set an example for the wide adoption of other tobacco control interventions with the main purpose of serving the policymaking process.

### **1.7. Study objectives**

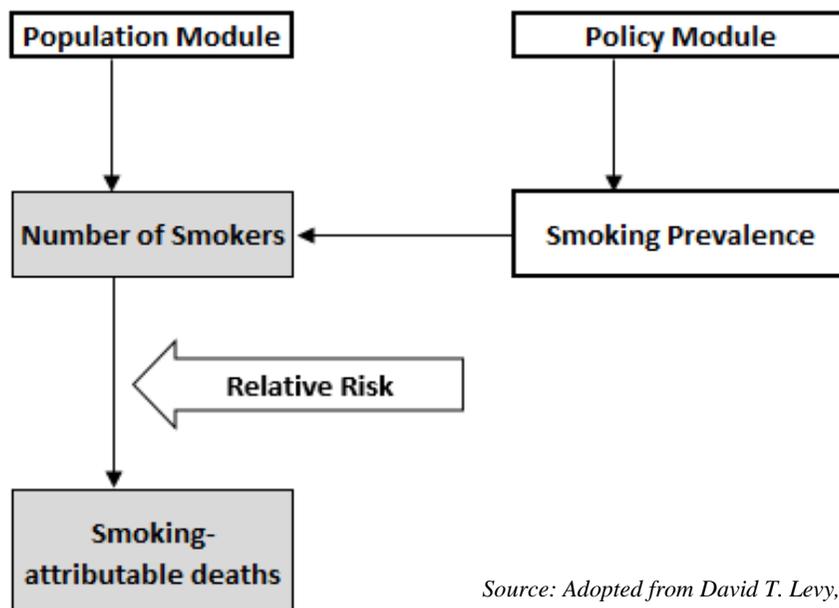
The overall purpose of this study is to support the evidence on health impact of different plans of raising tobacco tax in Vietnam. The specific objectives of this study included

- 1) Examine the cigarette price and tax in different plans for raising cigarette tax in Vietnam.
- 2) Estimate potential health impacts of different plans for raising cigarette tax in Vietnam through the application of Abridged SimSmoke model.

## 2. Methodology

### 2.1. Model structure

Following the original concept, the model structure was constructed with 3 modules: Population module; Smoking Prevalence module, and Policy Effect module (see **Figure 3**). The model was developed in Excel, covered the time frame from 2015 to 2020 by using the latest findings of Vietnam Global Adults Tobacco Use Survey 2015 and the implementation of new tax policies on tobacco products in Vietnam in 2021. The impacts of tax policy were estimated for the short-term (5 years after implementation) and long term (40 years).



*Source: Adopted from David T. Levy, 2004*

**Figure 3: Structure of the Abridged SimSmoke model**

Like the original SimSmoke model, the abridged version forecasted changes in smoking prevalence under the impact of new policy, then translated into smoking-attributable deaths resulting from the implementation of different tax plans for the period of 2021-2030. Specifically, the model would first calculate the baseline population cohort and the smoking cohort which are fully described in the below section. Afterward, the price increase was calculated in each tax scenarios and later used to calculate the effect of each new policy. The policy effect was then presented as the reduction in smoking prevalence of current smoking population. In the final module of SAD, the model used the relative reduction of mortality rate of current smokers compared to non-smokers to estimate the reduction in smoking-attributable death after implemented new policy. Required data inputs was described in *Table 2*. Since domestic cigarettes took the dominant share of tobacco market and limited data on a variety of tobacco products, the scope of this model would focus on domestic cigarettes only.

**Table 2: Data inputs & data sources**

<b>Input</b>	<b>Category</b>	<b>Table</b>	<b>Sources</b>
<b>Population Module &amp; Smoking Module</b>			
Population size	Break down by age group, gender, and residence	Table 3	Vietnam General Statistics Office (year 2015) (66)
Smoking prevalence	Break down by age group, gender, and residence	Table 3	Vietnam Global Adults Tobacco Use survey 2015 (3)

<b>Policy Module</b>			
Base price of tobacco products	Included factory price, retail margin and retail price	Table 7	Vietnam TaxSim simulation model (Vietnam Ministry of Finance, 2010) (54)
Price and tax components of cigarettes	Included data on excise tax, value added tax, tobacco control fund, retail margin at baseline	Table 7	Law on Special Excise Tax 2008 (67) & Law on Amendments of Special Excise Tax in 2014 (41)
Tax scenarios	Combination of proposed plans on changing ad-valorem tax and specific tax	Table 4	Discussion with experts from Vietnam MOF, MOH & WHO; Minh et al 2018 (42)
Retail price of cigarette	The final consumer price of 20-cigarette pack	Table 7	Author's calculation
Price elasticity of demand	Break down by high-, middle- and low-income country	Table 6	(52, 64, 65, 68, 69)

Consumer Index Price	Specific for beverages and tobacco products from 2010 to 2020 (April)	(Annex 1/ Table 19)	Vietnam General Statistics Office (year 2015) (70)
<b>Smoking-Attributable Death Module</b>			
Mortality rate	Applied for all current smokers	Table 6	(71)
Probability of avoiding premature death due to smoking	Break down by age group of quitting	Table 6	(71, 72)

## 2.2. Model inputs & assumptions

### 2.2.1. Population Module & Smoking Module

To simplify the flow structure of SimSmoke model, the abridged version employed one static cohort of population aged 15 years old and above with a fixed pattern on age group and gender. Due to the disproportionate pattern of smoking by gender, the model has separate modules for males and females to avoid the skewed estimation. For each gender, the population would be divided by 10-years age groups (15-24; 25-34; 35-44; 45-54; 55-64; 65+) and by residence (rural/urban) (see *Table 3*). Population data was taken from the Vietnam Population and Housing census 2015 (66). Number of current smokers

was calculated using data on demographic structure in Population Module and data of smoking prevalence in the corresponding population groups. Dataset of Vietnam Global Adults Tobacco Use surveys 2015 (3) was analyzed using SAS 9.4 to obtain the weighted figures of tobacco use in the study cohort.

**Table 3: Population size & Smoking prevalence**

	<b>Total</b>	<b>Male</b>	<b>Female</b>	<b>Urban</b>	<b>Rural</b>
<b>Population size</b>					
Total	69,521,302	33,599,511	35,921,793	23,991,940	45,529,366
15-24	13,727,680	7,018,848	6,708,832	4,465,165	9,262,516
25-34	14,836,331	7,389,728	7,446,603	5,278,602	9,557,730
35-44	13,502,779	6,688,147	6,814,632	4,757,572	8,745,206
45-54	12,196,790	5,903,079	6,293,710	4,267,763	7,929,027
55-64	8,324,364	3,853,037	4,471,327	2,990,662	5,333,702
65+	6,933,358	2,746,672	4,186,689	2,232,176	4,701,185
<b>Smoking prevalence</b>					
Total	22.69%	45.67%	1.09%	20.68%	23.70%
15-24	12.96%	24.78%	0.54%	11.04%	13.83%
25-34	25.04%	47.80%	0.49%	20.65%	27.45%
35-44	29.33%	60.07%	0.77%	28.01%	30.01%
45-54	27.68%	57.81%	1.98%	26.91%	28.08%
55-64	25.10%	50.55%	1.78%	21.52%	27.01%
65+	15.11%	35.53%	1.85%	13.60%	15.78%

## 2.2.2. Policy Module

### 2.2.2.1. Model scenarios

There are seven scenarios of raising tobacco tax included in this model (see *Table 4*). These scenarios illustrated both the core plans (what can be achieved at the current time) and the desirable plans (what can be achieved in the future). The first 5 scenarios represented two proposed plans by Vietnam Ministry of Finance (MOF) (scenario 1 & 2) and three proposed plans by Vietnam Ministry of Health (MOH) (scenario 3, 4 & 5) which might take effect since 2021. The two extreme scenarios (scenario 6 & 7) were developed based on discussions with experts in Vietnam to suggest potential strategies on achieving the 2025 target set by Vietnamese government (10% reduction in smoking prevalence).

**Table 4: Model scenarios on raising tobacco taxes in Vietnam**

Scenario	Excise tax		VAT	Source
	Ad valorem tax	Specific tax		
Scenario 1	80%	0	10%	MOF
Scenario 2	75%	1,000	10%	MOF
Scenario 3	80%	1,000	10%	MOH
Scenario 4	80%	2,000	10%	MOH
Scenario 5	75%	5,000	10%	MOH
Extreme scenario 1	80%	5,000	10%	Author's
Extreme scenario 2	100%	5,000	10%	Author's
Extreme scenario 3	200%	5,000	10%	Author's

### 2.2.2.2. *Calculation of policy impact on smoking prevalence*

In the Policy Module, the effect for tax policies is the product of (i) the actual magnitude of retail price increase and (ii) price elasticity of demand of tobacco products. The reduction in future smoking prevalence would be estimated using (i) the current smoking prevalence and (ii) the policy effect size in short-term and long term. All model algorithms are taken from the original Abridged SimSmoke model and described in three main steps as below.

#### ➤ Calculation of price increase

Due to the limited scope of this model, the price increase was estimated based on the change of retail price of domestic cigarette using 2015 as base year. The increase in retail price was calculated as the gap between the retail price in 2015 and 2020 using an arc elasticity formula.

$$\Delta P = \frac{P_{2015} - P_{2020}}{0.5 \times (P_{2015} + P_{2020})} \quad (1)$$

*In which:*

$\Delta PREV$  = Change in inflation-adjusted retail price between 2 specific years;

$P_i$  is the inflation-adjusted retail price of year  $i$ .

Data on price and tax of tobacco products was taken from Vietnam WHO Tobacco Tax Simulation Model (TaxSiM) (54) which collected the retail price of popular tobacco brands from 1998 to 2016. However, due to the lack of data on the average retail price of cigarette in Vietnam, the model used the most recent data of factory

price in 2016 as the base price for calculating the final retail price with assumption that, without inflation, the factory price remained constant from 2015-2020. The retail price from 2015 to 2020 was calculated separated for each year with (1) inflation - adjustment on the factory price and (2) changes in tax structure. Each year, the retail price is the total amount of factory price; excise tax; tobacco control fund; retail margin and VAT. The base value of excise tax and tobacco control fund was applied to the factory price. The amount of VAT was calculated as 10% of the factory price and excise tax. Finally, after combined the values of factory price, excise tax, VAT and tobacco control fund, the retail margin of 25% was applied to estimate the final consumer price.

➤ Calculation of policy effect size

The policy effect size used data from a single year to project the effect after short-term or long-term implementation. Short-term is defined as the 5-year after the implementation of the new policy and (ii) long-term is defined as 40 years after the implementation. The time frame of short-term and long-term projection was estimated from the complete SimSmoke (73) and applied in all Abridged SimSmoke models (64, 65, 73, 74). By assuming the policy level remains constant for both tax policy and non-price policies, the effect size is applied to the smoking prevalence in the year of new tax policy taking effect. Due to the change in tobacco tax policy and the availability of data on tobacco use in Vietnam, the model tracked the policy levels from 2015 to 2020 and projected the effect of new tax policy at 2025 (short-term) and 2060 (long-term). The short-term effect was calculated the reduction in smoking

prevalence from 2020 to 2025 based on the change in retail price from 2015 to 2020. The long-term effect is derived by multiplying the short-term effect with a long-term multiplier and the price elasticity. The formulas of short-term policy effect (ST-PRICE) and long-term policy effect (LT-PRICE) was employed as in below.

$$\mathbf{ST-PRICE = E \times \Delta P} \quad (2)$$

$$\mathbf{LT-PRICE = E \times \Delta P \times LT-MULT_{price}} \quad (3)$$

*In which:*

*ST-PRICE; LT-PRICE = Short-term & long-term effect size of price policy*

*E = price elasticity of consumption;  $\Delta P$  = Change in inflation-adjusted retail price (formula 1)*

*LT-MULT<sub>price</sub> = long-term multiplier of tobacco price and tax policy*

In this formula, the price elasticity of cigarette was obtained from previous SimSmoke model conducted in low-and-middle-income countries due to the dominance of cigarette consumers in tobacco industry in Vietnam. The value of -0.25 and -0.20 was assigned for low-income and middle-income country respectively. Otherwise, the long-term multiplier was set at 2 following previous Abridged SimSmoke models.

➤ *Calculation of short-term and long-term smoking prevalence after policy implementation*

The arc formula of prevalence elasticity was employed to estimate the change in smoking prevalence in the short-term and long term after policy

implementation. In this model, the prevalence elasticity was assumed to constant over the modelled time frame.

$$E = \frac{\frac{PREV_{2015} - PREV_{2020}}{0.5 \times (PREV_{2015} + PREV_{2020})}}{\frac{P_{2015} - P_{2020}}{0.5 \times (P_{2015} + P_{2020})}} \quad (4)$$

*In which:*

$PREV_i$  = Smoking prevalence in year  $i$ ;  $P_i$  = Retail price of cigarette in year  $i$

Applying the result of formula (2) and (3) in the formula (4), the future smoking prevalence under the short-term effect and long-term effect could be estimated as in below:

$$ST-PREV = PREV_{2015} \times \frac{2 \times ST-PRICE + 1}{2 \times ST-PRICE - 1} \quad (5)$$

$$LT-PREV = PREV_{2015} \times \frac{2 \times LT-PRICE + 1}{2 \times LT-PRICE - 1} \quad (6)$$

### 2.2.3. Smoking-Attributable Deaths Modules

Under the impact of tax policy, the reduction in smoking prevalence obtained from smoking module would be inputted to Smoking Module. This step is to re-calculate the change in number of current smokers after 5 years and 40 years of implementation. Based on the change in number of smokers, the number of smoking-attributable deaths (SADs) was calculated using the algorithm on relative risk of death from smoking. The model employed the finding of Doll et al (2004) (71) to assume that half of current smokers would die prematurely. This assumption was from Doll

et al 2004 showing the probability of avoiding premature death by quitting within a specific age range that obtained for a 50-year time frame (71). Also, the reduction of SADs would multiply the mortality rate with the relative reduction of mortality rate at age of quitting to obtain the estimation of SADs separately for 6 age groups. Specifically, about 98% of smokers quitting at age 15-24 could avoid premature death while this chance would decline with years quit from 85% (for aged 25-44) to 75% (for aged 45-64). For the eldest age group of 65 and above, only 25% could avoid a premature death (71, 72).

### **2.3. Model validation & Sensitivity analysis**

To validate the model prediction, we carried out the pilot model analysis with data in 2010-2015 together with sensitivity analysis on important model assumptions. In the pilot model analysis, the base year was set at 2010, providing the price increase of 25.4% at 2015 and provided similar projection to the observed data in 2015. The overall smoking rate in 2015 was projected at 22.62% (22.34% - 22.91%) compared to the reported prevalence of 22.5% in GATS 2015 (2). For men, the smoking prevalence was predicted at 45.05% (44.48% - 45.63%) which is close to the 2015 figure of 45.3%. Female remained at a steady low level of smoking. Rural area showed a similar result between projected and observed rate. However, observed rate in urban areas was merely at the lower limit projection which could be initially explained by the strong coverage of non-price interventions at urban areas (cessation services or smoke-free model).

**Table 5: Model validation with data from 2010 to 2015**

Groups	Baseline (2010)	2015	
		Projected	Observed
Total	23.8% (22.7%-24.9%)	22.62% (21.30%-23.97%)	22.5% (21.3%-23.8%)
Male	47.4% (45.4%-49.4%)	45.05% (42.61%-47.55%)	45.3% (43.1% -47.5%)
Female	1.4% (1.0%-2.1%)	1.33% (0.94%-2.02%)	1.1% (0.7%-1.6%)
Urban	23.3% (21.9%-24.7%)	22.15% (20.55%-23.78%)	20.6% (19.1%-22.3%)
Rural	24.0% (22.5%-25.6%)	22.81% (21.12%-24.64%)	23.5% (21.8% - 25.3%)

The sensitivity analysis was conducted on all three main assumptions used in this model including retail margin level; price elasticity and mortality rate (see **Table 6**).

Firstly, since the price increase was considered the most important parameter in this model, it is strongly influenced by the level of retail margin in the final consumer price. In general, the model applied the retail margin at 25% which brought the total tax share of retail price reached 36%, consistent with previous reports on tobacco tax in Vietnam. However, since the economy in Vietnam changes rapidly recently, the tobacco industry could lower the retail margin to keep retail price stable for their consumers. Therefore, retail margin at 10% and 30% were inputted for sensitivity analysis.

Secondly, Vietnam have moved to lower-middle-income country in 2018 which resulted in the change of suggested values from SimSmoke. Also, the price elasticity

of demand was taken from several studies and literature reviews, it might not be presented for Vietnam’s actual context. Therefore, both price elasticity of low-income country (-0.25) and middle-income country (-0.20) was applied and modelled. The lower and upper bounds of 25% were also employed in each price elasticity level.

Thirdly, there is an estimation that about 50% of cigarette smokers will die prematurely. However, in low- and middle-income countries, this figure can be lower at around 30% due to the attribution of other environmental factors (42). Hence, the mortality rate of 30% and 55% was applied for all age groups to assess the closeness of model outcomes with general findings from previous studies.

**Table 6: Sensitivity analysis on model’s main assumptions**

<b>Parameters</b>	<b>Category</b>	<b>Value</b>	<b>Lower limit</b>	<b>Upper limit</b>
Price elasticity of demand	Middle-income country	-0.20	-0.15	-0.25
	Low-income country	-0.25	-0.19	-0.31
Cigarette mortality	All age groups	50%	30%	55%
Retail margin	All tax scenarios	25%	10%	30%

### **3. Results**

#### **3.1. Description of Cigarette Price and Tax in model scenarios**

**Table 7** showed the cigarette tax and price components in seven scenarios of raising cigarette tax in 2020 in Vietnam. The main difference is on the change of excise tax rate which includes an increase in ad valorem tax and/ or an additional specific tax per 20-cigarette per pack. The increase in tax was accompanied by a rise in the earmarked tax for tobacco control fund from 1.0% in 2015 to 1.5% in 2016 and reached 2.0% in 2020. The factory price of one cigarette pack was 4,700 VND in the base year of 2015 and was 5,133 VND in 2020 (inflation-adjusted) assuming that the factory price remained constant over this period. The ad valorem tax was calculated based on the factory price and the corresponding rate in each scenario. The retail margin was set at 25% of the retail price. The percentage of total tax was varied from 38.1% to 58.2% while the retail price was increased from 18.0% to 89.7% compared to the 2015 retail price. The two extreme scenarios were not designed to meet the WHO recommendations but enable to drop short-term smoking prevalence to under 20% (extreme scenario 1) or achieve a drop of 10% compared to 2015's rate (extreme scenario 2).

**Table 7: Cigarette tax and price components in seven model scenarios**

Indicators (per 20-cigarette pack)	2015 (base year)	2020							
		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Extreme scenario 1	Extreme scenario 2	Extreme scenario 3
<b>TAX STRUCTURE</b>									
Ad-valorem	65%	80%	75%	80%	80%	75%	80%	100%	200%
Specific	-	-	1,000	1,000	2,000	5,000	5,000	5,000	5,000
Tobacco control fund	1.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
VAT	10%	10%	10%	10%	10%	10%	10%	10%	10%
Retail margin	25%	25%	25%	25%	25%	25%	25%	25%	25%
Inflation rate	0.00%	9.21%	9.21%	9.21%	9.21%	9.21%	9.21%	9.21%	9.21%
<b>PRICE &amp; TAX CALCULATION</b>									
Industry price	4,700	5,133	5,133	5,133	5,133	5,133	5,133	5,133	5,133
Ad valorem	3,055	4,106	3,850	4,106	4,106	3,850	4,106	5,133	10,266
Specific tax	-	-	1,000	1,000	2,000	5,000	5,000	5,000	5,000
Tobacco control fund	47	103	103	103	103	103	103	103	103
VAT/pack	1,076	1,289	1,391	1,426	1,564	1,943	1,978	2,120	2,828
Retail margin/pack	2,959	3,543	3,825	3,923	4,302	5,343	5,440	5,829	7,776
<b>Total tax/pack</b>	<b>4,131</b>	<b>5,395</b>	<b>6,241</b>	<b>6,533</b>	<b>7,671</b>	<b>10,792</b>	<b>11,084</b>	<b>12,253</b>	<b>18,093</b>
<i>Tax share (% of retail price)</i>	<i>34.9%</i>	<i>38.1%</i>	<i>40.8%</i>	<i>41.6%</i>	<i>44.6%</i>	<i>50.5%</i>	<i>50.9%</i>	<i>52.5%</i>	<i>58.2%</i>
<b>Retail price/pack</b>	<b>11,838</b>	<b>14,174</b>	<b>15,302</b>	<b>15,691</b>	<b>17,208</b>	<b>21,371</b>	<b>21,760</b>	<b>23,318</b>	<b>31,105</b>
<i>Price increase</i>	<i>-</i>	<i>18.0%</i>	<i>25.5%</i>	<i>28.0%</i>	<i>37.0%</i>	<i>57.4%</i>	<i>59.1%</i>	<i>65.3%</i>	<i>89.7%</i>

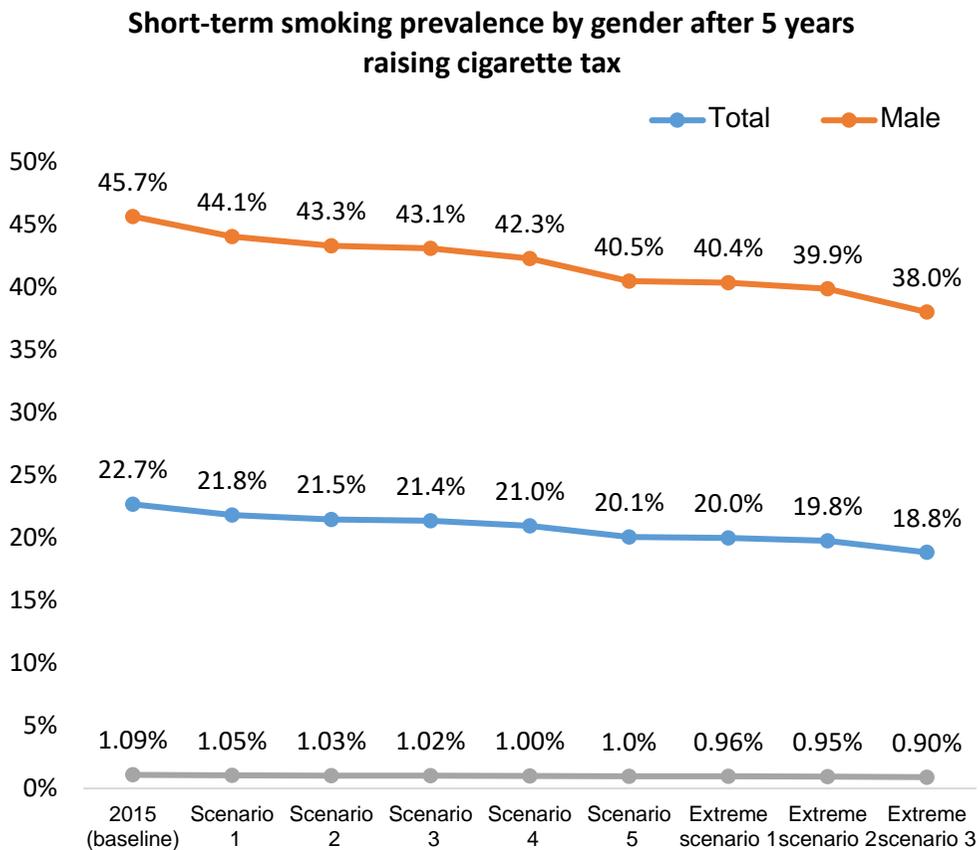
### **3.2. Effect of raising tobacco tax on adult smoking population**

Table 8 showed the estimation of smoking prevalence as well as the reduction in number of smokers and SADs after implementing new tax policy. The short-term smoking prevalence would reduce to 18.9% - 21.8% depending on the new tax level, while this percentage would even go down to 15.7% - 21.1% after 40 years of policy implementation. Following the decline in smoking prevalence, a reduction in number of smokers was projected from 276,795 to 1,291,683. Among men, about 276,580 – 1,290,679 smokers were estimated to quit with the new price increase, saving 109,645 -511,665 SADs. Among women, the expected number of smokers quitting due to new cigarette tax was much lower at 215 – 1,004 people which would avoid 70 - 326 deaths related to smoking. In total, the new tax policy would substantially reduce about 109,715 – 511,991 SADs for both sexes. In all scenarios, the health gains in males would have outweighed the figure of females with an extremely high male/female ratio. The scenario of ad valorem of 80% only had the lowest health impact, which was approximately one-third of the scenario 5 (ad valorem of 75% adding a specific tax of 5,000 VND/pack) and one-fifth of the last scenario (ad valorem of 200% adding a specific tax of 5,000 VND/pack).

**Table 8: Estimation on Smoking prevalence and Reduction in number of smokers and SADs in adult population**

No	Scenarios	Tax share in retail price	Smoking prevalence		Reduction in number of smokers			Reduction of number of SADs		
			Short term	Long term	Male	Female	Total	Male	Female	Total
1	Ad valorem 80% only	38.1%	21.8%	21.1%	276,580	215	276,795	109,645	70	109,715
2	Ad valorem 75% + 1000d/pack	40.8%	21.5%	20.4%	390,161	303	390,464	154,672	99	154,770
3	Ad valorem 80% + 1000d/pack	41.6%	21.4%	20.2%	426,851	332	427,183	169,217	108	169,325
4	Ad valorem 80% + 2000d/pack	44.6%	21.0%	19.5%	558,955	435	559,390	221,587	141	221,728
5	Ad valorem 75% + 5000d/pack	50.5%	20.2%	18.0%	851,024	662	851,686	337,372	215	337,587
6	Ad valorem 80% + 5000d/pack	50.9%	20.1%	17.8%	874,153	680	874,833	346,541	221	346,762
7	Ad valorem 100% + 5000d/pack	52.5%	19.9%	17.4%	960,897	747	961,644	380,929	243	381,172
8	Ad valorem 200% + 5000d/pack	58.2%	18.9%	15.7%	1,290,679	1,004	1,291,683	511,665	326	511,991

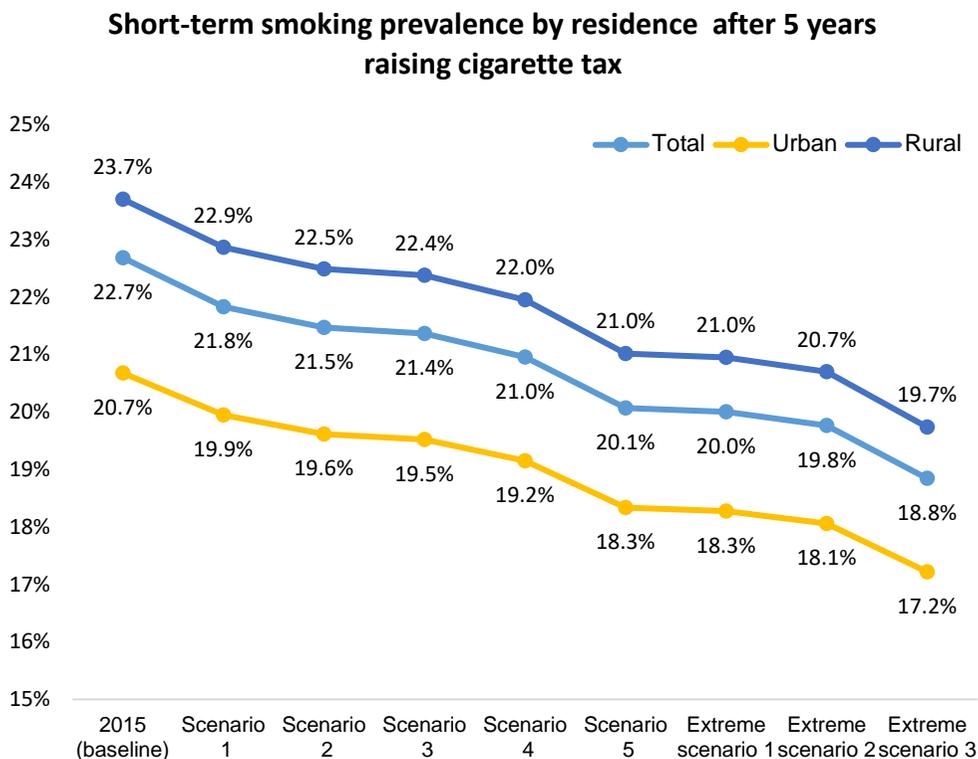
**Figure 4** below represented the short-term smoking prevalence by gender. Compared to the base year 2015, the overall smoking rate would decrease slightly from 22.7% (2015) to 21.8% (scenario 1) or 18.9% in the most extreme scenario. However, the male smoking rate could observe a higher decline. While the first scenario only had 1.6% reduction (45.7% → 44.1%), scenario 5 of ad valorem of 75% and 5,000 VND/pack of specific tax could lead to 5.0% reduction in smoking prevalence (45.7% → 40.6%). Extreme scenario 1 of ad valorem at 80% plus specific tax of 5,000VND/pack provided close projection to scenario 5. The extreme scenario of ad valorem of 100% and specific tax of 5,000VND/pack projected to decrease the overall smoking rate to 19.9% and the male smoking rate to 40.1%, which equivalent to a 10% reduction of the base rate. More than that, the extreme scenario of ad valorem of 200% and specific tax of 5,000VND/pack estimated the overall smoking prevalence of 18.1% (38.1% among male) showing a potential plan for reaching the set target. Among females, the reduction in smoking rate was merely 0.2% resulting from the relatively low rate at the baseline. The projected female smoking prevalence after policy implementation was around 0.91% - 1.05%.



**Figure 4: Smoking prevalence after 5 years of raising cigarette tax by gender**

**Figure 5** showed the smoking prevalence after 5 years of raising cigarette tax by residence. In urban areas, the projected smoking prevalence in urban areas was projected from 17.3% to 19.9%, which equated to a reduction of 0.8% - 3.4% compared to 2015 figure. In rural areas, the smoking prevalence was higher than the overall rate but also expected to decrease from 23.7% in 2015 to around 19.8%-22.9%. Rural areas have higher smoking prevalence in all scenarios compared to urban areas as this pattern was observed in several surveys since

2000s in Vietnam. Unlike the disproportionate pattern of gender, a similar volume of reduction due to tax policy was also estimated for both rural and urban areas.



**Figure 5: Smoking prevalence after 5 years raising cigarette tax by residence**

### 3.3. Effect of raising tobacco tax by age groups and sex

The profile of tobacco use was much more common among men and more sensitive for young age groups. Therefore, the effect of raising cigarette tax by age group would be presented separately for males and females to comprehensively illustrate the policy impact for Vietnam adult population.

*Table 9* showed the policy effect by age groups on male smoking population. In general, the highest reduction in smoking prevalence would be observed in age group 35-44 and 44-54, followed by age 55-64 while the age group 15-24 would have the lowest reduction in smoking rate. The number of smokers who quit and number of SADs averted due to price increase projected to be largest for three age groups 25-34, 35-44, 45-54 and smallest for age group 15-24 and 65+.

The first scenario (only raise ad valorem to 80%) projected the reduction in smoking prevalence from 0.87% to 2.12% for 6 age groups. Age group 35-44 have the highest reduction of smoking rate at 2.12% while the youngest age group 15-24 have the lowest reduction of 0.87%. The reduction in number of smokers was highest in aged 35-44 (85,167 quitters), following by age group 45-54 (69,635 quitters), 25-34 (59,583 quitters). The lowest reduction was estimated for aged 15-24 (15,209 quitters) and aged 65 and above (12,336 quitters).

The second scenario (raise ad valorem to 75% plus specific tax of 1,000 VND/ pack) estimated the highest reduction in smoking prevalence in age group 35-44 (2.99%) and lowest in aged 15-24 (1.23%). The highest decrease in smoking population was projected for middle age groups from 25-54 (ranging from 84,051 – 120,141 smokers). Age group 15-24 and age group of above 65 would have 21,455 and 17,261 fewer smokers. The number of SADs averted in each age group ranged from 2,158 to 51,060.

Scenario 3 of ad valorem at 80% combined with a specific tax of 1,000 VND/pack showed a reduction in smoking prevalence from 1.35% (age group 15-24) to 3.27%

(age group 35-44). The reduction in number of smokers would reach 120,414 – 172,118 for population aged 25-54. Age group 55-64 would have about 70,228 fewer smokers while this figure was about 30,737 for aged 15-24 and 24,729 for aged 65+. The number of SADs avoided was estimated at only 3,091 for the oldest age group while this would be 15,061 for aged 15-24 and 26,335 for aged 55-64. This number would reach more than 50,000 SADs for three age groups 25-34, 35-44, and 45-54.

The fourth scenario of ad valorem at 80% combined with specific tax of 2,000 VND/pack showed similar pattern by age group but the estimation was higher. The smoking prevalence would reduce by 1.77% (aged 15-24); 3.41% (aged 25-34); 4.28% (aged 35-44); 4.12% (aged 45-54); 3.61% (55-64) and 2.53% (aged 65 and above). In accordance to the reduction in smoking rate, the estimated number of quitters due to the new tax policy would be 30,737 (aged 15-24); 120,414 (aged 25-34); 172,118 (aged 35-44); 140,730 (aged 45-54); 70,228 (55-64) and 24,729 (aged 65 and above).

The scenario 5 (ad valorem 75% + 5000d/pack) provided the highest effect among 5 proposed plans. Middle-age group show reduction in smoking rate of around 5.19% - 6.52% while the smoking rate only reduce about 2.69% and 3.86% in the youngest and eldest age group respectively. The health outcome project in extreme scenario 1 would marginally larger than scenario 5 corresponding to its slightly higher price increase. The number of smokers would reduce by more than 100,000 for population aged 25-54; 48,069 for age group 15-24 and 38,674 for age group 65+. The number of avoided SADs would be 4,834 (65+); 23,554 (15-24); 41,186 (55-64); 80,034 (24-35); 82,533 (45-54) and 114,400 (35-44). All age groups 25-34, 35-44, 45-54 and 55-64 would

observe more than 5% reduction in smoking prevalence (from 5.33% - 6.70%) while the reduction in age group 15-24 and 65+ would be 2.76% and 3.96%, respectively.

Two highest extreme scenarios of specific tax of 5,000VND/pack combined with ad valorem of 100% or 200% projected the highest reduction on tobacco use for all age groups. The male smoking rate would fall by 3.04% -7.37% (scenario 6) or 4.08%-9.89% (scenario 7) varying for 6 age groups. The number of smokers quitting under the policy effect would be much higher than the previous five scenarios. About 42,512 – 295,887 quitters and 57,102-397,436 quitters were estimated for scenario 6 and 7, respectively. Following that figure, the number of SADs averted would be around 5,134 – 125,752 SADs in scenario 6 and around 7,138 – 168,910 in scenario 7.

**Table 9: Short-term policy effect by age groups among males**

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	23.9%	46.1%	57.9%	55.8%	48.8%	34.3%
Reduction in smoking prevalence	0.87%	1.69%	2.12%	2.04%	1.78%	1.25%
Reduction in number of smokers	15,209	59,583	85,167	69,635	34,750	12,236
Reduction in premature SADs	7,452	25,323	36,196	26,113	13,031	1,530

Age groups	15-24	25-34	35-44	45-54	55-64	65+
------------	-------	-------	-------	-------	-------	-----

**Scenario 2: Ad valorem 75% + 1000d/pack**

Short-term smoking prevalence	23.5%	45.4%	57.1%	54.9%	48.0%	33.8%
Reduction in smoking prevalence	1.23%	2.38%	2.99%	2.88%	2.52%	1.77%
Reduction in number of smokers	21,455	84,051	120,141	98,232	49,020	17,261
Reduction in premature SADs	10,513	35,722	51,060	36,837	18,383	2,158

**Scenario 3: Ad valorem 80% + 1000d/pack**

Short-term smoking prevalence	23.4%	45.2%	56.8%	54.7%	47.8%	33.6%
Reduction in smoking prevalence	1.35%	2.60%	3.27%	3.15%	2.75%	1.94%
Reduction in number of smokers	23,472	91,955	131,440	107,469	53,630	18,885
Reduction in premature SADs	11,501	39,081	55,862	40,301	20,111	2,361

Age groups	15-24	25-34	35-44	45-54	55-64	65+
------------	-------	-------	-------	-------	-------	-----

**Scenario 4: Ad valorem 80% + 2000d/pack**

Short-term smoking prevalence	23.0%	44.4%	55.8%	53.7%	46.9%	33.0%
Reduction in smoking prevalence	1.77%	3.41%	4.28%	4.12%	3.61%	2.53%
Reduction in number of smokers	30,737	120,414	172,118	140,730	70,228	24,729
Reduction in premature SADs	15,061	51,176	73,150	52,774	26,335	3,091

**Scenario 5: Ad valorem 75% + 5000d/pack**

Short-term smoking prevalence	22.1%	42.6%	53.5%	51.5%	45.1%	31.7%
Reduction in smoking prevalence	2.69%	5.19%	6.52%	6.28%	5.49%	3.86%
Reduction in number of smokers	46,797	183,334	262,054	214,265	106,924	37,651
Reduction in premature SADs	22,931	77,917	111,373	80,349	40,096	4,706

Age groups	15-24	25-34	35-44	45-54	55-64	65+
------------	-------	-------	-------	-------	-------	-----

**Extreme scenario 1: Ad valorem 80% + 5000d/pack**

Short-term smoking prevalence	22.0%	42.5%	53.4%	51.4%	44.9%	31.6%
Reduction in smoking prevalence	2.76%	5.33%	6.70%	6.45%	5.64%	3.96%
Reduction in number of smokers	48,069	188,316	269,176	220,088	109,830	38,674
Reduction in premature SADs	23,554	80,034	114,400	82,533	41,186	4,834

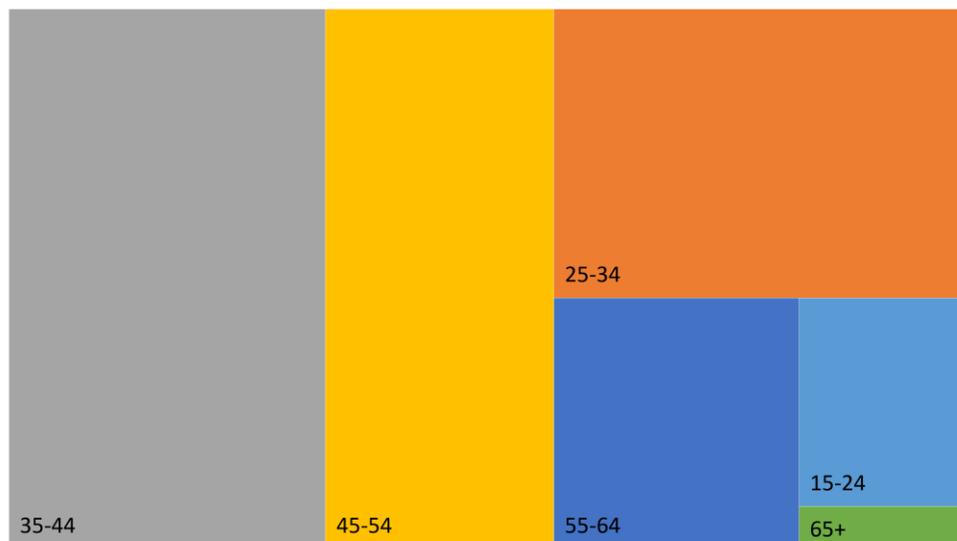
**Extreme scenario 2: Ad valorem 100% + 5000d/pack**

Short-term smoking prevalence	21.7%	41.9%	52.7%	50.7%	44.4%	31.2%
Reduction in smoking prevalence	3.04%	5.86%	7.37%	7.09%	6.20%	4.36%
Reduction in number of smokers	52,839	207,003	295,887	241,928	120,728	42,512
Reduction in premature SADs	25,891	87,976	125,752	90,723	45,273	5,314

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Extreme scenario 3: Ad valorem 200% + 5000d/pack</b>						
Short-term smoking prevalence	20.7%	39.9%	50.2%	48.3%	42.2%	29.7%
Reduction in smoking prevalence	4.08%	7.87%	9.89%	9.52%	8.33%	5.85%
Reduction in number of smokers	70,974	278,047	397,436	324,958	162,162	57,102
Reduction in premature SADs	34,777	118,170	168,910	121,859	60,811	7,138

**Figure 6** below presented the contribution of averted SADs among males by age groups. As can be seen, raising tobacco tax policy would bring the biggest benefits for population at working age from 25-54 with the largest percentage of averted SADs followed by smokers aged 55-64. The number of averted SADs was substantial in the youngest age group of 15-24 as it was estimated in the current smoking population only. The oldest age group of 65 and above had the smallest contribution in the total number of averted SADs since this age group has the lowest reduction of mortality rate after quitting compared to other age groups.

### Age distribution of potential avoided Smoking-attributable Deaths



*Figure 6: Averted smoking-attributable deaths by age groups among males*

**Table 10** showed the policy effect by age groups on female smoking population. The estimation of health impact of raising tobacco tax was much smaller in female compared to males because the base number of women smoked in Vietnam was also relatively low. Overall, the reduction in smoking prevalence would increase with age following the current pattern of female smokers. The reduction in number of smokers was also largest in older age groups but age group of 45-54 would have the highest reduction in number of avoided SADs.

The first scenario (only raise ad valorem to 80%) projected the reduction in smoking prevalence in each age group ranging from 0.02% - 0.07%. The reduction in number of smokers was highest in aged 45-54 (87 quitters), following by age group 55-64 (50 quitters) and 65+ (51 quitters). The lowest reduction in number of smokers was

estimated for aged 15-24 (7 quitters) and 25-34 (6 quitters). As a result, the number of avoided SADs was relatively low ranging from 3-33 SADs in each age group.

The second scenario (increase ad valorem to 75% plus specific tax of 1,000 VND/pack) estimated the highest reduction in smoking prevalence in age group 45-54 (0.09%) and lowest in aged 25-34 (0.02%). The highest decrease in smoking population was projected for aged 45-54 at 123 smokers while this figure in other age groups only ranged from 9-71 smokers. The number of SADs averted was 46 for age group 45-54; 26 for age group 55-64 and around 4-9 cases for other age groups.

The scenario 3 of ad valorem at 80% combined with specific tax of 1,000 VND/pack showed a reduction in smoking prevalence from 0.03% (age group 15-24 and 25-34) to 0.11% (age group 45-54). The reduction in number of smokers would be around 10-22 people aged under 45; 135 for age group 45-54 and 77-78 for age group above 55. The number of SADs avoided was about 4-9 SADs for smokers aged under 45; 51 SADs for those aged 45-54; 29 for those aged 55-64 and 10 for those aged 65+.

The 4<sup>th</sup> scenario of ad valorem at 80% combined with specific tax of 2,000 VND/pack showed a slightly higher estimation. The smoking prevalence would reduce by 0.04% (aged 15-24); 0.03% (aged 25-34); 0.06% (aged 35-44); 0.14% (aged 45-54) and 0.13% for both age group 55-64) and age 65+. Young female smokers would reduce by 13-29 for age group from 15-44 while the total number

would exceed 300 smokers for female smokers aged 45 and above. Except for age group 45-54 (66 SADs avoided) and 55-64 (38 SADs avoided), other age groups would avoid 5-13 SADs.

The scenario 5 (ad valorem 75% adding 5,000d/ pack) projected about 0.06-0.22% reduction in smoking rate across all age groups. This results in about 19-269 smoker would quit smoking and about 8-101 avoided SADs depending on the size of smoking population in each age group. Similarly, extreme scenario 1 of ad valorem 80% adding 5000d/pack provided the highest effect among 5 proposed plans. Three age groups from 45 and above would observe more than 0.2% reduction in smoking prevalence. The number of smokers would reduce by 20 (age group 15-24); 21 (age group 25-34); 45 (age group 35-44); 276 (age group 45-54); 158 (age group 55-64); 160 (age 65+). The number of avoided SADs would be highest for age 45-54 (104 SADs), followed by age group 55-64 (59 SADs).

The two extreme scenarios of a specific tax of 5,000VND/pack combined with ad valorem of 100% or 200% projected the highest reduction on tobacco use for all age groups. The male smoking rate would fall by 0.06%-0.24% (scenario 6) or 0.08%-0.33% (scenario 7) varying for 6 age groups. The number of smokers quitting under the policy effect would be much higher than the previous five scenarios. About 22-304 smokers and 29-408 smokers were estimated to quit in scenario 6 and 7, respectively. Following that figure, the number of SADs averted would be around 9-114 SADs in scenario 6 and around 12-153 SADs in scenario 7.

**Table 10: Short-term policy effect by age groups among females**

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	0.52%	0.47%	0.74%	1.91%	1.71%	1.78%
Reduction in smoking prevalence	0.02%	0.02%	0.03%	0.07%	0.06%	0.07%
Reduction in number of smokers	7	6	14	87	50	51
Reduction in premature SADs	3	3	6	33	19	6
<b>Scenario 2: Ad valorem 75% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.73%	1.88%	1.69%	1.76%
Reduction in smoking prevalence	0.03%	0.02%	0.04%	0.10%	0.09%	0.09%
Reduction in number of smokers	10	9	20	123	70	71
Reduction in premature SADs	5	4	9	46	26	9
<b>Scenario 3: Ad valorem 80% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.73%	1.88%	1.68%	1.75%
Reduction in smoking prevalence	0.03%	0.03%	0.04%	0.11%	0.10%	0.10%

<b>Age groups</b>	<b>15-24</b>	<b>25-34</b>	<b>35-44</b>	<b>45-54</b>	<b>55-64</b>	<b>65+</b>
Reduction in number of smokers	10	10	22	135	77	78
Reduction in premature SADs	5	4	9	51	29	10

**Scenario 4: Ad valorem 80% + 2000d/pack**

Short-term smoking prevalence	0.50%	0.45%	0.72%	1.84%	1.65%	1.72%
Reduction in smoking prevalence	0.04%	0.03%	0.06%	0.14%	0.13%	0.13%
Reduction in number of smokers	14	13	29	177	101	102
Reduction in premature SADs	7	5	12	66	38	13

**Scenario 5: Ad valorem 75% + 5000d/pack**

Short-term smoking prevalence	0.48%	0.43%	0.69%	1.77%	1.58%	1.65%
Reduction in smoking prevalence	0.06%	0.05%	0.08%	0.22%	0.19%	0.20%
Reduction in number of smokers	21	19	44	269	153	156
Reduction in premature SADs	10	8	19	101	58	19

**Extreme scenario 1: Ad valorem 80% + 5000d/pack**

Short-term smoking prevalence	0.48%	0.43%	0.69%	1.76%	1.58%	1.64%
-------------------------------	-------	-------	-------	-------	-------	-------

<b>Age groups</b>	<b>15-24</b>	<b>25-34</b>	<b>35-44</b>	<b>45-54</b>	<b>55-64</b>	<b>65+</b>
Reduction in smoking prevalence	0.06%	0.05%	0.09%	0.22%	0.20%	0.21%
Reduction in number of smokers	21	20	45	276	158	160
Reduction in premature SADs	11	8	19	104	59	20

**Extreme scenario 2: Ad valorem 100% + 5000d/pack**

Short-term smoking prevalence	0.47%	0.43%	0.68%	1.74%	1.56%	1.62%
Reduction in smoking prevalence	0.07%	0.06%	0.09%	0.24%	0.22%	0.23%
Reduction in number of smokers	24	22	50	304	173	176
Reduction in premature SADs	12	9	21	114	65	22

**Extreme scenario 3: Ad valorem 200% + 5000d/pack**

Short-term smoking prevalence	0.45%	0.41%	0.64%	1.66%	1.48%	1.55%
Reduction in smoking prevalence	0.09%	0.08%	0.13%	0.33%	0.29%	0.30%
Reduction in number of smokers	32	29	67	408	233	236
Reduction in premature SADs	16	12	28	153	87	29

### 3.4. Sensitivity analysis

#### 3.4.1. Sensitivity analysis for price elasticity

➤ *Price elasticity for middle-income country level at -0.20*

*Table 11* presented the lower limit and upper limit of the short-term smoking prevalence estimated by using the price elasticity of -0.20 (middle-income country). This result was aligned with the projected smoking prevalence in *Figure 4* and *Figure 5* above. The overall smoking prevalence would not vary largely, remaining above 20.0% except for scenario 5 and three extreme scenarios. Among males, the range of smoking prevalence was large from 41.6% to 44.5% (scenario 1 to scenario 4). Among five proposed plans, only scenario 5 showed a projected range under 40% (39.5%-41.9%) which is close to first extreme scenarios (39.4%-41.8%). The two highest extreme plans offered the reduced smoking rate at 38.8%-41.4% and 36.5%-39.9%, respectively. Among females, the lower limit and upper limit was mere, only about 0.1% or less. Otherwise, urban areas were estimated to have the highest range of smoking prevalence at 19.8%-20.1% in scenario 1 and the lowest range of smoking prevalence at 16.5%-18.1% in scenario 8. Similarly, rural areas would have the highest smoking prevalence in scenario 1 (22.7%-23.1%) and the lowest smoking prevalence in scenario 8 (18.9%-20.7%) compared to the base rate of 22.0%-25.4%.

**Table 11: Lower limit & upper limit of smoking rate with price elasticity at -0.20**

No	Scenarios	Total	Male	Female	Urban	Rural
0	2015 (baseline)	21.4%-	43.4%-	0.7%-	19.0%-	22.0%-
		24.0%	47.9%	1.5%	22.4%	25.4%
1	Ad valorem 80% only	21.6%-	43.7%-	1.0%-	19.8%-	22.7%-
		22.0%	44.5%	1.1%	20.1%	23.1%
2	Ad valorem 75% +	21.2%-	42.8%-	1.0%-	19.4%-	22.2%-
	1000d/pack	21.8%	43.9%	1.0%	19.9%	22.8%
3	Ad valorem 80% +	21.1%-	42.6%-	1.0%-	19.3%-	22.1%-
	1000d/pack	21.7%	43.8%	1.0%	19.8%	22.7%
4	Ad valorem 80% +	20.6%-	41.6%-	1.0%-	18.9%-	21.6%-
	2000d/pack	21.4%	43.2%	1.0%	19.6%	22.4%
5	Ad valorem 75% +	19.6%-	39.5%-	0.9%-	17.9%-	20.5%-
	5000d/pack	20.8%	41.9%	1.0%	19.0%	21.7%
6	Ad valorem 80% +	19.5%-	39.4%-	0.9%-	17.8%-	20.4%-
	5000d/pack	20.7%	41.8%	1.0%	18.9%	21.7%
7	Ad valorem 100% +	19.2%-	38.8%-	0.9%-	17.6%-	20.1%-
	5000d/pack	20.5%	41.4%	1.0%	18.7%	21.5%
8	Ad valorem 200% +	18.1%-	36.5%-	0.9%-	16.5%-	18.9%-
	5000d/pack	19.8%	39.9%	0.9%	18.1%	20.7%

➤ *Price elasticity for low-income country level at -0.25*

**Table 12** showed the estimation of short-term smoking prevalence using the price elasticity for low-income countries (-0.25). The lower limit and upper limit of smoking prevalence would be lower for both sexes and residence compared to the results of using price elasticity level of middle-income country. Scenario 1 & 2 (proposed by MOF) showed an estimation of overall smoking rate at 20.9% - 21.8%; 19.1%-19.9% for urban areas and 21.9%-22.8% for rural areas; 42.2%-43.9% for males and remained at 1.0% for females. Three scenarios proposed by MOH (scenario 3, 4 & 5) projected a lower estimation on smoking rate which ranged 18.8% - 21.5% (overall); 37.9%-43.3% (males); 0.9%-1.0% (females); 17.2%-19.6% (urban) and 19.7%-22.5% (rural). The extreme scenario 1 offers a close projection to the scenario 5. Extreme scenario of 100% ad valorem tax plus 5,000VND/pack of specific tax (scenario 7) could bring the overall smoking rate to 18.4%-20.0%; 37.2%-40.4% for males; 0.9%-1.0% for female; 16.8%-18.3% for urban areas and 19.3%-21.0% for rural areas. Raising the ad valorem tax to 200% in scenario 8 was projected to reduce the overall smoking rate to 17.1%-19.1%; 15.6%-17.5% for urban areas and 17.9%-20.0% for rural areas. Also, in this scenario, the smoking prevalence among men would reach 34.4%-38.6% compared to the current rate of 43.4%-47.9% while the female smoking prevalence would be around 0.8%-0.9%. Further results on smoking prevalence using price elasticity at -0.25 could be found in *Appendix 3* and *Appendix 4*.

**Table 12: Lower limit & upper limit of smoking rate with price elasticity at -0.25**

No	Scenarios	Total	Male	Female	Urban	Rural
0	2015 (baseline)	21.4%-	43.4%-	0.7%-	19.0%-	22.0%-
		24.0%	47.9%	1.5%	22.4%	25.4%
1	Ad valorem 80% only	21.4%-	43.2%-	1.0%-	19.5%-	22.4%-
		21.9%	44.2%	1.0%	20.0%	22.9%
2	Ad valorem 75% + 1000d/pack	20.9%-	42.2%-	1.0%-	19.1%-	21.9%-
		21.6%	43.5%	1.0%	19.7%	22.6%
3	Ad valorem 80% + 1000d/pack	20.7%-	41.8%-	1.0%-	18.9%-	21.7%-
		21.5%	43.3%	1.0%	19.6%	22.5%
4	Ad valorem 80% + 2000d/pack	20.2%-	40.7%-	1.0%-	18.4%-	21.1%-
		21.1%	42.6%	1.0%	19.3%	22.1%
5	Ad valorem 75% + 5000d/pack	18.9%-	38.1%-	0.9%-	17.3%-	19.8%-
		20.3%	41.0%	1.0%	18.6%	21.3%
6	Ad valorem 80% + 5000d/pack	18.8%-	37.9%-	0.9%-	17.2%-	19.7%-
		20.3%	40.9%	1.0%	18.5%	21.2%
7	Ad valorem 100% + 5000d/pack	18.4%-	37.2%-	0.9%-	16.8%-	19.3%-
		20.0%	40.4%	1.0%	18.3%	21.0%
8	Ad valorem 200% + 5000d/pack	17.1%-	34.4%-	0.8%-	15.6%-	17.9%-
		19.1%	38.6%	0.9%	17.5%	20.0%

### 3.4.3. Sensitivity analysis for mortality rate

➤ *Cigarette mortality rate at 30%*

**Table 13** showed the reduction in number of SADs by applying the cigarette mortality rate at 30%. The total number of SADs would vary from 65,829 – 307,195 in which the reduction among men would range from 65,787-306,999. The two scenarios proposed by MOF have the lowest number of SADs averted at 65,829 and 92,862, respectively for scenario 1 and 2. The three scenarios suggested by MOH was estimated to avoid from 101,595 to 202,552 SADs for both sexes. The extreme scenarios showed the highest impacts which potentially prevented 208,057-307,195 SADs. Little change in number of SADs among women would be observed as the reduction was small varying from 42 to 196 SADs.

**Table 13: Reduction in number of SADs with cigarette mortality rate of 30%**

No	Scenarios	Smoking prevalence		Reduction of number of SADs		
		Short term	Long term	Male	Female	Total
1	Ad valorem 80% only	21.8%	21.1%	65,787	42	65,829
2	Ad valorem 75% + 1000d/pack	21.5%	20.4%	92,803	59	92,862
3	Ad valorem 80% + 1000d/pack	21.4%	20.2%	101,530	65	101,595

No	Scenarios	Smoking prevalence		Reduction of number of SADs		
		Short term	Long term	Male	Female	Total
4	Ad valorem 80% + 2000d/pack	21.0%	19.5%	132,952	85	133,037
5	Ad valorem 75% + 5000d/pack	20.2%	18.0%	202,423	129	202,552
6	Ad valorem 80% + 5000d/pack	20.1%	17.8%	207,925	132	208,057
7	Ad valorem 100% + 5000d/pack	19.9%	17.4%	228,558	146	228,703
8	Ad valorem 200% + 5000d/pack	18.9%	15.7%	306,999	196	307,195

➤ *Cigarette mortality rate at 55%*

With the cigarette mortality rate at 30%, the total number of SADs would much higher, ranging from 120,686 – 563,190 SADs (see **Table 14**). Scenario 1 and 2 (proposed by MOF) could reduce the number of SADs by 120,686-170,247 SADs (men: 120,609-170,139 SADs; women: 77-108 SADs). Three scenarios suggested by MOH (scenario 3, 4 and 5) could potentially avoid about 186,257-371,346 SADs in which men would avoid 186,139-371,110 SADs and women would avoid 119-236 243 SADs. Three extreme scenarios have the highest lives saved from 381,438-563,190 SADs with the majority of these lives saved (381,196-561,832 SADs) would be males.

**Table 14: Reduction in number of SADs with cigarette mortality rate of 50%**

No	Scenarios	Smoking prevalence		Reduction of number of SADs		
		Short term	Long term	Male	Female	Total
1	Ad valorem 80% only	21.7%	20.8%	120,609	77	120,686
2	Ad valorem 75% + 1000d/pack	21.5%	20.4%	170,139	108	170,247
3	Ad valorem 80% + 1000d/pack	21.4%	20.2%	186,139	119	186,257
4	Ad valorem 80% + 2000d/pack	21.0%	19.5%	243,746	155	243,901
5	Ad valorem 75% + 5000d/pack	20.2%	18.0%	371,110	236	371,346
6	Ad valorem 80% + 5000d/pack	20.1%	17.8%	381,196	243	381,438
7	Ad valorem 100% + 5000d/pack	19.9%	17.4%	419,022	267	419,289
8	Ad valorem 200% + 5000d/pack	18.9%	15.7%	562,832	358	563,190

### 3.4.4. Sensitivity analysis for retail margin

#### ➤ Retail margin at 10%

**Table 15** presented the projected smoking prevalence as well as the reduction in number of smokers and SADs by applying the retail margin of 10%. With the retail margin of 10%, the tax share in retail price would be higher than the figure of retail margin at 25% used in main model, ranging from 44.7%-58.4% for five proposed scenarios and raise to more than 60% in two extreme scenarios. However, the potential health benefit estimated in all scenarios was smaller compared to the main model outcome. Scenario 1 and 2 projected the short-term smoking prevalence at 21.6%-21.8% with the reduction in number of smokers at 276,795-363,162 people and about 109,715-143,949 SADs averted. Three scenarios proposed by MOH (3, 4 and 5) projected the short-term smoking prevalence at 20.4%-21.5% which would result in about 400,781- 762,692 smokers quit smoking and 158,860-302,312 SADs averted. Extreme scenario 1 projected similar short-term smoking rate at 20.4% with scenario 5, but higher reduction in number of smokers (788,218 quitters) and number of avoided SADs (312,430 SADs). The extreme scenario of ad valorem tax at 100% combined with the specific tax of 5,000 VND/pack would increase the tax share to 60.7% and decrease the smoking rate to 20.1%, leading to the reduction in number of smokers at 883,653 people and reduction in number of SADs at 350,258 SADs. Scenario 7 with a tax share of 68.4% projected to decrease the smoking rate to 19.0%, saving 492,377 SADs and making about 1,2 million smokers quit smoking. Further results of health impacts of raising cigarette tax at retail margin of 10% would be found in Appendix 4 and Appendix 5.

**Table 15: Projected smoking prevalence, reduction in number of smokers & SADs with retail margin of 10%**

No	Scenarios	Tax share in retail price	Smoking rate		Reduction in no. of smokers			Reduction in no of SADs		
			Short term	Long term	Male	Female	Total	Male	Female	Total
1	Ad valorem 80% only	44.7%	21.8%	21.1%	276,580	215	276,795	109,645	70	109,715
2	Ad valorem 75% + 1000d/pack	47.2%	21.6%	20.6%	362,880	282	363,162	143,857	92	143,949
3	Ad valorem 80% + 1000d/pack	48.3%	21.5%	20.4%	400,470	311	400,781	158,759	101	158,860
4	Ad valorem 80% + 2000d/pack	51.4%	21.2%	19.8%	511,879	398	512,277	202,925	129	203,054
5	Ad valorem 75% + 5000d/pack	57.8%	20.4%	18.4%	762,099	593	762,692	302,120	192	302,312
6	Ad valorem 80% + 5000d/pack	58.4%	20.4%	18.3%	787,606	613	788,218	312,231	199	312,430
7	Ad valorem 100% + 5000d/pack	60.7%	20.1%	17.8%	882,966	687	883,653	350,035	223	350,258
8	Ad valorem 200% + 5000d/pack	68.4%	19.0%	16.0%	1,241,232	965	1,242,198	492,063	313	492,377

➤ ***Retail margin at 30%***

**Table 16** presented the projected smoking prevalence as well as the reduction in number of smokers and SADs by applying the retail margin of 30%. Overall, the estimated health impacts were higher when the retail margin increase to 30%. However, the tax share in retail price would be lower ranging from 35.9%-48.4% in proposed plans and ranging from 49.8%-54.8% in extreme scenarios. Scenario 1 and 2 projected the short-term smoking prevalence at 21.5%-21.8% with the reduction in number of smokers at 276,795-402,342 people and about 109,715-159,479 SADs averted. Three scenarios proposed by MOH (3, 4 and 5) projected the short-term smoking prevalence at 20.1%-21.4% which would result in about 438,674-888,415 smokers quit smoking and 173,879-352,146 SADs averted. Extreme scenario 1 projected smoking rate at 20.0% with about 910,614 quitters and 360,945 SADs averted. The tax share of 49.8% in extreme scenario 2 was estimated to decrease the smoking rate to 19.8%, leading to the reduction in number of smokers at 993,976 people and reduction in number of SADs at 393,737 SADs. The most extreme scenario of ad valorem tax at 100% combined with specific tax of 5,000 VND/pack (scenario 8) estimated to get about 1.3 million smokers to quit and save 520,231 SADs by reducing the smoking prevalence to 18.8%. Further results of health impacts of raising cigarette tax at retail margin of 10% would be found in ***Appendix 6 & Appendix 7.***

**Table 16: Projected smoking prevalence, reduction in number of smokers & SADs with retail margin of 30%**

No	Scenarios	Tax share in retail price	Smoking prevalence		Reduction in number of smokers			Reduction in number of SADs		
			Short term	Long term	Male	Female	Total	Male	Female	Total
1	Ad valorem 80% only	35.9%	21.8%	21.1%	276,580	215	276,795	109,645	70	109,715
2	Ad valorem 75% + 1000d/pack	38.6%	21.5%	20.4%	402,030	313	402,342	159,377	102	159,479
3	Ad valorem 80% + 1000d/pack	39.4%	21.4%	20.2%	438,333	341	438,674	173,769	111	173,879
4	Ad valorem 80% + 2000d/pack	42.3%	21.0%	19.4%	579,133	450	579,583	229,586	146	229,733
5	Ad valorem 75% + 5000d/pack	48.0%	20.1%	17.8%	887,725	690	888,415	351,922	224	352,146
6	Ad valorem 80% + 5000d/pack	48.4%	20.0%	17.7%	909,906	708	910,614	360,715	230	360,945
7	Ad valorem 100% + 5000d/pack	49.8%	19.8%	17.2%	993,204	773	993,976	393,737	251	393,988
8	Ad valorem 200% + 5000d/pack	54.8%	18.8%	15.6%	1,311,452	1,020	1,312,472	519,900	331	520,231

## **4. Discussion**

### **4.1. The gap between the suitable and desirable plan for raising cigarette taxes in Vietnam**

Overall, the health impact of raising tobacco tax policy is undeniable in both short-term and long-term projection. The study findings showed all model scenarios of tax raising showed a great potential benefit on smoking prevalence and potential smoking-attributable deaths. The health benefit was varied by age group, gender and residence at different levels. First on gender contribution, men would observe the manifest health benefit compared to the marginal impact among women due to the male-dominated characteristic of smoking behavior in Vietnam. Secondly, middle age group (25-54) have the major share of health benefit compared to young adulthood and eldest age group. This result might sound contradicted with previous findings of highest impacts falling upon young population who are twice sensitive to price changes compared to adults (42). However, this pattern is reasonable as the same price sensitivity was applied for the whole population aged 15 and above in our model. Also, this could be explained by the fact that the smoking prevalence in age group 25-34 is almost double the smoking rate of age group 15-24 (overall: 25.04% vs. 12.96%; men: 47.80% vs 24.78%) while the smoking rate in next age groups remained at a similar level compared to the youngest age group. Hence, the study finding should be careful interpreted with its solely scope on adult population.

For policy implication, the study findings suggested a few feasible plans for the upcoming policy amendment which should be discussed closely with Vietnam's current context. The rapid economic growth and challenges in managing the tobacco market has opposed a gap between the suitable and desirable plan of raising tobacco taxes in Vietnam. Among the five scenarios which have already been submitted to the National Assembly, tax plan of ad valorem tax of 75% and specific tax from 5,000 VND per pack (scenario 5) were deemed as the most suitable plan at the current time with the proposal from MOH and positive feedback from MOF. This tax plan satisfied both adequate health impacts and significant revenue gains. In term of health benefits, this scenario is expected to bring down the male smoking prevalence in 2025 to 39.4% and avoid nearly 350 thousand premature deaths among current smokers in Vietnam. In term of economic impacts, this scenario would be a win-win approach by offering better mechanism for tobacco market management. The mixed tax structure with sufficient price increase in the suitable plan would ensure an absolute increase in the inflation-adjusted retail price. Though, it should be noticed that even in this most suitable plan, the tax share remained lower than the WHO recommendation of at least 70%.

In addition to the support of the highest scenario proposed by Ministry of Health, there are some technical issues prior to policy development and implementation. Firstly, the amount of tax increase in scenario 5 would bring a sufficient increase in retail price which possibly makes cigarettes less

affordable, compared to the two scenarios proposed by Ministry of Finance (scenario 1 & 2) (75). Secondly, scenario 5 would be of advantage compared to extreme scenarios with a less extreme influence on the illicit trade of tobacco products while also contributing a huge amount for the revenue. However, the considerable gap between scenario 5 and other proposed plans would be questioned for its negative impact on illegal tobacco market as this has frequently argued by tobacco industry. An overall analysis of cigarette taxes and illicit trade in Europe in 2016 has shown that raising cigarette price in any country would result in a substantial increase in illicit tobacco market (76). In Vietnam, this claim might not be a strong debated point as the overall market is currently observed a net outflow of tobacco products (50).

On the other hand, the model outcomes showed that the extreme tax plans promised to bring greater health benefits for Vietnam population. These three extreme scenarios represented a potential pathway to achieve the health target by decrease the smoking prevalence to under 20% (40.1% and 38.1% among males in scenario 6 and 7, respectively). The number of SADs would be enormous ranging from 380,172 – 511,991 SADs which could equivalent to a great saving in healthcare cost and productivity loss. Although extreme scenario 2 & 3 was considered aggressive for one-time tax raise by increase ad valorem up to 100% - 200%, the first extreme scenario of ad valorem 80% and specific tax of 5,000VND/pack would be ideal plan for tax raise in near future. Furthermore, it would be extreme for current tax administration due to the high

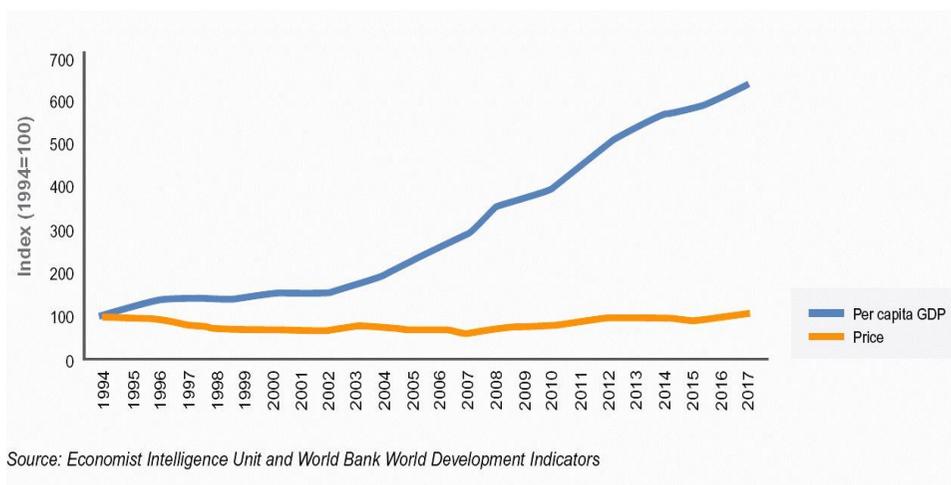
amount of one-time tax-raising. Hence, in the meantime, throughout research on budget impact analysis and market changes should be conducted to examine the adaptability of these extreme scenarios. This study suggested these two extreme scenarios as the potential options for the next amendment in tax policy or the development of a long-run road map on raising tobacco tax.

#### **4.2. Accelerating tobacco tax policy to strengthen the implementation of MPOWER package**

Since the first movement of tobacco tax policy toward controlling tobacco use in 2006, the actual impacts of these policy amendments remained questionable due to difficulties in monitoring and evaluation of tobacco use in Vietnam. Being aware of the important role of tax intervention in MPOWER package, this section would briefly summary of highlighted experiences for the long-term strategy of raising tobacco tax from many nations.

Firstly, timing factor and country inflation should be taken into account for strategy development of raising tobacco tax, which then ensures the maintainable impact over a certain period. There are shreds of evidence showing that tobacco tax should be raised on regular basis to reduce smoking rate. One-time tax-raising at a high level would have immediate flash on smoking population but the policy effect would likely fade out within the next few years. For example, in 2014, Korea had increased the retail price of cigarette by 80% and achieved 5% reduction in smoking rate the next year (77).

However, the tobacco use was started to raise again after 2 years of implementation (78) and initially explained by the increase of Purchasing Parity Power (PPP) which gave tobacco consumers higher purchasing ability of tobacco products. Also, this one-time tax raise came with public criticism for influencing vulnerable groups such as low-income group and elderly people (79). In Vietnam, the roadmap of raising tobacco tax was designed with the regular tax raise schedule but lack of attention on the high inflation rate in Vietnam. Hence, with four times of tax raise consecutively, the retail price of cigarette in Vietnam still failed to keep pace with the GDP per capita (see *Figure 7*), leaving the actual effect of previous tax raise questionable for public health.



**Figure 7: Changes in GDP per capita & cigarette price in Vietnam from 1994-2017 (unit:%) (75)**

The second highlighted issue that should be discussed here is the application of the mixed tax structure in Vietnam. Technically, the single tax structure of only ad

valorem has the advantage of less burden on the tax administration but it comes together with the undervaluation of the final price. The previous tax structure of only ad valorem tax in Vietnam would provide an example of this drawback. Tobacco manufacturer might have power over the ad valorem tax by altering the base price while in contrast, the nature of specific tax would be secure its power on tobacco market. The introduction of the specific tax in accompanying the ad valorem tax would solve this issue by control the tax rate based on the product quantity. Another burden will be placed on the management of tobacco manufacturing and consumption to hinder the under-reported manufacturing and illicit trade. In short, the issue of mixed tax structure should be considered carefully with the interpretation and application of this study findings.

Another valued recommendation for raising tobacco strategy is to consider the change in the earmarked tax of tobacco products. Currently, the compulsory contribution of tobacco products was about 2% with no plan to raise from 2020 onward. Increase the level of earmarked tax would fill two needs with one deed by not only increasing the retail price of tobacco products but also strengthening the tobacco control fund for accelerating other non-price interventions. Since 2013, tobacco control activities in Vietnam was mainly funded by Vietnam Tobacco Control Fund (36) including important community-based activities such as health promotion and education, cessation program and Quitline. Hence, the amount of tax raise would increase the funding and promote scaling up of other non-price

interventions in Vietnam. The success of raising tobacco tax policy will secure the joint effect of price and non-price interventions in MPOWER package.

### **4.3. Supporting the evidence of health impact of raising tobacco tax policy for Vietnam from other countries**

To confirm the health benefit of tobacco tax policy in this study, this section gather evidence from several countries to (i) explain the variation of tobacco tax effect by country income; (ii) show actual effect from existed tax raise in number of countries with different level of tax raise; and (iii) carry out a country comparison from several simulation modelling on tax policy.

The concept of raising tax to reduce goods consumption was classic and highly appraised in several health topics (80, 81). However, raising tobacco tax does not work out in the same way in all countries as this intervention varies largely by country-level economic features. Originally, tobacco product prices and tobacco consumers' income are the two major determinants for measuring tobacco demands. However, income growth of tobacco consumer can blow away the impact of tobacco price increase by making it more affordable. Seeing tobacco products as a common good, country-income classification was used for representing tobacco consumers' income while the country inflation and GDP per capital could be used for adjustment when possible. For such, the effect of tax policy, or *price elasticity* in this study, was classified for high-income, middle-income and low-income country classification. Price elasticity

is significantly different between high income and low-and-middle-income countries (82) and also mentioned in several simulation models. Apart from that, the variation of health impacts between countries could be attributed by their difference in smoking pattern and smoking population size.

Evidence of how raising tax reduces smoking prevalence was recorded in from high-income country (USA (83), Australia(84)) to low-and-middle income country (China (85), Bangladesh (86), Turkey (87)). Time-series analysis from Australia showed 25% tax increase was associated with immediate decline of 0.75% and sustained monthly decline of 0.023% from 2001-2017 (84). Also using the longitudinal data at state-level from 1993-2013, Wamamili et al showed a significant negative correlation between cigarette tax and smoking rate in all state whether they have low, median and high tax rate (83). In Bangladesh, between 2009 and 2017, average price of bidis had increased by 76.8% from 6.0 to 10.61 Bangladeshi taka (BDT). This resulted to the overall reduction in smoking rate from 23.0% in 2009 to 18.0% in 2017 which mainly from bidis (11.2% to 5%) (86). In Turkey, Kostova et al report the average price increase of 42.1% along with the decline of smoking rate by 14.6% from 2008 to 2012 (48). A case of modest tax raise in China reported 26.2% smokers reduced their smoking quantity and 0.6% almost quitting as a result of tax increase after having 0.15 US\$ price increase (7.27% price increase) in 2015 (85).

To further validate the model projection, the model outcomes on smoking prevalence, number of smokers and SADs were compared with other simulation models conducted in other countries with similar income group and tobacco use pattern. First, for the comparison of Abridged SimSmoke model for several countries. The results from sensitivity analysis of different tax scenarios were also employed and found the estimation in this Abridged SimSmoke model for tax policy was reasonably close to the findings from the complete model. The application of the Abridged SimSmoke model in this study showed similar findings with previous studies conducted in other countries such as Malaysia (74), Romania or Turkey (73). In the comparison with SimSmoke model, findings of 15 European countries from David Levy et al. 2014 reported similar results that premature deaths prevented in Ukraine, Turkey, Albania and Poland ranged from 27,093 to 362,500 each year (69). A summary of findings from Abridged SimSmoke models was presented in **Table 17** below. Other simulation models on tobacco control also showed similar findings if applied a close set of model parameters. For example, with cigarette mortality at 50% and elasticity ranging from -0.38 to -0.22, Lebanon was projected to have approximately 65,000 SADs for a 50% price increase (72).

**Table 17: Comparison of health impacts of raising tobacco tax with previous SimSmoke and Abridged SimSmoke models**

Country	Income group	Smoking population	Smoking prevalence	Base year	Increase in tax/ price	Price elasticity	Reduction in no. of smokers	Reduction in no. of SADs
Vietnam	MI	15,770,957	45.7% male; 1.09% female	2015	Tax increase: 42.1% → 68.4% Price increase: 86.0%	-0.20	1,242,198	492,377
Israel (65)	HI	1,093,088	24.5% male; 13.2% female	2014	Tax increase: 69% → 75%	-0.15	127,969	63,984 - 83,180
Egypt (64)	MI	10,445,839	37.7% male 0.5% female	2013	Tax increase: 72.5% → 75%	-0.20	397,900	129,300
Lebanon (64)	MI	582,100	45.1% male 29.1% female	2013	Tax increase: 33% → 75%	-0.20	332,800	108,200
Pakistan (64)	LI	19,341,200	32.4% male 5.5% female	2013	Tax increase: 46.2% → 75%	-0.20	7,794,700	2,533,300

Country	Income group	Smoking population	Smoking prevalence	Base year	Increase in tax/ price	Price elasticity	Reduction in no. of smokers	Reduction in no. of SADs
Tunisia (64)	MI	2,033,300	53.3% male 1.5% female	2013	Tax increase: 70% → 75%	-0.20	185,500	62,100
Malaysia (74)	LI	4,991,458	43.0% male; 1.4% female	2015	Tax increase: 49.4% → 78%	-0.20	2,905,282	1,452,641
Argentina (73)	MI	N/A	34.6% male 24.6% female	2010	Price increase 21%	-0.20	775,381	387,691
Estonia (73)	HI	N/A	49.0% male 25.3% female	2010	Price increase 30%	-0.15	35,147	17,574
Israel (73)	HI	N/A	30.9% male 17.6% female	2010	Price increase 41%	-0.15	160,269	80,134
Italy (73)	HI	N/A	30.6% male 16.4% female	2010	Price increase 10%	-0.15	370,466	185,233

Country	Income group	Smoking population	Smoking prevalence	Base year	Increase in tax/ price	Price elasticity	Reduction in no. of smokers	Reduction in no. of SADs
Latvia (73)	HI	N/A	50.6% male 23.7% female	2010	Price increase 102%	-0.15	208,828	104,414
Lithuania (73)	MI	N/A	48.4% male 20.1% female	2010	Price increase 53%	-0.20	216,253	108,127
Madagascar (73)	LI	N/A	27.3% male 1.8% female	2010	Price increase 28%	-0.25	253,907	126,953
Romania (73)	MI	N/A	45.2% male 23.6% female	2010	Price increase 69%	-0.20	1,762,454	881,227
Slovenia (73)	HI	N/A	29.6% male 21.9% female	2010	Price increase 15%	-0.15	25,871	12,936
Turkey (73)	MI	N/A	53.3% male 20.5% female	2010	Price increase 49%	-0.20	3,141,364	1,570,682

\* *LI* – low-income country; *MI*- Middle income country; *HI* – high income country

The study findings were also in alignment with previous studies in Vietnam. With a similar approach, the earliest simulation model on tobacco control in Vietnam carried out in 2006 by David Levy et al projected that price increase of 30% would reduce the smoking prevalence from 55.7% (2003) to 49.8% (2013) among males and from 1.9% (2003) to 1.2% (2013) among females (68). In David Levy et al 2006 (68), the comparable scenario of price increase of 37% provided a close result of smoking prevalence reduction at 6.3% (male) and 0.2% (female). David et al 2006 also have similar projection on the faster decline among youth smokers from tax increases than other older age groups (68). Jha Prabhat et al 2010 using a static model estimated up to 1 million lives saved with a 50% price increase which is higher than this study (88). This could be explained by the higher price elasticity in Jha Prabhat's model at -0.4, doubling the current price elasticity. Minh et al 2018 found that about 569,196 SADs would be saved from 52% price increase including 270,516 deaths avoided among current adult smokers and 298,680 among future adult smokers. This was comparable with the projection range of 326,227 – 525,335 SADs avoided in scenario 5 of a 59.1% price increase but Minh's finding was simulated with the price elasticity of -0.25.

Understandably, the difference between this study results and previous studies in Vietnam was due the nature characteristics of each simulation model. Therefore, further application of this model and its result could consider its unique strengths. First, the model designed for assessing actual proposed tax plans with extreme scenarios developed with closely discussions and recommendations of policy

makers in Vietnam. As a result, model results have a huge practical meaning for policy advocacy with real-time hypothetical scenarios. Secondly, this model was developed explicitly for tobacco tax with several improvements compared to previous health research not just in Vietnam but in the world. The model algorithm was improved by using arc formula that offered a better projection on prevalence elasticity. Sensitivity analysis of this parameter was carried out for comprehensive analysis of health outcome. Also, the module of tax and price in this model was conducted extensively with detailed calculations to transfer the tax increase to the price increase.

#### **4.4. Strengths & Limitations**

The study has its own strengths compared to previous works on tobacco tax in Vietnam. Firstly, the approach from Abridged SimSmoke model adopted in this simulation model has huge advantages from its transparent structure which enables the wide adoption of other individual interventions on tobacco control. This advantage scores good point for supporting health program planning and policymaking in Vietnam as the study findings would be presented and criticized by multisectoral stakeholders. Secondly, thanks to the well-recognized approach, model validation and comparison for the outcomes were available allowing the comparison with many countries regardless of income status, tobacco use pattern or culture. Thirdly, this model was developed explicitly for tobacco tax with an emphasis on calculation of tobacco tax and price. While previous works on this

topic usually employed a hypothetical final increase, detail description of price components was presented in this study. It aims to provide non-economic researchers, policymakers and general readers with appropriate understanding of this issue. As a result, this model not only overcome the limitations on tax assessment of previous health modeling in Vietnam but also suggest a good reference for understanding the concept of tax policy in health policy planning and advocacy. Furthermore, the model is expected to be a sample model for adoption with the upcoming findings from Vietnam GATS survey 2020.

Nevertheless, this study result should be carefully interpreted in line with the model's limitations. As a static model, the model does not integrate the demographic changes and is limited to a fixed cohort over the time frame which is a big obstacle for a country with an aging population trend like Vietnam. The fixed cohort modeled in this study only considered those aged 15 and above resulting in the lack of projection on health impact of adolescent population. The fact that youth was twice sensitive to price changes compared to adults (89), an additional component on adolescent population should be the priority of model improvement. Also, the study did not consider the full set of smoking behavior but leaving out the relapse and initiation rate in projecting reduction in number of smokers. The lack of accurate estimation of initiation and relapse rate in Vietnamese population could explain this limitation as it is the main reason why the abridged version was chosen instead of the complete version. However, considering the repeated pattern

of a high initiation rate of young adulthood from several surveys, this issue is highly recommended for further studies in tobacco control in Vietnam.

Another limitation is that the estimation of policy effect was subjected to uncertainty. The price elasticity applied in this model was taken from literature review and previous Abridged SimSmoke model. However, this parameter could be widely varied in each country and depended on the characteristics of consumers. The value range of  $-0.15 - 0.25$  of price elasticity of demand has been applied in simulation model of tobacco price since 2000s, hence, it might be underestimated or overestimated in the current time. Particularly, reviews on simulation models in Vietnam also provided a wide range of price elasticity of tobacco products from  $-0.20$  to  $0.4$  (52, 68, 90, 91). The model was developed for cigarettes only and excluded the contribution of other tobacco products such as water pipes or electronic tobacco. Being the second most consuming tobacco product, the water pipe was locally produced at a relatively low price and not subjected to specific tax. The rate of smokers using electronic tobacco showed raising trend recently and data on its market share is not yet available and get attention for research. Also, the price and tax of 2020 were estimated using the data on tobacco market from 2016 backward, hence, it might not reflect the actual market price.

Last not least, the whole world has suffered the sudden strike of COVID-19 throughout the year 2020 which has undoubtedly shifted the economy and healthcare negatively in almost every nation. With over 700,000 deaths worldwide and the temporary shut down on social, healthcare, education, and trading

activities, the changes in health burden from tobacco use and lifestyle behaviors to COVID-19 is predictable. The economic crisis that has been foreseen by many international agencies also presented a possibility of significant skewness in economic modeling. Therefore, further revisions and improvements are warranted on this topic worldwide and in Vietnam particularly.

#### **4.5. Further steps**

In Vietnam, health modeling in tobacco control is not new but remained a potential topic for further groundbreaking studies. With the experience of the previous raising tobacco tax in 2014, this model solely served as a complete model for raising tobacco tax aiming to enhance understanding of tax administration and how it influences health programs and policies. Although the National Assembly is reviewing the proposed plan of raising tobacco tax in 2020-2021, there is an opportunity to examine and validate this model for the next amendment on tobacco tax until 2030. The next step of this study is the extension of this model on other individual interventions (non-price interventions in MPOWER package) and the combination of all interventions with the findings from Vietnam GATS 2020. The expectation was set for a comprehensive assessment of all implemented tobacco control policies, highlighting the role of a sufficient tax increase of tobacco products.

## 5. Conclusion

The study findings showed that raising tobacco tax have a great benefit on reducing smoking prevalence and the smoking-attributable deaths in all modeled scenarios. Among the submitted plans to National Assembly, the study results supported the implementation of the new excise tax structure of the ad valorem at 80% of factory price and the specific tax of 2,000-5,000 VND/pack which was proposed by Vietnam Ministry of Health. Although this plan was the most suitable strategy at the current time, it should be emphasized that there is still a vacant space for Vietnam government to raise tobacco tax in the near future to maximize the effectiveness of this intervention. Hence, the study findings suggested the two extreme plans on raising tobacco tax that would potentially achieve the reduction of smoking prevalence by 10% after 5 years. These two plans are both recommended the specific tax of 5,000 VND/ pack and the ad valorem tax of 100% - 200%. Careful interpretation and implication of study results should be placed with the model scope and assumptions while further budget impact analysis is needed to ascertain the study findings. Otherwise, this model is expected to serve as a reference for a health impact assessment on tax policy in Vietnam as well as other non-price interventions regarding the study's limitations. Most importantly, the study findings once again concrete the evidence base on changing the consumption of tobacco products by raising tax. A strong message is sending out for the governmental concern and actions to move forward the policy agenda and community efforts to reduce the harms of tobacco use on human health in Vietnam.

## Bibliography

1. GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015. *Lancet* (London, England). 2017;389(10082):1885-906.
2. Drope J, Schluger N, Cahn Z, Drope J, Hamill S, Islami F, et al. *The Tobacco Atlas* (6th edition). Atlanta: American Cancer Society and Vital Strategies.; 2018.
3. Vietnam Ministry of Health, Hanoi Medical University, General Statistics Office, World Health Organization, Center for Disease Control and Prevention. *Global Adult Tobacco Survey (GATS) Vietnam 2015*. Hanoi; 2016.
4. NT Duyen, HV Minh, NV Huy, KB Giang, TT Ngan, NX Long, et al. Patterns of behavioral risk factors for non-communicable diseases in Vietnam: A narrative scoping review. *Health Psychology Open* 2020.
5. Jawad M, Charide R, Waziry R, Darzi A, Ballout RA, Akl EA. The prevalence and trends of waterpipe tobacco smoking: A systematic review. *PloS one*. 2018;13(2):e0192191-e.
6. Vietnam Ministry of Health. *Vietnam Global Youth Tobacco Survey (GYTS) 2003 in 5 cities (Fact sheet)*. Hanoi; 2003.
7. Vietnam Ministry of Health. *Vietnam Global Youth Tobacco Survey (GYTS) 2007 (Fact sheet)*. Hanoi; 2007.

8. Vietnam Ministry of Health, Vietnam Standing Committee on Smoking and Health, Hanoi Medical University, World Health Organization, Center for Disease Control and Prevention. Vietnam Global Youth Tobacco Survey (GYTS) 2014. Hanoi; 2014.
9. World Bank Group Global Tobacco Control Program. Vietnam: Overview of Tobacco Control Legislation, Use, and Taxation - A Country Brief. World Bank. Available \_\_\_\_\_ at <http://documents1.worldbank.org/curated/en/818741559223994957/pdf/Vietnam-Overview-of-Tobacco-Use-Tobacco-Control-Legislation-and-Taxation.pdf>; 2018.
10. Efroymson D, Pham HA, Jones L, FitzGerald S, Thu LT, Thu Hien LT. Tobacco and poverty: evidence from Vietnam. *Tobacco Control*. 2011;20(4):296.
11. US Department of Health EaW. Smoking and Health: Report of The Advisory Committee to the Surgeon General of the Public Health Services.
12. Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ. Cancer statistics, 2009. *CA: a cancer journal for clinicians*. 2009;59(4):225-49.
13. Arcavi L, Benowitz NL. Cigarette smoking and infection. *Archives of internal medicine*. 2004;164(20):2206-16.
14. Emily J. Grundy, Taiba Suddek, Filippos T. Filippidis, Azeem Majeed, Sophie Coronini-Cronberg. Smoking, SARS-CoV-2 and COVID-19: A review of reviews considering implications for public health policy and practice. *Tob Induc Dis*. 2020;18(July).

15. World Health Organization. WHO report on the global tobacco epidemic, 2013: Enforcing bans on tobacco advertising, promotion and sponsorship. WHO Library Cataloguing-in-Publication Data.
16. Ekpu VU, Brown AK. The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence. *Tob Use Insights*. 2015;8:1-35.
17. Goodchild M, Nargis N, Tursan d, Espaignet E. Global economic cost of smoking-attributable diseases. *Tobacco Control*. 2018;27(1):58.
18. Hoang Anh PT, Thu LT, Ross H, Quynh Anh N, Linh BN, Minh NT. Direct and indirect costs of smoking in Vietnam. *Tobacco control*. 2016;25(1):96-100.
19. Institute of Medicine. *Ending the Tobacco Problem: A Blueprint for the Nation*. Washington, DC: The National Academies Press; 2007.
20. Giovino GA. Epidemiology of tobacco use in the United States. *Oncogene*. 2002;21(48):7326-40.
21. Vietnam National Assembly. *Law on Protection of People's Health 1989*.
22. Vietnam National Assembly. *Resolution on the National Tobacco Control Policy in period 2000-2010*. 2000.
23. General Statistics Office of Vietnam. *Vietnam Living Standards Survey 1997-1998*. Hanoi; 1998.
24. General Statistics Office of Vietnam. *Vietnam Living Standards Survey 1992-1993*. Hanoi; 1993.
25. General Statistics Office of Vietnam. *Vietnam Living Standards Survey 2001-2002*. Hanoi; 2003.

26. Vietnam Ministry of Health. National survey on the Risk Factors of Non-Communicable Diseases (STEPS) Vietnam, 2015. Hanoi; 2016.
27. Vietnam Ministry of Health, Hanoi Medical University, General Statistics Office, World Health Organization, Center for Disease Control and Prevention. Global Adult Tobacco Survey (GATS) Vietnam 2020. Hanoi; 2020.
28. Vietnam Ministry of Health, Hanoi Medical University, General Statistics Office, World Health Organization, Center for Disease Control and Prevention. Global Adult Tobacco Survey (GATS) Vietnam 2010. Hanoi; 2010.
29. Nguyen Thanh Liem, Vu Cong Nguyen, Nguyen Hanh Nguyen. Using alcohol, beer and cigarette among Vietnamese Youth - The Analysis Result of Survey Assessment of Vietnamese Youth 2003 and 2009 (SAVY). Hanoi: Asian Development Bank; 2010.
30. Nguyen QN, Pham ST, Do LD, Nguyen VL, Wall S, Weinehall L, et al. Cardiovascular disease risk factor patterns and their implications for intervention strategies in vietnam. *International Journal of Hypertension*. 2012;2012.
31. Do HTP, Geleijnse JM, Le MB, Kok FJ, Feskens EJM. National prevalence and associated risk factors of hypertension and prehypertension among vietnamese adults. *American Journal of Hypertension*. 2015;28(1):89-97.
32. Vietnam National Assembly. Law on Tobacco Harms Prevention and Control 2012.
33. Minh HV, Ngan TT, Mai VQ, My NT, Chung le H, Kien VD, et al. Tobacco Control Policies in Vietnam: Review on MPOWER Implementation

Progress and Challenges. Asian Pacific journal of cancer prevention : APJCP. 2016;17(S1):1-9.

34. World Health Organization. WHO report on the global tobacco epidemic 2019 | Country profile: Vietnam. WHO Geneva; 2019.

35. Vietnam Government. Decree on Detailing the Implementation of the Law on Tobacco Harm Prevention regarding some interventions on tobacco control 2013.

36. NT Duyen, LN Khue, PT Hai, TT Anh, DT Son, AN Poudel, et al. Cost-effectiveness of population-based tobacco control interventions on the health burden of cardiovascular diseases in Vietnam Asian Pacific Journal Of Public Health2020.

37. World Health Organization. WHO report on the global tobacco epidemic 2015 | Country profile: Vietnam. WHO Geneva; 2015.

38. World Health Organization. WHO report on the global tobacco epidemic 2017 | Country profile: Vietnam. WHO Geneva; 2017.

39. Anh LV, Thanh Huong LT, Tuyet Hanh TT, et al. The compliance of tobacco advertising, promotion and sponsorship bans in Viet Nam,. Vietnam Journal of Public Health. 2010;8.

40. Vietnam National Assembly. Law on Amendment and Supplement of The Special Consumption Tax law and The Value Added Tax Law. Law No. 57/2005/QH11 of November 29, 2005 2005.

41. Vietnam National Assembly. Law on Amendment of the Law on Special Excise Duty 2008. 2014.

42. Minh HV, Duyen NT, Ngan TT, Ngoc NB, Son DT, Hai PT. Potential health impacts of increasing the cigarette tax in Viet Nam. The international journal of tuberculosis and lung disease : the official journal of the International Union against Tuberculosis and Lung Disease. 2018;22(11):1378-82.
43. Food and Agriculture Organization of the United Nations. FAOSTAT. Available from: <http://www.fao.org/faostat/en/#data/QC.2017>.
44. Vietnam General Statistics Office. Index of Industrial production by industrial activity. Available at [https://www.gso.gov.vn/default\\_en.aspx?tabid=627](https://www.gso.gov.vn/default_en.aspx?tabid=627).
45. Vietnam General Statistics Office. Index of Industrial Production, Shipment and Inventory by new methology. Available at [https://www.gso.gov.vn/default\\_en.aspx?tabid=627](https://www.gso.gov.vn/default_en.aspx?tabid=627).
46. Vietnam General Statistics Office. Statistical Indicator System at National level Available at [https://www.gso.gov.vn/danhmuc/HTCT\\_QG.aspx?ma=09](https://www.gso.gov.vn/danhmuc/HTCT_QG.aspx?ma=09) [
47. Euromonitor International. Cigarettes in Vietnam. Available at <https://www.euromonitor.com/cigarettes-in-vietnam/report>.; 2018.
48. United Nations Statistics Division. Trade of goods: Tobacco and manufactured tobacco substitutes. . Comodity Trade Statistics Database - United Nations Statistics Division.
49. World Health Organization. Tobacco Taxes in Viet Nam. Questions and Answers. Available from: <https://apps.who.int/iris/rest/bitstreams/1148386/retrieve>.; 2018.

50. Nguyen HTT, Giang LT, Pham TN. Empirical analysis on the illicit trade of cigarettes in Vietnam. *Tobacco Control*. 2020;tobaccocontrol-2019-055598.
51. Sunley E, Yurekli A, Chaloupka FJ. Tobacco control policies in developing countries | The design, administration, and potential revenue of tobacco excises. New York: Oxford University Press; 2000.
52. Guindon GE, Nguyen TT Hien, Hoang V Kinh, McGirr E, Dang V Trung, Nguyen T Lam. Tobacco Taxation in Vietnam. Paris: International Union Against Tuberculosis and Lung Disease; 2010.
53. Vietnam Ministry of Finance Department of Tax Policy, HealthBridge Foundation of Canada, Southeast Asia Tobacco Control Alliance. Vietnam Tobacco Tax Report Card. Available at <https://healthbridge.ca/images/uploads/library/VietnamTobaccoTaxReportCard.pdf>; 2017.
54. Tran TT, Tran TNT, Le TT, Dao TS, Nguyen TL, Goodchild M. Cigarette affordability and impacts of 2014 tax reform in Vietnam. *Tob Induc Dis*. 2018;16(1).
55. Vietnam National Assembly. Approval on the National Tobacco Control Program til 2020. Hanoi: Decision No. 229/QD-TTg dated 25 January 2013; 2013.
56. Roberts EB, Homer J, Kasabian A, Varrell M. A systems view of the smoking problem: Perspective and limitations of the role of science in decision-making. *International Journal of Bio-Medical Computing*. 1982;13(1):69-86.
57. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. The Health Consequences of Smoking: 50 Years of

Progress. A Report of the Surgeon General | Chapter 15. Appendix: Tobacco Control Simulation Models. Atlanta US2014.

58. Mendez D., Warner K. E. Adult cigarette smoking prevalence: declining as expected (not as desired). *American journal of public health*. 2004;94(2):251-2.

59. Mendez D, Warner KE, Courant PN. Has smoking cessation ceased? Expected trends in the prevalence of smoking in the United States. *American journal of epidemiology*. 1998;148(3):249-58.

60. Orme ME, Hogue SL, Kennedy LM, Paine AC, Godfrey C. Development of the health and economic consequences of smoking interactive model. *Tobacco Control*. 2001;10(1):55.

61. Tengs TO, Ahmad S, Moore R, Gage E. Federal policy mandating safer cigarettes: a hypothetical simulation of the anticipated population health gains or losses. *J Policy Anal Manage*. 2004;23(4):857-72.

62. Tengs TO, Osgood ND, Lin TH. Public health impact of changes in smoking behavior: results from the Tobacco Policy Model. *Medical care*. 2001;39(10):1131-41.

63. National Cancer Institute Cancer Intervention and Surveillance Modeling Network. SimSmoke Tobacco Control Policy Simulation Model. Available at <https://resources.cisnet.cancer.gov/registry/packages/simsmoke-georgetown/>.

64. Levy D. T., Fouad H., Levy J., Dragomir A. D., El Awa F. Application of the Abridged SimSmoke model to four Eastern Mediterranean countries. *Tobacco Control*. 2016;25(4):413-21.

65. Levy D, Abrams DB, Levy J, Rosen L. Complying with the framework convention for tobacco control: an application of the Abridged SimSmoke model to Israel. *Israel journal of health policy research*. 2016;5:41.
66. Vietnam General Statistics Office. Statistics on Population and Employment Available at [https://www.gso.gov.vn/default\\_en.aspx?tabid=774](https://www.gso.gov.vn/default_en.aspx?tabid=774). Accessed on 20 April 2020.2015.
67. Vietnam National Assembly. Law on Excise Tax 2008.
68. Levy DT, Bales S, Lam NT, Nikolayev L. The role of public policies in reducing smoking and deaths caused by smoking in Vietnam: results from the Vietnam tobacco policy simulation model. *Social science & medicine* (1982). 2006;62(7):1819-30.
69. Levy DT, Huang A-T, Currie LM, Clancy L. The benefits from complying with the framework convention on tobacco control: a SimSmoke analysis of 15 European nations. *Health Policy and Planning*. 2013;29(8):1031-42.
70. Vietnam General Statistics Office. Consumer Price Index Available at [https://www.gso.gov.vn/default\\_en.aspx?tabid=625](https://www.gso.gov.vn/default_en.aspx?tabid=625) [
71. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ (Clinical research ed)*. 2004;328(7455):1519.
72. Salti N, Brouwer E, Verguet S. The health, financial and distributional consequences of increases in the tobacco excise tax among smokers in Lebanon. *Social science & medicine* (1982). 2016;170:161-9.

73. David T Levy, Jennifer A Ellis, Darren Mays, An-Tsun Huang. Smoking-related deaths averted due to three years of policy progress. *Bulletin World Health Organization*. 2013;91:10.
74. Norashidah M.N., Hana R., Wency B.K.T., Judhiana A.G., Norayana H., Nizam B. Malaysia Abridged SimSmoke Model - Towards Achieving 2025 and 2045 Smoking Prevalence Targets. *Malaysian Journal of Medicine and Health Sciences* 2018.
75. Blecher E LT, Nguyen AN,. *Tobacconomics Policy Note: Affordability of Cigarettes in Vietnam*. Chicago: Institute for Health Research and Policy (University of Illinois); 2019.
76. Prieger JE, Kulick J. CIGARETTE TAXES AND ILLICIT TRADE IN EUROPE. *Economic Inquiry*. 2018;56(3):1706-23.
77. Kwon DS, Kim TH, Byun MK, Kim HJ, Lee HS, Park HJ, et al. Positive Effects of the National Cigarette Price Increase Policy on Smoking Cessation in South Korea. *Tuberc Respir Dis (Seoul)*. 2020;83(1):71-80.
78. Seung Eun Choi SIC, Jin Gyu Choi, Paul Isenman, Angela Burton, Spaeth Hill,. *Reducing Tobacco Use through Taxation: The Experience of the Republic of Korea*. Washington DC: World Bank Group. Available at <http://documents1.worldbank.org/curated/en/150681529071812689/pdf/127248-WP-PUBLIC-ADD-SERIES-WBGTobaccoKoreaFinalweb.pdf>; 2018.
79. Park M-B, Nam EW, Lee HL, Hong KS, Oh Y. Social phenomena following the tobacco tax increase in South Korea: Lessons and policy implications. *Tob Induc Dis*. 2018;16(May).

80. Goodchild M, Perucic A-M, Nargis N. Modelling the impact of raising tobacco taxes on public health and finance. *Bull World Health Organ.* 2016;94(4):250-7.
81. World Health Organization. More money for health, and more health for the money. Geneva: Taskforce on Innovative International Financing for Health Systems. Available from [http://www.who.int/tobacco/economics/en\\_tfi\\_economics\\_final\\_task\\_force\\_report.pdf](http://www.who.int/tobacco/economics/en_tfi_economics_final_task_force_report.pdf); 2009.
82. Nargis N, Stoklosa M, Shang C, Drope J. Price, Income, and Affordability as the Determinants of Tobacco Consumption: A Practitioner's Guide to Tobacco Taxation. *Nicotine & Tobacco Research.* 2020.
83. Wamamili BM, Garrow AP. Have higher cigarette taxes in the United States discouraged smoking? A review of data from 1999-2013. *Tob Prev Cessat.* 2017;3:15-.
84. Wilkinson AL, Scollo MM, Wakefield MA, Spittal MJ, Chaloupka FJ, Durkin SJ. Smoking prevalence following tobacco tax increases in Australia between 2001 and 2017: an interrupted time-series analysis. *The Lancet Public Health.* 2019;4(12):e618-e27.
85. Yu L, Cohen JE, Hoe C, Yang T, Wu D. Male smoking reduction behaviour in response to China's 2015 cigarette tax increase. *Tobacco Control.* 2020;29(4):405.

86. Nargis N, Hussain AG, Goodchild M, Quah AC, Fong GT. A decade of cigarette taxation in Bangladesh: lessons learnt for tobacco control. *Bull World Health Organ.* 2019;97(3):221-9.
87. Kostova D, Andes L, Erguder T, Yurekli A, Keskinikliç B, Polat S, et al. Cigarette prices and smoking prevalence after a tobacco tax increase--Turkey, 2008 and 2012. *MMWR Morb Mortal Wkly Rep.* 2014;63(21):457-61.
88. Jha P, Renu Joseph, David Li, Cindy Gauvreau, Ian Anderson, Patricia Moser, et al. *Tobacco Taxes: A Win-Win Measure for Fiscal Space and Health.* Asian Development Bank; 2012.
89. International Agency for Research on Cancer. Effectiveness of tax and price policies for tobacco control | Chapter 6: Tax, price and tobacco use among young people Lyon, France: IARC, 2011. . Lyon, France: IARC (Available from: <http://www.iarc.fr/en/publications/list/handbooks/>); 2011.
90. Higashi H, Truong KD, Barendregt JJ, Nguyen PK, Vuong ML, Nguyen TT, et al. Cost effectiveness of tobacco control policies in Vietnam: the case of population-level interventions. *Applied health economics and health policy.* 2011;9(3):183-96.
91. Eozenou Patrick, Fishburn Burke. Price Elasticity Estimates of Cigarette Demand in Vietnam. Munich Personal RePEc Archive: European University Institute, World Health Organization; 2001.

## Appendix

### Appendix 1: Consumer Price Index from 2010 to 2020 in Vietnam

(Overall index and index for beverage and tobacco products)

Table 18: Consumer Price Index (overall index) in Vietnam from 2010-2020

Year	Compared to previous year	Compared to 2015 (base year)	Inflation
2010	109.19%	68.60%	-31.40%
2011	118.58%	81.41%	-18.59%
2012*	109.66%	88.82%	-11.18%
2013	106.60%	94.67%	-5.33%
2014	104.09%	99.13%	-0.87%
2015	100.63%	100.00%	0.00%
2016	102.66%	103.24%	3.24%
2017	103.53%	106.88%	6.88%
2018	103.54%	110.66%	10.66%
2019	102.79%	113.75%	13.75%
2020**	104.90%	119.33%	19.33%

\* CPI as counted on October 2012; \*\* CPI as estimated on April 2020

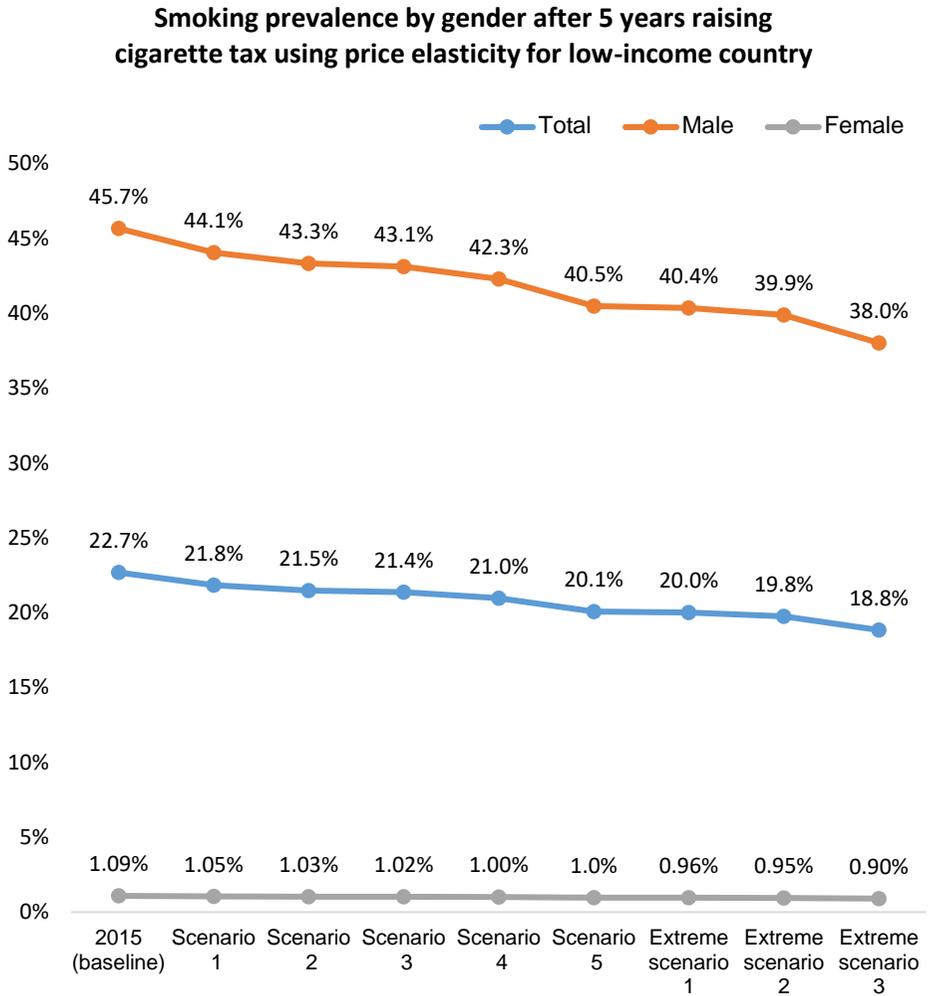
**Table 19: Consumer Price Index for beverage and tobacco products in Vietnam from 2010-2020**

<b>Year</b>	<b>Compared to previous year</b>	<b>Compared to 2015 (base year)</b>	<b>Inflation</b>
2010	108.22%	75.82%	-24.18%
2011	111.70%	84.69%	-15.31%
2012*	106.95%	90.57%	-9.43%
2013	104.20%	94.38%	-5.62%
2014	103.73%	97.90%	-2.10%
2015	102.15%	100.00%	0.00%
2016	102.21%	102.21%	2.21%
2017	101.52%	103.76%	3.76%
2018	101.42%	105.24%	5.24%
2019	101.99%	107.33%	7.33%
2020**	101.75%	109.21%	9.21%

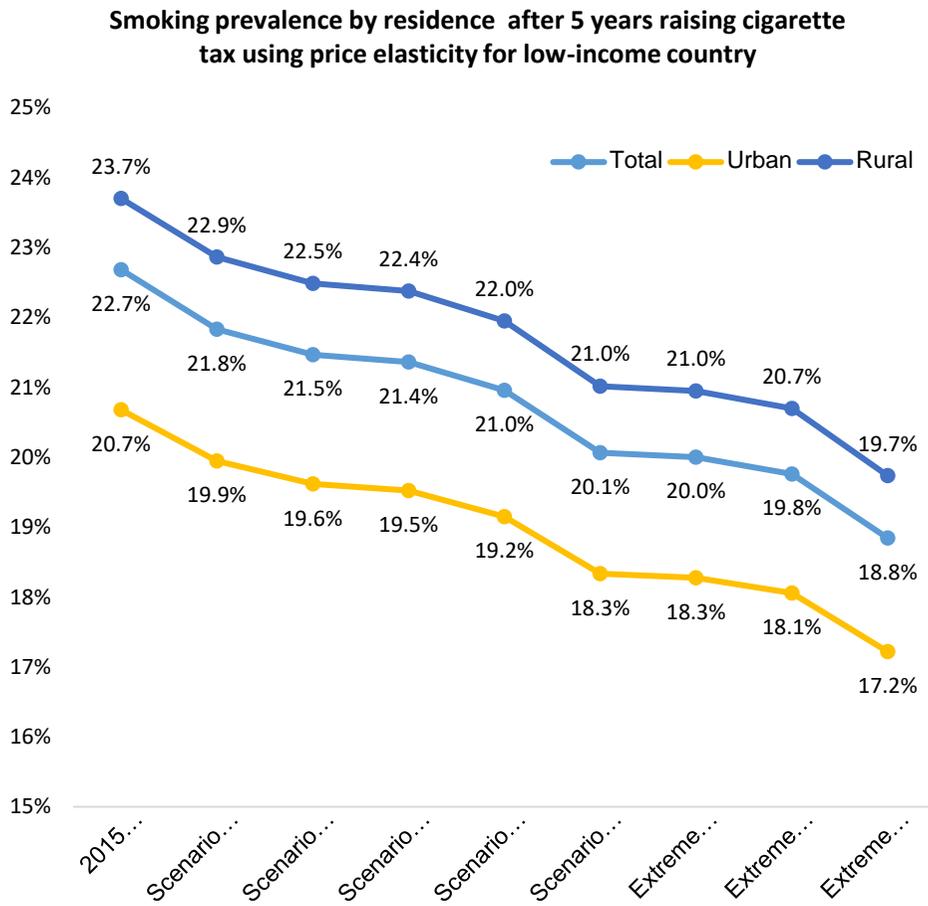
\* *CPI as counted on October 2012; \*\* CPI as estimated on April 2020*

Source: Vietnam General Statistics Office. Consumer Price Index. Available at [https://www.gso.gov.vn/default\\_en.aspx?tabid=625](https://www.gso.gov.vn/default_en.aspx?tabid=625) (accessed on August 20<sup>th</sup>, 2020).

**Appendix 2: Projection of short-term smoking prevalence using price elasticity of -0.25 for low-income countries**



**Figure 8: Smoking prevalence after 5 years raising cigarette tax by gender using the price elasticity for low-income country**



**Figure 9: Smoking prevalence after 5 years raising cigarette tax by residence using the price elasticity for low-income country**

**Appendix 3: The projected reduction in number of smokers and SADs using price elasticity of -0.25 for low-income countries**

**Table 20: Estimation on Smoking prevalence and Reduction in number of smokers and smoking-attributable deaths in adult population**

No	Scenarios	Tax share in retail price	Smoking prevalence		Reduction in no. of smokers			Reduction of no. of SADs		
			Short term	Long term	Male	Female	Total	Male	Female	Total
1	Ad valorem 80% only	38.1%	21.6%	20.7%	344,206	268	344,474	136,454	87	136,541
2	Ad valorem 75% + 1000d/pack	40.8%	21.2%	19.9%	484,684	377	485,061	192,144	122	192,266
3	Ad valorem 80% + 1000d/pack	41.6%	21.1%	19.7%	529,956	412	530,368	210,091	134	210,225
4	Ad valorem 80% + 2000d/pack	44.6%	20.6%	18.8%	692,520	539	693,059	274,537	175	274,711
5	Ad valorem 75% + 5000d/pack	50.5%	19.6%	16.9%	1,049,533	816	1,050,350	416,068	265	416,333
6	Ad valorem 80% + 5000d/pack	50.9%	19.5%	16.8%	1,077,665	838	1,078,503	427,220	272	427,492
7	Ad valorem 100% + 5000d/pack	52.5%	19.2%	16.3%	1,182,990	920	1,183,910	468,974	299	469,273
8	Ad valorem 200% + 5000d/pack	58.2%	18.1%	14.3%	1,580,805	1,230	1,582,034	626,680	399	627,079

**Appendix 4: The projected number of smokers and SADs by age groups among male using retail margin at 10%**

**Table 21: Short-term policy effect by age groups among males using retail margin at 10%**

<b>Age groups</b>	<b>15-24</b>	<b>25-34</b>	<b>35-44</b>	<b>45-54</b>	<b>55-64</b>	<b>65+</b>
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	23.9%	46.1%	57.9%	55.8%	48.8%	34.3%
Reduction in smoking prevalence	0.87%	1.69%	2.12%	2.04%	1.78%	1.25%
Reduction in number of smokers	15,209	59,583	85,167	69,635	34,750	12,236
Reduction in premature SADs	7,452	25,323	36,196	26,113	13,031	1,530
<b>Scenario 2: Ad valorem 75% + 1000d/pack</b>						
Short-term smoking prevalence	23.6%	45.6%	57.3%	55.1%	48.2%	33.9%
Reduction in smoking prevalence	1.15%	2.21%	2.78%	2.68%	2.34%	1.65%
Reduction in number of smokers	19,955	78,174	111,741	91,363	45,593	16,054
Reduction in premature SADs	9,778	33,224	47,490	34,261	17,097	2,007

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 3: Ad valorem 80% + 1000d/pack</b>						
Short-term smoking prevalence	23.5%	45.4%	57.0%	54.9%	48.0%	33.7%
Reduction in smoking prevalence	1.27%	2.44%	3.07%	2.95%	2.58%	1.82%
Reduction in number of smokers	22,022	86,272	123,316	100,827	50,315	17,717
Reduction in premature SADs	10,791	36,666	52,409	37,810	18,868	2,215
<b>Scenario 4: Ad valorem 80% + 2000d/pack</b>						
Short-term smoking prevalence	23.2%	44.7%	56.1%	54.0%	47.2%	33.2%
Reduction in smoking prevalence	1.62%	3.12%	3.92%	3.78%	3.30%	2.32%
Reduction in number of smokers	28,148	110,273	157,622	128,877	64,313	22,646
Reduction in premature SADs	13,792	46,866	66,989	48,329	24,117	2,831
<b>Scenario 5: Ad valorem 75% + 5000d/pack</b>						
Short-term smoking prevalence	21.8%	42.1%	52.9%	50.9%	44.5%	31.3%
Reduction in smoking prevalence	2.98%	5.74%	7.21%	6.94%	6.07%	4.27%
Reduction in number of smokers	51,755	202,756	289,817	236,964	118,251	41,639
Reduction in premature SADs	25,360	86,171	123,172	88,862	44,344	5,205

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 6: Ad valorem 80% + 5000d/pack</b>						
Short-term smoking prevalence	22.3%	43.0%	54.0%	52.0%	45.5%	32.0%
Reduction in smoking prevalence	2.49%	4.80%	6.04%	5.81%	5.08%	3.57%
Reduction in number of smokers	43,310	169,672	242,526	198,298	98,956	34,845
Reduction in premature SADs	21,222	72,110	103,074	74,362	37,108	4,356
<b>Extreme scenario 1: Ad valorem 100% + 5000d/pack</b>						
Short-term smoking prevalence	22.0%	42.4%	53.3%	51.3%	44.9%	31.5%
Reduction in smoking prevalence	2.79%	5.39%	6.77%	6.51%	5.70%	4.00%
Reduction in number of smokers	48,554	190,215	271,890	222,307	110,937	39,064
Reduction in premature SADs	23,791	80,841	115,553	83,365	41,601	4,883
<b>Extreme scenario 2: Ad valorem 200% + 5000d/pack</b>						
Short-term smoking prevalence	20.9%	40.2%	50.6%	48.7%	42.5%	29.9%
Reduction in smoking prevalence	3.92%	7.57%	9.51%	9.16%	8.01%	5.63%
Reduction in number of smokers	68,255	267,395	382,210	312,508	155,950	54,914
Reduction in premature SADs	33,445	113,643	162,439	117,191	58,481	6,864

**Appendix 5: Projection of number of smokers and SADs by age groups among females using retail margin at 10%**

**Table 22: Short-term policy effect by age groups among females using retail margin at 10%**

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	0.52%	0.47%	0.74%	1.91%	1.71%	1.78%
Reduction in smoking prevalence	0.02%	0.02%	0.03%	0.07%	0.06%	0.07%
Reduction in number of smokers	7	6	14	87	50	51
Reduction in premature SADs	3	3	6	33	19	6
<b>Scenario 2: Ad valorem 75% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.74%	1.89%	1.69%	1.76%
Reduction in smoking prevalence	0.02%	0.02%	0.04%	0.09%	0.08%	0.09%
Reduction in number of smokers	9	8	19	115	65	66
Reduction in premature SADs	4	3	8	43	25	8

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 3: Ad valorem 80% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.73%	1.88%	1.69%	1.76%
Reduction in smoking prevalence	0.03%	0.02%	0.04%	0.10%	0.09%	0.09%
Reduction in number of smokers	10	9	21	127	72	73
Reduction in premature SADs	5	4	9	47	27	9
<b>Scenario 4: Ad valorem 80% + 2000d/pack</b>						
Short-term smoking prevalence	0.50%	0.45%	0.72%	1.85%	1.66%	1.73%
Reduction in smoking prevalence	0.03%	0.03%	0.05%	0.13%	0.12%	0.12%
Reduction in number of smokers	13	12	26	162	92	94
Reduction in premature SADs	6	5	11	61	35	12
<b>Scenario 5: Ad valorem 75% + 5000d/pack</b>						
Short-term smoking prevalence	0.47%	0.43%	0.68%	1.75%	1.56%	1.63%
Reduction in smoking prevalence	0.06%	0.06%	0.09%	0.24%	0.21%	0.22%
Reduction in number of smokers	23	21	49	297	170	172
Reduction in premature SADs	11	9	21	112	64	22

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Extreme scenario 1: Ad valorem 80% + 5000d/pack</b>						
Short-term smoking prevalence	0.48%	0.44%	0.69%	1.78%	1.60%	1.66%
Reduction in smoking prevalence	0.05%	0.05%	0.08%	0.20%	0.18%	0.19%
Reduction in number of smokers	19	18	41	249	142	144
Reduction in premature SADs	9	8	17	93	53	18
<b>Extreme scenario 2: Ad valorem 100% + 5000d/pack</b>						
Short-term smoking prevalence	0.47%	0.43%	0.68%	1.76%	1.58%	1.64%
Reduction in smoking prevalence	0.06%	0.05%	0.09%	0.22%	0.20%	0.21%
Reduction in number of smokers	22	20	46	279	159	161
Reduction in premature SADs	11	8	19	105	60	20
<b>Extreme scenario 3: Ad valorem 200% + 5000d/pack</b>						
Short-term smoking prevalence	0.45%	0.41%	0.65%	1.67%	1.50%	1.56%
Reduction in smoking prevalence	0.08%	0.08%	0.12%	0.31%	0.28%	0.29%
Reduction in number of smokers	30	28	64	392	224	227
Reduction in premature SADs	15	12	27	147	84	28

**Appendix 6: Projection of number of smokers and SADs by age groups among males with retail margin at 30%**

**Table 23: Short-term policy effect by age groups among males using retail margin at 30%**

<b>Age groups</b>	<b>15-24</b>	<b>25-34</b>	<b>35-44</b>	<b>45-54</b>	<b>55-64</b>	<b>65+</b>
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	23.9%	46.1%	57.9%	55.8%	48.8%	34.3%
Reduction in smoking prevalence	0.87%	1.69%	2.12%	2.04%	1.78%	1.25%
Reduction in number of smokers	15,209	59,583	85,167	69,635	34,750	12,236
Reduction in premature SADs	7,452	25,323	36,196	26,113	13,031	1,530
<b>Scenario 2: Ad valorem 75% + 1000d/pack</b>						
Short-term smoking prevalence	23.5%	45.3%	57.0%	54.8%	48.0%	33.7%
Reduction in smoking prevalence	1.27%	2.45%	3.08%	2.97%	2.59%	1.82%
Reduction in number of smokers	22,107	86,608	123,796	101,220	50,511	17,786
Reduction in premature SADs	10,833	36,808	52,613	37,958	18,942	2,223

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 3: Ad valorem 80% + 1000d/pack</b>						
Short-term smoking prevalence	23.4%	45.1%	56.7%	54.6%	47.7%	33.5%
Reduction in smoking prevalence	1.39%	2.67%	3.36%	3.23%	2.83%	1.99%
Reduction in number of smokers	24,104	94,429	134,975	110,360	55,073	19,393
Reduction in premature SADs	11,811	40,132	57,364	41,385	20,652	2,424
<b>Scenario 4: Ad valorem 80% + 2000d/pack</b>						
Short-term smoking prevalence	22.9%	44.3%	55.6%	53.5%	46.8%	32.9%
Reduction in smoking prevalence	1.83%	3.53%	4.44%	4.27%	3.74%	2.63%
Reduction in number of smokers	31,846	124,761	178,331	145,810	72,763	25,622
Reduction in premature SADs	15,605	53,023	75,791	54,679	27,286	3,203
<b>Scenario 5: Ad valorem 75% + 5000d/pack</b>						
Short-term smoking prevalence	21.3%	41.1%	51.7%	49.7%	43.5%	30.6%
Reduction in smoking prevalence	3.46%	6.67%	8.39%	8.07%	7.06%	4.96%
Reduction in number of smokers	60,167	235,712	336,924	275,480	137,472	48,408
Reduction in premature SADs	29,482	100,178	143,193	103,305	51,552	6,051

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Extreme scenario 1: Ad valorem 80% + 5000d/pack</b>						
Short-term smoking prevalence	21.9%	42.2%	53.1%	51.1%	44.7%	31.4%
Reduction in smoking prevalence	2.88%	5.55%	6.97%	6.71%	5.87%	4.13%
Reduction in number of smokers	50,035	196,018	280,186	229,089	114,322	40,256
Reduction in premature SADs	24,517	83,308	119,079	85,909	42,871	5,032
<b>Extreme scenario 2: Ad valorem 100% + 5000d/pack</b>						
Short-term smoking prevalence	21.6%	41.7%	52.5%	50.5%	44.1%	31.0%
Reduction in smoking prevalence	3.14%	6.06%	7.61%	7.33%	6.41%	4.50%
Reduction in number of smokers	54,616	213,963	305,835	250,061	124,787	43,941
Reduction in premature SADs	26,762	90,934	129,980	93,773	46,795	5,493
<b>Extreme scenario 3: Ad valorem 200% + 5000d/pack</b>						
Short-term smoking prevalence	20.6%	39.8%	50.0%	48.1%	42.1%	29.6%
Reduction in smoking prevalence	4.15%	8.00%	10.05%	9.67%	8.46%	5.95%
Reduction in number of smokers	72,116	282,522	403,833	330,188	164,772	58,021
Reduction in premature SADs	35,337	120,072	171,629	123,820	61,790	7,253

**Appendix 7: Projection of number of smokers and SADs by age groups among females with retail margin at 30%**

**Table 24: Short-term policy effect by age groups among females using retail margin at 30%**

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 1: Ad valorem 80% only</b>						
Short-term smoking prevalence	0.52%	0.47%	0.74%	1.91%	1.71%	1.78%
Reduction in smoking prevalence	0.02%	0.02%	0.03%	0.07%	0.06%	0.07%
Reduction in number of smokers	7	6	14	87	50	51
Reduction in premature SADs	3	3	6	33	19	6
<b>Scenario 2: Ad valorem 75% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.73%	1.88%	1.69%	1.75%
Reduction in smoking prevalence	0.03%	0.02%	0.04%	0.10%	0.09%	0.09%
Reduction in number of smokers	10	9	21	127	72	73
Reduction in premature SADs	5	4	9	48	27	9

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Scenario 3: Ad valorem 80% + 1000d/pack</b>						
Short-term smoking prevalence	0.51%	0.46%	0.73%	1.87%	1.68%	1.75%
Reduction in smoking prevalence	0.03%	0.03%	0.04%	0.11%	0.10%	0.10%
Reduction in number of smokers	11	10	23	139	79	80
Reduction in premature SADs	5	4	10	52	30	10
<b>Scenario 4: Ad valorem 80% + 2000d/pack</b>						
Short-term smoking prevalence	0.50%	0.45%	0.71%	1.84%	1.65%	1.71%
Reduction in smoking prevalence	0.04%	0.04%	0.06%	0.15%	0.13%	0.14%
Reduction in number of smokers	14	13	30	183	104	106
Reduction in premature SADs	7	6	13	69	39	13
<b>Scenario 5: Ad valorem 75% + 5000d/pack</b>						
Short-term smoking prevalence	0.46%	0.42%	0.66%	1.71%	1.53%	1.59%
Reduction in smoking prevalence	0.07%	0.07%	0.11%	0.28%	0.25%	0.26%
Reduction in number of smokers	27	25	57	346	197	200
Reduction in premature SADs	13	10	24	130	74	25

Age groups	15-24	25-34	35-44	45-54	55-64	65+
<b>Extreme scenario 1: Ad valorem 80% + 5000d/pack</b>						
Short-term smoking prevalence	0.47%	0.43%	0.68%	1.75%	1.57%	1.64%
Reduction in smoking prevalence	0.06%	0.06%	0.09%	0.23%	0.21%	0.21%
Reduction in number of smokers	22	20	47	288	164	166
Reduction in premature SADs	11	9	20	108	61	21
<b>Extreme scenario 2: Ad valorem 100% + 5000d/pack</b>						
Short-term smoking prevalence	0.47%	0.42%	0.67%	1.73%	1.55%	1.62%
Reduction in smoking prevalence	0.07%	0.06%	0.10%	0.25%	0.23%	0.23%
Reduction in number of smokers	24	22	51	314	179	182
Reduction in premature SADs	12	9	22	118	67	23
<b>Extreme scenario 3: Ad valorem 200% + 5000d/pack</b>						
Short-term smoking prevalence	0.45%	0.41%	0.64%	1.65%	1.48%	1.54%
Reduction in smoking prevalence	0.09%	0.08%	0.13%	0.33%	0.30%	0.31%
Reduction in number of smokers	32	30	68	414	236	240
Reduction in premature SADs	16	13	29	155	89	30

# ACKNOWLEDGEMENT

First and foremost, I would like to thank and express my gratitude to my Professor Jin Kyoung Oh. I would have not been who I am today without her guidance, support, and encouragement. She is one of the greatest teachers whom I am forever indebted to. This work is honorably dedicated to her for not just open the door of knowledge but teach me how to deal with my problems patiently and sincerely.

Beside my advisor, I would like to thank Professor Min Kyung Lim. Being my teacher and my committee member, she has inspired me with her amazed knowledge and practical experiences which fuels my motivation to strike further in tobacco control and cancer. A special thank goes to Professor Sung-il Cho (Seoul National University) – my thesis committee member for his valuable insights and suggestions which have greatly improve my work academically and practically.

This work would have not been done without the great support from Dr. Dao The Son (The UNION) for the kind sharing of his work as well as his own experience in tobacco economics. I also take this opportunity to thank Professor Hoang Van Minh and Assoc. Prof. Vu Hoang Lan (Hanoi University of Public Health) for their advices, trust, and guidance throughout my career.

To my big family, especially Mom and Dad: Thank you for giving me so much to be grateful for. Thank you for your unconditional love and being my endless supply of endorphin, which raise me up even the darkest time. I am grateful for being your daughter.

My sincere thanks go to my friends at NCC-GSCP for the cheerful friendship we have. Meeting and knowing you all have brought glorious technicolor to my life in Korea. I wish all the best for your journey and I will wholeheartedly support you whatever choices you make.

Last but not least, I would like to thank Mr. Tung Pham and Mrs. Linh Bui – my mentors who help me to break free of my cocoon and fight for what I think is right.

Thank you all for the wonderful journey at NCC-GCSP!