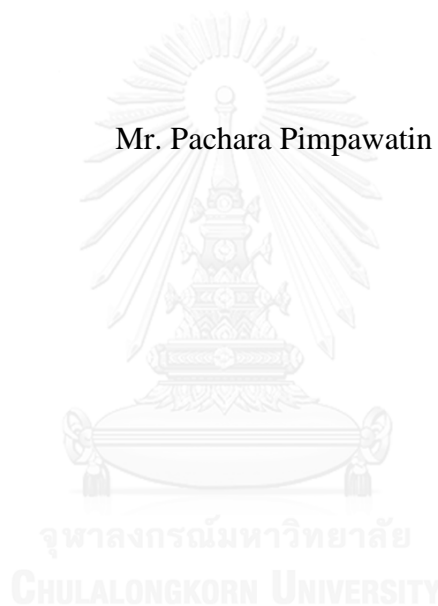


THE IMPACT OF PICTORIAL HEALTH WARNING ON SMOKING BEHAVIOR
IN THAILAND

Mr. Pachara Pimpawatin



บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)
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ผลของภาพคำเตือนสุขภาพบนซองบุหรี่ต่อพฤติกรรมการสูบบุหรี่ในประเทศไทย



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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เพชร พิมพ์วาทีน : ผลของภาพคำเตือนสุขภาพบนซองบุหรี่ต่อพฤติกรรมการสูบบุหรี่ในประเทศไทย (THE IMPACT OF PICTORIAL HEALTH WARNING ON SMOKING BEHAVIOR IN THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก:
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การสูบบุหรี่เป็นปัจจัยเสี่ยงที่สำคัญอันดับสองของสาเหตุการเกิดโรคไม่ติดต่อในประเทศไทยและยังส่งผลกระทบต่อความสูญเสียทางเศรษฐกิจเป็นจำนวนมาก ภาพคำเตือนบนซองบุหรี่เริ่มบังคับใช้ครั้งแรกเมื่อปีพ.ศ. 2547 เพื่อเตือนภัยภัยอันตรายของการสูบบุหรี่และเป็นมาตรการเพื่อลดอัตราการสูบบุหรี่ในประเทศการศึกษานี้มีจุดประสงค์ในการวิเคราะห์ผลของภาพคำเตือนบนซองบุหรี่ต่อพฤติกรรมการสูบบุหรี่ในประเทศไทย

การวิจัยแบบภาคตัดขวางนี้ศึกษาข้อมูลทุติยภูมิจาก โครงการสำรวจพฤติกรรมการสูบบุหรี่และการดื่มสุราของประชากร พ.ศ. 2557 ซึ่งจัดทำโดยสำนักงานสถิติแห่งชาติโดยมีครัวเรือนตัวอย่างทั้งสิ้น 25,758 ครัวเรือนเฉพาะในผู้ที่มีอายุ 15 ปีขึ้นไปโดยศึกษาผลของภาพคำเตือนบนซองบุหรี่ต่อ การสูบบุหรี่ ความถี่ของการสูบบุหรี่ จำนวนบุหรี่ที่สูบต่อวัน และผลต่อความตั้งใจในการเลิกสูบบุหรี่ นำมาวิเคราะห์ด้วยวิธีการวิเคราะห์ความถดถอยโลจิสติกและการวิเคราะห์ความถดถอยเชิงเส้น

ผลการวิจัยพบว่ากลุ่มตัวอย่างส่วนใหญ่ คือ ร้อยละ 94.92ของผู้สูบบุหรี่ และ 87.5ของผู้ไม่สูบบุหรี่เคยเห็นภาพคำเตือนบนซองบุหรี่ ผลของการเห็นภาพคำเตือนสามารถลดการเป็นผู้สูบบุหรี่ได้อย่างมีนัยสำคัญ โดยลดโอกาสการสูบบุหรี่ได้ถึง24.2% แม้ว่าการวิจัยไม่พบผลของการเห็นภาพคำเตือนบนซองบุหรี่ต่อความถี่ของการสูบบุหรี่และจำนวนบุหรี่ที่สูบต่อวัน แต่พบว่าการเห็นภาพคำเตือนมีผลอย่างมากต่อความตั้งใจเลิกสูบบุหรี่และจำนวนครั้งของความพยายามเลิกสูบบุหรี่ โดยผู้สูบบุหรี่ที่เห็นภาพคำเตือนจะเพิ่มโอกาสของการเลิกสูบบุหรี่ได้ 10.8% และเพิ่มโอกาสของความพยายามเลิกสูบบุหรี่มากกว่าสามครั้งได้ 5.6% จากผลวิจัยนี้สรุปได้ว่าภาพคำเตือนที่แสดงถึงพิษภัยของบุหรี่บนซองบุหรี่เป็นมาตรการที่มีประสิทธิภาพสามารถลดอัตราการเริ่มสูบบุหรี่และเพิ่มความตั้งใจและจำนวนครั้งของความพยายามเลิกสูบบุหรี่ได้อย่างมีนัยสำคัญ

จุฬาลงกรณ์มหาวิทยาลัย
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In Thailand, tobacco smoking is the second most significant risk factor for non-communicable diseases, with a large economic burden due to smoking-attributable illness. Pictorial health warning has been implemented since 2004 to inform smokers of negative consequences of smoking, and reduce the number of smokers. The purpose of this study is to evaluate the impact of pictorial health warning on cigarette package on smoking behaviors in Thailand.

This study analyzes secondary data from a national survey on Cigarette Smoking and Alcohol Drinking in 2014 by the National Statistical Office of Thailand. The survey covers 25,758 households, with participants aged more than 15 years. Logistic regressions and linear regressions are used to evaluate the impact of exposure to pictorial health warning on the probability of smoking, smoking behaviors (in terms of smoking frequency and number of cigarette smoked per day), and the intention to quit smoking.

The results show that, in 2014, the majority of respondents noticed pictorial health warning on cigarette packages: 94.92% of smokers and 87.5% of non-smokers. Exposure to pictorial health warning has a negative impact on the probability of becoming smokers significantly, i.e. 24.2% less likely to smoke. Although exposure to pictorial health warning has a statistically insignificant impact on the smoking frequency and the number of cigarettes consumed per day, it plays an important role on the intention to quit and the number of quit attempts. Smokers exposed to pictorial health warning have a higher probability of quitting and a higher probability of having attempted to quit more than 3 times by 10.8% and 5.6%, respectively. The study concludes that pictorial health warnings on the cigarette packages are an effective tool to prevent non-smokers from initiating smoking and they raise concerns such that current smokers are more likely to attempt quitting.



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Chapter 1

Introduction

1.1 Prevalence and burden of tobacco smoking

Tobacco is an addictive substance that remains legal and accessible. It is also a major cause of lung cancer and premature deaths worldwide (Doll, 2004). In Thailand, in 2009, tobacco smoking was the second most significant risk factor in the non-communicable diseases (K. Bundhamcharoen, 2012). The latest Thai national survey on Cigarette Smoking and Alcohol Drinking in 2014 collected by the National Statistical Office of Thailand reported that the prevalence of tobacco smoking among the Thai population over the age of 15 years was 20.7%, and it slightly increased from the earlier national survey on Health and Welfare in 2013 (19.9%) (The National Statistical Office of Thailand, 2013). Smoking in Thailand is statistically associated with the male population (18 times higher than the female population) as well as individuals with low education, low income levels and those living in rural areas (The National Statistical Office of Thailand, 2015). People who reported smoking regularly in 2014 started smoking at the average age of 17.8 years (The National Statistical Office of Thailand, 2015). Among regular smokers, 61.7% consumed manufactured cigarettes. The majority of smokers of manufactured cigarettes lived in urban areas (75.9%), while the majority of smokers in rural areas smoked roll-your-own cigarettes (68.4%). The average number of cigarettes smoked per day was 11.5 (The National Statistical Office of Thailand, 2015).

Smoking behavior is one of the leading preventable factors that cause many non-infectious diseases and also the premature death; examples of other preventable

causes of death include alcohol drinking, being overweight and high blood pressure. Many studies have shown strong evidence linking smoking and diseases. The 2004 U.S. Surgeon General reported that tobacco smoking hazardously affects almost every organ in the body (US Department of Health Human Services, 2004). Tobacco smoking causes more than 5 million deaths per year worldwide, due mainly to cardiovascular diseases, chronic obstructive pulmonary diseases, and lung cancer (Mathers & Loncar, 2006). In Thailand, it was the second major risk factor in 2009, and accounted for 7% of total burden of disease in terms of disability-adjusted life years lost (K. Bundhamcharoen, Aungkulanon, Makka, & Shibuya, 2015).

Smoking-attributable healthcare costs were, as reported by the World Bank in 1999, estimated to account for 6-15% of healthcare expenditures in high-income countries (The World Bank, 1999). The smoking-attributable healthcare costs and the value of lost productivity caused by smoking accounted for 2.1%-3.1% of gross domestic product (GDP) in Australia in 1992, 1.3%-2.2% in Canada in 1992, and 1.4%-1.6% in the United States in 1993 (Lightwood, Collins, Lapsley, & Novotny, 2000). In low- and middle- income countries, it was estimated that the total economic cost of smoking in China represented 0.5% of GDP in 2000 (Sung, Wang, Jin, Hu, & Jiang, 2006) and the inpatient healthcare cost caused by smoking in Vietnam approximately was 0.22% of GDP in 2005 (H. Ross, Trung, & Phu, 2007). A recent study from Thailand showed the economic burden in 2009 due to smoking-attributable illness accounted for 0.78% of GDP or as much as 74.88 billion Thai baht. Of this, 62.24 billion THB was lost from productivity loss and 12.64 billion THB was the total smoking-attributable medical cost or about 18.19% of total health expenditure (K. Bundhamcharoen et al., 2015).

1.2 Tobacco Control Measures in Thailand

Thailand has developed an anti-smoking stance for more than 40 years. It began with a movement of Thai medical doctors and now The Thai government has established 4 Acts already. First, the Tobacco Act of B.E. 2509 required that the permission be applied for and granted to individuals in tobacco business for every process, including production, sales, and imports and exports. This Act established the system of tobacco stamp fees, excise taxation and penalties for any violations. Second, the Tobacco Product Control Act of B.E. 2535 prohibited sale of tobacco products to minors (individuals under 18 years old), and stipulated a mandatory health warning label on cigarette packages. Third, Non-smoker's Health Protection Act of B.E. 2535 required that public venues be smoke-free areas, thereby allowing non-smokers to avoid second-hand smoking, and authorized state officials to enforce the Act. Finally, Thai health promotion fund Act of B.E. 2544 authorized the collection of 2% surcharge tax from tobacco sales to fund the Thai Health Promotion foundation, an organization which promotes health promotion activities, and raises awareness about smoking and drinking alcohol.

Moreover, the Thai government included tobacco control in a health behavior modification program as part of the 9th National Economic and Social Development Plan (2002-2006). In 2003, Thailand adopted the WHO FCTC (Framework Convention on Tobacco Control) which requires member countries to follow the articles of the Convention, such as price and tax measures to reduce the demand for tobacco (Article 6), packaging and labeling of tobacco products (Article 11), and tobacco advertising, promotion and sponsorship (Article 13) (World Health Organization, 2007).

Under the regulations mandated by the above Acts and FCTC, the Thai government has implemented multiple measures to control tobacco consumption—both fiscal and non-fiscal measures. First, fiscal measures refer to tobacco taxation; higher tax and therefore higher price of tobacco products are associated with lower tobacco consumption. It has been predicted that, on average, a 10% increase in price will reduce consumption by 4% in high-income countries and approximately 8% in low- and middle-income countries (The World Bank, 1999). Thailand uses the fiscal measure as an important instrument to control the tobacco consumption. Excise tax on tobacco products has been increasing continuously from 55% in 1992 to 90% in 2016 (Royal Thai Government, 2016), with an additional 2% and 1.5% taxation being earmarked to finance the Thai Health Promotion Fund and the Thai Public Broadcasting Service, respectively.

Second, non-fiscal measures are believed to have an impact on smoking behavior and awareness of hazardous of smoking (The World Bank, 1999). These measures refer to all non-price interventions in Thailand, including anti-smoking programs in school led by the Thai Teachers Networking for Smoke-Free Schools, which prohibited minors under 18 years old from purchasing tobacco products; however, in 2015, the Thai government approved in principle to increase the minimum age to 20 years (Ministry of Public Health, 2015). In addition, the Thai government has also banned all tobacco advertisements, including a display of any tobacco company logos at point of sale (under the Consumers Protection Act B.E. 2522 and the Tobacco Product Control Act of B.E. 2535), created a smoke-free environment to prevent secondhand smoke effect and stipulated the pictorial health warning labels on cigarette package.

In particular, pictorial health warning is supposedly a cost-effective policy instrument. It has been proved to increase awareness of hazardous of smoking, and reduce cigarette smoking (Canadian Cancer Society, 2014). Nowadays, at least 77 countries worldwide require pictorial health warning on cigarette packages, following the example of Canada, as the first country to implement pictorial warning, in 2001 (Canadian Cancer Society, 2014).

1.3 Development of warnings on cigarette package in Thailand

Thailand began with a text warning, which was implemented in 1972. The first text warning on cigarette packages stated, “Cigarette Smoking May Be Hazardous to Your Health” (Supawongse, 2007). This warning message was changed to “Smoking Can Damage Your Health” in 1982. However, tobacco companies allegedly tried to minimize the warning message recognition with a small font and an ambiguous color (Tobacco Research Control and Knowledge Management Center (TRC), 2009). As a consequence, in 1992, the template of a text warning message was designed by the government specifying the size of warning label of no less than 25% of total package and covering both the front and the back of a cigarette package.

The Tobacco Product Control Act of B.E. 2535 required tobacco companies to display constituents and carcinogens from emission on a side of the package. The text templates were designed by the Thai government describing the information about tobacco toxins and carcinogens such as “Carcinogen from smoking are Formaldehyde, Tar, Nitrosamine” printed in white against a black background, covering at least 50% of the area of each side. According to the Notification in 2016, health warning text templates were simplified and enlarged the size to 60%. Information on toxins and

carcinogens was changed to descriptive messages, according to Notification of the ministry of public health B.E. 2558, such as “Cigarette smoke contains the substance used in embalming” which represents the formaldehyde (all templates shown below).

Figure 1 Text health warnings on cigarette package according to Notification of the ministry of public health B.E. 2558



Source: Notification of the ministry of public health, 2015. Available at:

http://btc.ddc.moph.go.th/th/upload/slide/2015-04-03_slf6.pdf.

Pictorial health warning was implemented later. In 2004, following the adoption of the WHO FCTC, particularly Article 11 regarding packaging and labeling of tobacco products, the Thai government required that pictorial warning be shown, occupying at least 50% on both sides of the package. Six pictorial warning templates printed in four colors were issued. Thailand became the fourth country to stipulate the pictorial warning after Canada, Brazil and Singapore (Vathesatogkit, 2008).

In 2014, the Thai Supreme Administrative court approved the new Thai public health regulation requiring a larger size of pictorial warning, after tobacco companies filed a lawsuit against this measure in 2013 (WHO FCTC, 2014). The new measure requires a four-color pictorial health warning to cover at least 85% on both sides of the cigarette package, making Thailand the country with the largest pictorial health warning in the world, surpassing Australia at 82.5% (Canadian Cancer Society, 2014). In addition, the package must display the 1600 national quit-line number as well as toxic substances. All 10 updated templates of pictorial and text health warning must be printed differently on each package in one carton (10 packets). The new pictorial warnings according to Notification of the ministry of public health B.E. 2556 will show hazardous of tobacco on health such as lung cancer, mouth cancer and impotence (as shown below).

Figure 2 Pictorial health warning on cigarette package according to Notification of the ministry of public health B.E. 2556





Source: Notification of the ministry of public health, 2013. Available at: <http://btc.ddc.moph.go.th/th/upload/files/15.pdf>

1.4 Impact of pictorial health warning and gap in the literature

Pictorial health warning has been shown to be effective in reducing smoking. It acts as communication tool to inform consumers of negative consequences of smoking. A picture is worth a thousand words; a powerful graphic depiction of health consequences of smoking brings more attention and more fear to consumers (Physicians for a Smoke-Free Canada, 2010). The more fear they perceived, the more likely their attitude and intention would change and as a result their behavior would change (Witte & Allen, 2000). Pictorial health warning on cigarette package also serves as a portable advertisement that is carried around with consumers and reminds them of the hazardous of smoking every time they smoke (Monarrez-Espino, Liu, Greiner, Bremberg, & Galanti, 2014). In addition, it is an effective tool to communicate with non-smokers, especially low-educated and younger population, when they are exposed to cigarette package (Hammond, 2009).

In Thailand, pictorial health warning has been evaluated. Most studies were conducted using a small group survey, referring only to specific age groups (ABAC

Social Innovation in Management and Business Analysis (ABAC SIMBA), 2008; Jaroenchatree, 2007; Pengruksa, Kengganpanich, Kengganpanich, & Benjakul, 2015; Vansirorut, Termsirikulchai, Kengganpanich, & Kengganpanich, 2010). This study will make use of a national survey, Cigarette Smoking and Alcohol Drinking (CSAD) 2014, which was conducted by the National Statistical Office, with a nationally representative sample. The survey in 2014 contains specific questions about pictorial health warning on cigarette package that had never been asked before. These questions will be analyzed in this study to see how pictorial health warning influences Thai people at individual level. As an additional contribution, this study will also attempt to statistically improve the analysis of impact of pictorial health warning.

1.5 Research objectives

1.5.1 General Objective

To evaluate the impact of pictorial health warning on smoking behaviors in Thailand.

1.5.2 Specific Objectives

This study aims to analyze the impact of pictorial health warnings displayed on cigarette package in 3 dimensions.

- (1) To understand the impact of exposure to pictorial health warning on probability of smoking in Thai population (including current smokers and non-smokers).
- (2) To quantify the impact of exposure to pictorial health warning on smoking behaviors in term of smoking frequency among current smokers.

- (3) To analyze the impact of exposure to pictorial health warning on the intention to quit smoking among current smokers.

1.6 Hypotheses

This study has three main hypotheses:

- (1) Exposure to a pictorial health warning displayed on a cigarette package decreases the probability of becoming a smoker.
- (2) Exposure to a pictorial health warning displayed on a cigarette package can decrease the smoking intensity among smokers.
- (3) Exposure to a pictorial health warning displayed on a cigarette package is able to increase an individual smoker's intention to quit smoking as well as the number of attempt times in quitting smoking.

1.7 Scope

This study will analyze the impact of pictorial health warning on cigarette package in the Thai population. Secondary data used in this study will be drawn from the national survey on Cigarette Smoking and Alcohol Drinking in 2014 by the National Statistical Office of Thailand.

1.8 Possible benefits

The results from this study will help policy makers better understand the impact of pictorial health warning on the probability of smoking among non-smokers and current smokers, and also on cigarette consumption. Decision-makers in the public

sector can implement this result to evaluate the existing policies, and come up with mechanisms for further policy improvement.



Chapter 2

Literature review

2.1 Mechanisms underlying the impact of pictorial health warnings

Health warning labels on cigarette package have become an important tool to communicate with smokers and inform them of smoking-related diseases. Cigarette packages are one of the effective platforms to connect with smokers; exposure was estimated to be as frequent as 7,000 times per year (Wakefield, Morley, Horan, & Cummings, 2002). According to a European survey in 2009, more than 160 million people reported that health warning labels on cigarette packages effectively informed them about smoking-related health risks (European Commission, 2009). Studies in Thailand in 2007 and 2009 reported similarly that most people noticed graphic health warnings and could memorize at least one picture (Jaroenchatree, 2007; Tobacco Research Control and Knowledge Management Center (TRC), 2009).

In comparison to text warnings, exposure to pictorial health warning typically provides perceived severity of smoke-related health consequences to a greater extent than text-only warning (Vansirorut et al., 2010). A larger pictorial health warning appears to have more impact than text-only health warning and receive more attention (Hammond, 2011; Noar et al., 2016). However, a recent survey in Thailand reported differently; 67.1% of smokers reported having the same perception between 55% and 85% in size of pictorial warning (The ABAC Academic Network for Community Happiness Observation and Research Center (ABAC ANCHOR), 2013). Pengruksa also reported in 2015 similarly that there was no different in perception between 55% and 85% in size of pictorial warning (Pengruksa et al., 2015).

2.2 Impact of pictorial health warnings on the probability of becoming a smoker

Pictorial health warnings can help prevent people, especially youths, to start smoking. Based on Thailand, a study in 2014 showed that a high percentage of non-smoking high school students reported that they had an intention not to smoke after they saw pictorial health warning on the package (Pengruksa et al., 2015). A study in Nigeria in 2016, conducted among youths aged 13 - 17 years, reported that fear was the dominant emotion the interviewees perceived from pictorial warning, and concluded that pictorial warnings could prevent non-smokers from starting to smoke (Adebiyi, Uchendu, Bangboye, Ibitoye, & Omotola, 2016). Among adults, a similar impact is observed. Studies based on Thai adults, report that pictorial warning had a great impact on non-smokers and make them afraid to start smoking (Jaroenchatree, 2007; Tobacco Research Control and Knowledge Management Center (TRC), 2009). A meta-analysis study in 2015, confirmed that pictorial warning was effective to increase intentions to not start smoking (Noar et al., 2016).

2.3 Impact of pictorial warnings on cigarette consumption

In addition to preventing non-smokers from becoming smokers, pictorial health warnings can reduce the level of cigarette consumption among individuals who already smoke. A Canadian longitudinal telephone survey study in 2004 showed that 19% smokers reported they smoked fewer cigarettes per day after being exposed to pictorial warnings, while only 1% reported smoking more (Hammond, Fong, McDonald, Brown, & Cameron, 2004). Smokers who reported greater negative emotional response to pictorial warnings were more likely to reduce their cigarette

consumption per day (Hammond et al., 2004; Hammond, Fong, McDonald, Cameron, & Brown, 2003). An experimental economics study revealed that the cigarette package with pictorial warning has 17% lower in attributed value compare to text warning and theoretically reduce the cigarette demand (Thrasher et al., 2007). Another experimental auction study in 2013 found that cigarette packages with pictorial warnings could reduce the demand among 40 - 64% of smokers, and they were most effective at reducing demand among younger and lower educated smokers (Rousu & Thrasher, 2013). Taiwanese study in 2011 found that factors that influenced the effectiveness of pictorial health hazard warning were associated with female, older, lower education and income level respondents (Chang, Chung, Yu, & Chao, 2011), similar factors were reported from face-to-face survey in Mexico in 2012 (Hammond et al., 2012).

2.3 Impact of pictorial health warnings on intention to quit smoking

The International Tobacco Control Policy Evaluation Project (ITC) cohort studies in many countries such as Canada, the United States, the United of Kingdom, and Australia revealed that pictorial health warning was more effective than text-only warning at influencing more motivations to quit (Borland et al., 2009; Hammond et al., 2007). A recent evidence review suggested that health warning could increase smoker's motivation to quit and remain abstinent (Hammond, 2011). Another recent meta-analysis of the experimental literature found that pictorial health warnings were more effective than text-only warnings at increasing intentions to quit (Noar et al., 2016). A cohort study in 2009 compared Thailand and Malaysia health warning policies and found that adding a pictorial health warning to a text-only health warning, as was the case in Thailand, increased the likelihood of quitting (Fong et al., 2009). Another Thai

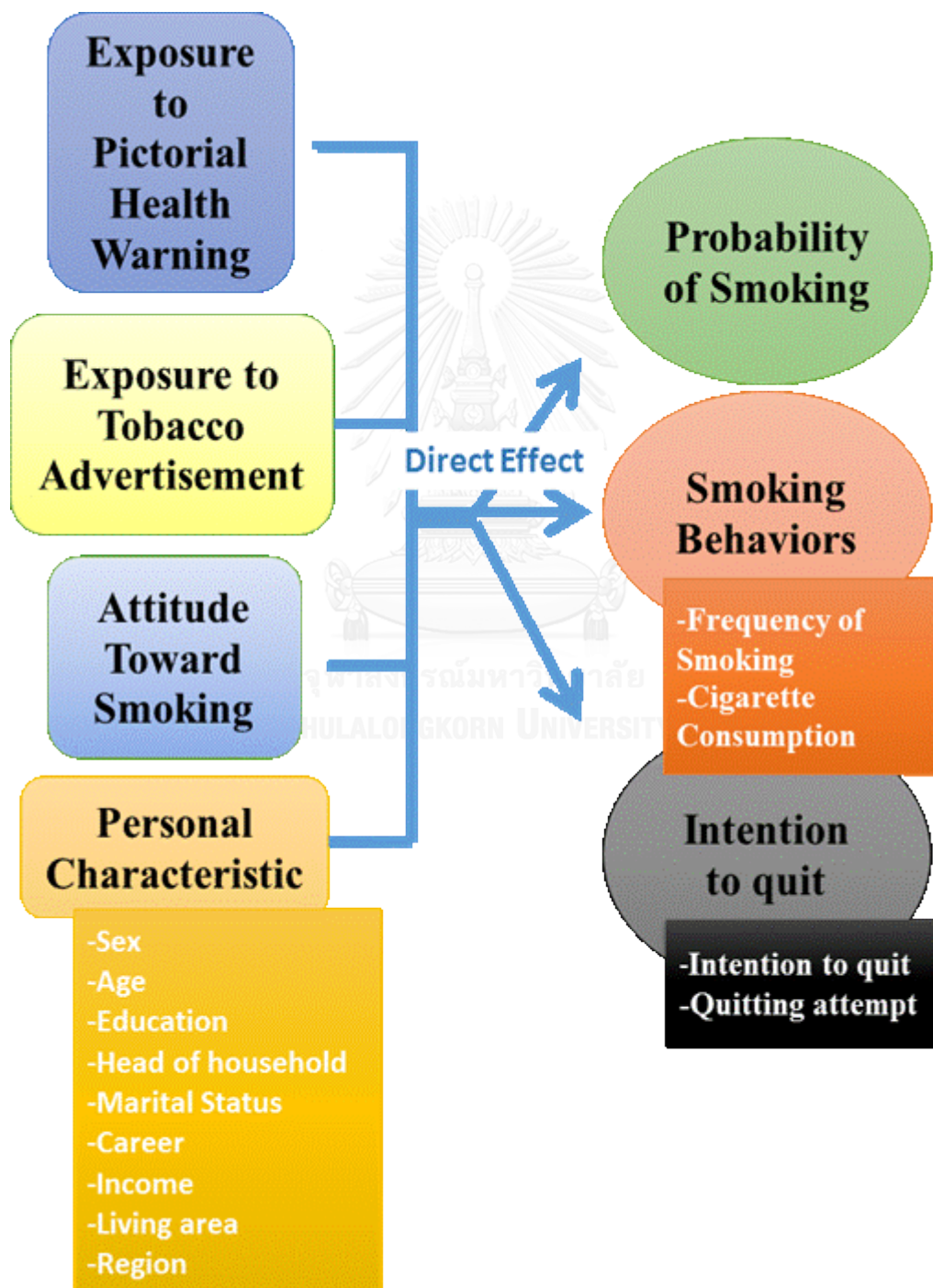
study reported that 50% of smokers said pictorial health warning had a huge effect on their decision to quit (ABAC Social Innovation in Management and Business Analysis (ABAC SIMBA), 2008). Finally, according to a cross-country comparison study in 2010, Brazil was the only country with pictures of human suffering on cigarette package, and had a highest impact on smokers to quit when compared to other countries with abstract pictorial warnings and text-only health warnings. The study also revealed that pictorial health warnings had particularly strong impacts among less educated, lower income people unlike the impact of text-only warning that only people with higher education level were more likely to read (Thrasher et al., 2010).

A systematic review in 2014 examined the studies of the impact of pictorial health warning on smoking behavior (such as reduction of cigarette consumption and attempt to quit) and found that only few countries conducted the studies on behavioral outcomes, most of the studies from developed countries such as Canada and Australia (Monarrez-Espino et al., 2014). The impact of exposure to pictorial health warning on smoking behaviors in low to middle income countries is still unclear and difficult to evaluate since the studies published in English are scarce; China (Elton-Marshall et al., 2015), Iran (Heydari, Ramezankhani, & Talischi, 2011), Malaysia (Fathelrahman et al., 2010), Mexico (Thrasher et al., 2013; Thrasher, Perez-Hernandez, Arillo-Santillan, & Barrientos-Gutierrez, 2012), and Thailand (Silpasuwan et al., 2008; Yong et al., 2013).

Chapter 3

Conceptual framework

Figure 3 Conceptual Framework



Shown in Figure 3, the conceptual framework of this study is to find the influence of exposure to pictorial health warning on the cigarette package on the probability of smoking, smoking behaviors (in terms of smoking frequency and number of cigarette smoked per day), as well as the intention to quit smoking. This study also considers other variables, including exposure to tobacco advertisement, attitude toward smoking, personal characteristics, and socioeconomic characteristics, that may also have impact on the probability of smoking, smoking behaviors and intention to quit. It should be noted that this study only focuses on the direct impacts of pictorial health warning and the other control variables on the probability of smoking, behaviors of smoking, and intention to quit smoking. Nevertheless, it is possible that there may exist some indirect impacts of pictorial health warning (and tobacco advertisement) on one of the main control variables, attitude toward smoking; in other words, it can be hypothesized that people exposed to pictorial health warning can develop a more negative attitude against smoking, and those exposed to tobacco advertisement can develop a more positive attitude. This study assumes away these indirect impacts, as they cannot be correctly captured given the data non-availability.

Chapter 4

Methodology

This study uses a regression analysis to evaluate the impact of pictorial warning on smoking behavior among Thai population using secondary data from the National Cigarette Smoking and Alcohol Drinking survey in 2014. The analysis consists of 3 parts; (1) Studying factors that have impact on probability of being a smoker (y_1), (2) Studying factors that influence behaviors of smoking (y_2, y_3), and (3) Studying factors that influence quitting intention (y_4, y_5). The y_1, y_2, y_3, y_4 and y_5 represent the dependent variables.

The independent variables are mainly composed of 2 parts: (1) Demographic data of participants, (2) Exposure to pictorial health warning. The demographic data are sex, age, marital status, education level, career, income, and living area.

4.1 Definition of dependent variables

4.1.1 Model 1: Probability of smoking.

The probability of smoking will be analyzed by a Logit regression. When the dependent variable is dichotomous (current smoker vs. non-smoker), a binary logistic regression is particularly appropriate to estimate the probability that a characteristic is present (estimate probability of smoking) given values of explanatory variables. The dependent variable takes the value of 0 if individual is a current non-smoker ($Y_1 = 0$), and 1 if individual is a current cigarette smoker ($Y_1 = 1$).

$$\pi_{1i} = \Pr(Y_{1i} = 1 | X_i = x_i) = \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)}$$

π_{1i} = Probability of smoking

Y_{1i} = whether individual is current smoker

x_i = explanatory variables

The marginal effects will be computed, where the marginal effect of an independent variable (X) measures the impact of a change in an independent variable (X) on the expected change in the dependent variable (Y) in a regression model. The marginal effect of each independent variable (X) on the dependent variable (Y) is computed by taking the partial derivative of $E(Y|X)$ with respect to X if the independent variable is continuous and thus differentiable (Lewis-Beck, Bryman, & Liao, 2003).

4.1.2 Model 2: Smoking behaviors.

The smoking behaviors in terms of smoking frequency will be analyzed by Logit model. First, current smokers who smoke cigarette daily are assigned $Y_2 = 0$, and current smokers with occasional (less than daily) smoking are represented by $Y_2 = 1$.

The model is as follows: -

$$\pi_{2i} = \Pr(Y_{2i} = 1 | X_i = x_i) = \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)}$$

π_{2i} = Probability of becoming daily smoker

Y_{2i} = whether individual is daily smoker

x_i = explanatory variables

Second, the smoking behaviors in terms of number of cigarette smoked per day will be analyzed by using OLS regression. The dependent variable is obtained from the question “How many stick of cigarette do you smoke per day?”. The specification is provided below: -

$$y_{3i} = \alpha_0 + \alpha_1 x_{1i} + \alpha_2 x_{2i} + \alpha_3 x_{3i} + \alpha_4 x_{4i} + \dots + \alpha_n x_{ni} + \varepsilon_i$$

y_{3i} = cigarette consumption per day

α_0 = constant value

x_{ni} = explanatory variables

ε_i = error term

α = coefficient value

It should be noted that the regression models 2 and 3 contain an additional variable, smoking initiation age, in the list of independent variables.

4.1.2 Model 3: Intention to quit smoking.

Smokers' intention to quit will be analyzed by Logistic regression model. First, individuals who reported that they “Never tried quitting” are assigned $Y_4 = 0$, and smokers who answered “I've tried quitting” are represented by $Y_4 = 1$. The model is shown below: -

$$\pi_{4i} = \Pr(Y_{4i} = 1 | X_i = x_i) = \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)}$$

π_{4i} = Probability of smoker has intention to quit

Y_{4i} = whether individual has intention to quit smoking

x_i = explanatory variables

Second, the number of quitting attempt times will be analyzed by using ordered Logit regression, as the variable of interest is ordinal. The dependent variable is based on answers from the question, How many times have you attempted to quit smoking?, which can be divided into 4 categories; never tried to quit, tried once, tried twice, and tried to quit more than 3 times. This model uses cumulative probabilities up to a threshold, thereby making the whole range of ordinal categories binary at that threshold. The model of a cumulative probability of a response less than equal to j is (Agresti, 2003):

$$P(Y_5 \leq j) = \pi_1 + \dots + \pi_j$$

Y_{5i} = whether individual tries to quit smoking at how many at how many attempts

π = the associated probabilities ($\pi_1, \pi_2, \dots, \pi_j$)

Then a cumulative Logit is defined as

$$\log\left(\frac{P(Y \leq j)}{P(Y > j)}\right) = \log\left(\frac{P(Y \leq j)}{1 - P(Y \leq j)}\right) = \log\left(\frac{\pi_1 + \dots + \pi_j}{\pi_{j+1} + \dots + \pi_j}\right)$$

The sequence of logit model may be defined as

$$\text{Never tried to quit, } L_1 = \log\left(\frac{\pi_1}{\pi_2 + \pi_3 + \pi_4}\right)$$

$$\text{Never tried to quit or Tried once, } L_2 = \log\left(\frac{\pi_1 + \pi_2}{\pi_3 + \pi_4}\right)$$

$$\text{Never tried to quit or Tried once or Twice, } L_3 = \log\left(\frac{\pi_1 + \pi_2 + \pi_3}{\pi_4}\right)$$

L_n = log-odds of falling into or below category n versus falling above it

Then marginal effects will be analyzed to interpret the results of ordered logit regression. The marginal effects show how the probabilities of each outcome change with respect to changes in independent variables (Lewis-Beck et al., 2003).

4.2 List of independent variables

Definitions of independent variables and their expected signs in the above models are provided in this subsection.

Exposure to pictorial health warning: Participants are asked “Have you seen pictorial health warning on cigarette package? Did it make you realize the health consequences of cigarette smoking?” Then they are categorized to never seen, seen and realized the health consequences. The expected sign is negative; individuals exposed to pictorial health warning will have less probability of smoking and cigarette consumption.

Exposure to tobacco advertisement: Yes and No answer from question “During recent 30 days, did you see any tobacco advertisement such as free sample, online advertisement, advertising at point of sale, CSR activity, etc.?”. The expected sign is positive; individuals exposed to tobacco advertisement are more likely to be smokers.

Attitude toward smoking: From question- Do you agree that cigarettes should be classified as a product that is harmful to health? – Answers are created to dummy;

Agree (anti-smoking preference), Disagree (smoking preference) and No idea (neutral). Individuals with anti-smoking attitude have less probability of becoming a smoker (negative expected sign), but those who have good attitude toward smoking will have higher probability of smoking (positive expected sign).

Initiation age: Individuals who experimented with smoking at younger age are more likely to become regular smokers; negative sign is expected for the probability of smoking regression model. Because nicotine is a highly addictive drug and adolescents are in critical periods of physical and mental development which make them more vulnerable to addict to it (National Center for Chronic Disease, Health Promotion Office on, & Health, 2014). Age at initiation of smoking is also a significant factor for continuation of smoking. Smokers who started smoking at earlier age tend not to quit smoking compared to those who started at later age (Khuder, Dayal, & Mutgi, 1999).

Sex: There is a stereotype that men take more risks than women including health-risk behaviors; positive expected sign for men in probability of smoking, and negative expected sign for women. Among the leading causes of death, cancer and cerebrovascular disease, the prevalence is higher in men due to their smoking behavior (Pampel, 2001).

Age: Harmful behaviors are often established early in life, can reduce the quality of life and even result in premature death such as smoking, poor nutrition, physical inactivity, and alcohol drinking. Elderly concern more about their health status and have more effort to change their health behavior to gain more life span (United Nations, 2010). Expected sign for age variable is negative as individuals are older, the probability of smoking is less.

Marital status: Individuals who involve in social relationships, particularly marital relationship, are associated with more health-promoting behaviors and fewer health-risk behaviors (Umberson, 1992). The expected sign for marital status is negative as the evidence shows that the married smoke and drink less alcohol than the unmarried (C. E. Ross, 2000).

Head of household: Head of household plays a role among determinants of household health choice and implements health behaviors to families. A study showed that head of household's educational attainment was a significant predictor of whether smoking was allowed in the house which could influence to other members of household (Alwan, Siddiqi, Thomson, & Cameron, 2010).

Education level: Less educated persons expose less often to warnings about smoking, but they instead expose more to advertisement that promotes enjoyment of smoking (Siahpush, McNeill, Hammond, & Fong, 2006); expected sign is negative in the probability of smoking model. However, differences in knowledge of risks of smoking might played a less important role now, because recent anti-smoking campaigns, public education, and comprehensive anti-smoking measures have successfully publicized smoking-related-health risks and reached to all level of population (Link, 2008).

Occupation: Unemployed persons have higher rates of smoking-related cancer, cardiovascular disease, and chronic lung disease compared with employed persons (Fagan, Shavers, Lawrence, Gibson, & Ponder, 2007). Unemployment is also associated with other substances use (Wadsworth, Moss, Simpson, & Smith, 2004).

Monthly income: Individuals who deprive economically and live in disadvantaged position have more chance of developing health-risk behaviors such as

smoking and drinking alcohol to relieve their stresses (Marmot, 2006). Studies show that smoking prevalence is higher among persons in high stress positions, including unemployed workers (Fagan et al., 2007), and those from disadvantaged backgrounds (Lynch, Kaplan, & Salonen, 1997). The expected coefficient sign in probability of smoking model is negative.

Living area: Divided into municipality and non-municipality areas. Individuals who live in municipality areas might be more stressful than life in rural areas, and lead to higher probability of smoking (Colby, Linsky, & Straus, 1994). Those who live in non-municipality area are also under stress in context of low income and social status which may lead to an increased risk of smoking (Ritchie, Parry, Gnich, & Platt, 2004). Therefore, it is not clear whether a higher or lower prevalence of smoking can be assumed in individuals living in urban areas compared to those living in rural areas (Völzke et al., 2006).

Region at national level: Dummy variables consist of Bangkok, Central, North, Northeast and South

Table 4. 1 List of variables and expected sign of coefficients

Variables	Expected sign				
	Y ₁ Probability of smoking	Y ₂ Smoking frequency	y ₃ Cigarettes smoked per day	Y ₄ Intention to quit	Y ₅ Quit attempt
x ₁ = Exposure to pictorial health warning	-	-	-	+	+
x ₂ = Exposure to tobacco advertisement	+	+	+	-	-
x ₃ = Attitude toward smoking	+/-	+/-	+/-	+/-	+/-
x ₄ = Smoking initiation age	-	-	-	+	+
x ₅ = Sex	+/-	+/-	+/-	+/-	+/-
x ₆ = Age	-	-	-	+	+
x ₇ = Education level	-	-	-	+	+

x ₈ = Head of household	+/-	+/-	+/-	+/-	+/-
x ₉ = Marital status	-	-	-	+	+
x ₁₀ = Career	-	-	-	+	+
x ₁₁ = Monthly income	-	-	-	+/-	+/-
x ₁₂ = Living area	+/-	+/-	+/-	+/-	+/-
x ₁₃ = Living region	n/a	n/a	n/a	n/a	n/a



Chapter 5

Data

5.1 Description of data

This study uses secondary data from a national survey on Cigarette Smoking and Alcohol Drinking in 2014. The National Statistical Office of Thailand has conducted surveys on smoking habit since 1976. The questions about tobacco smoking had been included as part of the national health and welfare surveys until 1988, when the national cigarette smoking and alcohol drinking behavior survey was established. The 2014 National Cigarette Smoking and Alcohol Drinking survey contains questions on perception toward pictorial health warning on the cigarette package that have never been included in any of the previous national surveys. This survey was conducted in June 2014, based on face-to-face interviews with Thai households, with members aged more than 15 years, and covered 25,758 households. The sample was selected using a stratified three-stage sampling; the sampling frame was divided into 77 stratum or provinces and then subdivided into villages, households and individuals as the first, second and third stage sampling units respectively. The questionnaire was completed by one person in the household only.

The last three national surveys on smoking behaviors contained only question set of current smoker's attention on pictorial health warning. In addition to previous surveys, this 2014 survey provided a set of questions on attention and perception toward pictorial health warning for every participant, both non-smoker and smokers. This study utilizes that question set as the key conceptual framework.

5.2 Description of dependent variables

This study has three outcomes of interest and accordingly three sets of dependent variables. The first outcome is the probability of becoming a smoker. It is represented by y_1 , which is based on the question “Do you currently smoke?” in the survey. The second outcome is smoking behaviors of smokers, which can be captured by two variables: y_2 or the frequency of smoking, which is based on the question “How often do you regularly smoke?”, and y_3 , or the level of cigarette consumption, drawn from the question “How many cigarettes you currently smoke per day?”. The final outcome of interest is quitting behaviors of smokers, which again can be captured by two variables: intention to quit (y_4) and the number of times that smokers in the sample had attempted to quit smoking (y_5), drawn from the questions “Have you ever tried to quit smoking?” and “How many times have you attempted to quit smoking?” respectively. The explanation of each of the five dependent variables is given in the table below.

Table 5.1 Description of dependent variables

Variables	Definitions	Questions	Explanations
y_1	Probability of smoking	Do you currently smoke?	-Current non-smoker ($y_1 = 0$) -Current cigarette smoker ($y_1 = 1$)
y_2	Smokers' behavior in frequency of smoking.	How often do you regularly smoke?	-Currently smoke cigarette daily ($y_2 = 0$) -Current smokers with occasional (less than daily) smoking ($y_2 = 1$)
y_3	Smokers' behavior in term of cigarette consumption	How many cigarettes you	-Continuous variable (sticks per day)

		currently smoke per day?	
y ₄	Intention to quit smoking	Have you ever tried to quit smoking?	-No, never tried (y ₄ =0) -Yes, I've tried (y ₄ =1)
y ₅	Number of attempt times	How many times have you attempted to quit smoking?	-Never tried to quit (y ₅ =0) -Once (y ₅ =1) -Twice (y ₅ =2) -More than 3 times (y ₅ =3)

The table below explains summary statistics of dependent variables. From the total population of 20,787 individuals aged over 15 years old in the survey, 4,273 respondents reported currently smoking (20.56%). Among those smokers, 88.79% smoked cigarettes daily and they smoked an average of 4.912 cigarettes per day (S.D. =6.576). A large proportion of smokers had no intention to quit (67.21%). Approximately 32.79% of smokers had tried to quit smoking and only 21.55% tried to quit more than once.

Table 5.2 Descriptive statistics of dependent variables

Variables	Definitions	Percent	Number of observations
Probability of smoking			
Current smoker y ₁	-Current non-smoker (y ₁ = 0)	79.44	16,514
	-Current cigarette smoker (y ₁ = 1)	20.56	4,273
Smoking behavior			
Frequency of smoking y ₂	-Occasional (less than daily) smoking (y ₂ = 0)	11.21	479
	-Daily smoking (y ₂ = 1)	88.79	3,794
Cigarette consumption y ₃	-Cigarette smoked per day	4.912* (6.576) *Mean (S.D.)	4,273

Intention to quit smoking			
Intention to quit y ₄	-Never tried	67.21	2,872
	-Have tried	32.79	1,401
Number of attempt times y ₅	-Never tried to quit	67.21	2,872
	-Once	11.23	480
	-Twice	7.58	324
	-More than 3 times	13.97	597
Number of observations		20,787	

5.3 Description of independent variables

The table below describes the independent variables used in this study. It comprises different independent variables used, description of each of the variables, and citation of survey's questions. The independent variables are mainly composed in 2 parts; (1) Demographic data of participants to describe characteristics of sample, (2) Exposure to pictorial health warning, this part also includes the exposure to tobacco companies' advertisement, attitude toward smoking, and smoking initiation age. The second part will explain tobacco-related experiences of each individual.

Table 5.3 Categorization of independent variables

Variables	Description	Survey Questions	Responses
Exposure to pictorial health warning			
x ₁	Exposure to pictorial health warning	Have you seen pictorial health warning on cigarette package? Did it make you realize the health consequences of cigarette smoking?	-Never seen (x ₁ =0) -Seen and realized the health consequences (x ₁ =0)

Exposure to tobacco companies' advertisements			
x ₂	Exposure to tobacco advertisement	During recent 30 days, did you see any tobacco advertisement such as free sample, online advertisement, and advertising at point of sale, CSR activity, etc.?	-No (x ₂ =0) -Yes (x ₂ =1)
Attitude toward smoking			
x ₃ Dummy	Attitude toward smoking	Do you agree that cigarettes should be classified as a product that is harmful to health?	-Agree -Disagree -No idea
x ₄ * *For model 2, 3	Smoking initiation age	Age when the individual first started to smoke	-Years (age)
Personal characteristics			
x ₅	Sex		-Male (x ₅ =0) -Female (x ₅ =1)
x ₆	Age		-Range between 15-110 years
x ₇ Dummy	Education level		-Not in education -Less than a high school diploma (including preparation school, pre-school, primary school, and middle school) -High school or vocational school graduate

			-Higher than high school degree (Associate degree, Bachelor's degree, and Higher degree)
x ₈	Head of household		-No (x ₈ =0) -Yes (x ₈ =1)
x ₉ Dummy	Marital status		-Single -Married -Divorced (including widowed, divorced, and separated)
x ₁₀ Dummy	Career		-Unemployed -Self-employed (business owner, family-owned business) -Government or enterprise employees -Private employees
x ₁₁	Monthly income		-Baht per month
x ₁₂	Living area		-Municipality (x ₁₂ =0) -Non-municipality (x ₁₂ =1)
x ₁₃ Dummy	Living region		-Bangkok -Central -North -Northeast -South

Table 5.4 (below) describes the statistics of independent variables used in this study. It comprises the number of observations, percentage distribution, mean and standard deviation corresponding to each category.

Table 5.4 Descriptive statistics of Independent Variables

Variables		Current non-smokers		Current smokers		Total	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Exposure to pictorial health warnings (PHW)							
Exposure to PHW		0.875	0.331	0.949	0.220	0.890	0.313
Exposure to tobacco advertisement (AD)							
Exposure to AD		0.088	0.283	0.115	0.319	0.093	0.291
Attitude toward smoking							
Preference (Excluded category = anti-smoking)							
	Prefer smoking	0.016	0.124	0.081	0.274	0.029	0.168
	Neutral	0.037	0.188	0.084	0.277	0.046	0.210
Initiation age of smoking		N/A	N/A	18.16	5.26	18.16	5.26
Personal characteristics							
Age		47.03	17.79	45.30	15.30	46.671	17.318
Gender	Female=1	0.664	0.472	0.071	0.257	0.542	0.498
Education (Excluded category = No education)							
	Less than high school	0.639	0.480	0.733	0.442	0.658	0.474
	High school	0.134	0.341	0.121	0.326	0.132	0.338
	Higher than high school	0.162	0.369	0.079	0.269	0.145	0.352
Head of household (Yes = 1)		0.483	0.500	0.650	0.477	0.518	0.500
Marital status (Excluded category = Single)							
	Married	0.614	0.487	0.666	0.472	0.624	0.484
	Divorced	0.187	0.390	0.128	0.334	0.175	0.380
Occupation (Excluded category =Unemployed)							
	Self-employed	0.403	0.491	0.486	0.500	0.420	0.494
	Enterprise employee	0.068	0.251	0.055	0.228	0.065	0.246
	Private employee	0.208	0.406	0.334	0.472	0.234	0.423
Income (Thai Baht/month)		9,776.62	15,770.67	9,260.07	11,035.08	9,670.44	14,921.68
Living area (Municipality =1)		0.434	0.496	0.358	0.479	0.419	0.493
Region (Excluded category = Bangkok)							
	Central	0.243	0.429	0.216	0.411	0.238	0.426
	North	0.242	0.428	0.229	0.420	0.239	0.426
	Northeast	0.223	0.416	0.229	0.420	0.224	0.417
	South	0.173	0.378	0.230	0.421	0.185	0.388

Number of observations	16,514	4,273	20,787
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Table 5.4 describes the independent variables used in this study. It is comprised of the description, mean, and standard deviation corresponding to each independent variable. Most of respondents reported having been exposed to pictorial health warning on cigarette package (89.03% out of total 20,787 observations). Among current smokers, 94.92% noticed pictorial health warning on cigarette packages. Only, a small proportion of people reported having ever seen tobacco advertisements: 8.79% of non-smokers and 11.51% of smokers. 92.44% of the sample realized that smoking was harmful, and only 8.14% of smokers had a good attitude toward smoking.

The profile of the sample is as follows. Age is represented as a continuous variable with 15 years as the minimum age, 104 years as the maximum age and the mean age of the sample being 46.67 years. The sample comprises 45.9% male and 54.21% female; most of respondent were married (62.44%), and 51.76% of them were heads of their households. Education level could be divided into 4 groups (no education, less than high school, high school diploma and higher educational attainment); the majority of the sample (65.83%) had education less than high school. The majority of the sample (42.00%) was self-employed (including business owner, family-owned business, farming, and etc.) while the occupation category with the lowest frequency was government or enterprise sector employees (6.49%). A large proportion of the sample resided in non-municipality areas (58.41%).

There is some difference between non-smokers and smokers. General characteristics of current smokers are mostly male (92.91%) in gender, average 45.3 years of age and started smoking at mean age of 18.16 years. While non-smoking

sample comprises large proportion of female (64.40%), average age of non-smokers is 45.30 years. For other personal characteristics, both smokers and non-smokers share similar characteristics; smokers are usually married (66.63%) and a head of household (65.04%) with basic education level but less than high school (73.34%), self-employed (48.56%) and average monthly income of 9,260.07 baht. 64.24% of current smokers live in non-municipality area.



Chapter 6

Results

As mentioned in Chapter 1, this study has three hypotheses. The first hypothesis is that exposure to a pictorial health warning displayed on a cigarette package decreases the probability that an individual would become a smoker. The second hypothesis is that, among smokers, exposure to a pictorial health warning displayed on a cigarette package decreases the smoking intensity, measured in terms of both the frequency of smoking and the number of cigarettes smoked per day. The third and final hypothesis is that, among smokers, exposure to a pictorial health warning displayed on a cigarette package increases an individual smoker's intention to quit smoking as well as the number of times in which he/she has made a quit attempt. This chapter tests those hypotheses.

6.1 Impact of pictorial health warning on probability of smoking, smoking behaviors and intention to quit

6.1.1 Impact of pictorial health warning on probability of smoking: A binary logistic model

This section is an analysis of the impact of pictorial warning on probability of smoking. The table below shows the results from a binary logit regression between the probability of smoking and exposure to pictorial health warning and other independent variables.

Table 6.1 Probability of smoking (Dependent variable = whether or not the individual is a current smoker)

Variables	Regression Coefficients (S.E.)	Average marginal effect (S.E.)
Exposure to pictorial health warning	0.583*** (0.090)	0.065*** (0.010)
Expose to tobacco advertisement	0.275*** (0.068)	0.031*** (0.008)
Attitude toward smoking (Excluded =Anti-smoking)		
Prefer smoking	1.532*** (0.106)	0.192*** (0.014)
Neutral	1.000*** (0.091)	0.123*** (0.012)
Age	-0.003* (0.002)	0.000* (0.000)
Gender	-3.288*** (0.067)	-0.369*** (0.006)
Education level (Excluded =No education)		
Less than high school	-0.487*** (0.094)	-0.060*** (0.012)
High school	-0.945*** (0.110)	-0.112*** (0.013)
Higher than high school	-1.519*** (0.116)	-0.166*** (0.013)
Head of household	0.013 (0.049)	0.001 (0.005)
Marital status (Excluded = Single)		
Married	0.074 (0.063)	0.008 (0.007)
Divorced	0.554*** (0.089)	0.064*** (0.010)
Occupation (Excluded =Unemployed)		
Self-employed	0.901*** (0.069)	0.093*** (0.007)
Enterprise employee	0.908*** (0.111)	0.094*** (0.012)
Private employee	1.249*** (0.076)	0.136*** (0.008)
Log (Income)	-0.005 (0.012)	-0.001 (0.001)
Living area	-0.227*** (0.049)	-0.025*** (0.005)
Region (Excluded =Bangkok)		
Central	-0.080 (0.082)	-0.009 (0.009)
North	0.031 (0.085)	0.003 (0.009)
Northeast	0.119 (0.087)	0.013 (0.010)
South	0.558*** (0.087)	0.065*** (0.010)
Number of observation = 20,787 Prob>chi2= 0.0000 Pseudo R2 = 0.3211		

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level; * Significant at 10% significance level

The table above shows results from a binary logit regression where the dependent variable is the probability of smoking. Exposure to pictorial health warning leads to an increase in the probability of smoking by 6.5% and the impact is statistically significantly, when other variables held constant. This finding is different from the expected outcome (hypothesis I), that pictorial health warning would educate people about dangers of smoking and would decrease the probability of becoming a smoker. However, the surprising result could be an impact of endogeneity, particularly the simultaneity bias; people who currently smoke would have more chance to see a pictorial health warning on the cigarette package, and vice versa.

Exposure to tobacco advertisements also plays an important role on the probability of smoking (a 3.1% increase, at the significance level of less than 1%). Respondents who are not concerned about the dangers of smoking or have a neutral attitude toward smoking are more likely to smoke by 19.2% and 12.3% respectively. Being a female is associated with a lower chance of becoming a smoker by 36.9%. Higher education attainment is associated with a lower probability of smoking at the significance level of less than 1%. Compare to being single, being divorced increases the probability of smoking by 6.4%. Being employed also increases the probability of smoking compared to being unemployed. Living in an urban area could decrease the probability of smoking by 2.5%, and living in the southern part of Thailand increases the probability of smoking by 6.5%.

6.1.2 Impact of pictorial health warning on smoking behaviors

The sub-section show the results of the impact of pictorial warning on smoking frequency among smokers, which is evaluated by a binary logistic regression, and the

impact of pictorial health warning on the number of cigarettes consumed per day based on a linear regression model. Smokers' behaviors in term of frequency of smoking and cigarette consumption per day: (1) frequency of smoking comprise occasional (less than daily) smoking ($y_2=0$) and daily smoking ($y_2=1$), (2) cigarette consumption per day is represented by continuous variable (sticks per day).

Table 6. 2 Smoking frequency and cigarette consumption per day (Dependent variables = whether or not the individual is a daily smoker, and number of cigarettes smoked per day)

Variables	Smoking frequency		Number of cigarettes smoked
	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)
Exposure to pictorial health warning	-0.242 (0.223)	0.023 (0.021)	1.361** (0.435)
Expose to tobacco advertisement	0.027 (0.154)	0.003 (0.015)	1.178*** (0.295)
Smoking initiation age	-0.062*** (0.008)	-0.006*** (0.001)	-0.060*** (0.019)
Attitude toward smoking (Excluded= Anti-smoking)			
Prefer smoking	0.563** (0.223)	0.045** (0.015)	0.162 (0.340)
Neutral	0.056 (0.186)	0.005 (0.018)	0.153 (0.338)
Age	0.020*** (0.004)	0.002*** (0.000)	-0.044*** (0.008)
Gender	-0.094 (0.199)	-0.009 (0.019)	-1.024** (0.402)
Education level (Excluded= No education)			
Less than high school	0.088 (0.217)	0.008 (0.021)	2.038*** (0.395)
High school	-0.131 (0.255)	-0.013 (0.025)	3.102*** (0.480)
Higher than high school	-0.351 (0.269)	-0.038 (0.028)	3.280*** (0.531)
Head of household	0.347** (0.111)	0.033** (0.010)	-0.312 (0.212)

Marital status (Excluded= Single)			
Married	0.218 (0.134)	0.021 (0.013)	0.840** (0.266)
Divorced	0.003 (0.197)	0.000 (0.020)	0.704* (0.377)
Occupation (Excluded= Unemployed)			
Self-employed	0.865*** (0.166)	0.101*** (0.023)	0.216 (0.339)
Enterprise employee	0.500** (0.249)	0.065** (0.031)	2.011*** (0.526)
Private employee	0.851*** (0.178)	0.100*** (0.024)	0.309 (0.369)
Log (Income)	-0.050 (0.032)	-0.005 (0.003)	0.255*** (0.063)
Living area	-0.184 (0.114)	-0.017 (0.011)	1.332*** (0.220)
Region (Excluded= Bangkok)			
Central	-0.387* (0.218)	-0.029* (0.015)	-1.368*** (0.385)
North	-0.661** (0.221)	-0.055** (0.017)	-4.007*** (0.395)
Northeast	-0.579** (0.225)	-0.047** (0.017)	-4.256*** (0.401)
South	-0.625** (0.219)	-0.051** (0.016)	-3.212*** (0.395)
Number of observation = 4273 Prob> chi2 = 0.0000 Pseudo R2 = 0.0600			Number of observation = 4273 Prob> F = 0.0000 R-squared = 0.1652 Adj R-squared = 0.1609

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level; * Significant at 10% significance level

The table demonstrates that exposure to pictorial health warning has a significant impact only on the number of cigarette smoked per day, but not on the frequency of smoking. Exposure to pictorial health warning, among smokers, increases the number of cigarettes smoked by 1.361, keeping the other variables constant. Even though pictorial health warning does not have an impact on the smoking frequency

statistically; the positive sign on the coefficient of pictorial health warning suggests that exposure to pictorial health warning might increase the frequency of smoking. These results again contradict the hypothesis that exposure to pictorial health warning decreases the smoking frequency and the number of cigarettes smoked, and these surprising results could be impacted by endogeneity bias.

Exposure to tobacco advertisements increases the number of cigarettes smoked per day by 1.178 (p value < 0.01). Smokers who started smoking habit earlier tend to smoke more intense both frequency and amount of cigarette compare to those who started smoking at late age. Older smokers are more likely to smoke daily but older age is associated with consuming fewer cigarettes per day. Smokers who live in Bangkok tend to smoke heavier than smokers in other regions in term of both frequency and cigarette per day. Factors that statistically associated with smoking daily are optimistic attitude to smoking, head of household and being employed. Smokers who are married or use to marry tend to smoke more cigarettes per day (0.84 and 0.704 higher amount of cigarette compare to being single, respectively).

6.1.3 Impact of pictorial health warning on intention to quit

This sub-section shows the results of a binary logistic regression, with the dependent variable being the intention to quit, and an ordered logit regression with the dependent variable being the number of quit attempts.

Table 6. 3 Intention to quit and the number of quit attempts (Dependent variables = whether or not the individual is having intention to quit, and how many attempts they have tried)

Variables	Intention to quit		Quit attempts			
	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Never tried	Once	Twice	More than 3 times
			Average marginal effect (S.E.)			
Exposure to pictorial health warning	0.512** (0.178)	0.108** (0.037)	-0.099** (0.037)	0.022*** (0.008)	0.022*** (0.008)	0.056*** (0.021)
Expose to tobacco advertisement	-0.034 (0.108)	-0.007 (0.023)	-0.002 (0.022)	0.000 (0.005)	0.000 (0.005)	0.001 (0.012)
Smoking initiation age	-0.005 (0.007)	-0.001 (0.001)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)
Attitude toward smoking (Excluded= Anti-smoking)						
Prefer smoking	-0.485*** (0.133)	-0.098*** (0.025)	0.103*** (0.024)	- 0.026*** (0.007)	-0.023*** (0.006)	-0.054*** (0.012)
Neutral	-0.919*** (0.148)	-0.169*** (0.022)	0.168*** (0.022)	- 0.047*** (0.007)	-0.038*** (0.005)	-0.083*** (0.010)
Age	0.003 (0.003)	0.001 (0.001)	-0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	0.001 (0.000)
Gender	0.317** (0.144)	0.067** (0.030)	-0.087*** (0.029)	0.019*** (0.007)	0.019*** (0.006)	0.049*** (0.017)
Education level (Excluded= No education)						
Less than high school	0.702*** (0.162)	0.129*** (0.025)	-0.129*** (0.025)	0.036*** (0.008)	0.029*** (0.006)	0.064*** (0.011)
High school	1.071*** (0.189)	0.210*** (0.034)	-0.211*** (0.033)	0.052*** (0.009)	0.047*** (0.008)	0.112*** (0.018)
Higher than high school	0.860*** (0.207)	0.163*** (0.038)	-0.170*** (0.037)	0.044*** (0.010)	0.038*** (0.008)	0.087*** (0.020)
Head of household	0.220** (0.078)	0.046** (0.016)	-0.046*** (0.016)	0.010*** (0.004)	0.010*** (0.003)	0.026*** (0.009)
Marital status (Excluded= Single)						
Married	0.695*** (0.103)	0.138*** (0.019)	-0.131*** (0.018)	0.033*** (0.005)	0.029*** (0.004)	0.068*** (0.009)
Divorced	0.491*** (0.141)	0.094*** (0.027)	-0.085*** (0.027)	0.023*** (0.007)	0.020*** (0.006)	0.043*** (0.014)
Occupation (Excluded= Unemployed)						
Self-employed	-0.031 (0.123)	-0.006 (0.026)	0.004 (0.025)	-0.001 (0.006)	-0.001 (0.005)	-0.002 (0.014)
Enterprise employee	0.316* (0.185)	0.069* (0.041)	-0.073* (0.039)	0.015* (0.008)	0.016* (0.008)	0.043* (0.023)
Private employee	0.091 (0.134)	0.019 (0.028)	-0.022 (0.027)	0.005 (0.006)	0.005 (0.006)	0.012 (0.015)
Log (Income)	-0.036 (0.023)	-0.008 (0.005)	0.006 (0.005)	-0.001 (0.001)	-0.001 (0.001)	-0.004 (0.003)
Living area	-0.025 (0.080)	-0.005 (0.017)	0.006 (0.016)	-0.001 (0.004)	-0.001 (0.004)	-0.004 (0.009)
Region (Excluded = Bangkok)						
Central	-0.236* (0.138)	-0.051* (0.030)	0.058** (0.029)	-0.012** (0.006)	-0.012** (0.006)	-0.033* (0.017)
North	-0.053 (0.141)	-0.012 (0.031)	0.018 (0.030)	-0.004 (0.006)	-0.004 (0.006)	-0.011 (0.018)

Northeast	-0.282* (0.144)	-0.060* (0.031)	0.070** (0.030)	-0.015** (0.006)	-0.015** (0.007)	-0.040** (0.018)
South	-0.258* (0.142)	-0.055* (0.031)	0.056* (0.030)	-0.012* (0.006)	-0.012* (0.006)	-0.032* (0.018)
Number of observation = 4273 Prob> chi2 = 0.0000 Pseudo R2 = 0.0377			Number of observation = 4273 Prob> chi2 = 0.0000 Pseudo R2 = 0.0250			

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level; * Significant at 10% significance level

Exposure to pictorial health warning increases probability of quitting by 10.8%, and also increases probability to attempt quitting more than once; 2.2%, 2.2% and 5.6% increased chance to try quit once, twice and more than 3 times, respectively (when other variables held constant). Exposure to tobacco advertisement plays no significant role in this intention to quit. Smokers who have good attitude toward smoking are prefer not to quit, 9.8% decreased the probability of quit smoking. Being female increases the probability of quitting by 6.7%, and has 5.9% increasing in probability of quit attempt more than 3 times, when other factors held constant. For smokers who have higher education attainment seem to increase the probability of quitting and number of attempt times. For smokers whom their status is head of household increases the probability of quitting by 4.6%, and 2.6% for more than 3 attempt times. Smokers who are married or used to be married have higher probability of quitting and more attempts compared to those who are single.

6.2 Addressing Endogeneity and Testing the Validity of Instrument Variables

The results shown in Table 6.1 and 6.2 demonstrate that exposure to pictorial health warning could increase the probability and intensity of smoking. These results contradict the first and the second hypotheses, possibly owing to the presence of endogeneity bias, whereby, upon making the decision to smoke, choosing the frequency

of smoking as well as the number of cigarettes smoked, smokers are more likely to be exposed to pictorial health warnings. To solve the problem of endogeneity bias, an attempt to find potential instrumental variables (IVs) has been made.

The list of potential instrumental variables is as follows: -

- 1) Exposure to secondhand smoking: This instrumental variable is created from a combination of two questions: “During recent 30 days, have you seen or been exposed to any smoking around you?” and “Are you exposed to in-house smoking?”. It is hypothesized that individuals exposed to secondhand smoking (i.e. being surrounded by smokers) would have a higher chance to see pictorial health warning on cigarette package and exposure to secondhand smoking would not affect smoking behavior directly.
- 2) Receipt smoking-related health risks from sources other than the cigarette package: This instrument is based on the question “During recent 30 days, have you received information of smoking related health hazard from other sources such as newspaper, television, radio, internet, etc.?”. It is hypothesized that individuals who receive health-risk information from other sources would have a higher likelihood of also paying attention on health-risk information as displayed on a cigarette package as well and the receipt of information through other channels should not impact smoking behavior directly.

The validity of these instrumental variables is tested, as shown in the table below. Using a simple over-identification test, it is found that both instrumental variables can explain statistically the main explanatory variable as well as the dependent variables. However, since the instrumental variable should be correlated with the endogenous

regressor, but uncorrelated with the outcome variable (Maddala, 1977), it can be concluded that the two potential instrumental variables are not appropriate to solve endogeneity.

Table 6. 4 Possible instrument variables with endogenous and exogenous variables

Variables	Endogenous variable	Outcome variable	Variables	Endogenous variable	Outcome variable
	<i>Exposure to pictorial health warning</i>	<i>Current smoker</i>		<i>Exposure to pictorial health warning</i>	<i>Current smoker</i>
	Regression Coefficients (S.E.)			Regression Coefficients (S.E.)	
<i>Exposure to second smoke</i>	0.846*** (0.055)	1.801*** (0.093)	<i>Perceived from others sources</i>	0.896*** (0.050)	-0.194*** (0.046)
Expose to tobacco advertisement	0.425*** (0.113)	0.214** (0.069)	Expose to tobacco advertisement	0.368*** (0.113)	0.302*** (0.069)
Attitude toward smoking (Excluded= Anti-smoking)					
Prefer smoking	-0.299** (0.149)	1.462*** (0.107)	Prefer smoking	-0.118 (0.150)	1.507*** (0.105)
Neutral	-1.167*** (0.087)	0.977*** (0.092)	Neutral	-1.004*** (0.087)	0.894*** (0.090)
Age	-0.032*** (0.002)	-0.001 (0.002)	Age	-0.033*** (0.002)	-0.005** (0.002)
Gender	-0.778*** (0.057)	-3.333*** (0.067)	Gender	-0.812*** (0.057)	-3.318*** (0.067)
Education level (Excluded= No education)					
Less than high school	0.774*** (0.074)	-0.474*** (0.096)	Less than high school	0.681*** (0.074)	-0.370*** (0.093)
High school	1.029*** (0.119)	-0.953*** (0.111)	High school	0.886*** (0.120)	-0.816*** (0.109)
Higher than high school	0.806*** (0.113)	-1.501*** (0.118)	Higher than high school	0.607*** (0.114)	-1.396*** (0.116)
Head of household	0.107* (0.056)	0.016 (0.050)	Head of household	0.105* (0.057)	0.016 (0.049)
Marital status (Excluded= Single)					
Married	0.637*** (0.076)	0.045 (0.064)	Married	0.661*** (0.076)	0.094 (0.063)
Divorced	0.395*** (0.094)	0.518*** (0.091)	Divorced	0.403*** (0.094)	0.555*** (0.089)
Occupation (Excluded= Unemployed)					
Self-employed	0.415*** (0.063)	0.865*** (0.070)	Self-employed	0.466*** (0.063)	0.936*** (0.069)
Enterprise employee	0.868*** (0.164)	0.844*** (0.112)	Enterprise employee	0.836*** (0.164)	0.968*** (0.111)
Private employee	0.267*** (0.082)	1.239*** (0.077)	Private employee	0.345*** (0.082)	1.274*** (0.076)

Log (Income)	0.025** (0.010)	-0.003 (0.012)	Log (Income)	0.023** (0.010)	-0.004 (0.012)
Living area	0.133** (0.056)	-0.226*** (0.050)	Living area	0.116** (0.056)	-0.219*** (0.048)
Region (Excluded= Bangkok)					
Central	-0.201** (0.103)	-0.082 (0.084)	Central	-0.156 (0.102)	-0.098 (0.082)
North	-0.269** (0.103)	0.064 (0.087)	North	-0.224** (0.103)	0.016 (0.085)
Northeast	-0.300** (0.106)	0.208** (0.089)	Northeast	-0.223** (0.105)	0.091 (0.087)
South	-0.062 (0.111)	0.534*** (0.089)	South	0.036 (0.111)	0.545*** (0.087)
Number of observation = 20,787					
Prob> chi2 = 0.0000					
	Pseudo R2 = 0.1699	Pseudo R2 = 0.3420		Pseudo R2 = 0.1769	Pseudo R2 = 0.3183

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level; * Significant at 10% significance level

6.3 Two-stage Instrumental Variable Estimation to Correct Endogeneity

The goal of a two-stage instrumental variable estimation is to find a proxy for the endogenous regressor, which would be independent from the error term. The first stage is to generate a predicted \hat{X} , using instrumental variables as additional independent variables. The second stage is to substitute the predicted \hat{X} over the endogenous variable and estimate the main regression equation (Rassen, Schneeweiss, Glynn, Mittleman, & Brookhart, 2009; Terza, Basu, & Rathouz, 2008).

However, since strong instrumental variables do not exist within the dataset (as seen in Table 6.4 above), the first stage estimation has to be without any instrumental variables and the identification is based on the non-linearity of the functional form only. In other words, to correct for the endogeneity problem, the approach used is to first run a binary logistic regression with exposure to pictorial health warning as the dependent variable and the other personal characteristics as shown in the earlier tables as explanatory variables, and then to run the main regression equations using the predicted

probability of exposure to pictorial health warning in place of the actual value of exposure to pictorial health warning.

Table 6. 5 Probability of smoking and smoking behaviors with predicted value of exposure to pictorial health warning (Dependent variables = whether or not the individual is a current smoker, a daily smoker, and number of cigarettes smoked)

Variables	Probability of smoking		Smoking frequency		Number of cigarettes smoked
	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)
Predicted Exposure to pictorial health warning	-2.148*** (0.581)	-0.242*** (0.065)	-0.606 (1.452)	-0.057 (0.137)	-0.224 (2.816)
Expose to tobacco advertisement	0.322*** (0.069)	0.036*** (0.008)	0.042 (0.156)	0.004 (0.015)	1.213*** (0.300)
Smoking initiation age			-0.062*** (0.008)	-0.006*** (0.001)	-0.059*** (0.019)
Attitude toward smoking (Excluded= Anti-smoking)					
Prefer smoking	1.497*** (0.106)	0.187*** (0.014)	0.556** (0.223)	0.044** (0.015)	0.150 (0.342)
Neutral	0.661*** (0.115)	0.080*** (0.014)	-0.019 (0.239)	-0.002 (0.023)	0.066 (0.449)
Age	-0.01*** (0.002)	-0.001*** (0.000)	0.019*** (0.006)	0.002*** (0.001)	-0.046*** (0.010)
Gender	-3.468*** (0.080)	-0.390*** (0.008)	-0.152 (0.234)	-0.014 (0.022)	-1.075** (0.481)
Education level (Excluded= No education)					
Less than high school	-0.168 (0.112)	-0.020 (0.014)	0.192 (0.261)	0.018 (0.026)	2.251*** (0.478)
High school	-0.614*** (0.127)	-0.071*** (0.015)	-0.023 (0.296)	-0.002 (0.030)	3.324*** (0.557)
Higher than high school	-1.215*** (0.130)	-0.129*** (0.015)	-0.247 (0.303)	-0.028 (0.033)	3.496*** (0.592)
Head of household	0.037 (0.049)	0.004 (0.006)	0.355** (0.112)	0.034** (0.011)	-0.300 (0.214)
Marital status (Excluded= Single)					
Married	0.173** (0.067)	0.019** (0.007)	0.244* (0.146)	0.024 (0.015)	0.860** (0.288)
Divorced	0.561*** (0.089)	0.064*** (0.010)	0.007 (0.197)	0.001 (0.021)	0.701* (0.378)

Occupation (Excluded= Unemployed)					
Self-employed	1.073*** (0.079)	0.110*** (0.007)	0.905*** (0.185)	0.107*** (0.026)	0.289 (0.383)
Enterprise employee	1.118*** (0.120)	0.115*** (0.013)	0.55** (0.267)	0.072** (0.034)	2.103*** (0.567)
Private employee	1.387*** (0.082)	0.149*** (0.008)	0.884*** (0.190)	0.105*** (0.026)	0.372 (0.398)
Log(Income)	-0.006 (0.012)	-0.001 (0.001)	-0.05 (0.032)	-0.005 (0.003)	0.255*** (0.063)
Living area	-0.198*** (0.049)	-0.022*** (0.005)	-0.177 (0.114)	-0.017 (0.011)	1.345*** (0.221)
Region (Excluded= Bangkok)					
Central	-0.11 (0.083)	-0.012 (0.009)	-0.399* (0.219)	-0.030* (0.015)	-1.388*** (0.387)
North	-0.007 (0.086)	-0.001 (0.009)	-0.684** (0.222)	-0.057*** (0.017)	-4.074*** (0.399)
Northeast	0.065 (0.088)	0.007 (0.010)	-0.597** (0.223)	-0.048** (0.017)	-4.284*** (0.406)
South	0.543*** (0.087)	0.064*** (0.010)	-0.639** (0.219)	-0.052*** (0.016)	-3.253*** (0.396)
	Number of observation = 20,787 Prob> chi2 = 0.0000 Pseudo R2 = 0.3181		Number of observation = 4273 Prob> chi2 = 0.0000 Pseudo R2 = 0.0603		Number of obs = 4273 Prob> chi2 = 0.0000 R-squared = 0.1633 Adj R-squared = 0.1590

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level; * Significant at 10% significance level

6.3.1 Impact of pictorial health warning on probability of smoking, after having adjusted for endogeneity

Having corrected for endogeneity, the result shows that exposure to pictorial health warning decreases the probability of smoking by 24.2%, other variables held constant (p value < 0.01). Exposure to tobacco advertisement increases the probability of smoking by 3.6% (p value < 0.01). Having a positive attitude toward smoking increases the probability of being smoker by 18.7%. Other factors associated with

decreasing the probability of smoking are being older (decreases by 0.1%), female (decreases by 39% compared to men), having higher education level (decreases by 12.9% for those who have education level higher than high school, and living in municipality area (decreases by 2.2%).

This study also performs a robustness check to examine how regression coefficients change when subsamples of observations are analyzed. The sample is substituted with only a “new smokers” group, i.e. those who started smoking less than 1 year prior to data collection, in the regression equation of probability of smoking (see table 6.6). It can be seen that, although pictorial health warning shows no significant impact on probability of becoming a new smoker due to smaller sample size, but the main regression coefficient demonstrates the same sign compared to the regression coefficient from the full sample (table 6.5); the model also shows similar magnitude of regression coefficients of other variables in this model. The study concludes that since the coefficients do not change much, the earlier estimated regression coefficients based on the full sample are robust (Lu & White, 2014).

Table 6. 6 Probability of becoming a new smoker with predicted value of exposure to pictorial health warning (Dependent variables = whether or not the individual is a new smoker (started smoking less than a year))

Variables	Probability of being a new smoker (Smoked less than 1 year)	
	Regression Coefficients (S.E.)	Average marginal effect (S.E.)
Predicted Exposure to pictorial health warning	-5.054 (9.390)	-0.017 (0.031)
Expose to tobacco advertisement	0.128 (0.398)	0.000 (0.001)
Attitude toward smoking (Excluded= Anti-smoking)		
Prefer smoking	1.482*** (0.455)	0.008** (0.004)

Neutral	1.035 (0.830)	0.005 (0.006)
Age	-0.167*** (0.028)	-0.001*** (0.000)
Gender	-3.162*** (0.658)	-0.010*** (0.002)
Education level (Excluded= No education)		
Less than high school	1.081 (1.349)	0.003 (0.002)
High school	0.911 (1.423)	0.002 (0.002)
Higher than high school	-0.256 (1.483)	0.000 (0.002)
Head of household	0.464 (0.356)	0.002 (0.001)
Marital status (Excluded= Single)		
Married	-0.003 (0.474)	0.000 (0.002)
Divorced	1.000 (0.854)	0.005 (0.006)
Occupation (Excluded= Unemployed)		
Self-employed	1.601*** (0.442)	0.006*** (0.002)
Enterprise employee	1.700* (0.894)	0.007 (0.006)
Private employee	1.283*** (0.433)	0.004** (0.002)
Log(Income)	0.017 (0.057)	0.000 (0.000)
Living area	0.107 (0.329)	0.000 (0.001)
Region (Excluded= Bangkok)		
Central	-0.701 (0.589)	-0.001 (0.001)
North	-0.024 (0.588)	0.000 (0.002)
Northeast	0.547 (0.569)	0.002 (0.002)
South	1.075** (0.525)	0.005** (0.002)
Number of observation = 16574 Prob > chi2 = 0.0000 Pseudo R2 = 0.3626		

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level;
* Significant at 10% significance level

6.3.2 Impact of pictorial health warning on smoking behaviors, after having adjusted for endogeneity

Although results show a non-significant impact of pictorial health warning on smoking behaviors, but the direction of impact seems to decrease the smoking frequency and less cigarettes smoked per day (negative coefficient values). Tobacco advertisement has a significant impact on cigarette consumption per day; smokers exposed to tobacco advertisement smoke more cigarettes per day by 1.213. Smokers who began smoking at a later age tend to smoke less than those who started smoke at an earlier age; the probability of daily smoking decreases by 0.62%, and that of smoking less cigarettes per day decreases by 0.059. Being older can increase the probability of daily smoking by 0.2% but is associated with a fewer amount of cigarettes consumed per day by 0.046. Gender and education level have an impact only on cigarette consumption; being female and having higher education decrease the amount of cigarettes smoked per day by 1.075 and 3.496, respectively. Monthly income also has a significant impact on cigarette consumption; smokers who have 1 percent higher income tend to smoke 0.255 more cigarettes per day, holding other variables constant. Smokers from Bangkok compared to other regions smoke more heavily in terms of both the frequency and the amount of cigarettes smoked per day.

Chapter 7

Discussion and conclusion

This paper analyzes the impact of pictorial health warning and personal characteristic factors on probability of smoking, smoking behaviors and intention to quit smoking according to the most recent national survey on Cigarette Smoking and Alcohol Drinking in 2014. Exposure to pictorial warning on cigarette package is used in combination with exposure to tobacco advertisement, attitude toward smoking and smoking initiation age to determine pattern of smoking among survey's respondents. Socioeconomic and demographic factors are also used in this evaluation.

7.1 Impact of pictorial health warning on probability of smoking

This study finds that most respondents have seen a pictorial health warning on cigarette package; 94.92% of smokers and 87.5% of non-smokers from this study notice pictorial health warning on a cigarette package. This finding confirms the previous results of small group surveys in 2007 and 2009 that most Thai people noticed pictorial health warnings on cigarette package (Jaroenchatree, 2007; Tobacco Research Control and Knowledge Management Center (TRC), 2009). The exposure to pictorial health warning has a negative impact on the probability of smoking significantly. Based on regression analyses, people who are exposed to pictorial health warning are 24.2% less likely to smoke, when other factors are held constant. The result is consistent with previous studies, which argue that pictorial health warnings prevent people from smoking (Jaroenchatree, 2007; Tobacco Research Control and Knowledge Management Center (TRC), 2009) and could increase intentions to not start smoking

(Noar et al., 2016). This study also finds that pictorial health warning has a similar effect across all income levels (see table A-1). The literature suggests that the impact of pictorial health warning compared to text-only warning is consistent across diverse racial/ethnic and socioeconomic populations (Borland et al., 2009; Cantrell et al., 2013; Hammond et al., 2007; Hammond et al., 2012). However, the advantage of the pictorial health warning measure is that it has the potential to reduce communication inequalities among all groups of population (Cantrell et al., 2013).

Among respondents, only fewer people are exposed tobacco advertisements, such as free sample, online advertisement, point of purchase advertising, sponsorships, etc.: 8.79% of non-smokers and 11.51% of smokers. Despite the fact that Thailand already has a comprehensive ban on tobacco advertisement, this study finds that some respondents are still exposed to tobacco advertisements. A recent survey conducted in Thailand reported that some retail stores and street vendors still showed cigarette packages, advertisements and offered promotional items (Yong et al., 2008). Tobacco companies have tried to find new marketing tactics such as using modern information technology and social media which are difficult to control, and marketing company image through corporate social responsibility (CSR) activities (Sangthong, Wichaidit, & Ketchoo, 2012). Although Thailand issued a regulation of the Television and Radio Broadcasting Act in 2004 to ban tobacco companies from broadcasting their CSR activities, tobacco companies use print media and the internet to publicize their CSR activities (Sangthong et al., 2012). Exposure to tobacco advertisement increases the probability of smoking by 3.6%. This result is similar to many previous studies, which find that tobacco advertisement could increase probability of smoking initiation (Wellman, Sugarman, DiFranza, & Winickoff, 2006). Tobacco advertisement can

increase positive people's attitude toward smoking, and influence normative beliefs of tobacco usage (Brown & Moodie, 2009). This study also finds that respondents who have a positive attitude toward smoking increase the probability of smoking by 18.7%.

7.2 Impact of pictorial health warning on smoking behaviors

This study tries to address the endogeneity in a situation whereby the secondary data are limited, and finds that, after an endogeneity adjustment, exposure to pictorial health warning has an insignificant impact on smoking behaviors, but smokers who are exposed to pictorial health warning seem to smoke less frequently and fewer cigarettes per day. A systemic review published in 2014 examined on impact of pictorial warning on smoking behavior such as reducing cigarette consumption also found it inconclusive (Monarrez-Espino et al., 2014). But other surveys and experimental economic studies reported that exposure to pictorial warning can decrease cigarette consumption per day (Hammond et al., 2004; Thrasher et al., 2007). The pictorial health warning, which displayed the pictures of people suffering from smoking, might give smokers a negative feeling to continue smoking (Hammond et al., 2004; Hammond et al., 2003).

Tobacco advertisement has a significant impact on cigarette consumption per day. Smokers who are exposed to tobacco advertisement increase cigarette consumption per day by 1.213. Advertisement is an important tool for tobacco companies to compete with anti-smoking measures. Although few prior studies found a relation between tobacco advertisement and cigarette consumption, empirical evidence showed that comprehensive tobacco advertisement bans could reduce tobacco consumption (Saffer & Chaloupka, 2000).

This study finds that monthly income has a significant impact on cigarette consumption; smokers who have a higher income tend to smoke more cigarettes per day. A previous study on cigarette consumption explained that income elasticity was about the same magnitude but opposite sign as tobacco price elasticity (Andrews & Franke, 1991). Smokers who have low income will have less money left for discretionary expenditure, so the changes in their income will definitely affect their smoking patterns (Townsend, Roderick, & Cooper, 1994). This finding suggests that higher tobacco tax measure can decrease cigarette consumption.

7.3 Impact of pictorial health warning on intention to quit

This study finds that exposure to pictorial health warning on cigarette package significantly impact on the intention to quit and also number of quit attempts. Smokers who are exposed to pictorial health warning have a higher probability of quitting by 10.8%. Pictorial health warning acts as a tool to raise awareness and knowledge of smokers about dangers of smoking. Smokers who notice pictorial health warning have a significantly higher level of knowledge about smoking related health risks and gain more intention to quit compared to those who do not (Hammond, Fong, McNeill, Borland, & Cummings, 2006).

This study also finds that attitude toward smoking is also important to the intention to quit. Smokers who have a good attitude toward smoking prefer not to quit, having a 9.8% lower probability of quitting smoking. This finding is confirmed by previous study that the attitude toward smoking can predict prospectively the probability of quit attempts among current smokers (Borland et al., 2009). The process

of inducing attitudinal changes toward smoking is called “denormalization”. Smoking denormalization is a strategy to reinforce the idea that tobacco smoking is not a mainstream or normal activity in society (Lavack, 1999). Smoking denormalization strategies include limiting public space where smoking is allowed, banning tobacco products advertisement, and informing the public about dangers of secondhand smoke through media campaigns (Lavack, 1999). The shift in public norms can turn tobacco usage to become less desirable and less accessible and tobacco smoking becomes less socially acceptable (Roeseler, Anderson, Hansen, Arnold, & Zhu, 2010).

7.4 Recommendation

Based on the findings, this study has made two important contributions to tobacco control policy. First, the findings show that pictorial health warning can decrease the probability of smoking and even greater impact on the intention to quit. The results also add on the knowledge of impact of pictorial health warning on smoking behaviors from previous Thai studies that have usually been conducted with small group population.

Second, this study partly evaluates the anti-smoking policy in Thailand, and helps policy makers better understand the impact of pictorial health warning on smoking behaviors among Thai population. This study suggests that besides the pictorial health warning on cigarette package, attitudes toward smoking are one of the most important factors that can decrease the probability of smoking and also motivate the intention to quit smoking. This can be implemented by strengthening smoking “denormalization” policy, as recommended by WHO FCTC (WHO, 2008).

Another remaining problem is tobacco companies' advertisement through internet sales, cross border advertising, depiction of tobacco company logos in international movies and tobacco-sponsored sport telecasts, and CSR activities by tobacco companies. The finding shows that the exposure to tobacco advertisement has the strong impact on higher probability of smoking and number of cigarettes smoked per day, which counteracts the effectiveness of pictorial health warning measure. This study suggests that all types of advertising, promotion, and sponsorship should be strictly banned.

7.5 Limitation

The limitation of this study is the insufficient treatment of endogeneity problems for the variable, exposure to pictorial health warning. Due to limited data, the study cannot find valid instrument variables to treat the endogeneity. Also, the 2014 survey contains too many questions, which may have led to respondent fatigue, causing an inaccurate data and some missing data. Probe questions may be required to gain more complete and more detailed answers in some specific topics.

Another limitation of this study is the fact that the study is conducted as a cross sectional analysis, so a further study in longitudinal experimental design is suggested, in order to capture the impact of pictorial health warning on smoking behavior in the longer run. Also, a more advanced study design is needed to analyze the indirect effect of pictorial health warning and tobacco advertisement on attitudes towards smoking to fulfill the gap in this study.

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APPENDIX



จุฬาลงกรณ์มหาวิทยาลัย
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Table A- 1 Impact of pictorial health warning on probability of smoking and smoking behaviors, intention to quit and number of quit attempts in each monthly income quantile groups

Variables	Monthly Income Quantile							
	Q ₁		Q ₂		Q ₃		Q ₄	
	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)	Average marginal effect (S.E.)	Regression Coefficients (S.E.)	Average marginal effect (S.E.)
Probability of smoking								
Predicted Exposure to pictorial health warning	-2.114*** (0.581)	- 0.238*** (0.065)	-2.244*** (0.582)	- 0.252*** (0.065)	-2.136*** (0.581)	- 0.240*** (0.065)	-2.283*** (0.582)	-0.256*** (0.065)
Smoking frequency								
Predicted Exposure to pictorial health warning	-0.549 (1.454)	-0.052 (0.138)	-0.682 (1.455)	-0.064 (0.138)	-0.491 (1.449)	-0.046 (0.137)	-0.618 (1.454)	-0.058 (0.137)
Number of cigarettes smoked								
Predicted Exposure to pictorial health warning	-1.602 (2.813)		0.062 (2.823)		-0.758 (2.820)		0.849 (2.800)	
Intention to quit								
Exposure to pictorial health warning	0.525*** (0.178)	0.110*** (0.037)	0.522*** (0.178)	0.110*** (0.037)	0.508*** (0.178)	0.107*** (0.037)	0.508*** (0.178)	0.107*** (0.037)
Quitting attempts								
Predicted Exposure to pictorial health warning	0.482*** (0.176)		0.480*** (0.176)		0.471*** (0.176)		0.470*** (0.176)	

Notes: *** Significant at 1% significance level; ** Significant at 5% significance level;
* Significant at 10% significance level

To assess how income level affects the impact of pictorial health warning, the study divided population group by their average monthly income into quantile; Q₁ or 25 percentile, Q₂ or 50 percentile, Q₃ or 75 percentile and Q₄ or 100 percentile. The study finds that pictorial health warning demonstrates the similar impact on population

in each income quantiles. The pictorial health warning decreases the probability of smoking by 23.8%, 25.2%, 24%, and 25.6% for individuals in monthly income quantile Q₁, Q₂, Q₃, and Q₄, respectively. For those who exposed to pictorial health warning have no significant impact on smoking behaviors, both smoking frequency and smoked cigarettes per day in all income quantiles. The pictorial health warning increases probability of quit smoking by 11%, 11%, 10.7%, and 10.7% in Q₁, Q₂, Q₃, and Q₄, respectively. The impact of pictorial health warning on quit attempt also shows similar results in all income quantiles.



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