EXPLORING THE EFFECTS OF KNOWLEDGE ON SMOKING: AN ANALYSIS OF ADULTS IN MALAYSIA

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ABSTRACT

In an effort to reduce the prevalence of smoking, the present study attempts to examine the factors that determine smoking. The present study uses two-tiered model to estimate the effects of demographic and knowledge factors on smoking participation and cigarette expenditure. As anticipated, knowledge is found to be negatively associated with an individual's propensity to smoke. In addition, the findings suggest that age, gender, wealth index, education, ethnicity and house locality are significantly associated with smoking. In particular, males are more likely to smoke than females. Education reduces the likelihood of smoking. Urban dwellers tend to spend more on cigarette than rural dwellers. Policies directed toward reducing the prevalence of smoking may need to consider improving the knowledge of smoking among the adults. The policies must also be designed carefully to take into account of the demographic factors which are correlated with smoking.

KEYWORDS: cigarette; demographics; education; knowledge; smoking

1. INTRODUCTION

Smoking is one of the serious public health issues worldwide. Each year, approximately 6 million mortalities are caused by smoking (World Health Organization, 2015). Of these mortalities, around 80% are related to direct smoking, while 20% are associated with passive smoking. Even though there are numerous studies on smoking, the actual role of knowledge on smoking behaviour remains unidentified. Previous studies use education as a proxy for knowledge and conclude that knowledge can affect an individual's health behaviour (Kenkel, 1991; Cawley and Ruhm, 2012). In particular, they use smoking and exercise to represent health behaviour and find that individuals who have better health knowledge are more likely to choose healthy lifestyle than their peers with poorer health knowledge. This is simply because better informed individuals are more aware of the benefits of being healthy. While using education to measure knowledge may seem as a solution for omitted variable issue, it would be even better if knowledge is included as a separate variable.

Considering the importance of knowledge, mass media have been widely used by government to alter population health behaviours, especially smoking. The media mainly focuses on improving knowledge in mass population by providing the public with health information. Numerous successful media campaigns in United States (US) are noteworthy. In New York, after introducing an anti-smoking media campaign in 2005, the number of smoking adults decreased about 18% (Campaign for Tobacco-Free Kids, 2016). Furthermore, a smoking cessation programme designed by the public health administrators in Florida successfully increased the proportion of quitting smoking among smokers by 13% in 2007 (Campaign for Tobacco-Free Kids, 2016). There was also a significant reduction in tobacco consumption among adults in California in the 1990s, as the smoking education and media programmes reduced around 13% of smoking prevalence (Campaign for Tobacco-Free Kids, 2016). As in Malaysia, a nationwide anti-smoking campaign, named *Tak Nak* (Say No) was introduced by the government in 2004. However, the outcomes of this campaign are not very promising. A likely reason is that the policy makers have poor information on how knowledge affects smoking behaviour (Tan et al., 2009). The present study attempts to examine the determinants of smoking in an in-depth manner.

2. THEORETICAL FRAMEWORK

Given the budget constraint, individuals need to consider the full price of additive goods and consume only when the expected benefits outweigh the price. The benefits are the instantaneous pleasures, while the full price consists of the current market price and the negative health consequences that could occur in the future (Gruber and Koszegi, 2001). Therefore, individuals who discount their future heavily are likely to consume addictive goods. Because the stock of consumption of addictive goods that individuals accumulate now increases their future consumption of addictive goods, an expected increase in the price of addictive goods in the future due to tax or realisation of negative health consequences may reduce the current consumption.

As mentioned earlier, the future price of smoking is health deterioration. However, individuals are uncertain about the actual future price of smoking. They can only predict it based on their knowledge. It is hypothesised that individuals who have better knowledge of smoking tend to anticipate a higher future price of smoking than those who lack knowledge. This implies that individuals who are more aware of the consequences of smoking are less likely to become smokers. Smoking also causes negative externalities as it can affect the health of non-smokers, thus, individuals who take into account these negative externalities may predict a higher future price than those who do not. The main objective of the present study is to test this hypothesis and identify whether knowledge can reduce smoking.

3. METHODS

3.1 Data

The data used in the present study is extracted from Global Adult Tobacco Survey (GATS) of Malaysia (Institute for Public Health, 2012). The survey was jointly conducted by Ministry of Health Malaysia and World Health Organization. Following the protocol of GATS, all the individuals in Malaysia aged 15 years and above are eligible for the survey, except tourists and those who are institutionalised in hospitals. The pretested questionnaires are used by the trained staffs to interview the respondents. The written consent must be obtained from the respondents prior to the interview. To ensure representativeness, the survey covers all the states in Malaysia (including Sabah and Sarawak). A multistage stratified sampling approach is used.

The measure of smoking consists of the question: 'How much money do you spend for the purchase of cigarettes per month?' During the survey, the respondents' age is also collected. Based on the guideline of GATS, the respondents' age is categorised into four categories: 15-24 years, 25-44 years, 45-64 years and ≥65 years. This would allow a non-linear relationship between age and smoking. The survey also records the respondents' gender. Inclusion of gender in the model is important because risk preference may vary across gender. Owing to data limitation, the present study uses wealth index to measure the respondents' financial capability, instead of household income. Wealth index is an indicator of wealth of households. It measures the value of all kinds of assets owned by a household, which include productive assets, non-productive assets and household's amenities (Rutstein and Johnson, 2004). Analysis of the wealth index is based on quintiles. There are total five quintiles: lowest, second, middle, fourth and highest.

The knowledge of smoking can be separated into two categories: the effects of smoking on smokers (knowledge1) and the effects of smoking on non-smokers (knowledge2). The respondents are asked to answer 'yes' or 'no' on few questions about the health consequences of smoking. To measure knowledge1, the questions are asked as: 'Based on your knowledge, does smoking cause the following illnesses?' The illnesses include stroke, heart attack, lung cancer, oral cancer, premature birth, throat cancer, miscarriage, gangrene, bladder cancer, stomach cancer and osteoporosis. Each 'yes' is assigned a value of 1, each 'no' is assigned a value of 0. Since there are total 11 questions, the maximum value is 11 (complete knowledge) whereas the minimum is 0 (empty knowledge). Similarly, as for knowledge2, the questions are asked as: 'Based on what you know, does breathing other people's smoke cause serious illnesses, heart diseases, lung illnesses and lung cancer?' Only 4 questions are asked, thus the maximum value is only 4.

The descriptive statistics of the survey respondents are presented in Table 1. The majority of the respondents aged 25-44 years (41.70%), followed by those aged 45-64 years (31.04%), 15-24 years (17.65%) and ≥65 years (9.61%). Slightly less than half of the respondents are males (48.83%). The distributions of wealth index are quite equal. Each group comprises around 20% of the respondents. The education breakdown consists of 48.11% the primary-educated, 42.19% the secondary-educated and 9.70% the tertiary-educated. The proportion of Malay (59.67%) somewhat outweighs that of non-Malay (40.33%). A large proportion of the respondents are married (63.47%). Of the total sample, 48.76 are urban dwellers, while 51.24% are rural dwellers. The average values of knowledge1 and knowledge2 are 8.63 and 3.31, respectively.

Table 1: Descriptive statistics of sample

Variables	Smoker	Non-smoker	Total
Age			
15-24	15.69	84.31	17.65
25-44	23.27	76.73	41.70
45-64	16.76	83.24	31.04
≥65	6.77	93.23	9.61
Gender			
Male	36.34	63.66	48.83
Female	1.13	98.87	51.17
Wealth index			
Lowest	15.56	84.44	20.27
Second	16.43	83.57	20.23
Middle	23.20	76.80	19.72
Fourth	18.29	81.71	19.74
Highest	18.27	81.73	20.03
Education			
Primary	16.37	83.63	48.11
Secondary	21.40	78.60	42.19
Tertiary	14.64	85.36	9.70
Ethnicity			
Malay	18.68	81.32	59.67
Non-Malay	17.79	82.21	40.33
Marital status			
Married	18.17	81.83	63.47
Unmarried	18.59	81.41	36.53
House locality			
Urban	18.52	81.48	48.76
Rural	18.14	81.86	51.24
Knowledge1	–	–	8.63
Knowledge2	–	–	3.31
Observations	761	3392	4153

Source: Global Adult Tobacco Survey (GATS)

3.2 Econometric specification

In order to maximise utilities, individuals need to consume goods in the market. However, not every good is consumed by all the individuals. Some of the goods may yield disutility to the consumers, such as cigarette. These consumers would maximise their utilities based on corner point solution, that is, they allocate all their budgets for goods other than cigarette. Therefore, there will be lots of zero in the data. To deal with this corner point solution, tobit model is proposed (Tobin, 1958). However, a limitation of tobit model is that it is too restrictive, as it relies only on a single process to decide the values of decision to smoke ($y > 0$), not to smoke ($y = 0$), as well as the amount of cigarette expenditure among smokers ($y > 0$). Specifically, $\partial P(y>0|\mathbf{x})/\partial x$ and $\partial E(y|\mathbf{x},y>0)/\partial x$ possess the identical sign, meaning that the impacts of independent variables on $P(y>0|\mathbf{x})$ and $E(y|\mathbf{x},y>0)$ are the same. See Wooldridge (2010) for proof.

In light of this problem, a more flexible model has been introduced by Cragg (1971), which is called two-tiered model. This model allows the values of decision to smoke and amount of cigarette expenditure to be determined by separate mechanisms. The first tier (i.e. smoking participation) is to analyse whether or not the individuals smoke. The second tier (i.e. smoking level) is to analyse how much the smokers spend on cigarette per month [in Malaysian Ringgit (RM)]. Although bivariate sample selection model is also able to overcome the weakness of tobit, studies have shown that two-tiered model is the most suitable model for

analysing smoking (Madden, 2008). The independent variables included in the first and second equations of two-tiered model are the same, which consist of age, gender, wealth index, education, ethnicity, marital status, house locality and knowledge of smoking.

4. RESULTS

Table 2 shows the result of a two-tiered model of cigarette expenditure using the sample from GATS. An advantage of two-tiered model is that the model does not require exclusion restriction in order to provide consistent and efficient parameter estimates (Wooldridge, 2010). As the results illustrate, the signs of the estimates of participation equation and level equation are not identical for all the variables. For instance, the estimate of marital status in participation equation has a negative sign, while the estimate in level equation has a positive sign. This has confirmed that the two-tiered model is less restrictive as compared to tobit model.

Table 2: Results of two-tiered model

Variables	Participation			Level		
	Estimates (γ)	Std. Error	*p*	Estimates (β)	Std. Error	*p*
Constant	-2.572	0.176	0.001	-51.532	160.409	0.748
Age						
15-24	–	–	–	–	–	–
25-44	0.464	0.090	0.001	-27.180	61.911	0.661
45-64	0.108	0.098	0.270	10.490	70.403	0.882
≥65	-0.504	0.142	0.001	-121.932	121.431	0.315
Gender						
Male	1.972	0.085	0.001	110.637	110.928	0.319
Female	–	–	–	–	–	–
Wealth index						
Lowest	–	–	–	–	–	–
Second	-0.013	0.089	0.888	29.464	64.637	0.649
Middle	0.182	0.089	0.041	107.274	61.325	0.080
Fourth	0.120	0.095	0.204	58.359	66.540	0.380
Highest	0.085	0.099	0.393	30.736	69.903	0.660
Education						
Primary	0.376	0.113	0.001	23.428	82.304	0.776
Secondary	0.392	0.104	0.001	12.302	75.902	0.871
Tertiary	–	–	–	–	–	–
Ethnicity						
Malay	0.120	0.058	0.039	21.084	42.371	0.619
Non-Malay	–	–	–	–	–	–
Marital status						
Married	-0.071	0.068	0.297	12.341	45.736	0.787
Unmarried	–	–	–	–	–	–
House locality						
Urban	0.088	0.058	0.134	114.676	40.272	0.004
Rural	–	–	–	–	–	–
Knowledge1	-0.028	0.009	0.001	-2.621	5.998	0.662
Knowledge2	-0.062	0.024	0.008	4.898	15.235	0.748
Count R^2	0.821			–		
Observations	4153			761		

Source: Global Adult Tobacco Survey (GATS)

The parameter estimates of age 25-44 and ≥65 have a positive and a negative signs, respectively. While these two age groups are highly significant in explaining the participation decision, none of which is significantly associated with the amount of cigarette expenditure. The estimate of gender in participation equation appears to have a positive sign, whereas the estimate in level equation is not significant. The *p*-values of all the quintiles in wealth index are quite high, except the middle quintile, which has a *p*-value of slightly less than 0.10 for both participation and level equations. Hence, it can be concluded that the positive relationship between wealth and smoking is significant but not strong. The positive parameter estimates of primary and secondary education are only significant in participation equation. This clearly indicates that education level has a negative impact on the decision to smoke but not on the amount of expenditure.

Assuming the values of all other variables are fixed, if the respondent is Malay, his/her probability to smoke is predicted to increase, suggesting that the ethnic majority in Malaysia has a higher preference for smoking than the minority. The estimate of marital status, however, shows that being married reduces the likelihood of smoking. In the level equation, both ethnicity and marital status variables do not have any notable effects on the amount of cigarette expenditure. The estimates of house locality provide an interesting insight into smoking behaviour. Even though being an urban dweller is not significantly associated with smoking participation, it has a strong positive effect on the level of smoking. As the estimates of knowledge1 and knowledge2 imply, knowledge about the effects of smoking on smokers and non-smokers could reduce an individual's propensity to smoke. However, it could not reduce the amount of cigarette expenditure.

Table 3 presents the marginal effects derived from the two-tiered equations. The probability of smoking is illustrated in column 1, while the conditional and unconditional means of cigarette expenditures are shown in column 2 and 3, respectively. Because the parameter estimates of the two-tiered model cannot be interpreted directly like linear regression, marginal effects of the independent variables are calculated using partial derivatives.

Table 3: Marginal effects of independent variables

Variables	$\partial P(y>0\|\mathbf{x})/\partial x$	$\partial E(y\|\mathbf{x},y>0)/\partial x$	$\partial E(y\|\mathbf{x})/\partial x$
Age			
15-24	–	–	–
25-44	0.075	-12.067	-17.204
45-64	0.017	4.665	6.651
≥65	-0.057	-50.820	-72.034
Gender			
Male	0.342	46.356	65.760
Female	–	–	–
Wealth index			
Lowest	–	–	–
Second	-0.002	13.205	18.831
Middle	0.030	49.022	69.870
Fourth	0.019	26.396	37.641
Highest	0.013	13.773	19.641
Education			
Primary	0.058	10.411	14.844
Secondary	0.062	5.458	7.781
Tertiary	–	–	–
Ethnicity			
Malay	0.018	9.329	13.299
Non-Malay	–	–	–
Marital status			
Married	-0.011	5.464	7.790
Unmarried	–	–	–
House locality			
Urban	0.013	50.937	72.562

Rural	–	–	–
Knowledge1	-0.004	-1.162	-1.657
Knowledge2	-0.009	2.173	3.098
Observations	4153	761	761

Source: Global Adult Tobacco Survey (GATS)

Compared to individuals who aged 15-24 years, those who are 25-44 years old are 7.5% more likely to smoke, whereas those who are 65 years old or older are 5.7% less likely to smoke. Holding other factors constant, males have a predicted probability of smoking about 34.2% higher than females. Compared to individuals who are in the lowest quintile of wealth index, those who are in the middle quintile of wealth index are 3% more likely to smoke. Conditional on those who smoke, individuals in the middle quintile of wealth index spend, on average, RM 49.02 more on cigarette, while unconditionally, they spend about RM 69.87 more.

If the primary-, secondary- and tertiary-educated individuals have the same socio-demographic characteristics and level of knowledge about smoking, the primary- and secondary-educated, on average, have a 5.8% and 6.2% higher probability of smoking, respectively, than the tertiary-educated. Considering the effect of ethnicity, Malays are predicted to be 1.8% more likely to smoke than non-Malays, holding other factors constant. On average, urban dwellers spend about RM 50.94 (conditional) and RM 72.56 (unconditional) more on cigarette per month than rural dwellers. The magnitudes of knowledge variables are significant but not large. If the values of other variables are fixed, one point increase in knowledge1 and knowledge2 lower the probability of smoking by 0.4% and 0.9%, respectively.

5. DISCUSSION

The effects of age on smoking appear to be inconsistent. As the results show, compared to individuals who aged 15-24 years, individuals who aged 25-44 years are more likely to smoke whereas individuals who aged ≥65 years are less likely to smoke. In other words, the probability to smoke increases with age when individuals are young, while reduces when individuals are old. These outcomes do not strongly support the findings evidenced by Yen (2005), Aristei and Pieroni (2008) and Lin (2010) that age reduces individuals' probability to smoke. The explanations are simple. Because individuals who aged 25-44 years are usually more financially independent than their counterparts who aged 15-24 years, they are more capable of consuming highly-taxed cigarettes. It is, however, that when individuals reach the age of 65 or above, they tend to be more concerned about their health. As the result, their preferences for smoking would be reduced.

The result on gender seems to be in agreement with those of previous studies (Manrique and Jensen, 2004; Alam et al., 2008; Lin, 2010). While gender is significantly associated with smoking participation, it does not explain the level of smoking. This concludes that men do not necessary spend more on cigarette than women, even they have a higher probability to smoke. Several reasons may explain why men tend to have a higher likelihood of smoking than women. First, men are less risk-averse than women (Croson and Gneezy, 2009). Since smoking is risky health behaviour, it is not surprising that men are more likely to engage in it as compared to women. Second, women tend to face lower social and cultural tolerance for smoking than men (Waldron, 1991).

Although wealth index is not a very good proxy for measuring budget constraint, it is sufficient for the present study. By including wealth index into the analysis, the present study can avoid omitted variable bias and identify whether or not smoking is more prevalent among individuals who are wealthier. Previous studies use income as an explanatory variable and find that higher income individuals are more likely to smoke than lower income individuals (Manrique and Jensen, 2004; Raptou et al., 2005; Kenkel et al., 2014), which are not totally in line with the findings of the present study as only middle wealth index group is statistically significant in explaining smoking. The increase in the expenditure on cigarette in middle wealth index group somewhat suggests that wealthier individuals may find cigarette more affordable than their less-wealthy counterparts.

Consistent with Yen (2005), Cho et al. (2008), Bilgic et al. (2010), Lin (2010) and Cheng and Kenkel (2010), there appears to be a a negative relationship between education and smoking. It is noteworthy that after controlling for knowledge, education is significantly correlated with smoking. This implies that there could be a 'third' variable which can explain the relationship between education and smoking. It is often claimed that this 'third' variable is time preference. As pointed out by Fuchs (1982), education can lower the rate of time preference. Furthermore, Van Der Pol (2011) explores the effect of time preference on health and argues that individuals who have a higher rate of time preference (i.e. the less-educated) are less likely to make an effort to improve their health than individuals who have a lower rate of time preference (i.e. the well-educated). This is due to the fact that they discount their future heavily.

Albeit ethnicity is a controlled variable, its effect on smoking is well worth discussing. Compared to non-Malays, Malays are significantly more likely to smoke. Similar findings are evidenced by Tan et al. (2009), Cheah (2012), Cheah and Naidu (2012) and Lim et al. (2013). It can be concluded that different ethnic backgrounds of individuals may adopt different lifestyles. Perhaps, this is attributed to the cultural differences. Another reason is related to the privilege of ethnic majority. It is possible that Malays may have better access to health care than non-Malay and consequently are less devoted to take care of their health.

House locality does not affect one's likelihood of smoking, but it affects one's expenditure on cigarette. In particular, urban dwellers tend to spend more money on cigarette than rural dwellers. The positive relationship between the degree of urbanisation and smoking has also been evidenced by Bauer et al. (2007). This outcome is not surprising because cigarette is more available in urban areas than in rural areas (Ho et al., 2010). Furthermore, urban dwellers also have better job opportunities and thus possess a better financial capability. Misconception about smoking could be another contributing factor of this outcome. People often think that smoking can reduce stress. Since urban dwellers tend to live a more hectic and stressful lifestyle than their rural counterparts (Ho et al., 2010), they may have a higher tendency to adopt smoking behaviour.

Confirming the prior hypothesis that knowledge is negatively correlated with smoking. Having a better understanding of the fact that smoking possesses adverse impacts on the health of smokers and non-smokers can significantly reduce an individual's intention to smoke. This finding is comparable to those evidenced by Kenkel (1990) and Hsieh and Lin (1997), who study the relationship between knowledge and use of medical care. Kenkel (1990) uses a two-stage model and find that health information increases an individual's likelihood of using medical care. Similarly, based on a survey of the elderly in Taiwan, Hsieh and Lin (1997) find that well-informed individuals are more likely to use preventive medical care than their counterparts with poor knowledge. Since non-smoking and use of medical care are favourable to health, it is concluded that knowledge can improve health outcomes.

Although the present study has shed light on the factors affecting smoking, it has several limitations, mainly because of the limited availability of data. First, the substitution and income effects of smoking cannot be tested as price is not included in the regression. Second, all the information obtained from the survey is self-reported. Hence, some respondents may under report their expenditure on cigarette. Third, few important health variables, such as self-rated health and presence of diseases are not taken into account. It seems reasonable to expect that individuals who have poorer health background are less likely to smoke than individuals with better health conditions.

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