Modeling Abstention of and Expenditure Shares on Alcohol and Tobacco in Thailand

Songsak Sriboonchitta[1], Aree Wiboonpongse[2] and Yaovarate Chaovanapoonphol[3]

[1]*Associate Professor, Faculty of Economics, Chiang Mai University, 50200 Thailand songsak@econ.cmu.ac.th*

[2]*Associate Professor, Department of Agricultural Economics, Faculty of Agriculture Chiang Mai University, 50200, Thailand aree@chiangmai.ac.th*

[3]*Lecturer, Department of Agricultural Economics, Faculty of Agriculture Chiang Mai University, 50200, Thailand agivchvn@chiangmai.ac.th*

Abstract

Systems of demand equations and expenditure share equations are often used to analyze the effect of price changes, tax and income on consumer demand. A practical problem that emerges is that expenditure on commodities like alcohol and tobacco products may be zero for a substantial part of population. In this case, least squares regression is inappropriate. Since there are criterion functions for demands for alcohol and tobacco, Tobit type II combined with seemingly unrelated regression is employed. Data obtained from the National Statistics Office provide a sample of 34,791 observations in 2004. The estimates of both models are statistically significant. The findings suggest both income and some demographic factors to be policy variables for abstention from both goods.

KEY WORDS: Demand equation, expenditure share equation, least squares regression, Tobit type II and seemingly unrelated regression

Introduction

Alcoholic beverage and tobacco consumption has become more common in the Thai society in the last several decades and tends to increase continuously. From the evidence, Thai per capita alcoholic beverage consumption increased dramatically during 1989-2002 from 20.2 litres per person per year in 1989 to 58 liters per person per year in 2002 which was the highest per capita consumption level in Asia. Moreover, the percentage of drinkers among young females increased sixfold, during the same period, with in the 15-19 year-old age group (Thai Health Promotion Foundation, 2005). In the meantime, each year the sale of cigarettes increases by five per cent. The statistics on smokers over 15-year-old indicate that 90 per cent of this group is teenager (Thai Health Promotion Foundation, 2005).

Alcoholic beverage and tobacco consumptions have direct impacts on households in terms of psychological and physical trauma as well as educational, social and financial aspects. In Thailand, alcohol has been estimated to be the third most significant health risk factor, with 5.3 per cent of overall disability adjusted life years attributed to its consumption. In addition to this, alcohol ranks third as health risk factor for Thai males and 11th for women (Thai Working Group on Burden of Disease (2002) cited in Thamarangsi (2006)). Road traffic injury is also one of the alcohol-related problems causing most concern. It is the second highest cause of death at about 13,000 deaths annually in 2004 (Wibulpolprasert, 2005 cited in Thamarangsi, 2006). A recent study repeats that families with drinking member(s) have a 3.84 times higher risk for family violence (Kongsagon, 2005 cited in Thamarangsi, 2006). The statistics show that each year 42,000 people die from smoking-related causes (World Bank, undated). Besides, the health, accidental and violent impacts of alcoholic beverage and tobacco consumption as stated above, the impact of those on economic is also important for the Thai government and the people. It is due to the fact that they have to spend an enormous amount of money on medical treatment of traffic accidents and other losses. People die in accident each year can cause an estimated loss of 90,000 million baht (World Bank, undated).

This paper tries to investigate the factor affecting the nonparticipation in and expenditure shares on alcohol and tobacco to benefit to government policy on consumption of alcohol and tobacco. Tobit Type II model together with seemingly unrelated regression are employed in this study to cope with the data. This paper is organized as follows: section 2 presents theoretical framework and econometric model; section 3 presents empirical results; and concluding remarks are given in last section.

Theoretical framework and econometric model

Verbeek (2000) states that in economics, (systems of) demand equations are often used to analyze the effect of, for example, income, tax or price changes on consumer demand. A practical problem that emerges is that expenditure on particular commodities may be zero for a substantial proportion, particularly if the goods are not aggregated into broad categories. This problem usually occurs with, for example, durable goods, number of hours worked (Quester and Green, 1982), and extramarital affairs (Fair, 1978). In such cases, least squares regression would be inappropriate (Greene, 2000).

With the assumption that a consumer maximizes utility as a function of the quantities of goods consumed, the Marshallian demand functions for each good are given as:

$$q_j = f_j(y, p) \qquad [1]$$

where q_j is the quantity of good *j, y* is total expenditure, and *p* denotes a vector of prices of the corresponding goods. In an empirical study, cross-sectional data might be employed and prices could be considered as constants to be absorbed into the functional form, leading to:

$$q_j = f^*_j(y) \qquad [2]$$

which is referred to as an Engel curve.

In empirical analysis, the Engel curve may be specified as:

$$s_j = \alpha_j + \beta_j \log y \qquad [3]$$

where $s_j = p_j q_j / y$ denotes for the expenditure share of good *j*.

Consider the elasticity of $f^*_j(y)$ with respect to *y*:

$$e_j = \frac{\partial f^*_j(y)}{\partial y} \frac{y}{q_j} \qquad [4]$$

and the Engel curve equation (3), then we obtain:

$$e_j = 1 + \beta_j / s_j . \qquad [5]$$

Good *j* is a necessity if $e_j < 1$ (that is, $\beta_j < 0$), while a luxury good is consistent with $\beta > 0$.

Econometrically, Engel curves may be written as:

$$s_{ji} = \alpha_{ji} + \beta_{ji} \log y_i + u_{ji}$$

where s_{ji} denotes household *i*'s budget share of good *j*; and y_i denotes total expenditure. The parameters α_{ji} and β_{ji} may depend upon household characteristics, such as age and education level of the household head, and the numbers of adults and children (Verbeek, 2000, p.202).

In this analysis of expenditure shares of alcohol and tobacco in Thailand, the number of zero expenditure shares is expected to comprise a substantial portion of the samples. However, the Engel curve does not apply to observations with $s_{ji} = 0$. Hence, the model may be adjusted as:

$$\begin{aligned} s^*_{ji} &= \alpha_{ji} + \beta_{ji} \log y_i + u_{ji} \\ s_{ji} &= s^*_{ji} \text{ if } s^*_{ji} > 0 \\ &\quad\ 0 \text{ otherwise} \end{aligned} \qquad [6]$$

which is a standard Tobit model if it assumed that $u_{ji} \sim NID\ (0, \sigma^2)$ for a given commodity j.

In this paper we estimate two separate Engel curves for alcohol and tobacco. It is assumed that α_{ji} is a linear function of the age of the household head, the number of adults in the household, and the numbers of children younger than 2 and 2 or older, while β_{ji} is a linear function of age and the number of adults. This leads to the following model to be estimated:

$$s_{ji} = \beta_1 + \beta_2 age_i + \beta_3\ noadults_i + \beta_4\ nochild \geqslant 2_i + \beta_5\ nochild < 2_i + \beta_6\ \log y_i + \beta_7\ age_i x \log y_i + \beta_8\ noadults_j x \log y_i + u_{ji}$$

where j = 1, for alcohol and j = 2 for tobacco.

Verbeek (2000, 207) states that the standard Tobit model imposes a structure which is often too restrictive, in that precisely the same variables that affect the probability of a non-zero observation also determine the level of a positive observation, and with the same sign. The sample selection model is then introduced, so that the Probit models for abstaining from alcohol and tobacco consumption must be estimated. The variables included, in both Probit models are a constant, age, noadults, nochild $\geq$ 2, nochild<2, log(y), age x log(y), noadults x log(y), blue collar, and white collar. A two-step estimation procedure with a selectivity variable (λ) for each Engel curve, namely for alcohol and tobacco, is then conducted.

The data and empirical results

Data for the study obtained from the National Statistics Office provide a sample of 34,791 observations in 2004. A summary of the data for the different variables in the probability of abstention of alcohol and tobacco and expenditure shares of alcohol and tobacco models for 34,791 observations are presented in Table 1. The consumers in the surveyed sample of the National Statistics Office were old-age population with the average age of 49.56 years. The average income of the sample was about 17,000 baht per year with the formal education level of 9.61 years. Moreover, the summary statistics show that the household size of the sample was quite small family with the average number of member of household being 3.34 persons. The average expenditure share of alcohol was higher than that of tobacco with the percentage of 0.16 and 0.05, respectively (Table 1).

Table 1: Summary Statistics of Key Variables of Alcohol and Tobacco Consumers in Thailand in 2004 (Probit Model)

Kurtosis	Skewness	Standard Deviation	Median	Mean	Variable
2.54	0.28	14.85	48.00	49.56	Age (year)
257.03	10.18	24,023.80	10,359.00	17,052.11	Income (baht per month)
2.80	0.46	4.96	7.00	9.61	Education (years)
40.14	3.60	0.18	0.11	0.16	Expenditure share of alcohol
154.58	7.47	0.08	0.03	0.05	Expenditure share of tobacco

Source: the National Statistics Office

A summary of data for the different variables in the Tobit model in two groups of consumers are presented in Table 2. The summary statistics are presented for separate consumers including 34,203 alcohol consumers and 32,348 tobacco consumers. The figures show similar statistics between two groups of consumers.

Table 2: Summary Statistics of Key Variables of Alcohol Consumers and Tobacco Consumers in Thailand in 2004 (Tobit type II)

Kurtosis	Skewness	Standard Deviation	Median	Mean	Variable
Alcohol consumers (34,203 observations)					
2.54	0.28	14.76	48.00	49.72	Age (year)
2.85	0.48	4.93	7.00	9.55	Education (years)
4.82	0.92	1.66	3.00	3.37	Household size (persons)
3.84	0.85	0.099	0.15	0.16	Expenditure share of alcohol
19.46	3.35	0.048	0.020	0.037	Inverse Mill's ratio
Tobacco consumers (32,348 observations)					
2.56	0.31	14.60	48.00	49.75	Age (year)
2.85	0.48	4.93	7.00	9.56	Education (years)
4.88	0.92	1.65	3.00	3.44	Household size (persons)
10.54	2.17	0.043	0.036	0.049	Expenditure share of tobacco
9.30	2.00	0.070	0.12	0.14	Inverse Mill's ratio

Source: The National Statistics Office

The estimation of Probit model of in first step is given in Table 3. The empirical results show that age, age*lnY and occupation variables have significant positive impacts on the probability of consumption with the coefficients of 0.059, 0.0041 and 0.12, respectively. This implies that the older consumers tend to have a higher probability to consume alcohol. Further, laborers are likely to be associated with a higher probability of consuming alcohol. On the other hand, age^2, lnY and sex variables have significant negative impacts on the probability of consumption with the coefficient of -0.00085, -0.57 and -0.17, respectively. The higher age^2 and lnY tend to have a lower probability of consuming alcohol. From the probability of abstention of alcohol and tobacco model estimates, it is indicated that household characteristics are factors influencing the nonparticipation in alcohol and tobacco consumption.

Table 3: Probit Models for Abstention of Alcohol and Tobacco in Thailand

Variable	Alcohol (34,791 observations)		Tobacco (34,791 observations)	
	Coefficient	Standard error	Coefficient	Standard error
Constant	5.21^{***}	0.64	4.83^{***}	0.42
Age	0.059^{***}	0.015	0.0036	0.0091
Age^2	-0.00085^{***}	0.0000056	-0.00059^{***}	0.0000035
Age*LnY	0.0041^{***}	0.0013	0.0067^{***}	0.00081
LnY	-0.57^{***}	0.065	-0.54^{***}	0.043
Education	-0.0062	0.0047	0.015^{***}	0.0028
Sex	-0.17^{***}	0.038	-0.25^{***}	0.022
Occupation	0.12^{**}	0.050	0.019	0.026
Log likelihood	-2546.957		-8402.761	
McFadden R-squared	0.145967		0.049900	
Akaike info criterion	0.146875		0.483502	
Schwarz criterion	0.148819		0.485447	
Hannan-Quinn criterion	0.147494		0.484122	

Note: *** at 99 per cent level of significance and ** at 95 per cent level of significance

In the two-step estimation procedure, as proposed by Heckman (1979), re-estimation of the two Engel curves considered to the sample selection problem due to possible endogeneity of the abstention decision. The results of this are displayed in Table 4, where ordinary least squares technique (OLS) is utilized but standard errors are adjusted to take into account heteroskedasticity and the estimation error in λ. The coefficient for $\hat{\lambda}$ are -0.026 and -0.096 for alcohol and tobacco, respectively. Moreover,

these indicate that the sample selection term λ has significant impact only on the expenditure share of tobacco. According to the OLS estimates of the models, all explanatory variables except dummy variable for labour have statistically significant power to explain the expenditure share at the one per cent level of significance for alcohol beverage consumption. For tobacco, all explanatory variables except lnY have statistically significant impacts on the expenditure share at the one per cent level of significance. The estimates of the impacts of household characteristics of Engel curves for alcohol and tobacco show consistent signs except the dummy variable for sex. It is quite surprising that the Engel curve for alcohol reveals the negative coefficient which indicates males tend to have lower expenditure share than females. For tobacco, on the other hand, it is found the positive coefficient on the same variable.

Table 4: Two-step Estimation of Engel Curves for Alcohol and Tobacco in Thailand (Tobit type II).

Variable	Alcohol (34,203 observations)		Tobacco (32,348 observations)	
	Coefficient	Standard error	Coefficient	Standard error
Constant	0.46***	0.019	0.10***	0.011
Age	0.0056***	0.00040	-0.0016***	0.00021
Age^2	-0.0000035***	0.00000024	-0.0000025***	0.00000019
Age*LnY	-0.00020***	0.0000038	-0.00013***	0.0000023
LnY	-0.041***	0.0023	-0.0033	0.0015
Education	-0.0029***	0.00012	-0.00064***	0.0000070
Sex	-0.026***	0.0010	0.0043***	0.00078
Household size	0.0084***	0.00034	0.0037***	0.00020
Occupation	0.00021	0.0011	0.00033***	0.00058
λ	-0.026	0.018	-0.096***	0.0097
R^2	0.0301227		0.065378	
Adjusted R^2	0.0301043		0.065118	
Log likelihood	36782.30		56989.03	
Akaike info criterion	-2.150238		-3.522878	
Schwarz criterion	-2.147771		-3.520286	
F-statistic	1637.767		251.3413	

Note: *** at 99 per cent level of significance and ** at 95 per cent level of significance.

Due to the fact that the second step of estimation using OLS of those two models, as described above, is estimated separately. To improve the estimation, seemingly unrelated regression is employed in this study to compare the results. The results presented in Table 5 showed estimates of Seemingly Unrelated Regression of alcohol and tobacco. It shows the similar empirical results in comparison with the results from the Tobit type II model (Table 5).

Table 5: Estimates of Seemingly Unrelated Regression of Alcohol and Tobacco in Thailand

Variable	Alcohol (34,203 observations)		Tobacco (32,348 observations)	
	Coefficient	Standard error	Coefficient	Standard error
Constant	0.46***	0.019	0.10***	0.011
Age	0.0056***	0.00040	-0.0016***	0.00021
Age^2	-0.0000035***	0.00000024	-0.0000023***	0.00000019
Age*LnY	-0.00020***	0.0000038	-0.00013***	0.0000023
LnY	-0.041***	0.0023	-0.0032	0.0015
Education	-0.0029***	0.00012	-0.00063***	0.0000070
Sex	-0.026***	0.0010	0.0043***	0.00078
Household size	0.0084***	0.00034	0.0037***	0.00020
Occupation	0.00023	0.0011	0.00034***	0.00058
λ	-0.025	0.018	-0.095***	0.0097
R^2	0.0301227		0.065378	
Adjusted R^2	0.0301043		0.065118	

Note: *** at 99 per cent level of significance and ** at 95 per cent level of significance.

Concluding remarks

In this paper, demand equations and expenditure share equations of alcohol and tobacco are examined using sample data from the National Statistics Office in 2004 based on a limited dependent variable models and seemingly unrelated regression model. Accordingly, the Tobit type II model is considered to estimate Engel curves for alcohol and tobacco.

The empirical results of the probability for abstention of alcohol and tobacco in Thailand show that household characteristics including age, income, education level, sex and household size have significant impact with the different signs on the probability of abstention from those products. For demand equations and expenditure share equations, the Tobit type-II using the Heckman two-step estimation is applied. The consumers, who consumed alcoholic beverage and tobacco from the survey, including 34,203 observations and 32,348 observations for alcohol and tobacco consumption, respectively, are analyzed in the OLS estimation. The estimates of OLS estimation, in the second stage, show the consistent estimates in terms of sign and magnitude to the Probit models. Therefore, the consumption and harm reduction strategies by the government should be promoted. More information on the impacts of alcohol and tobacco consumption should be reported to population incessantly thorough education system.

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