UNIVERSITI SAINS MALAYSIA

# LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA *PENDEK*

*FINAL REPORT OF SHORT TERM RESEARCH PROJECT*

Sila kemukakan laporan akhir ini melalui Jawatankuasa Penyelidikan di Pusat Pengajian dan Dekan/Pengarah/Ketua Jabatan kepada Pejabat Pelantar Penyelidikan



1. **Nama Ketua Penyelidik:** Andrew Tan Khee Guan
   *Name of Research Leader*

   ☐ Profesor Madya/ *Assoc. Prof.* ☑ Dr./ *Dr.* ☐ Encik/Puan/Cik *Mr/Mrs/Ms*

2. **Pusat Tanggungjawab (PTJ):**
   *School/Department* School of Social Sciences

3. **Nama Penyelidik Bersama:** -n/a-
   *Name of Co-Researcher*

4. **Tajuk Projek:**
   *Title of Project* Examining Malaysian Household Expenditure Patterns On Gambling Activities

5. **Ringkasan Penilaian/***Summary of Assessment*:

| | Tidak Mencukupi *Inadequate* | | Boleh Diterima *Acceptable* | Sangat Baik *Very Good* | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| i) **Pencapaian objektif projek:** *Achievement of project objectives* | ☐ | ☐ | ☐ | ☐ | ☑ |
| ii) **Kualiti output:** *Quality of outputs* | ☐ | ☐ | ☐ | ☐ | ☑ |
| iii) **Kualiti impak:** *Quality of impacts* | ☐ | ☐ | ☐ | ☐ | ☑ |
| iv) **Pemindahan teknologi/potensi pengkomersialan:** *Technology transfer/commercialization potential* | ☐ | ☐ | ☑ | ☐ | ☐ |
| v) **Kualiti dan usahasama :** *Quality and intensity of collaboration* | ☐ | ☐ | ☐ | ☐ | ☑ |
| vi) **Penilaian kepentingan secara keseluruhan:** *Overall assessment of benefits* | ☐ | ☐ | ☐ | ☐ | ☑ |

**6. Abstrak Penyelidikan / *Abstract of Research***

(An abstract of between 100 and 200 words must be prepared in Bahasa Malaysia and in English).
*This abstract will be included in the Annual Report of the Research and Innovation Section at a later date as a means of presenting the project findings of the researcher/s to the University and the community at large)*

Two papers were produced in this study. First, a trivariate Tobit system is estimated to investigate the demand for vices (tobacco, alcohol and gambling) in Malaysia. Estimation results, segmented by ethnicity, suggest that education level, occupation type, and age of household head negatively affects the likelihood to spend as well as amounts spent on tobacco by all Malaysians. Further, while higher income Malay households are more likely to spend and have higher tobacco expenditures, affluent Chinese and those of other races are more likely to spend and also spend more on smoking, drinking and gambling. Male-headed households of all races are more likely to spend and also spend more on smoking, drinking and gambling.

Second, we examined household participation decisions and expenditures on gambling in Malaysia using Heckman sample selection analysis. The marginal effects on probability, conditional mean and unconditional mean of socio-demographic determinants indicate that Chinese have higher gambling probabilities and expenditures than Indians or other races. While education reduces and age increases the likelihood and expenditures of gambling amongst Chinese, these effects are non-extant for Indians and those of other races. Households with higher income and those headed by males are more likely to partake and have higher expenditures in gambling for all races. Finally, white-collar Chinese and Indian have lower gambling likelihoods and unconditional expenditures than their blue-collar cohorts. In conclusion, policies to curb gambling activities in Malaysia can be specifically targeted at those more likely to participate and spend more in gambling (Chinese, affluent, male-headed, younger and non-white collar households).

*Hasil penyelidikan ini adalah dua kertas penyelidikan. Pertama, sistem "trivariate Tobit" telah dianggar untuk menyiasat permintaan untuk "vice" (tembakau, alkohol, perjudian) di Malaysia. Keputusan penganggaran yang disegmenkan oleh etnik, menunjukkan bahawa paras pendidikan, jenis pekerjaan, dan umur ketua isi-rumah mempengaruhi kebarangkalian membelanja dan juga amaun perbelanjaan tembakau secara negatif oleh rakyat Malaysia. Tambahan lagi, walau pun isi-rumah kaum Melayu yang berpendapatan tinggi adalah lebih cenderung berbelanja dan mempunyai perbelanjaan yang lebih tinggi ke atas barangan tembakau, kaum Cina dan kaum lain yang lebih kaya juga adalah lebih cenderung berbelanja dan mempunyai perbelanjaan yang tinggi ke atas merokok, minum alkohol dan berjudi. Isi-rumah pelbagai etnik yang diketuai oleh lelaki adalah lebih cenderung berbelanja dan mempunyai perbelanjaan yang lebih tinggi terhadap merokok, minum alkohol dan berjudi.*

*Kedua, keputusan mengambil bahagian dan perbelanjaan ke atas perjudian telah pun dikaji dengan menggunakan analisa Heckman sample selection. Kesan marginal terhadap kemungkinan, min kondisional, dan min tidak-kondisional pembolehubah socio-demografi menunjukkan bahawa kaum Cina mempunyai kebarangkalian dan perbelanjaan yang lebih tinggi berbanding kaum India dan lain-lain. Walau pun paras pendidikan mengurangkan dan umur meningkatkan kebarangkalian dan jumlah perbelanjaan menjudi di kalangan kaum Cina, kesan ini tidak wujud untuk kaumm India dan lain-lain. Isi-rumah yang berpendapatan tinggi dan yang diketuai oleh lelaki adalah lebih cenderung untuk mengambil bahagian dan berbelanja dalam perjudian untuk kesemua kaum. Akhir sekali, kaum Cina dan India yang berkolar-putih mempunyai kebarangkalian dan perbelanjaan tidak kondisional yang lebih rendah berbanding mereka yang berkolar-biru. Sebagai kesimpulan, polisi untuk mencegah aktiviti perjudian di Malaysia boleh ditujukan kepada mereka yang lebih cenderung dan mempunyai perbelanjaan yang lebih tinggi (kaum Cina, berpendapatan tinggi, isi-rumah yang diketuai oleh lelaki, lebih muda, dan bukan berkolar-putih).*

**7. Sila sediakan laporan teknikal lengkap yang menerangkan keseluruhan projek ini.**
**[Sila gunakan kertas berasingan]**
*Applicant are required to prepare a Comprehensive Technical Report explaning the project.*
*(This report must be appended separately)*

-Papers attached-

**Senaraikan kata kunci yang mencerminkan penyelidikan anda:**
*List the key words that reflects your research:*

| *Bahasa Malaysia* | *Bahasa Inggeris* |
|---|---|
| i. permintaan untuk "vices", "model trivariate Tobit", Malaysia | i. demand for vices, trivariate Tobit model, Malaysia |
| ii.keputusan mengambil bahagian, perbelanjaan, perjudian, model Heckman sample selection | ii.participation decisions, expenditures, gambling, Heckman sample selection model |

**8. Output dan Faedah Projek**
*Output and Benefits of Project*

(a) * **Penerbitan Jurnal**
*Publication of Journals*
**(Sila nyatakan jenis, tajuk, pengarang/editor, tahun terbitan dan di mana telah diterbit/diserahkan)**
*(State type, title, author/editor, publication year and where it has been published/submitted)*

Tan, A., S. T. Yen, R. M., Nayga (2008). "Socio-Demographic Determinants of Gambling Participation and Expenditures: Evidence from Malaysia." Paper submitted to *Social Science Quarterly* for review and possible publication (May 2008).

Tan, A., S. T. Yen, R. M., Nayga (2008). "The Demand for Vices in Malaysia: An Ethnic Comparison Using Household Expenditure Data." Paper submitted to *Applied Economics* for review and possible publication (January 2008).

(b) **Faedah-faedah lain seperti perkembangan produk, pengkomersialan produk/pendaftaran paten atau impak kepada dasar dan masyarakat.**
*State other benefits such as product development, product commercialisation/patent registration or impact on source and society.*

-n/a-

* Sila berikan salinan/*Kindly provide copies*

(c) **Latihan Sumber Manusia**
*Training in Human Resources*

i) Pelajar Sarjana: -n/a-
*Graduates Students*
(Perincikan nama, ijazah dan status)
*(Provide names, degrees and status)*

ii) Lain-lain: -n/a-
*Others*

9. **Peralatan yang Telah Dibeli:**
*Equipment that has been purchased*

-n/a-

**Tandatangan Penyelidik**
*Signature of Researcher*

12/06/08
**Tarikh**
*Date*

**Komen Jawatankuasa Penyelidikan Pusat Pengajian/Pusat**
*Comments by the Research Committees of Schools/Centres*

Output memuaskan. Telah menghasilkan 2 artikel. Dr Andrew juga telah membuat jaringan dengan penyelidik di peringkat antarabangsa. Jawatankuasa memperakui bahawa penyelidikan adalah berjaya, telah menjawab objektif kajian & menghasilkan output yang memuaskan.

13.6.08

**TANDATANGAN PENGERUSI**
**JAWATANKUASA PENYELIDIKAN**
**PUSAT PENGAJIAN/PUSAT**
*Signature of Chairman*
*[Research Committee of School/Centre]*

**Tarikh**
*Date*

# Socio-Demographic Determinants of Gambling Participation and Expenditures: Evidence from Malaysia*

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# Socio-Demographic Determinants of Gambling Participation and Expenditures: Evidence from Malaysia


## Abstract

*Objective:* This study examines the socio-demographic factors affecting household participation decisions and expenditures on gambling in Malaysia.

*Methods:* Heckman sample selection analysis is applied to Malaysian Household Expenditure Survey 2005/06 data. Marginal effects on probability, conditional mean and unconditional mean of socio-demographic determinants are calculated.

*Results:* Chinese have higher gambling probabilities and expenditures than Indians or other races. While education reduces and age increases the likelihood and expenditures of gambling amongst Chinese, these effects are non-extant for Indians and those of other races. Households with higher income and those headed by males are more likely to partake and have higher expenditures in gambling for all races. Finally, Chinese and Indian with white-collar occupations have lower gambling likelihoods and unconditional expenditures than their blue-collar cohorts.

*Conclusion:* Policies to curb gambling activities in Malaysia can be specifically targeted at those more likely to participate and spend more in gambling (Chinese, affluent, male-headed, younger and non-white collar households).

Gambling is considered one of the favorite past times amongst Malaysians, particularly amongst the non-Muslims. Such is the penchant for gambling in Malaysia that the country ranks second worldwide in terms of lottery sales as a percentage of Gross Domestic Product (2.81%) in 1997 (Garrett 2001). This is further evidenced by the fact that the legalized gambling industry grew by more than 121% from US$1.4 billion in 1991 to US$3.1 billion in 2003. It was also estimated that between US$1.7 billion to US$4.3 billion was transferred into illegal underground betting during the same periods (Richardson, 1992; John and Chelvi, 2004). In addition, gaming tax revenues have also resulted in more than US$1.8 billion collected between 2001 and 2004 (Bernama, 2005), despite the notion that the Malaysian government does not formally endorse gambling as its official Muslim religion forbids any form of gambling activities.

Notwithstanding its considerable economic significance and accompanying public revenues, the gambling industry is also often besieged by undesirable social problems. Although no formal study has been conducted in Malaysia that enumerates its social costs, local news reports have often linked disordered gambling behavior to social problems including debt to loan sharks, embezzlement, bankruptcies, incarceration, and relationship or family breakdowns. Studies conducted overseas have also suggested gambling-related problems such as its effect on low-income individuals, alcohol abuse, depression and suicide, health and mental problems, and loss of time from work or study (NGISCR 1999; Worthington et al., 2003).

Despite its upward growth trend, tremendous economic significance, and negative social effects, an extensive review of the literature indicates that although much attention have been historically devoted to the supply side issues of gambling, such as curbing illegal gambling, forming legislative regulations, taxation, and improving enforcement effectiveness, perspectives from the demand side of gambling have remained largely neglected. Although there exists

numerous micro-level gambling studies using disaggregated cross-sectional household data in Western cultures (Breen et al., 2002; Coups et al., 1998; Farrell and Walker, 1999; Niffenegger and Muuka, 2001; Sawkins and Dickie, 2002; Stranahan and Borg 1998a, 1998b; Thalheimer and Ali, 2008; Welte et al., 2002), there is, in contrast, a dearth of econometric analyses on the demand for gambling in Malaysia.

The exception and existing study by Ramayah et al. (2002) applied the theory of reasoned action to examine respondent's belief, attitude, subjective norm, intention, and behavior towards legal and illegal numbers gambling. However, their study is limited because its relatively small sample size of 198 respondents was drawn from the state of Penang alone and, as such, may not comprehensively project the actual scenario in Malaysia. Furthermore, the study did not focus on the socio-demographic determinants influencing an individual's decision to gamble or the amount of expenditures expended when one gambles.

As such, this study attempts to bridge the gap in literature by providing a detailed econometric analysis of the role of socio-demographic factors on gambling activities (including horse racing, 4-Digit, 3-Digit, Toto, lotteries) amongst households in Malaysia. A better understanding of how socio-demographic factors influence the likelihood of participation and the amount spent on gambling may be important to policymakers to balance intervention strategies that minimize the negative impacts of problem gambling behavior while further enhancing the potential benefits of gambling activities to the economy.

**The Sample Selection Model**

As in other consumer expenditure surveys, the data we used feature zero observations in gambling expenditures. To accommodate such data feature, we use the sample selection model

(Heckman, 1979), also known as type 2 Tobit model (Amemiya, 1985 pp. 385–387). Suppressing observation subscript, the model is characterized as

$$\begin{aligned} \log y &= x'\beta + v \quad \text{if} \quad z'\alpha + u > 0 \\ y &= 0 \qquad\quad \text{if} \quad z'\alpha + u \le 0, \end{aligned} \tag{1}$$

where $y$ is the dependent variable, $x$ and $z$ are vectors of explanatory variables, $\beta$ and $\alpha$ are conformable vectors of parameters, and the error terms $u$ and $v$ are distributed as bivariate normal with zero means, standard deviations 1 and $\sigma$, and correlation $\rho$. The logarithmic transformation on the dependent variables $y$ is a variance-stabilizing transformation which helps bring the error terms in conformity with homoscedasticity and normality; it also facilitates nonlinear estimation for the current application. The standard deviation of $u$ is not identified and therefore is set at unity because the selection outcomes are observed as binary. The model can be estimated by maximizing the sample likelihood function as described in Amemiya (1985, p. 386), with an additional Jacobian of transformation term $y^{-1}$ (from $\log y$ to $y$) for the non-limit observations. The model (1) reduces to the two-part model when the errors are independent ($\rho = 0$), in which case the log-likelihood function is separable in parameters $\alpha$ and $[\beta,\sigma]'$ and therefore estimation can be broken down to a probit model (to estimate $\alpha$) using the whole sample and a linear regression of $\log y$ on $x$ (to estimate $\beta$ and $\sigma$) using only the non-limit observations.

There is continued interest in the marginal effects calculation in the sample selection model. In applications of log-transformed sample selection models, marginal effects were often calculated by differentiating the logarithm of the conditional mean of the dependent variable (e.g., Hoffman and Kassouf, 2005; Cheng and Capps, 1988). Yen and Rosinski (2008) showed that such approximation can lead to substantial errors, and derived the conditional mean of the dependent variable and marginal effect formulas for a log-transformed sample selection model as

$$\mathrm{E}(y \mid y > 0) = \exp(x'\beta + \sigma^2/2)\Phi(z'\alpha + \rho\sigma)/\Phi(z'\alpha). \tag{2}$$

Since the marginal probability of a positive observation is:

$$\Pr(y > 0) = \Phi(z'\alpha), \tag{3}$$

the unconditional mean of $y$ is

$$E(y) = \exp(x'\beta + \sigma^2/2)\Phi(z'\alpha + \rho\sigma). \tag{4}$$

Differentiating equations (2), (3) and (4) gives the marginal effects of explanatory variables (Yen and Rosinski, 2008) which can be evaluated at data points of interest, such as the sample means of explanatory variables $x$ and $z$.

## Data and Variable Definitions

### *The Survey*

The data set used in this study came from the Malaysian Household Expenditure Survey 2004/05 collected by the Department of Statistics of Malaysia. This data set is the most recent of the national household expenditure surveys. The sample was designed using a stratified multi-stage, area probability sampling method, thus ensuring that socio-economic and geographical considerations are taken into account to reflect the Malaysian population.

In the survey, respondents were asked to record their total monthly expenditures on gambling activities. In addition, socio-economic and other demographic characteristics of the respondents were also recorded. While a total of 14084 households responded to this survey, 14082 observations with complete information are available for analysis. However, since Malays are strictly forbidden by religion and culture to partake in any gambling activities, the sample used in this analysis comprises only non-Malays. As such, a final total of 6117 households were used in this analysis, which include 3200 Chinese (52.31%), 810 Indians (13.24%) and 2107 households of other races (34.44%). The numbers of households reporting gambling

expenditures during the survey period are 791 Chinese (24.72%), 113 Indians (13.95%), and 126 households of other races (5.98%). The small proportions of households participating in gambling suggest that it is important to accommodate for zero observations in the expenditure.

***The Variables***

Given the lack of domestic empirical research on the subject, the selection of variables likely to affect household decisions and expenditures on gambling relies on the previous studies by Vong (2004), Worthington et al. (2003), Sawkins and Dickie (2002); Welte et al. (2002), Breen et al. (2002), Hing and Breen (2001), Niffenegger and Muuka (2001), McNeilly and Burke (2000), Coups et al. (1998), and Stranahan and Borg (1998a, 1998b). The following socio-demographic characteristics are therefore hypothesized to influence the probability and amount of expenditures on gambling in Malaysia: (1) ethnicity/race, (2) education level, (3) occupation type, (4) location of residence, (5) household size, (6) gender of household head, (7) gross monthly household income, and (8) age of household head (Table 1).

[Table 1 about here]

Studies by Scott and Garen (1994), Stranahan and Borg (1998a, 1998b) and Welte et al. (2002) suggest that ethnicity/race be included to allow for the possibility of cultural and taste differences to influence gambling expenditures. As most of these previous studies compare Caucasians, African Americans, Hispanics, and Asians in their ethnicity/race categories, the unique racial composition in Malaysia allows a comparison of three distinct races (Chinese, Indian and others who are of native descent) and culture to influence gambling behavior. In the current study, respondents are segregated into CHINESE (base group), INDIAN, and OTHER races to

allow for the possibility of cultural, ethnic and religious differences to influence gambling participation and expenditure patterns amongst Malaysians.

Previous researchers have found education level as a mixed factor that influence gambling participation and expenditure patterns. Coups et al. (1998), Stranahan and Borg (1998a, 1998b), and Scott and Garen (1994) found that education level had a significant but negative effect on lottery play. In fact, Vong (2004) noted that higher educated households with high school or university qualifications perceive gambling in a negative manner and those professionals disagree with the notion that gambling is one of the more rapid routes to attain wealth. However, education level was found to have a positive effect on gambling, with college educated households having higher participation rates in playing lotteries (Niffenegger and Muuka, 2001). In the current study, the number of years of formal education (EDUC) possessed by the household head is used, which ranges from no formal education (zero) to tertiary education (seventeen).

Sawkins and Dickie (2002) and King (1997) considered occupation type and concluded that those who are employed rather than retired or out of the labor market are more likely to purchase, and staked more when purchasing lotteries. While Stranahan and Borg (1998a) also used occupational variables in order to proxy the amount of disposable income individuals have available for lottery play, the results obtained showed that those in the sales and professional groups are important predictors of both the probability of playing the lottery and, given play, how much the individual is spending. Based on these studies, we include occupation type in our study with a dummy variable (WHITE-COLLAR) assigned a value of 1 for white-collar workers and 0 otherwise. It is expected that this variable will contribute to both the probability and level of gambling expenditures, other things being equal.

Another variable found to influence participation decisions and amount of expenditures on gambling is regional or location differences. Presumably, urban households could have a higher tendency to gamble compared to rural households because gambling spots, such as horse racing clubs, internet gambling cafes, and lottery ticket outlets are primarily within easy access in the urban areas. Nevertheless, there is also the possibility that rural households may tend to gamble more, especially illegally, as it may be their only form of entertainment compared to the various entertainment alternatives amongst urban households. However, Scott and Garen (1994) and Clotfelter and Cook (1987) noted that location does not significantly affect lottery participation. In this study, a dummy variable is assigned a value of 1 for urban households and a value of 0 for rural households. The expected relationship between this variable and household decisions and amount of expenditures on gambling will be ascertained.

Household size, represented by the number of persons living in a household, is also included in the current study to examine its effect on the probability of participation and its magnitude of expenditures on gambling. Worthington et al. (2003) and Layton and Worthington (1999) noted that household size had a negative effect on lottery play, whereby larger size households were less likely to gamble compared to smaller size households. One possible explanation is that an increase in household size may generally induce a proportional increase in household expenditures, especially on basic necessities. Therefore, households with more family members are hypothesized to be less likely to spend on gambling, with the assumption that gambling is not a necessity. Sawkins and Dickie (2002) also suggested that the effect of marriage or cohabitation may have a negative effect on expenditure levels amongst the sub-sample of those who gamble. As such, the relationships between household size and the likelihood of gambling participation and expenditure levels are both expected to be negative in this study.

The inclusion of gender in the current model is desirable as it may reflect the different gender preferences and behaviors that could influence gambling behavior. Based on cultural norms, males tend to be risk takers and speculators, whereas females tend to be less speculative. Sawkins and Dickie (2002), Welte et al. (2002), Hira and Monson (2000), and Kitchen and Powells (1991) have shown in their studies that men gambled more frequently and in bigger amounts than women. Additionally, Hing and Breen (2001) found that while gambling expenditure was lower amongst women, the types of gambling activities preferred by females were confined to bingo and gaming machines. Jang et al. (2000) also concluded that men strongly view gambling as a form of self-enhancement or self-expression. It is therefore hypothesized that households headed by males will have a higher likelihood to gamble as well as having larger expenditures.

Total monthly household INCOME (in Ringgit Malaysia, RM) (US$1.00 = RM3.13 or RM1.00 = US$0.32 as of March 31, 2008) is considered to account for household spending patterns. The studies of Worthington et al. (2003), Niffenegger and Muuka (2001), and Coups et al. (1998) have shown that income levels had a positive influence on lottery play. In general, it can be assumed that households with higher disposable incomes have a higher tendency to gamble because they are more likely to be able to afford it. However, this assumption cannot be sustained in all cases as Eaton (2000) has shown that per capita spending on gambling decreases as income increases. Breen et al. (2002) also found that heavy gamblers comprise low-income individuals, and this group had the largest spending on poker gaming machines. Furthermore, older studies such as Livernois (1987) and Clotfelter and Cook (1987) found that income does not influence lottery expenditures in a discernible manner. Given these mixed results, the

hypothesized relationship between household income on gambling participation decisions and expenditure patterns will be further examined in the current study.

Finally, AGE of the household head and age groups denoting younger (AGE15–30), middle-age (AGE31–56) and retiree (AGE ≥ 57) households are used in the current model with the assumption that differences in age and life-cycle patterns lead to variations in preferences and expenditure patterns for gambling activities. Since younger and older individuals are assumed to have differences in lifestyles and risk perceptions, those in different age groups may have differential impacts on the likelihood to gamble or the amount of expenditure spent. For example, Worthington et al. (2003) and Sawkins and Dickie (2002) found that age had a positive and significant effect on the probability of gambling as well as gambling expenditures. A likely rationalization is that gambling may be a social activity for the older households, especially for retired households who may have more time to engage in leisure activities. On the other hand, other studies have found that gambling participation rate declines with age (Welte et al. 2002; Breen, Hing and Weeks, 2002; Niffenegger and Muuka, 2001; Scott and Garen, 1994). Presumably, younger adults may have a more risk seeking attitude compared to older individuals. As such, younger individuals are more likely to participate in gambling activities to feed their needs for fun and excitement. Vong (2004) specifically noted that households between 26-45 years old with stable earnings and disposable income tend to gamble more as they consider gambling as a form of entertainment. Therefore, the respective relationships between the different age groups and household expenditures on gambling could yet be either positive or negative in the current study.

*Characteristics of Survey Respondents*

Descriptive statistics in the statistical model are briefly presented in Table 1, while a more comprehensive discussion can be obtained upon request. The average household expenditures on gaming amount to RM15.42 for the overall sample compared to RM91.56 amongst participating households. Within the entire sample, the average education attainment of the household head is slightly more than 8 years of formal education (at least high school education) and the average household size is 4.

In terms of ethnicity, 52% of the total samples are Chinese, with about 13% Indians and 34% of other races. It is acknowledged that this racial composition overstates the actual ethnic composition of the Malaysian population, whereby Malays (57%), Chinese (23%), and Indian (6%) form the main ethnic groups, while about 15% are dispersed amongst those of various other races. Meanwhile, it is noteworthy that a relatively large proportion of Malaysian Chinese households (24.72%) gamble compared to Indians (13.95%) and those of other races (5.98%). However, this phenomenon is not surprising considering the well-documented high rates of gambling attributed to ethnic Chinese worldwide, especially among males, in anecdotal accounts and empirical reports (Clark, King and Laylim, 1990; Fisher, 2000; Raylu and Oei, 2004; Papineau, 2005).

With 26% of the total sample classified as having white-collar occupations, these households have an average monthly income of about RM3,065. About 79% of the sample resides in urban areas, with 84% being headed by male household heads. The average age of the household head is about 47 years. About 12% of the samples are in the younger age group between 15–30 years old; 65% in the middle age group between 31–56 years old; and 23% are retirees in the 57 years and above age group (Table 1).

**Estimation Results**

The model was estimated by the method of maximum likelihood (ML) described above. According to ML results for all samples (Table 2), the error correlation coefficients ($\rho$) are all significant at the 1% level of significance. Statistical insignificance of the error correlation would have suggested lack of endogenous sample selectivity and use of the two-part model discussed above.

Our empirical strategy includes first testing for the appropriateness of the use of a pooled sample versus stratified samples by ethnicity. Denote the maximum log-likelihoods for the Chinese, Indian, Others and pooled samples as $\log L_C$, $\log L_I$, $\log L_O$ and $\log L_P$, with corresponding numbers of parameters $k_c$, $k_i$, $k_o$ and $k_p$, respectively. Then the test statistic $\mathrm{LR} = 2(\log L_C + \log L_I + \log L_O - \log L_P)$ is $\chi^2$-distributed with $k_c + k_i + k_o - k_p$ degrees of freedom (df). From the separate- and pooled sample ML results (Tables 2 & 3), the hypothesis of equal parameters across ethnic groups is rejected (LR = 84.75, df = 40, $p$-value < 0.00005), suggesting possible analysis by segmented samples. One other empirical issue in the estimation was the choice of regressors. As in other sample selection models, use of exclusion conditions can be useful in identifying the model parameters. While there is no a priori exclusion conditions for the current sample, our empirical approach is to use an age variable and its square (to capture the nonlinear relationship between age and gambling probability) in the selection equation and two age category variables in the level equation. Use of such different sets of variables in the two equations guarantees that the model identification conditions are met.

[Tables 2 & 3 about here]

With the separate equations to accommodate sample selection and level, and with the logarithmic transformation in the dependent variable, the effects of explanatory variables on the

probability and level of expenditures are non-trivial. To further explore the effects of explanatory variables, we calculate the marginal effects of these variables according to the procedure discussed above (by differentiating Equations (2), (3) and (4)). The results are presented in Table 4 for the pooled sample and Table 5 for the stratified sample by ethnicity. The effects of binary explanatory variables on the probability (2), conditional level (3) and unconditional level (4) are evaluated by simulating a finite change (e.g., from 0 to 1) in each variable, *ceteris paribus*. For statistical inference, standard errors of all marginal effects are calculated using the delta method (Greene, 2007).

[Tables 4 & 5 about here]

***Pooled Sample***

The marginal effects from the pooled sample indicate that education levels are statistically significant and negatively associated with the probability of gambling as an additional year of education possessed by the household head decreases the probability of gaming by 0.6% (Table 4). Conforming to the findings of Scott and Garen (1994), Coups et al. (1998), Stranahan and Borg (1998a, 1998b) and Vong (2004), this implies that schooling has a significant impact in reducing the likelihood of gambling amongst households in Malaysia.

The results based on the marginal effects from the pooled sample also indicate that income is statistically significant and the probability of gambling increases by 2.9% for each additional RM1000 increase in household income. In addition, the probability of participating in gambling activities decreases by 0.8% for every additional family member in the household.

Indian households and those of other races are 11.0% and 19.4%, respectively, less likely to gamble compared to Chinese. Furthermore, households with white-collar occupations are 5.2% less likely to partake in gambling vices compared to their blue-collar counterparts; urban

households have a 2.8% higher probability of spending on gambling compared to their rural counterparts; and the probability of wagering is 9.6% higher for households headed by males compared to those with female household heads.

While education is not statistically significant on the expenditures of current gamblers, its impact is evident on the unconditional levels of gambling as an additional year of education significantly decreases unconditional expenditure level by RM0.57. A RM1000 increase in income increases the conditional level of spending by RM16.24 and the unconditional level by RM4.16. An additional member in the family decreases unconditional gambling expenditure by RM0.49.

In addition, each 10-year increase in age of the household head initiates increases in conditional and unconditional expenditure levels by RM12.33 and RM3.72, respectively. This coincides with the findings of Sawkins and Dickie (2002) and Worthington et al. (2003) that older households are spending more on gambling expenditures compared to their younger counterparts.

Amongst those who wager, Indian households spend RM38.03 less while those of other races spend RM54.52 less compared to Chinese households. Overall, in terms of unconditional expenditures, Indian and those of other races spend RM17.05 and RM23.62 less respectively than Chinese households. Contrary to *a priori* expectations, white-collar households spend about RM4.00 less in unconditional gambling expenditures than their blue-collar cohorts. However, being in an urban area decreases gambling expenditures amongst existing gamblers by RM25.86, Finally, households headed by males have higher conditional (RM18.71) and unconditional (RM9.08) gambling expenditures compared to those led by females. It is interesting to note that age does not have any statistically significant impact on expenditure levels of gambling.

***By Ethnic Groups***

To further examine the marginal effects of the explanatory variables on household gambling expenditures, the sample is segregated into the three other ethnic groups in Malaysia (Chinese, Indian, Others) besides the Malay majority. However, the negative impact of education on the probability (1.1%) and both conditional (RM3.12) and unconditional levels (RM1.75) of gambling is only evident for Chinese households. Except for a minor effect of lowering the probability (0.2%) of gambling within those of other races, the impact of education is not statistically significant (Table 5).

The marginal effects of income by ethnic groups indicate that income is statistically significant and positively associated with the probability of gambling for all races. However, the magnitude is fairly small, with each additional RM1000 in household income increasing the probability of gambling by 3.9%, 2.4% and 2.5% amongst Chinese, Indian and other race households, respectively. The results also show that based on ethnic considerations, age is directly related to the probability of gambling only amongst Chinese households, with each additional 10 years increasing its likelihood to gamble by 7.1%. Having a white-collar occupation lowers the probability of punting amongst Chinese (7.0%), and Indian (9.5%) ethnic households. Residing in an urban locality significantly lowers the probability of gambling for only those of other races (4.6%) compared to their rural counterparts. Meanwhile, Chinese (13.1%), Indian (11.7%) and other race (3.9%) households led by males are more likely to gamble than those with female household heads.

The results also suggest that amongst households with gambling expenses, an increase of RM1000 in income leads to statistically significant and higher expenditure levels for other race households (RM16.63) compared to those of Chinese (RM21.56) descent. Income levels are also

statistically significant in determining unconditional levels of gambling by Chinese (RM8.79), Indian (RM2.07) and other (RM1.51) race households. For every 10-year increase in the age of the household head, Chinese households increase their conditional (RM32.09) and unconditional (RM14.33) expenditures accordingly.

White-collar workers have lower unconditional levels of expenditures than blue-collar workers among Chinese (RM7.67) and other Indian (RM6.01) households. Amongst gamblers, urban Chinese have lower levels of expenditures (RM43.67) compared to their rural counterparts. On the other hand, urban Chinese (RM15.70) have lower unconditional gambling expenditures while those of other races (RM1.21) have higher unconditional expenditures compared to their rural cohorts. Within the sample of gamblers, Indians (RM37.19) and other race (RM20.04) households with male heads spend more on gambling compared to those with female household heads. Overall, in contrast to a female-headed household, having a male household head increases the level of gambling expenditures of Chinese (RM17.03), Indian (RM9.93) and other race (RM2.25) households.

Finally, although households of other races in the younger age group (between 15–30 years) have lower conditional (RM18.51) and unconditional (RM1.13) levels of wagering expenditures, retired households of other races have higher conditional (RM80.47) and unconditional (RM4.90) levels of gambling expenditures compared to their middle-age (between 31–56 years) counterparts.

## Concluding Remarks

Although previous studies on the demand for gambling exist, no other study has evaluated the socio-demographic factors influencing gambling participation and expenditure

decisions in Malaysia. Using Heckman's sample selection model to address the statistical issue of zero observations in expenditures, our results suggest that while education has a significant impact in reducing the likelihood of gambling and levels of expenditures amongst Chinese households in Malaysia, its effect is not as evident for Indians and those of other races. Specifically, while an additional year of education decreases the probability of gambling of a Chinese household by about 1.1%, its effect is only 0.2% for those of other races and not statistically significant for those of Indian descent. The results of the study also imply that income has a statistically significant role in increasing the probability and expenditure levels of gambling amongst all races considered in the study. Even though age is statistically significant in spurring the likelihood to gamble and the amount of expenditures spent amongst Chinese households, its effect is non-extant for Indians and those of other races. Further, a white-collar occupation significantly lowers the probability and unconditional effects on gambling for Chinese and Indian ethnic groups. Finally, households headed by males are more likely to gamble and spend significantly more compared to those managed by females.

Since gambling has been identified as one of the main sources of social problems in Malaysia, the findings in our study can be used as a guide in designing public policies or programs aimed at problematic gamblers in Malaysia. First, the government authorities could target intervention initiatives toward those found specifically to be more vulnerable to gambling activities, such as those of Chinese ethnicity, younger age groups, more affluent, non-white collar occupations and households headed by males. Second, although educational programs to deter problem gambling may have limited effects on Indian and other groups, the focus on Chinese gamblers should be toward the less educated. For instance, warnings regarding the dangers and risks of gambling, as well as the odds where feasible, could be mandatorily posted in

(although not limited to) Chinese language at prominent locations in all gambling facilities. Third, as gambling expenditures increase in tandem with income of gamblers across all races, further increases in excise taxes could be a justifiable public policy to discourage participation as well as to raise tax revenues. Such monies could be channeled towards the creation of a fund for the development and support of specific problem gambling research or treatment programs.

Our study represents one of the first attempts at definitively and econometrically determining the socio-demographic factors affecting the likelihood of and expenditures on gambling among Malaysian households. With data availability, future studies should replicate our analysis using individual-level gambling expenditure or consumption data and also with longitudinal panel data to assess the robustness of our findings. While not the focus of the current study, longitudinal studies can also focus on analyzing and assessing the effectiveness of anti-gambling laws that have been implemented in Malaysia as well as the specific externalities that would further justify making gambling a public welfare and policy issue.

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TABLE 1

Variable Definitions and Sample Statistics: Segmented Samples by Ethnic Groups and Pooled Sample

| Variables | Definitions | Sample Means | | | |
|---|---|---|---|---|---|
| | | Chinese | Indian | Others | Pooled |
| EXPENDITURE | Household (HH) gambling expenditure (RM/mth) (dependent variable) | 25.66 | 7.57 | 2.88 | 15.42 |
| | | (87.30) | (30.12) | (22.60) | (66.33) |
| | Participating HH ($n$ = 1,030) | 103.80 | 54.27 | 48.15 | 91.56 |
| | | (150.79) | (63.22) | (80.07) | (138.45) |
| *Continuous Explanatory Variables* | | | | | |
| EDUC | Years of formal education of HH head | 8.61 | 8.78 | 6.94 | 8.06 |
| | | (4.74) | (4.64) | (4.89) | (4.85) |
| INCOME $\times 10^{-3}$ | Gross monthly HH income (in RM) | 3681.30 | 3059.91 | 2132.82 | 3065.65 |
| | | (3167.8) | (2547.0) | (2683.1) | (3014.0) |
| HH SIZE | Total number of family members in HH | 3.95 | 4.32 | 4.35 | 4.14 |
| | | (1.99) | (2.06) | (2.44) | (2.17) |
| AGE ÷ 10 | Age of HH head (in years) | 49.99 | 47.32 | 41.30 | 46.64 |
| | | (13.53) | (13.23) | (13.10) | (13.92) |
| *Binary Explanatory Variables (yes = 1; no = 0)* | | | | | |
| WHITE-COLLAR | HH head is a white-collar worker | 0.31 | 0.26 | 0.17 | 0.26 |
| | | (0.46) | (0.44) | (0.37) | (0.44) |
| URBAN | HH resides in an urban area | 0.87 | 0.81 | 0.65 | 0.79 |
| | | (0.34) | (0.39) | (0.48) | (0.41) |
| MALE | HH head is male | 0.85 | 0.83 | 0.82 | 0.84 |
| | | (0.36) | (0.37) | (0.38) | (0.37) |
| AGE 15–30 | HH head between 15–30 yrs. old | 0.07 | 0.09 | 0.22 | 0.12 |
| | | (0.25) | (0.28) | (0.41) | (0.33) |
| AGE 31–56 | HH head between 31–56 yrs. old (reference) | 0.63 | 0.68 | 0.65 | 0.65 |
| | | (0.48) | (0.47) | (0.48) | (0.48) |
| AGE ≥ 57 | HH head is ≥ 57 years old | 0.30 | 0.23 | 0.13 | 0.23 |
| | | (0.46) | (0.42) | (0.34) | (0.42) |

Source: Compiled from Malaysian Household Expenditure Survey 2004/05 (Department of Statistics Malaysia, 2005).

* Standard deviations in parentheses

TABLE 2

ML Estimation of Sample Selection Model: Pooled Sample

| Variable | Selection | Level |
|---|---|---|
| CONSTANT | –1.208*** | 5.901*** |
| | (0.212) | (0.445) |
| INDIAN | –0.386*** | 0.068 |
| | (0.060) | (0.156) |
| OTHER | –0.847*** | 0.430** |
| | (0.057) | (0.218) |
| EDUC | –0.028*** | 0.023 |
| | (0.005) | (0.015) |
| WHITE-COLLAR | –0.221*** | 0.299** |
| | (0.055) | (0.132) |
| INCOME $\times 10^{-3}$ | 0.128*** | 0.072 |
| | (0.024) | (0.065) |
| INCOME$^2 \times 10^{-6}$ | –0.006*** | –0.001 |
| | (0.002) | (0.004) |
| URBAN | 0.115** | –0.478*** |
| | (0.056) | (0.130) |
| HH SIZE | –0.034*** | 0.048* |
| | (0.011) | (0.029) |
| MALE | 0.452*** | –0.365** |
| | (0.063) | (0.186) |
| AGE ÷ 10 | 0.136 | |
| | (0.085) | |
| AGE$^2$ ÷ 100 | –0.020** | |
| | (0.009) | |
| AGE15–30 | | –0.148 |
| | | (0.153) |
| AGE ≥ 57 | | 0.159 |
| | | (0.107) |
| $\sigma$ | | 1.892*** |
| | | (0.159) |
| $\rho$ | –0.856*** | |
| | (0.051) | |
| Log likelihood | –8054.442 | |

Note: Robust standard errors in parentheses. Levels of significance: *** = 1%, ** = 5%, * = 10%.

TABLE 3

ML Estimation of Sample Selection Model by Ethnic Groups

| | Chinese | | Indian | | Others | |
|---|---|---|---|---|---|---|
| Variable | Selection | Level | Selection | Level | Selection | Level |
| CONSTANT | –1.195*** | 6.016*** | –2.254*** | 4.894*** | –1.955*** | 7.083 |
| | (0.273) | (0.491) | (0.691) | (1.224) | (0.422) | (4.556) |
| EDUC | –0.034*** | 0.019 | –0.019 | 0.063* | –0.019* | 0.060 |
| | (0.007) | (0.018) | (0.016) | (0.034) | (0.011) | (0.039) |
| WHITE-COLLAR | –0.215*** | 0.320** | –0.441*** | 0.432 | –0.055 | 0.032 |
| | (0.064) | (0.151) | (0.165) | (0.395) | (0.130) | (0.366) |
| INCOME $\times 10^{-3}$ | 0.124*** | 0.043 | 0.119* | 0.018 | 0.253*** | 0.119 |
| | (0.026) | (0.077) | (0.070) | (0.176) | (0.058) | (0.239) |
| INCOME$^2 \times 10^{-6}$ | –0.005** | 0.000 | –0.007 | –0.002 | –0.019*** | 0.001 |
| | (0.002) | (0.005) | (0.006) | (0.013) | (0.005) | (0.024) |
| URBAN | –0.077 | –0.234 | 0.202 | –0.471 | 0.421*** | –0.995 |
| | (0.073) | (0.162) | (0.159) | (0.330) | (0.113) | (0.606) |
| HH SIZE | –0.046** | 0.082 | –0.023 | 0.059 | –0.019 | –0.052 |
| | (0.015) | (0.034) | (0.032) | (0.070) | (0.021) | (0.072) |
| MALE | 0.438*** | –0.524*** | 0.604*** | 0.109 | 0.398*** | –0.034 |
| | (0.076) | (0.201) | (0.195) | (0.607) | (0.151) | (0.924) |
| AGE ÷ 10 | 0.227** | | 0.399 | | –0.116 | |
| | (0.105) | | (0.264) | | (0.215) | |
| AGE$^2$ ÷ 100 | –0.027*** | | –0.055* | | 0.003 | |
| | (0.010) | | (0.027) | | (0.025) | |
| AGE 15–30 | | 0.174 | | –0.364 | | –0.691 |
| | | (0.207) | | (0.337) | | (0.483) |
| AGE ≥ 57 | | 0.043 | | 0.673* | | 1.154*** |
| | | (0.119) | | (0.395) | | (0.388) |
| σ | | 2.000*** | | 1.662*** | | 2.072 |
| | | (0.193) | | (0.352) | | (1.335) |
| ρ | –0.887*** | | –0.856*** | | –0.920*** | |
| | (0.052) | | (0.116) | | (0.213) | |
| Log likelihood | –6123.249 | | –864.161 | | –1024.660 | |

Note: Robust standard errors in parentheses. Levels of significance: *** = 1%, ** = 5%, * = 10%.

TABLE 4

Marginal Effects of Explanatory Variables: Pooled Sample

| Variable | Probability | Cond. level | Uncond. level |
|---|---|---|---|
| | | Continuous Explanatory Variables | |
| EDUC | –0.006*** | –1.105 | –0.568*** |
| | (0.001) | (0.739) | (0.133) |
| INCOME × $10^{-3}$ | 0.029*** | 16.244*** | 4.163*** |
| | (0.005) | (3.817) | (0.740) |
| HH SIZE | –0.008*** | 0.019 | –0.487* |
| | (0.003) | (1.548) | (0.274) |
| AGE ÷10 | (0.031) | 12.330* | 3.720* |
| | (0.019) | (7.568) | (2.291) |
| | | Binary Explanatory Variables | |
| INDIAN | –0.110*** | –38.026*** | –17.045*** |
| | (0.015) | (8.347) | (2.154) |
| OTHER | –0.194*** | –54.522*** | –23.621*** |
| | (0.011) | (7.680) | (1.958) |
| WHITE-COLLAR | –0.052*** | –0.951 | –3.997** |
| | (0.012) | (7.870) | (1.562) |
| URBAN | 0.028** | –25.860** | –1.795 |
| | (0.013) | (9.815) | (1.886) |
| MALE | 0.096*** | 18.713** | 9.082*** |
| | (0.011) | (8.297) | (1.253) |
| AGE 15–30 | | –10.049 | –1.659 |
| | | (9.775) | (1.603) |
| AGE ≥ 57 | | 12.594 | 2.079 |
| | | (8.904) | (1.479) |

Note: Asymptotic standard errors in parentheses. Levels of significance: *** = 1%, ** = 5%, * = 10%.

TABLE 5

Marginal Effects of Explanatory Variables by Ethnic Groups

| Variable | Chinese | | | Indian | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|
| | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level |
| | | | | Continuous Explanatory Variables | | | | | |
| EDUC | –0.011*** | –3.120** | –1.750*** | –0.004 | 1.824 | 0.048 | –0.002* | 0.797 | –0.019 |
| | (0.002) | (1.244) | (0.369) | (0.003) | (1.443) | (0.246) | (0.001) | (1.226) | (0.056) |
| INCOME × $10^{-3}$ | 0.039*** | 21.557*** | 8.791*** | 0.024* | 7.634 | 2.071* | 0.025*** | 16.626* | 1.512*** |
| | (0.008) | (6.073) | (1.834) | (0.014) | (7.314) | (1.192) | (0.005) | (8.508) | (0.369) |
| HH SIZE | –0.014*** | 1.161 | –1.069 | –0.005 | 1.411 | –0.038 | –0.002 | –2.496 | –0.170* |
| | (0.005) | (2.623) | (0.781) | (0.007) | (2.482) | (0.414) | (0.002) | (1.714) | (0.100) |
| AGE ÷ 10 | 0.071** | 32.085** | 14.328** | 0.082 | 22.828 | 6.591 | –0.011 | –5.994 | –0.617 |
| | (0.033) | (14.802) | (6.513) | (0.053) | (14.652) | (4.109) | (0.021) | (14.084) | (1.227) |
| | | | | Discrete Explanatory Variables | | | | | |
| WHITE-COLLAR | –0.070*** | –0.220 | –7.669* | –0.095*** | –6.183 | –6.009** | –0.006 | –2.306 | –0.370 |
| | (0.020) | (12.809) | (4.172) | (0.033) | (14.335) | (2.678) | (0.015) | (10.564) | (0.824) |
| URBAN | –0.026 | –43.665** | –15.696** | 0.045 | –13.355 | 0.823 | 0.046*** | –10.239 | 1.211* |
| | (0.025) | (17.958) | (6.618) | (0.033) | (17.510) | (3.145) | (0.011) | (12.445) | (0.666) |
| MALE | 0.131*** | 14.495 | 17.027*** | 0.117*** | 37.194** | 9.934*** | 0.039*** | 20.039* | 2.247*** |
| | (0.020) | (14.652) | (3.548) | (0.030) | (14.457) | (2.381) | (0.012) | (10.462) | (0.704) |
| AGE 15–30 | | 20.343 | 5.574 | | –15.068 | –2.357 | | –18.510* | –1.126* |
| | | (26.202) | (7.227) | | (12.003) | (1.837) | | (10.586) | (0.622) |
| AGE ≥ 57 | | 4.670 | 1.280 | | 47.423 | 7.417 | | 80.469* | 4.897* |
| | | (13.120) | (3.599) | | (36.081) | (5.656) | | (40.586) | (2.696) |

Note: Robust standard errors in parentheses. Levels of significance: *** = 1%, ** = 5%, * = 10%.

# The demand for vices in Malaysia: An ethnic comparison using household expenditure data

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Running Title: Demand for vices in Malaysia

**Abstract**

A trivariate Tobit system is estimated to investigate the demand for vices (tobacco, alcohol and gambling) in Malaysia. Estimation results, segmented by ethnicity, suggest that education level, occupation type, and age of household head negatively affects the likelihood to spend as well as amounts spent on tobacco by all Malaysians. In addition, while higher income Malay households are more likely to spend and have higher tobacco expenditures, affluent Chinese and households of other races are more likely to spend and also spend more on smoking, drinking and gambling. Male-headed households of all races are more likely to spend and also spend more on smoking, drinking and gambling than female-led households.

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## I. Introduction

Recent statistics in Malaysia suggest that different types of vices are flourishing. For instance, there are currently about 3.1 million smokers aged 25-64 years, with a prevalence rate of 25.5%. In ethnic terms, 26.6% of Malays aged between 25-64 years are current smokers, followed by 21.2% Chinese, 16.2% Indian, 33.0% other Bumiputera (indigenous), and 22.7% other races. Although male smokers (46.5%) largely outnumber female smokers (3.0%) on the whole, 49.7% Malay men are current smokers, ensued by 35.4% Chinese men, 35.4% Indian men, 51.0% other Bumiputera men, and 47.0% of men of other races. These figures translate to one in every two males and one in every thirty-three females who light up an average of 14 cigarettes per day nationwide (NCD, 2006).

On the other hand, the latest figures of alcohol consumption in Malaysia indicate a prevalence rate of 12.2%, with about 1.5 million current drinkers aged 25-64 years. Ethnically, while only 0.4% of Malays between 25-64 years are current drinkers, 24.2% Chinese, 21.1% Indian, 37.6% other Bumiputera, and 8.3% of those from other races are current drinkers (NCD, 2006). In addition, although only 0.8% of Malay men between 25-64 years are current drinkers, 38.4% Chinese men, 44.44% Indian men, 55.3% other Bumiputera, and 47.0% of men of other races consume alcohol (NCD, 2006). While total per capita alcohol consumption by adults (age 15+) is about 1.06 liters in 2003, this signifies a 34% increase in volume from the previous decade. In catering to this demand, alcohol beverage sales increased steadily by about 27% from US$176 million in 2000 to US$223 million in 2004 (WHO, 2004). The alcohol industry growth is further evidenced by its total asset investments of US$315 million, while contributing to the Malaysian economy via direct annual employment costs (US$29 million), employment of over

500,000 people directly and indirectly, advertising and promotion (US$57 million) and packaging (US$14 million) (Confederation of Malaysian Breweries Berhad, 2007).

Unlike smoking and drinking, there exists little data to link the growth of the gambling industry in Malaysia to any specific ethnic groups. Nonetheless, causal evidence point to the contribution by the non-Malay communities given that Malays in Malaysia, by virtue of being Muslims, are strictly forbidden to consume alcohol or partake in any form of gambling activities. However, such is the penchant for gambling by the non-Malay communities that the country ranks second worldwide in terms of lottery sales as a percentage of gross domestic product (2.81%) in 1997 (Garrett, 2001). This is further evidenced by the fact that the Malaysian legalized gambling industry grew by more than 121% from US$1.4 billion in 1991 to US$3.1 billion in 2003, while about US$1.7 billion to US$4.3 billion was transferred into illegal underground betting during the same period (Richardson, 1992; John and Chelvi, 2004). In addition, gaming tax revenues amounted to more than US$1.8 billion between 2001 and 2004 (Bernama, 2005).

Despite the growing significance of these vices, a careful scrutiny of certain aspects of the Malaysian tobacco, alcohol, and gambling industries in Malaysia has largely been neglected. While an extensive literature review shows a number of micro-level demand studies of such industries in Western cultures using disaggregated cross-sectional consumption data on tobacco (Nayga, 1999; Ross and Chaloupka, 2004; Yen, 2005a, 2005b), alcohol (Atkinson *et al.*, 1990; Blaylock and Blisard, 1993; Yen, 1994) and gambling activities (Dorsett, 1999; Garrett, 2001; Sawkins and Dickie, 2002; Welte *et al.* 2002), there exists, in contrast, little research on the demand for these vices in Malaysia.

As such, this study attempts to fill this research gap by using available household expenditure survey data to quantitatively examine the role of ethnicity on participation decisions and the amount of money spent on tobacco (cigarettes, cigars, and other tobacco related items), alcohol (hard liquor, beer, wine, toddy) and gambling (horse racing, lotteries, numbers forecasting) amongst households in Malaysia. Given the unique co-existence of three distinct races amongst Malaysia's multi-ethnic population (i.e., Malay, Chinese, Indian and a proportion consisting those of various other races), the role of ethnicity is highlighted with the premise that different racial groups may exhibit differences in the demand for each of the vices. Understanding how such socio-demographic factors influence the likelihood of purchasing and the amount spent on these vice related products, while focusing on ethnicity differences, is important to policymakers interested in identifying household characteristics that influence the demand for such products in Malaysia. This may, in turn, be relevant towards designing effective prevention and cessation programs towards specific target groups in Malaysia.

## II. Econometric Specification

To motivate the econometric specification, consider an individual's choice set $q$ with prices $p$, both $n$-vectors. Also let $c$ be a vector of personal characteristics. Optimal levels of $q$ are determined by solving the constrained utility maximization problem

$$\max_{q} \{U(q,c) | p'q = m\} \tag{1}$$

where $m$ is income. Assuming the utility function $U(q,c)$ is continuous, increasing, and quasi-concave in $q$, optimal levels of quantities can be expressed as a function of prices, income and personal characteristics $h_i(p,m,c)$. In practice, the levels of consumption are also subject to

nonnegativity constraints, and therefore the amount consumed of each good can be either zero or positive, that is,

$$q_i = \max\{0, h_i(p,m,c)\}, i = 1,...,n \tag{2}$$

With a single cross section, prices are assumed constant and are therefore absorbed into the constant term. Using a vector $x$ to represent explanatory variables, a linear function to approximate the deterministic demand function, and a random error $u_i$ to capture the unobservable for each equation, we consider a trivariate system of censored equations (Amemiya, 1974)

$$q_i = \max\{0, x'\beta_i + u_i\}, i = 1,2,3 \tag{3}$$

where $\beta_i$ $(i = 1,2,3)$ are vectors of parameters and random error vector $u = [u_1, u_2, u_3]' \sim N(0, \Sigma)$, that is, $u$ is assumed to be distributed as trivariate normal with zero means and covariance matrix

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \rho_{12}\sigma_1\sigma_2 & \rho_{13}\sigma_1\sigma_3 \\ \rho_{21}\sigma_2\sigma_1 & \sigma_2^2 & \rho_{23}\sigma_2\sigma_3 \\ \rho_{31}\sigma_3\sigma_1 & \rho_{32}\sigma_3\sigma_2 & \sigma_3^2 \end{bmatrix} \tag{4}$$

where $\sigma_i$ are standard deviations and $\rho_{ij}$ are correlations among $u_i$. The censored system (3) amounts to the simultaneous-equations model of Amemiya (1974) which, when prices are constant as in the current application, is identical to the utility-theoretic Kuhn-Tucker model of Wales and Woodland (cf. Ransom, 1987, p. 357). To describe the maximum-likelihood (ML) estimation procedure, denote the joint probability density function (pdf) of $u$ as $f(u_1, u_2, u_3; \Sigma)$. Then, the likelihood function depends on the outcome (i.e., positive or negative for each good) of each sample observation. For an observation with all goods positive, the likelihood contribution is simply the pdf

$$L_c = f(q_1 - x'\beta_1, q_2 - x'\beta_2, q_3 - x'\beta_3; \Sigma) \tag{5}$$

For the other extreme, with all goods zeros, the likelihood contribution is the normal probability integral

$$L_c = \int_{-\infty}^{-x'\beta_1} \int_{-\infty}^{-x'\beta_2} \int_{-\infty}^{-x'\beta_3} f(u_1, u_2, u_3; \Sigma)\, du_1 du_2 du_3 \tag{6}$$

which, after standardization, reduces to the trivariate standard normal cdf. When the system is only partially censored, when goods 1 and 2 are zeros for instance, the likelihood contribution is

$$L_c = \int_{-\infty}^{-x'\beta_1} \int_{-\infty}^{-x'\beta_2} f(u_1, u_2, u_3; \Sigma)\, du_1 du_2 \tag{7}$$

which, by following the partial integration procedure (e.g., Pudney, 1989, pp. 327–328), simplifies to a bivariate standard normal cdf. The likelihood contributions for other partially censored sample regimes, with one or two zeros, is similar to Equation (7). The sample likelihood function is the product of likelihood contributions (5), (6) or (7) across the sample. The unknown parameters are $\beta_i$, $\sigma_i$, and $\rho_{ij}$.

As in other limited dependent variable models, the effects of explanatory variables can be explored by calculating its marginal effects. The probability of a positive observation for $y_i$ is

$$\Pr(y_i > 0) = \Pr(u_i > -x'\beta_i) = \Phi(x'\beta_i / \sigma_i) \tag{8}$$

and the conditional mean of $y_i$ is

$$E(y_i \mid y_i > 0) = x'\beta_i + E(u_i \mid u_i > -x'\beta_i) = x'\beta_i + \sigma_i \phi(x'\beta_i / \sigma_i) / \Phi(x'\beta_i / \sigma_i) \tag{9}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are univariate standard normal pdf and cdf, respectively. Using (8) and (9), the unconditional mean of $y_i$ is

$$E(y_i \mid y_i > 0) = \Phi(x'\beta_i / \sigma_i) x'\beta_i + \sigma_i \phi(x'\beta_i / \sigma_i) \tag{10}$$

Marginal effects of each explanatory variable, say $x_j$, are calculated by differentiating (and differencing, in the case of a discrete variable) (8), (9) and (10) for $i = 1,2,3$. For statistical inferences, standard errors of marginal effects are calculated by the delta method (Greene, 2007).

## III. Data

The data set used in this study is the Malaysian Household Expenditure Survey 2004/05 (MHES) collected by the Department of Statistics of Malaysia. This data set is the most recent of the national household expenditure surveys. The sample was designed using a stratified multi-stage, area probability sampling method, thus ensuring that socio-economic and geographical considerations are taken into account to reflect the Malaysian population.

In the survey, respondents were asked to record their total monthly expenditures on tobacco products, alcohol consumption and gambling activities. Socio-economic and other demographic characteristics of the respondents were also recorded (Table 1). A total of 14084 households responded to this survey, and a final sample of 14082 observations with complete information is used for the analysis. From this sample, 5291 (37.57%), 1108 (7.87%), and 1050 (7.46%) households reported tobacco, alcohol, and gambling expenditures, respectively, during the survey period.

Descriptive statistics of the variables in the statistical model are presented in Table 1.[1] For the whole sample, the average household expenditures on tobacco, alcohol, and gambling amount to RM27.84, RM7.17, and RM6.77, respectively.[2] In comparison, amongst the

1 A more comprehensive discussion of the characteristics of survey respondents can be obtained from the authors upon request.

2 As of January 2008, the exchange rate was approximately US$1 = RM3.34.

consuming households, average household expenditures for tobacco, alcohol, and gambling are RM74.09, RM91.13, and RM90.78, respectively. For the entire sample, the average education attainment of the household head is slightly more than 8 years of formal education (at least high school education) and the average household size is about 4 family members. Gross monthly household income (in RM) is RM2,732 while average age of the household head is about 47 years. The ethnic composition of the sample reflects the population of Malaysia, whereby Malays (57%), Chinese (23%), and Indians (6%) form the main ethnic groups, and about 15% are from various other races. Households with white-collar occupations form 25% of the total sample. About 67% of the sample reside in urban areas and 84% are headed by male household heads.

Table 2 presents the breakdown of purchasing/participating households and average monthly household expenditures of the vices by ethnic group. Among the Malays, about 40% reported expenditures on tobacco but only less than 1% purchased alcohol or gambled. A greater percentage of individuals in the Chinese and Indian groups spent on alcohol and gamble. Specifically, close to a quarter of the households in the Chinese ethnic group either purchased alcohol or participated in gambling. About 16% and 14% of the households in the Indian ethnic group either spent on alcohol or participated in gambling. Compared to Malays, significantly lower percentages of Chinese (28%) and Indian (34%) households purchased tobacco. The percentage of households from other races who spend on tobacco is also high at 45%. In summary, a greater percentage of the Malay households spent on tobacco compared to those in the Chinese and Indian ethnic groups but a greater percentage of the Chinese and Indian groups reported expenditures on alcohol and participated in gambling than those in the Malay ethnic group.

It is also interesting to note that while a higher percentage of Malay households use tobacco, the average monthly household tobacco expenditures of Chinese smokers are significantly higher (RM97.57) compared to Malay smokers (RM71.94). Similarly, although a smaller percentage of Indian households utilize tobacco, their average monthly household tobacco expenditures (RM70.44) is about the same as those of Malay households. Among alcohol purchasing households, average monthly expenditures are highest among Chinese (RM94.09) and those of other race (RM100.60). Average monthly gambling expenses of participating Chinese (RM103.80) are almost double the amount spent by Malay (RM50.77), Indian (RM54.27), and other (RM48.15) households (Table 2).

## IV. Results

Since the numbers of Malays engaged in alcohol consumption and gambling activities are nearly zeros, a censored system could not be estimated and therefore only the tobacco expenditure equation was estimated. For the other ethnic groups, the censored equation systems were estimated, by maximizing the likelihood function described above. To explore differences in consuming behavior, we test for equality of parameters across ethnic groups, by following a procedure similar to the Chow test in linear regression. Denote the maximum log-likelihoods for the Chinese, Indian, other race, and pooled sample as $\log L_1, \log L_2, \log L_3$ and $\log L_p$, and corresponding numbers of parameters as $k_1$, $k_2$, $k_3$, and $k_p$. Then the test statistic $LR = 2(\log L_1 + \log L_2 + \log L_3 - \log L_p)$ is $\chi^2$-distributed with $k_1 + k_2 + k_3 - k_p$ degrees of freedom (df). Based on the pooled and segmented sample results, the hypothesis of equal parameters was rejected (LR = 736.44, df = 72, $p$-value $< 1.0 \times 10^{-10}$), suggesting separate estimation of the censored system for the Chinese, Indian, and other race. Further, all error

correlations are statistically significant for all samples, justifying estimation of the equations in a system. ML estimates for the censored systems are not presented due to space consideration but are available upon request. Below, we focus our discussion on the marginal effects of explanatory variables by ethnic groups.

*Malay*

Marginal effects of explanatory variables on tobacco expenditures for the Malay households are presented in Table 3. Education plays a significant role in reducing the probability and expenditure levels of tobacco usage in Malaysia. Specifically, an additional year of education possessed by the Malay household head decreases the probability of purchasing tobacco by 101.8%. Each additional year of education reduces tobacco expenditures by RM1.51 conditional on consumption, all else equal. Overall, the marginal effect on the unconditional level suggests that every additional year of education reduces tobacco expenditures by RM1.90. These positive effects of education are consistent with previous findings on the role of education in Malaysia, particularly on smoking expenditures (Tan *et al.*, 2007).

In contrast to those with blue-collar occupations, white-collar households are 6.4% less likely to smoke, *ceteris paribus*. Amongst those smoking, these white-collar households also spend significantly less (RM5.44) compared to their blue-collar counterparts. Overall, households with white-collar occupations have significantly lower unconditional tobacco expenditures (RM6.71) than others. Thus, it can be surmised that Malay households are less likely to indulge in smoking and would spend less if one were to work in a white-collar type environment.

Income is a positive factor, with each additional RM1000 in household income increasing

the probability of smoking by 5.4%. Among the smoking, each additional RM1000 in household income increases tobacco expenditure by RM4.62. Overall, every RM1000 increase in household income results in the rise of unconditional tobacco expenditures by RM5.81. These positive effects of income on the probability and expenditure levels of tobacco suggest that income may be an important consideration for effective smoking prevention and cessation programs amongst the Malay communities in Malaysia. Since households with higher disposable incomes have a higher tendency to consume tobacco because they are more likely to be able to afford it, this raises questions about the level of tobacco taxes which are currently imposed in the country to discourage smoking.

Meanwhile, Malay households headed by males are 21.9% more likely to indulge in smoking activities than their female cohorts. Within the smoking group, male-dominant households have significantly higher conditional tobacco expenditures (RM18.38) compared to female-headed households. Male-headed households also have significantly higher unconditional expenditures for tobacco (RM20.91) than female-headed households. As such, one can conclude that there exist lower tolerance levels of such vice activities by Malay females compared to men

As a Malay household ages, the probability and expenditure levels of smoking declines, other factors remaining constant. In fact, each additional 10 years in age decreases the probability of smoking by 9.7%. In addition, every 10-year increase in age causes the conditional and unconditional expenditures of tobacco to decrease by RM8.32 and RM10.46, respectively. One can infer from these results that the likelihood and prevalence to indulge in smoking is reduced as the household head grows older. This may be because consumers view smoking as a health issue so much so that when one becomes older, one becomes more health conscious; hence, tobacco expenditures declines.

*Chinese*

Table 4 presents the marginal effects for the Chinese. Education levels are statistically significant and negatively associated with the probability of purchasing tobacco, alcohol and gambling tickets. In fact, an additional year of education possessed by the household head decreases the probability of purchasing tobacco, alcohol and gambling by 1.9%, 1.1% and 1.1 %, respectively. Among the "participating" households, education also has a statistically significant and negative impact on conditional tobacco, alcohol and gambling expenditures. Conditional on spending, each additional year of education reduces tobacco and alcohol expenditures by RM2.16 and RM1.99, respectively, and gambling expenditures by RM1.91. Overall, the marginal effects on the unconditional level suggest each additional year of education possessed by the household head decreases tobacco, alcohol, and gambling expenditures by RM2.32, RM1.80, and RM1.97, respectively. Education obviously plays a significant role in reducing the probability and expenditure levels of vice for Chinese households in Malaysia.

For the Chinese, income is a positive factor in vice activities. Each additional RM1000 in household income increases the probability of smoking by 1.1%, and the probability of drinking and gambling by 3.9% and 2.9%, respectively. Among the participants, each additional RM1000 in household income increases conditional tobacco, alcohol, and gambling expenditures by RM1.27, RM6.94, and RM4.97, respectively. Further, each additional RM1000 increase in household income results in the rise of unconditional tobacco, alcohol, and gambling expenditures by RM1.36, RM6.27, and RM5.12, respectively. Thus, echoing the tobacco results among the Malay, the positive effect of income on the probability and expenditure levels of vices among Chinese households again suggests that income should be an important concern for designing anti-vice policies in Malaysia. Given that affluent Chinese households have higher

tendencies to smoke and drink as well as to partake in gambling activities, increases in current tobacco, alcohol and gambling excise taxes may be a viable consideration.

Although the marginal effects of household size are not statistically significant for tobacco, each additional member in a Chinese household results in a decrease in the likelihood of alcohol expenditure by 1.9%, while the probability of gambling declines by 0.8%. Among the participants, an additional family member decreases alcohol and gambling expenditures by RM3.44 and RM1.28, respectively. At the same time, unconditional alcohol and gambling expenditures decrease by RM3.11 and RM1.32, respectively, for every additional member in the household. These findings may be due to the fact that Chinese households may not view alcohol and gambling expenditures as necessities. In other words, an increase in household size generally induces a proportional increase in household expenditures, especially on basic necessities. Therefore, larger households are less like to spend on alcohol and gambling, with the assumption that these activities are not necessities. Meanwhile, the addictive nature of cigarette smoking may not be reflected by the number of persons in a household on tobacco expenditures.

As a Chinese household head becomes older, the probability and expenditure levels of vices declines, other factors remaining constant. In fact, with each additional 10 years in age of the household head, the probability to smoke, drink, or gamble decreases by 5.5%, 2.7% or 1.9%, respectively. Further, every 10-year increase in age of the household head results in the conditional and unconditional expenditures of tobacco to decrease by RM6.36 and RM6.84, respectively. As for alcoholic beverages, every 10-year increase in age of the household head reduces conditional and unconditional expenditures by RM4.86 and RM4.40, respectively. At the same time, each 10-year increase in age of household head causes a decrease in gambling expenditure by RM3.15 within gambling households, while unconditional gambling expenditures

falls by RM3.25. Thus, it can be inferred that the likelihood and prevalence to indulge in vice activities decreases as a Chinese family becomes older. This is because consumers may view such activities as either hazardous to health or even unnecessary as they become older.

Chinese household heads with white-collar occupations are less likely to smoke (5.7%), drink (3.0%) or participate in gambling activities (6.2%) compared to their blue-collared counterparts, *ceteris paribus*. Amongst the participants, those with white-collar occupations have significantly lower conditional tobacco (RM6.65), alcohol (RM5.36) and gambling (RM10.47) expenditures than their blue-collared cohorts. Furthermore, households with white-collar occupations also have significantly lower unconditional tobacco (RM7.00), alcohol (RM4.77) and gambling (RM10.54) expenditures in relation to those with blue-collar professions. Thus, it can be surmised that the likelihood of a Chinese household as well as their expenditure levels in these vice activities will decrease if one were to work in a white-collar occupation.

Residing in an urban locality significantly lowers the probability of smoking amongst Chinese households by 7.3%. In addition, conditional and unconditional tobacco expenditures for an urban household decreases by RM8.42 and RM9.48, respectively. However, place of residence does not play a role in alcohol and gambling expenditures.

Meanwhile, households headed by Chinese males are more likely to indulge in vice activities, as evidenced by its higher probability to purchase tobacco (15.6%) and alcohol (11.9%) as well as its higher likelihood to participate in gambling activities (11.3%) compared to female-headed households. Amongst the consuming households, male-headed households have significantly higher tobacco (RM18.58), alcohol (RM22.78) and gambling (RM19.63) expenditures compared to female-managed households. Finally, male-headed households of Chinese descent have significantly higher unconditional expenditures for tobacco (RM17.64),

alcohol (RM17.81), and gambling (RM18.40) than their female cohorts. As such, one can conclude that there exist lower tolerance levels of such vice activities by females compared to men.

*Indian*

For the Indian (Table 5), each additional year of formal education (of the household head) lowers the probability of tobacco purchases by 1.2%. Among tobacco purchasers, an extra year of formal education reduces conditional expenditures by RM1.05, while unconditional expenditures fall by RM1.25. It is also of interest to note that education does not play a role in alcohol and gambling. These results suggest that schooling may have a deterring effect only on tobacco expenditures among the Indian ethnic group.

Although age does not affect gambling in a statistical manner, each additional 10 years in age of the Indian household head result in a decrease in the probability of tobacco and alcohol purchases by 3.7% and 2.5%, respectively. Further, every 10-year increase in age decreases conditional and unconditional tobacco expenditures by RM3.33 and RM3.95, respectively. On the other hand, for each 10-year increase in age, conditional and unconditional alcohol expenditures fall by RM3.11 and RM2.26, respectively. One may infer from these results that the likelihood and prevalence to indulge in tobacco and alcohol is reduced when Indian households becomes older. This may be due to the perception among the Indians that smoking and drinking are health related issues. Hence, as one becomes older, one becomes more health conscious; thus, tobacco and alcohol expenditures decline. However, one might not view gambling activities as major health concerns, as evidenced by the statistical insignificance of age.

Compared to those with blue-collar occupations, white-collar Indians are 10.3% less likely

to smoke and 9.8% less likely to gamble, *ceteris paribus*. For those who indulge in these vices, those with white-collar occupations have significantly lower levels of tobacco (RM9.17) and gambling (RM9.74) expenditures compared to their blue-collar counterparts. Additionally, white-collar households have significantly lower unconditional tobacco (RM10.50) and gambling (RM7.21) purchases in relation to those with blue-collar professions. As such, one can deduce that Indian households are less likely to indulge in smoking and gambling, and also spend less in these behaviors if they were to work in a white-collar type occupation.

An urban locale significantly lowers the probability of drinking amongst Indian households by 8.4%. Suppose a family resides in an urban setting, conditional and unconditional alcohol expenditures decrease by RM10.08 and RM8.16, respectively. Household locality does not affect tobacco and gambling expenditures.

In the meantime, Indian households headed by males are 8.3% more likely to drink and are 12.3% more likely to gamble than their female cohorts. Within those who indulge in these vices, male-headed households have significantly higher tobacco (RM7.09), alcohol (RM11.47) and gambling (RM12.86) expenditures compared to households led by females, other factors remaining constant. Overall, male-headed households have significantly higher unconditional tobacco (RM8.09), alcohol (RM7.16) and gambling (RM8.67) expenditures compared to female-headed households. One may thus conclude that female Indian household heads have lower tolerance levels of such vice activities.

*Other races*

Among households of other races, education level is statistically significant and negatively associated with the probability (1.5%), conditional (RM1.18) and unconditional (RM1.54)

tobacco expenditures only (Table 6). These results imply that education plays a significant role in reducing the probability and expenditure levels of only smoking for those of other races.

Income is a positive factor for all vices, with each additional RM1000 in household income for those of other races increasing the probability of smoking, drinking, and gambling by 5.6%, 2.7%, and 2.6%, respectively. Among those who indulge in these vices, each additional RM1000 in household income increases conditional tobacco, alcohol, and gambling expenditures by RM4.30, RM5.66, and RM3.99, respectively. Furthermore, every additional RM1000 increase in household income causes an increase in unconditional tobacco, alcohol, and gambling expenditures by RM5.60, RM3.52, and RM1.71, respectively. Thus, the direct relationships between income and the probability and expenditure levels suggests that wealthier family units have a higher tendency to partake and are better able to afford these vice activities.

While the marginal effects are not statistically significant for gambling, additional members in a household causes a reduction in the likelihood of smoking (1.2%) and drinking (0.9%). Conditional on consumption, an additional family member decreases tobacco and alcohol expenditures by RM0.92 and RM1.87, respectively. On the other hand, unconditional tobacco and alcohol expenditures decrease by RM1.20 and RM1.16, respectively, given an additional member in the household. These results suggest that households of other races may view tobacco and alcohol as non-necessities. Since increases in household sizes generally result in proportional increases in household expenditures, tobacco and alcohol are substituted by expenditures on other basic essential household items instead.

Each additional 10-year increase in age of the household head of other race decreases the probability of tobacco purchases by 4.3%. Every 10-year increase in age of household head reduces conditional and unconditional expenditures by RM3.30 and RM4.30, respectively. These

results suggest that when the household head becomes older, one is less likely to smoke or spend less on this activity. However, age does not affect alcohol and gambling expenditures.

White-collar households of other races are 8.0% less likely to smoke compared to those with blue-collar occupations, *ceteris paribus*. Further, those with white-collar occupations also have significantly lower conditional (RM6.00) and unconditional (RM7.63) tobacco expenditures compared to those with blue-collar professions. As such, the likelihood and expenditures of smoking will decrease if a household head of other race were to work in a white-collar type occupation.

Urban households of other races are 8.8% less likely to smoke and have 4.7% lower probability to purchase alcohol compared to rural residents. However, the opposite effect is true for gambling as urban households have a 4.3% higher tendency to gamble. Among those who indulge in vices, those residing in urban areas spend less in smoking (RM6.81) and drinking (RM9.61) in relation to those in rural surroundings. Nevertheless, the opposite effect is true for conditional gambling expenditures as urbanites spend RM6.99 more than their rural cohorts. In terms of unconditional expenditures, urban households of other races spend less in smoking (RM8.97) and drinking (RM6.25) but more in gambling (RM2.81) in matching up to rural residents of the same race.

Finally, households managed by males are more likely to indulge in vice activities, as verified by its higher probabilities to purchase tobacco (29.6%), alcohol (5.0%) as well as its higher likelihood to participate in gambling activities (4.2%) compared to female home managers. In considering consuming households, male-headed households have significantly higher tobacco (RM21.81), alcohol (RM11.29) and gambling (RM7.49) expenditures than female household heads. Male-headed households of other race also have significantly higher

unconditional expenditures for tobacco (RM25.41), alcohol (RM6.28), and gambling (RM2.69) than their female household head cohorts. These results substantiate earlier notions that there exist lower tolerance levels of vice activities among females compared to men.

## V. Summary and Concluding Remarks

The results of the study generally indicate that socio-demographic factors play important roles in determining the demand for vices among various ethnicities in Malaysia. First, education level of household head negatively affects the likelihood to spend as well as the amounts spent on tobacco by all Malaysians in a statistically significant manner. In other words, irrespective of ethnicity, as a household head possesses higher levels of education, the probability of smoking and its expenditures decrease in tandem. Coincidently, the decreasing magnitudes of likelihood and expenditures due to education are consistently greater across all ethnicities for tobacco compared to alcohol and gambling. A possible reasoning could be that Malaysians consider smoking to be more of a health hazard compared to drinking and gambling, resulting in larger magnitudes of avoidance.

Second, occupation type and age of household head also negatively affect the likelihood to spend and amounts spent on smoking by all Malaysians. When a household head holds a white-collar type occupation or becomes more mature, the probability of smoking and its corresponding amount of expenditures decrease as well. Third, wealth is a statistically significant factor in determining vice expenditures in Malaysia. In addition to higher income Malay households being more likely to spend and have higher tobacco expenditures, affluent Chinese and other race households also have higher probabilities to purchase while spending more on smoking, drinking and gambling. This suggests that higher disposable incomes contribute to

higher tendencies to expend on tobacco and alcohol as well as partake in greater amounts of gambling due to its affordability factor. Lastly, gender of household head is also a statistically significant factor of vice expenditures for all races in Malaysia. Male household managers of all races are more likely to purchase and also spend more on tobacco, alcohol or bet on gambling activities than households led by females.

Policy implications arising from our findings include targeting specific ethnic households to reduce their tendencies and consumption levels of tobacco and alcohol products as well as gambling. This could be in the form of educational or health awareness campaigns since education has consistently been found to be viable in reducing tobacco usage amongst the various races. Other measures to decrease the likelihood of smoking or drinking might include targeting smoking or drinking awareness programs toward the younger generation, households with blue-collar type occupations and males given that these socio-demographic characteristics are specifically found to define those who are more likely to indulge in these vices.

Finally, since cigarette, alcohol, and gambling expenditures increase in tandem with household incomes for most Malaysians, further increases in excise taxes could be a viable public policy to discourage participation and expenditures as well as to raise tax revenues that could, in turn, be used for public education programs or campaigns. From another viewpoint, the present levels of excise taxes on these vice activities may be too low to discourage participation or expenditure patterns in Malaysia. However, one possible caveat is highlighted. Excessively high levels of excise taxes may also result in the mushrooming of illegal cigarette and alcohol industries or even underground betting syndicates, currently ubiquitous in many Asian countries.

Our study represents one of the first attempts at econometrically determining the effects of socio-demographic factors on vice activities, namely expenditures on smoking, drinking and

gambling, in Malaysia. With data availability, future studies might repeat our analysis by using individual expenditure or consumption data and also with longitudinal panel data to assess the robustness of our findings. Longitudinal studies can also focus on the analysis and assessment of the effectiveness of anti-vice campaigns that have been implemented in Malaysia.

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**Table 1. Variable definitions and sample statistics**

| Variable | Definition | Mean | S.D. |
|---|---|---|---|
| Tobacco | Household expenditure on tobacco (RM/mo.) | 27.84 | 57.45 |
| | Consuming households ($n$ = 5,291) | 74.09 | 73.20 |
| Alcohol | Household expenditure on alcohol (RM/mo.) | 7.17 | 51.75 |
| | Consuming households ($n$ =1,108) | 91.13 | 162.45 |
| Gambling | Household expenditure on gambling (RM/mo.) | 6.77 | 44.53 |
| | Consuming households ($n$ = 1,050) | 90.78 | 137.77 |
| Education | No. of years of formal education of household head | 8.51 | 4.81 |
| HH size | Total number of family members in household | 4.35 | 2.22 |
| Income | Gross monthly household income (in RM) | 2732.03 | 2669.17 |
| Age | Age of household head (years) | 46.85 | 14.06 |
| Binary variables (yes = 1; no = 0) | | | |
| Malay | Malay household head (reference) | 0.57 | 0.50 |
| Chinese | Chinese household head | 0.23 | 0.42 |
| Indian | Indian household head | 0.06 | 0.23 |
| Other | Household head of other race | 0.15 | 0.36 |
| White | Household head is a white-collar worker | 0.25 | 0.43 |
| Urban | Household resides in an urban area | 0.67 | 0.47 |
| Male | Household head is male | 0.84 | 0.37 |

*Source*: Compiled from Malaysian Household Expenditure Survey 2004/05 (Department of Statistics Malaysia, 2005).

**Table 2. Summary statistics of purchasers/participants and non-purchasers/non-participants of vices**

| | Tobacco | | | Alcohol | | | Gambling | | |
|---|---|---|---|---|---|---|---|---|---|
| | Purchase | Did Not | Total | Purchase | Did Not | Total | Participate | Did Not | Total |
| Malay | | | | | | | | | |
| *n* | 3204 | 4761 | 7965 | 18 | 7947 | 7965 | 20 | 7945 | 7965 |
| Percentage | 40.23% | 59.77% | 100.00% | 0.23% | 99.77% | 100.00% | 0.25% | 99.75% | 100.00% |
| Avg. household exp (RM) | 71.94 | 0 | 28.94 | 15.80 | 0 | 0.04 | 50.77 | 0 | 0.13 |
| Std deviation | 70.90 | - | 57.15 | 25.08 | - | 1.38 | 89.65 | - | 5.06 |
| Min. | 0.20 | - | 0.00 | 0.80 | - | 0.00 | 1.00 | - | 0.00 |
| Max. | 630.00 | - | 630.00 | 73.40 | - | 73.40 | 400.00 | - | 400.00 |
| Chinese | | | | | | | | | |
| *n* | 873 | 2327 | 3200 | 724 | 2476 | 3200 | 791 | 2409 | 3200 |
| Percentage | 27.28% | 72.72% | 100.00% | 22.63% | 77.38% | 100.00% | 24.72% | 75.28% | 100.00% |
| Avg. household exp (RM) | 97.57 | 0 | 26.62 | 94.09 | 0 | 21.29 | 103.80 | 0 | 25.66 |
| Std deviation | 79.24 | - | 60.01 | 173.41 | - | 91.36 | 150.79 | - | 87.30 |
| Min. | 0.50 | - | 0.00 | 1.80 | - | 0.00 | 1.00 | - | 0.00 |
| Max. | 500.50 | - | 500.50 | 2337.50 | - | 2337.52 | 1500.00 | - | 1500.00 |
| Indian | | | | | | | | | |
| *n* | 279 | 531 | 810 | 126 | 684 | 810 | 113 | 697 | 810 |
| Percentage | 34.44% | 65.56% | 100.00% | 15.56% | 84.44% | 100.00% | 13.95% | 86.05% | 100.00% |
| Avg. household exp (RM) | 70.44 | 0 | 24.26 | 67.32 | 0 | 10.47 | 54.27 | 0 | 7.57 |
| Std deviation | 77.37 | - | 56.38 | 83.74 | - | 40.98 | 63.22 | - | 30.12 |
| Min. | 0.20 | - | 0.00 | 1.80 | - | 0.00 | 2.00 | - | 0.00 |
| Max. | 624.00 | - | 624.00 | 437.49 | - | 437.49 | 395.00 | - | 395.00 |
| Other | | | | | | | | | |
| *n* | 935 | 1172 | 2107 | 240 | 1867 | 2107 | 126 | 1981 | 2107 |
| Percentage | 44.38% | 55.62% | 100.00% | 11.39% | 88.61% | 100.00% | 5.98% | 94.02% | 100.00% |
| Avg. household exp (RM) | 60.66 | 0 | 26.92 | 100.60 | 0 | 11.46 | 48.15 | 0 | 2.88 |
| Std deviation | 68.92 | - | 54.91 | 163.45 | - | 63.67 | 80.07 | - | 22.60 |
| Min. | 0.50 | - | 0.00 | 1.00 | - | 0.00 | 1.20 | - | 0.00 |
| Max. | 638.50 | - | 638.50 | 1168.40 | - | 1168.42 | 512.00 | - | 512.00 |

**Table 3. Maximum-Likelihood estimates of single censored equation for tobacco expenditure and marginal effects: Malay**

| Variable | Parameter estimates | Marginal effects | | |
|---|---|---|---|---|
| | | Probability | Cond. level | Uncond. level |
| Constant | 21.123 | | | |
| | (15.779) | | | |
| Education | –4.995*** | –1.018*** | –1.508*** | –1.896*** |
| | (0.468) | (0.002) | (0.140) | (0.177) |
| White-collar | –18.506*** | –0.064*** | –5.439*** | –6.713*** |
| | (4.044) | (0.014) | (1.157) | (1.400) |
| Income $\times 10^{-3}$ | 15.229*** | 0.054*** | 4.618*** | 5.805*** |
| | (1.788) | (0.006) | (0.538) | (0.677) |
| Income$^2 \times 10^{-6}$ | –0.835*** | | | |
| | (0.127) | | | |
| Urban | –4.217 | –0.015 | –1.276 | –1.606 |
| | (3.078) | (0.011) | (0.933) | (1.175) |
| HH size | 1.146 | 0.004 | 0.346 | 0.435 |
| | (0.715) | (0.003) | (0.216) | (0.271) |
| Male | 69.061*** | 0.219*** | 18.379*** | 20.907*** |
| | (4.672) | (0.013) | (1.083) | (1.091) |
| Age ÷ 10 | –27.556*** | –0.097*** | –8.321*** | –10.460*** |
| | (6.347) | (0.022) | (1.915) | (2.408) |
| Age$^2 \div 10^2$ | (1.444** | | | |
| | (0.633) | | | |
| σ | 108.265*** | | | |
| | (1.510) | | | |
| Log likelihood | –22190.350 | | | |

*Note*: Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Table 4. Marginal effects of explanatory variables on probability, conditional level, and unconditional level of consumption: Chinese**

| | Tobacco | | | Alcohol | | | Gambling | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level |
| | Continuous explanatory variables | | | | | | | | |
| Education | –0.019*** | –2.159*** | –2.320*** | –0.011*** | –1.994*** | –1.803*** | –0.011*** | –1.912*** | –1.973*** |
| | (0.002) | (0.258) | (0.283) | (0.002) | (0.488) | (0.332) | (0.002) | (0.370) | (0.389) |
| Income × $10^{-3}$ | 0.011*** | 1.266*** | 1.361*** | 0.039*** | 6.936*** | 6.270*** | 0.029*** | 4.966*** | 5.123*** |
| | (0.004) | (0.485) | (0.526) | (0.003) | (0.544) | (0.543) | (0.005) | (0.772) | (0.827) |
| HH size | –0.005 | –0.522 | –0.561 | –0.019*** | –3.436*** | –3.106*** | –0.008** | –1.279** | –1.320** |
| | (0.004) | (0.469) | (0.508) | (0.004) | (0.777) | (0.677) | (0.004) | (0.640) | (0.668) |
| Age ÷ 10 | –0.055*** | –6.362*** | –6.835*** | –0.027*** | –4.864*** | –4.397*** | –0.019*** | –3.149*** | –3.249*** |
| | (0.007) | (0.815) | (0.884) | (0.007) | (1.226) | (1.115) | (0.007) | (1.151) | (1.182) |
| | Binary explanatory variables | | | | | | | | |
| White-collar | –0.057*** | –6.647*** | –6.997*** | –0.030* | –5.362* | –4.769* | –0.062*** | 10.474*** | 10.543*** |
| | (0.018) | (2.074) | (2.153) | (0.018) | (3.252) | (2.853) | (0.017) | (2.981) | (2.969) |
| Urban | –0.073*** | –8.420*** | –9.478*** | 0.001 | 0.188 | 0.170 | –0.037 | –6.208 | –6.583 |
| | (0.024) | (2.800) | (3.295) | (0.024) | (4.279) | (3.859) | (0.025) | (4.180) | (4.551) |
| Male | 0.156*** | 18.579*** | 17.640*** | 0.119*** | 22.775*** | 17.810*** | 0.113*** | 19.629*** | 18.399*** |
| | (0.018) | (2.313) | (1.935) | (0.017) | (3.543) | (2.435) | (0.020) | (3.654) | (3.105) |

*Note*: Asymptotic standard errors in parentheses. Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Table 5. Marginal effects of explanatory variables on probability, conditional level, and unconditional level of consumption: Indians**

| Variable | Tobacco | | | Alcohol | | | Gambling | | |
|---|---|---|---|---|---|---|---|---|---|
| | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level |
| | Continuous explanatory variables | | | | | | | | |
| Education | –0.012** | –1.055** | –1.251** | 0.000 | 0.026 | 0.018 | –0.003 | –0.240 | –0.195 |
| | (0.005) | (0.457) | (0.542) | (0.003) | (0.567) | (0.316) | (0.005) | (0.460) | (0.363) |
| Income × $10^{-3}$ | 0.021 | 1.912 | 2.268 | 0.014 | 1.777* | 1.288 | 0.016 | 1.480 | 1.200 |
| | (0.014) | (1.241) | (1.498) | (0.009) | (1.002) | (0.817) | (0.013) | (1.194) | (0.999) |
| HH size | 0.001 | 0.062 | 0.074 | –0.020*** | –2.508*** | –1.818*** | –0.002 | –0.142 | –0.115 |
| | (0.009) | (0.845) | (0.982) | (0.007) | (0.891) | (0.698) | (0.008) | (0.687) | (0.594) |
| Age ÷ 10 | –0.037*** | –3.329*** | –3.950*** | –0.025** | –3.112** | –2.255** | –0.021 | –1.989 | –1.613 |
| | (0.014) | (1.256) | (1.482) | (0.011) | (1.316) | (0.991) | (0.014) | (1.305) | (1.080) |
| | Binary explanatory variables | | | | | | | | |
| White-collar | –0.103** | –9.169** | –10.500** | –0.028 | –3.621 | –2.542 | –0.098*** | –9.737*** | –7.205*** |
| | (0.044) | (3.860) | (4.316) | (0.030) | (3.938) | (2.719) | (0.034) | (3.405) | (2.450) |
| Urban | –0.035 | –3.121 | –3.756 | –0.084** | –10.081** | –8.155** | 0.038 | 3.617 | 2.801 |
| | (0.044) | (3.984) | (4.860) | (0.039) | (4.486) | (4.016) | (0.035) | (3.481) | (2.571) |
| Male | 0.080 | 7.086* | 8.086* | 0.083*** | 11.465*** | 7.161*** | 0.123*** | 12.858*** | 8.673*** |
| | (0.049) | (4.352) | (4.775) | (0.029) | (4.355) | (2.479) | (0.036) | (4.351) | (2.459) |

*Note*: Asymptotic standard errors in parentheses. Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Table 6. Marginal effects of explanatory variables on probability, conditional level, and unconditional level of consumption: other race**

| Variable | Tobacco | | | Alcohol | | | Gambling | | |
|---|---|---|---|---|---|---|---|---|---|
| | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level | Prob-ability | Cond. level | Uncond. level |
| | Continuous explanatory variables | | | | | | | | |
| Education | –0.015*** | –1.184*** | –1.544*** | –0.001 | –0.297 | –0.185 | –0.002 | –0.342 | –0.147 |
| | (0.003) | (0.203) | (0.267) | (0.002) | (0.404) | (0.269) | (0.002) | (0.429) | (0.129) |
| Income × $10^{-3}$ | 0.056*** | 4.300*** | 5.604*** | 0.027*** | 5.663*** | 3.520*** | 0.026*** | 3.989*** | 1.710*** |
| | (0.009) | (0.665) | (0.889) | (0.004) | (0.686) | (0.492) | (0.008) | (1.093) | (0.538) |
| HH size | –0.012*** | –0.919*** | –1.197*** | –0.009*** | –1.872*** | –1.164*** | –0.003 | –0.437 | –0.187 |
| | (0.005) | (0.373) | (0.489) | (0.003) | (0.683) | (0.431) | (0.003) | (0.461) | (0.181) |
| Age ÷ 10 | –0.043*** | –3.301*** | –4.301*** | –0.001 | –0.194 | –0.120 | –0.008 | –1.200 | –0.514 |
| | (0.010) | (0.756) | (0.981) | (0.007) | (1.530) | (0.960) | (0.006) | (0.931) | (0.402) |
| | Binary explanatory variables | | | | | | | | |
| White-collar | –0.080*** | –6.000*** | –7.629*** | 0.020 | 4.185 | 2.709 | –0.008 | –1.280 | –0.532 |
| | (0.030) | (2.160) | (2.687) | (0.023) | (4.653) | (3.134) | (0.015) | (2.394) | (0.975) |
| Urban | –0.088*** | –6.808*** | –8.965*** | –0.047*** | –9.609*** | –6.252*** | 0.043*** | 6.992*** | 2.807*** |
| | (0.023) | (1.872) | (2.499) | (0.019) | (3.733) | (2.542) | (0.014) | (2.485) | (0.994) |
| Male | 0.296*** | 21.813*** | 25.406*** | 0.050*** | 11.292*** | 6.284*** | 0.042*** | 7.485*** | 2.688*** |
| | (0.025) | (1.846) | (1.961) | (0.016) | (3.946) | (1.973) | (0.013) | (2.514) | (0.796) |

*Note*: Asymptotic standard errors in parentheses. Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Appendix Tables: Maximum-Likelihood Estimates for Segmented Samples**

**Table A1. Maximum-likelihood estimation of censored equation system: Chinese**

| | Tobacco | | Alcohol | | Gambling | |
|---|---|---|---|---|---|---|
| Variable | Estimate | S.E. | Estimate | S.E. | Estimate | S.E. |
| Constant | 42.801 | 43.183 | –174.200** | 80.597 | –271.926*** | 71.060 |
| Education | –8.626*** | 1.048 | –9.200*** | 1.585 | –7.934*** | 1.540 |
| White-collar | –27.081*** | 8.589 | –25.037* | 15.351 | –44.411*** | 12.816 |
| Income $\times 10^{-3}$ | 6.170*** | 2.396 | 36.250*** | 3.031 | 27.625*** | 4.450 |
| Income$^2 \times 10^{-6}$ | –0.151** | 0.079 | –0.577*** | 0.095 | –0.954*** | 0.205 |
| Urban | –32.082*** | 10.170 | 0.870 | 19.773 | –25.114 | 16.500 |
| HH size | –2.086 | 1.876 | –15.853*** | 3.327 | –5.308** | 2.676 |
| Male | 82.746*** | 11.621 | 116.145*** | 20.109 | 88.227*** | 17.877 |
| Age ÷ 10 | –18.039 | 15.768 | –16.177 | 29.450 | 46.034* | 25.086 |
| Age$^2 \div 10^2$ | –0.738 | 1.520 | –0.627 | 2.846 | –5.911*** | 2.374 |
| $\sigma$ | 152.325*** | 4.199 | 228.434*** | 2.995 | 222.433*** | 3.730 |
| Error correlations ($\rho_{ij}$) | | | | | | |
| Alcohol | 0.272*** | 0.027 | | | | |
| Gambling | 0.255*** | 0.027 | 0.279*** | 0.033 | | |
| Log likelihood | –18663.268 | | | | | |

*Note*: Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Table A2. Maximum-Likelihood estimation of censored equation system: Indian**

| | Tobacco | | Alcohol | | Gambling | |
|---|---|---|---|---|---|---|
| Variable | Estimate | S.E. | Estimate | S.E. | Estimate | S.E. |
| Constant | 105.437* | 61.701 | –126.716 | 104.976 | –305.829*** | 107.037 |
| Education | –3.783** | 1.631 | 0.136 | 2.238 | –1.193 | 2.206 |
| White-collar | –34.265** | 14.924 | –19.600 | 21.579 | –51.294*** | 19.025 |
| Income $\times 10^{-3}$ | 16.424* | 8.600 | 8.965 | 8.517 | 12.427 | 9.830 |
| Income$^2 \times 10^{-6}$ | –1.564* | 0.820 | 0.079 | 0.519 | –0.830 | 0.738 |
| Urban | –10.993 | 13.789 | –50.227** | 21.143 | 18.496 | 18.400 |
| HH size | 0.224 | 2.943 | –13.332*** | 4.640 | –0.704 | 3.640 |
| Male | 26.593 | 17.097 | 66.245*** | 27.151 | 71.602*** | 27.952 |
| Age ÷ 10 | –57.363*** | 22.152 | 10.026 | 43.433 | 58.331 | 44.748 |
| Age$^2 \div 10^2$ | 4.800** | 2.205 | –2.807 | 4.591 | –7.207 | 4.640 |
| $\sigma$ | 116.331*** | 4.365 | 146.896*** | 10.189 | 115.331*** | 6.944 |
| Error correlations ($\rho_{ij}$) | | | | | | |
| Alcohol | 0.285*** | 0.064 | | | | |
| Gambling | 0.068 | 0.075 | 0.416*** | 0.089 | | |
| Log likelihood | –3835.384 | | | | | |

*Note*: Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.

**Table A3. Maximum-likelihood estimation of censored equation system: Other race**

| | Tobacco | | Alcohol | | Gambling | |
|---|---|---|---|---|---|---|
| Variable | Estimate | S.E. | Estimate | S.E. | Estimate | S.E. |
| Constant | –14.149 | 25.317 | –403.458*** | 85.776 | –264.705*** | 68.588 |
| Education | –3.694*** | 0.622 | –1.714 | 2.496 | –2.328 | 2.005 |
| White-collar | –19.508*** | 7.275 | 23.656 | 25.789 | –8.812 | 16.613 |
| Income $\times 10^{-3}$ | 15.738*** | 2.559 | 34.066*** | 4.501 | 38.665*** | 11.426 |
| Income$^2 \times 10^{-6}$ | –0.545*** | 0.142 | –0.327*** | 0.127 | –2.709** | 1.168 |
| Urban | –20.788*** | 5.565 | –54.215*** | 20.744 | 48.940*** | 17.879 |
| HH size | –2.866*** | 1.151 | –10.800*** | 3.823 | –2.969 | 2.803 |
| Male | 79.504*** | 7.875 | 68.844*** | 25.582 | 54.654 *** | 19.823 |
| Age ÷ 10 | –12.356 | 10.650 | 44.402 | 35.543 | –16.642 | 27.466 |
| Age$^2 \div 10^2$ | 0.250 | 1.124 | –5.512 | 3.741 | 1.028 | 2.871 |
| $\sigma$ | 93.147*** | 1.442 | 223.276*** | 8.815 | 130.376*** | 9.291 |
| Error correlations ($\rho_{ij}$) | | | | | | |
| Alcohol | 0.126*** | 0.041 | | | | |
| Gambling | 0.130*** | 0.046 | 0.480*** | 0.067 | | |
| Log likelihood | –9315.922 | | | | | |

*Note*: Asterisks *** indicate significance at the 1% level, and * at the 5% level of significance.