Поведінка споживача на ринку скретч-карток: модель подвійних перешкод

Вішал Джаункі[1], Боошан Рамсхурн[2]

[1]Центр енергетичної політики та економіки, ETH Цюріх,
Цюріхбергштрассе 18, 8032 Цюріх, ШВЕЙЦАРІЯ.
E-mail: vjaunky@ethz.ch.

[2]Факультет соціальних та гуманітарних наук,
Кафедра економіки та статистики,
Університет Маврикію, Редуіт, МАВРИКІЙ.
Email: nitish-r@hotmail.com.

В наш час Маврикій стає осередком азартних ігор і ця тенденція є особливо помітною з часу започаткування лото Маврикію (Mauritius Lotto), яке притягує натовпи азартних гравців кожної суботи, також відомої як 'Суботня лихоманка' і є причиною появи нового феномену – картонної картки, покритої спеціальною непрозорою речовиною, яку можна стерти – відому ще як Le Millionaire. Лото приносить миттєве задоволення, яке гравцю може принести лотерея. Дана робота досліджує соціо-демографічні чинники в поєднанні з особистими якостями, які пов'язані з частотою купівлі скетч-карток Le Millionaire.

Для аналізу поведінки споживача у відповідь на гру у Le Millionaire були задіяні перехресні мікро-дані, отримані з анкет, залишених в домогосподарствах, з кількістю вибірки 1007 спостережень. Дослідження проводилось приблизно протягом чотирьох місяців – з грудня 2010 по березень 2011. Всього було розповсюджено 1200 анкет.

Далі досліджується модель подвійних перешкод як альтернатива тобіт-моделі для змоделювання ступеня участі та витрати на Le Millionaire. Тест Вінсента вказує, що тобіт-модель не є найкращою моделлю для даних. В причину цього досліджуються моделі подвійних перешкод, такі як врізана та логнормальні моделі. Тести Вонга віддають перевагу логнормальній моделі подвійних перешкод перед врізаною моделлю.

Результати показують, що «Велика п'ятірка» особистих рис індивідуума в поєднанні з іншими факторами, такими як стать, регіональне розташування, дохід домогосподарства, подружній стан, схильність до інших азартних ігор та споживання алкоголю відіграють обов'язкову роль у визначенні поведінки споживача на ринку азартних ігор.

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Consumer Behavior in the Scratch Card Market: A Double-Hurdle Approach

Vishal Jaunky[1], Bhooshan Ramchurn[2]

[1]Centre for Energy Policy and Economics, ETH Zurich,
Zurichbergstrasse 18, 8032 Zurich, SWITZERLAND.
E-mail: vjaunky@ethz.ch.

[2]Faculty of Social Studies & Humanities,
Department of Economics and Statisitcs,
University of Mauritius, Reduit, MAURITIUS.
Email: nitish-r@hotmail.com.

This paper investigates how demographic and other forms of compulsive behaviour and personality are related to the buying frequency of Le Millionaire scratch cards. We employ cross-sectional micro-data obtained from our household drop-off survey with a sample size of 1007 observations. Consequently, we examine the double-hurdle model as an alternative to the Tobit model. The lognormal double-hurdle model is the best specification for the study according to the Vuong test. In essence, the "Big-Five" dimensions of personality traits, coupled with other factors such as age, gender, educational background, household income and marital status are found to play a sine qua non role in determining a consumer's behaviour in the scratch card market.

Keywords: Gambling, Le Millionaire Scratch Cards, Censored Regression Models
JEL Classification: L83, Z0.

I. Introduction

Mauritius is known for its aesthetic beauty and a paradise for its wonderful beaches, scenic topography, blue lagoons, great hotels, nice people, good climate, nice places of interest but now it can be known as a gambling paradise. The recent introduction of the Mauritian Lotto has been attracting both gamblers and even non-gamblers in front of their television screens to watch the draw. Gambling[1] can be viewed as a socially acceptable adult hobby or pastime which is connected with excitements and risks. Others may also consider it as an opportunity to win a substantial reward with small stakes. The legalization of gambling in Mauritius has seen a wide spectrum of gambling products extending to casino gambling, online gambling, horse racing and the national lottery. The Caudan Waterfront casino is the largest in terms of the overall number of games with the major ones being roulette, blackjacks and Baccara. Horse racing on June 25th 1812 was opened at the Mauritius Turf Club (MTC). It is the second oldest racecourse in the world and the oldest in the southern hemisphere. Racing is popular on the island often drawing crowds of over 35,000

[1] Ariyabuddhiphongs (2011) provides a theoretical framework about an individual's gambling motivations which include irrational belief, fun-seeking and lotteries' popularity.

inhabitants. Football betting has been officially launched in 2008 in parallel with the famous Euro 2008 football event. Now with the introduction of the Lottotech, Mauritian lotto and instant-win lotteries have sprout out, under the French slogan[2] "*la chance pour tous*", meaning luck for all.

The history of scratch cards begins in the early days when American computer scientist John Koza and retail promotion specialist Daniel Bower invented it in 1974[3]. The fact that the gambling public craved instant gratification rather than purchasing Massachusetts lottery cards allowed them to innovate in this field. The first scratch card named "*instant game*". Buy a card, scratch off the opaque covering and you can immediately see of you have a winning card or not. All this has been made possible with GTECH. This is what the gambling American GTECH is offering Mauritius in this revolutionary world by inducing scratch card under different brands namely: Blackjacks, Cars & cash, Lucky Cash, La Faya, Goldchest, Pile Face, Goal, Pitaye, OX and the most popular one being Le Millionaire at present. Leading lottery gaming firm and Lottomatica subsidiary, GTECH has recently been selected to be the technology provider of LottoTech Limited, the firm tasked by the small island developing state of Mauritius to handle its national online and ticket lottery over a period ending in 2019. These instant scratch cards have brought to life a revolutionary concept: the instant lottery with instant gratification. What is Le Millionaire? The game consists of both the card scratching method as well as a regular TV show. Around ten millions cards will be on sale at Rs. 50.00 each. Sixty persons will have a chance to turn the "*Le Millionaire wheel of fortune*".

II. Theoretical Model

A random utility model of individual's choice to gamble can be formulated. The individual's utility function is assumed to be subject to a budget constraint. The utility function encompasses characteristics of the gambling market *G* such as price of lottery ticket, jackpot size, result draws, etc. The theoretical model attempts to analyze the consumer behaviour in two different markets (e.g. Ross *et al.*, 2010). For instance, individual *i* will place a bet in market *G* if he derives higher utility than the alternative (non-gambling) market *N*. Market *N* includes insurance contracts, art and galleries, government securities, appliances, etc. The utility function is presented as follows in equation (1):

$$U_i^G\left(q_i^G\right) > U_i^N\left(q_i^N\right) \tag{1}$$

, where vector q_i denotes market characteristics faced by the *i*th individual household. The individual have chose to participate and spend in G. Individual participation can be defined as the degree to which a customer is involved in producing and delivering Le Millionaire scratch cards while an individual's expenditure is expenses incurred in the consumption of the service. Let individual's participation and expenditure be denoted by $P_i^G = (0,1)$ and $Y_i^G \geq 0$ respectively. Expenditure can be used as a proxy to measure utility since the latter cannot be easily quantified in practice. If $P_i^G = 1 \text{and} Y_i^G > 0$, then *i*th individual yields greater utility from market *G*. To test the framework as a function of q_i, data on gambling expenditure are employed.

III. Empirical Model

Cragg (1971) proposes the two-part or double-hurdle model which generalizes the Tobit model and allows for the separate analysis of participation and expenditure decisions. Following this model, two different hurdles must be crossed prior to come across a positive level of consumption. In essence, the Cragg model is a two-step procedure with a probit model for the probability of participation in the first stage and a truncated normal or lognormal expenditure regression model in the second stage, or alternatively the simultaneous estimation of these two likelihood functions. The Vuong test (Vuong, 1989), can be used to choose between the two specifications. More explicitly, the first hurdle, which is the participation decision, relates to the decision of whether or not to buy scratch cards. The choice of participation depends on various socio-economic, demographic and psychological factors. Indeed the factors are more and more applied in many fields and have been coined as the "Big-Five" (e.g. Goldberg, 1992). The second hurdle, which is the consumption or expenditure decision, relates to the number of scratch cards to buy. It illustrates the intensity of the desire to play Le Millionaire. The double-hurdle model can be specified as:

(i) *Observed Consumption*:

$$y = d.y^{**} \tag{2.1}$$

(ii) *Participation Decision Equation*:

$$w = q'z_i + u_i, \qquad u_i \sim N(0,1)$$
$$d = \begin{cases} 1 & \text{if } w > 0 \\ 0 & \text{otherwise} \end{cases} \tag{2.2}$$

(iii) *Expenditure Decision Equation*:

$$y_i^{**} = \max\left[0, y_i^*\right]$$
$$y_i^* = b'x_i + v_i, \qquad v_i \sim N\left(0, s^2\right) \tag{2.3}$$

Both hurdles are assumed to linear in their parameters (θ, β), with additive disturbance terms *u* and *v* assumed to be independently normally distributed. The matrices z_i and x_i include the factors influencing the participation and consumption decisions respectively. A positive level of scratch card expenditure *y* is observed only if the individual is a potential buyer ($d = 1$) and in reality

[2] More information is available online at: http://www.loterie-nationale.net/actualite/1-la-chance-pour-tous-avec-la-loterie-nationale.

[3] http://www.wildjackcasino.com/history-scratch-cards.html..

(y_i^{**}). In the double-hurdle models, observed zero expenditure are the result of either participation or expenditure decisions. Prospective Le Millionaire players may have zero expenditure. Furthermore, the error terms are assumed to be correlated. Thus, u_i and v_i are assumed to be distributed as a bivariate normal (BVN):

$$(u_i, v_i) \sim BVN(0, \Sigma), \qquad \Sigma = \begin{bmatrix} 1 & sr \\ sr & s^2 \end{bmatrix} \tag{3.1}$$

Hence, if the stochastic error terms are treated as interdependent, in general terms, the likelihood function for participation and expenditure decisions can be specified as follows:

$$L_1 = \prod_0 \left[1 - p(d=1)\, p\left(y_i^* > 0 \mid d=1\right)\right]$$

$$\prod_+ p(d=1)\, p\left(y_i^* > 0 \mid d=1\right) g\left(y_i^* \mid y_i^* > 0, d=1\right)$$

Thus,

$$L_1 = \prod_0 \begin{bmatrix} 1 - p(u_i > -q'z_i) \\ p(v_i > -b'y_i \mid u_i > -q'z_i) \end{bmatrix}$$

$$\prod_+ p(u_i > -q'z_i)\, p(v_i > -b'x_i \mid u_i > -q'z_i)$$

$$g(y_i \mid v_i > -b'x_i \mid u_i > -q'z_i) \tag{3.2}$$

The sample for equation (3.2) is divided into those observations with zero positive expenditure denoted by subscripts 0 and + respectively. Equation (3.2) can be referred as the "*full double-hurdle model*" (Jones, 1989) with dependence between the error terms u_i and v_i. In contrast, when the error terms u_i and v_i are independent, then model (3.2) boils down to the conventional Cragg model (Cragg, 1971) with likelihood:

$$L = \prod_0 \left[1 - p(u_i > -q'z_i)\, p(v_i > -b'x_i)\right]$$

$$\prod_+ p(u_i > -q'z_i)\, p(v_i > -b'x_i)\, g(y_i \mid v_i > -b'x_i) \tag{3.3}$$

As shown by equation (3.3), the conditional probability of a value of u_i and v_i is excluded when these stochastic components are assumed to be uncorrelated. If the standard Tobit model is further nested in within the Cragg model such as $p(v_i > -b'x_i) = 0$, then, it can be extracted from the Cragg model if the factors affecting participation are identical to those of. Given the possibility of both participation and expenditure decisions to be simultaneously taken and that the errors may be correlated, equation (3.2) will essentially be used in modeling consumer behaviour in Le Millionaire scratch card market. To choose between the truncated normal and the lognormal models, the Vuong non-nested test can be used. Let the two opposing double hurdle models be $R_d = \{r(y \mid x; d); d \in \Theta\}$ and $S_g = \{s(y \mid x; g); g \in \Phi\}$, where R_δ and S_γ are conditional models and r and s are conditional density functions. The following hypothesis is tested:

$$H_o = \frac{\sum_{i=1}^{n} (\log r_i - \log s_i)}{\sqrt{\sum_{i=1}^{n} (\log r_i - \log s_i)^2}} \overset{a}{\sim} N(0,1) \tag{4}$$

For instance, a critical value v from the standard normal distribution can be chosen. If the computed statistics are greater than v, the model R_δ is the preferred one. However, if the computed statistics are small than v, then the model S_γ is the preferred one.

IV. Data Description

For the purpose of the study, a questionnaire[4] has been designed to conduct a household drop-off survey. The journey started on the first week of December 2010 and ended on the first week of March 2011. The collection of the primary data took roughly four months. To ensure a representative sample of the population, a total of 1200 questionnaires were circulated randomly across various companies located in Port Louis and Eben. For instance, these were The Caudan Waterfront, British American Insurance Co. (BAI), Eben Way, Cyber Tower 2 and Nexteracom, Shoprite Trianon and Phoenix Les Halles, among others. Also visits to households were effected in every nook and cranny of the island such as Rose Belle, souillac, Plaine Magnien, Mahebourg, Flic-en-Flac, Flacq, Goodlands, Terre Rouge, Port Louis, Reduit, Quatre-Borne and Curepipe among others and as well along the coast lines.

Due to incompleteness and biasness, 14 questionnaires have to be discarded from the 1021 collected. The number of final sample size thus boils down to 1007 respondents. The questionnaire includes 30 items and has three parts. On the whole, it requires between 5 and 7 minutes to answering all the queries. Section A relates to the personal profile the respondent. This section was meant to collect information about the demographic characteristics of the individuals. Section B gathers data on the weekly expenditure on Le Millionaire card and cigarettes consumption habit. Finally, Section C amasses information about the respondent's personality traits using a five-point Likert-like scale. About 48% of the respondents buy the Le Millionaire card on a weekly basis while about 52% of the respondents do not play at the game.

V. Results

A Tobit model was first run. The coefficient on a given variable indicates the change in the latent dependent variable for a unit change in that variable, with the other variables held constant. Several socio-economic, demographic and psychological factors are found to have a significant impact on consumer weekly expenditure on

[4] The questionnaire is available upon request.

Le Millionaire scratch cards. These are gender, income, other gambles, alcohol consumption and the personality traits. For instance, a one unit increase in female population relative male population is associated with a 58.15 units decrease in the predicted value of consumer expenditure. However, Vincent (2010) proposes a Lagrange Multiplier (LM) test for the null hypotheses of the standard Tobit model against the alternative of a more general non-linear specification. A rejection of the null hypothesis implies that the Tobit model is unsuitable. The critical values for the Box Cox LM test are obtained through 5000 bootstrap replications. The null is rejected in favour of the alternative hypothesis.

As an alternative to the Tobit model, the double-hurdle model is considered. Two specifications will be used. These are the truncated normal model and the lognormal one. The normal double hurdle-model will not be considered given the skewness of the expenditure data. With regard to the first specification i.e. the truncated normal double, residential area, income, marital status, alternative gambling opportunities, alcoholic drinks consumption and most of the personality traits (apart from Openness) are found to have a statistically significant impact on the participation decision of an individual. Surprisingly, no variables were found to be statistically significant for the expenditure decision regression model. In parallel, the lognormal double-hurdle model is also estimated. The Vuong test reveals that the lognormal double-hurdle model is superior to the truncated normal one. The variables are found to have comparable impact on participation as discussed for the truncated normal double-hurdle. However, the estimates for the expenditure equation seem more realistic, where gender, other gambles, consumption of alcoholic drinks, and personality traits such as openness and neuroticism have statistically significant impact.

Several studies were done without real attention about correlation among the personality traits which can lead to multicollinearity problems. Ignorance of multicollinearity can make "… precise estimation difficult (Gujarati, 1995)." In theory it is conceivable to expect a link among the Big-Five. Wright *et al.* (2006) provide some scientific evidence about an association between extraversion and neuroticism. Indeed, a Spearman correlation matrix is constructed and a statistically significant correlation is found to prevail among the personality traits. The null of no correlation is strongly rejected. Hence, to control for multicollinearity and to obtain more robust estimates, five different models are run, each including a specific personality trait. It is also to be noted that it is an efficient way to avoid decreasing degrees of freedom and thus obtain more precise estimates. Once more, the Tobit models are run. In general, residential location, income, other gambling activities, alcohol consumption, and personality traits such as Openness, Conscientiousness, Extraversion and Neuroticism are found to have a statistically significant influence on scratch card gambling. Agreeableness variable is found to have no impact. However, the Vincent Box Cox LM test provides evidence about the inappropriateness of the Tobit model to analyze consumer behaviour in the scratch card market. Hence, the double-hurdle models are next estimated. First, five truncated normal models are estimated. Practically similar results are obtained. The Vuong tests once more reveal the superiority of the lognormal models vis-à-vis the truncated normal ones.

VI. Conclusion

The behaviour of consumers have been studied from a household drop-off survey conducted over the period December 2010 to March 2011. In all 1021 questionnaires were collected among which 1007 were used to contruct various reduced-form models. The tobit model was found to be limited and inappropriate. The lognormal double-hurdel model was found to best fit the data. The findings reveal that the ''Big-Five'' personality traits coupled with other factors such as age, gender, educational background, household income and marital status are important factors in determining consumers' behavior in gambling market.

VII. References

[1] Ariyabuddhiphongs, V. (2011) Lottery Gambling: A Review. Journal of Gambling Studies 27,1, 15-33.

[2] Cragg, J. G. (1971) Some statistical models for limited dependent variables with application to the demand for durable goods, Econometrica, Vol. 39, No.5, 829-844.

[3] Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure, Psychological Assessment, 4, 26-42.

[4] Gujarati, D. N. (1995) Basic Econometrics, International Third Edition, McGraw-Hill, Inc. New York.

[5] Jones, A. M. (1989) A Double-Hurdle Model of Cigarette Consumption, Journal of Applied Econometrics, 4, 1, 23-39.

[6] Ross, B. R., Shanoyan, A. and Conner, D. S. (2010) Consumer participation and expenditure at Michigan farmers' markets: Implications for agrifood entrepreneurs. Working paper. Online at: https:// www.ifama.org/events/conferences/2010/cmsdocs/156_paper.pdf.

[7] Vincent, D. (2010) LM Tests in the Box Cox Tobit model, Stata Boston conference, 2010.

[8] Vuong, Q.H. (1989). Likelihood ratio test for model selection and non-nested hypotheses, Econometrica, 57, 307–333.

[9] Wright, C. I., William, D., Feczko, E., Barrett, L. F., Dickerson, B. C., Schwartz, C. E. and Wedig, M. M. (2006) Neuroanatomical Correlates of Extraversion and Neuroticism, Cerebral Cortex, 16, 1809-1819.