E C O N O M I C S   B U L L E T I N

The demand for lottery expenditure in Taiwan: a quantile regression approach

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Abstract

This paper is a pioneering attempt to apply the quantile regression method (QRM) to the demand for lottery expenditure in order to consider the extreme behavior of lottery expenditure as well as clarify the diverse results obtained from previous studies on lottery expenditure. The results of this study reveal that there exists a complementary correlation both between benevolent donations and lottery expenditure, and between entertainment expenditure and lottery expenditure. By contrast, the results from using OLS reveal that benevolent donations do not have a significant impact on lottery expenditure and that entertainment expenditure does not have a negative impact on lottery expenditure. Besides, expenditure on cigarettes and alcohol is found to have a positive impact on lottery expenditure, which coincides with the results of Balabanis (2002).

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1. Introduction

The Taiwan government allowed lottery tickets to be issued on the island on January 16, 2002. Right from the start they were widely accepted and sales of lottery tickets exceeded NT$99 billion and yielded NT$29.7 billion in revenue in the first year of issuance, with half of the yield being earmarked for local social welfare expenditure, i.e. NT$14.8 billion.[1] In several counties in Taiwan, the surplus from the sale of lottery tickets has exceeded 50% of local social welfare expenditure. Although many people hold negative views regarding the issuance of lottery tickets because of insufficient and regressive gains, unstable income sources, and inferior social practices which may possibly encourage gambling,[2] lotteries have played an important role in the daily life of the people in Taiwan and the surpluses from the lotteries have served as important sources for local governments.

While many people purchase lottery tickets, lottery expenditure does not exhibit a normal distribution, i.e. the high levels of lottery expenditure and the low levels of lottery expenditure are not symmetric. Most people try their luck by buying a small quantity of lottery tickets for entertainment purposes, incurring a small loss with a view to possibly getting a huge gain as risk-lovers. People who expend large amounts on lottery tickets are mainly risk-averse agents and care about winning, which causes them to gamble, as Cain, *et al.*, (2002) indicated.

To sum up, different levels of lottery expenditure imply different preferences of consumers toward risk. Since most people buy small quantities of lottery tickets, averaging or generalizing behavior when performing estimations tends to lead to biased estimation results and accordingly gives rise to misguided policies. Unfortunately, the previous studies on related issues all focus on averaged or generalized estimation of behavior and analysis, e.g., the Ordinary Least Squares (OLS) model applied by Mikesell and Zorn (1987), Mikesell (1994), Jackson (1994), and Price and Novak (2000), the Tobit model utilized by Clotfelter and Cook (1987) and Borg and Mason (1988), and the Two Stages Approach, i.e. the Probit model used to estimate whether people buy lottery tickets first and the Selection Bias Correction model proposed by Heckman (1979) or the Truncated Tobit model used to estimate how many lottery tickets are purchased (e.g., Scott and Garen (1994), Farrell and Walker (1999), Stranahan and Borg (1998a, 1998b), Sawkins and Dickie (2002), and Rubenstein and Scafidi (2002)).[3] The weakness with these approaches as already mentioned lies in their pursuing a normal distribution of hypothesized data. In practice, lottery expenditure is mainly small in amount, with a relatively minute section of the population being involved in large expenditure. Thus, the structure of lottery expenditure is not normally distributed, i.e. there is asymmetry or skewness. In other words, the lottery expenditure distribution is positively skewed. Thus, the extreme behavior associated with lottery expenditure merits an in-depth investigation. Unfortunately, most of the previous published work has ignored this finding. In order to achieve a breakthrough, this study first adopts the Quantile Regression Model (QRM) proposed by Koenker and Bassett (1978) to estimate the influential factors of lottery expenditure for different quantiles, so as to make up for a gap in previous studies. The empirical results of this study

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[1] Based on the statistics of Taiwan's lottery website, i.e.http://www.roclotto.com.tw.

[2] For example, Mikesell and Pirog-Good (1990) realized that lottery issuance is closely related to criminals if burglar and car loss rates are taken as the proxy variables for the criminal rate.

[3] Stranahan and Borg (1998b) proposed different views on the second stage Selection Bias Correction model proposed by Scott and Garen (1994), as revealed in Stranahan and Borg (1998b). Currently, most studies on lottery-related issues adopt the Truncated Tobit model in the second stage proposed by Stranahan and Borg (1998b). Besides, the sample data used in this study cover people who buy lottery tickets only.

can not only interpret the biased results arrived at in previous studies, but can also help to analyze the "extreme behavior." This is the main contribution of this study to the related studies.

The remainder of this paper is organized as follows. Section 2 discusses the empirical methodology applied in this study. Section 3 provides the empirical results. Section 4 summarizes the key results and presents the conclusions.

2. Method

Lottery expenditure is mainly small in amount and the corresponding data structure is not normally distributed but is rather skewed. Biased estimation results will thus occur if the OLS model is used to generalize lottery expenditure behavior. Besides, when the data are skewed, extreme types of behavior may carry more information. For these reasons, in this study the QRM proposed by Koenker and Bassett (1978) is applied to estimate the determinants of Taiwan's lotteries, where lottery expenditure is estimated in different quantiles and where the analysis of extreme lottery types of behavior can help clarify the influential factors and the effect of lottery expenditure.

According to Koenker and Bassett (1978), assume that y is defined as the random variable for the distribution function F_y and the θ^{th} quantile of F_y is denoted as $Q_y(\theta)$, which can be defined by

$$Q_y(\theta) = F_y^{-1}(\theta) = \inf\left\{a \mid F_y(a) \geq \theta\right\} \quad (1)$$
$$where \quad F_y(a) = p(y \leq a) \ and \ \theta \in (0,1)$$

So, the empirical quantile function can be denoted as

$$\hat{Q}_y(\theta) = \hat{F}_y^{-1}(\theta) = \inf\left\{a \mid F_y(a) \geq \theta\right\} \quad (2)$$

Thus, the θ^{th} quantile of F_y can be formulated as the solution to the minimization problem: [4]

$$\hat{Q}_y(\theta) = \arg\min_a \left\{\theta \int_{y>a} |y-a| dF_Y(a) + (1-\theta) \int_{y<a} |y-a| dF_Y(a)\right\} \quad (3)$$

When y is regressed on a vector of independent variables x, its conditional quantile function can be defined similarly as in Eq.(4). Assuming that the linear regression model is $y = x'\beta + e$, the linear conditional quantile function is as follows:

$$Q_y(\theta \mid x) = F_y^{-1}(\theta \mid x) = \inf\left\{a \mid F_y(a \mid x) \geq \theta\right\} = \int_k \beta_k(\theta) x_k = x'\beta(\theta) \quad (4)$$

In an analogy to Eq.(3), the solution in terms of the θ^{th} conditional quantile regression coefficients can be obtained by minimizing Eq.(4) with respect to $\beta(\theta)$:

4 Most regression approaches seek to minimize the sum of the model's errors. To prevent the offsetting effect between the positive and negative errors, two approaches are used. One involves minimizing the sum of the squared errors leading to an approximation of the conditional mean function, which is the OLS method and is easily affected by outliers. Another approach is the so-called least absolute deviation (LAD) method, which minimizes the sum of the absolute errors and leads to an approximation of the median function. That is the QRM.

$$\hat{\beta}(\theta) = \arg\min_{\beta(\theta)} \left\{ \theta \int_{y > x'\beta} \left| y - x'\beta \right| dF_y(a \mid x) + (1-\theta) \int_{y < x'\beta} \left| y - x'\beta \right| dF_y(a \mid x) \right\} \quad (5)$$

As long as θ is given, the $\hat{\beta}(\theta)$ can be obtained.

Notice that, when θ = 0.5, equation (4) is called the median regression. The median regression is a special case of a quantile regression, which is not necessarily representative of those types of behavior characterizing an overall sample as in the case of the OLS model when the conditional distribution is not normal. On the other hand, when the data structure exhibits a skewed distribution, the quantile regression could be a more representative way of analyzing the extreme behavior.

3. Empirical Analysis

This study adopts the data of the Survey of Family Income and Expenditure in the Taiwan Area of the Republic of China in 2003, with a total sample of 13,681 families and 48,294 people. People under 18 years old are not allowed to buy lottery tickets. Thus, the people sampled are over 18 years old with income.

Data on family income and expenditure contains an abundance of variables, e.g., the statistical variables of individual as well as family members, consumption expenditure variables, and non-consumption expenditure variables, etc. In referring to previous studies, the key determinants of the demand for lottery ticket purchases include: gender, age, marital or co-habiting status, family members, education, individual income, family income, jobless status, living in cities or the countryside, receiving government transfer income, social insurance benefit income, personal accident medical insurance expenditure, benevolent donation expenditure, entertainment expenditure, alcoholic drink expenditure, and cigarette expenditure. Due to the failure to consider extreme behavior in lottery expenditure, inconsistent empirical results have been found in previous studies on lottery-related issues. Thus, the empirical results of this study present the determinants of the demand for lottery expenditure for different quantiles, and point out the differences between the OLS results and the results of the quantile regression from this study.

Table 1 presents the summary statistics for our sample. It shows that lottery expenditure ranges from NT$50 to NT$1,200,000, with an average of NT$3,271 and a standard deviation of NT$16,000, where 90% of lottery expenditure is less than NT$2,950 (which is not revealed in Table 1). Thus, lottery expenditure is mainly small in amount and is not symmetric[5]. Therefore, the estimates based on lottery expenditure, regardless of whether the OLS model or the Tobit model is used, together with the corresponding influential factors, could be biased.

Table 1. ***Sample Statistics***

Variables	Mean	Min	Max	SD	Skewness	Kurtosis
Lottery Expenditure	3.271 【1.5】	0.05	1200	16.207	58.687	4067.55
Demographic and Economic Factors:						
Gender (=1, Male)	0.746	0	1	0.436		

[5] The assumption of a normal distribution for lottery expenditure is rejected in this study.

Table 1. ***Sample Statistics (continued)***

Variables	Mean	Min	Max	SD	Skewness	Kurtosis
Age (Years old)	42.690 【42】	18	88	12.660	.578	3.116
Marital status(=1, Married or co-habiting)	0.710	0	1	0.454		
Family members	3.962 【4】	1	12	1.637	.749	4.618
Education (Year)	11.326 【12】	0	18	3.507	-.589	3.298
Individual Income	693.73 【590.3】	16.64	8538.63	452.195	3.348	30.664
Occupational status (=1,Jobless)	0.079	0	1	0.270		
Cities or countryside (=1, cities)	0.852	0	1	0.355		
Social insurance benefits	26.449 【20.67】	0	1921.58	67.266	21.231	515.070
Regular government transfers	10.988 【6.38】	0	580.11	22.284	8.788	115.02
Other factors:						
Accident insurance	4.083 【2.32】	0	75.00	5.756	3.379	21.973
Benevolent donations	3.065 【1】	0	310	10.881	14.338	294.04
Entertainment expenditure	3.265 【2.63】	0	88	3.128	6.832	112.10
Expenditure on cigarettes and alcohol	4.226 【2.59】	0	66.43	5.347	3.191	21.668

Note: 1.All variables units are Thousand NT$ except for notices in parentheses. All variables reject the normal distribution at the 5% significance level.
2. Observations in sample is 7767.
3. Numbers in the 【】 represent median; SD represents standard deviation.

As revealed by the averages of the statistics on demographic and economic characteristics, people who buy lottery tickets possess the following properties: male, average age of 43, married or co-habiting (71%), 4 people in the family, high-school education background, NT$690,000 income annually, employed (92%), living in cities (85%), receiving NT$26,000 in social insurance subsidies annually, and receiving NT$11,000 in government transfer income. As for the other factors, lottery ticket buyers purchase NT$4,000 of personal accident medical insurance, donate NT$3,000, spend NT$3,300 on entertainment, and expend NT$4,200 on cigarettes and alcohol on average per year.

Cross analyses of independent variables (dummy variables only) and lottery expenditure reveal that independent variables have different impacts on lottery expenditure in different quantiles as presented in Table 2.[6] Factors such as gender, occupational status, living in cities or the country, or marital status result in different impacts on lottery expenditure for different quantiles. Males purchase more lottery tickets than females for both high quantiles and low quantiles. There is a similar tendency in the married and not married counterparts. Employed people purchase fewer lottery tickets than unemployed ones for high quantiles of lottery expenditure. People living in cities purchase fewer lottery tickets than people living in the countryside. Furthermore, if personal accident medical insurance expenditure is regarded as indicating the preferences toward risk of consumers, when consumers' personal accident medical expenditure is 25% lower than the personal accident medical expenditure of the entire sample, i.e. less than or equal to NT$170, a lower level of risk aversion will result. On the other hand, if the consumers' personal accident medical expenditure is 75% higher than the accidental medical expenditure of the entire sample, i.e. more than or equal to NT$5,500, more risk aversion will result. Except for the minimum and maximum, as Table 2 reveals, consumers who are more risk-averse will tend to purchase more lottery tickets, which coincides with the conclusion reached in Cain, et al. (2002). In other words, people with different risk attitudes have different lottery expenditures in different quantiles. The Wilcoxon rank-sum test is further employed to verify whether different risk attitudes give rise to different lottery expenditures. As expected, different risk attitudes lead to significantly different lottery expenditures (Z=-5.421, p-value=0.0000)[7]. Based on the above findings, it is reasonable to employ the QRM model to verify how factors influence lottery expenditure in various quantiles.

Table 2. ***Expenditure for Dummy Variables under Different Lottery Quantiles***

Factors	Minimum	0.05Q	0.25Q	0.5Q	0.75Q	0.95Q	Maximum	Percentage (%)
Gender:								
Male	0.05	0.3	1.0	2.0	4.0	10.4	1200	74.56
Female	0.05	0.2	0.5	1.0	2.0	5.5	48	25.44
Occupational Status:								
Jobless	0.05	0.2	0.5	1.2	3.0	12.0	1200	7.91
Employed	0.05	0.3	0.8	1.6	3.2	10.0	600	92.09
Cities or Countryside:								
Cities	0.05	0.2	0.8	1.5	3.0	10.0	600	85.22
Non-cities	0.10	0.3	0.8	1.8	3.4	9.0	1200	14.78
Marital Status:								
Married or co-habiting	0.05	0.3	0.8	1.8	3.5	10.4	1200	71.02
Not married nor co-habited	0.05	0.2	0.6	1.2	3.0	8.0	120	28.98
Medical Insurance:								

[6] The non-dummy variables are omitted because of space limitations.
[7] The quantile regression does not need to assume any distribution specification and can be deemed as a nonparametric model. Thus, the Wilcoxon rank-sum test is used in this study.

Table 2. ***Expenditure for Dummy Variables under Different Lottery Quantiles (continued)***

Factors	Minimum	0.05Q	0.25Q	0.5Q	0.75Q	0.95Q	Maximum	Percentage (%)
Lowest 25%	0.05	0.2	0.6	1.4	3.0	9.6	1200	49.69
Highest 25%	0.05	0.3	1.0	1.9	3.6	12.0	600	50.31

Note: All variables units are Thousand NT$.

The results for the QRM and OLS models are given in Table 3 in which it can be seen that different significances and signs of the coefficients with regard to the independent variables result from these two models. While gender and age are significant in the QRM but not in the OLS model, entertainment expenditure exhibits different signs of impact in both models. Furthermore, gender, age, education, individual income, personal accident medical insurance, benevolent donations, and expenditure on cigarettes and alcohol exhibit a positive impact on lottery purchases in different quantiles, where factors lead to greater impacts with higher quantiles for lottery expenditure, e.g., higher expenditure on cigarettes and alcohol leads to higher lottery expenditure, revealing that the complementary effects of higher quantiles for lottery expenditure are especially stronger. Social insurance benefits exhibit a significant impact only in relation to higher levels of lottery expenditure. On the contrary, entertainment expenditure exhibits an impact only on lower levels of lottery expenditure. People living in cities with median levels of lottery expenditure do not tend to engage in lottery expenditure. Whether they purchase a larger or smaller quantity is unknown, but the OLS results indicate that people living in cities do not tend to buy lottery tickets. Marital status and the number of family members do not have a significant impact on lottery expenditure. The impact of regular government transfers is not significant either, except for the positive impact it has on large amounts of lottery expenditure. Entertainment expenditure exhibits impacts with different signs on lottery expenditure using the quantile regression and OLS approaches, probably because the OLS approach estimates the average behavior and the average lottery expenditure is NT$3.271 thousand, with 90% of the expenditure less than NT$2.950 thousand. Besides, the impact of entertainment expenditure tends to result in lower lottery expenditure, which consequently results in varying signs. Age and education are found to give rise to non-linear impacts on lottery expenditure in the QRM tests but no significant impact is found in the OLS.

To sum up, the results of the QRM expose the inconsistent results from the OLS in previous studies. These results can be seen more clearly in Table 4. The empirical results in this study also indicate that “generalized analyses” of lottery expenditure behavior arising from the use of OLS are not reasonable, since lottery expenditure exhibits a severe skewed distribution.

Table 3. ***Empirical Results for Quantile Regression and OLS(.05Q-.5Q)***

Factors	.05Q	.1Q	.2Q	.3Q	.4Q	.5Q
Gender (=1, Male)	.1073	.1809	.2331	.3695	.4195	.6213
	(.0137)	(.0191)	(.0233)	(.035)	(.0347)	(.0455)
Age		.0084	.0176	.0285	.0346	.0542
		(.0027)	(.0045)	(.0053)	(.0076)	(.0094)
Marital status (=1, Married or co-habiting)						
Family Members						
Education (Year)		.0129	.0221	.0382	.0596	.0741
		(.0048)	(.0103)	(.0132)	(.0160)	(.0172)
Individual Income			.0003	.0003	.0006	.0008
			(.0001)	(.0001)	(.0001)	(.0002)
Occupational status (=1, Jobless)	-.0646	-.1309				
	(.0367)	(.0347)				
Cities or Country (=1, cities)			-.0737	-.1345	-.2190	-.197
			(.0383)	(.0428)	(.0534)	(.0752)
Social Insurance Benefits						-.0006
						(.0003)
Regular Government Transfers						
Accident Insurance	.0022	.0033	.0077	.0061	.0073	
	(.0014)	(.0013)	(.0020)	(.0031)	(.0033)	
Benevolent Donations		.0033	.0044	.0078	.0078	.0097
		(.0018)	(.0021)	(.0024)	(.0029)	(.0038)
Entertainment Expenditure	.0083	.0111	.0116	.0220	.0268	.0373
	(.0035)	(.0022)	(.0052)	(.0093)	(.0082)	(.0117)
Expenditure on Cigarettes and Alcohol	.0069	.0096	.0231	.0312	.0514	.0612
	(.0019)	(.0023)	(.0031)	(.0037)	(.0063)	(.0076)
Square of Age		-.0001	-.0002	-.0003	-.0003	-.0006
		(.0000)	(.0000)	(.0001)	(.0001)	(.0001)
Square of Individual Income					-.0000	-.0000
					(.0000)	(.0000)
Square of Education		-.0008	-.0014	-.0021	-.0032	-.0039
		(.0003)	(.0005)	(.0007)	(.0008)	(.0010)
Pseudo R^2	.01	.0155	.0187	.0206	.0257	.0366

Notes:

1. P-value are given in parentheses.
2. Blanks represent insignificance at the 10% significance level.
3. The p-values have been calculated by bootstrapping with 2,000 replications and this number of replications is large enough to guarantee a small degree of variability in the estimated covariance matrix, as portrayed by Buchinsky (1998). The results from the bootstrapping with 20 replications and no bootstrapping are available upon request.
4. The pseudo-R^2 is not comparable with the OLS (R^2 with OLS) as it is a local measure of goodness of fit rather than a global measurement.

Table 3. ***Empirical Results for Quantile Regression and OLS(.6Q-.95Q and OLS)***

Factors	.6Q	.7Q	.8Q	.9Q	.95Q	**OLS**
Gender (=1, Male)	.8015	1.0181				
	(.0656)	(.0865)				
Age	.0754	.1000	.1376	.1754		
	(.0137)	(.0176)	(.0289)	(.0365)		
Marital status (=1, Married or co-habiting)						
Family Members						
Education (Year)	.0891	.0836	.1493			
	(.0320)	(.0303)	(.0606)			
Individual Income	.0010	.0014	.0023	.0044	.0043	.0036
	(.0002)	(.0003)	(.0004)	(.0015)	(.0020)	(.0009)
Occupational status (=1, Jobless)						
Cities or Country (=1, cities)	-.2493					
	(.0937)					
Social Insurance Benefits	-.0013	-.0023	-.0034	-.0057	-.0113	-.0175
	(.0006)	(.001)	(.0012)	(.0021)	(.0036)	(.0031)
Regular Government Transfers					.0443	
					(.0169)	
Accident Insurance				.0578	.1096	
				(.0236)	(.0541)	
Benevolent Donations			.0273	.0272		
			(.0119)	(.0136)		
Entertainment Expenditure	.0359	.0539	.0555			-.1073
	(.0150)	(.0237)	(.0273)			(.0647)
Expenditure on Cigarettes and Alcohol	.0815	.1094	.1345	.2342	.3535	.3995
	(.0100)	(.0129)	(.0192)	(.0417)	(.0603)	(.0348)
Square of Age	-.0008	-.0010	-.0014	-.0019	-.0031	
	(.0001)	(.0002)	(.0003)	(.0004)	(.0017)	
Square of Individual Income						.0000
						(.0000)
Square of Education	-.0047	-.004	-.0076			
	(.0016)	(.0016)	(.0030)			
Pseudo R^2	.0353	.0434	.0543	.0627	.0764	.0473

Notes:

1. P-value are given in parentheses.
2. Blanks represent insignificance at the 10% significance level.
3. The p-values have been calculated by bootstrapping with 2,000 replications and this number of replications is large enough to guarantee a small degree of variability in the estimated covariance matrix, as portrayed by Buchinsky (1998). The results from the bootstrapping with 20 replications and no bootstrapping are available upon request.
4. The pseudo-R^2 is not comparable with the OLS (R^2 with OLS) as it is a local measure of goodness of fit rather than a global measurement.

Table 4. ***Summary of the Results***

Variable	QRM	OLS
Gender	L/Q, M/Q, +sign.	not sign.
Age	+sign., increasing	not sign.
Sq. of age	-sign., inverse U	not sign.
Marital status	not sign.	not sign.
Family members	not sign.	not sign.
Education	+sign., increasing	not sign.
Sq. of education	-sign., inverse U	not sign.
Income	+sign., increasing	+sign.
Sq. of income	-sign., inverse U	+sign., not inverse U
Jobless	L/Q, -sign.	not sign.
City/country	M/Q, -sign.	not sign.
Social insurance benefit	M/Q, H/Q, -sign.	-sign.
Government transfers	H/Q, +sign.	not sign.
Accident insurance	L/Q, H/Q, +sign.	not sign.
Donations	+sign.	not sign.
Entertainment	+sign., increasing	-sign.
Cigarettes and Alcohol	+sign., increasing	+sign.

Notations:

L/Q: low quantiles
M/Q: middle quantiles
H/Q: high quantiles
+sign.: positive coefficient and significant at 10% level
-sign.: negative coefficient and significant at 10% level
inverse U: exhibiting inverse U shape
increasing: the higher quantiles the larger the coefficients
not sign : no significance at 10% level.

4. Conclusion

The QRM empirical results of this study reveal that there exists a complementary relationship both between benevolent donations and lottery expenditure, and between entertainment expenditure and lottery expenditure, whereas the results from the OLS reveal that benevolent donations do not give rise to a significant impact on lottery expenditure but that entertainment expenditure does give rise to a negative impact on lottery expenditure. Besides, expenditure on cigarettes and alcohol has a positive impact on lottery expenditure, which coincides with the results of Balabanis (2002). Furthermore, in this study we discover a stronger complementary correlation between expenditure on cigarettes and alcohol as well as the high quantile of lottery expenditure. The impact of entertainment expenditure in the QRM and OLS model exhibits varying signs, probably resulting from the “averaging” behaviors in the OLS. Age and education are identified to have non-linear relationship in regard to the lottery expenditure in the QRM but no significant relationship is found in the OLS. Besides, other factors like marital status and the number of family members exhibit the same results in the QRM as well as OLS models.

In this study, it is proved that the QRM approach is feasible in applying the determinants of lottery expenditure because most lottery expenditure is small and skewed. Compared to the OLS results, the results of this study not only provide abundant information regarding related studies but also clarify the diverse results obtained in previous studies. The results of this study will also serve as useful reference for lottery issuers and relevant government authorities in future policy-making.

REFERENCES

Balabanis, G. **(**2002) "The relationship between lottery ticket and scratch-card buying behaviour, personality and other compulsive behaviours" *Journal of Consumer Behaviour* **2**, 7-22.

Borg, M. O. and P. M. Mason (1988) "The budgetary incidence of a lottery to support education" *National Tax Journal* **41**, 75-85.

Buchinsky, M. (1998) "Recent advances in Quantile regression models: a practical guideline for empirical research" *Journal of Human Resources* **33**, 88-126.

Cain, M., D. Peel and D. Law (2002) "Skewness as an explanation of gambling by locally risk averse agents" *Applied Economics Letters* **9**, 1025-1028.

Clotfelter, C. T and P. J. Cook (1987) "Implicit taxation in lottery finance, *National Tax Journal*" **40**, 533-546.

Farrell, L. and I. Walker (1999) "The welfare effects of lotto: evidence from the UK" *Journal of Public Economics* **72**, 99-120.

Heckman, J. J. (1979) "Sample selection bias as a specification error" *Econometrica* **47**, 153-162.

Jackson, R. (1994) "Demand for lottery products in Massachusetts" *Journal of Consumer Affairs* **28**, 313-325.

Koenker, R. and G. Bassett. (1978) "Regression Quantiles" *Econometrica* **46**, 33-50.

Mikesell, J. L. (1994) "State lottery sales and economic activity" *National Tax Journal* **47**, 165-171.

Mikesell, J. L. and C. K. Zorn. (1987) "State lottery sales" *Growth and Change* **18**, 10-19.

Mikesell, J. L. and M. A. Pirog-Good. (1990) "State lotteries and crime" *American Journal of Economics and Sociology* **40**, 7-9.

Price, D. I., and E. S. Novak. (2000) "The income redistribution effects of Texas state lottery games" *Public Finance Review* **28**, 82-92.

Rubenstein, R. and B. Scafidi. (2002) "Who pays and who benefits? Examining the distributional consequences of the Georgia lottery for education" *National Tax Journal* **55**, 223-238.

Sawkins**,** J. W. and V. A. Dickie. (2002) "National lottery participation and expenditure: preliminary results using a two stage modelling approach" *Applied Economics Letters* **9**, 769-773.

Scott, F. and J. Garen. (1994) "Probability of purchase, amount of purchase, and the demographic incidence of the lottery tax" *Journal of Public Economics* **54**, 121-143.

Stranahan, H. A. and M. O. Borg. (1998a) "Horizontal equity implications of the lottery tax" *National Tax Journal* **51**, 71-82.

Stranahan, H. A. and M. O. Borg. (1998b) "Separating the decisions of lottery expenditures and participation: a truncated Tobit approach" *Public Finance Review* **26**, 99-117.