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The Income Elasticity of Lottery: New Evidence from Micro Data

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Abstract

The authors analyze consumer expenditure on the National Lottery in Spain, a popular game with over 100 draws per year and annual turnover of about three billion euros. Based on Tobit estimates using data from two nationally representative surveys, National Lottery players tend to be middle-aged married males with relatively low education. In contrast to previous research, the authors find a strong relationship between lottery expenditure and income, with estimated income elasticities of more than one. A parameter decomposition indicates that the effect of income on expenditure works through existing lottery players, not by attracting new players.

Keywords

Tobit, gambling, income elasticity, lottery, consumer spending

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The relationship between lottery expenditure and income interests economists for several reasons. First, lotteries are extremely popular and quite homogenous consumer goods that are purchased by large numbers of people in countries around the world.[1] The economic determinants of demand for widely purchased consumer goods holds considerable interest for those who study consumer behavior. Second, lottery tickets and investment goods like stocks and bonds share many characteristics like uncertain but potentially large payoffs and wide availability. But lottery tickets are poor investments in that the price of the typical lottery ticket exceeds the expected payoff, making it difficult to explain the popularity of lotteries in the context of expected utility maximizing models of consumer behavior. This tension between theory and observed consumer behavior heightens interest in understanding the determinants of lottery spending, including the relationship between household income and lottery spending. Third, nearly all lotteries are government-owned monopolies designed to generate operating surpluses for the residual claimant, in this case the government. Introducing lottery games gave government access to a new and substantial source of tax revenue. These operating surpluses are generated by charging a price well above average cost. In this sense, lotteries implicitly tax consumers who voluntarily choose to purchase lottery tickets; understanding the progressivity or regressivity of the implicit tax included in the lottery ticket price constitutes an important part of our understanding of the economic consequences of this government-sponsored activity. Thus, the analysis of who plays the lottery is very interesting not only from the point of view of market analysis but also from the perspective of public policy.

In this article, we analyze the determinants of household expenditure on lotteries as well as the incidence of implicit lottery taxation in order to identify patterns in lottery play across the income distribution. In addition, critics of government sponsored lotteries frequently claim that low-income individuals purchase a disproportionate number of lottery tickets, adding additional emphasis to research on the relationship between income and lottery spending.

A large literature on the determinants of lottery play exists. In this literature, lottery expenditures are typically regressed on income and other socioeconomic and demographic control variables in order to examine the relationship between lottery spending and income. One strand of this literature consistently finds that the burden of the implicit lottery tax falls disproportionately on those with lower income.[2] A second strand of this

literature consistently estimates the income elasticity of lottery spending less than one using both aggregated and micro data. See, for example, Clotfelter and Cook (1987), Farrell and Walker (1999), Price and Novak (2000), and Oster (2004). Some studies, including Mikesell (1989) and Scott and Garen (1994), find no relationship between income and lottery spending. Income elasticities less than one suggest a regressive implicit lottery tax. In this article, we examine the relationship between income and lottery spending on an extremely popular, long-lived lottery game, the Spanish National Lottery, using micro data from two recent nationally representative surveys.

The government-operated Spanish National Lottery, one of the largest passive lottery markets in the world, was introduced in the nineteenth century to increase the amount of money flowing into the Public Treasury without levying new or higher taxes. The revenues obtained by the Spanish government from the National Lottery now fund social programs. The National Lottery is viewed as one of Spain's most traditional and popular gambling activities. According to a 2006 National Gambling Commission report, Spanish people spent over five thousand million euros on the National Lottery, about 124 euros per inhabitant. This represents 56.5 percent of state-operated games turnover and 18.9 percent of total spending on gambling in Spain.

Despite the growing interest in research on consumers' spending on lottery and the relative importance of the Spanish market in the worldwide lottery business, empirical evidence on the determinants of participation and expenditure in passive lotteries is limited and, apart from Garvía (2007), previous research has focused neither on passive lotteries nor on Spanish lottery games. With this in mind, this article summarizes the empirical findings of a number of relevant studies dealing with the impact on the relative distribution of income among the population to assess whether the implicit tax on lottery spending is progressive, neutral, or regressive and focuses on the analysis on spending on the National Lottery in Spain. We use detailed micro data on consumer spending from nationally representative surveys of Spaniards. The cross-sectional survey data allow us to estimate the effect of income on lottery spending, conditional on participation and other factors. We use an econometric model, the Tobit model, designed to account for the presence of zeros in the data and find, unlike much of the previous research, a fairly large income effect—income elasticity of one—suggesting that the implicit lottery tax in Spain is not regressive.

The Spanish National Lottery

The National Lottery is managed by a public institution, Loterías y Apuestas del Estado (LAE), which is also responsible for several lotto games, the football pools, and some games related to horse racing. Currently, the National Lottery has become the main source of public revenues in the Spanish gambling market. The National Lottery is a draw lottery, a passive game where the tickets are prenumbered and the player cannot choose the numbers but instead buys a ticket, or a fraction of it, and waits for the draw that identifies the winning ticket. Although passive-draw lottery games are not universal—very few countries have passive lotteries—Spain is an exceptional case since it has a very popular passive lottery. Selling periods are usually long between draws and prizes are set in advance and do not depend on sales. The Spanish National Lottery draw takes place every Thursday and Saturday throughout the year. In addition to these regular draws, there are special draws taking place at specific times of the year, including the Christmas Lottery draw—the most popular lottery draw in Spain[3]—and the Epiphany draw. There are also monthly draws tied to particular celebrations (i.e., a summer special draw) and some draws to benefit charity or promote health organizations, like the Spanish Red Cross or the Spanish Cancer Association, with sales over eighty-five million euros. This adds up to more than 100 draws per year.

The prevalence and scale of passive draw lottery games in Spain can be explained by several factors that make the Spanish National Lottery different from other lottery systems and worthwhile to analyze. The National Lottery distributes 70 percent of sales as prizes[4]—so the Spanish government receives the remaining 30 percent of the revenue from ticket sales, less the operations costs—which leads to approximately 35 percent of tickets winning some prize and also generates appealing high jackpots. The philosophy of the game is based on generating a maximum number of prizes for players, so player have ample opportunities to recover bets. Prizes are paid immediately and there are no taxes on both sales and winnings. Yet Spain's lottery is notable not just for the sums to be won but also for its unique prize structure.

National Lottery tickets are sold in most, but not all, LAE offices nationwide in Spain. Each ticket contains preprinted numbers; players have no ability to select specific numbers in this game. Prizes are awarded based on the number of digits matching the winning numbers. Additional numbers are drawn to determine lower prizes. Each draw uses tickets with five-digit numbers between 00000 and 99999 (except in the Christmas Lottery draw where numbers range from 00000 to 84999). The probability of winning the

Table 1. Spanish National Lottery Features

	2006		
Sales (euros)	5,452,525,289		
Prizes offered (euros)	6,136,200,000		
Tickets printed	100,300,000		
"Series" printed	1,030		
Tickets sold	49,187,379		
Draw	Sales (euros)	Price (euros)	Jackpot (euros)
Loteria Nacional (Thursday)	238,728,813	3	1,200,000
Loteria Nacional (Saturday)	4,994,749,776	6–12	3,000,000–5,000,000

grand prize in each draw is one in one hundred thousand. The lottery also offers enough smaller prizes in addition to its jackpots to give participants almost a one-in-six chance of winning something. Due to the enormous popularity of the game,[5] each set of numbers is sold multiple times, in several "series." There is no difference in prize money across series. That is, a prize on a five-digit number is paid on that number in every series. Therefore, the series number is merely administrative. LAE encourages mass participation by dividing each entire ticket (called a '*billete*') in tenths (called '*décimos*' or a tenth part of an entire lottery number). Thursday tenths cost three euros while Saturday tenths cost between six and twelve euros depending on the draw. For special draws, the tenth price is increased to twenty euros, with a corresponding increase in prize money. Players can ask for a specific number to be ordered and retained for long-term customers at the lottery office. Players can also buy a complete lottery ticket but that type of play is uncommon because of the expense.

Table 1 reports some basic facts about the National Lottery based on data from 2006. Note that "Prizes offered" represents the theoretical maximum that would be paid out in prizes of all tickets were sold. Since roughly 50 percent of the tickets printed were sold, the actual prize money paid out would be considerably smaller. Either individually or through associations and other organizations, it is also possible to buy or be given smaller portions of one ticket. Usually, the price of those portions is increased by a supplement that is paid as a donation to the intermediary organization. Players can also improve their odds by buying small shares in many tickets, often by forming syndicates with friends and colleagues.[6] All this has transformed the National Lottery in Spain

from a tax on the poor, as it is in most countries, into a social phenomenon. Buying and sharing tickets has become a way to reinforce social ties.

Probably, the most popular draws of the National Lottery are the Christmas Lottery and the Epiphany draw, which both take place during the Christmas period. The Christmas Lottery draw takes place on December 22 offering a prize of three million euros for the holders of each whole ticket issued in 185 "series" while the Epiphany draw takes place on January 6 and has a top prize in each "series" of two million euros.

Empirical Findings from the Economic Literature

Many previous studies have examined the relationship between lottery spending and income using micro data. Although the settings and empirical approaches differ, these studies uniformly report either low-income elasticities, suggesting that lottery tickets are inferior goods and lottery players predominately come from the lower end of the income distribution, or no relationship between income and lottery spending, suggesting that lottery tickets purchases are not related to income and lottery players are uniformly distributed across the income distribution.

Spiro (1974) conducted the first analysis of lottery spending using micro data collected from lottery winners in Pennsylvania in the early 1970s. This study reported an income elasticity of 0.22 based on ordinary least squares (OLS) estimates of a model of the determination of the number of lottery tickets purchased by lottery winners. Other early studies reporting income elasticities of 0.5 or less based on OLS estimates include Brinner and Clotfelter (1975), Clotfelter and Cook (1987), and Borg and Mason (1988).

Livernois (1987) examined the relationship between income and lottery spending in the Canadian province of Alberta using a representative sample of Albertans from 1983. Since survey data from random samples of individuals contain a nontrivial number of zeros generated by nonparticipants, econometric techniques to account for these zeros must be used. Livernois (1987) used the Tobit estimator and found that the parameter on the income variable was not statistically significant. Kitchen and Powells (1991) applied Tobit to micro data from the 1986 Canadian Family Expenditure Survey and report income elasticities of between 0.70 and 0.93 using pooled data for Canadian regions. However, this study used after tax income, while the other studies discussed use before tax income. Other studies reporting income elasticities below 0.5, or no relationship between income and lottery spending, based on Tobit estimates include Scott and Garen (1994) using data from Kentucky, Farrell and Walker (1999) using data from the United

Kingdom, Worthington (2001) using data from Australia, and Worthington et al. (2007).

A handful of studies have used other econometric techniques to account for the presence of zeros in survey data on gambling spending. Scott and Garen (1994) and Farrell and Walker (1999) estimate two-step Heckman selectivity models. These studies find no relationship between income and lottery spending and implied income elasticities smaller than 0.5, respectively. Abdel-Ghany and Sharpe (2001) estimate a double hurdle model using data from the 1996 Canadian Family Expenditure Survey. The implied income elasticities, based on data pooled by province, ranged from 0.025 to 0.427.[7] However, Jones (2000) points out that the two-step Heckman selectivity model is not consistent with zeros generated by corner solutions in the consumers' utility maximization problem; the likelihood function for the Heckman model requires that all observed nonparticipants will never participate in lottery. This assumption appears to be inappropriate for the zeros in these data, which could represent individuals who would participate in the National Lottery in some circumstances but had not participated recently when surveyed. This may explain why Scott and Garen (1994) and Farrell and Walker (1999) find no relationship between income and lottery spending. Jones (2000) also points out that both Tobit models and two-part models, like the double hurdle model estimated by Abdel-Ghany and Sharpe (2001), can be applied to cases where the observed zeros represent corner solutions to the consumers' utility maximization problem at current lottery prices and expected payoffs.

Evidence on the relationship between income and lottery spending derived from micro data has consistently found either no statistical relationship between income and lottery spending or income elasticities smaller than 0.5. These results use survey data from U.S. sates, Canadian provinces, and nationally representative surveys from Canada, Australia, and the United Kingdom. They are based on a wide variety of econometric approaches, including OLS estimates from samples of lottery participants and Tobit, Heckman selectivity, and double hurdle model estimates from random population samples of gamblers and nongamblers. We extend this line of research using nationally representative survey data from Spain. The Spanish lottery market differs from the other lottery markets analyzed in the literature in several important ways.

An Econometric Model of Lottery Expenditure

We consider lottery tickets to be a good that households purchase like any other consumption good, and no assumptions are made about the

household's risk aversion. Under this assumption, the appropriate econometric framework to adopt has to deal with the censoring of the expenditure variable at zero. The Tobit model takes this into account, assuming that the dependent variable has a number of its values censored at a certain value, usually zero.[8]

Following McDonald and Moffit (1980), the Tobit model specification can be written as

$$\begin{aligned} y^* &= X_i\beta + u_i \\ y_i &= y^* \quad \text{if} \quad y^* > 0 \\ y_i &= 0 \quad \text{if} \quad y^* \leq 0 \\ i &= 1, 2, \ldots, N, \end{aligned} \tag{1}$$

where N is the number of observations, y_i is the dependent variable—defined here as individual expenditure on National Lottery—and X_i is a vector of covariates of individual i. Assuming that u is a random variable, then the model generates both positive observations of y for those households that purchase lottery tickets and observations piled up at zero for those households who do not purchase gaming goods because the purchase of lottery tickets is not utility maximizing.

Let u be an identical and independently distributed random variable drawn from a standard normal distribution, $u \sim N(0, \sigma_u^2)$. Under these conditions, the likelihood function for N independent observations generated by this model can be expressed

$$L = \Pi_0[1 - \Phi(X'\beta/\sigma)]\Pi_0\sigma^{-1}\phi(y - X'\beta)/\sigma], \tag{2}$$

where Π_0 is the product operator applied to observations where $y = 0$, Π_1 is the product operator applied to observations where $y = 1$, $\Phi(\cdot)$ is the standard normal distribution function and $\phi(\cdot)$ is the standard normal density function. This likelihood function is the Tobit estimator.

Even though the Tobit model may be unattractive because of its sensitivity to the assumption of normality of the unobservable equation error term, as pointed out by Farrell and Walker (1999), we use this model to estimate consumers' spending on National Lottery and to calculate income elasticities as in Farrell and Walker (1999).

Characteristics of Lottery Consumers

In this article, we use data from two household computer-assisted random digit dial (RDD) telephone interview surveys of gambling behavior in Spain

administered by LAE in 2005 and 2006. Both surveys consisted of random samples of all adult residents of Spain. The first survey took place in the spring of 2005, the second in the summer of 2006. A total of 1,412 households participated in the first survey, and 1,205 households participated in the second survey. These surveys contain a considerable amount of detailed information about consumers purchase. Additionally, the survey contains information about monthly expenditure on lottery and other sociodemographic factors such as age, gender, education, and employment status. Although a large number of identical questions appeared on both, there were a few differences between the two surveys. The exact age of the head of the household was available in the first survey, but only age intervals were available in the second. We recoded each age interval variable at the midpoint of the range for the second survey. Also, monthly income data were collected by income range, and we recoded the income variable reported for each respondent at the midpoint of the range.

As discussed above, the Christmas and Epiphany lotteries differ significantly from other draws of the National Lottery. In this article, we focus on regular draws of the National Lottery, not on the Christmas lottery. We exclude participants in the Christmas lottery through the following procedure. The first survey explicitly asked if the respondent played only the Christmas lottery or played the National Lottery throughout the year. For individuals who indicated that they played only the Christmas lottery, we set spending on the National Lottery equal to zero. The second survey did not contain a question about participation in the Christmas lottery, but it did contain a question about frequency of participation in the National Lottery. Responses included participation "every time there is a draw," "at least one time per week," "at least one time per month," "with less frequency," and "never or almost never." For individuals who reported participating in the National Lottery "with less frequency" and "never or almost never," we set total spending on the National Lottery equal to zero. That is, we assume that individuals in the second survey who report infrequent participation in the National Lottery are only participating in the Christmas lottery. The results reported below are not sensitive to this assumption.

Table 2 shows summary statistics for the household economic and demographic variables in the surveys. The respondents were equally distributed by gender. Most were married and employed. The average years of education of the respondents is less than the number of years required to complete a college education under the educational system in Spain. The average income of respondents is close to the average household income in Spain

Table 2. Summary Statistics

Variable	Mean	Std. dev.	Min	Max
Percent reporting regular participation	16.1	—	—	—
Average monthly spending on National Lottery	3.81	41.55	1	2000
Age of head of household	46	17	18	93
Real monthly income	1,577	1,039	250	5,020
Real monthly income per person	605	490	25	5,020
Male head of household	0.48	0.50	0	1
Single head of household	0.13	0.33	0	1
Years of education	13.69	5.56	0	22
Employed head of household	0.66	0.48	0	1

at the time of the surveys. Similar comparisons could be made for the other variables.

Empirical Results

The likelihood function described above, equation (2), describes the empirical model for explaining consumers' spending on the Spanish National Lottery where the dependent variable is monthly lottery expenditure. A common vector of explanatory variables, including age and age squared,[9] income, gender, marital status, employment status, and the level of education, has been used in most previous empirical studies of consumer expenditure on gambling goods. We also use this set of covariates to explain consumer expenditure on the National Lottery. In addition we use the household income variable divided by the (size) number of persons in the household as an alternative explanatory variable. The lottery expenditure question is asked to the reference person and that person may not have access to all the household income when making decisions about gambling expenditure. For example, if the reference person is a husband and his wife also works, household income would be the sum of the two incomes. However, the husband may or may not be able to purchase gambling goods out of his wife's income. Dividing household income by the number of persons in the household is a simple way to implicitly control for access to household income.[10]

Table 3 shows the parameter estimates and p values for the Tobit model, equation (2). All of the estimated parameters on the explanatory variables have the expected signs based on economic theory and previous literature. Age is significant and positive, and age squared significant and negative. This indicates age has an inverse U-shaped relationship with lottery ticket

Table 3. Parameter Estimates and *p* Values, Tobit Model

Dependent Variable is Monthly Expenditure on Spanish National Lottery		
Variable	Model 1	Model 2
Age	7.213 (<0.001)	7.018 (<0.001)
Age^2	−0.068 (<0.001)	−0.066 (<0.001)
Income	8.776 (0.024)	—
Income/number of members	—	15.57 (0.050)
Male	20.44 (0.005)	21.63 (0.003)
Single	−7.411 (0.517)	−20.53 (0.100)
Years education	−2.447 (0.001)	−3.300 (0.011)
Employed	5.110 (0.615)	6.482 (0.525)
Constant	−294 (<0.001)	−178 (<0.001)
N	2,458	2,425
Log likelihood	−3006	−2982

Note: *p* values are shown in parentheses.

expenditure over the life cycle, with average monthly expenditure rising from youth to middle age, peaking in middle age, and declining thereafter. Males tend to spend more on National Lottery tickets than females. Single persons spend less on National Lottery tickets than married persons, which is again consistent with previous results in the literature. The results do not show a strong relationship between employment status and expenditure on lottery tickets. As in most previous studies, we found that spending on National Lottery falls with the level of education. The marital status variable is significant just in the model 2.

Most previous research finds a weak positive relationship, or no relationship, between income and expenditure on lottery tickets. One exception is results on the relationship between lottery spending and income based on the Suits Index. Beckert and Lutter (2009) recently found that spending on lottery in Germany was regressive based on the Suits Index using survey data and summarized results for ten additional papers that contained evidence of a regressive relationship between lottery spending and income. However, the Suits Index is an unconditional measure of the relationship between lottery expenditure and income that does not control for the effect of other factors related to income, like education and age, which could confound an unconditional measure like the Suits Index. The unconditional nature of the Suits Index and the conditional nature of the results reported here explain the differences in the relationship between income and spending on lottery.

The results on Table 3 indicate that consumer spending on Spanish National Lottery increases with monthly household income, identifying the National Lottery as a normal good. However, it should be noted that in this type of research, there is a tendency from respondents to underreport lottery expenditures (Jaffe, Pasternak, and Grifel 1983), meaning that the conclusions reached here should be interpreted with caution. In any case, these results hold for both the household income and the household income per person model specifications. When income squared was added to models 1 and 2, the parameter was significant in model 2 only, providing weak support for a nonlinear relationship between income and National Lottery expenditure (results available on request).

Above, we discussed the possibility that the Tobit model is not the best econometric approach for dealing with the zeros present in this survey data in the literature review above. In addition to the Tobit model, Jones (2000) advocates the use of two-part models like the double hurdle model as alternative econometric approaches. As a robustness check, we estimated one of the two-part models discussed by Jones, the Cragg model (Cragg 1971) using the same sample as reported on Table 3. The Cragg model is a maximum likelihood approach that includes the simultaneous estimation of a probit model for participation in lottery markets and a truncated regression model for expenditure on lottery. The estimates from the expenditure model were quite similar to those reported on Table 3, in terms of the sign and statistical significance of the estimated parameters on the explanatory variables.

A complete understanding of the relationship between income and expenditure on lottery tickets requires some additional work. McDonald and Moffitt (1980) describe the complex relationship between changes in an explanatory variable and the dependent variable in the Tobit model. Because of the presence of zeros in the data, the effect of a change in income on lottery expenditure works on two margins: the effect of changes in income on the decision to buy lottery tickets and the effect of changes in income on the amount spent on lottery tickets. In other words, an increase in income can have two effects: induce some people who did not previously purchase lottery tickets—the zeros in the data—to purchase lottery tickets and induce people who already purchase lottery tickets to spend more. This dual effect complicates the calculation of elasticities in the Tobit model.

McDonald and Moffitt (1980) develop a method for decomposing the parameter estimates from Tobit models into the effect on nonparticipants and participants. Recall, from equation (1) that the Tobit model is motivated by a latent variable model. In this model, the purchase of lottery tickets

Table 4. Tobit Parameter Decomposition and Elasticity

	Model 1	Model 2
Estimated percent of sample above threshold	0.500	0.500
Percent of total response due to response above threshold	0.999	0.999
Change in expenditure above threshold	4.388	7.785
Change in expenditure below threshold	0.006	0.011
Elasticity	1.816	1.237
Average monthly income	1,577	605
Average lottery ticket expenditure	3.81	3.81

generates latent utility, and people purchase lottery tickets only of this latent utility exceeds some threshold value, y^*. The expected value of expenditure on lottery tickets for those people who are above the threshold value (i.e., those who already purchase lottery tickets) is

$$E[y*] = \Pr(y > 0)E[y|y > 0] = X_i\beta + \sigma f(z)/F(z), \tag{3}$$

where σ is the variance of the equation error term in the Tobit model, u, $z = X\beta/\sigma$, $f(z)$ is the normal density function, and $F(z)$ is the normal cumulative density function. McDonald and Moffit (1980) show how a change in any explanatory variable X_i can be decomposed into two parts

$$\partial Ey/\partial X_i = F(z)(\partial Ey*/\partial X_i) + E[y*](\partial F(z))/\partial X_i). \tag{4}$$

The first term captures the effect of the change in X_i on those above the threshold (current purchasers of lottery tickets) weighted by the probability that they are above this threshold, and the second term captures the effect of the change in X_i on the probability that an individual is above the threshold (people who switch from not purchasing lottery tickets to purchasing them) weighted by the expected utility. Given estimates of β and σ from the Tobit estimator, and standard statistical tables, equation (4) can be easily calculated. The decomposition sheds light on the relative magnitudes of the effect of increases in income on the decision to participate in lottery markets, and the effect of increases in income on spending on lottery tickets, conditional on participation.

Table 4 summarizes the parameter decomposition and elasticity estimates for the income variable in the Tobit model. The estimated percentage of the sample above the threshold value is based on the parameter estimate on income only and is larger than the actual participation rate in the sample. The income elasticity is roughly unitary elastic for the household income

model and a bit lower for the income per person model. Both suggest that a 1 percent increase in income produces a roughly proportionate change in lottery ticket expenditure. However, the parameter decomposition indicates a radically different story about the effect of income changes on lottery ticket expenditure. Virtually all of the effect of changes in income on lottery expenditure takes place above the threshold value; an increase in income induces current lottery ticket buyers to spend more on tickets but does not lead nonparticipants to enter the market. This effect holds for both definitions of income. In this case, the elasticity estimate masks a more complex response to changes in income. This decomposition suggests that lottery ticket buyers in Spain are distributed throughout the income distribution, since increases in income have little effect on the decision to purchase. However, conditional on purchase, the effect of increases in income on expenditure is quite strong.

Discussion and Concluding Remarks

The regression-based analysis of consumer expenditure on National Lottery tickets in Spain reveals several interesting features. First, the characteristics of participants in this market are quite clear. The relationship between expenditure and age follows the familiar inverted U-shape. Based on the point estimates from model 1 on Table 3, lottery expenditure peaks at about fifty-two years of age in this sample. Men spend more on lottery tickets than women. Expenditure on the Spanish National Lottery, like expenditure on other lottery games around the world, falls with the level of education. So the prototypical Spanish National Lottery player is a middle-aged married male with relatively low education.

The relationship between education and expenditure may be related to the passive nature of the National Lottery. Passive games are not complex—the buyer simply purchases a ticket with a preassigned number and waits for the draw. Participation takes a minimal amount of mental effort, as opposed to active draw lotteries that require the selection of numbers. Active draw lotteries, and other decisions made under uncertainty, may be subject to the "illusion of control" where individuals believe that their ability to make specific choices can affect uncertain outcomes. This has been shown to exist in many decisions under uncertainty, like portfolio choice (De Bondt 1998). This may also explain the differences between our results and those in Sawkins and Dickie (2002) who find that participation and expenditure in an active lottery game in Canada increases with the level of education.

The decomposition of the estimated Tobit parameters on income and the income elasticity calculation have some interesting implications for the understanding of consumer demand for lottery and for assessing the incidence of the implicit tax on lotteries. We find higher income elasticities than any others reported in the literature using micro data. Our income elasticity estimate is similar to the income elasticity reported by Oster (2004) for periods when the Powerball lotto game in the United States had a large number of consecutive rollovers; this is the largest estimated income elasticity reported in studies using aggregated data. Unlike lottery tickets in the United States, Canada, Australia, and the United Kingdom, tickets for the Spanish National Lottery are normal goods. Several reasons for this high elasticity immediately come to mind. First, LAE returns about 70 percent of lottery sales as prizes. This 30 percent take-out rate is among the smallest in the world and relatively tiny compared to the 45 to 55 percent take-out rates common in the United States, Canada, Australia and the United Kingdom. Farrell and Walker (1999) show that the takeout rate affects the implicit price of lottery tickets. By setting a low takeout rate, LAE may be setting an effective price in the elastic region of the demand curve, inducing participation by individuals in Spain, who would not participate in lotteries with higher takeout rates. This explanation requires that income elastic varies systematically with prices, implying non-homothetic preferences. Alternatively, takeout rates may affect participation through some channel other than the effective price. Second, unlike in the United States, lottery winnings in Spain were not taxed at the time this survey was conducted. This may induce higher income individuals to participate in the Spanish national lottery. Finally, the Spanish National Lottery has been in existence since the eighteenth century, while most lotteries in the United States, Canada, Australia, and the United Kingdom have only been in existence a few decades, at most. The long tradition of lottery participation in Spain may induce different patterns of lottery participation compared to other countries.

These results have some implications for lottery design, especially in other countries where lotteries appear to be regressive, like the United States, the United Kingdom, and Canada. Designing a lottery that attracts more players from the upper portion of the income distribution would clearly be desirable from an equity perspective. The Spanish National Lottery has several features that could be adopted in new lottery games. First, the National Lottery has a relatively low takeout rate. The 45 percent takeout rate common in other lotteries could be reduced in new lottery products, which could induce individuals with higher income to participate. Second,

the National Lottery is frequently played collectively by groups of friends or family members. New lottery products could be designed with features that encourage participation by groups, perhaps in conjunction with new social media like Facebook. Third, the National Lottery is a passive lottery, and most of the more regressive lotteries are active lotteries that allow participants to pick their own numbers. If this characteristic attracts individuals with higher income to participate, then new lottery products could incorporate some passive elements, perhaps in conjunction with design elements incorporating collaborative participation.

As Clotfelter and Cook (1987), first pointed out, lotteries can be viewed as implicit taxes from a public finance perspective. One important determinant of the incidence of a tax is the income elasticity of the good being taxed. Our estimates indicate that the implicit tax generated by the National Lottery falls on higher income individuals, conditional on participation. This result differs from others in the literature, which uniformly report negative or small positive income elasticities, implying regressive implicit lottery taxes. Our results suggest that all lotteries are not regressive. To the extent that the low takeout rate in the Spanish National Lottery affects the income elasticity, lottery designers may have some affect on the incidence of the implicit lottery tax. However, because participation is unrelated to income, the overall incidence of the tax is difficult to assess. Clearly, this area deserves attention in future research.

This article uses a Tobit regression model to investigate the influence of socioeconomic household features on consumers' spending on the Spanish National Lottery. This is the first attempt to analyze determinants of lottery expenditure in one of the largest lottery markets in the world, the Spanish lottery market. We find that the characteristics of National Lottery participants in Spain are similar to those reported in other settings: middle-aged married males with relatively low education. We also find that the income elasticity of lottery expenditure is high and that the effect of income on expenditure works primarily through individuals who already play the lottery not by attracting new players. This finding suggests an additional line of future research. The Tobit results in this article indicate that the decision to purchase lottery tickets differs from the decision about how much to spend conditional on the decision to purchase. Future research should examine this more fully. One approach would be to use econometric models that allow for the determinants of participation and expenditure to differ, like the hurdle models described by Jones (2000), which has been used to analyze lottery spending in only one previous study (Abdel-Ghaney and Sharpe 2001). Jones (2000) point out that double hurdle models apply to

zeros generated by corner solutions in consumers' utility maximization decisions, a likely source of the zeros observed in survey data on lottery spending.

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Notes

1. Apart from the United States, lottery dominates most gambling markets for a number of reasons. It is a very simple game that does not require specific knowledge such as is needed for other gambling activities like sports betting. This makes lottery gambling much more accessible than other forms of gambling and therefore it is to be expected that participation rates are higher than for other modes.
2. Examples include Spiro (1974), Brinner and Clotfelter (1975), Livernois (1987), Borg and Mason (1988), Price and Novak (2000), and Combs, Kim, and Spry (2008).
3. As measured by the total prize payout, the Christmas Lottery draw could be considered the biggest lottery worldwide. In 2006, if all of the tickets were sold, the total amount payout of prizes would be worth more than 2.1 billion euros. The total amount of all prizes of the first category was 540 million euros that was distributed among 180 winning tickets that won three million euros each.
4. As far as we know, this is the highest percentage in the world.
5. According to reports in the press, at Christmas time around 98 percent of all Spanish people share a lottery ticket with other people, even if they do not

gamble during the rest of the year (this includes tickets purchased or received as a gift or exchanged with family and acquaintances).

6. As pointed out by Garvía (2007) such syndicated play is very common in Spanish National Lottery.
7. The income elasticity for one province, Alberta, was 0.751. This study also used after tax income.
8. See Livernois (1987) and Clotfelter and Cook (1990), among others, for empirical applications of Tobit models in gambling consumption.
9. Both age and age squared are used to allow for a nonlinear relationship between age and expenditure.
10. We also estimated an alternate model that included both income and the number of people in the household linearly. The estimated parameter on number of persons in the household was not statistically significant, and the parameter estimates on the other explanatory variables, including income, did not change in sign or significance.

References

Abdel-Ghany, Mohamed, and Deanna L. Sharpe. 2001. "Lottery Expenditures in Canada: Regional Analysis of Probability of Purchase, Amount of Purchase, and Incidence." *Family and Consumer Sciences Research Journal* 30:64-78.

Beckert, Jan, and Mark Lutter. 2009. "The Inequality of Fair Play: Lottery Gambling and Social Stratification in Germany." *European Sociological Review* 25:475-88.

Borg, Mary O., and Paul M. Mason. 1988. "The Budgetary Incidence of a Lottery to Support Education." *National Tax Journal* 41:75-86.

Brinner, Roger E., and Charles T. Clotfelter. 1975. "An Economic Appraisal of State Lotteries." *National Tax Journal* 28:395-404.

Clotfelter, Charles T., and Philip J. Cook. 1987. "Implicit Taxation in Lottery Finance." *National Tax Journal* 40:533-46.

Clotfelter, Charles T., and Philip J. Cook. 1990. "On the Economics of State Lotteries." *Journal of Economic Perspectives* 4:105-19.

Combs, Kathryn L., Jaeboem Kim, and John A. Spry. 2008. "The Relative Regressivity of Seven Lottery Games." *Applied Economics* 40:35-39.

Cragg, John G. 1971. "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods." *Econometrica* 39:829-44.

De Bondt, Werner F. M. 1998. "A Portrait of the Individual Investor." *European Economic Review* 42:831-44.

Farrell, Lisa, and Ian Walker. 1999. "The Welfare Effects of Lotto: Evidence from the UK." *Journal of Public Economics* 72:99-120.

Garvía, Roberto. 2007. "Syndication, Institutionalization and Lottery Play." *American Journal of Sociology* 113:603-53.

Jaffe, Eugene D., Hanoch Pasternak, and Avi Grifel. 1983. "Response Results of Lottery Buyer Behavior Surveys: In-Home vs. Point of Purchase Interviews." *Public Opinion Quarterly* 47:419-26.

Jones, Andrew A. 2000. "Health Econometrics." In *Handbook of Health Economics*, edited by A. Cuyler and J. Newhouse, vol. 1A. New York: North-Holland.

Kitchen, Harry, and Scott Powells. 1991. "Lottery Expenditures in Canada: A Regional Analysis of Determinants and Incidence." *Applied Economics* 23:1845-52.

Livernois, John R. 1987. "The Redistributive Effects of Lotteries: Evidence from Canada." *Public Finance Quarterly* 15:339-51.

McDonald, John F., and Robert A. Moffit. 1980. "The Uses of Tobit Analysis." *The Review of Economics and Statistics* 62:318-21.

Mikesell, John L. 1989. "A Note on the Changing Incidence of State Lottery Finance." *Social Science Quarterly* 70:513-21.

Oster, Emily. 2004. "Are all Lotteries Regressive? Evidence from the Powerball." *National Tax Journal* 57:179-87.

Price, Donald I., and E. Shawn Novak. 2000. "The Income Redistribution Effects of Texas State Lottery Games." *Public Finance Review* 28:82-92.

Sawkins, John W., and Valerie A. Dickie. 2002. "National Lottery Participation and Expenditure: Preliminary Results Using a Two Stage Modelling Approach." *Applied Economics Letters* 9:769-73.

Scott, Frank, and John Garen. 1994. "Probability of Purchase, Amount of Purchase, and the Demographic Incidence of the Lottery Tax." *Journal of Public Economics* 54:121-43.

Spiro, Michael H. 1974. "On the Tax Incidence of the Pennsylvania Lottery." *National Tax Journal* 27:57-61.

Worthington, Andrew C. 2001. "Implicit Finance in Gambling Expenditures: Australian Evidence on Socioeconomic and Demographic Tax Incidence." *Public Finance Review* 29:326-42.

Worthington, Andrew C., Kerry Brown, Mary Crawford, and David Pickernell. 2007. "Gambling Participation in Australia: Findings from the National Household Expenditure Survey." *Review of Economics of the Household* 5:209-21.

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