On the Economics of State Lotteries

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State lotteries can be evaluated from either of two perspectives familiar to economists: as a consumer commodity or as a source of public revenue. As a commodity, the lottery is notable for its broad market penetration and rapid growth. Sixty percent of the adults in lottery states play at least once in a year. The annual growth in real per capita sales in lottery states has averaged 12 percent, rising in 1989 dollars from $22 in 1975 to $108 in 1989. As a source of public revenue, lotteries account for a rather modest fraction of revenue in states that run them (3.3 percent in 1986), but they are nonetheless one of the most visible state government activities. Lottery sales exceed those of all other products sold directly by state governments to the public and are larger than all but three major activities of state government: education, public welfare and highways (Clotfelter and Cook, 1989, Table 2.5).

Moreover, lotteries are a qualitatively new activity for state governments, in that they are a business operated, in effect, for profit. State liquor stores are perhaps the closest analog, but they were created to encourage temperate drinking practices and do not engage in the sales promotion and marketing activities that are characteristic of the lotteries.

Lotteries enjoy an honored place in American history as a device for raising funds for public purposes. Funding for such institutions as the Jamestown settlement, Harvard College, and the Continental Army, as well as hundreds of bridges, fire houses and schools came from lotteries. But after the

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notorious Louisiana lottery of the post-Civil War era,[1] lotteries were prohibited by every state in this century until 1963, when New Hampshire adopted one. Thus, modern lotteries are a restoration of a device for exploiting the widespread interest in gambling at long odds for the sake of funding worthy activities. Since 1963, 32 states and the District of Columbia have created lotteries, and it is a good bet that other states will follow in the next few years.

This article examines several aspects of the economics of state lotteries, focusing primarily on the demand for lottery products. We begin by giving a descriptive overview. The succeeding sections examine the motivations for playing lottery games and evidence on the determinants of lottery demand. The final section considers the welfare economics of the apparent objective of lotteries—to maximize profits for the state.

An Overview of State Lottery Operations

Table 1 provides summary information on the 32 American state lotteries in operation during 1989.[2] States are arranged in decreasing order of gross sales for 1988, and data are provided on the year the lottery began operation, the per capita sales, the distribution of revenues, and the types of games offered. Table 1 displays an interestingly high variation between states in sales per capita. For example, Massachusetts outsells neighboring Vermont by a factor of three, despite the fact that they both have well-established lotteries offering very similar products. These interstate differences suggest that tastes for lottery gambling differ widely across population groups.

The next three columns of Table 1 show how each state distributes its lottery revenues. On average, half of all lottery revenues are returned in the form of prizes, a ratio that is much lower than that offered by other forms of commercial gambling such as bingo (74 percent), horseracing (81 percent), or slot machines (89 percent) (Clotfelter and Cook, 1989, Table 2.1). In 1989 the payout rate for lotteries ranged from a low of 45 percent in West Virginia to a high of 60 percent in Massachusetts. Operating expenses, which include the roughly 5 percent of sales paid as commissions to retail sales agents, average 10

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[1]From 1878 until 1894, the Louisiana Lottery Company offered the only legal game in the country. Most of its sales were to residents of other states, where lotteries were outlawed. In response to increasing demands for federal intervention, Congress enacted a series of restrictions on the use of the mails to conduct lotteries, and finally in 1895 barred all lottery activity in interstate commerce. The Lottery Company earned its reputation of corruption by routinely bribing Louisiana legislators to continue its monopoly charter in the state.
[2]Minnesota's lottery began selling tickets in April 1990.

Table 1

U.S. Lottery Sales and Distribution of Revenues

State	Year Began	1989 Sales (millions)	1989 Sales per capita	Payout prizes, from FY 1989 (percent)	Operation costs from FY 1989 (percent)	Net Revenue from FY 1989 (percent)	Games Offered[a]
California	1985	$2595	$89	50%	11%	39%	I, L
New York	1967	2034	113	47	7	46	I, L, N
Florida	1988	1982	156	50	12	38	I, L, N
Pennsylvania	1972	1653	137	51	8	42	I, L, N
Massachusetts	1972	1551	262	60	10	30	I, L, N
Ohio	1974	1540	141	49	12	39	I, L, N
Illinois	1974	1521	130	55	7	38	I, L, N
New Jersey	1970	1250	161	49	9	43	I, L, N
Michigan	1972	1171	126	48	10	42	I, L, N
Maryland	1973	765	163	47	8	45	I, L, N
Connecticut	1972	494	152	49	6	44	I, L, N
Virginia	1988	375	61	50	15	34	I, L, N
Arizona	1981	295	83	48	13	40	I, L
Wisconsin	1988	262	54	52	11	37	I, L
Washington	1982	255	54	46	13	41	I, L, N
Missouri	1986	223	43	50	16	34	I, L, N
Kentucky	1989	217	58	51	16	33	I, L
Iowa	1985	170	60	54	18	29	I, L
Oregon	1985	164	58	52	15	33	I, L, N
District of Columbia	1982	144	240	47	16	37	I, L, N
Indiana[b]	1989	143	26				I
Maine	1974	105	86	51	17	32	I, L, N
Colorado	1983	105	32	51	25	23	I, L
New Hampshire	1964	86	77	53	11	36	I, L, N
Kansas	1988	76	30	49	19	32	I, L
Delaware	1975	64	96	53	10	38	I, L, N
West Virginia	1986	62	33	45	25	30	I, L, N
Rhode Island[c]	1974	61	61	47	14	39	I, L, N
Vermont	1978	39	68	52	16	32	I, L, N
Idaho[b]	1989	33	33				I
South Dakota	1988	20	28	46	24	30	I
Montana	1988	13	16	46	30	24	I, L
United States		$19468	$108	51%	10%	40%	

[a] L = Lotto, N = Numbers, I = Instant
[b] Began operation after July 1, 1989.
[c] Sales are for fiscal year ending June 30.
Sources: Gaming and Wagering Business 11 (February 15, 1990), 30; (May 15, 1990), 47; U.S. Bureau of the Census, *Current Population Reports*, Series P-25, No. 1058, *State Population and Household Estimates: July 1, 1989*, March 1990. Table 1: unpublished information obtained from state lottery agencies.

percent of gross revenues. The states at the top of the list have lower operating costs per dollar of sales than states with lower sales figures at the bottom of the list, which provides some evidence of increasing returns to scale in the provision of lottery products.[3] From Table 1, it appears that scale economies in provision are exhausted at about $300 million in annual sales.

The "profit" or net revenue remaining after prizes and operating expenses are deducted goes to the state treasury. These transfers can be thought of as implicit taxes levied on the purchase of lottery tickets. Expressed in a form comparable to excise tax rates these implicit taxes are extraordinarily high: the average profit rate of 40 percent (of gross revenues) is equivalent to an excise tax rate of 66 percent (of expenditures net of this tax).[4] By virtue of the evident economies of scale in lottery operation, the large states enjoy the highest rates of profit.

The product line offered by state lotteries today bears little resemblance to the games available in the early 1970s. As late as 1973, the only significant lottery product was a sweepstakes game conducted in much the same way as colonial lotteries; it was essentially a raffle in which bettors bought tickets and waited days or weeks to see if their ticket was drawn. Today this old-fashioned game is virtually extinct, having been replaced by games with quicker payoffs, bigger prizes, and greater intrinsic "play value." The lotteries' first major innovation was the instant game ticket, offering players a chance to discover immediately if they had won a prize. The second new lottery product was a daily numbers game, a computerized imitation of the illegal game that has long been popular in many cities. Designed to appeal largely to this pre-existing market, this game (like its illegal counterpart) lets players choose their own numbers, thus providing an opportunity to become actively involved in the gambling process.

The on-line computer network that supports the numbers game also made it possible to offer a third major lottery product in the early 1980s: lotto. This game features long odds and huge jackpots that build from one drawing to the next if there are no winners. One typical format is a 6/44 game, in which players select six out of 44 numbers, with a probability of 1 in 7.1 million of

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[3]The differences among state lotteries with respect to operating expenses are in part the result of differences in advertising budgets. Collectively lotteries spent 1.4 percent of sales revenue on advertising during fiscal year 1989. At the high end of the distribution, five states spent more than 4 percent: Colorado, Kansas, South Dakota, Virginia, and West Virginia. All of these states had sales below a half billion dollars. Of the nine states with sales above $1 billion, California spent the largest percentage on advertising, at 2.2 percent. Thus part of the scale economies in producing lotteries may be in connection with advertising. (Data from *Gaming & Wagering Business*, March 15, 1990.)

[4]These figures refer to implicit tax rates and do not relate to the administrative costs of lottery finance. Some have suggested that lotteries are an especially inefficient form of taxation since it "costs," say, 11 cents to raise 40 cents, which is much higher than the ratio of administrative costs per dollar of revenue raised for most taxes. This comparison is flawed because the 11 cents per dollar of operating costs for lotteries pays for the provision of a product, not just the collection of revenue. The lottery is not simply a tax.

picking all six numbers correctly. With jackpots (typically stated as the undiscounted sum of 20 annual payments) reaching as high as $100 million, lotto has garnered enormous public interest. As shown in Table 1, most lottery states now offer all three of these games—instant, numbers and lotto—and there is every indication that the states will continue to develop new products in the quest for increased sales. Oregon introduced sports betting in 1989, and a number of states are considering video game slot machines.[5]

Why People Play

Setting aside its game-playing aspects for a moment, a lottery ticket is a sort of risky financial asset, offering a prospect of prizes in return for an investment of 50 cents or a dollar. Since the expected value of the prizes is typically only half the ticket price, the question naturally arises as to why so many adults consider this investment worthwhile. It is true that well-informed players who schedule their bets carefully can improve on the standard 50 percent payout rate. When a lotto jackpot grows sufficiently large through rollovers accumulating from a series of drawings in which no one wins, it may even be possible to place a favorable bet, that is, one with an expected return greater than the cost of the ticket (Thaler and Ziemba, 1988; Chernoff, 1981). But such occasions are rare indeed, and it is safe to say that normally this asset has no place in the portfolio of a prudent investor. Nonetheless, it has very broad appeal.

For some, playing the lottery is an amusing pastime, one that offers the modest pleasures of discovering whether an instant ticket is a winner or discussing lotto strategy with workmates. When players in California were asked whether they played the lottery more for fun or the money, the respondents were about evenly divided. However, of those with incomes below $30,000, 25 percent more respondents cited money than fun, while the reverse was true at upper incomes (*Los Angeles Times* Poll, 1986). In addition to promoting the idea that it is fun to play, lotteries encourage people to think of playing as a public-spirited activity, with the proceeds going to support education or other public services, and that thought may indeed strengthen some citizens' motivation to play.[6] But surely, the hope of private gain is what sells the bulk of lottery tickets.

The challenge to the analyst is understanding why the risky prospects offered by lottery games appeal to people who exhibit some aversion to risk in other circumstances. As a simple example of risk aversion, it has been shown

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[5]South Dakota has such devices in place at lottery outlets. Its video lottery terminals offer an electronic version of poker and several other games. West Virginia lottery has recently introduced video keno at racetracks.

[6]A marketing strategist for one of the largest lottery suppliers, Scientific Games, Inc., argued that the Colorado lottery's decision to earmark revenues for parks and recreation made it possible to sell tickets to many citizens who would otherwise not have played. See "Scientific Games Lures Lifestyles," *American Demographics*, October 1986, *8*, 26–27.

that most people, when given a choice between a 50 percent chance of receiving $1000 and a sure thing of $400, prefer the latter (Kahneman and Tversky, 1979). The propensity to gamble at unfavorable odds was the subject of the classic article by Milton Friedman and L. J. Savage (1948). They suggested that people may perceive a disproportionate benefit to a prize that is large enough to elevate their social standing, and be willing to pay a premium for that sort of chance.

The Friedman-Savage explanation for why otherwise risk-averse people may buy unfavorable chances at large prizes is intuitively appealing. Among other things, it helps explain why lottery games with a relatively modest top prize appeal primarily to low-income players (for whom $500 may be enough to buy a quantum improvement in standard of living, at least temporarily), whereas games with comparatively large jackpots attract more middle-class players (Clotfelter and Cook, 1987, p. 538).

A quite different line of explanation for why rational people would accept unfair bets at long odds is offered by the cognitive psychology literature. In the usual lotto format, the odds against hitting the jackpot are several million to one. Such probabilities are well beyond the realm of experience gained from playing the game, and as a result players cannot be expected to have much intuition about their chances. For example, someone who spends $20 per week on a 6/49 lotto game for his or her adult lifetime would have less than 1 in 200 chance of winning the jackpot. Faced with such a remote chance, people tend to assess the prospect on the basis of rough heuristics like what Tversky and Kahneman (1974) called "availability," defined as the ease with which instances of the event can be brought to mind. In the case of lotteries, the ability to visualize such instances is aided by the steady stream of winners, who are announced each week with considerable fanfare, and by the advertising of lottery agencies.

We documented how lottery advertising emphasizes the chance of winning big with a sample of over 151 television and radio ads from 13 of the largest state lotteries. These ads included very little objective information on the probability of winning. Only 12 percent of our sample ads provided any information about the odds of winning, and none of them stated the probability of winning one of the large prizes. On the other hand the dollar amounts of prizes were mentioned in fully half the ads, and in most cases the reference was to the largest prize.

These ads accentuated the possibility of winning. Out of the 52 television ads in the sample that portrayed a lottery player, two-thirds showed at least one person winning a prize. Some ads debunked pessimists who claimed it was unlikely to win big, or offered themes like: "Somebody's going to win. Why not you?" Such messages, implicit or explicit, help make the dream of wealth credible. By aiding "availability," such ads may tend to produce an exaggerated sense of the likelihood of winning. A gamble which is objectively unfair may thus be perceived as attractive by people who normally are averse to risk.

Tversky and Kahneman's explanation may appeal to economists because it preserves a view of the lottery player as an objective, albeit poorly informed, assessor of the risky prospect offered by a game. However, a more fundamental departure from the economist's expected utility framework may be necessary to explain the existence of an apparently profitable business of providing advice to players on how to choose their numbers. Although every possible play in numbers or lotto has the same chance of winning, many players are willing to pay for advice in the form of "dream books," consultations with astrologers, tabloids offering numerology columns, and computer software that facilitates the analysis of patterns in recent drawings of winning numbers. There is a common tendency to deny the operation of chance even in situations that are entirely chance-determined: an "illusion of control," to use psychologist Ellen Langer's term. She has demonstrated in several gambling experiments that this illusion is heightened if subjects are asked to make choices, even if their efforts have no effect on the probability of winning (Langer 1975, 1978). Thus the success of the lottery may in part reflect the widespread illusion that choosing winning numbers is partly a matter of skill.

Who Plays the Lottery?

Most adults who live in lottery states have played the lottery at least once, but a small percentage of lottery customers are so active as to account for the bulk of all sales. In any given week about one-third of all adults play; over the course of a year participation broadens to encompass 60 percent of the adult public.[7] Among those who do play, the most active 10 percent of players account for 50 percent of the total amount wagered, while the top 20 percent wager about 65 percent of the total.

Interestingly, the degree of concentration among players (as indicated by these percentages) does not depend on the time interval under consideration.[8] This pattern of concentration of sales is typical of consumer products. One rule of thumb in marketing, the "law of the heavy half," holds that the top 20 percent of consumers of any commodity account for about 80 percent of total purchases.[9] Unless heavy players are appreciably less responsive to advertising

[7]Personal communication from Irving Piliavin, estimated from a national telephone survey conducted by the University of Wisconsin Letters & Science Survey Center between June and August, 1989 ($n = 733$). Results from this survey also show that 20 percent of adults living in states without a lottery played at least once in the preceding year, yielding an overall national participation rate of 47.5 percent.

[8]The figures cited are based on *Los Angeles Times* Poll 104, March 1986. Measures of concentration are virtually identical for three surveys that asked respondents to report lottery expenditures for some period preceding the interview: a one-week period (Maryland, 1984), a two-month period (California, 1985), and a twelve-month period (all lottery states combined, 1974). For a discussion of these surveys, see Clotfelter and Cook (1989).

[9]This is also referred to as Pareto's law of the "80/20 rule." See Buell (1986, pp. 8–10).

than occasional players, this concentration implies that the "typical" (median) consumer is of little relevance in marketing the lottery, since it is the atypical, relatively heavy player who accounts for most of the sales. It appears that the primary instrument for converting moderate or inactive players into active players is product innovation, rather than advertising.

Socioeconomic patterns of lottery expenditures have received considerable attention from social scientists as well as lottery marketing directors. We obtained information on the characteristics of players from a number of sources, including several household surveys. Whether measured by participation rate, average expenditure, or the prevalence of heavy players, certain consistent generalizations emerged from our analysis of these sources. Men play somewhat more than women. Adults play more in their middle years than when young (18 to 25) or old (65 and over). Catholics play more than Protestants, approximately half again as much. And lottery play is systematically related to social class, although perhaps not always as strongly as the conventional wisdom would suggest in this regard.

The pattern is clear with respect to one indicator of social class: lottery play falls with formal education. For example, a survey in California found that the proportion of adults who participated during one week in July 1986 ranged from 49 percent for those with less than a high school education to 30 percent for those with a college degree. With respect to occupation, in the California survey lottery play was most common among laborers (including both skilled and unskilled) at 46 percent, and least among advanced professionals (25 percent). Retired people and students played least of all. With respect to race, survey evidence suggests that Hispanics in the west and blacks in the east play more than non-Hispanic whites.

Remarkably, the same sources of data do not demonstrate any consistent relationship between lottery play and household income over the broad middle range; the average expenditure in dollars for households making $10,000 is about the same as for those making $60,000. One implication of this pattern of demand is that the tax implicit in lottery finance is regressive, in the sense that as a percentage of income, tax payments decline as income increases.

It is interesting to note that even when all these socioeconomic factors are taken into account, there remain certain individuals who simply display a strong propensity toward gambling that is strongly predictive of lottery play. The most complete survey of gambling participation ever conducted in the United States was the National Study of Gambling, a national survey conducted in 1975 involving 1,735 respondents (Commission on the Review of the National Policy toward Gambling, 1976). Questions were asked concerning participation in all forms of commercial gambling, both legal and illegal. For the respondents from lottery states, lottery participation was twice as high among gamblers as among those who did not participate in other commercial gambling (74 percent as opposed to 36 percent), and that association remained strong in a multivariate analysis.

However, the majority of lottery players were not otherwise involved in commercial gambling, and would not have been in the absence of the lottery. For example, a person with the socioeconomic characteristics associated with a 27 percent likelihood of participating in some form of commercial gambling if living in a non-lottery state had a participation probability of 52 percent in a lottery state. In sum, the lottery has an especially strong appeal to established gamblers, but it also recruits many people who would not otherwise become involved in commercial gambling.

The Effect of Changing Prices and Payoffs

An appropriate definition of price is not obvious in the case of lottery products because there is no single best definition of quantity. One reasonable definition of the quantity unit is "one dollar's worth of expected prize value." Price would then be the cost of buying that unit, or the reciprocal of the payout rate. Consider, for example, the straight three-digit numbers game, in which the probability of winning is 1 in 1000. Most states pay off at a rate of 500 to 1, for an average payout rate of 50 percent and a price, by this definition, of $2.00. In Massachusetts, which is unique in paying 700 to 1 on a straight three-digit bet in its numbers game, the price would be $1.43. Although quantities of different lottery games cannot be added together—one "unit" of the numbers game cannot be added to one "unit" of lotto to get a meaningful total—total expenditures may be.

It would be surprising indeed if a reduction in price (an increase in the payout rate) did not increase expenditures somewhat. One common pattern of lottery play is for players to "reinvest" small prizes in additional tickets (Clotfelter and Cook, 1989, p. 111), which virtually ensures an expenditure increase from a hike in the payout rate, even if players' evaluation of the game does not change.[10] If it is true that total expenditures are stimulated by an increase in the payout rate, then by definition the demand for lottery products is elastic. But knowing that would not be sufficient for a lottery designer who requires assurance that an increase in the payout rate will increase the lottery's profitability, a result that would require under current payout rates a price elasticity greater than 2 in absolute value.[11]

[10] This behavior could be understood as an effort by players to limit their net expenditures on lottery products, staying within a self-imposed budget that allocated a certain amount to lottery play each week.

[11] Let $C(Q)$ represent operating costs as a function of quantity units, where one quantity unit is defined as one dollar in expected value of prizes. The lottery agency's net profits are given by $N = PQ - Q - C(Q)$, where P is the price charged for a quantity unit. The first-order condition for profit maximization can be written

$$-E_{PQ} = P(1 - C')/[P(1 - C') - 1].$$

If marginal operating costs are 6 percent of sales and the payout rate is 50 percent, we have $P = 2$

This issue cannot be resolved with available data, simply because payout rates over time and across states are too uniform to create the necessary contrast. For example, as of 1986 numbers games in all states except for Massachusetts offered a payout rate of 50 percent. Lotto exhibits slightly more interstate variation in payout rates, but it also differs across states in format and the size of the betting pool, which may also influence sales and make specifying a demand equation difficult. Our regression analyses suggested that sales were quite sensitive to price, but the coefficient estimate was not very stable with respect to alternative specifications for cross-section data on states.[12]

Much more clearcut is the evidence that lotto sales are responsive to rollovers in the jackpot. Under typical lotto rules, if a drawing fails to produce a winner the money in that jackpot is "rolled over" to the subsequent drawing. If several consecutive drawings produce no winners, the jackpot continues to accumulate and the expected value of a bet grows accordingly.[13] This form of price reduction stimulates sales.[14] We estimated an equation using data on 170 consecutive drawings in the Massachusetts lotto game, covering the period from July 18, 1984 to March 1, 1986. For each thousand dollars of "rollover" added to the jackpot, we estimated an increase of sales of $418, with a standard error of $19.[15] The stimulus to betting is insufficient in this case to make it worthwhile for the state to augment the jackpot "artificially," in the absence of a rollover.

There is also intriguing evidence on the cross-price elasticity of demand for closely related lottery products. Although each number in the numbers game has the same probability of winning, some players choosing the numbers do not

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and $C' = .12$, implying that the price elasticity of demand at maximum profit is -2.3. For an increase in the payout rate to increase profits, E_{PQ} must exceed 2.3 in absolute value.

[12]Log-linear equations were estimated for per capita numbers and lotto sales, where independent variables were population, income, percent black, percent urban, and payout rate. The estimated elasticities of sales with respect to the payout rate (with t-statistics in parentheses) were 3.05 (0.7) for numbers and 2.55 (2.3) for lotto. The equations were estimated with 15 and 16 observations, respectively. For the complete equations, see Clotfelter and Cook (1989, Table A.4).

[13]If players play randomly, it can be shown that the expected value of a lotto bet increases monotonically with the total amount bet, assuming there is no rollover in the jackpot. The expected value of a lotto bet for a given number of bettors is of course increased if a rollover is added to the pot. Thus the addition of a rollover to the jackpot increases the jackpot both directly, by increasing the available prize money, and indirectly, by attracting more action which also increases the amount of available prize money.

[14]The prospect offered by a lotto bet when the jackpot has been augmented by rollovers is qualitatively different than when there are no rollovers; the probability of winning remains the same, but the probability distribution for the amount won (which depends on the number of other winners, since the jackpot is divided among them) is transformed by the increase in the number of players. Thus, strictly speaking, the difference between a lotto drawing with and without rollovers present is not just a difference in "price," as we have defined that term. But the qualitative difference in the two products is slight enough that we believe our regression results can sustain the interpretation offered above.

[15]We extended the analysis to take account of the fact that the rollover generates more action and hence a still larger jackpot than the rollover itself would produce. In this "rational expectations" formulation, each $1000 of increase in predicted jackpot size increases play by $333 (S.E. = $15) (Cook and Clotfelter, 1989).

view them as perfect substitutes. They see some numbers as "luckier" than others; 777 and 333 are perennial favorites. In most states, there is a fixed payout (500 to 1), so that every number has the same price. But a few states calculate payoffs on a parimutuel basis, so that popular numbers have a lower payout and higher price than unpopular numbers. A comparison of patterns of play in two states suggests that players are responsive to differences in price for specific numbers. In Maryland, where numbers have equal payout rates, players concentrate their bets on popular numbers. Players in the parimutuel state of New Jersey, on the other hand, tend to spread their bets out, placing fewer bets on the most popular numbers and more on the least popular numbers.

Are Lottery Products Substitutes for Each Other or Other Games?

Most lotteries added lotto to their existing product line during the 1980s, and in the majority of states it soon became the sales leader. It is natural to suppose that lotto sales would to some extent come at the expense of reducing the sales of the numbers and instant games.[16] But surprisingly, the evidence indicates that the sales of existing games have not been hurt by the introduction of lotto. We compared the average growth rates in sales for numbers and instant games during the two-year periods before and after the introduction of lotto for a sample of 13 states. In only four states did the growth rate decrease, as would be expected if lotto were a substitute for the other games. The growth rate of the other games *increased* in the other nine states.

Another type of evidence supports this conclusion, too. Lotto sales tend to vary widely from drawing to drawing, depending on the size of the jackpot (as determined by the rollovers from previous drawings). If lotto were a substitute for other games, then the run-up in lotto sales when there is a large jackpot would depress sales of other games. An analysis of Massachusetts numbers sales data for 85 consecutive weeks was conducted to test for this possibility; it revealed that the size of the lotto jackpot, which had an enormous effect on lotto sales, had *no* discernible effect on sales of the numbers game. The additional betting on lotto was "new" money.

It would be of great interest to know whether this result extends to illegal gambling, and especially the illegal numbers game of which the state numbers games are a direct imitation. Not surprisingly, there is no reliable evidence on the illegal game's profitability or sales, although it has clearly survived the introduction of the legal game. Whatever their effect on the illegal numbers game, we do know that the state lotteries have greatly broadened participation in commercial gambling, legal and illegal included.

[16]This intuition follows from the presumption that players will view lotto as a substitute for other lottery games. Alternatively, a transactions cost argument suggests one basis for complementarity. The introduction of lotto broadens participation in the lottery, and some of these new bettors may not limit themselves to lotto tickets when they make a lottery purchase.

The Peculiar Economies of Scale of Lotto

For the game of lotto, bigger is better. Small states appear to be unable to mount a lotto game that attracts much public interest because the jackpots are inevitably small compared to the multimillion-dollar bonanzas generated in California and New York. As a result, multistate lottery consortiums have formed to offer a lotto game that, by combining the populations of several small states, rivals the games of the largest states. The first such consortium was the Tri-State (Maine, New Hampshire, and Vermont). The second was LottoAmerica, initiated in 1988, with the District of Columbia and five widely scattered states with a combined population of about 12 million.

Lotto is a game with peculiar economies of scale. It is a parimutuel game, with the jackpot set equal to a percentage of the amount bet (typically about 25 percent). If a drawing has no jackpot winner, the money in that jackpot rolls over into the jackpot for the next drawing. When several players win, the jackpot is divided among them. The reason that the population base is important to lotto sales, but not sales of other lottery games, hinges on the role of the jackpot in attracting lotto action. An example may help explain how this works.

Suppose state A has an adult population of 10 million and state B has only 100,000. Given equally attractive games, we assume that lotto purchases in both states will average $1 per capita at each drawing. In state A the initial jackpot is then worth $2.5 million, compared with only $25,000 in state B. If both states set the probability of winning at 1 in 100,000 with the average price per winner the same in both states, then state A will have an average of 100 winners while state B will have one winner. Given these rules, the games in the two states do not appear to differ much. However, state A has the option of reducing the probability of winning to, say, 1 in 10 million, in which case each state has only one winner on the average.

Under these rules, state A offers one hundred times the jackpot of state B and only 1 percent of state B's probability of winning. For reasons discussed above, most players prefer state A's game to state B's. The prize in state A is the stuff that dreams are made of, and in case anyone is not paying attention, the lottery agency will focus its advertising on the magnitude of this jackpot. Yet the offsetting large difference in probabilities between the two states has little influence on potential players. As long as most drawings produce a winner, the prospect of winning will be credible in both states.

The Government's Business

As they are presently constituted, state lotteries are guided by one objective: to raise as much revenue as possible for state treasuries. This objective is sometimes stated explicitly in state law and often in the annual reports of

lottery agencies and in state government studies.[17] It is also evident in the lotteries' high price (implied by the 50 percent average payout rate) and the vigorous style of marketing. By focusing on net revenue, the lotteries are behaving as if the public are shareholders in this state enterprise, and hence that the "bottom line" is a valid guide to the public interest.[18]

However, the normative perspective guiding this revenue maximization objective is incomplete. It ignores the fact that the lottery is a commodity as well as a revenue source. This fact opens the door to a consideration of alternative objectives for government. If the commodity were seen as a more or less harmless form of entertainment, reducing the markup over cost would be welfare-enhancing. Alternatively, the government might believe that lottery games are harmful, perhaps creating negative externalities for nonplayers. After all, gambling has long been viewed as a vice that justifies public concern and government regulation. In that case, high prices would be justified as a means for discouraging consumption, either on efficiency grounds, to reflect negative externalities, or on sumptuary grounds, to signal society's disapproval.

However, two aspects of existing lotteries make it very clear that revenue maximization, and not a desire to curtail consumption, motivate the high price of lotteries. First, the percentage of lottery sales going to the state treasury exceeds the comparable tax rates on alcoholic beverages and on cigarettes, both of which are more harmful commodities by any metric. Although we lack the necessary knowledge about parameters of demand to apply formulas of optimal taxation, it seems very likely that the implicit tax rate on lottery purchases is too high relative to taxes on other commodities.[19] The high price/low payout strategy may serve the public well in their role as "stockholders," but it shortchanges the majority of the public in their dual role as consumers.

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[17]Of course, this objective is constrained in various ways. In some states the enabling legislation specifies revenue as the primary objective subject to preservation of "the dignity of the state" (Arizona), "the general welfare of the people" (Michigan), or "the public good" (West Virginia). Every state bans sales to minors, and two states have placed limits on the content of advertising.

[18]This bottom line ignores the fact that lottery expenditures affect other sources of tax revenues. Clotfelter and Cook (1989, Chap. 11, App.) offer a general equilibrium model suggesting that the lottery reduces other tax collections by a few percentage points. More important is the question of how lottery promotion affects the public's propensity to work, save, invest, and otherwise engage in productive economic activity. If the image of easy wealth undermines productive activity, the effect on public revenues over the long run could be considerable.

[19]The optimal excise tax rate on a commodity depends on its price elasticity, whether it produces externalities, and the distribution of its consumption over income. Ignoring externalities and distribution, the efficient assignment of excise tax rates requires minimization of deadweight loss by taxing those items with elastic demand less heavily than those with inelastic demand. If it is indeed true that the price elasticity of demand for lottery tickets exceeds one in absolute value, as argued above, then lottery taxation generates proportionately greater deadweight loss than taxation of items with inelastic demand. One natural comparison is between the implicit tax rates on lottery products to excise tax rates on alcohol and tobacco. The implicit lottery tax rate in the U.S. exceeds the others, yet on the basis of externality and distributional considerations, and perhaps price elasticity as well, lotteries should probably be taxed less rather than more heavily relative to those commodities. For a discussion of this point, see Clotfelter and Cook (1987).

The other reason the sumptuary pricing argument fails to explain lottery prices becomes obvious when one examines the second important characteristic of supply—the active marketing of the product. The agencies seek to recruit new players by improving distribution networks and offering coupons and tie-in sales to encourage novices to try playing. To increase sales to regular players they have increased the frequency of drawings, offered some bets on a subscription basis, and (in one state) packaged instant game tickets together in groups of five. Advertising, publicity, and product innovations boost sales by recruiting new players and increasing the activity of existing players. In short, the lottery agencies are clearly *not* interested in discouraging sales of their products. The low payout rate is motivated by revenue rather than sumptuary concerns.

A lottery could be operated in other ways. A state could license one or more private firms to take the place of its lottery agency. This would allow the state to distance itself from the promotion of gambling, but it would also lessen the state's control over operations, which to date has been effective in keeping the games free of corruption. Furthermore, the lottery agencies could increase payout rates to levels typical of other forms of commercial gambling, increasing consumer surplus at the expense of state revenue collections. Another option would be to require lottery agencies to disclose more information on the probability distribution of prizes, and to be more candid in characterizing the value of jackpots paid out in the form of annuities. Restrictions on advertising, of the sort currently in effect in Virginia and Wisconsin, could be adopted in other states.[20] However, states appear to have little enthusiasm for making any major changes in what has become a popular and profitable formula for raising revenue.

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[20] For a discussion of alternative models of lottery operations, see Clotfelter and Cook (1990).

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