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THE DEMAND FOR LOTTERY PRODUCTS

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ABSTRACT

Lotteries constitute one of the fastest-growing catagories of consumer expenditure in the United States. Not only have an increasing number of states legalized state lotteries, but the per capita expenditures on lotteries in lottery states have increased at an annual rate of 13 percent after inflation between 1975 and 1988. This article examines the demand for lottery products. A majority of the adult public in lottery states play in any one year, but relatively few of these players account for most of "the action". Socioeconomic patterns of play, measured from both sales data and household surveys, offer some surprises -- for example, that the Engle curve of lottery expenditures decline with income. There is some evidence that lottery sales increase with the payout rate, although it is not clear that it would be profitable for the states to increase payout rates. The addition of a new game, such as lotto, does not undercut sales of existing games, and the oft-heard claim that interest (and sales) will "inevitably" decline is contradicted by the data. The organizational form of the lottery is evolving in response to the quest for higher revenues: in particular, smaller states are forming multistate game. This article is a chapter from Selling Hope: State Lotteries in America, an NBER monograph to be published by Harvard University Press in November, 1989.

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THE DEMAND FOR LOTTERY PRODUCTS

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Who plays the lottery, how much do they play, and what factors affect their participation? Questions such as these underlie the empirical analysis of the demand for any consumer product, and the lottery may be examined in much the same way. First among those interested in the demand for lottery products is, not surprisingly, the state lottery agencies. As we discuss in greater detail in our book*, these agencies use modern methods of marketing to increase their sales. Knowledge of the market and the factors that influence demand are essential ingredients in any marketing strategy. Not only do marketers need to know who buys their product, but they also aim to distinguish heavy users from occasional users and determine how the product's price or promotion affects demand. One question that often arises in discussions of lottery marketing is whether lottery purchases constitute "impulse buying" -- irregular purchases determined on the spur of the moment.

But there are good reasons other than the mercantile interests of marketing to examine the demand for lottery products. One is the pragmatic concern of states that may be considering whether or not to adopt a lottery: how much revenue can a state expect to collect from a lottery? Another application for the empirical study of lottery demand is in assessing the

distributional incidence of the revenue burden of lotteries. As we discuss in Chapter 11, lotteries levy an implicit tax on players, and the incidence of that implicit tax corresponds to the distribution of lottery expenditures.

In this chapter we explore the diversity of lottery participation. We first develop a picture of high concentration in the context of broad participation. Then we demonstrate that some population groups play more often than others on the average. Of special concern is whether minorities and low-income groups are especially active in lottery play. Finally we examine the variables associated with high levels of lottery expenditures and analyze specifically the demand for lotto games.

The Curious Majority, the Intense Few

Most adults who live in lottery states have played the lottery at least once, but the real market for the lottery consists of those who play on a regular basis or who might be enticed into playing regularly by the offer of a new game or a more effective sales pitch. As with most products, a small percentage of lottery customers are so active (relatively speaking) as to account for the bulk of all sales. This group is of special interest to those responsible for marketing lotteries, as well as to those concerned about the financial hardships caused by excessive gambling.

In 1986 the average expenditure on lottery tickets was slightly over $110 per adult in lottery states, which works out to about $2 per week. But the $2 bettor is not at all typical of lottery players. Rather, the distribution of lottery play is concentrated among a relatively small fraction of the public who spend much more than that. In this respect the lottery is like most other commodities. First of all, not everyone plays the lottery. In any given week only about one-third of all adults play; over the course of a year participation broadens to encompass one-half or more of the adult public.

Among those who do play, the top 10 percent of players in terms of frequency 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. 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).

The distribution for the California survey is depicted in Figure 6.1, which illustrates the importance of heavy players in determining total lottery sales. Half of the survey respondents said that they had purchased a lottery ticket in the preceding two months. Within this group the median expenditure was a modest $12, but those players who bet that amount or less accounted for only about one-seventh of the total handle. The top 10 percent of players reported spending more than $50 and accounted for over half the total.

How does the distribution of lottery play compare with the distribution of expenditures for other commodities? One rule of thumb of marketing, the "law of the heavy half," holds that the top 20 percent of consumers of any commodity account for 80 percent of total purchases.[1] If this is indeed a law, then lotteries are in violation, since the most active 20 percent of players account for only 65 percent of lottery play. Still, the qualitative outcome is the same: a relatively small minority of all consumers are responsible for the bulk of total expenditures.

While expenditures on lotteries are somewhat less concentrated than this "law" would suggest, expenditures on other sorts of commercial gambling are more concentrated. A survey conducted by the University of Michigan Survey

Research Center in 1975, titled Gambling in the United States, provides the most complete available account of self-reported gambling participation in the United States. Thirty percent of the national sample reported having participated in some form of commercial gambling, legal or illegal, in 1974 (not including state lotteries). The top 20 percent of these players (about 6 percent of the sample) accounted for fully 93 percent of the total reported wagers, and the top 10 percent of players wagered 84 percent of the total. To what extent this is due to differences in the availability of the various forms of commercial gambling is unclear. Whatever the explanation, the state lotteries have considerably broader participation, and less concentration of play among participants, than other forms of commercial gambling. There is, however, one form of illegal gambling whose distribution of play appears to resemble that of its legal cousin quite closely. Calculations based on data from a 1972 study of the illegal numbers game in New York City shows that the degree of concentration among participants of the illegal game was quite similar to that in Maryland's three-digit legal numbers game in 1986.[2]

A commodity that has much in common with commercial gambling and lotteries is alcohol, and it is illuminating to compare this distribution across the adult population. Drinking and gambling are both subject to special legal controls and have been broadly condemned in religious teachings. The dominant modern view is that moderate indulgence in either of these activities is acceptable, but the potential exists for excess and abuse and must be curtailed through special regulations. The distribution of alcohol consumption reflects both the moderate nature of "normal" drinking, and the potential for trouble. Most adults in the United States abstain (33 percent) or drink moderately. The top 10 percent of drinkers average about ten drinks each day, and account for about half of total alcohol consumption.[3] Thus, the degree of concentration of drinking is much the same as the concentration of

lottery play, and the basic implication is the same for both alcohol and lotteries: most participants indulge lightly; the majority of the "action" involves the relatively small group at the top of the distribution.

For lotteries, as for alcohol and other commodities, the relatively heavy participants are of special interest. From the perspective of the state lottery agencies, since this is the group that accounts for most of the revenues, maintaining the interest of the heavy players is essential to the financial health of the lottery. Because of the predominance of regular players in total lottery sales, one lottery marketing consultant has disputed the common belief that lottery demand is based on impulse buying.[4] On the contrary, he says, for many lottery players -- especially the big spenders -- purchases are planned and are made regularly. Upon such distinctions depend crucial choices about how best to market the product. Finally, from the perspective of lottery critics, the heavy players are the ones at greatest risk from the hazards associated with gambling: the feeding of self-destructive compulsion and the temptation to neglect other financial obligations for the sake of pursuing the dream of wealth.

The concentration of lottery play is also of interest because of its effect on public perceptions. The typical lottery player may quite rightly be perceived as someone who spends a few dollars a week or less. For this player the lottery is surely a harmless diversion. What is not so easily understood from casual observation is that the typical player is not the source of the typical revenue dollar.

Who Plays?

The focus here is on the readily observable characteristics of individuals and groups; age, gender, race, income, place of residence,

education, family status. We do not explore the more subtle dimensions of human diversity, such as personality characteristics or attitudes, although these may well be instrumental and have been studied extensively by those whose job it is to market lottery products. But the politics of the question "Who plays?" is dominated by socioeconomic concerns, especially the pattern of play across income distribution. As it turns out, several socioeconomic characteristics are highly correlated with lottery play, but income is not one of them.

At least three measures of lottery involvement may be used to measure the play of a given population group. The first is the participation rate: the percentage of group members who bought at least one lottery ticket during a given period of time. Second is the average expenditure by members of the group — the total expenditure over some period of time divided by the number of people belonging to the group. Third is the prevalence of heavy players within the group: the percentage of group members who spent a relatively large amount over the specified time period. In practice these three measures are closely related, in the sense that groups that rank relatively high on one measure are also high on the other two. For example, dividing the adult population of California into four groups by educational level, we find that the group with the highest average expenditure (those who did not complete high school) is also the group with the highest participation rate and the highest concentration of heavy players. While it is logically possible that certain groups might attain a high average expenditure level despite a low participation rate (that is, if those who did participate were all heavy players), this possibility is not observed in practice.

We obtained information on the characteristics of players from a number of different sources. Most important were household surveys from Arizona, California, Maryland, and the nation at large that included questions about

participation in state lotteries. We also have used information based on household surveys taken in Massachusetts and New Jersey and a national household survey of gambling made in 1944, and we have examined lottery data aggregated by zip code for California and Maryland.[5] In analyzing who plays lotteries it is informative to begin by examining simple two-way classifications that compare the rates of play for members of various demographic groups. We have also analyzed these data using multivariate analysis techniques that control for the effects of other characteristics, but in general we have found that the simple tabulations give a good qualitative picture of the patterns of lottery play.

Differences by Socioeconomic Group

Figure 6.2 compares the rates of lottery play among various population groups based on a survey taken in California in 1986, at a time when only instant games were available in that state. For each group the figure shows the participation rate, measured by the percentage of people who played in the previous week. In the entire adult population 38 percent bought at least one ticket during the week. The discussion here presents a number of generalizations which are illustrated by the patterns in Figure 6.2, but which are based on a number of other sources of information as well.

Gender. Men gamble more than women as a rule, but the difference is small in the case of lotteries. The national surveys of gambling in 1975 found that 68 percent of men participated in some form of gambling, compared with only 55 percent of women. In California the difference in lottery participation is small, as shown in Figure 6.2. A survey in Massachusetts also found similar participation rates for men and women in all three lottery games.[6] Generally the gender difference in amount played is more notable than the difference in participation rates, with men having a definite edge.

Age. The pattern of lottery participation by age is an inverted U, with the young (eighteen to twenty-five) and the old (sixty-five and over) playing less than the broad middle range. Heavy play is most prevalent in the middle years as well. Interestingly, this pattern is a departure from the age profile of gambling in general, which shows the highest rates of gambling among young adults and a steady decline in participation with age.

Religion. In lottery play as with gambling in general, the biggest religious difference is the markedly higher rates of participation among Catholics. Previous surveys of gambling have shown that participation rates for Catholics are half again as large as those of Protestants, and the differences for lottery purchases shown in Figure 6.2 are similar. Roman Catholic dogma is tolerant of moderate gambling, and Catholic churches, unlike Protestant ones, have long used bingo nights as a fund-raising device. Lottery play among those not affiliated with organized religious bodies falls in between rates for Catholics and those of other religious groups.

Education. Anytime a lottery critic calls the lottery a "sucker bet" or decries the exploitation of uninformed citizens the role of education in lottery play is being questioned. Indeed there is no more clear-cut correlation with lottery participation: lottery play falls with formal education. Figure 6.2 shows that the proportion of adults who participate drops from 49 percent for those with less than a high school education to 30 percent for those with a college degree. Yet this clear association contrasts sharply with that for gambling in general. In national surveys conducted in 1944 and 1975 gambling was shown to increase with education. Whatever the role of education in the ability of players to assess objective aspects of betting, it is clear that lotteries appeal to a less well-educated clientele than most other forms of gambling.

Occupation and employment status. Another way to gain a picture of who

plays lotteries is to examine how play breaks down by occupation and employment. Among six broad occupational categories in the California survey lottery play was most common among laborers (including both skilled and unskilled), with a participation rate of 46 percent. Right behind are service and protective and clerical workers. Among the occupations showing the lowest rates of play were advanced professionals, although even among them the participation rate was over 25 percent. Retired people and students played the least.

Race and ethnic group. Racial and ethnic classifications are, of course, loaded with social and political significance in almost any context, for better or worse. In the case of lotteries the social significance is enhanced by the history of the daily numbers game. As we saw in Chapter 4, the daily numbers games developed by state lotteries were copies of illegal numbers games that had operated for decades. Blacks, and to a lesser extent Hispanic groups, considered policy and numbers "their" games, and with good reason. These illegal games had thrived in minority neighborhoods for decades, providing a source of cheap entertainment, employing hundreds of residents as runners and bankers, and ultimately becoming a fixture of the cultural landscape.[7]

Although the evidence is somewhat mixed, it appears that in the United States blacks and Hispanics play more than non-Hispanic whites. Figure 6.2 shows that in California Hispanics played considerably more than other whites but that the rates of play for blacks was similar to that for non-Hispanic whites. Betting at least $5 per week was twice as common for Hispanic adults as for others. Similarly, a survey taken in Arizona showed a higher rate of play for Hispanics than other whites. While only 9 percent of other whites in that state reported playing the lottery at least once a week, the rate for

Hispanics was 28 percent.[8] The available survey material in the East suggests that blacks play more than whites in that region.[9] Calculations based on a survey taken in Maryland in 1986 reveal that some 43 percent of whites had played the lottery within the previous month, but among blacks the comparable figure was 68 percent. The size of this racial difference depends on the type of lottery game, and is largest for the legal version of the numbers game. In Maryland blacks participated in the three-digit numbers game at a rate over twice that of whites, 61 to 24 percent, whereas the difference for lotto was only 54 to 38 percent.[10] A survey in New Jersey produced similar findings, showing blacks and Hispanics playing numbers games at a rate twice that of the population in general and lotto at a rate 30 percent higher than average.[11] This preponderance of blacks and Hispanics in the daily numbers game also closely parallels the racial pattern of play in New York's illegal numbers game.[12] Given the importance that has been attached to racial differences in lottery play, one must ask whether differences such as these can be explained by other observable differences. We turn to this question in considering the last of the demographic variables to be discussed.

Income. The relationship between income and lottery expenditures is of particular interest owing to the frequent charge that lotteries are played disproportionately by the poor. In fact there has been more research on this question than on almost any other related to lotteries. The preponderance of the evidence suggests that there is little systematic relationship between income and the amount spent on lottery play. Absolute expenditures appear to be remarkably uniform over a broad range of incomes. This uniformity is noteworthy since spending, say, $10 per week on the lottery represents a much greater financial commitment for a household with an income of $10,000 per year than for one earning $40,000 per year. Yet we find no consistent differences in participation or play over this range, with the possible

exception of daily numbers games, whether or not other household characteristics are taken into account.

Figure 6.3 depicts the patterns of lottery play by income using data from the 1986 California survey. Most of the respondents lived in households with incomes in the range of $10,000 to $60,000. Over this range average play does not differ much. As a percentage of income, however, average play declines over the entire income range, as shown by the dotted line in Figure 6.3. While the average person in the lowest income class spent 2 percent of his household income on lottery tickets, those with incomes above $40,000 spent less than 0.5 percent on tickets. The expenditure pattern evident in this table is consistent with several previous studies of lottery expenditures, most of which were based on weekly passive lottery games.[13] It is also consistent with the patterns that emerge when expenditures are estimated by counting the number of winners by zip code (see Table 6.1). Using data for Maryland and Massachusetts we found that, with one exception, the estimated average level of expenditures bore no consistent relationship with the average income by zip codes. The exception was lotto games with comparatively large jackpots, for which expenditures tended to rise with income.

Of the various data sets we analyzed there was just one showing the poorest respondents playing more than others. A 1984 Gallup survey in Maryland (see Table 6.2) found that respondents with incomes below $15,000 (about 15 percent of the sample) played more than those with higher incomes -- indeed more than twice as much. Whether this difference is valid or an artifact of the special difficulties involved in surveying poor neighborhoods is not clear. The less error-prone data on winners by zip codes, found in Table 6.1, does not provide much support for this result.

On the basis of a number of data sets for different states and years, we conclude that there is no strong and consistent pattern of lottery play across income categories. Indeed, the upper and lower ranges of the middle class play at about the same rate on the average. Income patterns differ somewhat among games, with lotto having a relatively strong appeal to upper income households, and numbers to lower-income players. The most definitive finding is that, as a percentage of household income, lottery expenditures decline steadily as income rises.

In sum, members of certain groups are more likely to play lotteries and to play them heavily: males, Hispanics, blacks, the middle-aged, Catholics, laborers, and those with less than a college degree. One question that arises in the interpretation of such results is whether or not these factors remain significant when the others are taken into account. Does income have an effect, for example, when education and race are accounted for? In order to examine the independent effects of race, education, and other individual characteristics, we estimated multivariate equations explaining average weekly expenditures based on the survey of Maryland residents. Largest and statistically most significant among the explanatory variables is race, with blacks spending an average of about $4.50 more than whites, other characteristics being the same. This racial difference is so large in this data set that we estimated separate equations for blacks and whites. (The estimated equations are given in Table 6.2). Lottery expenditures for whites and blacks alike tend to fall with education. This effect is significant only for whites, with the difference between college graduates and those who did not complete high school being almost $5 per week. A similar pattern with smaller differences is observed for blacks, but owing to the small sample the coefficients are estimated very imprecisely. Regarding age, the estimates imply that expenditures on lottery products are lowest for the elderly and

highest in the prime earning years of twenty-five to fifty-four. Males spend more than females: the estimates imply a difference of about $1 for whites and $4 for blacks. Surprisingly, expenditures do not vary significantly between urban and rural counties once income, race, and other characteristics are held constant.

The estimated effects of income reflect the patterns previously discussed. Among those who report their income, expenditures are lowest in the $15,000 to $25,000 income group, other factors being equal. The highest expenditures are recorded at the under-$10,000 level for the entire sample, a pattern which the separate regressions suggest is limited to black respondents; for whites. there are no significant differences in play by income category.

Other Gambling

The demographic categories used here to describe lottery players give a useful but incomplete picture of who plays the lottery. There are also less readily observable characteristics that affect whether people play regularly, such as personality (do they like to take chances?) and associates (do their friends gamble?). One obvious indicator is the extent of participation in other forms of commercial gambling: people who participate in other kinds of gambling are more likely to play the lottery, and to play it heavily, than people who do not. But the introduction of a lottery does not simply provide those who already participate in commercial gambling, whether legally or illegally, with a new game. Lotteries also recruit a great many people into commercial gambling. The participation rates in state lotteries far exceed participation rates for other forms of commercial gambling.

The most complete survey of gambling paticipation ever conducted was

the 1975 "Gambling in the United States." A total of 1,735 respondents were interviewed, of whom 907 lived in states that operated lotteries in 1974. Questions were asked concerning participation in all aspects of commercial gambling, both legal and illegal. Overall, 58 percent of lottery state residents reported gambling at some time during 1974, compared with only 27 percent of residents from nonlottery states. Most of this difference was due to the much higher rate of lottery play by residents of lottery states: comparing the two groups by participation in commercial gambling other than the lottery, the lottery state residents are only "ahead" by a margin of 34 to 23 percent.

These differences are dramatic and strongly suggest that the introduction of a state lottery brings a large fraction of the adult population into commercial gambling. To confirm this conclusion it must be demonstrated that the observed differences in commercial gambling are not the result of other differences between residents of lottery and nonlottery states. Hence, we conducted a multivariate statistical analysis (probit) of participation in commercial gambling for the entire sample, which included variables for sex, race, religion, frequency of church attendance, household income, age, education, the size of the respondent's city of residence, and whether or not the respondent lived in the South. Controlling for all of these variables, we found that the likelihood of participation in commercial gambling was still heavily influenced by whether or not the respondent lived in a lottery state. For example, a person with the socioeconomic characteristics associated with a participation probability of 27 percent if living in a non-lottery state had a participation probability of 52 percent in a lottery state. Thus we conclude with considerable confidence that the lottery is a powerful recruiting device, which in 1974 was responsible for inducing about one-quarter of the adult population, who would not otherwise have done so, to participate in commercial

gambling.

The national data do confirm, however, that people who participate in other forms of commercial gambling are more likely than average to play the lottery, if given the opportunity. Indeed for 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). We can sum up these results this way: the lottery has an especially strong appeal to established gamblers, but it also creates new ones.

One indication from the "Gambling in the United States" survey is that most commercial gamblers do not specialize in a single type of gambling. Even within the confines of the lottery many players will regularly buy tickets for two or more types of games. To demonstrate the overlap in play among various lottery products we report findings from surveys in Massachusetts and New Jersey. Lotto is very popular in Massachusetts, and, according to one survey commissioned by the state lottery agency, almost everyone who bought lottery tickets played lotto. Overall, 62 percent of adults played at least one game. About half of these played lotto exclusively, and the remainder played lotto in combination with one or both of the other games (numbers and instant games). As might be expected, those who play more than one game usually bet more than those who dabble in only one. For example, those who play only lotto bet an average of about $12 per week, but those who combined lotto with numbers bet an average of $31, and those who played all three bet over $42.[14] The heavy players who account for such a large share of total lottery wagers thus tend to diversify their portfolio of lottery games.

A New Jersey survey affirmed the predominance of lottery players who play more than one game. For example, 22 percent of the population played the

numbers game, but among lotto players 43 percent also played numbers.[15] The survey reveals the degree of overlap between participation in the lottery and in other forms of commercial gambling, reinforcing the results reported in the NSG study. In general, those who play the lottery are more likely than average to bet on bingo or horse races. And, according to this survey, lottery players are much less likely than average to use cents-off coupons in stores, whereas they are more likely than average to participate in giveaway games. Between the prudent coupon-clipper and the let's-take-a-chance sweepstakes player, there is little doubt who will be in line to buy lottery tickets.

Conclusion

The socioeconomic variables by which social scientists classify people -- sex, race, age, religious background, education, income, profession -- provide a useful framework in which to understand observed patterns in lottery play. But even when such readily observed characteristics are accounted for, there remains considerable diversity. Ultimately the question of personality enters: some people simply find gambling a more engaging activity than others. When the state introduces a lottery, residents who are already betting on the horses or bingo or the illegal numbers game tend to become regular customers. But the lottery also finds a large following among the majority who had not previously been spending money on commercial games and whose taste for gambling needed the stimulus of the lottery in order to be awakened.

Of course whether and how much someone plays the lottery is not simply a function of circumstances and tastes. Also important is the nature and quality of the products being offered by the lottery. In the next sections we consider the determinants of lottery sales which are under the control of the state agency, including the types of games offered, the payout rate, the prize

structure, and the amount of advertising.

Influencing Demand

In fiscal 1986 Massachusetts lottery revenues were $193 per capita, the highest in the nation. The lottery with the lowest sales that year was neighboring Vermont, at $23 per capita. Both states had well-established lotteries, offering all three of the major games—lotto, numbers, and an instant game. How can this eight-to-one disparity in per capita sales be explained? What can Vermont and other states with relatively low sales learn from Massachusetts, Maryland, and other states whose lotteries have been sales leaders?

We have described the socioeconomic patterns of lottery participation. Much of the interstate variation in lottery sales is the result of differences in these factors, which are determinants of the gambling propensity of the resident population. For example, 84 percent of Massachsetts residents live in urban areas, compared with only 34 percent of Vermont residents. In Massachusetts sales also are enhanced in comparison with Vermont by the relatively high percentage of residents who are Roman Catholics and/or members of ethnic groups in which participation in commercial gambling has traditionally been high. Such factors help explain the large interstate disparities in sales,[16] but this sort of explanation is not very helpful to the lottery manager seeking to increase sales. Presumably this manager is not in a position to proselytize for the Catholic church or encourage rural residents to move to the city.

A number of actions that <u>are</u> available to lottery managers are potentially effective in stimulating sales. First, expanding the product line by introducing a new game will increase total sales. Second, increasing the payout rate on existing games will probably increase sales, and a carefully

considered restructuring of the prize offerings may also help in this respect. Third, for the game of lotto an increase in the population base (through joining a consortium of states) will increase sales by making it possible to offer larger jackpots.

Expanding the Product Line

The typical pattern for lotteries which began operating in the 1980s was to get started with the instant game and then introduce one of the on-line games (numbers or lotto) several months or even years later, with the other following after an additional interval. There is a natural concern that introducing a new game will detract from sales of existing games -- for example, that given a chance, players may redirect some of their instant game expenditures to playing lotto. If this were to happen, then the increase in overall lottery sales would be somewhat less than the sales of the new game. In technical terms the concern is that the several types of lottery games are substitutes for one another, just as are, say, different brands of cigarettes. This concern is plausible, especially since most lottery participants play more than one game, given the opportunity. But the evidence very clearly indicates that the standard lottery games are not substitutes for one another. Indeed, sales of an existing game or games are unaffected by the introduction of a new one.

Figure 6.4 depicts sales trends for four states that introduced new games during the 1980s. In each case it appears that the sales trend in existing games was unperturbed by the introduction of a new one. Patterns for other states help confirm this remarkable result. In particular, we checked sales trends for numbers and instant games in thirteen states around the time they introduced a lotto game. In each state we compared the average growth rates for the two-year periods before and after the introduction of lotto. In nine

of these states the growth rate increased; in only four did the growth rate decrease, as would be expected if lotto were a substitute for the other games.[17] Based on this evidence we conclude that the introduction of lotto in a state does not reduce sales of other games; expenditures on lotto come from increased play and new players. The three major games are thus not substitutes for one another.

Another type of evidence provides further support for this conclusion. Lotto sales tend to vary widely from drawing to drawing, depending on the size of the jackpot (as determined by the number of consecutive rollovers from previous drawings). Figure 4.1 in Chapter 4 illustrates this effect. If lotto and other games were substitutes, 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 eighty-five 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.[18]

The evidence presented here is limited to the three major games currently offered. In the future, as new games like keno and sports pools are developed and widely introduced, the pattern may be change. But at present the three available games are remarkably independent of one another. For states that do not already offer all three games, expanding the product line is virtually guaranteed to increase sales.

Increasing the Payout Rate

Much has already been said about the low payout rate offered by the lotteries. Most states pay about 50 cents in prizes to every dollar of revenue, and in about half the states the authorizing legislation would have

to be amended in order to increase this rate. The uniformly low payout rates are likely to persist until persuasive evidence is produced that a higher payout rate would increase net revenues to the state treasury, and available evidence on this subject is not especially persuasive one way or the other.

The basic issue here is analagous to the attention paid in the field of public finance to the relationship between a tax rate and the amount of tax revenue collected. During the early years of the Reagan administration the economist Arthur Laffer became famous for his claim that lowering the federal income tax rates would increase federal revenues. In the case of the lottery the analagous assertion is that an increase in the payout rate would increase sales by so much that net revenues would increase, despite the reduction in net revenue per dollar of sales.

It would be surprising indeed if an increase in the payout rate did not increase sales somewhat. Given a higher payout rate, the lottery game designers could increase the lotto jackpot or the numbers prize, thus enhancing the appeal. Alternatively, designers could increase the number or size of small prizes in lotto or instant games, thus giving more players the experience of being winners and encouraging them to continue playing. In short, a larger payout rate would give the designers new options for creating attractive prize offerings, which would in turn generate increased action from players whether they evaluated a game on the basis of actuarial science or on instinct.

Interestingly, one common pattern of lottery play — reinvestment of winnings — virtually ensures a sales increase from a higher payout, even if players' evaluation of the game does not change. In a poll conducted for the Los Angeles Times in March 1986 respondents who reported having won money in California's instant game were asked, "When you win, what do you usually do?

Do you put the cash in your pocket or do you reinvest your winnings by buying more California lottery tickets with the money you have won?" Only 14 percent reported taking the cash; the rest said they reinvested the winnings (73 percent) or did both about equally (12 percent).[19] If more prize money is paid out, then more will be re-invested, at least for the instant game. The virtually inevitable result is that an increase in the payout rate will increase sales. But the question remains whether the increase would be sufficient to increase net revenue to the state.[20]

This question cannot be answered from the available data. For example, take the case of the numbers game. As of 1986 every state but one offered a payout rate of 50 percent. The exception was Massachusetts, with a payout rate of 60 percent. It is true that Massachusetts' per capita sales were relatively high: 36 percent higher than Connecticut's, for instance, and the difference was greater still compared with other neighboring states. But Massachusetts also has much higher instant game and lotto sales per capita than its neighbors, and for those games its payout rate is no different from theirs. It is thus not feasible to infer what proportion of Massachusetts' numbers sales are due to its high payout rate.[21]

The game of lotto offers slightly more interstate variation in payout rates. In fiscal 1986 nineteen states offered lotto. While most of these had a payout rate of 50 percent, five had lower payout rates. A regression analysis of sales data for lotto did yield a coefficient estimate significantly greater than zero for one specification. Indeed, the point estimate was large enough to suggest that an increase in payout would increase net revenue, although the coefficient was estimated imprecisely enough to leave considerable statistical doubt about this conclusion. Other variables included in this specification were population, per capita income, and percent urban (all positive and significant) and percent black (small and

insignificant). Other specifications yielded smaller coefficient estimates on payout rate.[22] Given the multitude of plausible specifications and the small number of observations, this approach does not yield confidence-inspiring estimates.[23]

From the point of view of a lottery agency, increasing the payout rate is an expensive tactic for stimulating sales. (For example, the unit cost of increasing the payout rate by 2 percentage points is equivalent to more than doubling the advertising budget in most states.) While it seems likely that the tactic would be effective in increasing sales somewhat, it is not clear that sales are sufficiently responsive to the payout rate that net revenues would increase. At the level of payout rates currently being offered, an increase in the rate would produce an increase in net revenues only if sales were increased by more than 2 percent for each percentage point hike in the payout rate.[24] In particular, increasing the payout rate from 50 percent to 60 percent would increase net revenues only if sales increased by more than 30 percent as a result.[25] Given currently available evidence, there is no persuasive basis for predicting whether that much of an increase would be likely to occur.

Modifying the Prize Structure

Most players do not care about the payout rate per se; indeed, very few lottery participants even know the payout rate of the games they play. Players <u>are</u> concerned about the prizes offered by a game, and presumably different players focus on different aspects of the prize structure -- the likelihood of winning some prize, or the size of the top prize, or the likelihood of winning a prize that is above some minimum magnitude. While players may not have an accurate impression of the prize structure, they can form some sort of impression from personal experience (and the experience of

their acquaintances) in playing the game and from advertising and promotional material. The primary objective in designing a prize structure for a game is to create as favorable an impression on the market as possible within the financial limits of the game. The reason why we expect an increase in the payout rate to increase sales is that the payout rate defines the budget for the prize structure, which if increased would allow changes that would make the prize structure more attractive to at least some potential players. Put another way, the success of a game depends not just on its payout rate but to a large extent on how the payout is structured into prizes.[26]

This point is illustrated with a case study from Ohio. In November 1987 the Ohio lottery introduced a new instant game, Holiday Cash, with an unprecedented payout rate of 75 percent, compared with the normal 50 percent. Holiday Cash sales averaged about $4 million per week during the first month, which was about double the sales rate for the two previous instant games introduced by the Ohio lottery. At first glance this appears to be evidence that sales are highly sensitive to an increase in the payout rate. Subsequent history casts doubt on that interpretation, however, since the two games introduced after Holiday Cash enjoyed sales just as high, despite the fact that these games offered the traditional 50 percent payout rate. Why did sales persist at the new level after the payout rate reverted to the old level? One possible explanation is that Holiday Cash introduced a new prize structure along with the high payout rate. The new structure eliminated prizes above $1,000 and increased the number of smaller prizes. Subsequent games continued to emphasize lower-tier prizes. So it would appear that the new prize structure found a larger market than the old, even with the payout rate at the old level.[27]

Game design is an inexact science at best, but lottery agencies have been

quite active in experimenting with changes in prize structures for instant games and for lotto. Ohio provides another interesting example, in this case a lotto format experiment. Prior to February 1986 Ohio offered a twice-a-week drawing for a 6/40 lotto game that placed only 43 percent of the prize pool into the jackpot. That month the agency introduced a new 6/44 game, with 70 percent of the prize pool in the jackpot. The two games ran side by side for over a year, with one weekly drawing for each. In April 1987 the old game was dropped in favor of a twice-a-week drawing of the new game. What the agency had learned from this experiment was that the new game had about the same sales as the old when there was no rollover, but that the new game had more rollovers (as one would expect from the format) and as a result generated higher total sales.

The prize structure is an important feature of lotto and instant games, and, unlike in the case of the payout rate, lottery agencies have felt free to experiment. Given the diverse motivations for and styles of playing the lottery (discussed in Chapter 5), it is perhaps not surprising that designing prize structures that will maximize public appeal remains more a matter of trial and error than science.

Increasing the Population Base

For the game of lotto bigger is better. Small states are 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 in order 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, including the

District of Columbia and five widely scattered states with a combined population of about 12 million. The states in both of these consortiums have enjoyed a considerable jump in lotto sales since joining together. Explaining the peculiar economies of scale for lotto requires more than a sentence or two.

Lotto is a parimutuel game, with the jackpot set equal to a percentage of the amount bet (typically about 25 percent). If there is no jackpot winner in a drawing, the money in that jackpot rolls over into the jackpot for the next drawing, as described in Chapter 4. When several players win, the jackpot is divided among them. The explanation of why 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.[28] 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, then there will be an average of one hundred winners in state A and one winner in state B, with the average prize per winner the same in both states. Given these rules, the games in the two states do not appear to differ much. State A, however, has the option of reducing the probability of winning to, say, 1 in 10 million, in which case there would be only one winner on the average. Under these rules, which state has the more attractive lotto game?

Compared with state B, state A offers one hundred times the jackpot but a much lower probability of winning -- 1 percent of state B's probability. For reasons discussed in Chapter 5, 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 correspondingly large difference in probabilities between the two states has little influence on potential players. The failure of intuition to comprehend such probabilities, or the belief that the chance of winning is influenced by effort and skill, ensure that probability has less meaning to the average player than to an actuary. As long as most drawings produce a winner, the prospect of winning will be equally credible in both states.

Our statistical analysis of lotto sales data confirms that the number of sales per capita is driven by the size of the jackpot and is quite insensitive to the objective probability of winning that jackpot.[29] Under these circumstances, then, a large population base can generate a more attractive lotto game than a small one. Of course it is these large lotto jackpots that produce much of the folklore of the lottery as well. For a small state that wishes to be part of the lottery action, joining a lotto consortium is a sensible move.

The "Inevitable" Decline in Interest

The conventional wisdom regarding lotteries is that after they have been around for a while, the public loses interest.[30] Maintaining sales requires the introduction of new games or new versions of old games. As in Alice's experience through the looking glass, it is necessary for the lottery agencies to run very fast just to hold their ground. In the words of one observer: "Two considerations motivate the constant search for new ways to dress up the lotteries' ancient arithmetic. The first is the hope that a new combination of price, prize, and gimmick will attract new players. The second is the inevitable decay of a consumer product that...is not unlike the hula hoop or Coca Cola, and closer to the hula hoop than Coca Cola."[31]

Is waning interest inevitable? Certainly it is true that new lotteries in the mid-1980s experienced a surge of interest when first introduced, which dissipated quickly. California sold over $120 million in instant game tickets during its first week of operation but by the end of a year was down to about $20 million per week. After this honeymoon period is over, however, the pattern is not one of further decay, as is suggested by the statement just quoted, but rather of more or less steady growth. The introduction of a new game, notably lotto, creates a surge in total sales, but even in the absence of such innovations it appears that growth is the norm in all three types of games. The sales trends in Figure 6.4 support this conclusion.

Perhaps the impression of declining interest is created in comparison with an expectation of very high growth. Per capita sales in lottery states increased at an annual rate of 14 percent in real terms between 1975 and 1985. To sustain this sales trajectory, in which sales double every five years or so, would require major innovations in product and marketing techniques. Recent history suggests that in the absence of such innovations, sales will grow at a moderate rate. Consumers are not going to lose interest in the lotteries anytime soon.

Conclusion

Lottery managers are very much concerned with increasing their "profits," the net revenue that remains after prizes and other costs of doing business are paid. In most circumstances achieving growth in profits requires increasing sales. Recent experience indicates two methods that have enjoyed universal success--adding lotto to the product line and (for smaller states) joining a consortium of states to expand the population base for lotto games. One cannot be so confident about the effects of changing the prize structure

of an existing game or changing the payout rate.

The state agencies have been remarkably timid about experimenting with payout rates. Their reluctance to increase payout rates may result from the fact that this is a costly strategy for increasing sales on a per unit basis. And while it is certainly to be expected that increasing the payout rate on a game from, say, 50 to 60 percent would increase sales, there is no persuasive evidence that it would stimulate sales enough (more than 30 percent) to increase net revenues. Perhaps if the competition were to increase among states for cross-border sales, the standard 50 percent payout would no longer be tenable.[32]

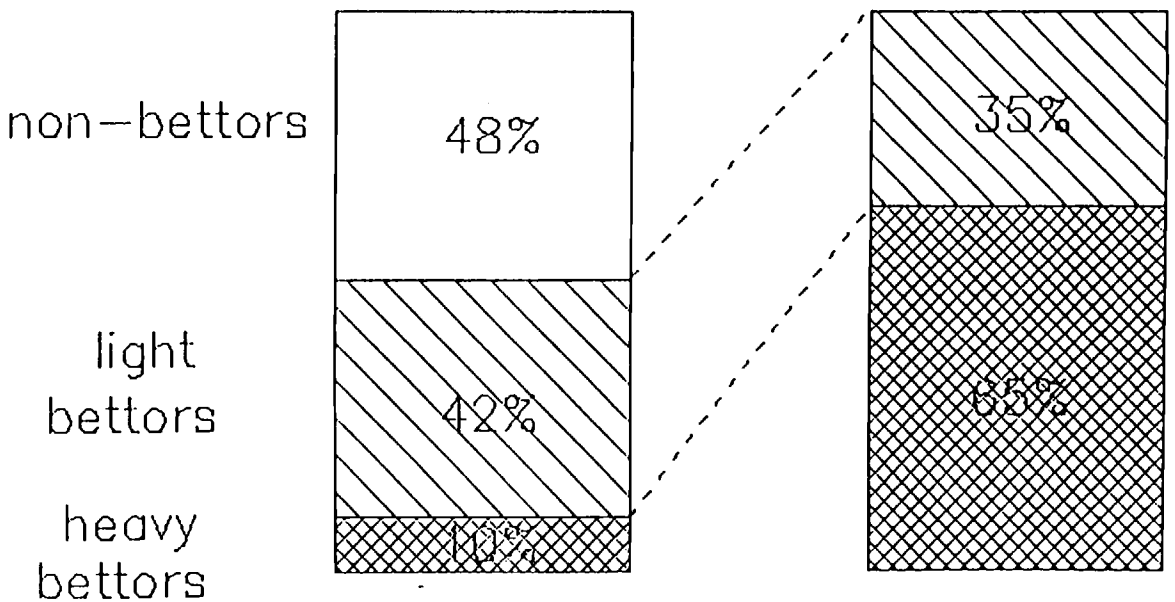
In addition to the modifications in product line, product design, and payout discussed here, lottery agencies seek to increase demand through marketing and promotion efforts and by increasing the number of outlets. These mechanisms are described in Chapter 10.

Finally, the various methods for increasing sales may also influence the distribution of sales across different population groups. Introducing or expanding the game of lotto brings in more middle class players, just as the numbers game brought in more minority players. The lottery has a vast and varied market. The contour lines of growth of this market depend in part on the detailed choices of the lottery agencies.

Figure 6.1

Concentration in Lottery Wagers, California, March 1986

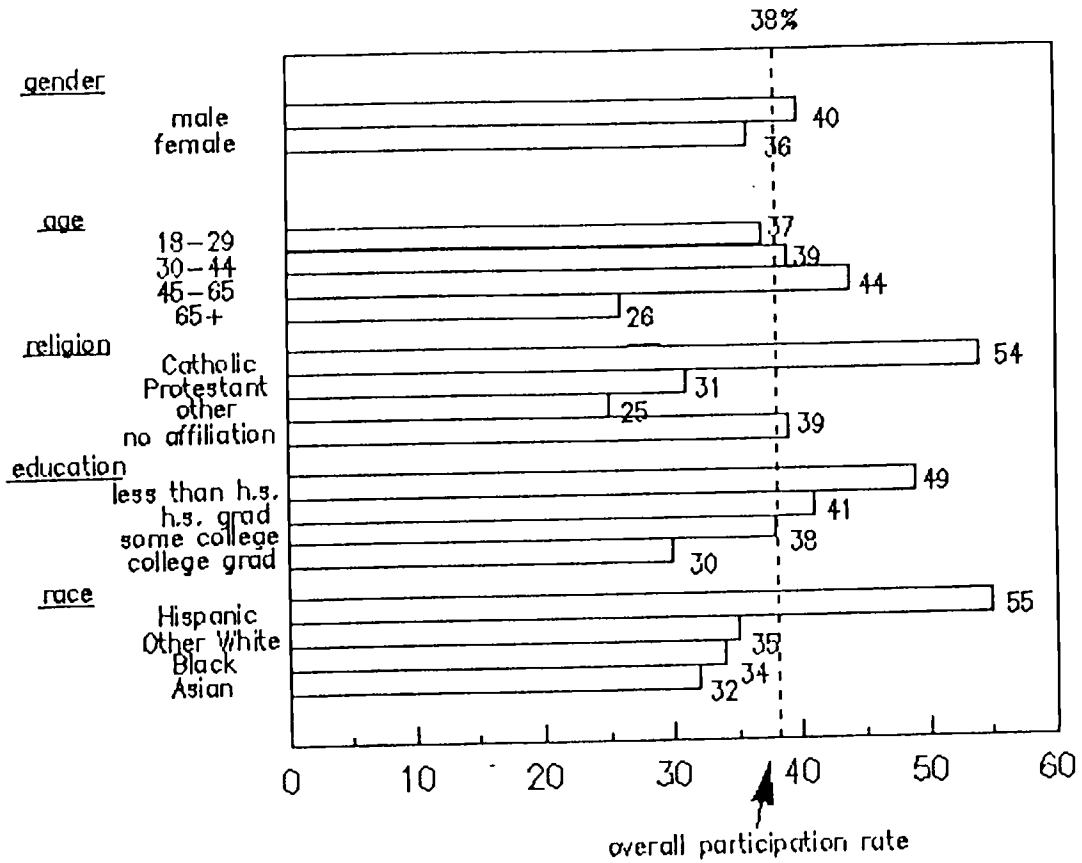
The 10% of the adult population who bet most heavily accounted for 65% of the total wagers



Source: Los Angeles Times Poll, March 1986

Figure 6.2

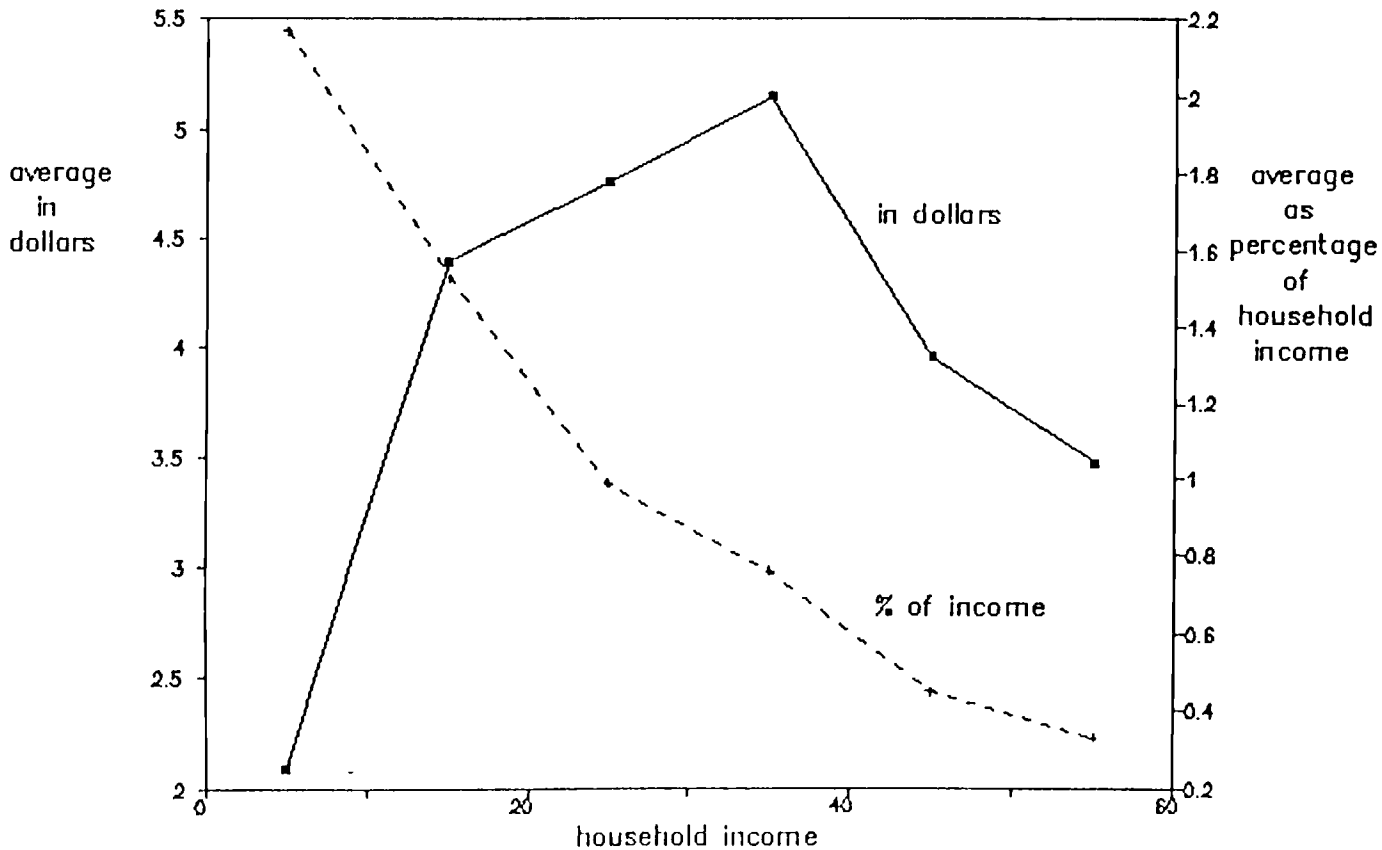
Lottery Participation Rates, One Week, California, March 1986



Source: Los Angeles Times Poll, 1986
LATTAB 1635.7/19/88.c86; July 19,1988

Figure 6.3

Household Weekly Expenditure on Lottery
California, March 1986



Source: Los Angeles Times poll, LATIAB 136, 8/14/88 , LATIAB 1635, 7/18/88

Figure 6.4

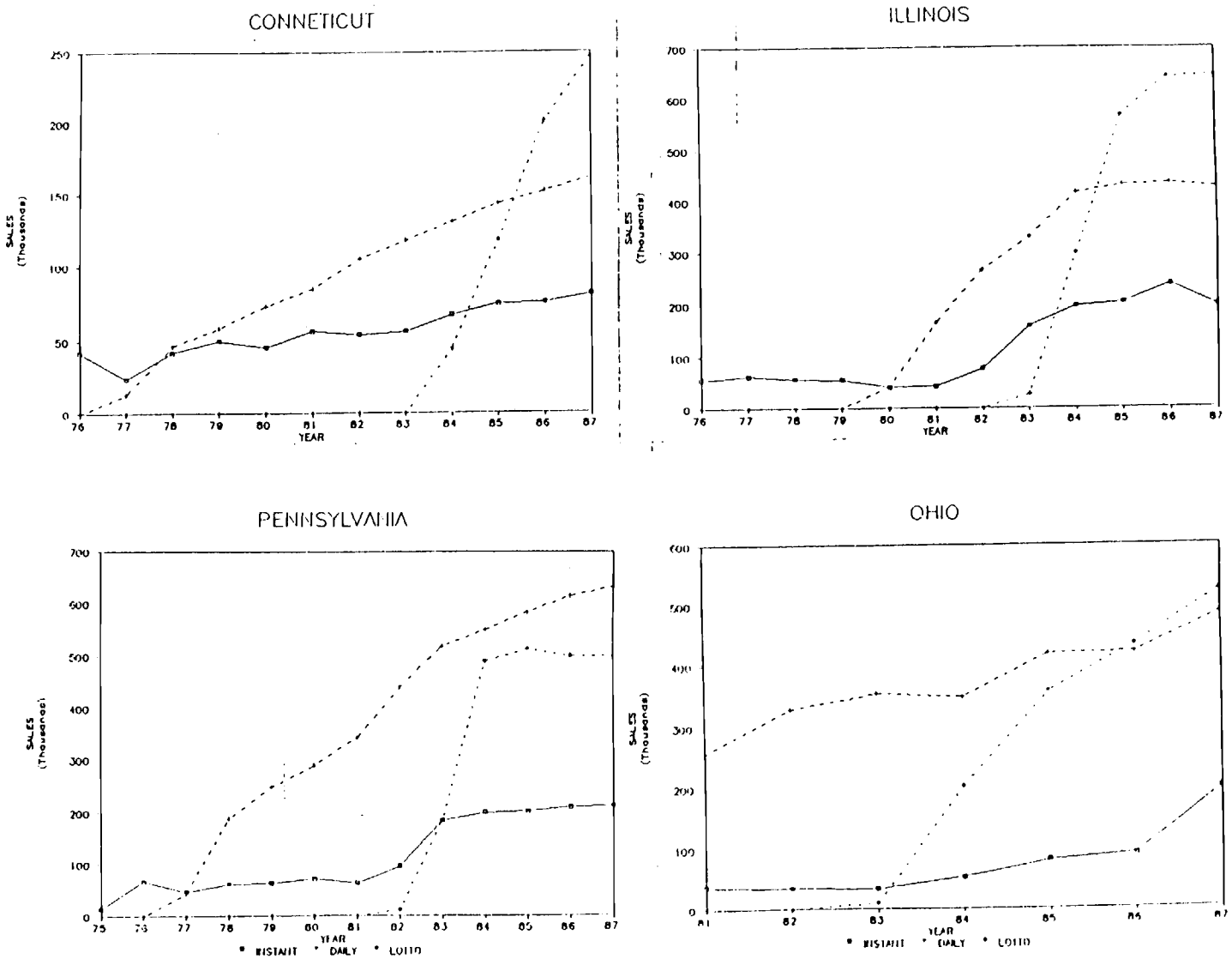

CONNETICUT
ILLINOIS
PENNSYLVANIA
OHIO
SALES (Thousands)
YEAR
INSTANT
DAILY
LOTTO

Table 6A.1

Weekly Lottery Expenditures, for Three Lottery Games, by Income

Maryland 1984

Income	Sample Size	Average weekly expenditures: 3-digit numbers	4-digit numbers	Lotto	Total
Under $10,000	85	$3.65	$1.58	$1.88	$7.30
$10,000 under $15,000	104	2.99	.98	1.23	5.37
$15,000 under $25,000	226	1.26	.49	1.22	2.99
$25,000 under $50,000	451	1.61	.40	1.26	3.21
$50,000 and over	206	1.19	.37	.99	2.57
Don't know, refused	175	1.44	.50	.86	2.79
TOTAL	1247	$1.86	$ .55	$1.19	$3.46

Sources: Gallup Poll, November 1984 (see text); U.S. Bureau of the Census (1986, p. 19).

NOTE: Components do not add to totals because those who did not know amounts were excluded, and sample sizes varied.

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Table 6A.2

Relative Expenditures by Income, Selected Lottery Games

State and data		Number of Winners	Median household income for zip code, 1980				
			Under $10,000	$10,000 under $15,000	$15,000 under $20,000	$20,000 under $25,000	$25,000 and over
Maryland							
Upper-tier winners, 1/86 to 8/86	Number of zip codes	--	34	116	150	99	99
Lotto jackpot winners, 1/84 to 8/86	Ratio of share of sales in class to share of households, by game						
	4-digit numbers	211	1.34	1.01	.92	1.31	.74
	Instant	66	1.85	1.48	.90	1.20	.48
	Lotto	581.5[a]	1.00	.72	.89	1.12	1.20
Massachusetts							
Lotto jackpot winners, 12/82 to 3/86	Number of zip codes	--	28	113	227	135	67
	Ratio of share of sales in class to share of households						
	All lotto	425	.47	.90	1.01	1.24	.89
	Lotto when jackpot exceeded $5 million	123	.24	.85	.90	1.60	.71

[a]Ticket shared with non-resident. All winners of shared tickets with only one zip code shown were assumed to reside in the same zip code. Otherwise, shared tickets were prorated among zip codes.

Source: MASS 4617 8/7/86; MDZIP 3252, 9/2/86

Table 6A.3

Average Weekly Expenditures on Lottery Products in the Last Month, Maryland, 1984

Equation	10.1 Full Sample	10.2 Whites	10.3 Blacks
Education			
High school graduate only	- 2.79	- 4.93*	1.36
	(1.98)	(1.98)	(5.19)
College graduate	- 8.34*	-11.24*	0.62
	(2.08)	(2.08)	(5.55)
Age			
25–39	1.70	.51	5.15
	(1.68)	(1.70)	(4.39)
40–54	3.81*	1.73	11.61*
	(1.84)	(1.83)	(4.90)
55–69	3.59	3.44	3.62
	(2.10)	(2.02)	(6.67)
70+	- 2.43	- 2.25	- 8.61
	(3.67)	(3.37)	(13.59)
Race			
Black	10.20*	-----	-----
	(1.48)		
Hispanic and other nonwhite	- 3.12	-----	-----
	(4.34)		
Income			
Under $10,000	4.50	0.90	25.02*
	(2.55)	(2.60)	(6.94)
$10,000–15,000	0.89	1.14	10.02
	(2.33)	(2.53)	(5.50)
$25,000–50,000	0.85	0.48	5.55
	(1.67)	(1.60)	(5.14)
$50,000 and over	- 1.25	1.05	4.48
	(2.02)	(1.92)	(6.67)
Refused, don't know	- 1.59	- 2.02	6.71
	(2.12)	(2.10)	(5.86)

Table 6A3 (Continued)

Equation	10.1 Full Sample	10.2 Whites	10.3 Blacks
Male	3.14* (1.16)	2.59* (1.12)	7.45* (3.46)
Percent urban in county	.036 (.023)	.020 (.021)	.128 (.084)
Intercept	6.72 (3.18)	- 0.10 (3.05)	- 23.8* (10.4)
Log Likelihood	- 2485.8	- 1797.1	- 619.9
Mean of dependent variable	3.73	2.71	8.79
Proportion non-zero	.500	.455	.725
N	1051	847	182
F(z)	.444	.420	.548

Note: Method of estimation was Tobit. Standard errors are in parenthesis. Asterisks (*) denote t-statistics 2.0 or greater in absolute value. The derivative of the expected expenditure with respect to any right-hand variable is equal to the estimated Tobit coefficient multiplied by F(z).

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Table 6A.4

FY 1986 Per Capita Sales Regressions:

Log Linear Specification

Independent variable	Number sales	Lotto sales
1. Intercept	-4.50	-18.06
	(.2)	(2.9)
2. Population[a]	-0.11	0.52**
	(.5)	(6.8)
3. Income[b]	1.06	1.94*
	(.4)	(2.8)
4. Black[c]	0.72*	-.14
	(2.7)	(2.0)
5. Urban[c]	-0.28	1.04*
	(.2)	(2.6)
6. Payout rate[d]	3.05	2.55*
	(.7)	(2.3)
N	15	16
R^2	.75	.89
Root MSE	.79	.23
Mean sales	$3.22[e]	$3.44[e]

* $p<.05$

** $p<.01$

Note: All variables are in natural log form. Numbers in parentheses are t-statistics.

[a] Estimates of 1985 population from Bureau of Census, Series P-25, Number 998, December 1986.

[b] Per capita income for 1985, from Government Finances (GF 85-No.3).

[c] Percent black and percent urban for 1980 from Statistical Abstract of the United States, 1986.

[d] Payout rates obtained by telephone from state lottery commissions.

[e] Per capita sales computed using FY 1986 data from Gaming and Wagering Business, May 1987, and provisional population estimates (note a).

P95 (wp)

12/13/88

Table 6A.5

Regression Explaining Logarithm of

Per Capita Daily Lotto Sales

Variable	Coefficient	t-statistic
Logarithm of:		
probability	-0.01	0.3
jackpot	0.40	40.3
proportion of prize pool in lower prizes	0.38	4.6
payout	1.35	1.6
Drawings per week	0.20	3.8
Time trend	- .00093	3.9
State dummy variable (Ohio omitted)		
Arizona	0.13	2.3
District of Columbia	-0.08	0.5
Delaware	-0.14	1.5
Maryland	0.15	2.3
Missouri	-1.01	8.3
New York	-0.12	1.3
West Virginia	-0.96	6.8
Intercept	-6.8	6.4

Note: Regression weighted by the square root of state population.

R^2 = .92

N = 1029

LOTTONEW 2325, 8/29/88, p. 8

C93 (wp), August 30, 1988

FOOTNOTES

* Selling Hope: State Lotteries in America, National Bureau of Economic Research Monograph (Cambridge: Harvard University Press, forthcoming).

[1]This is also referred to as Pareto's law or the "80/20 rule." See Handbook of Modern Marketing, ed. Victor P. Buell, 2d ed. (New York: McGraw-Hill), 1986, pp. 8-10, and Macmillan Dictionary of Marketing and Advertising, ed. Michael S. Baker (New York: Nichols Publishing Company, 1984), p. 150.

[2]Calculations based on Oliver Quayle and Co., Appendix, in Fund for the City of New York, Legal Gambling in New York (New York: for the Fund, 1972), p. 19, indicate that the top 10.5 percent of players in the illegal game made 47.8 percent of the bets, quite similar to the 48 percent of bets made by the top 10 percent of players in Maryland. The top 20 percent bet about 67 percent in the illegal game, compared to about 63 percent in Maryland.

[3]National Institute of Alcohol Abuse and Alcoholism, Sixth Special Report to the U.S. Congress on Alcohol and Health, Washington, D.C., January 1987, p. 3.

[4]John Koza, "Who Is Playing What: A Demographic Study," pt. 2, Public Gaming 12 (March 1984): 72. Likewise, Maryland's advertising agency cites evidence that the great bulk of lottery purchases are made by "regular, loyal, repeat customers," and concludes that it would be incorrect to base a marketing strategy on stimulating impulse sales. Trahan, Burden, and Charles, Inc., Advertising and Marketing the Maryland State Lottery, Senate Governmental Affairs Committee, Subcommittee on Intergovernmental Relations, September 1984.

[5]The data sets referred to in this section are: American Institute of Public Opinion, national survey of gambling, conducted in 1944, summarized in Edward C. Devereux, Jr., Gambling and the Social Structure (Ph.D. dissertation, Harvard University, 1949; New York: Arno, 1980), Appendix D; University of Michigan Survey Research Center, Gambling in the United States (ICPSR 7495), unpublished data from national survey, conducted Summer 1975; Gallup Organization, Inc., Gallup Study GO 84190, unpublished data from survey conducted November, 1984; Arizona State Univer-sity, Survey Research Lab, Arizona Survey P1922, unpublished data from survey conducted Fall 1985/Winter 1986; The Field Institute, The California Poll 8504, unpublished data from survey conducted November-December 1985; Los Angeles Times, Los Angeles Times Poll No. 103, unpublished data from survey conducted March 1986; The Field Institute, The California Poll 8602, unpublished data from survey conducted May 1986.

[6]Calculations are based on Gallup Study GO 84190, unpublished data from survey conducted November, 1984.

[7]For descriptions of the role of numbers and policy, see, for example, St. Clair Drake and Horace R. Cayton, Black Metropolis: A Study of Negro Life in a Northern City (New York: Harcourt, Brace and World, 1945; 1970); Illinois House of Representatives, Policy Numbers Game Study Committee, "Report and Recommendations to the Legislature," June 1975 (Photocopied); and Fund for the City of New York, Legal Gambling in New York. 1972). Witnesses testifying on the possible legalization of policy in Chicago agreed about its prevalence in black neighborhoods, some expressing the hope that a legalized and locally administered game would continue to provide employment for blacks. One witness stated: "Policy is an evil in the Black community which we might compare with mosquitoes and flies. None of us like them particularly, but we know they are there to stay and we must live with them". (Illinois Study

Committee, p. 31). Another gave the positive side: "Policy offers a positive expectation that one could be lifted out of the most sordid entrapments of life in the ghetto". (p. 17).

[8]Calculations are based on Arizona State University, Survey Research Lab, unpublished data from survey conducted Fall 1985/Winter 1986.

[9]Data from household surveys were requested from the Massachusetts and Illinois lottery agencies, but neither consented to allow them to be used for this study.

[10]Calculations are based on Gallup survey, 1984 (see Note 5) and are corrected for the 9 percent of the population (all non players) who were excluded from the survey.

[11]Koza, "Who Is Playing What." For each game regular players were defined so as to account for 80 to 90 percent of all expenditures. Indices of participation were then calculated as the ratio of regular players in a group as a percentage of all regular players to adults in the group as a percentage of all adults. Data were taken from a household survey in New Jersey. Index values for blacks and Hispanics were 199 for four-digit numbers, 197 for three-digit numbers, 131 for lotto, and 105 for instant games.

[12]Oliver Quayle and Co., Appendix, p. 9, reports that 20 percent of whites and 40 percent of blacks and Puerto Ricans played the numbers.

[13]For example, Roger E. Brinner and Charles T. Clotfelter, "An Economic Appraisal of State Lotteries," National Tax Journal 28 (December 1975), 400, presents data on expenditures by income based on surveys of three states. For none of the states is there a pattern of absolute expenditures with income. Likewise, Daniel Suits, "Gambling Taxes: Regressivity and Revenue Potential," National Tax Journal 30 (1977), 23, tabulates average lottery

expenditures by income based on the national study of gambling in 1974. The average bet rises from $7.48 in the under-$5,000 income class to almost $17 between $5,000 and $14,999, and then falls again to about $8.72 in the $30,000-and-above class.

[14]Hill, Holliday, Connors, Cosmopulos, Inc. Quantitative Research Findings: The Massachusetts State Lottery Game, Wave II. Report prepared for the Massachusetts State Lottery (Boston: March 1986).

[15]John Koza. "Who Is Playing What: A Demographic Study," Public Gaming 12 (Part I: March 1984, 12; Part II: April 1984, 37).

[16]For example, in fiscal 1986 most of the interstate differences in per capita numbers sales could be explained by the percentage of blacks in the population. The correlation between the logarithms of these two variables (per capita sales and percent black), is .87 for the sixteen numbers games operating that year.

[17]The states are Arizona, Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, Ohio, Pennsylvania, and Vermont.

[18]The data are for the period from July 18, 1984, to March 8, 1986. Each of the 170 observations consists of the sum of three days' numbers sales, in thousands of dollars (NUM), corresponding in each case to the three-day period between lotto drawings. The regression equation included a time trend (T), a dummy variable for the second half of the week (SAT), and a variable giving the amount of rollover included in the lotto jackpot (R), equal to zero if there was a winner in the previous drawing, otherwise the amount advertised as the official jackpot for the preceding drawing, measured in thousands of dollars. The estimated equation (with standard errors in parentheses) was: NUM = 2797 (21) - 0.0018 (.0038) R + 332 (18) SAT + 4.34 (0.19) T, R-squared = 0.84, mean of dependent variable $3,331 (thousand). The coefficient on the

rollover variable was equal to just one quarter of its standard error. If taken literally, the point estimate implies that a $1,000 increase in rollover reduces numbers sales by less than a penny.

[19]Calculations are based on Los Angeles Times Poll, 1986 (see Note 5).

[20]It is not plausible that the reinvestment pattern would by itself increase net revenue. Even if all the additional prize money were reinvested following an increase in the payout rate, the states' net revenue would fall somewhat because a percentage of the additional sales would go to retailers as commissions. Of course, where there are other mechanisms by which the payout rate influences sales, then sales may increase enough to increase net revenue.

[21]A series of cross section regressions of numbers sales was run to estimate the effect of payout rate. Using fiscal 1986 data for the fifteen states that were offering a numbers game at that time, we found that the coefficient estimate on the payout rate in no case exceeded its standard error. A total of seven (log linear) specifications were tried, using various combinations of the following set of variables: percent black, population, per capita income, and percent urban. The only variable that was statistically different from zero by normal standards was percent black. Its coefficient implied an elasticity of about .7. This result is given in Table A.4.

[22]See Table A.4.

[23]There have been a number of attempts to estimate the payout elasticity of demand using regression analysis of state sales data for all games combined. Unsurprisingly they reach contradictory conclusions on this issue and others. For example, Larry DeBoer, "Lottery Taxes May Be Too High," Journal of Policy Analysis and Management 5 (Spring 1986), 594-596, reports

a strong positive effect from the payout rate, while Jon David Vasche, "Are Taxes on Lotteries Too High?" Journal of Policy Analysis and Management 4 (Winter 1985), 269-271, reports a negative effect. These and other authors choose differing sets of control variables, and there is no a priori method of choosing which are most appropriate. See John L. Mikesell, "The Effect of Maturity and Competition in State Lottery Markets," Journal of Policy Analysis and Management 6 (Winter 1987); Jerome F Heavey, October 1978, "The Incidence of State Lottery Taxes," Public Finance Quarterly 6 (October 1978), 415-426; and Roger E. Brinner and Charles T. Clotfelter, "An Economical Appraisal of State Lotteries," National Tax Journal 28 (December 1975), for additional regression analyses of interstate sales patterns.

If the different types of lottery games have independent markets, as we have argued, then the preferred econometric strategy is to estimate separate regressions for sales of each game rather than a single equation on total sales. This is what we have done for numbers and lotto in Table A.4. This disaggregated approach provides the basis for estimating the distinct patterns associated with each game, rather than averaging them together. Most important, separate equations avoid the problem that an overall payout rate is a sort of price average with different weights in each state and is hence endogenous to the pattern of sales.

[24]At a payout rate of 50 percent and a marginal cost of administration of 6 percent, the elasticity of sales with respect to the payout rate would need to be 1.14. To see this algebraically, let net revenue be $N = S(p) - pS - C(S)$, where S is sales, p is the payout rate, and C is the cost of administration (including commissions). The effect of the payout rate on sales is given by $N'(S) = S'(p) - S - pS'(p) - C'(S)\,S'(p)$, where primes denote partial derivatives. This will be positive if the elasticity of sales with respect to the payout rate $(S'(p)\,(p/S)$ is greater than $p/(1 - p -$

C'(S)). If the payout rate is 50 percent (.5) and the marginal cost is 6 percent, the elasticity must exceed 1.14.

[25]For example, consider a lottery with sales of $100, fixed costs of $5, a payout rate of 50 percent, and commissions and additional administrative costs amounting to six cents per dollar. After subtracting prizes of $50 and operating costs of $11, net revenue would be $39. Could the lottery increase its revenues by increasing its payout rate to 60 percent? It could if sales rose at least 30 percent, to $130. Then deducting prizes of $78 (60 percent of $130), the fixed cost of $5, and other costs of $7.80, net revenues would be $39.20.

[26]See Z. Adar and N. M. Edelson, "Gambling Behavior and Lottery Prize Structures," Discussion Paper 72, Fels Center of Government, University of Pennsylvania, May 1975. See also Chapter 4.

[27]This account of the history of Holiday Cash was provided by Anne Bloomberg, public information manager for the Ohio state lottery, in a telephone call in September 1987. The lottery also provided weekly sales data for Holiday Cash and other games played just before and after Holiday Cash.

[28]A number of regressions (log linear form) were run on fiscal year 1986 lotto sales data for the sixteen states that operated lotto games at that time. The specifications included different subsets of the following variables: income per capita, percent black, percent urban, and payout rate. The state population was included in every specification, and was highly statistically significant in each case. The point estimate implies that a 10 percent increase in population causes a 5 percent increase in sales per capita. The results for one specification are given in Table A.4.

[29]A pooled sample of sales by drawing period was compiled by eight states' lotto games for calendar years 1986 and 1987. An equation was estimated explaining the logarithm of average daily per capita sales. Independent variables included state dummies, a time trend, and the logarithms of the probability of any ticket's winning the grand prize, the advertised jackpot, the proportion of the prize pool devoted to prizes below the grand prize, and the payout rate. The estimated elasticities of these last variables (with t-statistics in parentheses) were: -0.01 (0.3), 0.40 (40.3), 0.38 (4.6) and 1.35 (1.6), respectively. Table A.5 gives the full regression.

[30]For example, Elder Witt, "States Place Their Bets On a Game of Diminishing Returns," Governing 1 (November 1987), 52: "Bettors want new games or they quit."

[31]Chris Wood, "Odds Makers: The Very Profitable Gamble of Canada's Four Public Lottery Corporations," Canadian Business 57 (April 1984), 25.

[32]One impediment to this sort of competition is the federal prohibition on using the mail to ship lottery materials. As of 1988 that restriction was being circumvented through the use of other shippers, telephone orders, and illegal couriers. But these methods are somewhat costly and inconvenient to players. If federal restrictions were eliminated, a true national market in lottery tickets would emerge, with profound effects on game design and sales patterns.