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STATE LOTTERY SALES AND ECONOMIC ACTIVITY

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Abstract *- American state lottery sales growth slowed dramatically in the recent recession compared with the experience of the last decade. Evidence from pooled quarterly per capita sales data for lottery states from the end of 1983 through 1991 shows a high real income elasticity relative to other state revenues, around 3.9. Furthermore, lottery sales are sensitive to changes in the state unemployment rate, increasing by about 0.17 percent for each one percent increase in that rate. For instance, an increase in unemployment from 4 to 5 percent would be associated with around a 4.25 percent increase in quarterly lottery sales, other influences unchanged. That pattern is consistent with the hypothesis that in recession people find more attractive the small chance of winning a huge lottery prize for the low ticket price. The unemployment rate relationship works as partial offset to the income relationship. The analysis also finds lower lottery sales where states rely less on lotto in the game portfolio and that sales decay with lottery age, although sales flatten as the lottery matures. Combining all influences, per capita real sales would be expected to flatten out as economic expansion continues.*

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Lottery sales growth has been spectacular over the last decade. From fiscal 1980 through fiscal 1991, total state lottery sales grew at an annual compound rate of 22.3 percent. Some growth came from adding new state lotteries: 14 states offered lotteries in 1980, compared with 32 states plus the District of Columbia in 1991. Even excluding the new lotteries, however, the annual growth rate remains an impressive 16.8 percent and in no year did aggregate sales fall (U.S. Bureau of Census, 1981 and 1992).[1] Against that history, the fact that lottery sales did not increase from 1990 to 1991 shocked the lottery industry (*Gaming and Wagering Business*, 1992).[2] The national recession and slow economic recovery certainly shaped those results, but it is not clear by how much and how those conditions mixed with other influences on sales performance. Operators of modern state lotteries had no real experience to suggest what to expect when the 1990 recession began or generally what to expect through the economic cycle. The present paper measures the income elasticity of lottery sales across the economic climate of the last decade.

THE LOGIC OF LOTTERY SALES

What is the income elasticity of lottery sales, and, specifically, how do sales be-

have through the economic cycle? Logic suggests that state personal income, as a measure of economic activity, would influence lottery sales because household consumption, of which lottery spending is a part, usually depends on personal income levels. Indeed, earlier studies, including those by DeBoer (1986) and Mikesell and Zorn (1987), found sales to be positively influenced by income, but Vrooman (1976) discovered a negative relationship. These studies, however, provide no clear answer to the critical question under consideration, because, in various combinations, they encompass no recession periods, use annual data which cannot adequately capture the effect of short recessions of recent experience, or date from years when lottery games were considerably different from those available now.

Personal income may not, however, capture the full influence of the cyclical condition of the state economy, especially in brief downturns, because personal income includes transfer payments that work to mitigate cyclical decline. A cyclical measure, like the unemployment rate, can capture the effects that may be masked if only personal income is examined.[3] But the unemployment rate can also reflect changed perception of the attractiveness of the lottery gamble, making it especially important to include as an argument in the model. That gamble offers a purely random opportunity to win a jackpot, often multiple millions of dollars for the best modern lotto games, for a small price. In difficult economic times, as reflected by high state unemployment rates, more people may find this tiny but real chance of winning a huge prize more attractive than when unemployment rates are lower and traditional economic opportunities are brighter.[4] This logic suggests a positive relationship between the unemployment rate and lottery spending, regardless of personal income level.

Other influences need to be controlled, however, before judging the relationship between lottery sales and economic activity. One influence is how long the lottery has been offered. Although DeBoer (1986) and Vasche (1985) found sales to rise with age, more recent work by Mikesell and Zorn (1987) found sales to rise for some years, but then to decline. That latter pattern is at least partially consistent with Stover's (1987) finding that lotteries experience an initial adoption sales bulge. Because of the wide range of lottery ages in the data to be examined here, the period of time the lottery has been operated does merit consideration as an influence on lottery sales.

Studies by Stover (1990) and Mikesell and Zorn (1986) have shown the significance of the lotto format to overall lottery sales. Not all states offer lotto, states have introduced that format at different points in the development of their game portfolios, and state markets have shown different degrees of suitability for the lotto format. Therefore, the lotto share will differ: those states not able to offer lotto as a major part of the lottery portfolio should have lower lottery sales than states which can. As this share is lower, lottery sales would be expected to be higher.

EVIDENCE FROM THE LOTTERY SALES MODEL

To estimate the elasticity of state lottery sales, the model takes the following form:

$$L = f(Y, A, U, S)$$

where L is the state lottery sales, Y is the state personal income, U is the state unemployment rate, A is the age of the state lottery in quarters, and S is the nonlotto share of state lottery sales. To explore the widest possible range of lot-

National Tax Journal
Vol. 47, no. 1, (March, 1994), pp. 165-71

tery experience and to capture the influence of short duration economic fluctuation, the data for the analysis come from quarterly state lottery experience for the period October 1983 through December 1991.[5] All states offering lotteries in 1991 are included, except Rhode Island, because quarterly data were not available, and Texas, because of the newness of its lottery. The pooled framework using quarterly data is excellent for examination of the impact of state economies and economic cycles, the influence of lottery offerings, and the role of lottery maturation. Because the lottery states differ dramatically in size, both lottery sales and personal income were *per capitized*. All data are in logarithmic transformation, to provide constant elasticity measures. Income and sales data were both adjusted to 1987 price levels.[6] Tests add a matrix of dummy variables to identify from which state the other data are taken, thus isolating state-by-state social, cultural, demographic, and economic differences beyond those specified directly in the model; to avoid singularity, there is no dummy for West Virginia.

The results of this OLS regression (Table 1) generally coincide with expectations. There is, however, a problem because the share of sales coming from nonlotto games results from endogenous purchase decisions by lottery customers. Therefore, I re-estimated the equation using two-stage least squares (TSLS) to provide a more reliable test of the influence of state economic activity on lottery sales. The approach purges ln *S* of its correlation with the error term in the original equation by regressing ln *S* on the other independent variables and on some additional predetermined variables. The new predicted variable is then used to re-estimate the lottery sales equation. In this instance, state population and whether the lottery had an adjacent state which offered no lottery (an easily available export market for large-prize lotto games) were the additional variables.

The logic of the additional predetermined variables is straightforward. First, high population states provide an environmental conducive to the large parimutuel prize pools that make lotto particularly attractive. Hence, high population would be associated with a lower nonlotto share. Second, the close export market, found by Stover (1990) and Mikesell and Zorn (1987) (but not this study) to significantly influence overall lottery sales,[7] would be particularly significant for the large prize lotto format. An absence of such markets would make development and promotion of lotto less attractive to lottery operators and work toward a higher traditional game share. Both these patterns did appear in the estimating equation for ln *S*.

The TSLS results in Table 1 provide the basis for further discussion and interpretation.[8] The equation yields a coefficient of determination (adjusted for degrees of freedom) of 0.833 and an *F*-statistic equal to 114.24; the fit of the equation is excellent. The individual variables not related to income or unemployment are statistically significant at high confidence levels, and the direction of influence is consistent with that found in the preponderance of existing literature.[9] First, lottery sales decline with the age of the lottery, although at a decreasing rate; for older lotteries, the profile with each additional quarter would appear almost flat. Second, lottery sales are lower when traditional game sales constitute a greater share of total lottery sales. The large share may be because market forces have prevented the lotto format from becoming important or because lotto is not offered at all, as may be the case when lottery managers believe the market environment is not appropriate

TABLE 1
EQUATIONS FOR *PER CAPITA* LOTTERY SALES (ln), POOLED STATE DATA, IV:1983–IV:1991 (n = 820)

	OLS Results		TSLS Results	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
Constant	−30.903	1.858	−33.846	2.104
ln Y	3.566	0.197	3.899	0.224
ln U	0.054	0.047	0.171	0.057
ln A	−0.225	0.024	−0.561	0.078
ln S	−0.531	0.039	−1.573	0.231
State dummies				
AZ	−0.813	0.082	−1.534	0.180
CA	−1.222	0.114	−1.836	0.182
CT	−0.522	0.120	−0.265	0.141
CO	−1.050	0.089	−0.875	0.104
DC	0.021	0.119	0.297	0.142
DE	−0.066	0.094	0.565	0.171
FL	−0.200	0.111	−0.822	0.181
ID	−0.384	0.105	−0.596	0.122
IL	0.081	0.093	0.267	0.108
IN	−0.457	0.118	−0.846	0.153
IA	−0.618	0.085	−0.735	0.095
KS	−1.539	0.104	−1.924	0.140
KY	−0.182	0.101	−0.479	0.127
LA	−0.187	0.198	−0.513	0.225
MA	0.329	0.107	0.781	0.152
MI	0.369	0.088	0.785	0.131
MD	0.286	0.104	0.911	0.176
ME	−0.165	0.081	0.220	0.121
MN	−0.974	0.138	−1.249	0.160
MO	−0.923	0.089	−0.993	0.098
MT	−1.105	0.087	−1.362	0.109
NH	−0.800	0.099	−0.278	0.156
NJ	−0.262	0.116	0.165	0.156
NY	−0.548	0.101	−0.496	0.109
OH	0.515	0.082	0.873	0.118
OR	−0.704	0.085	−1.015	0.114
PA	0.565	0.087	1.114	0.152
SD	0.213	0.094	0.480	0.117
VA	−0.657	0.122	−0.813	0.136
VT	−0.437	0.082	−0.090	0.116
WA	−1.111	0.091	−1.637	0.151
WI	−0.660	0.110	−0.935	0.133
	R^2 = 0.862 Adjusted R^2 = 0.856 F-statistic = 136.38		R^2 = 0.840 Adjusted R^2 = 0.833 F-statistic = 114.24	

for lotto or when they face organizational or legal barriers to the game.

Holding the influences previously considered constant, what do the results suggest about the impact of personal income and unemployment rates on lottery sales? The income elasticity of lottery sales in remarkably high, 3.90, and statistically significant at confidence levels well better than 0.001. This elasticity is higher than found for state-local income, property, general sales, or selective sales taxes, generally by a considerable margin.[10] For the lottery states over the period examined here, the mean percentage change in real personal income *per capita* in expansion quarters was 0.68 percent, compared to −0.24 percent in recession quarters.[11] That dif-

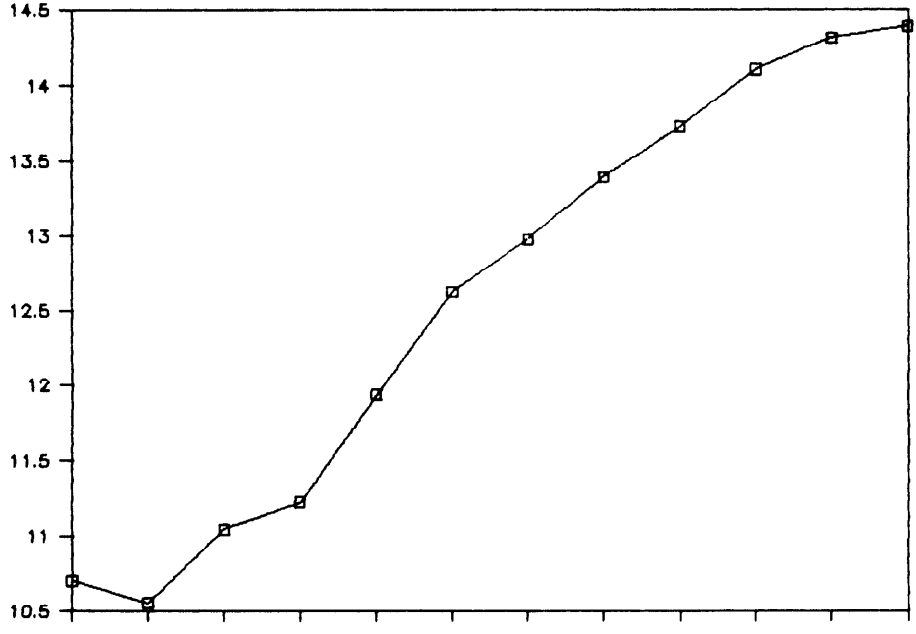
National Tax Journal
Vol. 47, no. 1, (March, 1994), pp. 165-71

ference, working through the high income elasticity, translates into substantial changes in real *per capita* lottery sales.

State unemployment rates also influence lottery sales. The elasticity, positive and statistically significant at the 0.003 level, indicates that lottery sales would increase by 0.171 percent when unemployment increases by one percent. Although the coefficient is relatively small, unemployment rates do change by substantial percentages because the beginning base tends to be relatively small. For instance, over the states and quarters examined here, state unemployment rates ranged from 2.3 to 12.7 percent, although not in the same state or in adjacent quarters. In more practical terms, moving from 4 to 5 percent unemployment rates, a 25 percent increase, would be associated with a 4.275 percent increase in quarterly lottery sales, *cet par.*, a change which would be of considerable consequence to the sales profile.

What profile might lottery sales follow in an economic expansion, given the different influences of income and unemployment? In order to answer that question, I simulated real *per capita* lottery sales, using the equations from Table 1. These assumptions about the independent variables were used: unemployment and real personal income *per capita* started at their national values in the first quarter of 1991, with quarterly change matching comparable quarters of the 1982–90 expansion, state population at the median for the lottery states reporting data for that quarter (4.6 million), with quarterly change as occurred in the

FIGURE 1. Simulated real lottery sales per capita (dollars), quarterly (first three years of expansion).



national average during the 1982–90 expansion, lottery age at the median for the first quarter of 1991 (36 quarters); no nonlottery states on the borders; and a state dummy coefficient for a state of about median lottery age and population in the first quarter of 1991.

The results of this simulation, traced through 12 quarters, appear in Figure 1. The pattern shows generally rising real lottery sales per capita, although the increase declines with time. That results from the combined influences of improving employment, an aging lottery, improving real income, and a larger population, all traced through the model. Of course, not all expansions have the same changes of income and unemployment and there will certainly be differences among states. The pattern shown here does, however, provide some evidence of what behavior could be anticipated from the several influences shaping the lottery market.[12] The findings mean that for many states the change in lottery sales otherwise produced by state personal income will be offset, sometimes considerably, by the influence of the unemployment rate.

Conclusions

The previous evidence from pooled quarterly state lottery data shows the influence of state economic activity on lottery sales. Major findings include the following.

(1) The income elasticity of state lottery sales is positive and extremely high, around 3.9, a sensitivity much greater than typically found for other state-local revenues.

(2) The elasticity of lottery sales to the state unemployment rate is positive as well, although relatively small. Therefore, when real state personal income rises and the state unemployment rate falls, as will often be the case, the unemployment effect will offset some of the personal income effect. The elasticity is relatively small, but, given the nature of unemployment rate changes, can cause relatively large movements in state lottery sales.

(3) Lottery sales decay as the lottery ages, although the rate diminishes with maturity.

(4) High reliance on traditional (nonlotto) games is associated with low lottery sales.

Lottery sales have a high positive income elasticity, and, while the elasticity to the unemployment rate is positive but relatively small, common magnitudes of change in that rate would induce a considerable change in sales. Reduced prospects in the regular economy appear to make the tiny but real chances of winning a large lottery prize more attractive to households. The influences from income would cause long-term increasing lottery sales with variation from changes in the unemployment rate.

ENDNOTES

My colleagues, David Good, Daniel Mullins, and Kurt Zorn, made helpful suggestions, as did Joel Slemrod and reviewers for this journal. Margaret Smith helped with data management.

[1] Sales did fall in some years in a few states, however.

[2] Mikesell and Zorn (1986) noted individual state revenue volatility well before recent lottery experience.

[3] The state employment rate and state real personal income *per capita* are certainly correlated, but not as closely as might be thought. For the entire sample analyzed later, the simple correlation is −0.34. For each state with 15 or more quarters in the sample, the median correlation is −0.49, with individual state correlations ranging from −0.95 to +0.44.

[4] The Fox and Campbell (1984) study of sales tax base components found spending on nondurables to rise as the economy entered recession and to fall as it entered expansion, an effect going beyond that of changes in state personal income. As a nondurable

National Tax Journal
Vol. 47, no. 1, (March, 1994), pp. 165-71

spending category, lottery play may also follow that pattern.

[5] Most sales data came from *Gaming and Wagering Business*; state lottery commissions helped with filling omissions and correcting for peculiarities. Consistent sales data were unavailable for quarters earlier than those included in the study, and later data have not been published in reliable form.

[6] Quarterly population estimates by state were interpolated from annual data reported in the *Survey of Current Business*.

[7] Vrooman (1976), however, found no such impact, although with a much different lottery portfolio than found today.

[8] To allow for seasonal variation in lottery sales, dummy variables for the first three quarters were tested. The variables were not significantly different from zero, individually or together; hence, they were excluded from further analysis. Personal income and the state unemployment rate are both seasonally adjusted. A complete fixed effects model with dummies for each quarter of observation was tested. These dummies, neither individually nor jointly significantly different from zero at the 15 percent level, were excluded from final estimates as well.

[9] Five of the state dummies are not individually significant at the 0.05 level, although they are jointly significant.

[10] For a listing of state and local tax elasticities that encompasses many taxes, many studies, many analytic methods, and many periods, see Aten (1986, pp. 576–77).

[11] The mean percentage change over all quarters was 0.47 percent.

[12] Similar simulations were run with assumptions of differing state sizes and lotteries ages; the patterns were generally consistent with those shown here.

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National Tax Journal
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