Contribution

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The Impact of Education Earmarking on State-Level Lottery Sales

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Abstract: Prior research argues that lottery consumers consider how funds are to be used in making lottery purchase decisions. Possible explanations for this behavior include altruism as well as the desire of low-income families to provide educational opportunities within their community. This paper uses a panel of lottery sales for U.S. states covering the period 1980–2000 to test hypotheses regarding the impact of educational earmarking on lottery purchases. Our estimates suggest that states earmarking all or part of their revenue to education experience an increase in lottery sales between 11% and 25%, depending on the specification of state trends. Whether the propensity for earmarking to increase sales is viewed positively or negatively depends largely on one's ethical and moral views of lotteries.

Keywords: lottery, earmarking, education

1 Introduction

Roughly half of U.S. state lotteries in operation today earmark net proceeds either in part or entirely to education. As of 2010, nineteen states allocated 100 percent of lottery receipts to either K-12 education, higher education, or both. Twelve states have modified their earmarking of lottery revenues since 1980, mostly from general funds to education. Though the trend appears to be moving toward education earmarking, sixteen states have never specifically targeted any earmarked dollars

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for education. Other targets of earmarked funds include the elderly, the environment, sports arenas, state employee pension funds, or simply general funds.

Conventional wisdom is that earmarked funds do not tend to increase spending in the targeted areas, but rather the funds supplant money that is already budgeted to that particular area. For example, if the current budget for K-12 education is \$10 million, and this year's net lottery proceeds equal \$9 million, most researchers conclude that K-12 will not wind up with a budget of \$19 million. Instead, the lottery funds will supplant, or replace, general funds, maintaining a \$10 million budget. However, now the state has \$9 million extra dollars in revenue that can be spent anywhere.

Though the literature overwhelmingly suggests that funds earmarked for education usually supplant general fund money (Borg and Mason 1988; Garrett 2009; Kaplan 1984; Mikesell and Zorn 1986; Spindler 1995), a few scholars report a positive correlation between earmarked funds and education spending (Evans and Zhang 2007; Lauth and Robbins 2002; Novarro 2002). Bhatt, Rork, and Walker (2011), using data for the period 1996–2008, find that while increased earmarked education funding coincided with a decline in education's portion of general funds overall education funding increased. Nevertheless, it is unlikely that the average consumer of lottery tickets is aware of the possibility that lottery funds are not going directly to improving education in their state. The central issue is not whether the education lottery actually increases the funds allocated to education programs. As long as the public *perceives* this to be the case, it is likely that some individuals will purchase lottery tickets to help facilitate and be part of the process. The perception that lottery proceeds make it possible for disadvantaged students to receive a higher quality primary or secondary education, or attend college, may be a powerful motivator for community members desiring to contribute to that effort, particularly those consumers that are unable to contribute by more tangible means.

To the extent that communities purchase lottery tickets hoping to increase the number of low-income college graduates, available empirical evidence suggests the efforts are not successful. Hawley and Rork (2013) observe that while state sponsored scholarship funds (typically funded from lottery proceeds) strongly impact students' propensity to enroll in higher education, these higher enrollments do not translate into greater numbers of college graduates. Moreover, Henricks (2014) finds that black communities with low levels of educational attainment generally contribute more to educational funding via the lottery as compared to higher income communities.

Members of a low-income community could derive a sense of accomplishment and well-being, at a relatively inconsequential marginal cost, by joining a collective effort to send children to college. The perception may be that rather than one

family paying \$10,000 a year to send one student to college, five thousand families can pay \$5 a week and make a year of college possible for 150 students.

The remainder of this article is organized as follows: Section 2 briefly reviews existing work regarding explanations for earmarking and lottery participation; Section 3 introduces our research design in order to estimate the impact of earmarking on lottery participation; Section 4 describes our dataset while Section 5 explores regional patterns in lottery adoption; Section 6 presents our main empirical results, followed by a number of robustness checks in Section 7. Finally, Section 8 concludes and discusses potential policy implications.

2 Existing Literature

Earmarking tax revenue for specific expenditures predates the existence of state run lotteries in the United States. In his pioneering work on earmarking, Buchanan (1963) uses a median voter model to demonstrate that earmarking can be more efficient from the perspective of the taxpayer beneficiary as compared to an integrated comprehensive budget. Subsequent literature addresses various implications of earmarking (Goetz 1968; Browning 1975) without addressing factors governing the decision to earmark. Jackson (2013) develops a theoretical model which suggests that earmarking may be motivated by current government uncertainty regarding future government policy choices, a prediction that is supported by his empirical results which show a relationship between extent of single party dominance and the propensity to earmark. Moreover, Jackson's empirical models suggest that education earmarking for state lottery proceeds may signal a state's preference for earmarking, but that growth in the prevalence of state lotteries coincided with an overall decline in earmarking. Jackson attributes the decline in earmarking among lottery states to increased revenue available from lottery sources.

In attempting to understand why people play the lottery, several theories emerge. One strand of literature suggests that insurance purchasing by gamblers may invalidate expected utility theory as said individuals seem to simultaneously exhibit risk aversion and risk preference. Alternative explanations for these behaviors, consistent with expected utility theory, include preference functions that are globally concave but locally convex (Friedman and Savage 1948); loss aversion which may explain why individuals are willing to accept a series of small bets over time while rejecting a single bet equal to the cumulative total (Rabin 2000), and gambling wealth that is separate from total

wealth (Lewandowski 2014). The “something for nothing” view of lottery participation (Nyman, Welte, and Dowd 2008) argues that gamblers derive utility beyond the winnings by not experiencing the utility lost associated from working. More specifically, Kwang argues that introducing the assumption of indivisibility of expenditures, such as a college education, results in a marginal utility function of income that makes the risk of a small amount for a larger payoff a rational utility-maximizing choice, especially for the poor household (Kwang 1965).

Several researchers argue that there is a “fun” component of gambling that increases utility when playing the lottery (Conlisk 1993; Wu 1979). There may be a general lack of understanding for the probabilities and risks associated with playing the games, particularly among those with lower incomes and less education (Camerer 2000; Kahneman and Tversky 1979). Though players must be gaining utility from purchasing lottery products, the additional utility gained as a direct result of player having “fun” is unlikely to be related to whether the state earmarks net lottery revenues for education funding or any other specific use. Moreover, a player’s ability to understand probabilities and calculate risks associated with the lottery does not depend on legislative earmarking. The theories of lottery participation that follow are more relevant when considering whether earmarking matters when an individual considers whether to participate in the lottery.

Blalock, Just, and Simon (2007) hypothesize that the poor see the lottery as a relatively low marginal cost opportunity for improving their standard of living on a grand scale, thereby reaping huge marginal benefits. According to a 1999 survey by the Consumer Federation of America/Primerica, when asked “what is your best chance to obtain half a million dollars or more in your lifetime,” 45 percent of respondents with incomes between \$15,000 and \$25,000 chose a lottery, as compared to only 27 percent of all respondents. This indicates that the poor are more likely to view the lottery as an investment tool, perhaps their only hope for moving out of poverty (Blalock, Just, and Simon 2007; Heberling 2002), with lower income individuals viewing the lottery in the same way that persons with higher incomes view savings accounts or other interest bearing assets.

Walker (1998) assigns an altruistic motive to people’s desire to purchase lottery tickets. Assuming people derive pleasure from altruism, Walker suggests that prospective buyers’ perception that revenues are used in part to support charitable causes or public works would lead some people to use the lottery as a conduit for charitable giving. This theory of pleasure being derived from rewards less tangible than money, according to Walker, is compatible with empirical evidence that lottery participation occurs, to varying degrees, at all income levels.

In his analysis of the British National Lottery, Peacock (2000) suggested that lottery consumers see the lottery as a substitute for direct charitable contributions. According to Peacock, people can contribute indirectly by purchasing lottery tickets, “safe in the knowledge that they are helping others as well as giving themselves a chance of gaining financially”. A decline in direct donations to charity since the British National Lottery began lends support to the idea that lottery tickets and charitable donations may be substitutes.

The distinction between lottery gambling and charitable giving may be blurred even more by “charitable gaming”, the use of Monte Carlo nights, bingo games and raffles for fundraising by non-profit organizations. The District of Columbia has placed the Charitable Gaming division under the purview of the D.C. lottery commission, labeling it The D.C. Lottery and Charitable Games. The D.C. lottery website has a prominent link to Charitable Games that may reinforce the connection some players make between lottery gambling and indirect charitable contributions.

The participation theory most relevant to our research relates to the earmarking of funds for education. If individuals value the contributions made from lottery receipts to education budgets and college scholarships, and believe that lottery funds are responsible for making college possible for students who otherwise could not afford to attend, they may be more likely to purchase lottery tickets as indirect contributions to finance education.

McCrary and Condrey (2001) report survey results showing that among respondents who play the Georgia lottery, 88.9 percent would vote to continue the lottery as it is, but only 35.6 percent would vote for continuing the lottery if it does not fund education. Only 32.4 percent of *all* respondents (players and nonplayers) would vote to continue the lottery without education earmarking. This clearly indicates that earmarking of lottery funds to education programs is critical to the broad public support enjoyed by the Georgia lottery.

If lottery participation is in part a function of the perceived use of funds, and if lower income and minority households consider lottery funds as their family’s best hope of getting to college, those households may view purchase of a lottery ticket as an indirect contribution to their education. If that is the case, there should be a statistically significant difference between lottery sales in general fund lottery states and education lottery states.

3 Research Design

In our main analysis, we employ cross-state variation in the timing of education earmarking adoption to assess its impact on lottery sales. Our empirical strategy

is similar to that employed in a number of recent studies evaluating the impacts of various social programs, such as WIC (e. g., Hoynes, Page, and Stevens 2011), food stamps (e. g., Almond, Hoynes, and Schanzenbach 2011), or Medicare (e. g., Finkelstein and McKnight 2008).

Specifically, we exploit the fact that different states adopted education earmarking at different times, which allows us to employ a difference-in-differences (DD) analysis, which compares changes in the outcomes within “treated” states (those that already adopted education earmarking) to changes within “control” states (those who have not yet adopted education earmarking). To implement this strategy, we estimate regression models of the following form:

$$y_{st} = \alpha + \beta(Earmark_{st}) + \theta X_{st} + LotteryAge_t + \lambda_t + \gamma_s + \varepsilon_{st} \quad (1)$$

where y_{st} are log real per-capita lottery sales, X_{st} is a vector of state specific control variables, and $Earmark_{st}$ denotes an indicator for state earmarking (i. e., equal to one if any lottery funds are earmarked to education and zero otherwise) in state s at time t . Moreover, $LotteryAge_t$, λ_t , and γ_s are complete sets of fixed effects for lottery age, time, and state, respectively. While time and lottery-age fixed effects capture time trends (along both dimensions) in a flexible, non-parametric way, we will also assess the robustness of our baseline results using a number of alternative specifications with various parametric trends, including state and “treatment group” specific trends.

In this setup, the coefficient on $Earmark_{st}$ captures the effect of adopting education earmarking on (log) lottery sales (y_{st}) under two identifying assumptions: first, trends in “control” states reasonably approximate the experience of “treated” states in the absence of earmarking; second, there are no concurrent events in the “treated” states that are correlated with both the decision to earmark and subsequent lottery sales. While the basic intuition behind our identification strategy is the same as in the standard DD framework, our application is somewhat complicated by two factors: first, not all “treated” states implement education earmarking at the same time; second, both “treated” and “control” states established their state lotteries at very different times ranging from 1964 in New Hampshire to 1996 in New Mexico. To address this complication, regression model (1) includes time, lottery-age, and state fixed effects, such that identification comes exclusively from cross-state variation in the *timing* of earmarking adoption.

To see the importance of time *and* lottery-age fixed effects, consider the following hypothetical example: Suppose there are only two states, A and B. State A, our “treated” state, introduces earmarking in 1982, 2 years after establishing a lottery in 1980, while state B, our “control” state, has not yet

introduced earmarking despite establishing its lottery much earlier in 1970. The standard DD framework (with state and time fixed effects but without lottery-age fixed effects) would postulate that the post-1985 trend in lottery sales within state B reasonably approximates the counterfactual experience within state A, had it not adopted earmarking. However, this thought experiment assumes that, conditional on general trends/economic conditions, sales growth within a 12-year-old lottery is expected to be the same as that of a 2-year-old lottery.

As there is no reason to believe that young lotteries should necessarily perform in the same way as old lotteries, it is of key importance to also include lottery-age fixed effects. This ensures that we compare trends within lotteries of the same age, while simultaneously controlling for general time trends. For example, previous work has shown that lotteries tend to experience gradual increases in sales over the first few years, with revenues likely to fall as lotteries mature (Borg and Mason 1988; Mikesell and Zorn 1986). The novelty may wear off, making it more difficult to attract new entrants into the market. While lottery-age fixed effects capture trends in a very flexible way, we also show robustness checks with various parametric specifications.

To account for other potentially confounding state-specific events that may influence both the decision to earmark and lottery sales, we additionally include a number of state specific control variables in X_{st} . These variables are described in detail in the following section.

4 Data

Using state-level panel data for years 1980 through 2000 for all thirty seven states operating lotteries by year 2000 yields 581 observations (see Table 1 for a complete list of included states). States adopted the lottery beginning in different years from 1964 through 1996. Total time periods per state vary from a minimum of 4 to maximum of 21 years resulting in an unbalanced panel. Data were collected from several sources, including LaFleur's 1970-Present Historical Sales Report, the U.S. Census Bureau, the U.S. Bureau of Labor Statistics, state lottery boards, and the North American Association of State and Provincial Lotteries (NASPL). In addition, Dr. Garrick Blalock of Cornell University kindly provided the dataset and codebook he and his colleagues used to estimate the impact of poverty rates on lottery sales from 1990 to 2002 (Blalock, Just, and Simon 2007). Earmarking information was provided by Dr. Neva Navarro of Pomona College (Navarro 2002).

The dependent variable in our baseline regression model (1) is logged per capita lottery sales by state and year, converted to 2000 dollars. Lottery sales

Table 1: State lotteries in sample, 1980–2000.

Sorted by state			Sorted by starting year			Sorted by earmarking in 2000		
State	Year lottery began	Education earmarking in 2000	State	Year lottery began	Education earmarking in 2000	State	Year lottery began	Education earmarking in 2000
AZ	1981	0 %	NH	1964	100 %	PA	1971	0 %
CA	1985	100 %	NY	1967	100 %	CT	1972	0 %
CO	1983	0 %	NJ	1970	Partial	MA	1972	0 %
CT	1972	0 %	PA	1971	0 %	MD	1973	0 %
DE	1975	0 %	MI	1972	100 %	ME	1974	0 %
FL	1987	100 %	CT	1972	0 %	RI	1974	0 %
GA	1993	Partial	MA	1972	0 %	DE	1975	0 %
IA	1985	0 %	MD	1973	0 %	AZ	1981	0 %
ID	1989	Partial	IL	1974	100 %	WA	1982	0 %
IL	1974	100 %	OH	1974	100 %	CO	1983	0 %
IN	1989	0 %	ME	1974	0 %	IA	1985	0 %
KS	1987	0 %	RI	1974	0 %	MT	1986	0 %
KY	1989	Partial	DE	1975	0 %	KS	1987	0 %
LA	1991	0 %	VT	1977	100 %	SD	1987	0 %
MA	1972	0 %	AZ	1981	0 %	WI	1988	0 %
MD	1973	0 %	WA	1982	0 %	IN	1989	0 %
ME	1974	0 %	CO	1983	0 %	MN	1990	0 %
MI	1972	100 %	OR	1984	100 %	LA	1991	0 %
MN	1990	0 %	CA	1985	100 %	NJ	1970	Partial
MO	1986	100 %	IA	1985	0 %	WV	1986	Partial
MT	1986	0 %	MO	1986	100 %	VA	1988	Partial
NE	1993	100 %	WV	1986	Partial	ID	1989	Partial
NH	1964	100 %	MT	1986	0 %	KY	1989	Partial
NJ	1970	Partial	FL	1987	100 %	GA	1993	Partial
NM	1996	100 %	KS	1987	0 %	NH	1964	100 %
NY	1967	100 %	SD	1987	0 %	NY	1967	100 %
OH	1974	100 %	VA	1988	Partial	MI	1972	100 %
OR	1984	100 %	WI	1988	0 %	IL	1974	100 %
PA	1971	0 %	ID	1989	Partial	OH	1974	100 %
RI	1974	0 %	KY	1989	Partial	VT	1977	100 %
SD	1987	0 %	IN	1989	0 %	OR	1984	100 %
TX	1992	100 %	MN	1990	0 %	CA	1985	100 %
VA	1988	Partial	LA	1991	0 %	MO	1986	100 %
VT	1977	100 %	TX	1992	100 %	FL	1987	100 %
WA	1982	0 %	GA	1993	Partial	TX	1992	100 %
WI	1988	0 %	NE	1993	100 %	NE	1993	100 %
WV	1986	Partial	NM	1996	100 %	NM	1996	100 %

dollars are defined as total dollars spent by consumers with lottery agents. The key independent variable is a dummy variable indicating whether all state lottery revenue was earmarked for education. Six states included in the dataset have earmarked 100 percent of lottery funds to education every year from 1980 to 2000. Seventeen states did not earmark any funds for education, and three states had partial education earmarking for the entire sample period. The remaining twelve states changed earmarking of lottery funds between 1980 and 2000. In every case but one, earmarking changed toward more funds being allocated to education rather than less. Only Montana moved from total education earmarking to none.¹ See Figures 1 and 2 for illustrations of changes in earmarking over time. To control for potentially confounding state-specific developments, regression model (1) additionally includes a number of state-specific control variables, which we discuss below:

Figure 1: Lottery states by year of adoption, 1964–2000 (Sample 1980–2000).

1 In 1995, the Montana legislature eliminated numerous earmarks in a continuing effort to direct funds to more general purposes rather than small groups of targeted recipients and uses (Reece, 2007).

Figure 2: Education earmarking at adoption vs. 2010.

Income. Most research in the area of state lotteries analyzes the lottery in terms of equity, with almost unanimous agreement that lotteries are regressive (Brown, Kaldenberg, and Browne 1992; Clotfelter and Cook 1989; Rubenstein and Scafidi 2002; Scott and Garen 1994), meaning that lower income earners spend greater percentages of their incomes on lottery play than higher income earners. So much attention has been paid to the regressive structure of the lottery that it seems counterintuitive to conclude that lottery sales would increase as incomes increase, yet both Mikesell and Zorn (1986) and Scott and Garen (1994) found a strong positive relationship between lottery sales

per capita and per capita income. Conversely, Stivender and Amato's (2015) study using individual data found a lower likelihood of participating and a tendency to spend fewer dollars among individuals from the lowest income grouping. Coefficients for higher income earners were not statistically significant for either the probability of playing the lottery or for lottery spending patterns.

In determining the likely impact of differences in income on lottery sales dollars, it is critical to separate the impact on probability of play from the impact of dollars played. Stranahan and Borg (1998) found that people earning lower incomes are more likely to play, but among people who play, higher income players spend more dollars. An increase in income will yield an increase in total dollars spent only if the individuals earning the higher income are buying lottery products. This points to a shortcoming of using state-level data instead of data reflecting the consumption patterns of individuals. In the aggregate, an increase in income could lead to fewer players, but players with higher incomes could spend more dollars. The net impact on lottery sales would depend upon the relative magnitude of the two opposing forces.

To control for the impact of income on lottery sales we use real per capita personal income, in 2000 dollars.

Race and Education. Many studies have found that probabilities of playing the lottery and expenditures for those who play are a function of race and educational attainment. Heberling (2002) reports that people who most heavily play the lottery are the poor, the less educated, and minorities. In contrast, Stranahan and Borg (1998) found that race and educational attainment were not significant predictors of probability of play, but were significant when explaining dollars spent on the lottery, with minority players and less educated players spending more relative to their counterparts. Using individual level data, Stivender and Amato (2015) found black respondents spending significantly more than white respondents, but equally likely to participate. In the same study, educational attainment was negatively related to participation and spending.

To control for the impact of race on lottery sales, we include a measure of black residents as a percentage of total state population. Educational attainment is measured as the percent of the total state population with a high school diploma and percent that are college graduates. Both race and educational attainment vary annually within all states.

Marketing. Increased marketing efforts are likely to increase consumption of lottery products and should be accounted for in the model. Unfortunately, historical marketing expenditure data are not available. Blalock, Just, and Simon (2007) who found an inverse relationship between lottery sales and

total state revenue suggest that states may step up marketing when revenues from all sources fall or flatten, and may reduce marketing dollars when revenues increase. In contrast, Szakmary and Szakmary (1995) found lottery revenue and revenue from all other sources to be uncorrelated. To control for a possible correlation between lottery sales and non-lottery revenue, we included total government revenue minus net lottery proceeds. If state administrators respond to decreasing or flat revenue collections by boosting marketing efforts on the lottery, it is likely that there is a lag between revenue collection and increased marketing. To account for time to recognize the need for action, we lag total non-lottery revenue 1 year.²

Unemployment. Mikesell (1994) found lottery sales to be positively related to changes in the state unemployment rate, increasing by about 0.17 percent for each one percent increase in unemployment. However, Blalock, Just, and Simon (2007) found a negative relationship between per capita sales and unemployment rates in a study using aggregate level data from 39 states over 10 years. Though a theoretical argument could be made for either outcome, it is clear that annual unemployment rates should be included in the model.

Multistate Jackpots. Lottery sales are likely to increase as states add games with significantly larger jackpots including when a state joins multi-state lotteries such as 'Powerball' and 'Mega Millions'. These games pool lottery numbers games with jackpots in the millions of dollars. Twenty six of the thirty seven lottery states included in the dataset participated in one game or the other (not both) during the sample period. Our model includes a dichotomous variable by year indicating whether a state is a member of either Powerball or Mega Millions.

Poverty Rate. Blalock, Just, and Simon (2007) reported that poverty rates had a significant positive effect on lottery sales per capita, with the greatest impact being from those just below the poverty line. The authors suggest that the poor are more willing to purchase lottery tickets as a quick and relatively inexpensive

² Revenue data was obtained from Statistical Abstracts of the U.S. Census Bureau. The 1991 edition lists total revenue by state for the year 1988, and the 1992 edition provides equivalent revenue data for 1990, skipping over 1989 data. A search of government compendiums and other census documentation that contain equivalent data yielded no 1989 data. The Statistical Abstracts team of the U.S. Census Bureau stated in two telephone conversations that they were not aware of the omission and did not have any documentation to explain why the year of data was skipped. Therefore, 1989 total revenue figures were interpolated by averaging 1988 and 1990 figures.

way to improve their financial lives. We include annual state poverty rates to control for this possible correlation.

Lottery Prize Percent. Expectations of higher payouts may yield increased lottery sales relative to those states with lower payout rates so we include prize percentage in the model as a control variable.

Price of Tickets. Though it is intuitive to include the price of lottery products when estimating state-level lottery sales, lottery ticket prices have not varied over time or between states. To control for this lack of variation, researchers have used changes in the expected value of lottery product consumption to proxy price fluctuations (Clotfelter and Cook1989; Walker 1998; Scott and Garen 1994). The expected value of a lottery product is a function of expected payouts, participation and prize percentages. As these values are different for various lottery products (i. e., scratch-offs, Powerball, Pick-3 games), we cannot estimate accurate expected values across products, and therefore cannot accurately proxy lottery ticket prices in our estimation of aggregate total lottery sales by state from all sources.

All variables in dollar units are adjusted to 2000 price levels and log transformed to provide constant elasticity measures. See Tables 2 and 3 for variable descriptions and descriptive statistics.

Table 2: Variable descriptions (N = 581).

Dependent	
lottsals_percap	Real gross per capita lottery sales – total per capita dollars crossing the counter from consumers to lottery sales agents, 2000 dollars.
Independent	
earmark	All or some funds earmarked for education, 1 = Yes 0 = No
revpc_lag1	Real per capita revenue from non-lottery sources, lagged 1 period, 2000 dollars
lottprize_pct	Percent of lottery sales awarded in prizes
multi_st	State participates in multi-state jackpot game, 1 = Yes 0 = No
lotage (lotage ²)	Number of years lottery has been operating
unempl_rate	State unemployment rate
pct_over_18	Percent of population over 18 years of age
college_grads	Percent of population with at least bachelor's degree
HS_grads	Percent of population with high school diploma or equivalent
income_percap	Real per capita personal income, 2000 dollars
estbkpct	Percent of population estimated to be black
pov_rate	Percent of residents below poverty threshold

Table 3: Descriptive statistics ($N = 581$).

Variable	Mean	St. Dev.	Min	(ST, YR)	Max	(ST, YR)
Dependent						
lotsales_percap	143.918	128.740	9.185	(VT, 80)	822.367	(RI, 00)
Independent						
earmark	0.396	0.489	0		1	
revpc_lag1	3,347.9	774.6	1,770.7	(NH, 82)	5,848.2	(DE, 99)
lottprize_pct	0.499	0.101	0.009	(GA, 94)	.706	(MA, 96)
multi_st	0.404	0.491	0		1	
lot_age	13.6	7.9	1.0		37.0	
unempl_rate	5.641	1.988	2.242	(NH, 87)	15.575	(MI, 82)
pct_over_18	74.780	2.153	69.058	(ID, 90)	92.671	(CT, 80)
college_grads	19.759	4.223	10.400	(WV, 87)	34.600	(CO, 00)
HS_grads	74.450	7.206	55.900	(CO, 83)	91.800	(WA, 00)
income_percap	25,774.13	3,968.59	17,361.07	(ME, 81)	41,920.39	(CT, 00)
estbkpct	8.540	7.556	0.225	(VT, 80)	32.490	(LA, 00)
pov_rate	11.979	3.344	2.900	(CT, 89)	26.400	(LA, 93)

5 Sample Selection and Spatial Patterns

Unbalanced panels are often the result of individuals dropping out of the panel at various times for some reason. If an individual leaves early there will be missing observations for the last time periods. If the reason for attrition is systematic rather than random, the resulting bias must be corrected. The dataset used in this paper is unique in that the states are dropping *in* to the study group at various times. States enter the dataset in the year that they begin selling lottery products. Since there are specific reasons why one state may adopt the lottery before another state, the decision to adopt is not random, and so attrition bias must be considered. Model (1) accounts for this by controlling for observed and unobserved (through state, time, and lottery-age fixed effects) heterogeneity between the states and over time.

To gain some intuition for the unobserved heterogeneity it may be useful to inspect spatial patterns to help uncover why states would drop into the study group and therefore are important to consider. Spatial processes do not necessarily operate the same in all places and spatial analysis can reveal geographic areas in which the effects differ (Baller et al. 2001). The literature examining states' lottery adoption suggests neighboring state lottery competition appears to play a role in lottery adoption (Tosun and Skidmore 2004). Spatial dependence is scale dependent and presents challenges to how we

analyze spatial data. In their study, Ghent and Grant (2007) used voting and sales data from the South Carolina Education Lottery to test whether voters for a new lottery were driven by a latent demand for the lottery. The authors suspected that cross-border shoppers from North Carolina (which did not have a lottery at the time) would be drawn to South Carolina if South Carolina instituted a lottery and lottery dollars in counties that border Georgia (which did have a lottery) would remain in South Carolina once South Carolina instituted its lottery. The author's found that counties along the northern border of South Carolina experienced greater than average sales compared to other counties. The authors used county level data which enabled them to perform spatial analysis and detect autocorrelation. Scale is critical in determining the presence of autocorrelation.

Spatial autocorrelation is loosely defined as occurring when values that are nearby spatially are similar (or dissimilar). For example, with positive spatial autocorrelation, high or low lottery sales may tend to cluster among states whereas with negative spatial autocorrelation, states with high or low lottery sales tend to be surrounded by neighbors with very different values (Chi and Zhu 2008).

The first step in a spatial analysis is to test the null hypothesis of spatial randomness against the alternative of spatial autocorrelation (Cliff and Ord 1981; Ord and Getis 1995). Our assessment consisted of Exploratory Spatial Data Analysis (ESDA)³ of the global patterns of spatial autocorrelation in lottery sales across the entire study area. We examined the Moran's I statistic to determine if global spatial autocorrelation can be detected. The global measure pertains to the complete data set (each panel in this study).

A positive and significant Moran's I would indicate clustering among states with lottery sales. Our estimated *z*-scores and *p*-values indicate that we cannot reject the null hypothesis. State lottery sales indicate a random pattern and do not exhibit statistically significant clustering or dispersion in all years except 1981 and 1982. We found no evidence of spatial autocorrelation based on the Moran's I test statistic in all other years. The results indicate it is likely that the observed spatial pattern reflects the theoretical random pattern represented by our null hypothesis. Table 4 shows the critical *p*-values and *z*-scores at the 90% confidence level.

³ ESDA often involves visualizing spatial patterns exhibited in the data, identifying spatial clusters and spatial outliers, and diagnosing possible misspecification of spatial aspects of the statistical models (Chi and Zhu 2008).

Table 4: Spatial autocorrelation (Moran’s Index).

Year	<i>N</i> = Sates w/Lottery	Moran’s Index	Z-score	<i>p</i> -value
1980	14	0.05572	1.11464	0.265005
1981	14	0.130975	1.73337	0.083029**
1982	15	0.13817	1.7829	0.074602**
1983	17	0.116404	1.618078	0.105646
1984	17	0.049643	1.058827	0.289679
1985	18	0.029089	0.878683	0.379573
1986	22	−0.002934	0.612444	0.540244
1987	22	−0.028451	0.401143	0.688315
1988	26	−0.011232	0.543026	0.587112
1989	29	−0.037093	0.329721	0.741611
1990	32	−0.046799	−0.1876	0.851189
1991	32	−0.054041	−0.27997	0.779499
1992	33	−0.066731	−0.4423	0.658271
1993	34	−0.069467	−0.47803	0.632632
1994	36	−0.082934	−0.65138	0.514798
1995	36	−0.068363	−0.46751	0.640137
1996	36	−0.052772	−0.26876	0.788111
1997	37	−0.032862	−0.00801	0.993606
1998	37	−0.02462	0.101046	0.919514
1999	37	−0.012151	0.264146	0.791668
2000	37	0.014468	0.462168	0.643961

***p* < 0.01.

We turn our attention to the results for years 1981 and 1982. The magnitudes of the Moran’s I statistics are not particularly high, with 1982 having the highest value of 0.13817. The z-score for 1981 and 1982 are 1.733373 and 1.7829 respectively, which indicates that there is less than a 10 percent likelihood that the clustered pattern could be the result of random chance.

The local Moran statistic is closely related to the global Moran’s I. Examining the local statistics allows us to identify observations that are “extreme contributions” (or clustering) to the global statistic by noting which values are two or more standard deviations from the mean (Anselin and Cho 2002). The results of the local Moran statistic reveal that states with lottery sales in 1981 and 1982 have no observed spatial pattern (or insignificant clustering).⁴ The global Moran’s I reveal less than a 10 percent chance that the spatial pattern is not random and the local statistic does not find any states exhibiting clustering.

⁴ Details for local Moran statistics are available upon request.

6 Main Results

We begin our main empirical analysis with a baseline DD specification, nested within model (1), that does not include state-specific control variables. Column 1 of Table 5 shows the results and illustrates a point estimate of 0.229 for the earmarking

Table 5: Effects of education earmarking on lottery sales.

<i>Dep. Var.: Log Lottery Sales</i>	<i>Control variables</i>		
	<i>Baseline</i>	<i>Full Sample</i>	<i>Lott. Pct. > = 40 %</i>
	(1)	(2)	(3)
Edu. Earmark	0.229** [0.105]	0.241*** [0.0855]	0.241*** [0.0719]
Log State Revenue		-0.143 [0.381]	0.0342 [0.274]
% Rev. paid		-2.699*** [0.655]	4.218*** [1.130]
Power + Mega		-0.049 [0.121]	-0.155 [0.103]
% Over 18		0.0336** [0.0146]	0.0293* [0.0159]
% College Grads		-0.0347 [0.0220]	-0.00899 [0.0204]
% HS Grads		0.00227 [0.00727]	-0.00367 [0.00621]
Poverty Rate		0.00835 [0.0153]	-0.0152 [0.0112]
Unemployment Rate		0.0461 [0.0375]	0.0578* [0.0297]
Log Median Income		4.820*** [1.309]	2.924*** [1.003]
% Black		-0.116 [0.0706]	-0.125** [0.0541]
Observations	581	581	544
R ²	0.549	0.692	0.72
State FEs	yes	yes	yes
Time FEs	yes	yes	yes
Lottery-Age FEs	yes	yes	yes

Notes: The table reports regressions of log lottery sales on an education earmarking indicator, a set of control variables, as well as state, time, and lottery-age fixed effects, based on model (1). Column 1 does not include control variables. Column 2 adds control variables. Column 3 restricts the sample to years and states in which at least 40 % of the lottery revenues were paid out in prizes. Standard errors are reported in square brackets and are clustered on state. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

indicator, suggesting that education earmarking may increase lottery sales by as much as 25.7 percent. Notice that this effect is significant at the 95 percent level.⁵

As discussed in detail above, in addition to trends, it is also important to control for coincident state-specific developments that may influence both the decision to earmark and lottery sales. Therefore, column 2 of Table 5 reports results that are conditional on a host of demographic and other state and time specific economic indicators, resulting in a marginally larger coefficient of 0.241, confirming the estimate of our baseline specification. While the main purpose of this specification is to control for potentially confounding developments that may bias our estimated effects of education earmarking, a number of the coefficient estimates are of interest in their own right and have been discussed in existing work.

For example, consistent with the results found by Scott and Garen (1994) and Mikesell and Zorn (1986), our estimates suggests a positive association between lottery sales and median per capita income. Stranahan and Borg (1998) found that people earning less income are more likely to play, but among people that do play, higher income players spend more dollars.

We do not find a statistically significant relationship between lottery sales and the unemployment rate, which is not surprising given the mixed evidence found in previous literature. For example, Mikesell's (1994) finds a significantly positive relationship while Scott and Garen (1994) as well as Blalock, Just, and Simon (2007) report negative relationships.

Surprisingly, the coefficient on the percent of state revenues paid as prizes is statistically significant and negative. This seemingly counterintuitive result is likely an artifact of outliers in the data.⁶ Restricting the regression to only the observations in the sample with values for lottery prize percentage greater than 40 percent yields a significantly positive relationship between prize percentage and per capita lottery sales, while leaving the estimated earmarking effect and almost all other estimates essentially unaffected. Two notable exceptions are the unemployment rate and the percent of black individuals in the state. While the point estimates have not changed, these coefficients are now statistically significant. The latter result is in line with the previous literature (Heberling 2002; Kearney 2005; Stivender and Amato 2015; Stranahan and Borg 1998) finding no

⁵ All inference presented is based on standard errors that are clustered at the state level. While clustering at the state level is in principle preferred given our setup, the low number of cross-sectional units may significantly bias this inference (Cameron and Miller 2015). As a robustness check, we confirmed that the usual heteroskedasticity robust standard errors lead to the same inference for all our specifications. These results are available upon request.

⁶ Delaware, Rhode Island, South Dakota and Georgia report prize payout percentages below ten percent for multiple years. It is not clear whether there were errors in the reporting or recording of the data, or whether the figures are accurate.

strong relationship between the black percentage of the population and lottery participation. Column 3 in Table 5 reports these results.

The insignificant relationship between state revenue from non-lottery sources and lottery sales supports Szakmary and Szakmary’s (1995) finding of no correlation between other revenue and lottery revenue, and suggests that this variable may not be a reasonable proxy for marketing efforts, as Blalock et al. suggest (Blalock, Just, and Simon 2007).

7 Robustness Checks

Given the importance of the parallel trends assumption for our DD setup, we conduct several robustness checks to investigate the role of trends for our estimated effects. We start with exploring the importance of overall trends in time and lottery-age separately. To do so, Table 6 reports four models with state fixed effects and several combinations of time and lottery-age effects. A comparison of Column 1 with Columns 3 and 4 reveals that the failure to control for time and lottery-age trends drastically biases the estimated earmarking effect upward. Moreover, Columns 2 and 3 consider models with either time effects (the standard DD specification) or lottery-age effects in separation. A comparison with Column 4 (our baseline regression as in Column 1 of Table 5) reveals that controlling for both types of trends leads to an additional reduction in the

Table 6: The role of time fixed effects.

Dep. Var: Log Lottery Sales	State	State + Time	State + Lott. Age	All
	(1)	(2)	(3)	(4)
Edu. Earmark	0.732*** [0.157]	0.236** [0.103]	0.250* [0.130]	0.229** [0.105]
Observations	581	581	581	581
R ²	0.077	0.534	0.47	0.549
State FEs	yes	yes	yes	yes
Time FEs		yes		yes
Lottery-Age FEs			yes	yes

Notes: The table reports regressions of log lottery sales on an education earmarking indicator, as well as state, time, and lottery-age fixed effects, based on model (1). Columns 1–4 include state fixed effects. Column 2 adds time fixed effects. Column 3 adds lottery-age fixed effects. Column 4 adds both time and lottery-age fixed effects. Standard errors are reported in square brackets and are clustered on state. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

estimated effect. Thus, jointly controlling for trends in time *and* lottery-age is not only conceptually important, but it also appears to materially impact the estimated effects of earmarking within our DD setup.

As an alternative to lottery-age fixed effects we further consider three versions of parametric trends (linear, quadratic, and cubic) reported in Columns 2–4 of Table 7 (Column 1 repeats the baseline results as a reference). While the estimated earmarking effects vary slightly across specifications, the particular parameterization of lottery-age specific trends does not appear to have any material impact on our main results.

Another potential threat to identification in any DD setup are pre-existing differential trends. That is, if the “treated” states are on a trend trajectory that is significantly different from that of the “control” states *prior* to the introduction of earmarking, then the estimated effects from model (1) may be spurious. Unfortunately, this assumption is hard to assess directly in the current context, as each state introduces earmarking in a different year. However, as a suggestive robustness check, we estimate two specifications that address this concern. First, we allow for a linear trend in lottery age that is specific to the set of states switching to earmarking within our sample. Second, we include state specific linear trends in lottery age as well as time. All of these specifications require the estimation of a large set of parameters within a very small panel. The loss in statistical power is immediately revealed in the fact that standard errors roughly double, while the coefficient estimates on education earmarking are approximately cut in half. However, despite the lack of statistical power, both specifications still result in a point estimate suggesting a positive impact of earmarking on lottery sales. Columns 5 through 7 of Table 7 report these results.

As a final robustness check we alternatively estimate an “event study” specification. That is, instead of estimating the average DD effect of education earmarking as in model (1), we estimate the period-by-period deviations from a flexible trend specification in the years immediately before and immediately after the introduction of earmarking within treated states. This alternative specification will provide another way to assess whether our main results are likely driven by general, pre-existing differential trends in “treated” and “control” states and will also shed some light on the dynamic effects of introducing education earmarking. To implement this design we estimate the following modification of model (1):

$$y_{st} = \alpha + \sum_i \delta_i 1[\eta_{st} = i] + \theta X_{st} + \text{LotteryAge}_t + \lambda_t + \gamma_s + \varepsilon_{st} \text{ for } i \text{ in } [a, b]. \quad (2)$$

This model is identical to model (1), except that we now replaced the main earmarking indicator with a set of indicators for the periods a years before and

Table 7: Parametric trends.

Dep. Var.: Log Lottery Sales	Parametric aggregate age trends			Group specific age trends		
	Baseline	Linear	Quadratic	Cubic	Treatment	State
	(1)	(2)	(3)	(4)	(5)	(6)
Edu. Earmark	0.241*** [0.0855]	0.212** [0.0867]	0.219** [0.0867]	0.237*** [0.0865]	0.146 [0.134]	0.108 [0.154]
Log State Revenue	-0.143 [0.381]	-0.0313 [0.371]	-0.0238 [0.373]	-0.113 [0.367]	-0.00662 [0.355]	-0.218 [0.297]
% Rev. paid	-2.699*** [0.655]	-2.588*** [0.608]	-2.595*** [0.615]	-2.689*** [0.619]	-2.623*** [0.616]	-2.444** [0.906]
Power + Mega	-0.049 [0.121]	0.011 [0.125]	0.0061 [0.127]	-0.0218 [0.121]	0.017 [0.124]	0.0366 [0.120]
% Over 18	0.0336** [0.0146]	0.0329** [0.0145]	0.0339** [0.0139]	0.0346** [0.0151]	0.0312** [0.0151]	0.000048 [0.0117]
% College Grads	-0.0347 [0.0220]	-0.037 [0.0243]	-0.0426* [0.0212]	-0.0357* [0.0211]	-0.0392 [0.0246]	-0.0378** [0.0174]
% HS Grads	0.00227 [0.00727]	0.002 [0.00743]	0.00269 [0.00708]	0.00146 [0.00664]	0.00232 [0.00726]	0.00467 [0.00639]
Poverty Rate	0.00835 [0.0153]	0.0102 [0.0153]	0.0085 [0.0146]	0.00916 [0.0148]	0.0101 [0.0153]	0.0163 [0.0113]
Unemployment Rate	0.0461 [0.0375]	0.0465 [0.0376]	0.047 [0.0374]	0.045 [0.0366]	0.0569 [0.0421]	-0.0241 [0.0334]
Log Median Income	4.820*** [1.309]	4.645*** [1.192]	4.644*** [1.205]	4.624*** [1.243]	4.815*** [1.249]	1.08 [1.724]
% Black	-0.116 [0.0706]	-0.133* [0.0708]	-0.135* [0.0693]	-0.119 [0.0709]	-0.124* [0.0691]	-0.0586 [0.0550]

(continued)

Table 7: (continued)

Dep. Var.: Log Lottery Sales	Parametric aggregate age trends			Group specific age trends		
	Baseline	Linear	Quadratic	Cubic	Treatment	State
	(1)	(2)	(3)	(4)	(5)	(6)
Lottery Age		0.0191 [0.0322]	0.014 [0.0349]	0.0646 [0.0491]		
Lottery Age^2			0.000222 [0.000543]	-0.00347 [0.00209]		
Lottery Age^3				0.0000746* [0.0000383]		
Observations	581	581	581	581	581	581
R ²	0.692	0.676	0.677	0.683	0.678	0.817
State FEs	yes	yes	yes	Yes	yes	yes
Time FEs	yes	yes	yes	Yes	yes	yes
Lottery-Age FEs	yes					yes
“Treatment” Specific					yes	
Age-Trend						
State Specific Age-Trend						yes
State Specific Time-Trend						yes

Notes: The table reports regressions of log lottery sales on an education earmarking indicator, control variables and various alternative parametric trends. Column 1 repeats the baseline results from Table 5. Columns 2–4 replace lottery-age fixed effects with parametric trends in lottery age. Columns 5 and 6 replace lottery-age fixed effects with linear trends specific to “treated” states and states, respectively. Column 7 replaces time effects with state specific time trends. Standard errors are reported in square brackets and are clustered on state. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

b years after the introduction of earmarking within state s . For example η_{s0} is equal to one in the year that state s implements earmarking. Likewise η_{s-2} is equal to one exactly two years before state s adopts earmarking, etc. We omit event year $i = -1$, so that the year immediately before earmarking adoption is the reference year. The coefficients δ_i then measure the period-by-period deviations of log lottery sales within “treated” states from counterfactual trends based on “control” states within a window of a years before and b years after the introduction of earmarking. Notice that, as in model (1), we still control for both general trends in lottery sales over time as well as trends in the age of the lottery.⁷

Figure 3 plots our estimates for coefficients δ_i against the “event time”, i. e. the 10 years immediately before and after the introduction of earmarking. Like with our estimation of state specific trends above, this specification is very demanding given the small number of states that actually switch to earmarking

Figure 3: Dynamic effects of education earmarking on lottery sales.

Notes: The Figure plots regressions coefficients δ_i from regression model (2) against “event time”, i. e. the years immediately before and after the adoption of education earmarking. The effect one year prior to introduction of earmarking is normalized to zero and serves as the reference period. The plotted coefficients are conditional on the same fixed effects and control variables as the baseline model in column 2 of Table 5. For this specification we drop Montana starting with 1996, as it stopped education earmarking at that time, after a five year period with education earmarking. The gray dashed lines indicate 90 % confidence intervals.

⁷ For this specification we drop Montana starting in 1996 as it stopped earmarking to education at that point, after a 5-year period with full earmarking. Otherwise we would falsely count Montana as a “treated” state after 1996, even though it stopped earmarking.

within our sample. Nevertheless, the estimates deliver two reassuring results: first, prior to earmarking, the point estimates fluctuate around zero, indicating no notable deviations from general trends within states that eventually adopt earmarking. Second, over the 10 years after the introduction of earmarking, the point estimates are consistently positive and the 90 % confidence intervals only marginally include zero for the majority of this 10-year period, with the point estimates at $i = 4$ and $i = 7$ significant at the 90 % level. Moreover, our estimated DD effect of 0.241 from model (1) is very close to the path of post-earmarking point estimates based on model (2) displayed in Figure 3.

In sum, these robustness checks reveal that our baseline estimates are not very sensitive to alternative trend specifications and that pre-existing differential trends do not appear to materially bias our results.

8 Conclusion

Our results support the notion that lottery consumers do consider what lottery funds will be used for when making their purchase decisions. It is not evident from these results whether lottery sales increase because a greater number of individuals decide to consume lottery products, or because the individuals that already have a propensity for consuming the lottery products are spending more dollars. It is likely a combination of both effects.

The relevance of this study depends on whether you are on the side of the state or the consumer. Because there is a moral dimension to lotteries, states may have more of a challenge than is typical when attempting to adopt it when the populous is not ready for it. States must show that government sanctioned gambling promotes social welfare and is morally appropriate (Miller and Pierce 1997). Therefore, many states market lotteries by earmarking proceeds for a “good” cause, like education (Clotfelter and Cook 1989). For example, three of the most recent states to adopt are the North Carolina Education Lottery, the South Carolina Education Lottery, and the Arkansas Scholarship Lottery. Another recent adopter, New Mexico, sells their tickets with the slogan “*Benefiting New Mexico’s Future*”. The state of New York, earmarking 100 percent of their lottery proceeds to education since 1967, advertises with the slogan, “*Raising billions to educate millions*”. The state of Missouri adopted the lottery in 1986 with no funds earmarked specifically to education, but changed to 100 percent earmarking in 1993 with the slogan, “*When you play, students win.*”⁸

⁸ Slogans and lottery titles found on various state lottery board public websites.

From the perspective of the state, if consumers perceive their lottery dollars as being funneled into K-12 and college education for state residents, and are therefore willing to spend more on lottery products, the rational strategy for a revenue-maximizing state is to earmark 100 percent of lottery funds for education. Seven of the last nine states to adopt the lottery have earmarked 100 percent of net revenues to education funding. Though we found no empirical literature prior to this research demonstrating the relationship between earmarking and lottery sales, state policymakers must either believe the relationship exists, or they have found the education lottery easier to market to constituents that are likely to consume the lottery ticket with no expectation of winning simply to feel like they are participating in the process and sending needy children to school. Alternatively, individuals with higher levels of education and income may see an education lottery as being more legitimate than one that is not specifically earmarked for education, and therefore the stigma associated with lottery participation is lessened.

Opponents of the lottery would consider a relationship between earmarking and lottery sales as yet another reason to oppose the lottery, particularly if the data suggest the increased lottery sales are coming from the most at-risk consumers. The regressive nature of the lottery already means that lower income buyers are paying a higher percentage of their incomes when they consume lottery products. The notion that those buyers considered most vulnerable are being encouraged to buy even more lottery tickets, with the hope that their children will benefit from higher education expenditures, would likely fuel the opposition to state lotteries.

Mintrom and Vergari (1998), who clearly have strong opinions about earmarked education funds, said,

Earmarking is a blatant rationalization of the lottery – it allows governments to rationalize government sponsored gambling, allows voters to rationalize a YES vote on lotteries, and allows ticket purchasers to rationalize gambling because proceeds go for a good cause. Why is it necessary? Because lotteries are morally questionable as a policy and a practice, which is why legitimization of them is so interesting and necessary.

To combat the opposition, it would be in the state's best interest to either disclose how earmarked funds are handled within the state budget, operating with more transparency than the system currently provides, or design an earmarking structure with obvious benefits and programs directly funded by lottery proceeds, such as a scholarship program that makes it necessary for the state to develop a new process by which students can access state funds for college. As an example, all funds from the Georgia lottery are earmarked not just for education but for specific education programs that did not exist before the

lottery began. Proceeds pay for three things – college scholarships, pre-K classes and technology for classrooms. Almost everyone in the state of Georgia knows someone with a child that attended college on a Georgia Lottery HOPE Scholarship. This clear connection between gambling and education may be one reason why the Georgia lottery is considered a success (McCrary and Condrey 2001).

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