

ECONOMIC RESEARCH



Weed Money: How Fungibility affects Colorado's Education Funding Gap

Michael Howard, Junior Sophister

January of 2014 saw the legalization of the sale of recreational marijuana in Colorado, but further stipulated the first \$40 million from a 10% excise tax on retail marijuana be reserved for public school capital construction. This draws upon the wider issues that Colorado's tax revenues are interchangeable, and as such taxes can be reallocated accordingly which may obstruct current federal education-based initiatives such as grants. Therein, aim of this paper remains to detect if the relationship between earmarked marijuana tax dollars and government grants to CPE is one of replacement or supplementation. This will be done by implementing a standard ordinary-least squares (OLS) method combined with a restricted and unrestricted model comparison. The econometric analysis concludes replacement, and subsequently goes onto consider possible policy implications and extensions to this study.

Introduction

In January of 2014, the sale of recreational marijuana became legal in Colorado. The amendment which accomplished this, Amendment 64, required that the first \$40 million from a 10% excise tax on retail marijuana be earmarked for public school capital construction. Once it was clear that revenues from this tax would exceed \$40 million inside a few years, lawmakers changed this policy to earmark revenues in excess of \$40 million (from what was now a 15% excise tax) for the state public school fund. Therefore, the marijuana industry's funding of

Colorado public education (CPE) is explicitly made proportional to its own revenue by state law. This likely influenced certain demographics – namely parents and educators- in their stance on legalization and the growth of the recreational marijuana industry in general. These demographics are especially amenable to such measures due to Colorado’s poor performance in many areas of public education finance.

However, if Colorado’s tax revenues are fungible – that is, if monies can be easily reallocated from one sector to another, there is a possibility that hypothecations of tax revenue from the marijuana industry could replace some state and federal grants rather than supplement them. This would mean that these injections would fail to close Colorado’s education funding gap. In general, the certainty of some future funding for a particular sector can encourage those in charge of fund distribution to direct generic monies away from that sector in the future or the present. This can cancel out the positive effects of new revenue sources or, if the average amount of money leaving a sector due to this phenomenon exceeds the amount of earmarked money coming in for a given period, cause total funding to decrease over time.

There is empirical evidence for this phenomenon. In Ohio, the hypothecation of casino revenues to public schools encourages lawmakers to reduce education funding on the grounds that schools have consistent revenue from other sources. These cuts are larger on average than the revenue coming in from casinos, resulting in an overall widening of the funding gap (Hollinger, 2015). Likewise, the presence of state lotteries, the revenues of which are allocated largely or entirely to education, is found to have no effect on the proportion of education expenditure due to the ineffectiveness of earmarking as a means of bolstering funding (Jones, 1994). However, there is also evidence that hypothecation can occur without significant displacement. For instance, while the introduction of earmarked gambling revenues in Illinois, Michigan and Missouri displaced a small amount of education funding, total funding was virtually unaffected and even stabilized following the emergence of these revenue sources (Ozurumba, 2009).

Clearly, it is not settled whether setting aside revenues for the reduction of specific funding gaps is a reliable strategy. The intricacies of local, state and federal budgetary politics make discussing this question in theoretical terms cumbersome. Until tax policy research unearths the characteristics which make a state’s tax revenues fungible, empirical investigations of the financial effects after the fact are the most valuable resources for policymakers.

The avenues of funding between the retail marijuana industry and CPE have been open for four years. The aim of this paper is to detect whether the relation-

ship between earmarked marijuana tax dollars and government grants to CPE is one of replacement or supplementation. I find that the empirical evidence suggests replacement, and recommend that the earmarks be removed from excise tax dollars before Colorado's schools become dependent on revenues from the marijuana industry.

Data and Empirical Approach

This analysis conducts ordinary least squares (OLS) estimation using monthly multivariate data from March 2014 to November 2017 on the following variables:

- **grants:** State and federal grants to Colorado public schools and PK-12 education programs, collected from grant payment detail reports on 882 grants compiled by the Colorado Department of Education (CDE) (2017a).
- **salestax and extax:** Sales and excise tax revenues from retail marijuana, collected from tax reports compiled by the Colorado Department of Revenue (2018).
- **enrollment:** Public school enrollment numbers, collected from CDE files on pupil membership from pre-school to 12th grade (2017b).
- **propvoter40plus:** The proportion of registered voters over 40, collected from voter demographics reports compiled by the Colorado Secretary of State (Williams, 2017).

Observations are used in a linear regression of the form:

$$\Delta \text{grants}_i = \beta_0 + \beta_1 \Delta \text{extax}_i + \beta_2 \Delta \text{salestax}_i + u_i$$

where variables preceded by Δ are calculated as the change in dollars from last month, and u_i is the random error term. Due to the fact that excise tax dollars are earmarked and sales tax dollars are not, a regression which includes only total tax revenue as an explanatory variable fails to capture the effects of earmarked monies as opposed to generic monies. Likewise, a regression which includes only excise tax dollars fails to correct for the impact of generic tax dollars on the size of government coffers. Hence, I have decomposed tax revenue into excise tax and sales tax.

Under the assumption that earmarked monies are replacing state and federal grants, we would expect to estimate a negative value for β_1 . This would indicate that an increase in excise tax revenue- a definite future injection into CPE- would accompany a decrease in state and federal grants. Revenue from sales tax is split between state and local government tax coffers, with 90% going to the former. Therefore, we would expect to estimate a positive value for β_2 , as the monies described by $\Delta \text{salestax}_i$ should contribute by some amount to the monies described

by Δgrants_i .

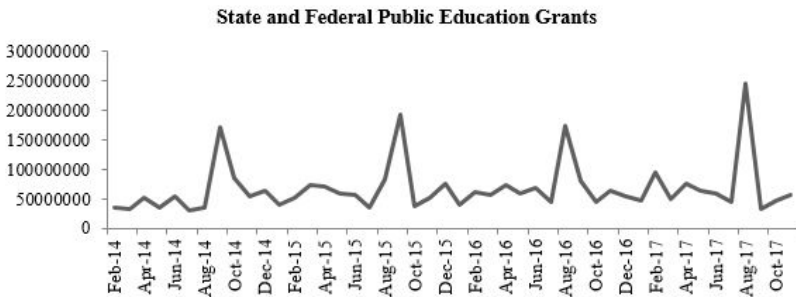
In order to detect changes in the electorate or in public schools across the state which might affect Δgrants_i , I compare the explanatory power of the restricted model above with the unrestricted model

$$\Delta\text{grants}_i = \beta_0 + \beta_1\Delta\text{extax}_i + \beta_2\Delta\text{salestax}_i + \beta_3\text{enrollment}_i + \beta_4\text{propvoter40plus}_i + u_i$$

Limitations on Inference

The most severe limitation on inference from this paper is sample size. As mentioned, the avenues of funding between the retail marijuana industry and CPE have only existed for four years. It is reasonable to speculate that trends which emerge within four years of a change to tax policy may not persist on longer time scales, or that the most drastic effects have yet to emerge.

Additionally, there is some seasonality in grants which creates outliers in the data. Somewhat predictably, the sum of CPE grants jumps drastically following the beginning of the school year.



It is possible that more precise estimations of the coefficients in both models could be obtained by weighting observations in September. No effort has been made to do this here, as determining accurate values for these weights would require an estimation of the magnitude of this seasonal effect using large pools of data. Since the aim of this study is to determine which of two effects has occurred, not to produce accurate estimations of CPE funding based on marijuana tax revenue, it is assumed that neglecting to omit or weight these outliers will not significantly impact results.

Lastly, precise interpretation of the models is curtailed by multicollinearity between the predictors. Increases in excise tax revenue for a particular product are obviously related to increases in sales tax revenue for that same product. While the explanatory power of each model as a whole remains unaffected by

this characteristic, the variance of the coefficient estimates is higher due to correlation between the explanatory variables. However, this correlation is not as tight as one might expect, presumably due to sales tax rounding and variation between retail marijuana establishments. OLS regressions of each retail marijuana tax component on the other return values of R^2 less than 0.5, indicating that the variance inflation factor (VIF) of each of these variables is low enough that this characteristic can be safely ignored. Furthermore, I would reiterate that this study does not aim at precise estimates of the coefficients in either model but only at obtaining their signs and rough magnitudes.

Results

OLS estimation using the restricted model returns the following:

OLS estimation using the restricted model returns the following:

Multiple R	0.56925		
R Square	0.324945426		
Adjusted R Square	0.291857113		
	Coefficients	t Stat	P-value
<i>Intercept</i>	-4231593	-0.49666	0.622021
<i>Asalestax</i>	32.63757	4.289977	0.000103
<i>Aextax</i>	-30.7682	-2.59569	0.012951

Replacing the relevant parameters in the restricted model with their estimated values gives:

$$\Delta \text{grants}_i = -4231593 - 30.77 \Delta \text{extax}_i + 32.64 \Delta \text{salestax}_i$$

Including enrollment and propvoter40plus returns the following:

Multiple R	0.577855778		
R Square	0.333917		
Adjusted R Square	0.267309		
	Coefficients	t Stat	P-value
<i>Intercept</i>	-1038495800	-0.419	0.677459
<i>Asalestax</i>	32.76473418	4.200382	0.000145
<i>Aextax</i>	-31.28453693	-2.58028	0.013649
<i>enrollment</i>	346.7267869	0.224285	0.823677
<i>propvoter40plus</i>	1216076013	0.599512	0.552212

Neither of the variables unique to the unrestricted model is found to have significant explanatory power. Due to the fact that the adjusted R^2 of the restricted model is greater than its unrestricted counterpart, only the restricted model will be interpreted. Furthermore, the intercept term is found to be statistically insignificant and to vary wildly between models. This does not affect the restricted model's ability to be interpreted in the context of this study, as I am interested only in the information captured by the coefficients, but it precludes the possibility of using either model to forecast values for the dependent variable with any sort of accuracy.

Interpretation of Results

The signs and rough magnitudes of the coefficients in the restricted model suggest replacement and are significant at $\alpha=0.05$. Again, not too much should be made of the exact estimations of β_1 and β_2 due to the inferential limitations discussed earlier, but even the 95% upper bound of β_1 in the restricted model, estimated to be -6.85 , suggests a more than one-to-one degree of replacement of state and federal dollars by excise tax dollars in CPE funding.

Policy Implications

Based on the results of this study, Colorado's tax revenues are highly fungible, and this has allowed state and federal grants to CPE to be replaced by excise tax revenues rather than supplemented with them. It is recommended that earmarks be removed from excise tax dollars, as unmarked dollars from sales tax do not exhibit this replacement property. The fact that sales tax revenues exert a significant positive effect on CPE funding suggests that Colorado's education funding gap would be reduced more quickly if the stream of generic tax revenue from the retail marijuana sector to government coffers consisted of both sales and excise tax dollars.

These results should not be interpreted as evidence against earmarking in all cases. Hypothecation may be appropriate for specific projects and sectors, and may even be effective at closing education funding gaps in certain states, as suggested by Ozurumba (2009). However, it appears that the dynamics of financial politics pertaining to CPE funding are such that hypothecation is an inappropriate response to Colorado's poor performance in education finance.

It is worth noting that the demographics most concerned with education finance overlap strongly with the demographics most disapproving of recreational marijuana, and that the financial relationship between the two sectors is in danger of becoming one of dependence. If government funds are being taken out of CPE in expectation of compensating injections from the retail marijuana industry,

Colorado's schools may become financially dependent to some degree on that industry's success. Therefore, it is recommended that the earmarks be removed soon, before this relationship is given a chance to develop. Fortunately, the data used in this study suggests that tax revenues from retail marijuana currently make up only a small proportion- less than 2%- of total CPE funding, so the degree of dependence, if any exists, is likely to remain small for some time.

Further Investigation

The precision of policy research in this area increases with time. In the context of the method used in this paper, available data and sample size increase as policies sink in. It is recommended that similar investigations of Colorado's situation be made in the future. Additionally, some investigation into the effects of seasonality in the dependent variable grants may improve the accuracy of coefficient estimates. Lastly, as the legalization of recreational marijuana continues to crop up as a salient issue in many states, it is likely that there will be more opportunities- and perhaps obligations- in the coming years to conduct this sort of investigation in different political and economic environments. In the likely event that legalization laws pass in more states, it is imperative that the field of tax policy research provides sufficient advice on how to make the most of these new revenue sources.

Reference List:

1. Allison, P. 2012. 'When can you Safely Ignore Multicollinearity?' Statistical Horizons. [on-line], <https://statisticalhorizons.com/multicollinearity>. [Accessed: 24 January 2018].
2. Colorado Department of Education, 2017a. 'Grant Payment Detail Report.' [on-line], http://www.cde.state.co.us/cdefisgrant/grant_distribution_reports. [Accessed: January 1 2018].
3. Colorado Department of Education, 2017b. 'PK-12 Pupil Membership by Grade with Historical Data.' [on-line], <https://www.cde.state.co.us/cdereval/pupilcurrent>. [Accessed: January 26 2018].
4. Colorado Department of Education, 2017c. 'Dropout Statistics.' [on-line], <https://www.cde.state.co.us/cdereval/dropoutcurrent>. [Accessed: January 26 2018].
5. Colorado Department of Revenue, 2018. 'State of Colorado Marijuana Taxes, License, and Fee Revenue February 2014 to Date.' [on-line], https://www.colorado.gov/pacific/sites/default/files/1217_CalendarReport%20PUBLISH.pdf. [Accessed: January 1 2018].
6. Hollinger, M. 2015. 'The Fungibility of Sin Taxes: An Economic Analysis of the Effect on Our K-12 Public School System.' Malone University, Ohio-

- LINK Electronic Theses and Dissertations Center. [on-line], https://etd.ohiolink.edu/pg_10?0::NO:10:P10_ACCESSION_NUM:ma1431083284 [Accessed 25 January 2018].
7. Jones, T. H. 1994. 'America's gamble: Lotteries and the Finance of Education.' Presented at the American Educational Studies Association annual meeting, Chapel Hill, NC. [on-line], https://archive.org/details/ERIC_ED380903. [Accessed 20 January 2018].
 8. Ozurumba, C. 2009. 'The Impact of Legalized Casino Gambling on State Education Spending Displacement.' *Journal of Public Budgeting, Accounting & Financial Management*, 21:1: 84-104.
 9. United States Census Bureau 2016. 'Public Education Finances: 2014.' G14-ASPEF, U.S. Government Printing Office, Washington, DC. [on-line], <https://www.census.gov/content/dam/Census/library/publications/2016/econ/g14-aspef.pdf>. [Accessed: January 26 2018].
 10. Williams, W. W., 2017. 'Voter Registration Statistics.' Colorado Secretary of State. [on-line], <http://www.sos.state.co.us/pubs/elections/VoterRegNumbers/VoterRegNumbers.html>. [Accessed: January 1 2018].