

# **The impact of cigarette excise taxes on beer consumption**

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## **ABSTRACT**

This study attempts to determine what if any impact a state's decision to increase its cigarette excise tax rate has on the alcohol consumption of its residents. A panel regression which posits beer consumption as the dependent variable and cigarette tax rates as the independent variable and also accounts for fixed effects shows that the relationship for all 50 states and the District of Columbia is not statistically significant. However, for the ten states that increased their cigarette excise taxes the most between 1996 and 2005, the same regression is suggestive of a corresponding reduction in beer consumption.

## **ABOUT THE AUTHORS**

Jeremy Cluchey and Frank DiSilvestro are entering their second year in the Masters of Public Policy program at the Terry Sanford Institute at Duke. They completed this project for Professor Phil Cook's Quantitative Evaluation Methods course in the spring of 2008, and are grateful to him for his guidance and support. Any questions or feedback can be directed to Frank and Jeremy at [jhc24@duke.edu](mailto:jhc24@duke.edu) or [fdisil@gmail.com](mailto:fdisil@gmail.com).

# *What is the nature of the relationship between changes in state cigarette excise tax rates and beer consumption?*

## **I. INTRODUCTION**

Each day across the country, state lawmakers consider policies that will generate concrete consequences – both intended and unintended – for their constituents. Often the direct change in behavior prompted by a policy will result in unforeseen new behavior, and in some cases the outcome of this modification is less than desirable. In general, a policy is considered sound when it generates the desired intended consequences and minimizes any negative unintended consequences, or externalities. However, the effect of those unintended consequences can be difficult to gauge.

In the case of state cigarette excise taxes, the primary intended effect is to generate revenue for the state. The widespread implementation of cigarette taxes demonstrates the policy's success in this regard. Increasing cigarette taxes also has the added benefit of reducing smoking, which in turn yields lower healthcare costs associated with smoking and secondhand smoke exposure – another positive outcome. But are there unintended consequences of increasing cigarette excise tax rates? What are they?

For the purposes of this project, we set out to determine whether a change in beer consumption is an unintended consequence of increasing cigarette excise tax rates. To do this, we compared beer consumption in each state over a ten year period (1996-2005) with the state's cigarette excise tax rates during that time. We hoped this comparison would reveal whether cigarettes and beer are substitutes or complements – whether people typically drink more or less as the cost of smoking rises – or, alternatively, whether increases in the cigarette tax rate have no measurable impact on beer consumption.

Our findings suggest that, generally speaking, cigarette excise tax rates do not affect beer consumption. While the data suggests that there is a slight decrease in beer consumption as cigarette tax rates rise, that finding is not statistically significant. However, when we isolated the states with the highest changes in cigarette tax rates, the relationship between the cigarette tax rate and beer consumption was stronger, with beer consumption dropping in those states. This suggests that beer consumption and cigarettes are complements if they are anything, but that only dramatic changes in the cigarette excise tax rate will reduce beer consumption in any significant way.

## **II. THE QUESTION**

Current cigarette excise tax rates vary across the states, from \$0.07 in South Carolina to \$2.58 in New Jersey. Many states increased their cigarette tax rates substantially between 1996 and 2005, while other states have increased the tax only marginally. Seven states have not changed it at all during that time period. Given this range of cigarette tax rates, and since recent data on tax rates

and beer consumption is readily available, we chose to focus on this time span to gauge the impact of cigarette tax rate changes on beer consumption.

The policy motivations associated with our analysis stem from the social and economic effects of beer consumption. Cigarette taxes are a common policy tool used to raise revenue and reduce costs associated with smoking. However, it would be useful to know if there are “displacement” effects from increasing cigarette taxes. For instance, if higher cigarette taxes cause an increase in beer consumption, that new behavior has social and economic costs that lawmakers should consider.

The relationship between cigarette tax rates and beer consumption does not appear to have been widely explored in the literature. We were able to locate one article, however, that did examine the impact of regulatory policies, including excise taxes and marketing restrictions, on demand for cigarettes and liquor. The study, published in the *Southern Economic Journal* in 1995, focused only on hard alcohol (excluding beer and wine) and excluded nine states because of missing data. Based on their regression analysis, the authors concluded:

The positive cross-price elasticity implies that cigarettes and liquor are substitutes in consumption. In other words, an increase in the price of cigarettes leads to an increase in the consumption of liquor and conversely.<sup>1</sup>

This conclusion is contrary to the results drawn from our project, which suggest that, if they are anything, beer and cigarettes are complements in consumption. There are of course fundamental differences in the data and regression analysis used in our project and that used by the authors of the *Southern Economic Journal* article. Additionally, public behavior could have changed over the time between each study. Still, we thought this divergent conclusion worth noting.

### **III. THE DATA**

The data for cigarette tax excise tax rates from 1996 to 2005 comes from the Centers for Disease Control’s State Tobacco Activities Tracking and Evaluation (STATE) System, which provides the data per year by state. For beer consumption, we use the National Institute on Alcohol Abuse and Alcoholism’s information on per capita ethanol consumption for states for the decade in question, which includes data specific to beer consumption for each state for every year in our study. All data used in the project comes from respected national institutions or state agencies.

Our project also utilizes several other variables in order to control for other factors that could influence behavior around beer consumption. These variables include state unemployment rates by year, which were obtained from the Bureau of Labor Statistics, and beer tax rates, which we received from Professor Phil Cook. The beer tax data combined federal and state beer tax rates and adjusted them for inflation and was derived from the National Conference of State Legislatures’ *State Tax Actions, 1995-2002*.

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<sup>1</sup> Rajeev K. Goel and Mathew J. Morey, “The Interdependence of Cigarette and Liquor Demand,” *Southern Economic Journal*, October 1995, p. 451.

The variables used in the regression are as follows (a complete table defining every variable more fully is included in Appendix 1):

**beer:** annual per capita beer consumption, in gallons of ethanol

**cigtax:** state cigarette excise tax amount, in 1982 dollars per pack

**beertax:** combined federal and state beer tax amount, in 1982 dollars per gallon

**unemp:** percent of state population considered unemployed

Beer consumption was established as the dependent variable, with cigarette excise taxes, beer taxes, and unemployment posited as independent variables. The validity of the cigarette and beer tax information is enhanced by the fact that it is in dollars, rather than percentages. The data utilized in the project contained no missing information, with the exception of the beer tax rate data, which only included tax rate information through 2002. To correct for this fact, we obtained beer tax rate data for the few states that had changed beer tax rates in the three subsequent years, adjusted it for inflation based on the CPI, and added it to our dataset.

#### IV. RESULTS OF ANALYSIS

We performed two types of analysis on the data to better understand the effect of cigarette taxes on beer consumption.

Analysis 1: The first type of analysis we conducted was a panel regression using dummy variables to capture the fixed effects for each of the 10 years and 51 states in our data. Beer consumption was the dependent variable for the regression. The independent variables were state cigarette tax, state beer tax, and state unemployment rate. All taxes were adjusted for inflation using the CPI.

The formula for the regression is as follows:

$$\lnbeer = a + b \text{cigtax} + c \text{beertax} + d \text{unemp} + f \text{state and year fixed effects}$$

After running this regression we found no significant relationship between beer consumption and cigarette tax rates (see Appendix 3). Looking at the regression output, we see that an increase in cigarette tax rate appears to have a slightly negative impact on beer consumption (a -.007 effect on  $\lnbeer$  for every \$1 increase in tax). However, the P-value for this effect is .63. Therefore, we can only reject the null hypothesis – that there is no relationship between cigarette excise taxes and beer consumption – at a 37 percent confidence level.

The coefficient for the impact of unemployment rates on beer consumption is negligible given the P-value of .98. For the beer tax, an increase in the tax appears to have a more significant effect on decreasing beer consumption, as we might expect. However, the null hypothesis can only be rejected at a 74 percent confidence level (P-value of .264).

Notably, comparing the changes in cigarette tax rates and changes in beer consumption for all states reveals an apparent correlation between these two factors. States that enacted a larger

increase in their cigarette excise taxes experiences a larger reduction in beer consumption. A graph of this trend can be seen in Appendix 5.

Analysis 2: The second type of analysis we conducted was to look at the ten states that had the highest dollar increase in cigarette taxes from 1996-2005 (adjusted for inflation). These states are listed in Figure 1 below.

**Table 1:** States with largest changes in cigarette tax, adjusted for inflation (1996-2005)

State	Change in Cigarette Tax
New Jersey	\$0.97
Rhode Island	\$0.87
Maine	\$0.79
Montana	\$0.76
Alaska	\$0.63
Michigan	\$0.55
Washington	\$0.51
Pennsylvania	\$0.49
Ohio	\$0.49
Connecticut	\$0.45

We coded these 10 “high tax” states with an indicator variable of “1” and ran a panel regression to see if the relationship between cigarette taxes and beer consumption was different than what we found looking at all the states. Looking at the regression output reveals a slightly stronger relationship between cigarette tax and beer consumption in these “high tax” states (Appendix 4). A \$1 increase in the cigarette tax appears to decrease beer consumption by -.047 of the natural log of beer consumption, which corresponds to a 4.6 percent reduction in beer consumption. We can therefore reject the null hypothesis for these states at an 86 percent confidence level – a much stronger confidence level than we saw looking at all 50 states. This relationship can be seen clearly in the trend line shown in Appendix 6.

In addition, we can conclude that increasing beer tax rates causes a decrease in beer consumption (P-value .01). We also see a more pronounced relationship between beer consumption and unemployment rates. We can conclude that as unemployment rates go up, beer consumption goes down by .013 of the natural log of beer consumption (P-value .03).

## V. DISCUSSION

Our regression analysis of the relationship between cigarette excise tax rates and beer consumption leads us to conclude that beer consumption is generally not affected by an increase in the cigarette tax. However, our comparison of states with dramatic cigarette tax increases suggests that large increases in the cigarette tax rate have a stronger negative effect on beer

consumption. In other words, beer and cigarettes are likely weak complements, with the impact on beer consumption only becoming clear after substantial cigarette tax hikes.

To this end, further research should explore the threshold at which that effect becomes evident. Is a nominal cigarette tax increase of \$1.20 over ten years sufficient to yield a statistically significant reduction in beer consumption? How about \$1.50? Further exploration of the relationship between changes in the cigarette excise tax rate and beer consumption would help policymakers better understand the full effects of cigarette taxes and inform their decision-making. Additionally, including more years in the analysis would improve the study's validity.

In the same vein, our study's internal validity may have been weakened by alternative causes for changes in beer consumption. Our panel regression took into account the state, time, beer tax and unemployment effects on beer consumption. However, if other regional factors affected beer consumption (i.e. local media stories, regional shifts in consumption toward other types of alcoholic beverages, etc.) this would weaken our internal validity. Since the study is nationwide in scope, the applicability of the findings within the United States is evidence of the study's strong external validity. Applying the findings to other countries would present challenges, however, since factors that may be pertinent abroad are not controlled for in this study.

## **APPENDIX 1: Variable Definitions**

**beer:** Per capita beer consumption (in gallons of ethanol, based on population age 14 and older)

**lnbeer:** Natural log of beer consumption.

**cigtax:** state cigarette excise tax amount, in dollars per pack

**unemp:** state unemployment rate (represents the number of unemployed as a percent of the civilian labor force)

**year:** year coded as 1-10 (1996-2005)

**state:** 50 states and the District of Columbia (coded alphabetically as 1-51)

**a1-a10:** “dummy” variables for each of the 10 years used. These variables account for the “fixed effects” between the different years.

**t1-t10:** “dummy” variables for each of the 51 states used. These variables account for the “fixed effects” between the different states.

**tax\_indc:** a 0-1 indicator variable used to tag those states with more than a \$1 change in cigarette taxes between 1996 and 2005



## APPENDIX 2: Descriptive Statistics

Variable	Mean	Standard Dev.	Min	Max
<b>Beer Consumption (gallons of ethanol)</b>	1.26	0.20	0.69	1.91
<b>Beer Tax (in 1982 dollars)</b>	\$0.47	\$0.11	\$0.31	\$0.95
<b>Cigarette Tax (in 1982 dollars)</b>	\$0.30	\$0.23	\$0.02	\$1.3
<b>Unemployment Rate</b>	4.8%	1.2%	2.3%	8.5%

State	Change in Cigarette Tax (in 1982 dollars)	State	Change in Cigarette Tax (in 1982 dollars)
Alabama	0.11	Montana	\$0.76
Alaska	0.63	Nebraska	\$0.11
Arizona	0.23	Nevada	\$0.19
Arkansas	0.09	New Hampshire	\$0.25
California	0.21	New Jersey	\$0.97
Colorado	0.30	New Mexico	\$0.33
Connecticut	0.45	New York	\$0.41
Delaware	0.13	North Carolina	\$0.12
District of Columbia	0.10	North Dakota	-\$0.06
Florida	-0.04	Ohio	\$0.49
Georgia	0.11	Oklahoma	\$0.38
Hawaii	0.33	Oregon	\$0.36
Idaho	0.11	Pennsylvania	\$0.49
Illinois	0.22	Rhode Island	\$0.87
Indiana	0.18	South Carolina	-\$0.01
Iowa	-0.05	South Dakota	\$0.06
Kansas	0.25	Tennessee	\$0.02
Kentucky	0.13	Texas	-\$0.05
Louisiana	0.06	Utah	\$0.19
Maine	0.79	Vermont	\$0.33
Maryland	0.28	Virginia	\$0.13
Massachusetts	0.29	Washington	\$0.51
Michigan	0.55	West Virginia	\$0.17
Minnesota	0.32	Wisconsin	\$0.11
Mississippi	-0.02	Wyoming	\$0.23
Missouri	-0.02	<b>Average Change</b>	<b>\$0.26</b>

Sources for data: Centers for Disease Control's State Tobacco Activities Tracking and Evaluation (STATE) System; National Institute on Alcohol Abuse and Alcoholism; Bureau of Labor Statistics; National Conference of State

*Legislatures' State Tax Actions, 1995-2002.*

### APPENDIX 3

regress lnbeer a1-a10 t1-t51 cigtax beertax unemp

Source	SS	df	MS	
Model	13.1848978	62	.212659641	Number of obs = 510
Residual	.512732963	447	.001147054	F( 62, 447) = 185.40
				Prob > F = 0.0000
				R-squared = 0.9626
				Adj R-squared = 0.9574
Total	13.6976307	509	.026910866	Root MSE = .03387

lnbeer	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
a1	.003286	.0099506	0.33	0.741	-.0162698	.0228418
a2	-.0066852	.009464	-0.71	0.480	-.0252847	.0119143
a3	-.0018853	.0094127	-0.20	0.841	-.0203839	.0166133
a4	.0071271	.0092263	0.77	0.440	-.0110053	.0252595
a5	.0035198	.0090196	0.39	0.697	-.0142063	.021246
a6	.0042041	.007861	0.53	0.593	-.0112451	.0196532
a7	.0103284	.006847	1.51	0.132	-.0031278	.0237846
a8	(dropped)					
a9	-.0083371	.0068832	-1.21	0.226	-.0218645	.0051903
a10	-.0285078	.007412	-3.85	0.000	-.0430746	-.013941
t1	.0367304	.0205897	1.78	0.075	-.0037342	.0771951
t2	.1632075	.0221861	7.36	0.000	.1196054	.2068096
t3	.2219035	.0184408	12.03	0.000	.1856621	.2581449
t4	-.0664224	.0163498	-4.06	0.000	-.0985543	-.0342905

(State dummy variables continue t5- t50)

t51	.1891759	.0213385	8.87	0.000	.1472397	.2311121
<b>cigtax</b>	<b>-.0070608</b>	<b>.0146512</b>	<b>-0.48</b>	<b>0.630</b>	<b>-.0358546</b>	<b>.021733</b>
beertax	-.1066729	.0954705	-1.12	0.264	-.2942996	.0809538
unemp	-.0000608	.0028043	-0.02	0.983	-.0055721	.0054505
_cons	.1940925	.0476343	4.07	0.000	.1004776	.2877075

**APPENDIX 4**

**regress lnbeer a1-a10 t1-t51 cigtax beertax unemp if tax\_indic==1**

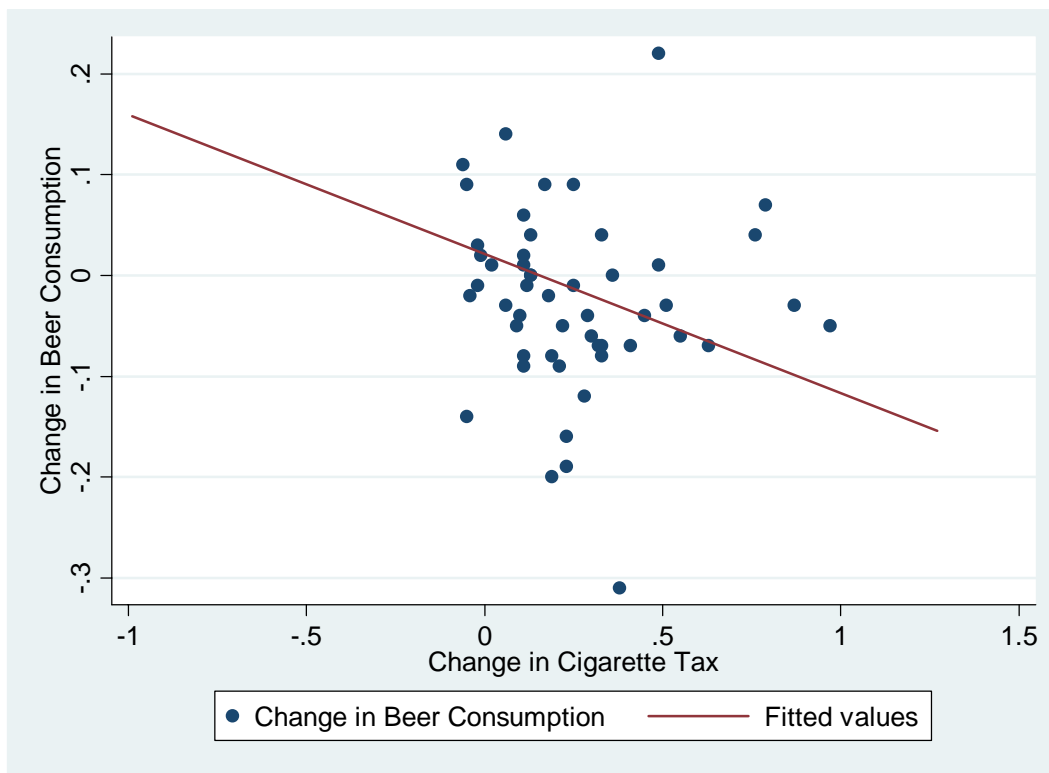
Source	SS	df	MS	Number of obs =	100
Model	2.05414711	21	.097816529	F( 21, 78) =	77.67
Residual	.098228909	78	.001259345	Prob > F =	0.0000
				R-squared =	0.9544
				Adj R-squared =	0.9421
Total	2.15237602	99	.021741172	Root MSE =	.03549

lnbeer	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
a1	-.0111736	.0197916	-0.56	0.574	-.0505756	.0282284
a2	-.0228729	.0193217	-1.18	0.240	-.0613395	.0155937
a3	-.0257862	.0202778	-1.27	0.207	-.0661562	.0145838
a4	-.0287874	.0210941	-1.36	0.176	-.0707825	.0132077
a5	-.047672	.0224244	-2.13	0.037	-.0923157	-.0030284
a6	-.0227058	.0206031	-1.10	0.274	-.0637233	.0183118
a7	.0088383	.0163129	0.54	0.590	-.0236382	.0413147
a8	(dropped)					
a9	-.0071376	.0163768	-0.44	0.664	-.0397413	.025466
a10	-.0132013	.0182818	-0.72	0.472	-.0495975	.0231949
t1	(dropped)					

(All other state dummy variables not listed below were dropped.)

t7	-.4566504	.0355575	-12.84	0.000	-.5274399	-.3858609
t20	-.1733489	.0254157	-6.82	0.000	-.2239476	-.1227502
t23	-.2048703	.0297999	-6.87	0.000	-.2641974	-.1455431
t27	.0246513	.0406212	0.61	0.546	-.0562192	.1055219
t31	-.4154431	.0356135	-11.67	0.000	-.4863441	-.3445421
t36	-.1204534	.0372478	-3.23	0.002	-.1946081	-.0462987
t39	-.1476519	.0421183	-3.51	0.001	-.2315029	-.0638009
t40	-.2503819	.0374649	-6.68	0.000	-.3249687	-.175795
t48	-.2608999	.0250865	-10.40	0.000	-.3108432	-.2109566
<b>cigtax</b>	<b>-.0473227</b>	<b>.0319904</b>	<b>-1.48</b>	<b>0.143</b>	<b>-.1110106</b>	<b>.0163652</b>
beertax	-.3898216	.1440243	-2.71	0.008	-.6765521	-.1030912
unemp	-.0137722	.0064093	-2.15	0.035	-.0265321	-.0010122
_cons	.6625577	.1141151	5.81	0.000	.4353721	.8897433

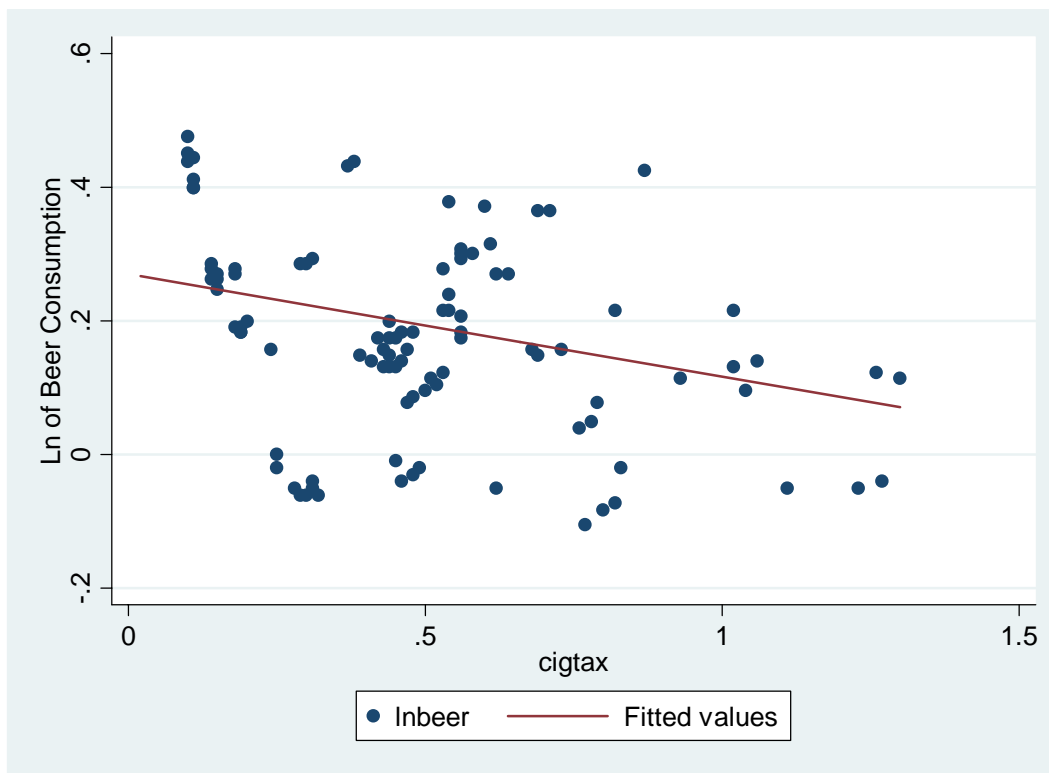
**APPENDIX 5: Scatter Plot of Change in Beer Consumption against Change in Cigarette Tax for All States, 1996-2005**



STATA command:

```
graph twoway (scatter beer_change cig_change if year==10)(lfit beer_change cig_change)
```

**APPENDIX 6: Scatter Plot of Beer Consumption (lnbeer) against Cigarette Tax (cigtax) for 10 States with Highest Increase in Cigarette Tax, 1996-2005**



STATA command:  
graph twoway (scatter lnbeer cigtax if tax\_indic==1) (lfit lnbeer cigtax)