

Project work for the teaching Policy Evaluation – Luca Pennella

The aim of the project is to estimate the effect of a tax on soft drinks on the consumption of soft drinks by the population.

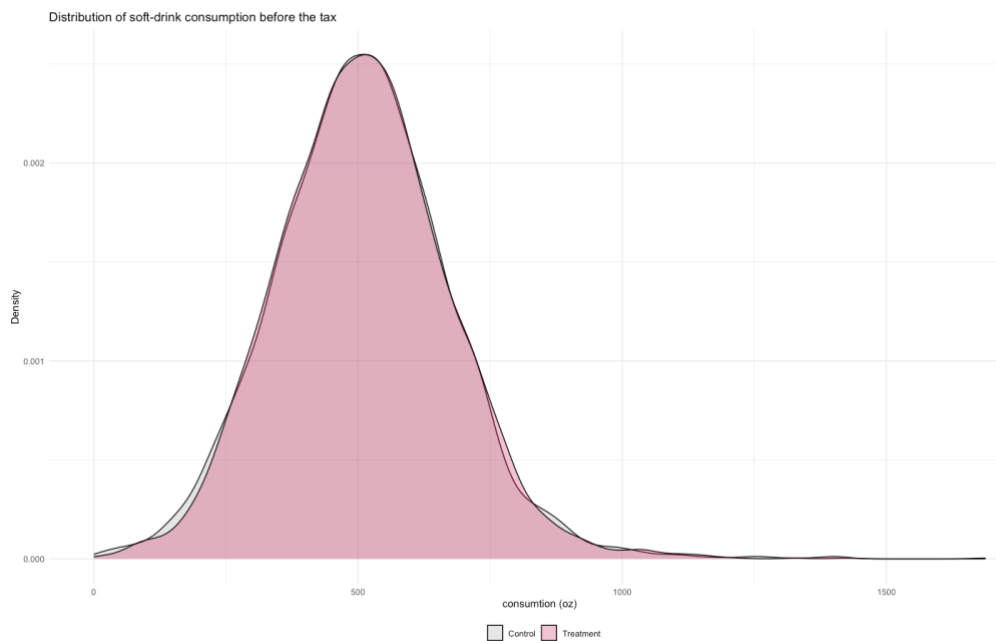
For this purpose we will use a dataset with the following scheme:

- **id**: A unique number identifier for each of the 7,500 inhabitants.
- **district**: The name of the district in which the corresponding unit lives.
- **treatment**: A dummy variable that signals whether the subject lived in a district where the tax was implemented.
- **pre_tax**: The weekly sugar-added drink consumption in ounces before the tax was imposed
- **post_tax**: The weekly sugar-added drink consumption in ounces after the tax was imposed

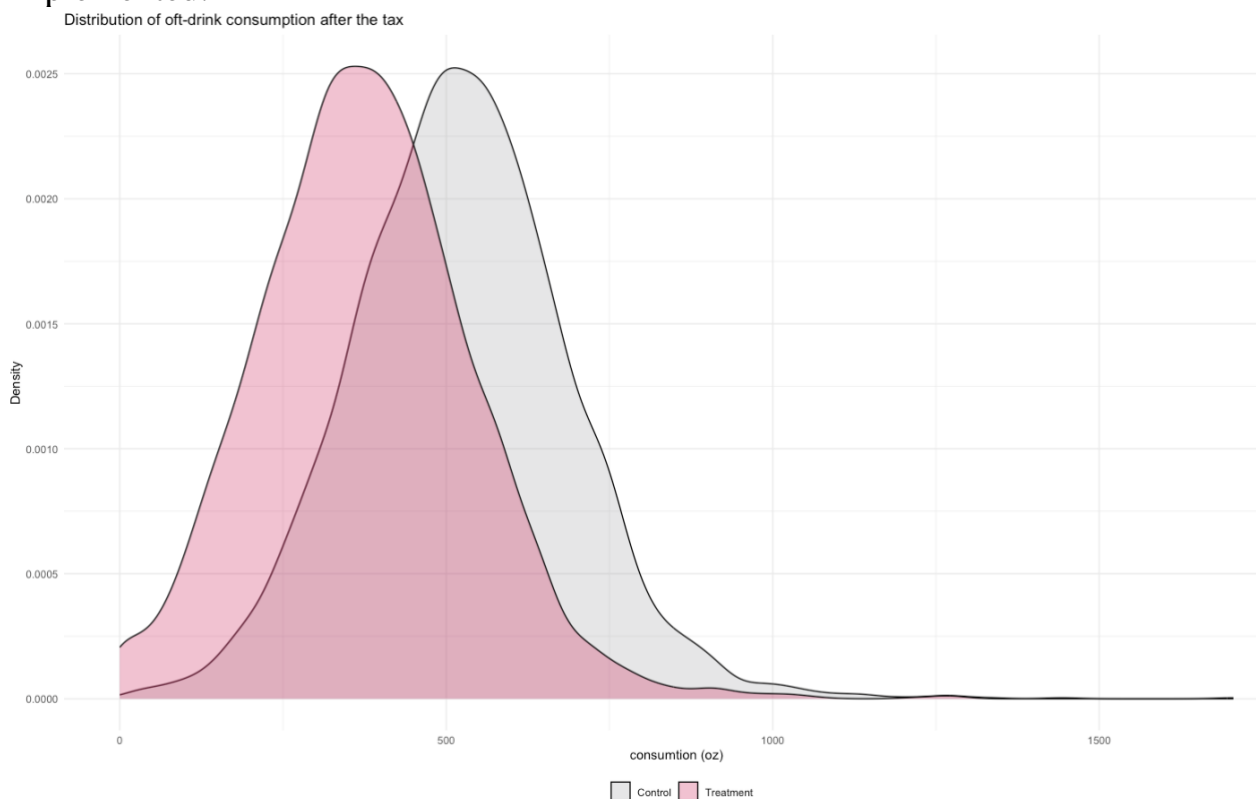
id	district	treatment	period	soda_drunk	after_tax
1	Snake Lounge	0	pre_tax	1687.64377	0
1	Snake Lounge	0	post_tax	1705.57906	1
2	Snake Lounge	0	pre_tax	427.29527	0
2	Snake Lounge	0	post_tax	438.25264	1
3	Snake Lounge	0	pre_tax	566.46926	0
3	Snake Lounge	0	post_tax	559.66640	1
4	Snake Lounge	0	pre_tax	606.92939	0
4	Snake Lounge	0	post_tax	623.90571	1
5	Snake Lounge	0	pre_tax	572.64025	0
5	Snake Lounge	0	post_tax	606.86543	1

The sample is made up of 7500 units, the average pre-tax consumption is 509.7 ounces of beer consumption which varies to 449.8 once the tax is applied.

The first step is to observe the distribution of beer consumption before the tax between the control group and the treaty group, at this stage we want the groups to consume the same amount of beer.

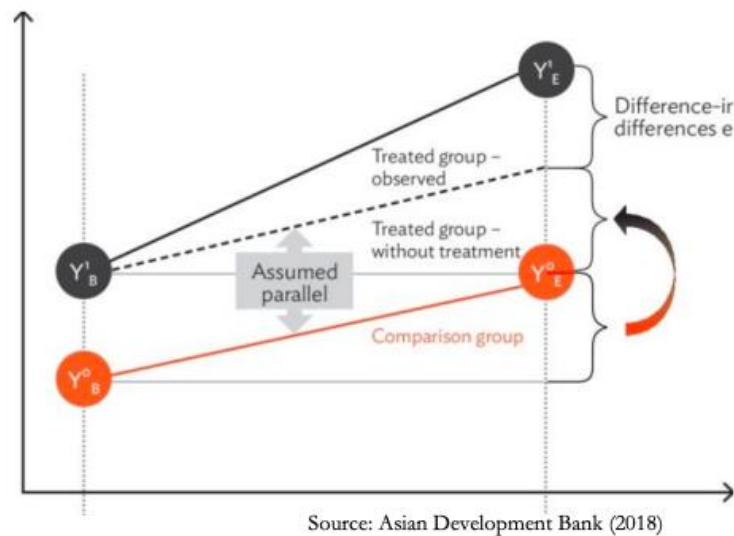


From the evaluation of the graph above we can see that the distribution between the control group and the treated group does not show significant differences. A first assessment of a possible effect of the tax on consumption can be made by reproducing the graph of beer consumption for the two groups once the tax has been implemented:



From a first graphical evaluation the consumption of the control group remained unchanged while the treatment group saw a decrease in beer consumption. However, graphical evaluation can be a useful clue, but to confirm it proceeds with the estimation of a Difference-in-differences model that compares changes in results over time between units in different treatment states. Difference in Differences allows

us to correct for any differences between the treatment and comparison groups that are constant over time assuming that the trends in time are parallel.



Modeling

A first step is the estimation of a model considering only the post-tax situation to explore the average effect on the treaties:

Dependent variable:	
post_tax	
treatment	-146.918*** (3.798)
Constant	523.273*** (2.686)
Observations	7,500
R2	0.166
Adjusted R2	0.166
Residual Std. Error	164.465 (df = 7498)
F Statistic	1,496.245*** (df = 1; 7498)

Those who lived in districts where the tax was implemented consumed on average 146.9 ounces less of sugar-added drinks per week compared to those who lived in districts where the tax was not implemented.

To believe the model results, we would have to think carefully about possible factors that could differentiate our treatment and control groups. We use a treatment indicator based on the districts where the measure was able to be implemented.

Treatment was not fully randomly assigned, so there may be lots of potential confounders that create baseline differences in the scores which also affect the after-treatment comparisons.

In this situation we are not evaluating the intra-temporal difference but only the difference between the two groups, for this reason it is also advisable to evaluate the difference between the two groups in time $t = 0$ and in time $t = 1$.

D^*	$t = 0$	$t = 1$	Difference
1	$\beta_0 + \beta_1$	$\beta_0 + \beta_1 + \beta_2 + \beta_{DD}$	$\beta_2 + \beta_{DD}$
0	β_0	$\beta_0 + \beta_2$	β_2

In our case:

	Treatment	Pre-tax	Post-tax	Difference
1	511.13	376.35	-134.78	
0	508.31	523.27	14.97	

Where $\beta_{DD} = -134.78 - 14.97 = -149.76$.

We can introduce the time component to our model by incorporating the pre-treatment levels of sugar-added drink consumption, which gives us the diff-in-diff estimation:

Dependent variable:		
	change (1)	post_tax (2)
treatment	-149.744*** (0.246)	-146.918*** (3.798)
Constant	14.967*** (0.174)	523.273*** (2.686)
Observations	7,500	7,500
R2	0.980	0.166
Adjusted R2	0.980	0.166
Residual Std. Error (df = 7498)	10.671	164.465
F Statistic (df = 1; 7498)	369,242.400***	1,496.245***

We could read this result as: those who lived in districts where the tax was implemented consumed on average 149.7 ounces less of soft drinks per week compared to those who lived in districts where the tax was not put in place. This

calculation would give us the change, or difference, in sugar-added drink consumption for treatment and control groups.

To believe the results of our difference in differences model, we would need to believe that there are parallel trends between the two groups.

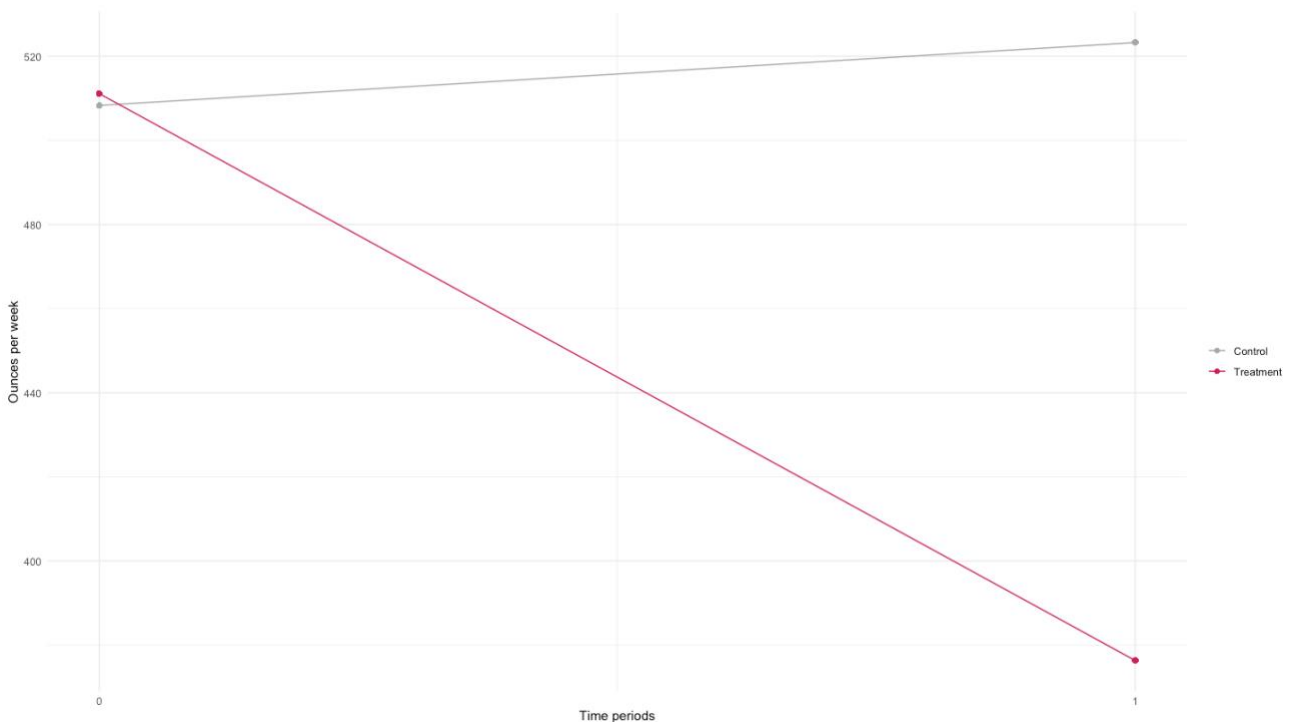
We can estimate the diff-in-diff effect with time and treatment dummies with this model:

$$Y_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 P_t + \beta_{DD}(Treat_i * P_t) + \varepsilon_{it}$$

Where $Treat_i$ tell us i is in the treatment group and P_t indicates the point in time (1 for post).

Dependent variable:	

treatment	2.827 (3.799)
after_tax	14.967*** (3.836)
treatment:after_tax	-149.744*** (5.372)
Constant	508.306*** (2.708)
=====	
=====	



Observing the results of the estimated DiD model we can see that the treatment group before the implementation of the tax consumed on average 2.83 ounces of beer per week more (the only non-significant parameter), once the tax was applied the consumption of beer varied in population of 14.96 ounces of beer while the treated group saw a contraction in beer consumption per week equal to 150 ounces of beer less.

We can say that the tax seems to have had the desired effect, with a contraction in the tax districts of 4.5 liters of beer consumed.

From this first evaluation we can see how the DiD analysis allows us to compare two groups taking into account the temporal and intra-group differences.