Section 3

Econ 152

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Introduction

Today we'll review ideas difference-in-differences and do an example of labor supply with home production.

Difference-in-Differences (D in D)

Motivation

Remember (?) from last section omitted variable bias. Let our model be

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

This is true by definition, since ε_i is everything else that affects Y_i. If we estimate an OLS regression

$$Y_i = \hat{\alpha} + \hat{\beta} X_i + e_i$$

we might have omitted variable bias given by

$$\hat{\beta} = \beta + \frac{Cov(X_i, \varepsilon_i)}{Var(X_i)}$$

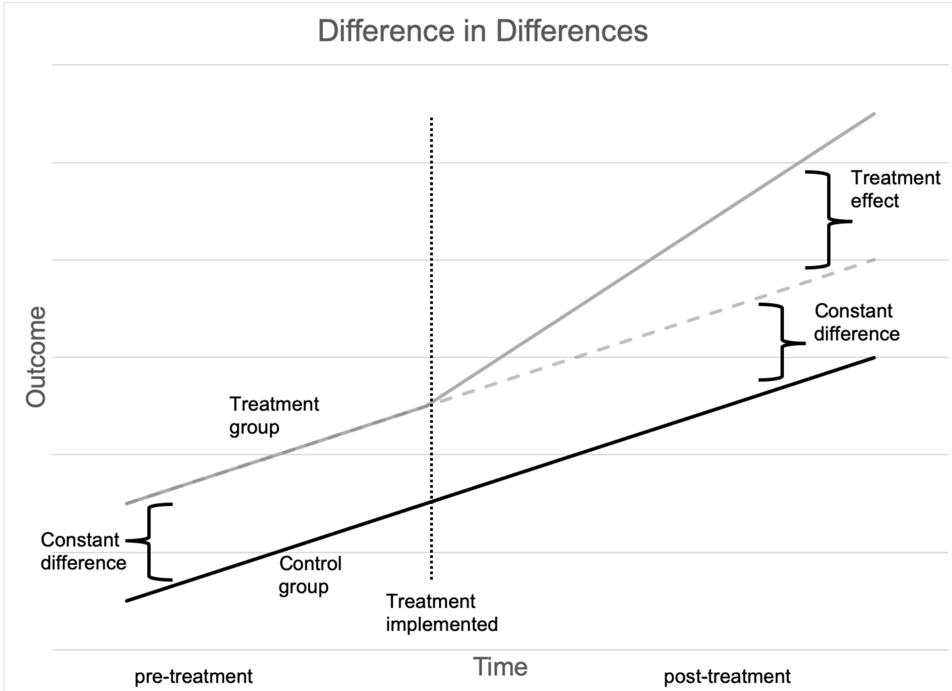
We hope that $\hat{\beta} = \beta$, but this isn't always true.

The ideal thing to do is to run an experiment, since this ensures that $Cov(X_i, \varepsilon_i) = 0$ (why?). But this isn't usually possible in economics. **Difference-in-differences** (also, D-in-D and diff-in-diff) is a simple technique to try to approximate an experiment.

Basic idea. We basically apply an experimental analysis to a "quasi-experiment" – an even that isn't actually a random experiment, but looks close to one. There's a "control group" and a "treatment group". Before the treatment, they look similar. We measure the treatment effect after controlling for the change in the "control group".

Estimator

This figure summarizes the situation we're hoping for.



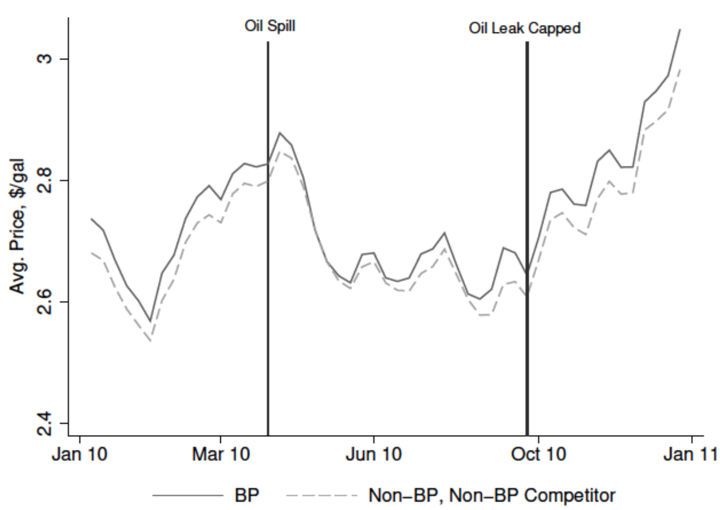
Pre-treatment, we have **two groups that are not the same, but look like they're changing in the same way**. This is called the **parallel pre-trends assumption**. After treatment, the treatment group now changes in a different way.

The estimator formula comes straight from this picture:

$$\text{effect} = \underbrace{\left(\bar{Y}^{treatment}_{post} - \bar{Y}^{control}_{post}\right)}_{\text{constant difference + treatment effect}} - \underbrace{\left(\bar{Y}^{treatment}_{pre} - \bar{Y}^{control}_{pre}\right)}_{\text{constant difference}}$$

Here's an example of diff-in-diff in the wild:

Figure 1: Average Weekly Retail Price for BP and Comparison Group Stations



Home production

Suppose we have an individual with utility function $U(x, l)$ and a market wage w. For simplicity, we'll ignore non-labor income, so $V = 0$. Now we introduce "non-market" home production $f(h_N)$, where h_N is hours devoted to non-market work.

- Home production can be interpreted as monetizable informal self-employment, like knitting and selling sweaters. It could also be interpreted as household chores. For simplicity, we'll just assign a consumption-equivalent value to this.

Drawing & writing the budget constraint:

1. Solve $f'(h_N) = w$ for h_N. This gives the value of h_N^* where the consumer switches from home production to market labor. (Why?)
   - What happens if $f'(h_N) < w$ always, or $f'(h_N) > w$ always?
2. For the first h_N^* hours of work, draw the home production function (adding V if necessary)
3. For the last $T - h_N^*$ hours of work, draw the wage.
4. The budget constraint function is defined piecewise:

$$C \leq \begin{cases} f(T-L) + V & L > T - h_N^* \\ w \cdot (T - L - h_N^*) + f(h_N^*) + V & L \leq T - h_N^* \end{cases}$$

   - What's the interpretation of each part?

Optimizing:

1. Check the tangency condition along the wage slope: $MRS_{LC} = w$ and plug into the market work portion of the BC. What happens if this gives a solution $L > T - h_N^*$?
2. If you got the solution $L < h_N^*$ above, check the tangency condition along the home production portion: $MRS_{LC} = f'(T - L)$ and plug into the home work portion of the BC.

Exercise 1. Let utility be $U(C, L) = C^{1/2}L^{1/2}$. Suppose $w = 3$ and home production is $f(h_N) = 12 \cdot \sqrt{h_n}$. For simplicity, let $V = 0$ and $T = 24$.

1. Draw the budget constraint.
2. Express the budget constraint as a function.
3. Solve for the optimal bundle.
4. (At home) Suppose home production is given by $f(h_N) = 24 \cdot \sqrt{h_n}$. What's the optimal bundle?