

GEQ1000 Asking Questions

Economics (Social Science) Segment

Video 1.5

Difference-in-differences

In this video, we will look at the quasi-experimental method called Difference-in-differences.

A hypothetical example

Let's look at a fictitious example. Suppose there is a government program that provides financial assistance to needy families headed by single mothers, that has been in operation for several years. In City A, local politicians decided in the year 2008 to raise the amount of assistance from five thousand dollars a year to six thousand dollars a year.

One might suspect that this rise in assistance would lead some single mothers to cut their working hours or stop work entirely. The question is then posed: by how much does the rise in financial assistance reduce the recipients' hours of work? The treatment here is the one thousand dollar rise in assistance, and the outcome of interest is the average hours worked in a year by recipients.

As a first pass, we may decide on this simple strategy. First, measure the average work hours of recipients in 2007, one year before the rise in assistance. Then measure the average work hours of recipients in 2009, one year after the rise in assistance. Then simply take the difference to obtain the treatment effect.

Now if we want to claim that the difference we have measured is indeed the treatment effect, what identification assumption are we making? To think this through, think of the strategy we are using here as being akin to doing a controlled experiment. Who forms our control group? Who forms our treatment group? You may wish to pause the video to think about this.

OK, suppose we think about our strategy as a controlled experiment. The treatment is the rise in assistance, so the treatment group comprises the program recipients in 2009 who received the additional one thousand dollars. Our control group comprises the recipients in 2007. We are thus assuming that in all matters that affect decisions on work hours other than the treatment itself, our two groups are not different.

But this is not a controlled experiment. It is an observational study. We cannot ensure that other things stay the same between 2007 and 2009. Perhaps the country's economy fell into recession during this period of time. Work hours will fall in 2009 simply because it is harder for people to find work in an economic downturn. Thus, our difference is measuring not just the treatment effect, but also the effect of the recession on work hours. The recession is a confounder that will create a bias in our estimate of the treatment effect.

But suppose we have City B, which run the same program, but its officials have kept the level of assistance unchanged at five thousand dollars a year. Since City B is also going through the same recession as City A, one might argue that taking the same difference between 2007 and 2009 but now for City B, will allow us to measure the effect of the recession on work hours.

Can you guess the next step? Exactly! We take the difference in the two differences. This removes the effect of the recession, leaving the treatment effect.

Now you can see why this method is named Difference-in-Differences!

We should not think that we have freed ourselves from making identification assumptions. Here we are assuming that the recession has the same impact on work hours in both cities. Indeed we are assuming that all other factors affecting work hours of recipients between 2007 and 2009, have the same impact in both cities. This is sometimes called the common trend assumption, and it need not be solid. Perhaps City B is worse hit by the recession than City A. In that case, our difference-in-differences estimation will still be biased.

A real example

Difference-in-differences has been used to examine the effects of many policies, but the most famous use concerns the question of how changes in the minimum wage affect employment. In the middle of 1992, the state of New Jersey raised its minimum wage from four dollars and twenty-five cents an hour to five dollars and five cents an hour.

The prevailing economic wisdom of the time was that this would inevitably lead to job losses for workers making minimum wage, such as waiters in fast food restaurants. Because the neighbouring state of Pennsylvania did not raise its minimum wage, this presented an opportunity for economists David Card and Alan Krueger to examine the prevailing wisdom. They collected data on employment at fast food restaurants in both states just before, and shortly after, New Jersey raised the minimum wage.

What they found was highly surprising, to say the least. Employment per restaurant in New Jersey went up from 20.44 employees to 21.03 employees, a positive difference of 0.59. Employment per restaurant in Pennsylvania fell from 23.33 to 21.17 over the same period, a negative difference of 2.16. The difference-in-differences is therefore positive 2.76 workers per restaurant. This means that New Jersey's raising of the minimum wage actually increased employment rather than reduced it, a result that is totally at odds with what most economists had expected.

Card and Krueger's work is not the final say on the economics of the minimum wage. Indeed their counter-intuitive finding has sparked an entire industry of empirical work that has clarified the impact of the minimum wage on employment. Today, most economists believe that small increases in the minimum wage do not have large negative effects on employment.