Applied Economics- August 19th and 20th, 2017

1) You are interested in analyzing a national program that is going to install surveillance cameras at various locations of several cities in Paraguay (the government has identified 400 eligible cities in Paraguay). Suppose you have (and you will have in the future) geo-referenced crime data (so that each crime reported in the country can be mapped to a geographic location, such as a street segment of no more than 100 meters). Assume that a camera can monitor exactly a street segment. Design an experiment to identify (i) the impact of the cameras on crime and (ii) potential effects of crime displacement (given the nature of the country, assume that displacement may only occur within a city, and not between cities).

Answer

A nice experimental design in a first step would random assign some cities to receive cameras (treated cities) and some cities not to receiving cameras (control cities). A nice addition would recognize that 200 cities in the treated group and 200 cities in the control group would maximize statistical power.

In a second step, within treated cities randomly assign a proportion of street segments to receive the cameras (ending up with treated street segments and control street segments in theses treated cities). This proportion can be fixed, but you can also randomly assign different proportion of cameras to each city, for example 0%, 20%, 40%, 60%, 80% and 100%).

Then, within treated cities you can identify whether the introduction of cameras in treated areas (street segments) had any effect on crime relative to those untreated areas. This can be done simply by an OLS equation of crime on a dummy variable for treated street segments.

Finally, to identify displacement you can compare control street segments in treated cities to street segments in control cities. Under the hypothesis of displacement effect you should observe that after the introduction of the cameras there is an increase in crime in control street segments in treated cities relative to street segments from control cities.

2) Consider the following system of simultaneous equations.

$$Y_{1t} = X_{1t}\,\beta_1 + X_{2t}\,\beta_2 + e_{1t}\,(1)$$
$$Y_{2t} = Y_{1t}\,\gamma_1 + Y_{3t}\,\gamma_2 + e_{2t}\,(2)$$
$$Y_{3t} = Y_{1t}\,\gamma_3 + Y_{2t}\,\gamma_4 + X_{2t}\,\beta_3 + e_{3t}\,(3)$$

In this system, both X_1 and X_2 are exogenous variables. Determine which of the system equations are identified (individually, that is, determine which system parameters can be consistently estimated). Please notice that the question is not asking if the system is identified as a whole.

Answer

Equation (1) is identified, since both X_1 and X_2 are exogenous. This equation can be consistently estimated using OLS.

Equation (2) is also identified, since there are 2 endogenous variables (Y_1 and Y_3) and 2 instruments (since X_1 and X_2 are excluded from equation (2)). The parameters of this equation can be consistently estimated using IV.

Equation (3) is not identified, since there are 2 endogenous variables (Y_1 and Y_2) and only one instrument (since X_1 is excluded from equation (3), but X_2 is included). Therefore, there are no enough instruments.

3) Consider that you want to estimate the impact of having a personal computer (PC) on GPA: GPA = $\alpha_0 + \alpha_1$ PC + u, where PC is a binary variable that takes the value 1 when the student owns a PC and zero otherwise. (i) Discuss whether parent income is a good instrument for PC. Why or why not? (ii) Suppose that a social program randomly assigned computers to half the students. Explain how you could use this information to identify the parameter of interest.

Answer

Parent income is not a suitable instrument since, even though it is not included in the estimated equation, it can have an impact on GPA for reasons not related to owning a PC.

The random assignment could help by providing an instrument for having a PC. Here is important to recognize that most surely there would be a lot of non-compliance, but that this problem can be solved by means of an instrumental variables approach. Here a correct answer should recognize that the IV estimator is providing a local average treatment effect (the average treatment effect for the group of compliers).

4) The government of an African country is about to build a hospital in the country. The country has 30 provinces, which are relatively isolated one with the other (meaning that only people from the province would benefit from the new facility). Given current health facilities, the hospital is expected to be a great improvement for people living in the region. All individuals have the right to use the hospital. Provide two designs (an experimental design and a non-experimental design) that allow you to identify the causal impact of the hospital on health outcomes. Please explain which are the treated and control groups, and possible limitations to your designs.

Answer

Since all individuals have the right to use the hospital, the best approach is to use an encouragement design, sending letters to a random sample of individuals in the region. The intuition is that those receiving the letter should be more likely to attend the facility. So the idea is to use the randomly assigned encouragement as an instrument for attending the facility. Probably, a limitation is that non-compliance will be too high, affecting the external validity of the impact evaluation analysis.

An important feature of this design is that the letter should not include any information that potentially impact directly on the outcome of interest, since in that case the instrument would be violating the exclusion restriction.

More details would be nice. For example, the proposal should explain that the best approach is to obtain a random sample of individuals from the population (a sample that is big enough, of course) and then split randomly this sample in encourage to treatment (receive the letter) and encourage to

control (not receiving the letter). Since the hospital is going to be constructed in the future, it is possible to run a pre-treatment survey and a post-treatment survey. At the very least, the sample of individuals has to be interviewed in a final survey. Given the random assignment, the pre-treatment survey is not needed for consistency, but would help for efficiency.

An alternative (non-experimental) design is to use the distance of the individual's house to the facility as an instrument of treatment (using the hospital).

Another alternative (non-experimental) design is to use a synthetic controls approach using a long enough time historical data at the province level.