**Directions**: Use the following table to answer the questions listed. The table contains group-time ATT, or ATT(g,t), for a simulated dataset of 1000 firms spread over 40 states observed as a panel for 30 years; 250 firms were treated in 1986, 250 in 1992 and so forth. Treatment effects were dynamic and their respective time path are shown in each group’s column.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **ATT(1986,t)** | **ATT(1992,t)** | **ATT(1998,t)** | **ATT(2004,t)** |
| 1980 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 |
| 1986 | 10 | 0 | 0 | 0 |
| 1987 | 20 | 0 | 0 | 0 |
| 1988 | 30 | 0 | 0 | 0 |
| 1989 | 40 | 0 | 0 | 0 |
| 1990 | 50 | 0 | 0 | 0 |
| 1991 | 60 | 0 | 0 | 0 |
| 1992 | 70 | 8 | 0 | 0 |
| 1993 | 80 | 16 | 0 | 0 |
| 1994 | 90 | 24 | 0 | 0 |
| 1995 | 100 | 32 | 0 | 0 |
| 1996 | 110 | 40 | 0 | 0 |
| 1997 | 120 | 48 | 0 | 0 |
| 1998 | 130 | 56 | 6 | 0 |
| 1999 | 140 | 64 | 12 | 0 |
| 2000 | 150 | 72 | 18 | 0 |
| 2001 | 160 | 80 | 24 | 0 |
| 2002 | 170 | 88 | 30 | 0 |
| 2003 | 180 | 96 | 36 | 0 |
| 2004 | 190 | 104 | 42 | 4 |
| 2005 | 200 | 112 | 48 | 8 |
| 2006 | 210 | 120 | 54 | 12 |
| 2007 | 220 | 128 | 60 | 16 |
| 2008 | 230 | 136 | 66 | 20 |
| 2009 | 240 | 144 | 72 | 24 |
| ATT(g) |  |  |  |  |
| Simple ATT |  |  |  |  |
| Group ATT |  |  |  |  |

1. The ATT(g,t) for 1998 in 2003 is 36. What does 36 mean?
2. How many group-time ATT parameters are there not counting the pre-treatment ones? *There are 60 ATT(g,t) in this data.*

**Aggregation**

1. Calculate the ATT(g) for each column by taking the average of each group’s ATT(g,t) and fill in. What weight did you use and were they the same for each group or were they different?
2. Calculate and interpret the simple ATT as the uniformly weighted average over all ATT(g,t) parameters.
3. Calculate and interpret the group ATT as the uniformly weighted average over all ATT(g) parameters.
4. If both simple ATT and group ATT are averages over the same ATT(g,t) then why aren’t they the same number?

**Feasible Aggregation**

1. Estimating group-time ATT(g,t) using DiD requires having an untreated group satisfying parallel trends as comparison for the same time period. Which of these parameters can and cannot be estimated then?
2. Compare the number that we can identity with the number you found in question 2. Are they the same?
3. Repeat questions 3-5 using only the parameters we can identify using DiD.
4. Under CS, each parameter can be identified using any units “not yet treated” at that time. Which groups will we use as our control group, then, for identifying these parameters:
   1. ATT(1986,1986) to ATT(1986,1991)
   2. ATT(1986,1992) to ATT(1986,1997)
   3. ATT(1992,1992) to ATT(1992,1997)
   4. ATT(2004,2004) to ATT(2004,2009)

|  |  |  |  |
| --- | --- | --- | --- |
| **Groups** | **Relative year** | **CATT** | **SA** |
|  | **t-3** | 0 |  |
|  | **t-2** | 0 |  |
|  | **t-1** | 0 |  |
|  | **t=0** | 8 |  |
|  | **t+1** | 16 |  |
|  | **t+2** | 24 |  |
|  | **t+3** | 32 |  |
|  | **t+4** | 40 |  |
|  | **t+5** | 48 |  |
|  | **t+6** | 63 |  |
|  | **t+7** | 72 |  |
|  | **t+8** | 81 |  |
|  | **t+9** | 90 |  |
|  | **t+10** | 99 |  |
|  | **t+11** | 108 |  |
|  | **t+12** | 130 |  |
|  | **t+13** | 140 |  |
|  | **t+14** | 150 |  |
|  | **t+15** | 160 |  |
|  | **t+16** | 170 |  |
|  | **t+17** | 180 |  |
|  | **t+18** |  |  |
|  | **t+19** |  |  |
|  | **t+20** |  |  |

**Event study**

1. Fill in the missing lead and lag causal parameters (CATT column) as the mean of relative group-time ATT parameters from the previous slide.
2. Which groups are used in the aggregation of each relative time aggregation and why does it change over time?
3. Why are the lagged treatment effects increasing at an increasing rate?
4. What’s the most lags that SA and CS can identify and why?
5. What’s the most lags that TWFE will attempt to identify and why?