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ACG5906

Econometrics

12/4/2024

Assignment 5

1. C

2. C D

3. D

4. A C

5. A C

6. A C

7. A B C D

8. B

9. C

10. A D

11.

a) No, it seems like the system is implemented for every employee at t=1, so the dummy could capture the effect of the new system along with the time effects going from period 0 to 1. The dummy could also capture individual effects from differences in employees.

b) productivity = β0 + β1 emailsystemdummy + β2timedummy + ϵit. Since the implementation is now random, differences in employees should not affect the treatment email system coefficient. I also include a time fixed effect to control for productivity differences between the two periods.

c) productivity = β0 + β1 post t2 + β2 emailsystemdummy + β3(post t2 x emailsystemdummy) + ϵit. Having multiple time periods means we need a difference in difference estimate.

d) productivity = β0 + β1 post t1 + β2 emailsystemdummy + β3(post t1 x emailsystemdummy) + ϵit. Same model as above but our post time dummy is for t=1 and beyond, our only preperiod is t=0.

12.

a) Not consistent and not good. The estimator cannot be calculated due to x1 and x2 being perfectly collinear.

b) Yes this estimate is consistent as the OLS estimates the two parameters of the true model. However the b1 estimate may not be good, as the true model contains some fixed effect alpha which the OLS estimate is not accounting for.

c) Yes the estimate will still be consistent, since the data is randomly missing (would be different if the missing data was due to some variable). The estimate is probably not good, especially if the sample size is small.

d) Not consistent and not good, omitting a time trend if x1 is dependant on time will lead to a biased and inconsistent estimator.

13.

First running a very basic difference in difference model between time and treatment gives a significant effect of the system (productivity increased by 13.96). While it is significant at 1%, the magnitude is still fairly different from the true value of 5.

```
. reg y time d did

      Source |       SS           df       MS      Number of obs   =   100,000
-------------+----------------------------------   F(3, 99996)     =      1.98
       Model |  3.9714e+11         3  1.3238e+11   Prob > F        =    0.1146
    Residual |  6.6871e+15    99,996  6.6874e+10   R-squared       =    0.0001
-------------+----------------------------------   Adj R-squared   =    0.0000
       Total |  6.6875e+15    99,999  6.6876e+10   Root MSE        =   2.6e+05

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |  -99.90269   2452.314    -0.04   0.968    -4906.407    4706.602
           d |   4002.104   2327.214     1.72   0.085    -559.2059    8563.415
         did |   13.96349   3291.177     0.00   0.997    -6436.703     6464.63
       _cons |   140000.8   1734.048    80.74   0.000       136602    143399.5
------------------------------------------------------------------------------
```

Including time and individual fixed effects, and all of the controls gives a similar result from above, not close to 5 but significant.

```
HDFE Linear regression                            Number of obs   =    100,000
Absorbing 2 HDFE groups                           F(  11,  89980) =  326588.20
                                                  Prob > F        =     0.0000
                                                  R-squared       =     1.0000
                                                  Adj R-squared   =     1.0000
                                                  Within R-sq.    =     0.9756
                                                  Root MSE        =    10.1172
```

y	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
did	14.97564	.1287644	116.30	0.000	14.72326	15.22801
x1	1.128718	2.087621	0.54	0.589	-2.962999	5.220436
x2	-1.995548	.0038272	-521.41	0.000	-2.003049	-1.988047
x3	-4.000001	.0040188	-995.32	0.000	-4.007878	-3.992124
x4	-9.999357	.0084036	-1189.88	0.000	-10.01583	-9.982886
x5	-.393563	.3378254	-1.16	0.244	-1.055698	.2685715
x6	1.987666	.0169184	117.49	0.000	1.954506	2.020826
x7	2.000539	.0019964	1002.07	0.000	1.996626	2.004452
x8	-.0071336	.0033639	-2.12	0.034	-.0137269	-.0005404
x9	-.392338	.3375757	-1.16	0.245	-1.053983	.2693072
x10	-.7336988	.3371707	-2.18	0.030	-1.39455	-.0728476
_cons	142204.2	.0797305	1.8e+06	0.000	142204	142204.3

Looping through different tuples of controls yielded similar results, around 15 for the DiD estimate:

tuple beta1

x3 x4 x5 x6 x7 x8 x9 x10 14.74599

x2 x4 x5 x6 x7 x8 x9 x10 14.72339

x2 x3 x5 x6 x7 x8 x9 x10 14.70789

x2 x3 x4 x6 x7 x8 x9 x10 14.97461

x2 x3 x4 x5 x7 x8 x9 x10 14.99328

x2 x3 x4 x5 x6 x8 x9 x10 14.61633

x2 x3 x4 x5 x6 x7 x9 x10	14.97681
x2 x3 x4 x5 x6 x7 x8 x10	14.97544
x2 x3 x4 x5 x6 x7 x8 x9	14.97473
x1 x4 x5 x6 x7 x8 x9 x10	14.55008
x1 x3 x5 x6 x7 x8 x9 x10	14.4832
x1 x3 x4 x6 x7 x8 x9 x10	14.74648
x1 x3 x4 x5 x7 x8 x9 x10	14.7653
x1 x3 x4 x5 x6 x8 x9 x10	14.43487
x1 x3 x4 x5 x6 x7 x9 x10	14.74693
x1 x3 x4 x5 x6 x7 x8 x10	14.74624
x1 x3 x4 x5 x6 x7 x8 x9	14.74603
x1 x2 x5 x6 x7 x8 x9 x10	14.45843
x1 x2 x4 x6 x7 x8 x9 x10	14.72436
x1 x2 x4 x5 x7 x8 x9 x10	14.74239
x1 x2 x4 x5 x6 x8 x9 x10	14.36459
x1 x2 x4 x5 x6 x7 x9 x10	14.72211
x1 x2 x4 x5 x6 x7 x8 x10	14.72393
x1 x2 x4 x5 x6 x7 x8 x9	14.7234
x1 x2 x3 x6 x7 x8 x9 x10	14.71016
x1 x2 x3 x5 x7 x8 x9 x10	14.73001
x1 x2 x3 x5 x6 x8 x9 x10	14.34343
x1 x2 x3 x5 x6 x7 x9 x10	14.71598
x1 x2 x3 x5 x6 x7 x8 x10	14.70917
x1 x2 x3 x5 x6 x7 x8 x9	14.70682

x1 x2 x3 x4 x7 x8 x9 x10	14.99426
x1 x2 x3 x4 x6 x8 x9 x10	14.6161
x1 x2 x3 x4 x6 x7 x9 x10	14.97701
x1 x2 x3 x4 x6 x7 x8 x10	14.97553
x1 x2 x3 x4 x6 x7 x8 x9	14.97473
x1 x2 x3 x4 x5 x8 x9 x10	14.63331
x1 x2 x3 x4 x5 x7 x9 x10	14.99555
x1 x2 x3 x4 x5 x7 x8 x10	14.99411
x1 x2 x3 x4 x5 x7 x8 x9	14.99334
x1 x2 x3 x4 x5 x6 x9 x10	14.61962
x1 x2 x3 x4 x5 x6 x8 x10	14.61518
x1 x2 x3 x4 x5 x6 x8 x9	14.61551
x1 x2 x3 x4 x5 x6 x7 x10	14.9768
x1 x2 x3 x4 x5 x6 x7 x9	14.97601
x1 x2 x3 x4 x5 x6 x7 x8	14.97453
x2 x3 x4 x5 x6 x7 x8 x9 x10	14.97548
x1 x3 x4 x5 x6 x7 x8 x9 x10	14.74651
x1 x2 x4 x5 x6 x7 x8 x9 x10	14.72443
x1 x2 x3 x5 x6 x7 x8 x9 x10	14.71054
x1 x2 x3 x4 x6 x7 x8 x9 x10	14.97569
x1 x2 x3 x4 x5 x7 x8 x9 x10	14.99422
x1 x2 x3 x4 x5 x6 x8 x9 x10	14.6159
x1 x2 x3 x4 x5 x6 x7 x9 x10	14.97696
x1 x2 x3 x4 x5 x6 x7 x8 x10	14.97548

x1 x2 x3 x4 x5 x6 x7 x8 x9	14.97468
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	14.97564