ECON 7103 Homework 4

Yifan Liu (yliu3494)

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1 Python

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1. Visualization of the parallel trends

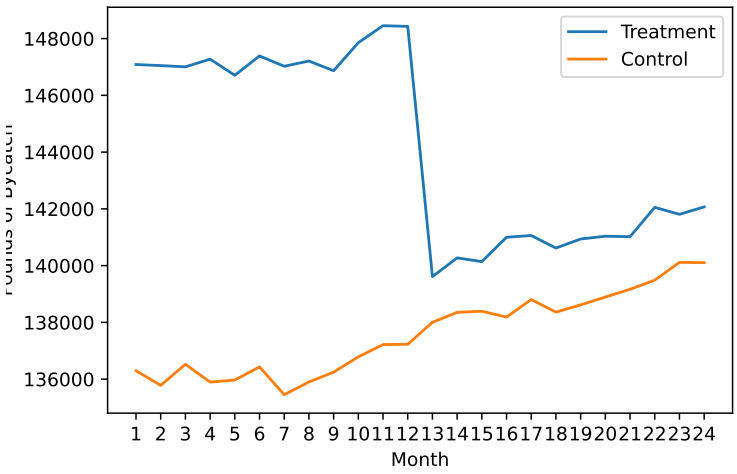

Figure 1: Bycatch before and after treatment for treated and control groups in months of 2017 and 2018

From Figure 1, we can tell that there are parallel trends before treatment (January 2018) between treatment and control groups.

2. DID

$DID = \{E[Y_{igt}|g(i) = treat, t = Post] - E[Y_{igt}|g(i) = treat, t = Pre]\} - \{E[Y_{igt}|g(i) = control, t = Post] - E[Y_{igt}|g(i) = control, t = Pre]\}$

= (139612.51 - 148430.64) - (138001.81 - 137228.6)

= -9591.35

The DID estimator is defined as the difference in average monthly yields of bycatch in the treatment group before and after treatment minus the difference in average monthly yields of bycatch in the control group before and after treatment.

The intuition of the estimator here is the effect of the program on the monthly yields of bycatch. The program was implemented by an environmental nonprofit to reduce bycatch.

3.

(a)

Table 1 shows the two-period difference-in-differences estimator using the regression specification in the equation (3) and the observations in December 2017 and January 2018 only.

Dep. Variable:	bycatch	**R-squared:**	0.003
Model:	OLS	**Adj. R-squared:**	-0.028
Method:	Least Squares	**F-statistic:**	3.161
Date:	Sun, 12 Feb 2023	**Prob (F-statistic):**	0.0327
Time:	17:30:18	**Log-Likelihood:**	-1270.4
No. Observations:	100	**AIC:**	2549.
Df Residuals:	96	**BIC:**	2559.
Df Model:	3		
Covariance Type:	cluster		

	coef	**std err**	**z**	**P> |z|**	**[0.025**	**0.975]**
const	1.38e+05	1.87e+04	7.396	0.000	1.01e+05	1.75e+05
pre	-773.2158	598.685	-1.292	0.197	-1946.617	400.186
treated	1.12e+04	2.35e+04	0.477	0.634	-3.49e+04	5.73e+04
treated:post	-9591.3495	3231.787	-2.968	0.003	-1.59e+04	-3257.164

Omnibus:	11.020	**Durbin-Watson:**	2.387
Prob(Omnibus):	0.004	**Jarque-Bera (JB):**	11.533
Skew:	0.697	**Prob(JB):**	0.00313
Kurtosis:	3.908	**Cond. No.**	6.89

Notes:
[1] Standard Errors are robust to cluster correlation (cluster)

Table 1: Two-period difference-in-differences estimator using the regression specification in the equation (3)

(b)

Table 2 shows the treatment estimator using the regression specification in the equation (4) and the full monthly sample.
I deleted the month 13 to avoid multicollinearity.
Using the full monthly sample, the estimate of the treatment effects becomes smaller than the result with the observations in December 2017 and January 2018.

(c)

Table 3 shows the treatment estimator using the regression specification in the equation (5) with added controls and the full monthly sample.
The estimate of the treatment effects becomes a bit smaller after adding controls.

(d)

Table 4 reports the results from the previous three questions (a) (b) (c) in a table with clustered standard errors at the firm level. Note that here we omit the estimates of the coefficients on the month and firm indicators in the table.

The result in the model (a) is the same with my previous calculation in the question 2. The estimator is smaller in the model (b). This means the treatment effect of the program is smaller while using the full monthly sample. The estimator in the model (c) is a bit smaller than that in the model (b) due to the addition of control variables. The lack of these controls can make the treatment effect of the program biased upward. After controlling for firm size and other covariates that change over time, the estimator becomes slightly smaller.

2 Stata

1.

(a)

The long table shows the regression results using the equation (6) after generating indicator variables for each firm.
PS: I failed to display Table 6 in multiple pages using "longtable" in a tidy way, but it worked somehow generating many repeated pages.

(b)

Table 6 shows the regression results of within-transformation after demeaning each variable.

(c)

Table 7 reports the estimates from (a) and (b) in the same table.

Comparing (a) and (b), we find that the estimates of the coefficients are same in terms of the treatment effects of the program. The within-transformation reduces the clustered standard errors.

Comparing Table 4 and Table 7, we find that considering indicator variables for each firm makes the treatment effects smaller than the previous estimates. The interpretation of the estimates now becomes the treatment effects of the program while taking into account the heterogeneity of each firm.

Dep. Variable:	bycatch	**R-squared:**	0.003
Model:	OLS	**Adj. R-squared:**	-0.018
Method:	Least Squares	**F-statistic:**	7.349
Date:	Sun, 12 Feb 2023	**Prob (F-statistic):**	1.74e-09
Time:	17:30:18	**Log-Likelihood:**	-15242.
No. Observations:	1200	**AIC:**	3.054e+04
Df Residuals:	1174	**BIC:**	3.067e+04
Df Model:	25		
Covariance Type:	cluster		

	coef	**std err**	**z**	**P> |z|**	**[0.025**	**0.975]**
const	1.377e+05	1.86e+04	7.401	0.000	1.01e+05	1.74e+05
treated	1.105e+04	2.32e+04	0.477	0.633	-3.43e+04	5.65e+04
treated:post	-8956.7837	3166.921	-2.828	0.005	-1.52e+04	-2749.732
month_1	-1585.8815	539.636	-2.939	0.003	-2643.549	-528.214
month_2	-1843.1931	500.218	-3.685	0.000	-2823.603	-862.783
month_3	-1524.8250	514.584	-2.963	0.003	-2533.392	-516.258
month_4	-1667.3508	516.646	-3.227	0.001	-2679.958	-654.743
month_5	-1941.1701	556.739	-3.487	0.000	-3032.359	-849.981
month_6	-1359.7701	592.424	-2.295	0.022	-2520.900	-198.640
month_7	-2007.1326	691.661	-2.902	0.004	-3362.764	-651.501
month_8	-1701.7864	567.648	-2.998	0.003	-2814.356	-589.217
month_9	-1726.8567	584.867	-2.953	0.003	-2873.175	-580.538
month_10	-945.9439	559.874	-1.690	0.091	-2043.276	151.388
month_11	-422.6513	555.809	-0.760	0.447	-1512.018	666.715
month_12	-430.5503	480.193	-0.897	0.370	-1371.711	510.610
month_14	517.6268	513.551	1.008	0.313	-488.915	1524.168
month_15	464.9736	477.082	0.975	0.330	-470.089	1400.036
month_16	833.5673	571.850	1.458	0.145	-287.238	1954.373
month_17	1151.7560	445.231	2.587	0.010	279.119	2024.392
month_18	707.9408	401.926	1.761	0.078	-79.819	1495.701
month_19	998.7330	453.848	2.201	0.028	109.208	1888.258
month_20	1178.5464	410.169	2.873	0.004	374.630	1982.463
month_21	1295.0004	369.765	3.502	0.000	570.275	2019.726
month_22	2000.9103	477.260	4.192	0.000	1065.498	2936.323
month_23	2157.1445	441.289	4.888	0.000	1292.233	3022.056
month_24	2293.5956	385.532	5.949	0.000	1537.967	3049.224

Omnibus:	95.036	**Durbin-Watson:**	2.431
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	124.308
Skew:	0.670	**Prob(JB):**	1.02e-27
Kurtosis:	3.832	**Cond. No.**	30.9

Notes:
[1] Standard Errors are robust to cluster correlation (cluster)

Table 2: The treatment estimator using the regression specification in the equation (4)

Dep. Variable:	bycatch	**R-squared:**	0.991
Model:	OLS	**Adj. R-squared:**	0.991
Method:	Least Squares	**F-statistic:**	4733.
Date:	Sun, 12 Feb 2023	**Prob (F-statistic):**	3.57e-75
Time:	17:30:18	**Log-Likelihood:**	-12401.
No. Observations:	1200	**AIC:**	2.486e+04
Df Residuals:	1171	**BIC:**	2.501e+04
Df Model:	28		
Covariance Type:	cluster		

	coef	**std err**	**z**	**P> |z|**	**[0.025**	**0.975]**
const	1424.1693	1176.857	1.210	0.226	-882.428	3730.767
firmsize	-2119.7133	3406.960	-0.622	0.534	-8797.232	4557.805
treated	-21.9017	308.244	-0.071	0.943	-626.049	582.246
shrimp	1.0554	0.053	19.991	0.000	0.952	1.159
salmon	0.6021	0.210	2.871	0.004	0.191	1.013
treated:post	-8436.2817	2823.973	-2.987	0.003	-1.4e+04	-2901.397
month_1	122.8366	285.466	0.430	0.667	-436.666	682.339
month_2	138.6053	289.076	0.479	0.632	-427.973	705.183
month_3	107.4263	253.662	0.424	0.672	-389.742	604.594
month_4	111.6298	232.909	0.479	0.632	-344.863	568.122
month_5	118.7962	225.810	0.526	0.599	-323.784	561.377
month_6	67.0887	166.699	0.402	0.687	-259.635	393.812
month_7	104.8093	189.877	0.552	0.581	-267.343	476.962
month_8	67.2376	136.640	0.492	0.623	-200.571	335.046
month_9	63.9654	131.159	0.488	0.626	-193.102	321.033
month_10	22.4845	100.222	0.224	0.822	-173.947	218.916
month_11	-16.6447	54.718	-0.304	0.761	-123.889	90.600
month_12	-20.9227	48.266	-0.433	0.665	-115.523	73.677
month_14	-65.7937	63.417	-1.037	0.300	-190.089	58.501
month_15	-35.9279	78.513	-0.458	0.647	-189.810	117.954
month_16	-128.3744	87.097	-1.474	0.141	-299.082	42.333
month_17	-142.7108	116.243	-1.228	0.220	-370.543	85.121
month_18	-64.5680	118.037	-0.547	0.584	-295.915	166.779
month_19	-148.3208	146.065	-1.015	0.310	-434.603	137.962
month_20	-193.6003	175.165	-1.105	0.269	-536.917	149.717
month_21	-162.2639	187.038	-0.868	0.386	-528.852	204.325
month_22	-254.3110	268.104	-0.949	0.343	-779.785	271.163
month_23	-326.6586	280.257	-1.166	0.244	-875.952	222.635
month_24	-285.8655	257.347	-1.111	0.267	-790.257	218.526

Omnibus:	717.103	**Durbin-Watson:**	1.297
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	6623.424
Skew:	-2.679	**Prob(JB):**	0.00
Kurtosis:	13.186	**Cond. No.**	4.57e+06

Notes:

[1] Standard Errors are robust to cluster correlation (cluster)

[2] The condition number is large, 4.57e+06. This might indicate that there are strong multicollinearity or other numerical problems.

Table 3: The treatment estimator using the regression specification in the equation (5)

	Estimates (clustered s.d.)		
	(a)	(b)	(c)
Treatment group(gamma)	11202.04	11052.45	-2119.71
	(23502.9)	(23162.97)	(3406.96)
When a firm is treated (delta)	-9591.35	-8956.78	-8436.28
	(3231.79)	(3166.92)	(2823.97)
Constant	138001.81	137739.93	1424.17
	(18657.8)	(18611.19)	(1176.86)
Observations	100	1200	1200

Table 4: The treatment estimators using the regression specification in the equation (3)(4)(5)

VARIABLES	(1) Model (a)
treat_post	-8,085.14**
	(2,619.21)
firmsize	13,324.03
	(16,512.47)
shrimp	1.55**
	(0.18)
salmon	-0.68
	(1.12)
is_firm2	2,159.06
	(1,158.41)
is_firm3	-10,871.00
	(12,019.17)
is_firm4	649.41
	(2,990.21)
is_firm5	30,998.38**
	(9,455.23)
is_firm6	11,274.67
	(6,691.67)
is_firm7	1,985.19*
	(786.74)
is_firm8	13,233.66**
	(4,089.06)
is_firm9	10,042.46**
	(2,692.08)
is_firm10	17,142.73**
	(4,628.40)
is_firm11	3,801.00
	(3,323.47)
is_firm12	-5,175.76
	(14,752.98)
is_firm13	12,777.17*
	(5,722.38)
is_firm14	7,629.15**
	(2,094.00)
is_firm15	14,524.54**
	(3,949.60)
is_firm16	940.38
	(9,461.48)
is_firm17	9,311.01**
	(2,848.01)
is_firm18	141.97
	(289.61)
is_firm19	2,338.84
	(2,841.33)
is_firm20	-27,032.95
	(25,724.48)
is_firm21	2,319.24*
	(1,109.61)
is_firm22	5,756.95**
	(1,687.67)
is_firm23	-39.15
	(5,739.60)
is_firm24	23,080.47**
	(7,343.87)
is_firm25	31,120.47**
	(9,043.49)
is_firm26	3,819.14**
	(1,257.15)
is_firm27	-20,743.21**
	(4,814.81)
is_firm28	-4,861.41
	(3,891.39)
is_firm29	12,391.48**

VARIABLES	(1) Model (b)
demean_treat_post	-8,085.14**
	(2,563.92)
demean_shrimp	1.55**
	(0.17)
demean_salmon	-0.68
	(1.10)
demean_is_month1	-954.54
	(1,279.17)
demean_is_month2	-766.79
	(1,180.94)
demean_is_month3	-768.87
	(1,101.65)
demean_is_month4	-518.26
	(956.11)
demean_is_month5	-238.15
	(817.78)
demean_is_month6	-147.46
	(646.88)
demean_is_month7	160.22
	(619.64)
demean_is_month8	359.10
	(411.86)
demean_is_month9	470.32
	(375.93)
demean_is_month10	0.18
	(403.89)
demean_is_month11	12.19
	(277.52)
demean_is_month12	-6.67
	(299.14)
demean_is_month14	-121.61
	(304.14)
demean_is_month15	-152.11
	(304.77)
demean_is_month16	-154.95
	(432.27)
demean_is_month17	-311.46
	(335.52)
demean_is_month18	225.19
	(442.97)
demean_is_month19	131.52
	(488.68)
demean_is_month20	164.29
	(582.88)
demean_is_month21	254.78
	(668.95)
demean_is_month22	120.91
	(886.73)
demean_is_month23	42.71
	(905.28)
demean_is_month24	-27.06
	(796.00)
Constant	-0.00
	(0.00)
Observations	1,200
R-squared	0.43

Robust standard errors in parentheses
** p<0.01, * p<0.05

Table 6: The regression results of within-transformation

VARIABLES	(1) Model (a)	(2) Model (b)
treat_post	-8,085.14**	
	(2,619.21)	
shrimp	1.55**	
	(0.18)	
salmon	-0.68	
	(1.12)	
demean_treat_post		-8,085.14**
		(2,563.92)
demean_shrimp		1.55**
		(0.17)
demean_salmon		-0.68
		(1.10)
Constant	709.11	-0.00
	(714.23)	(0.00)
Observations	1,200	1,200
R-squared	1.00	0.43

Robust standard errors in parentheses
** p<0.01, * p<0.05

Table 7: Comparison of estimates from (a) and (b)