Asigment 1

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Summary Statistics

Provide and discuss a table of simple summary statistics showing the mean, standard deviation, min, and max of hospital total revenues and uncompensated care over time.

Create a figure showing the mean hospital uncompensated care from 2000 to 2018. Show this trend separately by hospital ownership type (private not for profit and private for profit).

TWFE Specification

Using a simple DD identification strategy, estimate the effect of Medicaid expansion on hospital uncompensated care using a traditional two-way fixed effects (TWFE) estimation:

$$y_{it} = \alpha_i + \gamma_t + \delta D_{it} + \varepsilon_{it}, (\#eq:dd) \tag{1}$$

where $D_{it} = 1(E_i \leq t)$ in Equation @ref(eq:dd) is an indicator set to 1 when a hospital is in a state that expanded as of year t or earlier, γ_t denotes time fixed effects, α_i denotes hospital fixed effects, and y_{it} denotes the hospital's amount of uncompensated care in year t. Present four estimates from this estimation in a table: one based on the full sample (regardless of treatment timing); one when limiting to the 2014 treatment group (with never treated as the control group); one when limiting to the 2015 treatment group (with never treated as the control group); and one when limiting to the 2016 treatment group (with never treated as the control group). Briefly explain any differences.

Event Study Specification

Estimate an ''event study'' version of the specification in part 3:

$$y_{it} = \alpha_i + \gamma_t + \sum_{\tau<-1} D_{it}^{\tau}\delta_{\tau} + \sum_{\tau>=0} D_{it}^{\tau}\delta_{\tau} + \varepsilon_{it}, (\#eq:event) \tag{2}$$

where $D_{it}^{\tau} = 1(t - E_i = \tau)$ in Equation @ref(eq:event) is essentially an interaction between the treatment dummy and a relative time dummy. In this notation and context, τ denotes years relative to Medicaid expansion, so that $\tau = -1$ denotes the year before a state expanded Medicaid, $\tau = 0$ denotes the year of expansion, etc. Estimate with two different samples: one based on the full sample and one based only on those that expanded in 2014 (with never treated as the control group).

SA Specification

Sun and Abraham(SA) show that the δ_τ coefficients in Equation @ref(eq:event) can be written as a non-conxvex average of all other group-time specific average treatment effects. They propose an interaction weighted specification:

$$y_{it} = \alpha_i + \gamma_t + \sum_e \sum_{\tau \neq -1} \left(D_{it}^\tau \times 1(E_i = e)\right) \delta_{e,\tau} + \varepsilon_{it}.(\#eq:iwevent) \tag{3}$$

Re-estimate your event study using the SA specification in Equation @ref(eq:iwevent). Show your results for $\hat{\delta}_{e,\tau}$ in a Table, focusing on states with $E_i = 2014$, $E_i = 2015$, and $E_i = 2016$.

Present an event study graph based on the results in part 5. Hint: you can do this automatically in `R` with the `fixest` package (using the `sunab` syntax for interactions), or with `eventstudyinteract` in `Stata`. These packages help to avoid mistakes compared to doing the tables/figures manually and also help to get the standard errors correct.

CS Specification

Callaway and Sant'Anna (CS) offer a non-parametric solution that effectively calculates a set of group-time specific differences, $ATT(g,t) = E[y_{it}(g) - y_{it}(\infty)|G_i = g]$, where g reflects treatment timing and t denotes time. They show that under the standard DD assumptions of parallel trends and no anticipation, $ATT(g,t) = E[y_{it} - y_{i,g-1}|G_i = g] - E[y_{it} - y_{i,g-1}|G_i = \infty]$, so that $A\hat{T}T(g,t)$ is directly estimable from sample analogs. CS also propose aggregations of $A\hat{T}T(g,t)$ to form an overall ATT or a time-specific ATT (e.g., ATTs for τ periods before/after treatment). With this framework in mind, provide an alternative event study using the CS estimator. Hint: check out the `did` package in `R` or the `csdid` package in `Stata`.

RR Specification

Rambachan and Roth (RR) show that traditional tests of parallel pre-trends may be underpowered, and they provide an alternative estimator that essentially bounds the treatment effects by the size of an assumed violation in parallel trends. One such bound RR propose is to limit the post-treatment violation of parallel trends to be no worse than some multiple of the pre-treatment violation of parallel trends. Assuming linear trends, such a violation is reflected by

$$\Delta(\bar{M}) = \left\{ \delta : \forall t \geq 0, |(\delta_{t+1} - \delta_t) - (\delta_t - \delta_{t-1})| \leq \bar{M} \times \max_{s<0} |(\delta_{s+1} - \delta_s) - (\delta_s - \delta_{s-1})| \right\}.$$

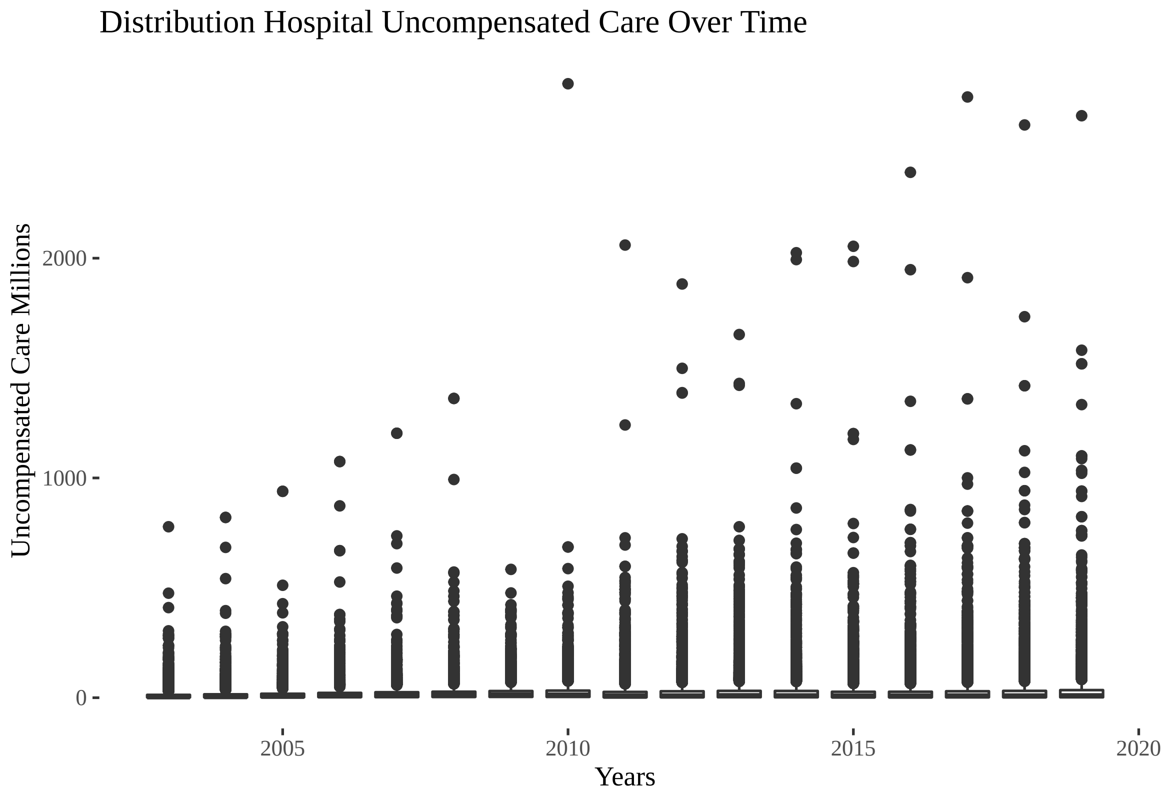
Using the `HonestDiD` package in `R` or `Stata`, present a sensitivity plot of your CS ATT estimates using $\bar{M} = \{0, 0.5, 1, 1.5, 2\}$. Check out the GitHub repo here for some help in combining the `HonestDiD` package with CS estimates.

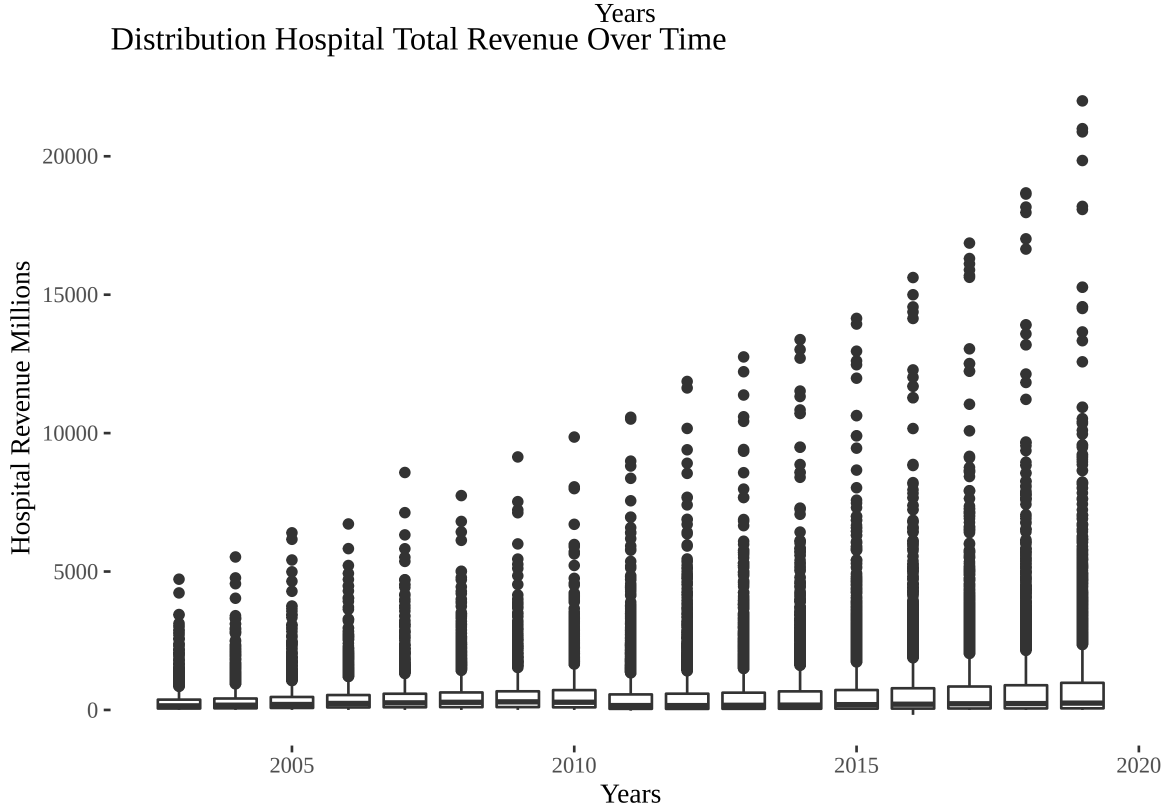
Discussion

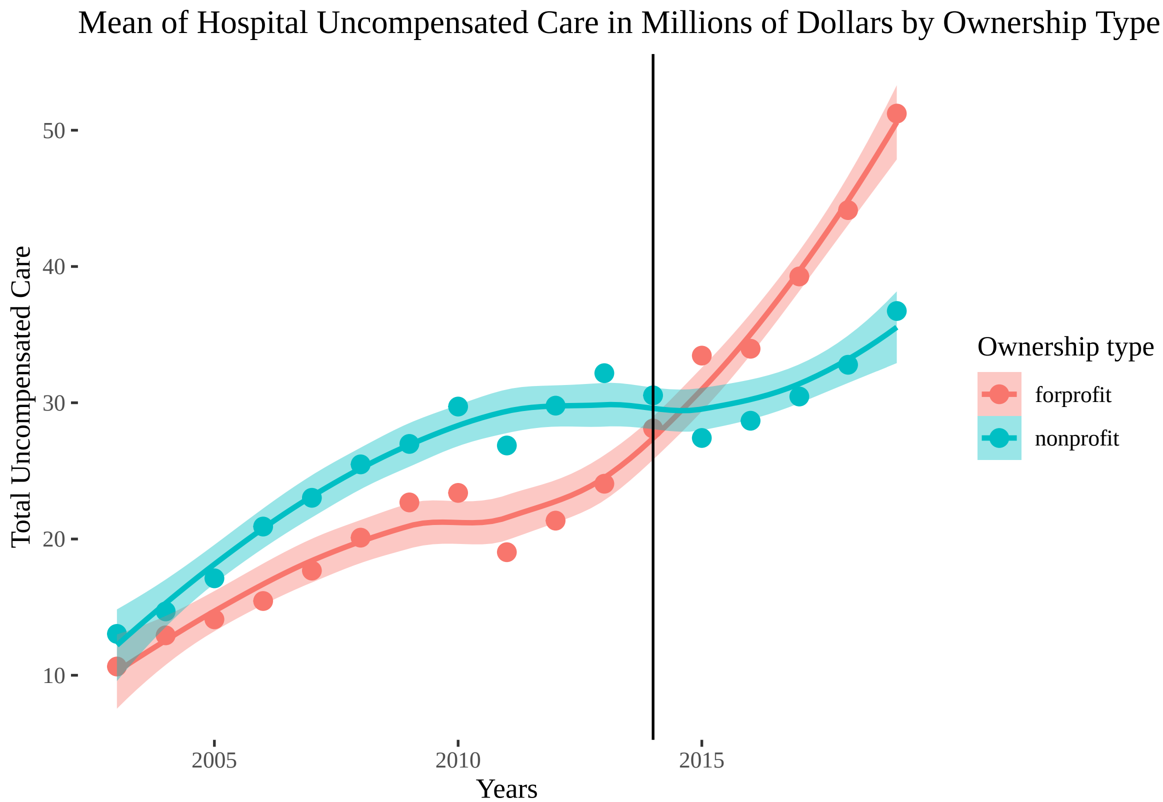
Discuss your findings and compare estimates from different estimators (e.g., are your results sensitive to different specifications or estimators? Are your results sensitive to violation of parallel trends assumptions?).

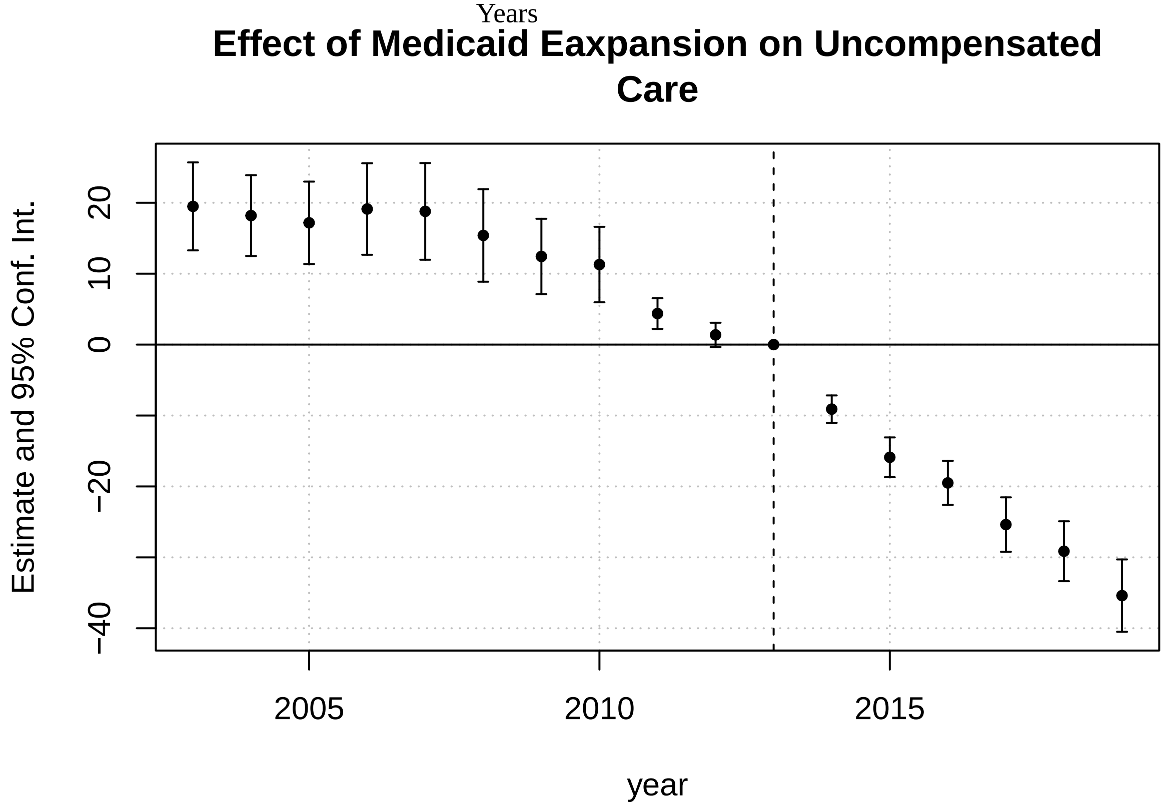
Reflection

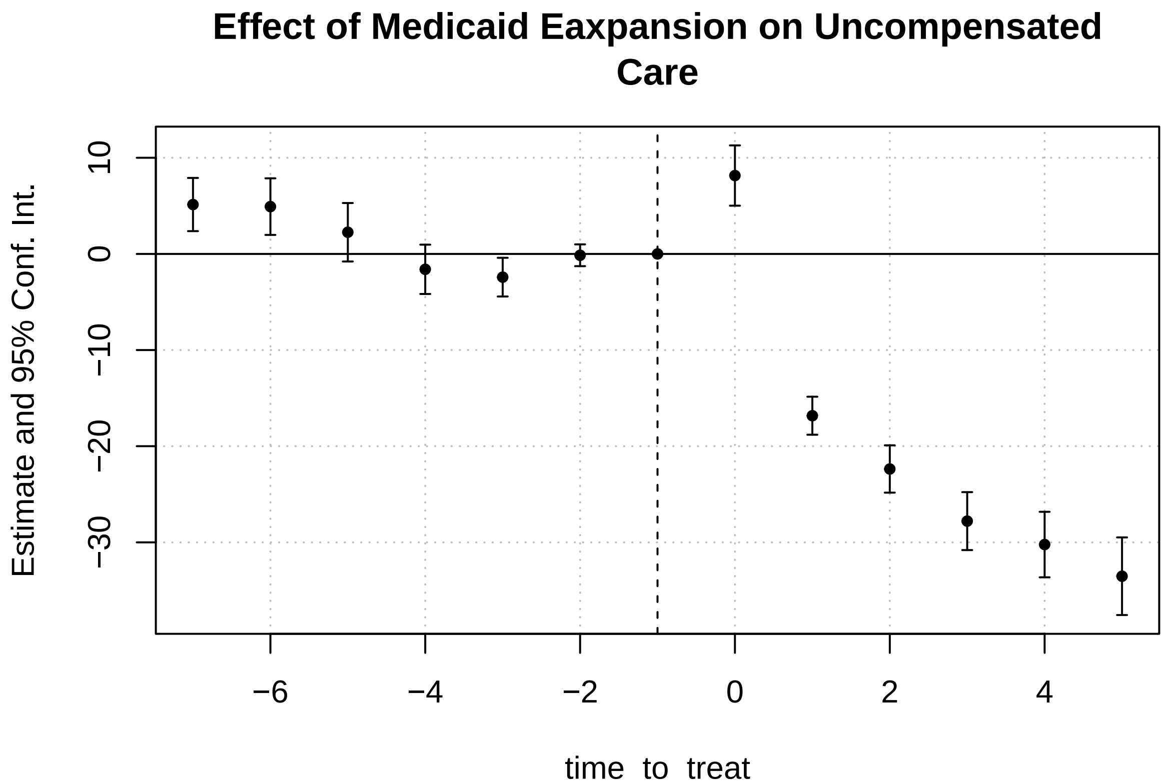
Reflect on this assignment. What did you find most challenging? What did you find most surprising?

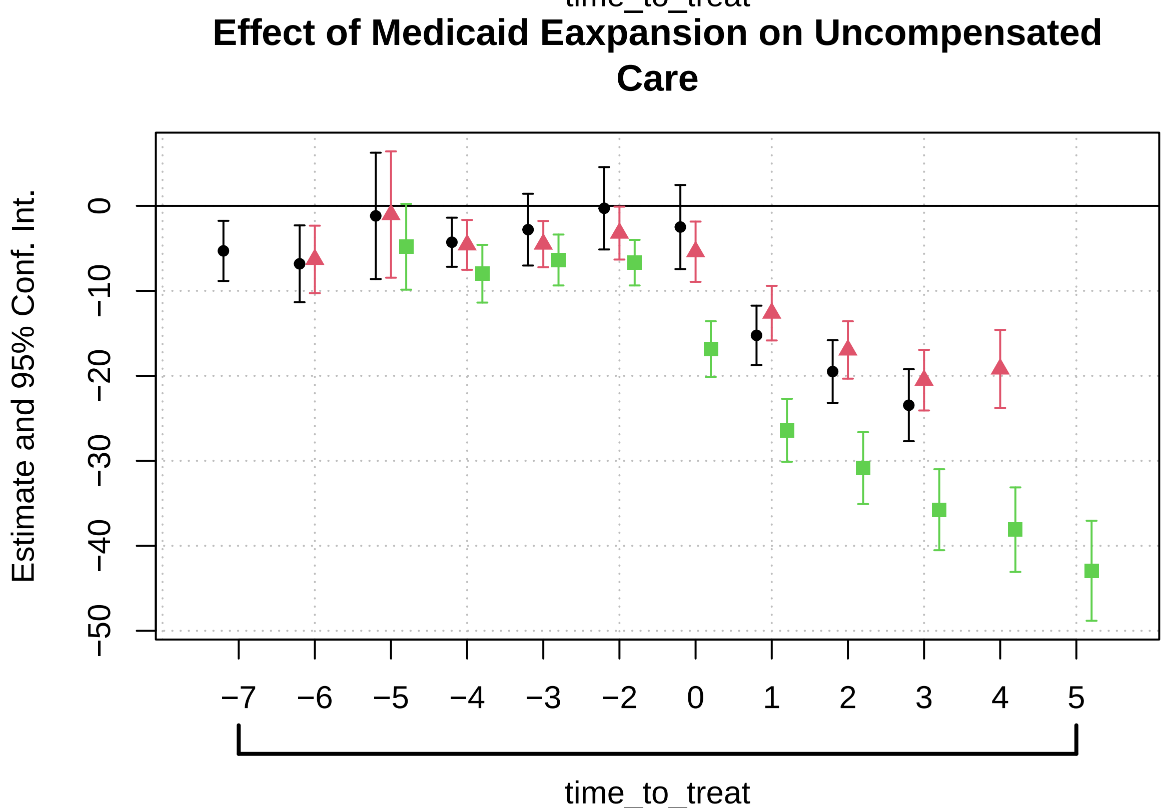


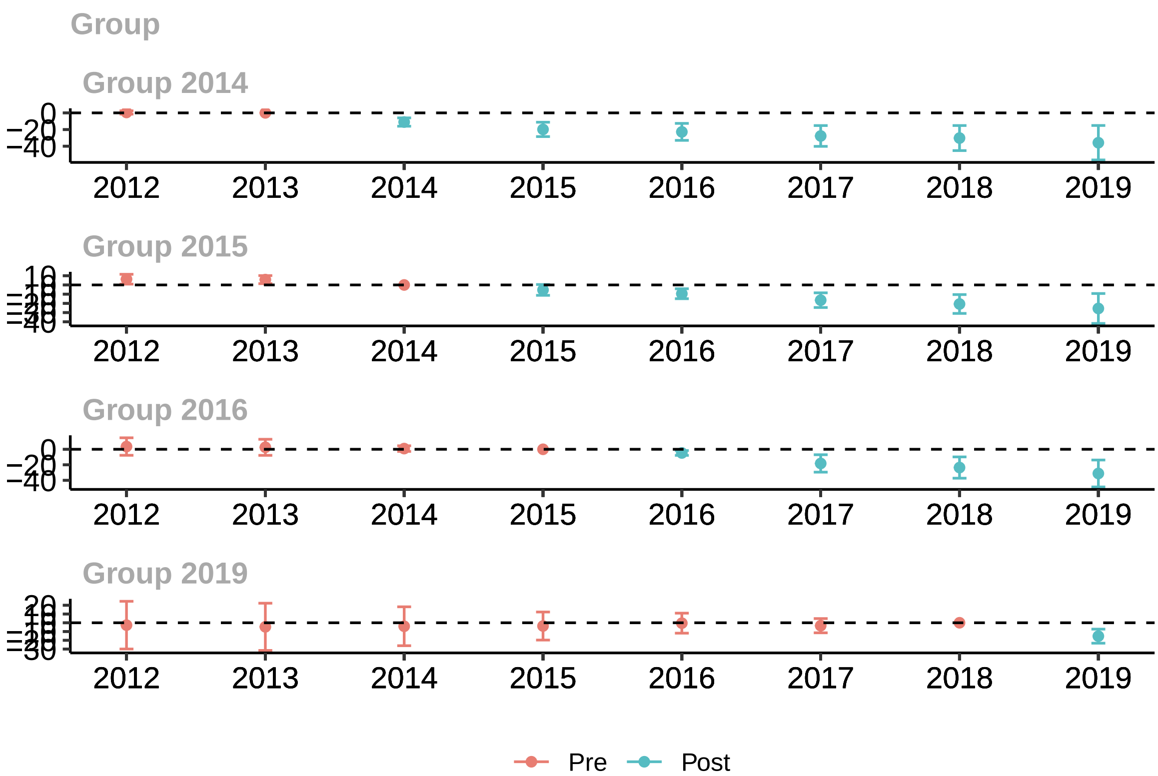


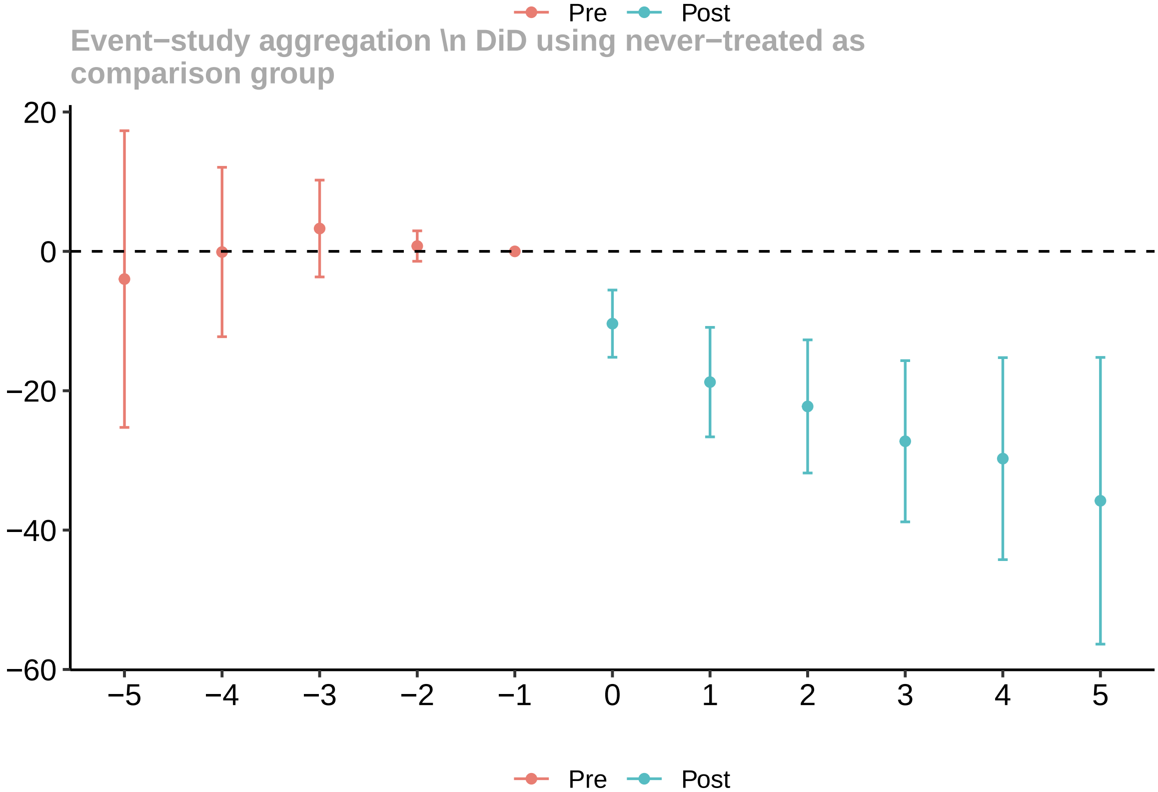

Mean of Hospital Uncompensated Care in Millions of Dollars by Ownership Type
Total Uncompensated Care
50
40
30
20
10
2005
2010
2015
Years
Ownership type
forprofit
nonprofit

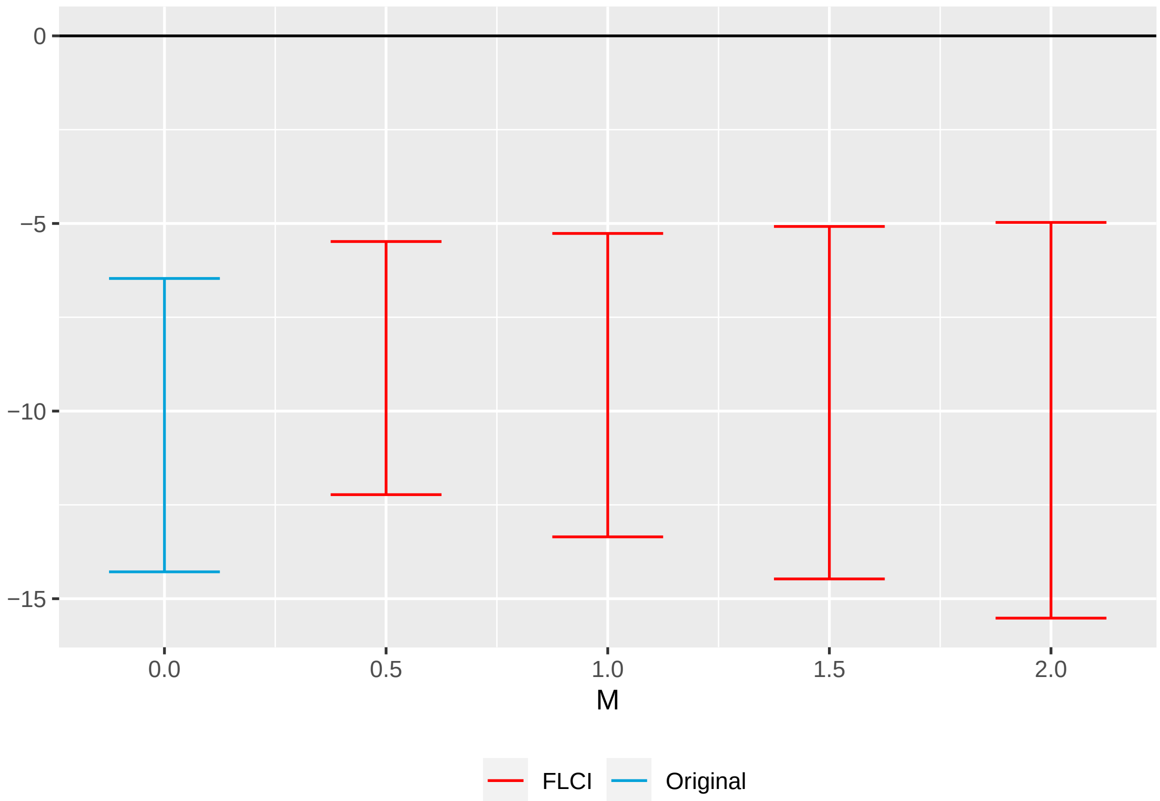

Effect of Medicaid Eaxpansion on Uncompensated Care
Estimate and 95% Conf. Int.
20
10
0
−20
−40
2005
2010
2015
year

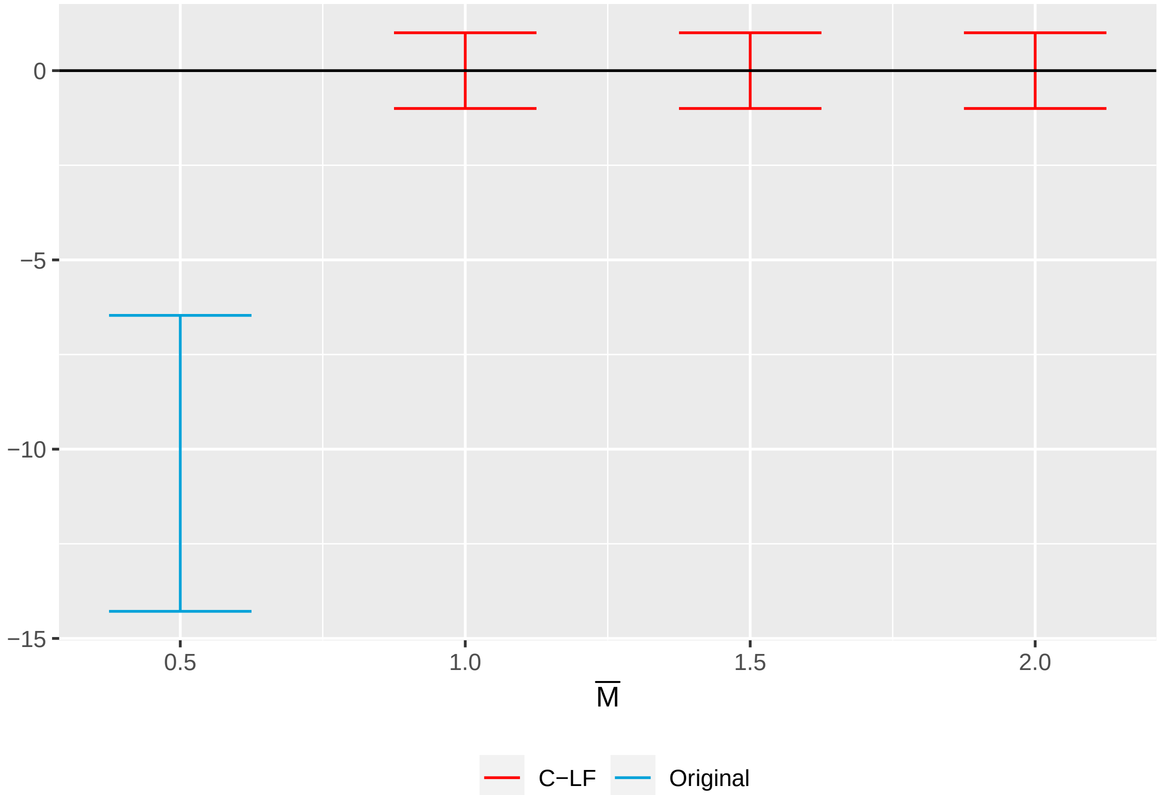

Effect of Medicaid Eaxpansion on Uncompensated Care
Estimate and 95% Conf. Int.
10
0
−10
−20
−30
−6
−4
−2
0
2
4
time_to_treat


Effect of Medicaid Eaxpansion on Uncompensated Care
Estimate and 95% Conf. Int.
0
−10
−20
−30
−40
−50
−7
−6
−5
−4
−3
−2
0
1
2
3
4
5
time_to_treat


Group
Group 2014
Group 2015
Group 2016
Group 2019
2012
2013
2014
2015
2016
2017
2018
2019
Pre
Post


Event−study aggregation \n DiD using never−treated as comparison group
20
0
−20
−40
−60
−5
−4
−3
−2
−1
0
1
2
3
4
5
Pre
Post





unc_care_mean	unc_care_sd	unc_care_min	unc_care_max	hosp_rev_mean	hosp_rev_sd	hosp_re
28.16735	123.623	-97.30909	20405.51	546.2998	960.0214	-17

Tabelle 2: Two Way Fixed Effects long format

	d	d_14	d_15	d_16
Treatment	-28.191^{***}	-26.243^{***}	-12.003^{***}	-12.424^{***}
	(1.883)	(1.795)	(1.811)	(1.543)
Num.Obs.	79 557	79 557	79 557	79 557
R2	0.699	0.697	0.690	0.690
R2 Adj.	0.675	0.673	0.665	0.665
AIC	817 139.6	817 654.2	819 537.5	819 575.0
BIC	871 294.5	871 809.1	873 692.4	873 729.9
RMSE	38.22	38.34	38.80	38.81
Std.Errors	by: pn	by: pn	by: pn	by: pn

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

year	unc_care_mean	unc_care_sd	unc_care_min	unc_care_max	hosp_rev_mean	hosp_rev_sd
2003	13.55729	32.03610	-0.128490	777.9874	196.3262	339.2561
2004	15.32890	36.66149	0.000001	820.2530	217.0803	379.3015
2005	17.40974	37.81384	0.000001	939.1340	237.4987	419.2160
2006	20.95880	47.15167	-2.667140	1074.6250	262.1557	464.1907
2007	23.56387	51.27956	0.000001	1203.3748	285.9671	508.0396
2008	26.42960	57.06260	0.000001	1361.8056	311.2402	555.7333
2009	27.43706	46.41793	0.000001	583.9753	341.9184	613.2093
2010	29.88757	72.40899	0.000001	2793.9230	365.1954	647.9589
2011	26.76233	63.14211	-54.283503	2059.6983	393.8051	712.2275
2012	29.81961	72.48623	-7.440619	1882.6199	417.7530	765.5364
2013	31.89600	72.59600	-4.503324	1652.5760	446.2969	833.9052
2014	31.76630	77.36949	-25.850677	2024.8518	478.1198	905.1911
2015	29.81547	74.65024	-0.033577	2054.1505	517.6197	970.8773
2016	35.52159	310.04681	-0.018982	20405.5142	562.2181	1070.3765
2017	33.37365	87.34864	-0.027988	2733.5950	603.0033	1167.5586
2018	35.88876	90.47501	-0.064101	2606.3455	651.7126	1283.8391
2019	39.77855	99.47749	-97.309089	2648.2579	706.4571	1419.7912

Tabelle 1: Two Way Fixed Effect Model

	Dependent variable:			
	unc_care			
	M1	M2	M3	
Treatment	-28.191^{***}	-26.243^{***}	-12.003^{***}	-12.424^{***}
	(1.883)	(1.795)	(1.811)	(1.543)
Observations	79,557	79,557	79,557	79,557
R^2	0.699	0.697	0.690	0.690
Adjusted R^2	0.675	0.673	0.665	0.665
Residual Std. Error (df = 73725)	39.701	39.829	40.304	40.313

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Tabelle 3: Event Study Common Treatment

	Model 1
year = 2003 × treated	19.485***
	(3.164)
year = 2004 × treated	18.189***
	(2.908)
year = 2005 × treated	17.172***
	(2.965)
year = 2006 × treated	19.119***
	(3.292)
year = 2007 × treated	18.782***
	(3.478)
year = 2008 × treated	15.392***
	(3.328)
year = 2009 × treated	12.430***
	(2.711)
year = 2010 × treated	11.285***
	(2.717)
year = 2011 × treated	4.376***
	(1.106)
year = 2012 × treated	1.371
	(0.873)
year = 2014 × treated	−9.102***
	(0.987)
year = 2015 × treated	−15.893***
	(1.431)
year = 2016 × treated	−19.503***
	(1.585)
year = 2017 × treated	−25.378***
	(1.959)
year = 2018 × treated	−29.139***
	(2.155)
year = 2019 × treated	−35.394***
	(2.603)
Num.Obs.	79 557
AIC	804 621.4
BIC	804 779.2
RMSE	38.01
Std.Errors	by: pn
FE: pn	X
FE: year	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Tabelle 4: Even Study Staggered

	Model 1
time_to_treat = -7 × treated	5.137^{***}
	(1.412)
time_to_treat = -6 × treated	4.920^{**}
	(1.502)
time_to_treat = -5 × treated	2.254
	(1.551)
time_to_treat = -4 × treated	-1.602
	(1.308)
time_to_treat = -3 × treated	-2.416^{*}
	(1.027)
time_to_treat = -2 × treated	-0.141
	(0.578)
time_to_treat = 0 × treated	8.151^{***}
	(1.599)
time_to_treat = 1 × treated	-16.830^{***}
	(1.009)
time_to_treat = 2 × treated	-22.370^{***}
	(1.256)
time_to_treat = 3 × treated	-27.793^{***}
	(1.537)
time_to_treat = 4 × treated	-30.231^{***}
	(1.738)
time_to_treat = 5 × treated	-33.524^{***}
	(2.060)
Num.Obs.	79 557
AIC	805 085.8
BIC	805 206.5
RMSE	38.12
Std.Errors	by: pn
FE: pn	X
FE: year	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Tabelle 5: SA especification

	mod.sa.2016	mod.sa.2015	mod.sa.2014
time_to_treat = -7	-5.298^{**}		
	(1.806)		
time_to_treat = -6	-6.820^{**}	-6.301^{**}	
	(2.306)	(2.025)	
time_to_treat = -5	-1.181	-1.023	$-4.815+$
	(3.792)	(3.790)	(2.575)
time_to_treat = -4	-4.281^{**}	-4.591^{**}	-7.985^{***}
	(1.474)	(5.908)	(1.733)
time_to_treat = -3	-2.801	-4.501^{**}	-6.371^{***}
	(2.155)	(2.097)	(1.529)
time_to_treat = -2	-0.286	-3.207^{*}	-6.684^{***}
	(2.473)	(1.384)	(1.369)
time_to_treat = 0	-2.493	-5.394^{**}	-16.855^{***}
	(2.524)	(1.278)	(1.673)
time_to_treat = 1	-15.240^{***}	-12.623^{***}	-26.405^{***}
	(1.783)	(1.921)	(1.890)
time_to_treat = 2	-19.497^{***}	-16.957^{***}	-30.859^{***}
	(1.880)	(2.156)	(2.158)
time_to_treat = 3	-23.461^{***}	-20.513^{***}	-35.758^{***}
	(2.161)	(2.128)	(2.431)
time_to_treat = 4		-19.194^{***}	-38.103^{***}
		(5.484)	(2.538)
time_to_treat = 5			-42.934^{***}
			(3.003)
Num.Obs.	79 557	79 557	79 557
AIC	807 862.7	807 729.3	804 897.4
BIC	807 964.8	807 831.4	804 999.5
RMSE	38.79	38.76	38.07
Std.Errors	by: pn	by: pn	by: pn
FE: pn	X	X	X
FE: year	X	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Tabelle 6: CS specification

	Model 1
ATT(2014,2012)	0.501
	(0.852)
ATT(2014,2013)	0.000
ATT(2014,2014)	−10.982
	(2.115)
ATT(2014,2015)	−19.827
	(3.640)
ATT(2014,2016)	−22.794
	(4.308)
ATT(2014,2017)	−27.690
	(5.275)
ATT(2014,2018)	−30.212
	(6.353)
ATT(2014,2019)	−35.792
	(8.740)
ATT(2015,2012)	6.244
	(2.258)
ATT(2015,2013)	5.781
	(1.853)
ATT(2015,2014)	0.000
ATT(2015,2015)	−5.401
	(2.480)
ATT(2015,2016)	−9.522
	(2.284)
ATT(2015,2017)	−16.522
	(3.369)
ATT(2015,2018)	−20.673
	(4.328)
ATT(2015,2019)	−25.534
	(6.872)
ATT(2016,2012)	3.523
	(4.775)
ATT(2016,2013)	2.544
	(4.380)
ATT(2016,2014)	0.879
	(1.537)
ATT(2016,2015)	0.000
ATT(2016,2016)	−4.752
	(1.310)
ATT(2016,2017)	−18.249
	(4.751)
ATT(2016,2018)	−23.546
	(5.796)
ATT(2016,2019)	−31.190
	(7.334)
ATT(2019,2012)	−2.711
	(11.516)
ATT(2019,2013)	−4.623
	(11.396)
ATT(2019,2014)	−3.978
	(9.381)
ATT(2019,2015)	−3.711
	(6.772)
ATT(2019,2016)	−0.441
	(4.826)
ATT(2019,2017)	−3.331

Tabelle 7: CS specification Event Study

	Model 1
ATT(-5)	-3.978
	(9.229)
ATT(-4)	-0.094
	(5.270)
ATT(-3)	3.277
	(3.012)
ATT(-2)	0.764
	(0.947)
ATT(-1)	0.000
ATT(0)	-10.375
	(2.090)
ATT(1)	-18.762
	(3.406)
ATT(2)	-22.253
	(4.142)
ATT(3)	-27.251
	(5.016)
ATT(4)	-29.744
	(6.283)
ATT(5)	-35.792
	(8.920)
Num.Obs.	51
Std.Errors	by: state_id
type	dynamic
ngroup	4.000
ntime	8.000
control.group	nevertreated
est.method	dr