Untitled

2023-08-25

```
confound_figs <- list.files(here::here("figures/"), pattern = "^b")
confound_tables <- list.files(here::here("tables/"), pattern = "^b")

for (file in confound_figs){
  source(here::here(paste0("figures/", file)))
}
```

```
## did2s (v1.1.0). For more information on the methodology, visit <https://www.kylebutts
##
## To cite did2s in publications use:
##
##   Butts & Gardner, "The R Journal: did2s: Two-Stage
##   Difference-in-Differences", The R Journal, 2022
##
## A BibTeX entry for LaTeX users is
##
##   @Manual{,
```

```
##     title = {did2s: Two-Stage Difference-in-Differences Following Gardner (2021)},
##     author = {Kyle Butts and John Gardner},
##     year = {2021},
##     url = {https://journal.r-project.org/articles/RJ-2022-048/},
##   }

## Rows: 8472786 Columns: 76
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (10): rd, beat_of_occurrence, district_of_occurrence, beat_of_service, ...
## dbl  (53): event_number, district, entry_to_onscene, first_watch, second_wat...
## dttm  (5): entry_received_date, dispatch_date, on_scene_date, cleared_date, ...
## date  (8): date, shotspot_activate, shotspot_activate_cpd, shotspot_activate...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
## Rows: 22 Columns: 2
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## dbl  (1): district
## date (1): bwc_date
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
## Joining with `by = join_by(district)`
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ i(time_to_treat, ref = c(-1, -1000))`
```

```
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## NOTE: 1,585,458 observations removed because of NA values (LHS: 1,585,458).
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ i(time_to_treat, ref = c(-1, -1000))`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
```

```
for (file in confound_tables){
  source(here::here(paste0("tables/", file)))
}
```

```
## Rows: 22 Columns: 2
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## dbl  (1): district
## date (1): bwc_date
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
## Joining with `by = join_by(district, bwc_date)`
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ treatment`
```

```
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ treatment`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_bwc + ..ctrl`
##  - second stage formula `~ treatment`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## NOTE: 1,585,458 observations removed because of NA values (LHS: 1,585,458).
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ treatment`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
```

```
## NOTE: 1,435,849 observations removed because of NA values (LHS: 1,435,849).
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_sdsc + ..ctrl`
##  - second stage formula `~ treatment`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## NOTE: 1,585,458 observations removed because of NA values (LHS: 1,585,458).
##
## Running Two-stage Difference-in-Differences
##  - first stage formula `~ treatment_bwc + ..ctrl`
##  - second stage formula `~ treatment`
##  - The indicator variable that denotes when treatment is on is `treatment`
##  - Standard errors will be clustered by `district`
##
##
## Rows: 12 Columns: 6
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (5): shotspot_activate, shotspot_activate_cpd, shotspot_activate_first_s...
## dbl (1): district
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
## Joining with `by = join_by(district)`
```

```
confounding_table %>%
  landscape()
```

Table 1: Robustness of Estimates Controlling for Other Technologies

	SDSC Controls				BWC Controls	
			Omitting Districts 7 and 9			
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Call-to-Dispatch						
ShotSpotter Activated	50.097**	69.056***	57.445**	86.995***	61.256***	71.856***
	(22.185)	(20.481)	(23.098)	(19.580)	(20.988)	(22.523)
SDSC Activated	16.921		17.795			
	(22.102)		(22.342)			
BWC Activated					-30.735	
					(20.755)	
Mean of Dependent Variable	281.890	281.890	289.018	289.018	281.890	281.890
Observations	3,582,560	3,582,528	3,198,525	3,198,500	3,582,560	3,582,528
Wild Bootstrap P-Value	0.008	0.003			0.062	
Panel B: Call-to-On-Scene						
ShotSpotter Activated	68.486**	100.562***	72.692**	123.226***	98.403***	120.214***
	(27.013)	(28.118)	(29.436)	(24.756)	(27.843)	(28.246)
SDSC Activated	43.771*		48.562*			
	(24.711)		(25.830)			
BWC Activated					-40.821	
					(26.223)	
Mean of Dependent Variable	770.863	770.863	790.897	790.897	770.863	770.863
Observations	1,997,102	1,997,076	1,762,676	1,762,656	1,997,102	1,997,076
Wild Bootstrap P-Value	0.008	0.003			0.062	
Gardner (2022) Robust		X		X		X

Note:
* p < 0.1, ** p < 0.05, *** p < 0.01
Standard errors are clustered by district.

```
## event study entry to dispatch
entry_1_sdsc_es
```

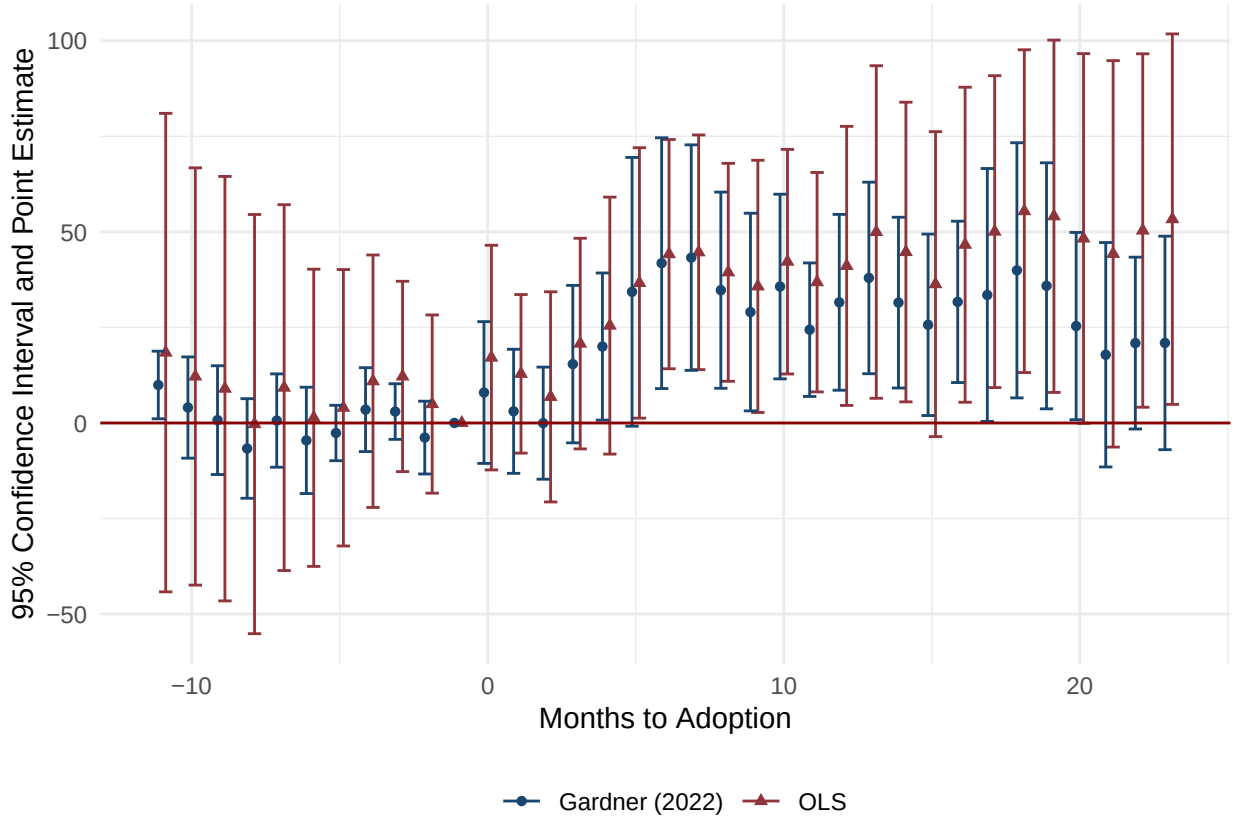

Figure 1: Event Study w/ SDSC Controls (Call-to-Dispatch)

Note: This figure shows the event study as specified in Equation 2 for Call-to-Dispatch times. Call-to-Dispatch is the amount of time from a 911 call to a police officer being dispatched to the crime scene. The x-axis denotes the number of months pre/post adoption of ShotSpotter technology. The y-axis denotes the 95% confidence intervals and point estimates (in seconds). The red errorbars/points represent confidence intervals/point estimates from OLS estimation while the blue are from Gardner (2022) two-stage difference-in-difference estimators which are robust to heterogeneous treatment effects in staggered adoptions. All pre/post periods are normalized by the month before ShotSpotter adoption. Twelve periods are estimated, but only 11 pre-periods and 23 post-periods are reported as the -12 and +24 are binned endpoints. Controls are synonymous with the preferred specification in addition to SDSC rollout. Standard errors are clustered at the district level.

```
## event study entry to on scene
eos_1_sdsc_es
```

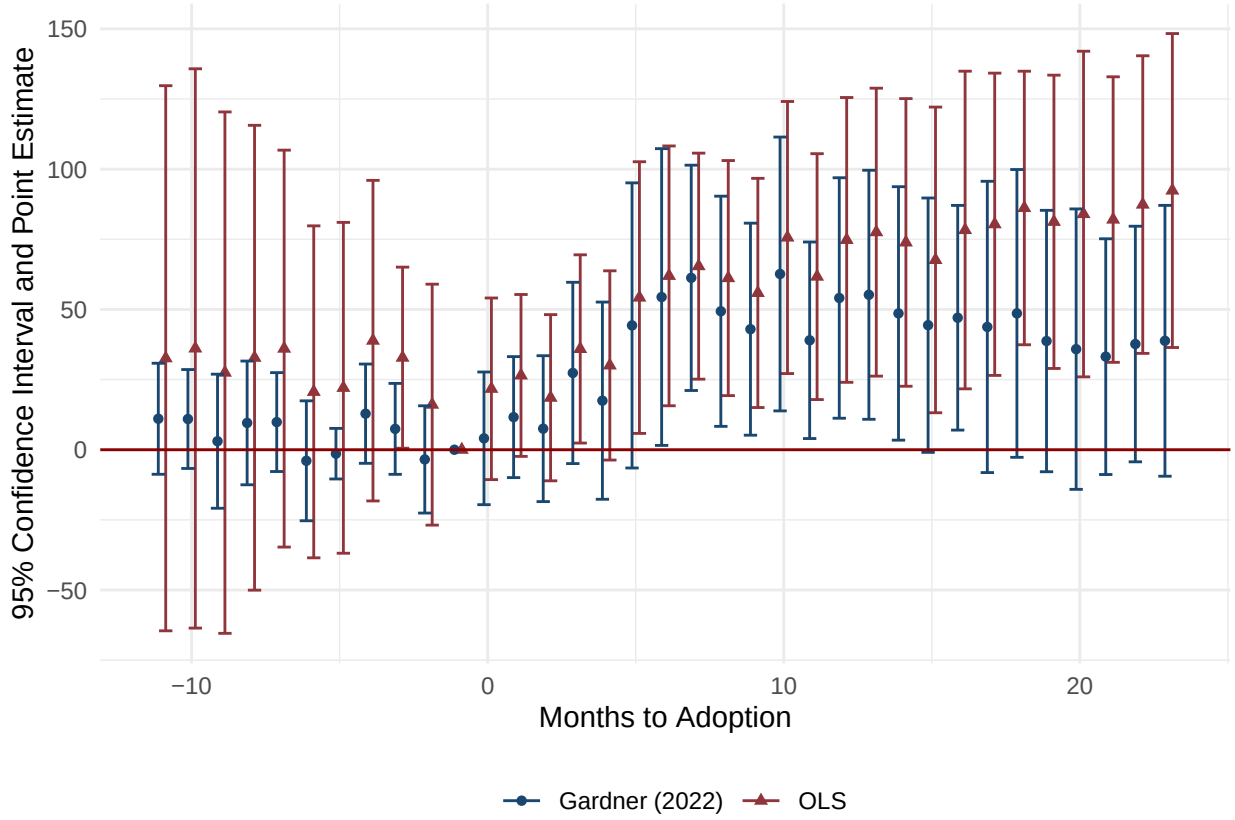

Figure 2: Event Study w/ SDSC Controls (Call-to-On-Scene)

Note: This figure shows the event study as specified in Equation 2 for Call-to-On-Scene times. Call-to-On-Scene is the amount of time from a 911 call to a police officer arriving to the crime scene. The x-axis denotes the number of months pre/post adoption of ShotSpotter technology. The y-axis denotes the 95% confidence intervals and point estimates (in seconds). The red errorbars/points represent confidence intervals/point estimates from OLS estimation while the blue are from Gardner (2022) two-stage difference-in-difference estimators which are robust to heterogeneous treatment effects in staggered adoptions. All pre/post periods are normalized by the month before ShotSpotter adoption. Twelve periods are estimated, but only 11 pre-periods and 23 post-periods are reported as the -12 and +24 are binned endpoints. Controls are synonymous with the preferred specification in addition to SDSC rollout. Standard errors are clustered at the district level.