Assignment_Three Q2

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December 8, 2022

```
name<- Sys.info()
name[7]
   user
"erico"
```

```
library(rlang)
library(dplyr)
library(kableExtra)
library(ggdag)      # For plotting DAGs
library(dagitty)    # For working with DAG logic
library(modelsummary) # For making regression tables
library(AER) # this package has lots of applied metrics packages
library(foreign)
# Helpful for reading in data from Stata or other code languages
library(lubridate) # For figures
library(stargazer) # For tables
library(data.table)  #data manipulation and wrangling
library(lme4)
library(psych)
library(readxl) # Read in data
library(expss) #value labelling from spss style
library(readstata13)
library(marginaleffects) # To calculate marginal effects
library(knitr) # Alternative table package
library(ggplot2)




######
```

```
### 0. Load the packages we will need for this file ####
library(tidyverse) # load the installed package for each new session of R
library(broom)
library(causaldata) # Useful toy data sets
library(here) # Helpful in working with directories and projects
library(zoo) # Helpful packages for organizing dates
library(tidysynth) # For synthetic controls
library(gsynth) # For synthetic controls
library(gghighlight) # For figures
library(binsreg) # For binscatters
library(nprobust) # Local linear regression

library(fixest)

set.seed(032620) # random number generators; same numbers across machines
```

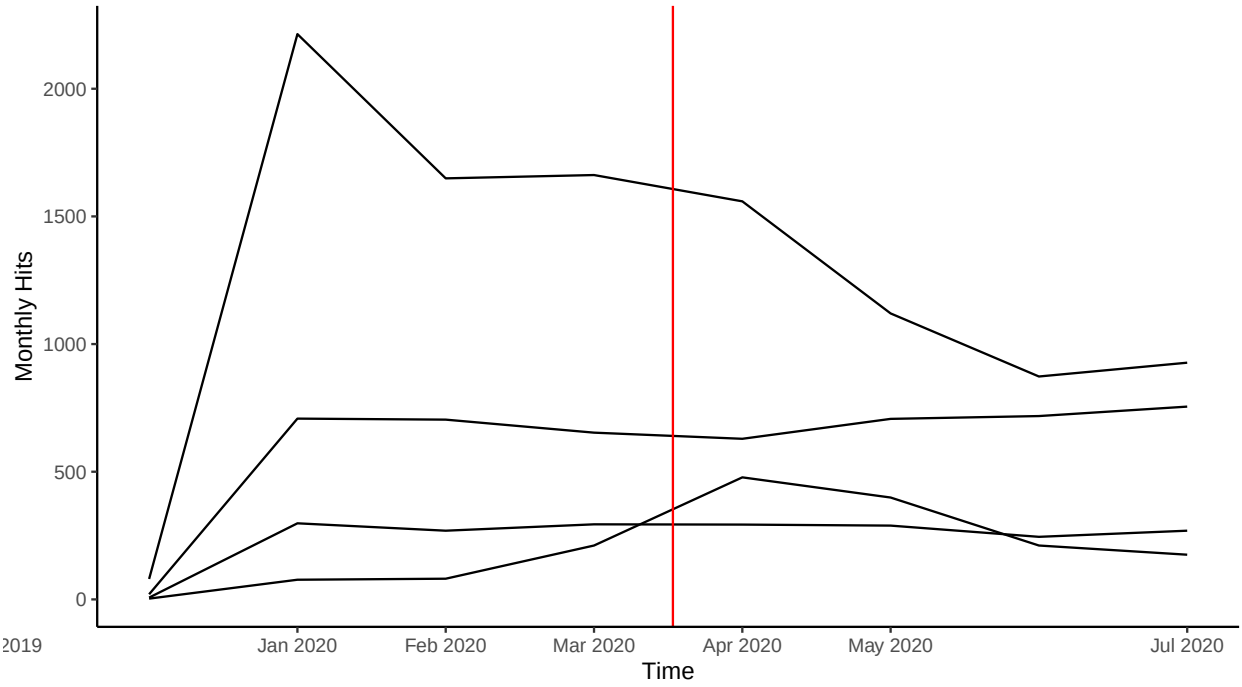
#QUESTION ONE

```
mydata<- read_excel("C:/Users/erico/Desktop/ACADEMICS/MY UofT COURSES/YEAR TWO/SEMESTER

#View(mydata)


#regdata$the_date<-mydata$date  # I will use this data later

mydata$date <- as.yearmon(mydata$date)


table(mydata$date)

Dec 2019 Jan 2020 Feb 2020 Mar 2020 Apr 2020 May 2020 Jun 2020 Jul 2020
       4      124      116      124      120      124      120      124
table(mydata$hits)

  2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21
 35  30  12  22  21  15  57  80  75  26  10  10  10   5   7   7   9  16  18  27
 22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41
 30  35  37  23  11  17  12  17  14   9   4   5   2   7   2   4   2   2   5   5
 42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60  61
  2   5   1   4   3   6   2   2   3   9   7   4   1   5   5   5   5   1   5   2
 62  63  64  65  66  67  68  69  70  71  72  74  76  77  78  80  84  85  86  87
  4   1   4   2   5   2   3   3   3   1   3   1   1   1   1   1   2   2   1   1
 89 100
  1   1
```

```
table(mydata$keyword)

   cereal  sandwich      soup sourdough
      214       214       214       214
table(mydata$time)

2020-01-01 2020-08-01
                856
table(mydata$gprop)

web
856
table(mydata$category)

  0
856
table(mydata$geo)

 US
856
```

#QUESTION ONE A:

```
# Group to month level
mydata <- mydata %>% group_by(date, keyword) %>%
  summarize(hits = sum(hits,na.rm=T))
#Show hits over time for each Keyword
ggplot(mydata,aes(x=date,y=hits,group=keyword)) + geom_line() +
  theme_classic() + labs(x="Time",y="Monthly Hits")+
  geom_vline(xintercept = '2020.211',color='red')
```



QUESTION ONE B:

```
table(mydata$keyword)

   cereal  sandwich      soup sourdough
        8         8         8         8


# Definition of key variables
mydata <- mydata %>% mutate(treated = ifelse(keyword == "sourdough", 1, 0),
                            interaction = ifelse(keyword == "sourdough",date,0))

# Statistical tests: are the two groups' trends different?
pretrend_test <- lm(hits ~ date + interaction, data=mydata)
msummary(list(pretrend_test),
         vcov=c(rep("robust",1)),
         stars=c('*' = .1, '**' = .05, '***' = .01)) # Interpret each coefficient here
```

QUESTION ONE C:

	Model 1
(Intercept)	−536 001.232
	(988 733.741)
date	265.669
	(489.387)
interaction	−0.248***
	(0.067)
Num.Obs.	32
R2	0.170
R2 Adj.	0.112
AIC	495.7
BIC	501.6
Log.Lik.	−243.856
F	11.121
RMSE	493.52
Std.Errors	HC3

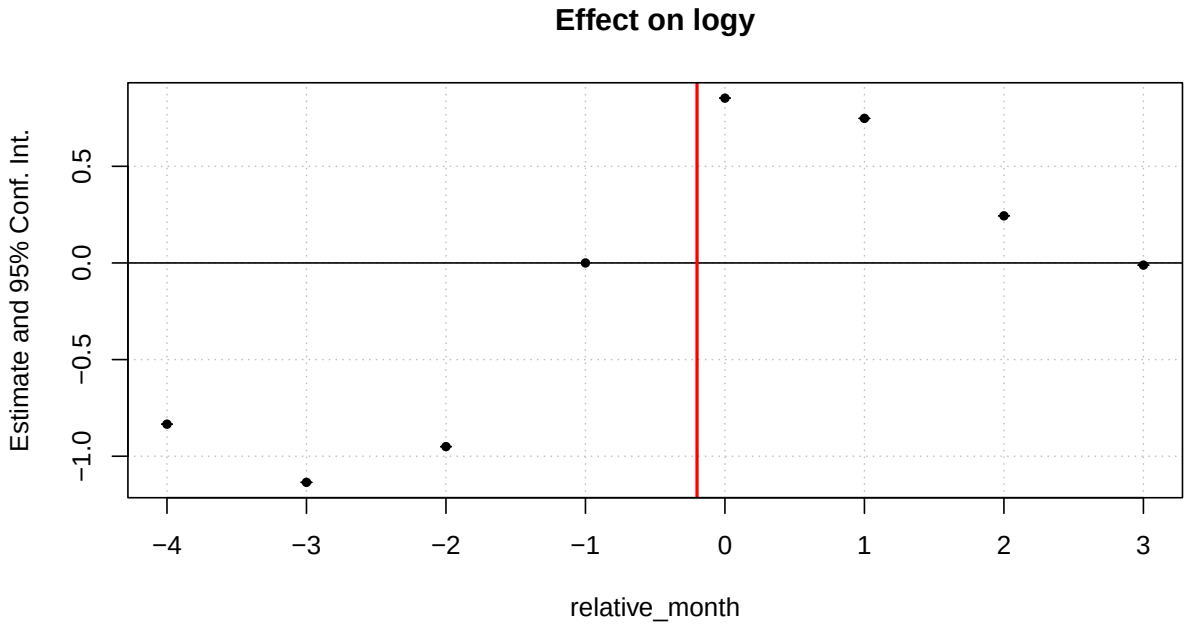
* p < 0.1, ** p < 0.05, *** p < 0.01

```
# Definition of key variables
mydata <- mydata %>% mutate(the_keyword = ifelse(keyword == "sourdough",1,0))
mydata <- mydata %>% mutate(After = ifelse(date >= "Mar 2020",1,0))
#mydata <- mydata %>% mutate(inter = keyword * post)

table(mydata$hits)

  3   7  20  77  80  81 175 211 245 269 289 293 294 298 399 478
  1   1   1   1   1   1   1   2   1   2   1   1   1   1   1   1
629 653 704 707 708 718 755 873 927 1120 1559 1649 1662 2214
  1   1   1   1   1   1   1   1   1   1   1   1   1   1
table(mydata$After)

 0  1
12 20
table(mydata$the_keyword)

 0  1
24  8


# transform the data #Run pre trends again?
mydata <- mydata %>% mutate(logy = log(hits))
```

```
# First, construct relative time variable
mydata <- mydata %>% mutate(relative_month = round((as.numeric(date) - 2020.211)*12))

#View(mydata)
```

#QUESTION ONE D

```
#difference-in-difference estimate of the effect of lockdown on sourdough popularity.


dte <- feols(logy ~ i(relative_month, the_keyword, ref = -1) |
                date + keyword, data = mydata)

# And use coefplot() for a graph of effects
iplot(dte,ref.line=-0.2,
         ref.line.par=list(col="red",lty=1,lwd=2))
```



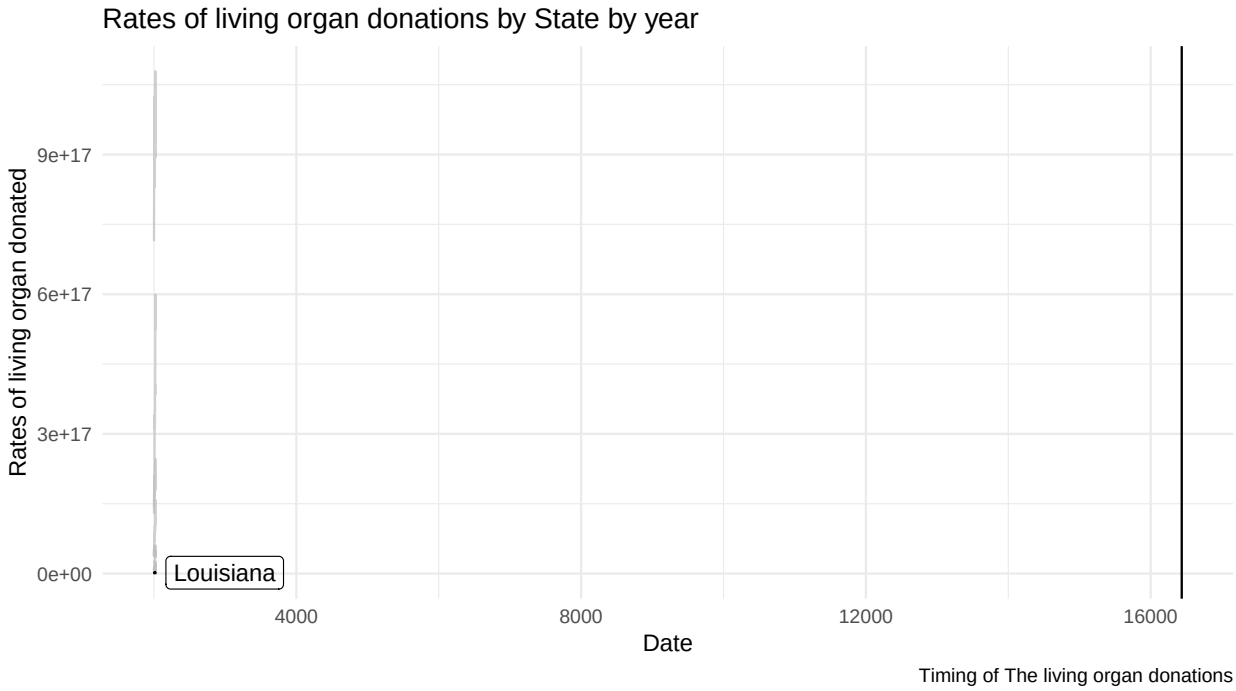
#QUESTION TWO

#A

```
mydata2<- read_excel("C:/Users/erico/Desktop/ACADEMICS/MY UofT COURSES/YEAR TWO/SEMESTER

#View(mydata2)
```

```
summary(mydata2$LivingDonors)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    0.0    18.0    72.5   118.1   162.0   743.0

summary(mydata2$AllDonors)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    0.0    48.0   192.0   272.2   357.0  1822.0


summary(mydata2$WaitinglistAdditions)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    0.0   115.0   551.5   993.0  1210.0  7878.0
```

```
#population-adjusted
mydata2$LivingDonors<-mydata2$LivingDonors*mydata2$Population
mydata2$AllDonors<-mydata2$AllDonors*mydata2$Population
mydata2$WaitinglistAdditions<-mydata2$WaitinglistAdditions*mydata2$Population

mydata2$GDP_percapita<-mydata2$GDP/mydata2$Population

#rate of living organ donations
mydata2$rate_LivingDonors<-(mydata2$LivingDonors*mydata2$Population)
#table(mydata2$rate_LivingDonors)



# Some descriptive figures
ggplot(mydata2, aes(x = Year,
                y = rate_LivingDonors,
                group = State)) +
  geom_line() +
  gghighlight(State=="Louisiana",
              label_params = list(fill = NA, alpha=1)) +
  geom_vline(xintercept = lubridate::make_date(2015), linetype = "solid") +
  labs(
    title = "Rates of living organ donations by State by year",
    caption = "Timing of The living organ donations",
    x = "Date",
    y = "Rates of living organ donated"
  ) +
  theme_minimal()
```



#B

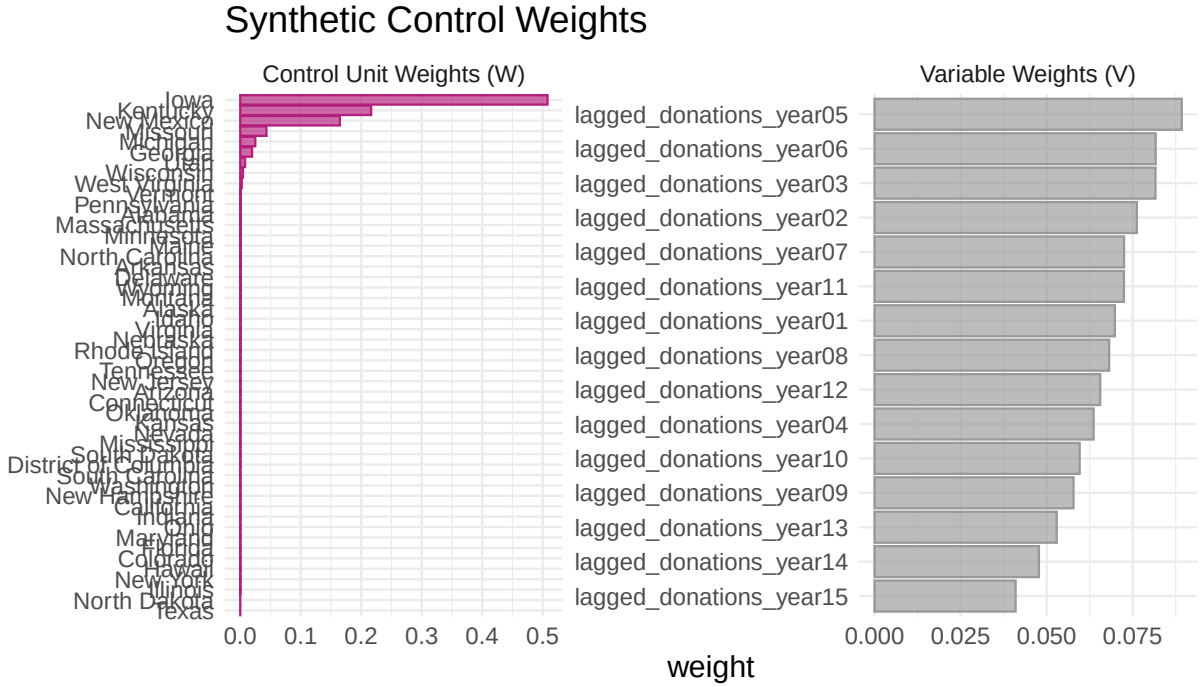
#C

#D

```
mydata2$centered_year<-mydata2$Year-2015
# Construct Synthetic Controls
donation_out <-
  mydata2  %>%
  # initial the synthetic control object
  synthetic_control(outcome = rate_LivingDonors, # outcome
                    unit = State, # unit index in the panel data
                    time = centered_year, # time index in the panel data
                    i_unit = "Louisiana", # unit where the intervention occurred
                    i_time = 0, # time period when the intervention occurred
                    generate_placebos=T # generate placebo synthetic controls (for infe
  ) %>%
  # Matching on fully vaccinated the weeks before the intervention
  generate_predictor(time_window = -15, lagged_donations_year15 = rate_LivingDonors) %>%
  generate_predictor(time_window = -14, lagged_donations_year14 = rate_LivingDonors) %>%
  generate_predictor(time_window = -13, lagged_donations_year13 = rate_LivingDonors) %>%
  generate_predictor(time_window = -12, lagged_donations_year12 = rate_LivingDonors) %>%
  generate_predictor(time_window = -11, lagged_donations_year11 = rate_LivingDonors) %>%
  generate_predictor(time_window = -10, lagged_donations_year10 = rate_LivingDonors) %>%
  generate_predictor(time_window = -09, lagged_donations_year09 = rate_LivingDonors) %>%
  generate_predictor(time_window = -08, lagged_donations_year08 = rate_LivingDonors) %>%
```

```
  generate_predictor(time_window = -07, lagged_donations_year07 = rate_LivingDonors) %>%
  generate_predictor(time_window = -06, lagged_donations_year06 = rate_LivingDonors) %>%
  generate_predictor(time_window = -05, lagged_donations_year05 = rate_LivingDonors) %>%
  generate_predictor(time_window = -04, lagged_donations_year04 = rate_LivingDonors) %>%
  generate_predictor(time_window = -03, lagged_donations_year03 = rate_LivingDonors) %>%
  generate_predictor(time_window = -02, lagged_donations_year02 = rate_LivingDonors) %>%
  generate_predictor(time_window = -01, lagged_donations_year01 = rate_LivingDonors) %>%
  # Generate the fitted weights for the synthetic control
  generate_weights(optimization_window = -15:-1, # time to use in the optimization task
                   margin_ipop = .02,sigf_ipop = 7,bound_ipop = 6 # optimizer options
  ) %>%
  # Generate the synthetic control
  generate_control()




#relative weights

# Which states are we using, and what weights are they given?
donation_out %>%
  grab_unit_weights() %>%
  mutate(weights = round(weight, digits = 4)) %>%
  select(unit, weights) %>%
  filter(weights>0.0001) %>%
  as.data.frame() %>%
  stargazer(summary = FALSE, rownames = FALSE)

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: m
% Date and time: Tue, Nov 29, 2022 - 8:43:25 PM
\begin{table}[!htbp] \centering
  \caption{}
  \label{}
\begin{tabular}{@{\extracolsep{5pt}} cc}
\\[-1.8ex]\hline
\hline \\[-1.8ex]
unit & weights \\
\hline \\[-1.8ex]
Alabama & $0.001$ \\
Alaska & $0.0003$ \\
Arkansas & $0.0003$ \\
Delaware & $0.0003$ \\
Georgia & $0.020$ \\
```

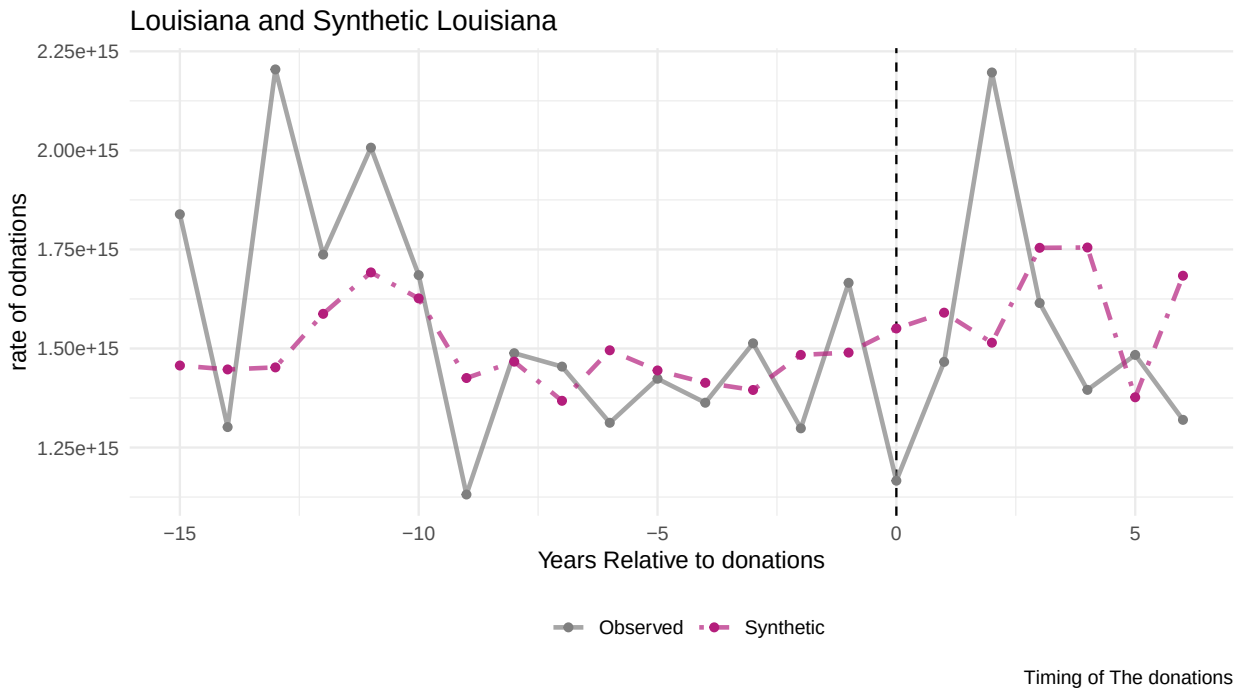
```
Idaho & $0.0003$ \\
Iowa & $0.508$ \\
Kentucky & $0.216$ \\
Maine & $0.0004$ \\
Massachusetts & $0.001$ \\
Michigan & $0.025$ \\
Minnesota & $0.0004$ \\
Missouri & $0.043$ \\
Montana & $0.0003$ \\
Nebraska & $0.0002$ \\
New Mexico & $0.165$ \\
North Carolina & $0.0004$ \\
Oregon & $0.0002$ \\
Pennsylvania & $0.001$ \\
Rhode Island & $0.0002$ \\
Utah & $0.008$ \\
Vermont & $0.001$ \\
Virginia & $0.0003$ \\
West Virginia & $0.002$ \\
Wisconsin & $0.004$ \\
Wyoming & $0.0003$ \\
\hline \\[-1.8ex]
\end{tabular}
\end{table}

# What about the independent variables?
donation_out %>%
  plot_weights() +
  labs(title="Synthetic Control Weights")
```



#E

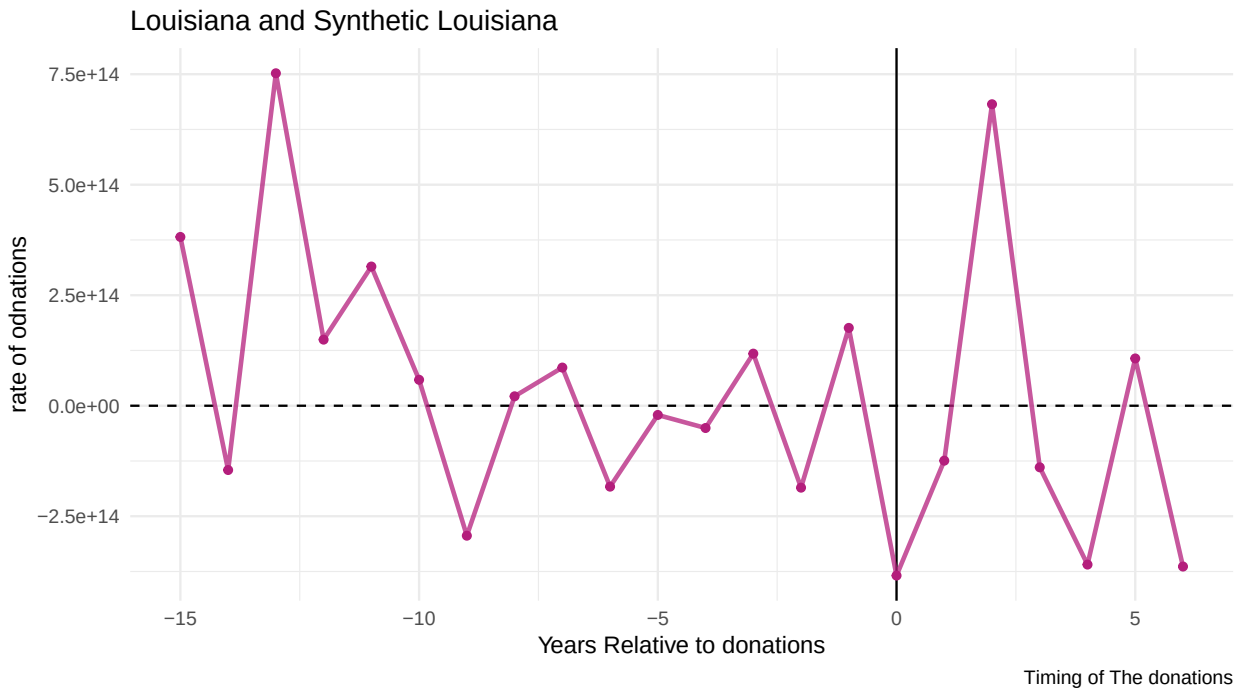
```
# Balance Table
donation_out %>%
  grab_balance_table() %>%
  mutate(difference = Louisiana - synthetic_Louisiana) %>%
  select(variable, Louisiana, synthetic_Louisiana, difference, donor_sample) %>%
  as.data.frame() %>%
  stargazer(summary = FALSE, rownames = FALSE,
            caption = "Balance Table",
            label = "balancetable") # Note: try this in R Markdown
##
## % Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-ma
## % Date and time: Tue, Nov 29, 2022 - 8:43:25 PM
## \begin{table}[!htbp] \centering
##   \caption{}
##   \label{balancetable}
## \begin{tabular}{@{\extracolsep{5pt}} ccccc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
## lagged\_donations\_year15 & $1,319,851,859,912,850$ & $1,457,035,344,380,630.000$ &
## lagged\_donations\_year14 & $1,483,800,974,156,250$ & $1,447,104,549,384,350.000$ &
## lagged\_donations\_year13 & $1,395,553,322,380,941$ & $1,452,286,909,650,623$ & $$-
## lagged\_donations\_year12 & $1,614,745,840,495,356$ & $1,587,463,377,309,169.000$ &
## lagged\_donations\_year11 & $2,196,624,305,716,264$ & $1,692,022,033,305,052.000$ &
```

```
## lagged\_donations\_year10 & $1,466,186,669,526,880$ & $1,626,469,853,644,183$ & $$-
## lagged\_donations\_year09 & $1,166,314,344,440,175$ & $1,425,441,392,419,097$ & $$-
## lagged\_donations\_year08 & $1,665,676,690,617,807$ & $1,466,762,951,583,733.000$ &
## lagged\_donations\_year07 & $1,298,511,928,784,136$ & $1,367,953,163,942,311$ & $$-
## lagged\_donations\_year06 & $1,513,117,631,692,800$ & $1,495,480,252,617,920.000$ &
## lagged\_donations\_year05 & $1,363,082,892,535,584$ & $1,444,558,235,673,127.000$ &
## lagged\_donations\_year04 & $1,423,671,401,562,500$ & $1,413,462,190,641,220.000$ &
## lagged\_donations\_year03 & $1,312,474,487,376,608$ & $1,395,289,402,262,460.000$ &
## lagged\_donations\_year02 & $1,454,264,998,213,572$ & $1,483,796,193,113,750.000$ &
## lagged\_donations\_year01 & $1,488,113,115,347,661$ & $1,489,630,916,423,581.000$ &
## \hline \\[-1.8ex]
## \end{tabular}
## \end{table}
##
## % Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-ma
## % Date and time: Tue, Nov 29, 2022 - 8:43:25 PM
## \begin{table}[!htbp] \centering
##   \caption{}
##   \label{balancetable}
## \begin{tabular}{@{\extracolsep{5pt}} c}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
## Balance Table \\
## \hline \\[-1.8ex]
## \end{tabular}
## \end{table}


donation_out %>% plot_trends() +
  scale_x_continuous(breaks = c(-15,-10,-5,0,5)) +
  labs(
    title = "Louisiana and Synthetic Louisiana",
    caption = "Timing of The donations",
    x="Years Relative to donations",
    y="rate of odnations"
  )
```



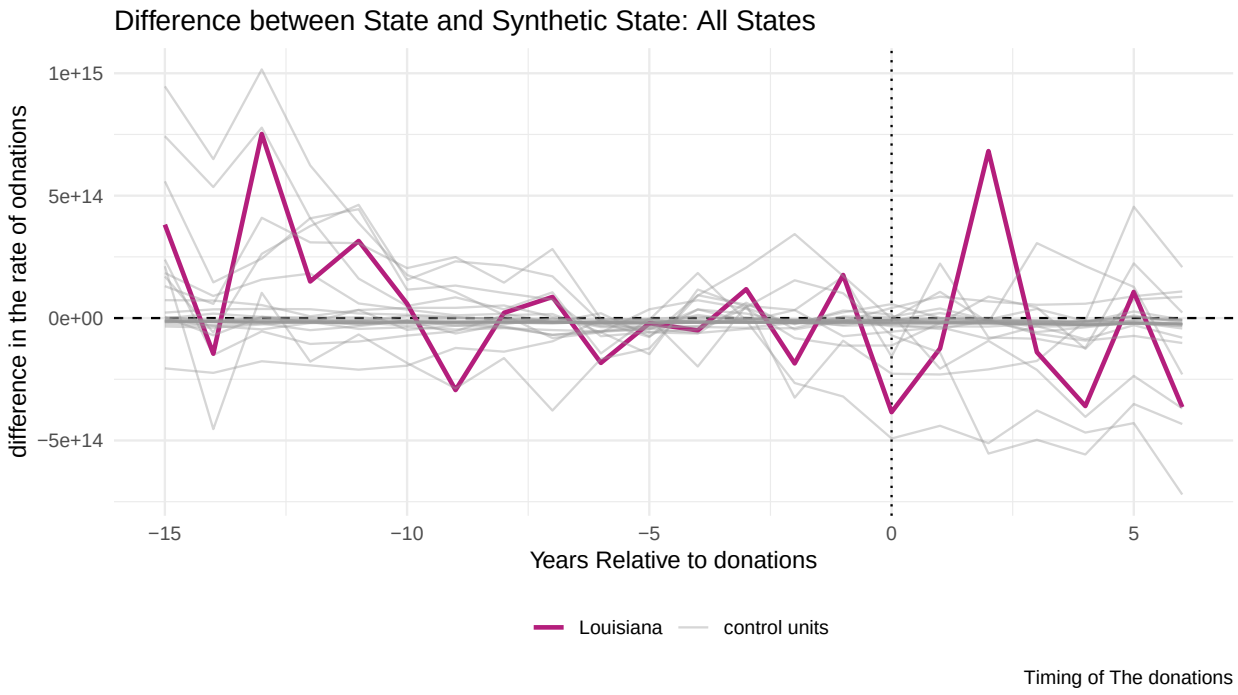
#F

```
# Plot Model Differences
donation_out %>% plot_differences() +
  scale_x_continuous(breaks = c(-15,-10,-5,0,5)) +
  labs(
   title = "Louisiana and Synthetic Louisiana",
    caption = "Timing of The donations",
    x="Years Relative to donations",
    y="rate of odnations"
  )
```



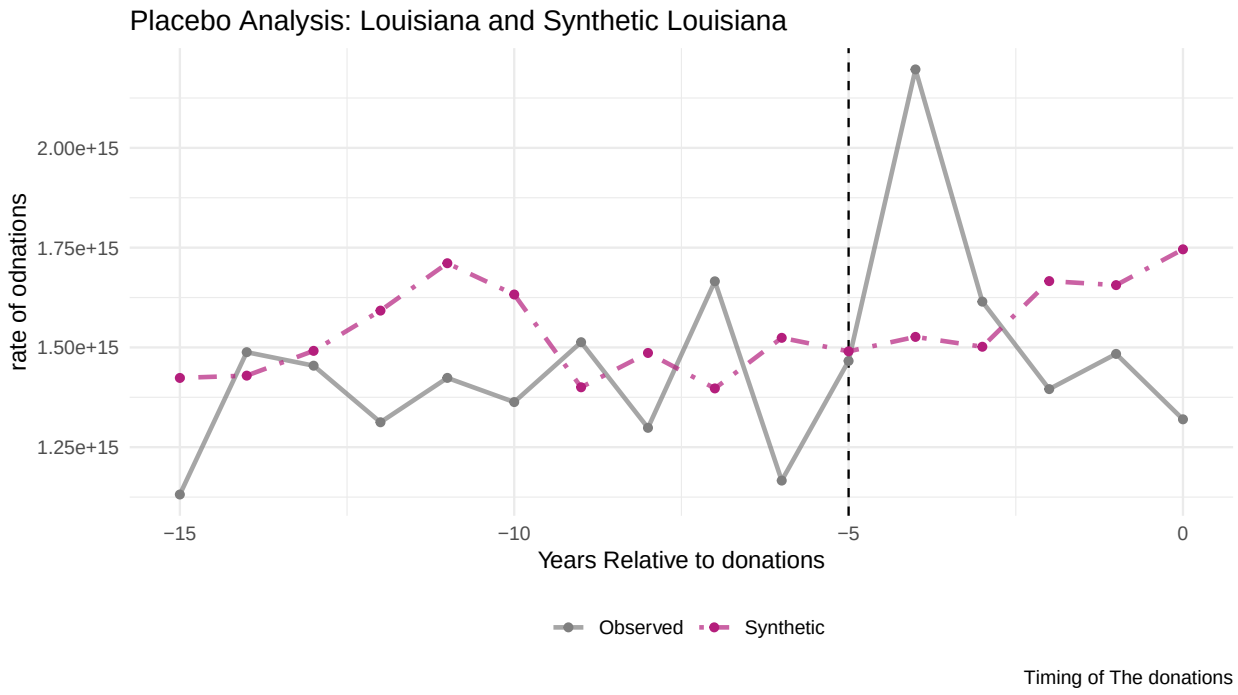
#G

```
#i:
# Plot placebos of different states' assignments
donation_out %>% plot_placebos() +
  scale_x_continuous(breaks = c(-15,-10,-5,0,5)) +
  labs(
    title = "Difference between State and Synthetic State: All States",
    caption = "Timing of The donations",
    x="Years Relative to donations",
    y="difference in the rate of odnations"
  )
```

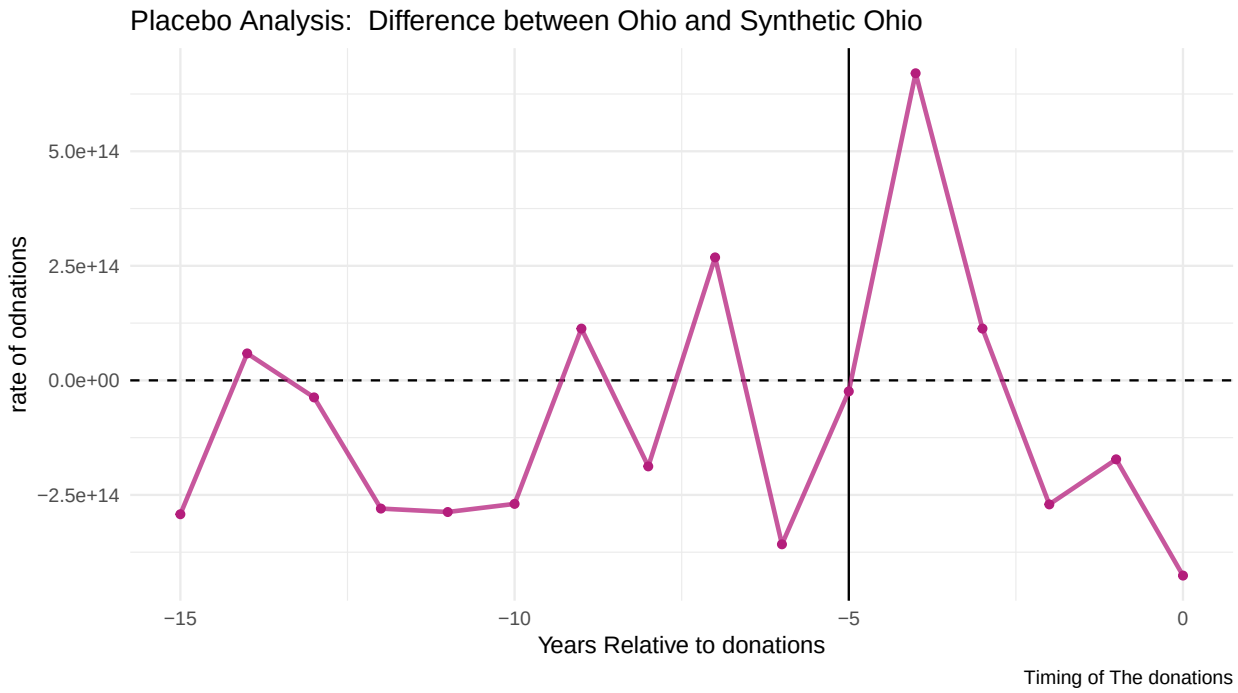



```
#ii

# This test shifts the pre-treatment window back five weeks.
# This analysis was included in our pre-registration as a demonstration of the
# method and to show that we did not find treatment effects before the lottery
# was announced.

placebo_out <-
  mydata2 %>%
  filter(centered_year <= 0) %>%
  # initial the synthetic control object
  synthetic_control(outcome = rate_LivingDonors, # outcome
                    unit = State, # unit index in the panel data
                    time = centered_year, # time index in the panel data
                    i_unit = "Louisiana", # unit where the intervention occurred
                    i_time = -5, # time period when the intervention occurred
                    generate_placebos=T # generate placebo synthetic controls (for infe
  ) %>%

  # Matching on fully vaccinated the weeks before the intervention
  generate_predictor(time_window = -15, lagged_donations_yr15 = rate_LivingDonors) %>%
  generate_predictor(time_window = -14, lagged_donations_yr14 = rate_LivingDonors) %>%
  generate_predictor(time_window = -13, lagged_donations_yr13 = rate_LivingDonors) %>%
  generate_predictor(time_window = -12, lagged_donations_yr12 = rate_LivingDonors) %>%
```

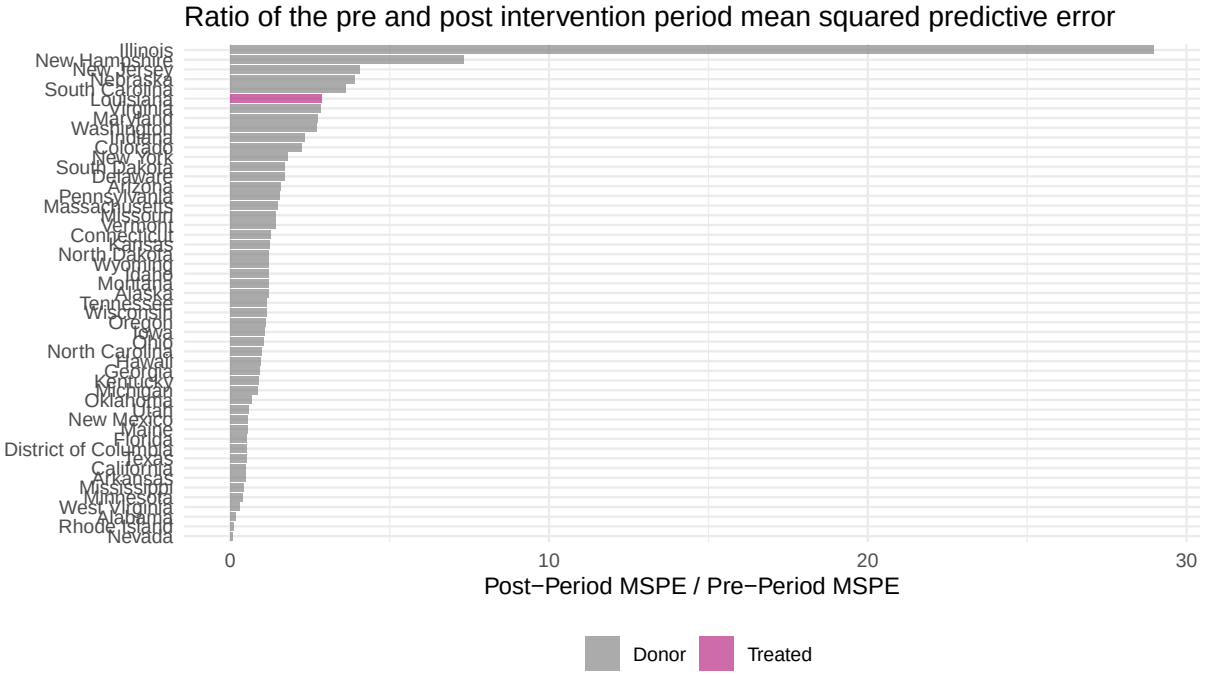
```
  generate_predictor(time_window = -11, lagged_donations_yr11 = rate_LivingDonors) %>%
  generate_predictor(time_window = -10, lagged_donations_yr10 = rate_LivingDonors) %>%
  generate_predictor(time_window = -09, lagged_donations_yr09 = rate_LivingDonors) %>%
  generate_predictor(time_window = -08, lagged_donations_yr08 = rate_LivingDonors) %>%
  generate_predictor(time_window = -07, lagged_donations_yr07 = rate_LivingDonors) %>%
  generate_predictor(time_window = -06, lagged_donations_yr06 = rate_LivingDonors) %>%
  generate_predictor(time_window = -05, lagged_donations_yr05 = rate_LivingDonors) %>%
  generate_predictor(time_window = -04, lagged_donations_yr04 = rate_LivingDonors) %>%
  generate_predictor(time_window = -03, lagged_donations_yr03 = rate_LivingDonors) %>%
  generate_predictor(time_window = -02, lagged_donations_yr02 = rate_LivingDonors) %>%
  generate_predictor(time_window = -01, lagged_donations_yr01 = rate_LivingDonors) %>%
  # Generate the fitted weights for the synthetic control
  generate_weights(optimization_window = -15:-1, # time to use in the optimization task
                   margin_ipop = .02,sigf_ipop = 7,bound_ipop = 6 # optimizer options
  ) %>%
  # Generate the synthetic control
  generate_control()



placebo_out %>% plot_trends()  +
  labs(
    title = "Placebo Analysis: Louisiana and Synthetic Louisiana",
  caption = "Timing of The donations",
    x="Years Relative to donations",
    y="rate of odnations"
  )
```




```
placebo_out %>% plot_differences()  +
  labs(
    title = "Placebo Analysis:  Difference between Ohio and Synthetic Ohio",
   caption = "Timing of The donations",
    x="Years Relative to donations",
    y="rate of odnations"
  )
```




```
placebo_out %>% grab_signficance() %>% filter(unit_name=="OH")
## # A tibble: 0 x 8
## # ... with 8 variables: unit_name <chr>, type <chr>, pre_mspe <dbl>,
## #   post_mspe <dbl>, mspe_ratio <dbl>, rank <int>, fishers_exact_pvalue <dbl>,
## #   z_score <dbl>
placebo_out %>% grab_unit_weights() %>% arrange(desc(weight))
## # A tibble: 50 x 2
##    unit           weight
##    <chr>           <dbl>
##  1 Iowa          0.348
##  2 Kentucky      0.306
##  3 New Mexico    0.271
##  4 Georgia       0.0376
##  5 Michigan      0.0302
##  6 Utah          0.00321
##  7 Arkansas      0.00212
##  8 Nevada        0.000232
##  9 Pennsylvania 0.000221
## 10 Missouri      0.000171
## # ... with 40 more rows

placebo_out %>% plot_mspe_ratio()
```



#H

```
packages <- knitr::write_bib(file = 'packages.bib')
packages
```

$AER @Manual{R-AER, title = {AER: Applied Econometrics with R}, author = {Christian Kleiber and Achim Zeileis}, year = {2022}, note = {R package version 1.2-10}, url = {https://CRAN.R-project.org/package=AER}, }

$base @Manual{R-base, title = {R: A Language and Environment for Statistical Computing}, author = {{R Core Team}}, organization = {R Foundation for Statistical Computing}, address = {Vienna, Austria}, year = {2022}, url = {https://www.R-project.org/}, }

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