HW3

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Contents

Question 1

a If the variable nbp is 1, that means that the state in question was regulated by the NO_x budget trading program. This was a cap-and-trade system to regulate the emissions of nitrogen oxides.

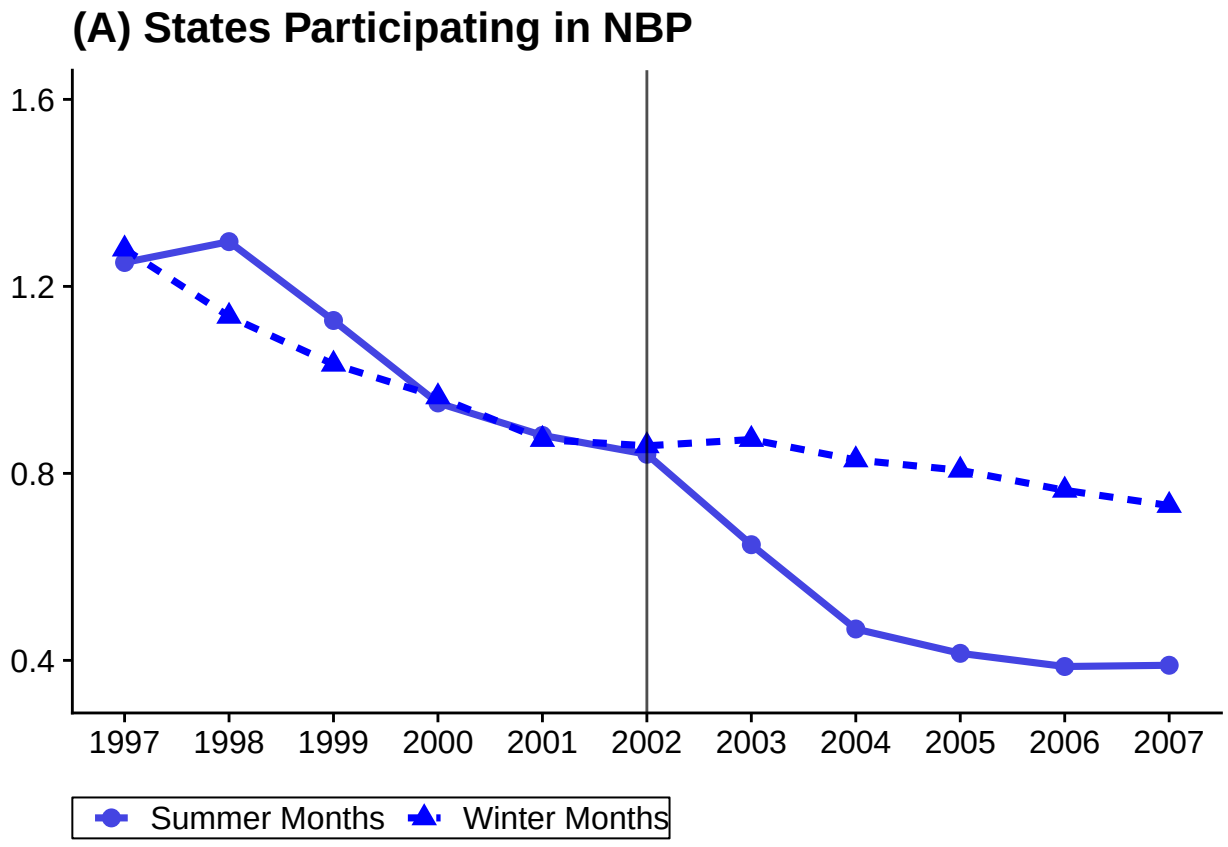
b If the variable summer is 1, that indicates that the observation occurred during the summer. There is seasonal variation in emissions, which this variable helps to capture.

c If the variable post is 1, the year the observation was taken was after 2003. 2003 was the year the NBP program went into effect, so this variable captures the cutoff point for the diff-in-diff estimator.

Question 2

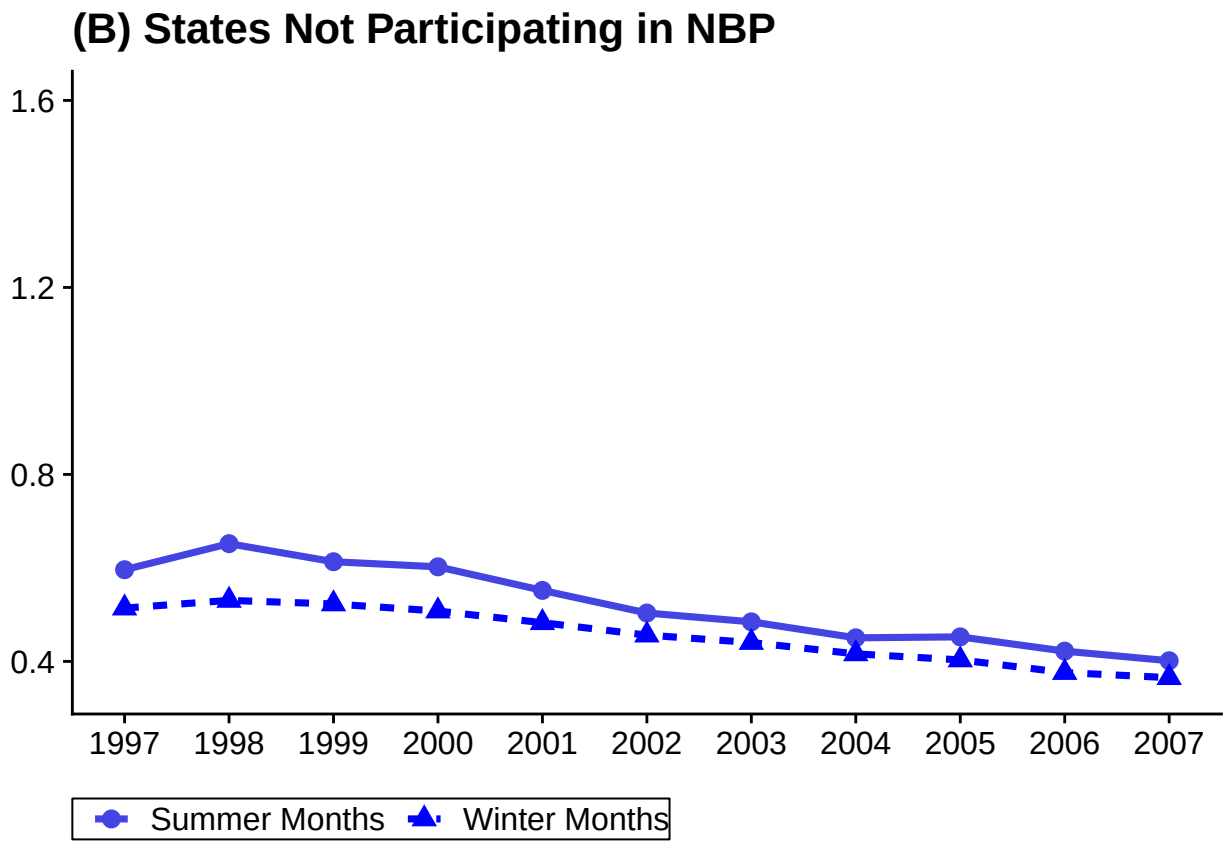
```
# Compute the year over year averages for summer

nbp_summer =
  nbp |>
  filter(nbp == 1 & summer == 1) |>
  group_by(year) |>
  summarise(nox_emit = mean(nox_emit),
            summer = "Summer Months")

# Compute the year over year emissions averages for winter

nbp_winter =
  nbp |>
  filter(nbp == 1 & summer == 0) |>
  group_by(year) |>
  summarise(nox_emit = mean(nox_emit),
            summer = "Winter Months")

# Combine the data sets

nox_emit_df = bind_rows(nbp_summer, nbp_winter)
```

```r
# Fix the row types

nox_emit_df %<>% mutate(summer = as.factor(summer))

# Make the graph

nox_emit_df |>
  ggplot(aes(x = year, y = nox_emit, color = summer, linetype = summer)) +
  geom_line(size = 1.25) +
  geom_point(aes(shape = summer), size = 3) +
  geom_vline(xintercept = 2002, alpha = 0.7) +
  scale_x_continuous(breaks = scales::breaks_pretty(n = 10)) +
  scale_color_manual(values = c("#4444e2", "#0000ff")) +
  ylim(0.35, 1.6) +
  labs(x = NULL,
       y = NULL,
       title = "(A) States Participating in NBP") +
  theme(legend.position = 'bottom',
        legend.box.background = element_rect(color = 'black'),
        legend.title = element_blank())
```



Question 5

```
# Compute the year over year averages for summer and no nbp

no_nbp_summer =
  nbp |>
  filter(nbp == 0 & summer == 1) |>
  group_by(year) |>
  summarise(nox_emit = mean(nox_emit),
            summer = "Summer Months")

# Compute the year over year emissions averages for winter and no nbp

no_nbp_winter =
  nbp |>
  filter(nbp == 0 & summer == 0) |>
  group_by(year) |>
  summarise(nox_emit = mean(nox_emit),
            summer = "Winter Months")

# Combine the data sets

no_nox_emit_df = bind_rows(no_nbp_summer, no_nbp_winter)

# Make the graph

no_nox_emit_df |>
  ggplot(aes(x = year, y = nox_emit, color = summer, linetype = summer)) +
  geom_line(size = 1.25) +
  geom_point(aes(shape = summer), size = 3) +
  scale_x_continuous(breaks = scales::breaks_pretty(n = 10)) +
  scale_color_manual(values = c("#4444e2", "#0000ff")) +
  ylim(0.35, 1.6) +
  labs(x = NULL,
       y = NULL,
       title = "(B) States Not Participating in NBP") +
  theme(legend.position = 'bottom',
        legend.box.background = element_rect(color = 'black'),
        legend.title = element_blank())
```


(B) States Not Participating in NBP
1.6
1.2
0.8
0.4
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Summer Months
Winter Months