```
------------------------------------------------------------------------------------------
> ------------------
      name:  <unnamed>
       log:  C:\Users\corcorsp\Dropbox\_TEACHING\Regression II\Lectures\Lecture 6 - Sy
> nthetic control me
> thods\In-class exercise\Inclass-exercise-6-log.txt
  log type:  text
 opened on:  27 Oct 2025, 20:36:22

.         set more off

.
. // install synth package and necessary mat2txt:
.         *ssc install synth, all
.         *ssc install mat2txt
. // synth_runner package:
.         *net install st0500.pkg, from(http://www.stata-journal.com/software/sj17-4/)
. // synth2:
.         *ssc install synth2, all replace
.
.
. // *****
. // (1)
. // *****
. // ************************************************************************
. // Use synth2 command to obtain weights, construct a synthetic control, and
. //    estimate treatment effects in each post-period year.
. // Outcome: Black male prisoners (per 100,000 population)
. // Treated state: Texas
. // Year of treatment: 1993
. // ************************************************************************
. // NOTE: synth2 only works in Stata 16+. If this command doesn't work for you,
. // the earlier synth and synth_runner commands can accomplish the same things
.
.
. // Read source data - panel data from 1985 to 2000
.
.         use https://github.com/scunning1975/mixtape/raw/master/texas.dta, clear

.
. // Note data has already been "xtset" with statefip as cross sectional-unit
. // and year as time period
.
.         xtset

Panel variable: statefip (strongly balanced)
 Time variable: year, 1985 to 2000
         Delta: 1 unit

.         desc

Contains data from https://github.com/scunning1975/mixtape/raw/master/texas.dta
 Observations:           816
    Variables:            24                  15 Dec 2022 13:08
------------------------------------------------------------------------------------------
> ------------------
Variable      Storage   Display    Value
    name         type    format    label      Variable label
------------------------------------------------------------------------------------------
> ------------------
statefip        float   %9.0g
year            float   %8.0g                 Year
race            float   %9.0g
bmprison        double  %10.0g                BM Prison
wmprison        double  %10.0g                WM Prison
bmpop           long    %12.0g                BM POP
wmpop           long    %12.0g                WM POP
error           float   %9.0g
crack           float   %9.0g                 Crack index
alcohol         float   %9.0g
income          long    %12.0g
ur              float   %9.0g
```

```
poverty         float   %9.0g
black           float   %9.0g
perc1519        float   %9.0g
aidscapita      float   %9.0g                 AIDS mortality per 100,000 in t
state           str20   %20s
parole          long    %10.0g                parole
probation       long    %10.0gc               probation
capacity_rated  long    %10.0g                capacity_rated
capacity_oper~l long    %10.0g                capacity_operational
capacity_design long    %10.0g                capacity_design
bmprate         float   %9.0g
wmprate         float   %9.0g
------------------------------------------------------------------------------------------
> ------------------
Sorted by: statefip  year

.
. // Attach labels to state FIPS codes. Texas is state 48.
. // Note: labmask is a user-created command (part of labutil)
.
.         // ssc install labutil
.         labmask statefip, values(state)

.         label list
statefip:
           1 Alabama
           2 Alaska
           4 Arizona
           5 Arkansas
           6 California
           8 Colorado
           9 Connecticut
          10 Delaware
          11 District of Columbia
          12 Florida
          13 Georgia
          15 Hawaii
          16 Idaho
          17 Illinois
          18 Indiana
          19 Iowa
          20 Kansas
          21 Kentucky
          22 Louisiana
          23 Maine
          24 Maryland
          25 Massachusetts
          26 Michigan
          27 Minnesota
          28 Mississippi
          29 Missouri
          30 Montana
          31 Nebraska
          32 Nevada
          33 New Hampshire
          34 New Jersey
          35 New Mexico
          36 New York
          37 North Carolina
          38 North Dakota
          39 Ohio
          40 Oklahoma
          41 Oregon
          42 Pennsylvania
          44 Rhode Island
          45 South Carolina
          46 South Dakota
          47 Tennessee
          48 Texas
          49 Utah
          50 Vermont
          51 Virginia
```

```
          53 Washington
          54 West Virginia
          55 Wisconsin
          56 Wyoming

.
. // Note: the Mixtape chapter is unclear about which outcome variable should be
. // used. bmprison is the total number of incarcerated black males. bmprate is
. // the number of incarcerated per 100,000 population (bmprison/bmpop)*100000.
. // The code in the book chapter uses the count (bmprison) but the rate makes
. // more sense to me. Cunningham recommends comparing the results when using
. // rates vs. levels. (One notable differences is in the states given weights).
.
.         list statefip state year bmprison bmprate if statefip==48, noobs

  +-------------------------------------------------+
  | statefip   state   year   bmprison    bmprate |
  |-------------------------------------------------|
  |    Texas   Texas   1985      14828   1575.474 |
  |    Texas   Texas   1986      15207   1592.324 |
  |    Texas   Texas   1987      15780   1647.653 |
  |    Texas   Texas   1988      16956   1764.544 |
  |    Texas   Texas   1989      19366   1994.531 |
  |-------------------------------------------------|
  |    Texas   Texas   1990      22634   2284.281 |
  |    Texas   Texas   1991      23249   2301.002 |
  |    Texas   Texas   1992      27568   2673.328 |
  |    Texas   Texas   1993      29260   2770.353 |
  |    Texas   Texas   1994      40451   3748.448 |
  |-------------------------------------------------|
  |    Texas   Texas   1995      55602   5009.667 |
  |    Texas   Texas   1996      55810   4920.532 |
  |    Texas   Texas   1997      58393   5049.555 |
  |    Texas   Texas   1998      59709   5068.465 |
  |    Texas   Texas   1999      60785   5083.799 |
  |-------------------------------------------------|
  |    Texas   Texas   2000      61861   5330.947 |
  +-------------------------------------------------+

.
. // synth2 command syntax:
. //   bmprate = Black male incarceration rate per 100,000 (outcome)
. //   next 13 variables = pre-treatment outcomes and covariates
. //   truint(48) = Texas (state 48) is the treated unit
. //   trperiod(1993) = 1993 is the first treatment year
. //   mspeperiod( )= the pre-treatment period used to find the synthetic control
. //          via minimizing the RMSPE. May or may not differ from preperiod.
. //          NOTE: Cunningham's code used 1985(1)1993 for the pre-period--I
. //          think it should be 1985(1)1992. This is the default entire pre-
. //              period.
. //   preperiod( )= defines the pre-treatment period
. //   postperiod( )= defines the post-treatment period (starts with first
. //          year of treatment)
. //   xperiod( )= defines the periods over which covariates are averaged,
. //      where applicable. May or may not differ from mspeperiod.
. //   "nested" = fully nested optimization procedure that searches among
. //      all (diagonal) positive semidefinite V-matrics and sets of W-
. //      weights. NOTE: better accuracy but takes much longer to run
. //   "allopt" = gaining fully robust results if nested is specified
. //      (runs nested optimization 3 times using 3 different starting
```

```
. //      points)
.
.       synth2 bmprate bmprate(1988) bmprate(1991) bmprate(1992) ///
>               alcohol(1990) aidscapita(1990) aidscapita(1991) income ur ///
>               poverty black(1990) black(1991) black(1992) perc1519(1990), ///
>               trunit(48) trperiod(1993) mspeperiod(1985(1)1992) ///
>               preperiod(1985(1)1992) postperiod(1993(1)2000) ///
>               xperiod(1985(1)1992) /*nested allopt*/ ///
>               savegraph(set1, replace)
Fitting results in the pretreatment periods:
------------------------------------------------------------------------------
 Treated Unit             :      Texas     Treatment Time           :       1993
------------------------------------------------------------------------------
 Number of Control Units  =         50     Root Mean Squared Error  =   67.42838
 Number of Covariates     =         13     R-squared                =    0.96543
------------------------------------------------------------------------------

Covariate balance in the pretreatment periods:
------------------------------------------------------------------------------------
     Covariate    |  V.weight    Treated    Synthetic Control     Average Control
                  |                          Value          Bias   Value        Bias
------------------+-----------------------------------------------------------------
    bmprate(1988) |   0.0028   1764.5443   1775.8312     0.64%  1903.8403     7.89%
    bmprate(1991) |   0.0013   2301.0017   2349.9358     2.13%  2351.1624     2.18%
    bmprate(1992) |   0.0012   2673.3281   2585.7208    -3.28%  2449.8657    -8.36%
    alcohol(1990) |   0.0000      2.4700      2.4078    -2.52%     2.5040     1.38%
 aidscapita(1990) |   0.0009     13.5899     13.5291    -0.45%     8.7631   -35.52%
 aidscapita(1991) |   0.0007     14.8350     14.7723    -0.42%    10.1259   -31.74%
           income |   0.0000  16108.6250  16204.1307     0.59% 17080.3450     6.03%
               ur |   0.0000      7.4260      7.0739    -4.74%     6.1534   -17.14%
          poverty |   0.0000     17.2000     16.2830    -5.33%    13.3922   -22.14%
      black(1990) |   0.2166     16.1546     16.1601     0.03%    11.2884   -30.12%
      black(1991) |   0.6479     16.2998     16.2984    -0.01%    11.4180   -29.95%
      black(1992) |   0.1285     16.4595     16.4159    -0.27%    11.5657   -29.73%
   perc1519(1990) |   0.0000      7.7030      7.2955    -5.29%     7.1928    -6.62%
------------------------------------------------------------------------------------
Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
      "Synthetic Control" is the weighted average of donor units with optimal weights.
      "Average Control" is the simple average of all control units with equal weights.

Optimal Unit Weights:
---------------------------------
        Unit         |    U.weight
---------------------+-----------
           Tennessee |      0.1910
            Oklahoma |      0.1390
           Wisconsin |      0.1290
             Montana |      0.1100
       WestVirginia |      0.1090
 DistrictofColumbia |      0.1020
            Arkansas |      0.1010
            Illinois |      0.0670
             NewYork |      0.0440
           Louisiana |      0.0070
---------------------------------
Note: The unit Alabama Alaska Arizona California Colorado Connecticut Delaware Florida
>  Georgia Hawaii
      Idaho Indiana Iowa Kansas Kentucky Maine Maryland Massachusetts Michigan Minneso
> ta Mississippi
      Missouri Nebraska Nevada NewHampshire NewJersey NewMexico NorthCarolina NorthDak
> ota Ohio Oregon
      Pennsylvania RhodeIsland SouthCarolina SouthDakota Utah Vermont Virginia Washing
> ton Wyoming in
      the donor pool get a weight of 0.
```

```
Prediction results in the posttreatment periods:
-----------------------------------------------------------
 Time | Actual Outcome  Synthetic Outcome  Treatment Effect
------+----------------------------------------------------
 1993 |     2770.3533          2710.5056           59.8477
 1994 |     3748.4478          2899.9797          848.4680
 1995 |     5009.6675          3043.0000         1966.6675
 1996 |     4920.5317          3234.2971         1686.2346
 1997 |     5049.5547          3337.7361         1711.8186
 1998 |     5068.4648          3605.2271         1463.2378
 1999 |     5083.7988          3752.2852         1331.5137
 2000 |     5330.9468          3735.8499         1595.0969
------+----------------------------------------------------
 Mean |     4622.7207          3289.8601         1332.8606
-----------------------------------------------------------
Note: The average treatment effect over the posttreatment period is 1332.8606.

file set1_bias.gph saved
file set1_weight_vars.gph saved
file set1_weight_unit.gph saved
file set1_pred.gph saved
file set1_eff.gph saved

Finished.

.
.
.         // Combine 5 graphs produced from the above
.         graph combine "set1_bias.gph" "set1_pred.gph" "set1_weight_vars.gph" ///
>                 "set1_eff.gph" "set1_weight_unit.gph" , cols(2) ysize(12) xsize(15)
> ///
>                 name(synth2_set1, replace) altshrink

.         graph export synth2_set1.png, as(png) replace
file synth2_set1.png saved as PNG format

.
.
. // *****
. // (2)
. // *****
. // ************************************************************************
. // Use synth2 command to obtain placebo tests for statistical inference.
. // Two types of tests: "in space" and "in time"
. // ************************************************************************
.
.         // ****************************
.         // "In-space" placebo test (unit)
.         // ****************************
.
.         synth2 bmprate bmprate(1988) bmprate(1991) bmprate(1992) ///
>                 alcohol(1990) aidscapita(1990) aidscapita(1991) income ur ///
>                 poverty black(1990) black(1991) black(1992) perc1519(1990), ///
>                 trunit(48) trperiod(1993) mspeperiod(1985(1)1992) ///
>                 preperiod(1985(1)1992) postperiod(1993(1)2000) ///
>                 xperiod(1985(1)1992) /*nested allopt*/ ///
>                 placebo(unit) savegraph(set2, replace)
Fitting results in the pretreatment periods:
-------------------------------------------------------------------------------
 Treated Unit             :      Texas     Treatment Time           :       1993
-------------------------------------------------------------------------------
 Number of Control Units  =         50     Root Mean Squared Error  =   67.42838
 Number of Covariates     =         13     R-squared                =    0.96543
-------------------------------------------------------------------------------
```

Covariate balance in the pretreatment periods:

Covariate	V.weight	Treated	Synthetic Control Value	Synthetic Control Bias	Average Control Value	Average Control Bias
bmprate(1988)	0.0028	1764.5443	1775.8312	0.64%	1903.8403	7.89%
bmprate(1991)	0.0013	2301.0017	2349.9358	2.13%	2351.1624	2.18%
bmprate(1992)	0.0012	2673.3281	2585.7208	-3.28%	2449.8657	-8.36%
alcohol(1990)	0.0000	2.4700	2.4078	-2.52%	2.5040	1.38%
aidscapita(1990)	0.0009	13.5899	13.5291	-0.45%	8.7631	-35.52%
aidscapita(1991)	0.0007	14.8350	14.7723	-0.42%	10.1259	-31.74%
income	0.0000	16108.6250	16204.1307	0.59%	17080.3450	6.03%
ur	0.0000	7.4260	7.0739	-4.74%	6.1534	-17.14%
poverty	0.0000	17.2000	16.2830	-5.33%	13.3922	-22.14%
black(1990)	0.2166	16.1546	16.1601	0.03%	11.2884	-30.12%
black(1991)	0.6479	16.2998	16.2984	-0.01%	11.4180	-29.95%
black(1992)	0.1285	16.4595	16.4159	-0.27%	11.5657	-29.73%
perc1519(1990)	0.0000	7.7030	7.2955	-5.29%	7.1928	-6.62%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
"Synthetic Control" is the weighted average of donor units with optimal weights.
"Average Control" is the simple average of all control units with equal weights.

Optimal Unit Weights:

Unit	U.weight
Tennessee	0.1910
Oklahoma	0.1390
Wisconsin	0.1290
Montana	0.1100
WestVirginia	0.1090
DistrictofColumbia	0.1020
Arkansas	0.1010
Illinois	0.0670
NewYork	0.0440
Louisiana	0.0070

Note: The unit Alabama Alaska Arizona California Colorado Connecticut Delaware Florida
> Georgia Hawaii
Idaho Indiana Iowa Kansas Kentucky Maine Maryland Massachusetts Michigan Minneso
> ta Mississippi
Missouri Nebraska Nevada NewHampshire NewJersey NewMexico NorthCarolina NorthDak
> ota Ohio Oregon
Pennsylvania RhodeIsland SouthCarolina SouthDakota Utah Vermont Virginia Washing
> ton Wyoming in
the donor pool get a weight of 0.

Prediction results in the posttreatment periods:

Time	Actual Outcome	Synthetic Outcome	Treatment Effect
1993	2770.3533	2710.5056	59.8477
1994	3748.4478	2899.9797	848.4680
1995	5009.6675	3043.0000	1966.6675
1996	4920.5317	3234.2971	1686.2346
1997	5049.5547	3337.7361	1711.8186
1998	5068.4648	3605.2271	1463.2378
1999	5083.7988	3752.2852	1331.5137
2000	5330.9468	3735.8499	1595.0969
Mean	4622.7207	3289.8601	1332.8606

Note: The average treatment effect over the posttreatment period is 1332.8606.

```
Implementing placebo test using fake treatment unit Alabama...Alaska...Arizona...Arkan
> sas...California..
> .Colorado...Connecticut...Delaware...DistrictofColumbia...Florida...Georgia...Hawaii
> ...Idaho...Illinoi
> s...Indiana...Iowa...Kansas...Kentucky...Louisiana...Maine...Maryland...Massachusett
> s...Michigan...Min
> nesota...Mississippi...Missouri...Montana...Nebraska...Nevada...NewHampshire...NewJe
> rsey...NewMexico..
> .NewYork...NorthCarolina...NorthDakota...Ohio...Oklahoma...Oregon...Pennsylvania...R
> hodeIsland...South
> Carolina...SouthDakota...Tennessee...Utah...Vermont...Virginia...Washington...WestVi
> rginia...Wisconsin
> ...Wyoming...
```

In-space placebo test results using fake treatment units:

Unit	Pre MSPE	Post MSPE	Post/Pre MSPE	Pre MSPE of Fake Unit/ Pre MSPE of Treated Unit
Texas	4546.5863	2.10e+06	462.5255	1.0000
Alabama	7145.3228	9508.9957	1.3308	1.5716
Alaska	3.22e+04	2.47e+05	7.6668	7.0818
Arizona	2.26e+05	2.08e+05	0.9166	49.8117
Arkansas	2704.1346	1.16e+05	42.8731	0.5948
California	2.44e+04	1.18e+05	4.8566	5.3630
Colorado	5.23e+04	1.65e+05	3.1663	11.4951
Connecticut	5.74e+04	1.16e+06	20.1676	12.6314
Delaware	6.34e+04	4.65e+05	7.3315	13.9528
DistrictofColumbia	1.08e+07	1.31e+07	1.2202	2370.0152
Florida	6048.6280	2.85e+04	4.7173	1.3304
Georgia	843.9226	3.70e+04	43.8205	0.1856
Hawaii	8528.3743	2.20e+06	258.2551	1.8758
Idaho	1.42e+05	9.16e+05	6.4422	31.2631
Illinois	1556.5487	1.03e+05	66.1686	0.3424
Indiana	1.30e+04	3.02e+05	23.2644	2.8538
Iowa	5.65e+04	2.80e+06	49.6587	12.4210
Kansas	6.84e+04	3.02e+04	0.4420	15.0472
Kentucky	1.39e+04	1.66e+05	11.9061	3.0639
Louisiana	3307.2636	9826.1476	2.9711	0.7274
Maine	1.13e+04	9.44e+05	83.8732	2.4753
Maryland	2.15e+04	2.60e+05	12.1083	4.7307
Massachusetts	4806.5621	9.05e+05	188.3527	1.0572
Michigan	3.74e+04	3.23e+05	8.6300	8.2335
Minnesota	1.17e+04	6.98e+04	5.9797	2.5669
Mississippi	1.04e+06	1.56e+06	1.4981	229.6734
Missouri	2.64e+04	9.14e+04	3.4688	5.7974
Montana	5.69e+04	1.33e+05	2.3288	12.5239
Nebraska	3.05e+04	5.85e+05	19.1905	6.7014
Nevada	5.59e+05	1.39e+05	0.2487	122.8975
NewHampshire	1.72e+05	2.26e+05	1.3151	37.8550
NewJersey	4851.5951	3.97e+04	8.1775	1.0671
NewMexico	2.74e+04	4.24e+04	1.5477	6.0294
NewYork	1.44e+04	8.17e+05	56.7777	3.1637
NorthCarolina	1.38e+04	5.11e+04	3.6953	3.0404
NorthDakota	9260.7205	1.78e+06	192.4486	2.0369
Ohio	2378.3438	4.18e+04	17.5612	0.5231
Oklahoma	1.97e+04	2.61e+04	1.3257	4.3270
Oregon	1.43e+05	6.62e+05	4.6436	31.3748
Pennsylvania	1.53e+04	5.95e+04	3.8949	3.3613
RhodeIsland	2.13e+05	2.58e+05	1.2128	46.8005
SouthCarolina	9117.4745	1.08e+05	11.8945	2.0053
SouthDakota	4.71e+04	1.81e+05	3.8435	10.3663
Tennessee	1.91e+04	7.27e+04	3.8035	4.2028
Utah	2.57e+05	6.96e+04	0.2711	56.4467
Vermont	6.50e+04	1.90e+06	29.3217	14.2888
Virginia	458.1601	5.17e+04	112.8315	0.1008
Washington	5.58e+04	1.16e+04	0.2078	12.2806
WestVirginia	1.04e+04	2.50e+04	2.4048	2.2875
Wisconsin	2.22e+04	1.74e+06	78.5288	4.8774
Wyoming	1.51e+05	6.39e+04	0.4234	33.1992

Note: The probability of obtaining a post/pretreatment MSPE ratio as large as Texas's

```
> is 0.0196.

In-space placebo test results using fake treatment units (continued):
------------------------------------------------------------
 Time |  Treatment Effect      p-value of Treatment Effect
      |                     Two-sided   Right-sided   Left-sided
------+-----------------------------------------------------
 1993 |          59.8477       0.7255       0.4118       0.6078
 1994 |         848.4680       0.1765       0.0784       0.9412
 1995 |        1966.6675       0.0392       0.0392       0.9804
 1996 |        1686.2346       0.0392       0.0392       0.9804
 1997 |        1711.8186       0.0588       0.0588       0.9608
 1998 |        1463.2378       0.1373       0.0980       0.9216
 1999 |        1331.5137       0.1961       0.1176       0.9020
 2000 |        1595.0969       0.1373       0.0784       0.9412
------------------------------------------------------------
Note: (1) The two-sided p-value of the treatment effect for a particular period is def
> ined as the
      frequency that the absolute values of the placebo effects are greater than or eq
> ual to the
      absolute value of treatment effect.
      (2) The right-sided (left-sided) p-value of the treatment effect for a particula
> r period is
      defined as the frequency that the placebo effects are greater (smaller) than or
> equal to the
      treatment effect.
      (3) If the estimated treatment effect is positive, then the right-sided p-value
> is recommended;
      whereas the left-sided p-value is recommended if the estimated treatment effect
> is negative.

file set2_bias.gph saved
file set2_weight_vars.gph saved
file set2_weight_unit.gph saved
file set2_pred.gph saved
file set2_eff.gph saved
file set2_eff_pboUnit.gph saved
file set2_ratio_pboUnit.gph saved
file set2_pvalTwo_pboUnit.gph saved
file set2_pvalRight_pboUnit.gph saved
file set2_pvalLeft_pboUnit.gph saved

Finished.

.
.         // combine 5 added graphs related to the placebo test
.
.         graph combine "set2_eff_pboUnit.gph" "set2_ratio_pboUnit.gph" ///
>                 , rows(1) ysize(4) xsize(8) ///
>                 name(synth2_set2a, replace) altshrink

.         graph export synth2_set2a.png, as(png) replace
file synth2_set2a.png saved as PNG format

.
.         graph combine "set2_pvalTwo_pboUnit.gph" "set2_pvalRight_pboUnit.gph" ///
>                 "set2_pvalLeft_pboUnit", cols(2) ysize(6) xsize(5) ///
>                 name(synth2_set2b, replace) altshrink

.         graph export synth2_set2b.png, as(png) replace
file synth2_set2b.png saved as PNG format
```

```
.
.
.         // ***********************************************
.         // "In-space" placebo test (unit)--excluding bad fits
.         // ***********************************************
.         // NOTE: can include cutoff(#c) in the placebo(unit) option to toss
.         // out fake treatment units with pre-treatment MSPE #c times larger
.         // than that of the treated unit
.
.         synth2 bmprate bmprate(1988) bmprate(1991) bmprate(1992) ///
>                 alcohol(1990) aidscapita(1990) aidscapita(1991) income ur ///
>                 poverty black(1990) black(1991) black(1992) perc1519(1990), ///
>                 trunit(48) trperiod(1993) mspeperiod(1985(1)1992) ///
>                 preperiod(1985(1)1992) postperiod(1993(1)2000) ///
>                 xperiod(1985(1)1992) /*nested allopt*/ ///
>                 placebo(unit cutoff(3)) savegraph(set2alt, replace)
Fitting results in the pretreatment periods:
------------------------------------------------------------------------------
 Treated Unit             :      Texas     Treatment Time           :       1993
------------------------------------------------------------------------------
 Number of Control Units  =         50     Root Mean Squared Error  =   67.42838
 Number of Covariates     =         13     R-squared                =    0.96543
------------------------------------------------------------------------------

Covariate balance in the pretreatment periods:
------------------------------------------------------------------------------
     Covariate    |  V.weight    Treated    Synthetic Control     Average Control
                  |                           Value          Bias   Value        Bias
------------------+-----------------------------------------------------------------
    bmprate(1988) |   0.0028   1764.5443   1775.8312     0.64%  1903.8403     7.89%
    bmprate(1991) |   0.0013   2301.0017   2349.9358     2.13%  2351.1624     2.18%
    bmprate(1992) |   0.0012   2673.3281   2585.7208    -3.28%  2449.8657    -8.36%
    alcohol(1990) |   0.0000      2.4700      2.4078    -2.52%     2.5040     1.38%
 aidscapita(1990) |   0.0009     13.5899     13.5291    -0.45%     8.7631   -35.52%
 aidscapita(1991) |   0.0007     14.8350     14.7723    -0.42%    10.1259   -31.74%
           income |   0.0000  16108.6250  16204.1307     0.59% 17080.3450     6.03%
               ur |   0.0000      7.4260      7.0739    -4.74%     6.1534   -17.14%
          poverty |   0.0000     17.2000     16.2830    -5.33%    13.3922   -22.14%
      black(1990) |   0.2166     16.1546     16.1601     0.03%    11.2884   -30.12%
      black(1991) |   0.6479     16.2998     16.2984    -0.01%    11.4180   -29.95%
      black(1992) |   0.1285     16.4595     16.4159    -0.27%    11.5657   -29.73%
   perc1519(1990) |   0.0000      7.7030      7.2955    -5.29%     7.1928    -6.62%
------------------------------------------------------------------------------
Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
      "Synthetic Control" is the weighted average of donor units with optimal weights.
      "Average Control" is the simple average of all control units with equal weights.

Optimal Unit Weights:
---------------------------------
        Unit        |    U.weight
--------------------+------------
          Tennessee |     0.1910
           Oklahoma |     0.1390
          Wisconsin |     0.1290
            Montana |     0.1100
       WestVirginia |     0.1090
 DistrictofColumbia |     0.1020
           Arkansas |     0.1010
           Illinois |     0.0670
            NewYork |     0.0440
          Louisiana |     0.0070
---------------------------------
Note: The unit Alabama Alaska Arizona California Colorado Connecticut Delaware Florida
>  Georgia Hawaii
      Idaho Indiana Iowa Kansas Kentucky Maine Maryland Massachusetts Michigan Minneso
> ta Mississippi
      Missouri Nebraska Nevada NewHampshire NewJersey NewMexico NorthCarolina NorthDak
> ota Ohio Oregon
      Pennsylvania RhodeIsland SouthCarolina SouthDakota Utah Vermont Virginia Washing
> ton Wyoming in
      the donor pool get a weight of 0.
```

Prediction results in the posttreatment periods:

Time	Actual Outcome	Synthetic Outcome	Treatment Effect
1993	2770.3533	2710.5056	59.8477
1994	3748.4478	2899.9797	848.4680
1995	5009.6675	3043.0000	1966.6675
1996	4920.5317	3234.2971	1686.2346
1997	5049.5547	3337.7361	1711.8186
1998	5068.4648	3605.2271	1463.2378
1999	5083.7988	3752.2852	1331.5137
2000	5330.9468	3735.8499	1595.0969
Mean	4622.7207	3289.8601	1332.8606

Note: The average treatment effect over the posttreatment period is 1332.8606.

Implementing placebo test using fake treatment unit Alabama...Alaska...Arizona...Arkan
> sas...California..
> .Colorado...Connecticut...Delaware...DistrictofColumbia...Florida...Georgia...Hawaii
> ...Idaho...Illinoi
> s...Indiana...Iowa...Kansas...Kentucky...Louisiana...Maine...Maryland...Massachusett
> s...Michigan...Min
> nesota...Mississippi...Missouri...Montana...Nebraska...Nevada...NewHampshire...NewJe
> rsey...NewMexico..
> .NewYork...NorthCarolina...NorthDakota...Ohio...Oklahoma...Oregon...Pennsylvania...R
> hodeIsland...South
> Carolina...SouthDakota...Tennessee...Utah...Vermont...Virginia...Washington...WestVi
> rginia...Wisconsin
> ...Wyoming...

In-space placebo test results using fake treatment units:

Unit	Pre MSPE	Post MSPE	Post/Pre MSPE	Pre MSPE of Fake Unit/ Pre MSPE of Treated Unit
Texas	4546.5863	2.10e+06	462.5255	1.0000
Alabama	7145.3228	9508.9957	1.3308	1.5716
Alaska	3.22e+04	2.47e+05	7.6668	7.0818
Arizona	2.26e+05	2.08e+05	0.9166	49.8117
Arkansas	2704.1346	1.16e+05	42.8731	0.5948
California	2.44e+04	1.18e+05	4.8566	5.3630
Colorado	5.23e+04	1.65e+05	3.1663	11.4951
Connecticut	5.74e+04	1.16e+06	20.1676	12.6314
Delaware	6.34e+04	4.65e+05	7.3315	13.9528
DistrictofColumbia	1.08e+07	1.31e+07	1.2202	2370.0152
Florida	6048.6280	2.85e+04	4.7173	1.3304
Georgia	843.9226	3.70e+04	43.8205	0.1856
Hawaii	8528.3743	2.20e+06	258.2551	1.8758
Idaho	1.42e+05	9.16e+05	6.4422	31.2631
Illinois	1556.5487	1.03e+05	66.1686	0.3424
Indiana	1.30e+04	3.02e+05	23.2644	2.8538
Iowa	5.65e+04	2.80e+06	49.6587	12.4210
Kansas	6.84e+04	3.02e+04	0.4420	15.0472
Kentucky	1.39e+04	1.66e+05	11.9061	3.0639
Louisiana	3307.2636	9826.1476	2.9711	0.7274
Maine	1.13e+04	9.44e+05	83.8732	2.4753
Maryland	2.15e+04	2.60e+05	12.1083	4.7307
Massachusetts	4806.5621	9.05e+05	188.3527	1.0572
Michigan	3.74e+04	3.23e+05	8.6300	8.2335
Minnesota	1.17e+04	6.98e+04	5.9797	2.5669
Mississippi	1.04e+06	1.56e+06	1.4981	229.6734
Missouri	2.64e+04	9.14e+04	3.4688	5.7974
Montana	5.69e+04	1.33e+05	2.3288	12.5239
Nebraska	3.05e+04	5.85e+05	19.1905	6.7014
Nevada	5.59e+05	1.39e+05	0.2487	122.8975
NewHampshire	1.72e+05	2.26e+05	1.3151	37.8550
NewJersey	4851.5951	3.97e+04	8.1775	1.0671
NewMexico	2.74e+04	4.24e+04	1.5477	6.0294
NewYork	1.44e+04	8.17e+05	56.7777	3.1637
NorthCarolina	1.38e+04	5.11e+04	3.6953	3.0404
NorthDakota	9260.7205	1.78e+06	192.4486	2.0369

```
              Ohio | 2378.3438   4.18e+04        17.5612                    0.5231
          Oklahoma |  1.97e+04   2.61e+04         1.3257                    4.3270
            Oregon |  1.43e+05   6.62e+05         4.6436                   31.3748
      Pennsylvania |  1.53e+04   5.95e+04         3.8949                    3.3613
       RhodeIsland |  2.13e+05   2.58e+05         1.2128                   46.8005
     SouthCarolina | 9117.4745   1.08e+05        11.8945                    2.0053
       SouthDakota |  4.71e+04   1.81e+05         3.8435                   10.3663
         Tennessee |  1.91e+04   7.27e+04         3.8035                    4.2028
              Utah |  2.57e+05   6.96e+04         0.2711                   56.4467
           Vermont |  6.50e+04   1.90e+06        29.3217                   14.2888
          Virginia |  458.1601   5.17e+04       112.8315                    0.1008
        Washington |  5.58e+04   1.16e+04         0.2078                   12.2806
     WestVirginia |  1.04e+04   2.50e+04         2.4048                    2.2875
         Wisconsin |  2.22e+04   1.74e+06        78.5288                    4.8774
           Wyoming |  1.51e+05   6.39e+04         0.4234                   33.1992
-------------------------------------------------------------------------------
Note: (1) Using all control units, the probability of obtaining a post/pretreatment MS
> PE ratio as
      large as Texas's is 0.0196.
      (2) Excluding control units with pretreatment MSPE 3 times larger than the treat
> ed unit, the
      probability of obtaining a post/pretreatment MSPE ratio as large as Texas's is 0
> .0556.
      (3) The pointwise p-values below are computed by excluding control units with pr
> etreatment MSPE
      3 times larger than the treated unit.
      (4) There are total 33 units with pretreatment MSPE 3 times larger than the trea
> ted unit,
      including Alaska Arizona California Colorado Connecticut Delaware DistrictofColu
> mbia Idaho Iowa
      Kansas Kentucky Maryland Michigan Mississippi Missouri Montana Nebraska Nevada N
> ewHampshire
      NewMexico NewYork NorthCarolina Oklahoma Oregon Pennsylvania RhodeIsland SouthDa
> kota Tennessee
      Utah Vermont Washington Wisconsin Wyoming.

In-space placebo test results using fake treatment units (continued, cutoff = 3):
-------------------------------------------------------------
 Time |  Treatment Effect      p-value of Treatment Effect
      |                     Two-sided   Right-sided   Left-sided
------+------------------------------------------------------
 1993 |          59.8477       0.6667       0.4444       0.6111
 1994 |         848.4680       0.2222       0.0556       1.0000
 1995 |        1966.6675       0.0556       0.0556       1.0000
 1996 |        1686.2346       0.0556       0.0556       1.0000
 1997 |        1711.8186       0.0556       0.0556       1.0000
 1998 |        1463.2378       0.1667       0.0556       1.0000
 1999 |        1331.5137       0.2222       0.0556       1.0000
 2000 |        1595.0969       0.2222       0.0556       1.0000
-------------------------------------------------------------
Note: (1) The two-sided p-value of the treatment effect for a particular period is def
> ined as the
      frequency that the absolute values of the placebo effects are greater than or eq
> ual to the
      absolute value of treatment effect.
      (2) The right-sided (left-sided) p-value of the treatment effect for a particula
> r period is
      defined as the frequency that the placebo effects are greater (smaller) than or
> equal to the
      treatment effect.
      (3) If the estimated treatment effect is positive, then the right-sided p-value
> is recommended;
      whereas the left-sided p-value is recommended if the estimated treatment effect
> is negative.
```

```
file set2alt_bias.gph saved
file set2alt_weight_vars.gph saved
file set2alt_weight_unit.gph saved
file set2alt_pred.gph saved
file set2alt_eff.gph saved
file set2alt_eff_pboUnit.gph saved
file set2alt_ratio_pboUnit.gph saved
file set2alt_pvalTwo_pboUnit.gph saved
file set2alt_pvalRight_pboUnit.gph saved
file set2alt_pvalLeft_pboUnit.gph saved

Finished.

.
.         // see relevant graphs (imposes cutoff(3))
.
.         graph combine "set2alt_eff_pboUnit.gph" "set2alt_ratio_pboUnit.gph" ///
>                 , rows(1) ysize(4) xsize(8) ///
>                 name(synth2_set2alt, replace) altshrink

.         graph export synth2_set2alt.png, as(png) replace
file synth2_set2alt.png saved as PNG format

.
.
.         // ********************************************************************
.         // "In-time" placebo test (setting the treatment year to a previous
.         // "fake" treatment year = 1989). Note had to remove predictors that
.         // were 1989 or later. Replaced some of these with earlier years.
.         // Keep trperiod() the same but put placebo year in placebo() option.
.         // ********************************************************************
.
.         synth2 bmprate bmprate(1985) bmprate(1987) bmprate(1988) ///
>                 alcohol(1986) aidscapita(1986) aidscapita(1987) income ur ///
>                 poverty black(1986) black(1987) black(1988) perc1519(1986), ///
>                 trunit(48) trperiod(1993) ///
>                 xperiod(1985(1)1988) /*nested allopt*/ ///
>                 placebo(period(1989)) savegraph(set3, replace)
Fitting results in the pretreatment periods:
------------------------------------------------------------------------------
 Treated Unit             :      Texas     Treatment Time           :       1993
------------------------------------------------------------------------------
 Number of Control Units  =         50     Root Mean Squared Error  =  258.07433
 Number of Covariates     =         13     R-squared                =   -0.92921
------------------------------------------------------------------------------

Covariate balance in the pretreatment periods:
------------------------------------------------------------------------------------
     Covariate    |  V.weight    Treated    Synthetic Control     Average Control
                  |                          Value          Bias   Value        Bias
------------------+-----------------------------------------------------------------
    bmprate(1985) |   0.0000   1575.4741   1572.4819    -0.19%  1563.3614    -0.77%
    bmprate(1987) |   0.0000   1647.6528   1644.6007    -0.19%  1724.5808     4.67%
    bmprate(1988) |   0.0000   1764.5443   1761.1749    -0.19%  1903.8403     7.89%
    alcohol(1986) |   0.0000      2.6300      2.6268    -0.12%     2.6204    -0.37%
 aidscapita(1986) |   0.0000      5.0352      5.1765     2.81%     3.2096   -36.26%
 aidscapita(1987) |   0.0000      7.4590      7.0939    -4.90%     4.3598   -41.55%
           income |   0.0000  14572.7500  14500.5255    -0.50% 15242.8200     4.60%
               ur |   0.0000      7.9125      7.8816    -0.39%     6.3752   -19.43%
          poverty |   0.0000     17.2000     17.0687    -0.76%    13.3960   -22.12%
      black(1986) |   0.1308     15.8747     15.8501    -0.15%    11.4270   -28.02%
      black(1987) |   0.6636     15.8473     15.8227    -0.15%    11.4034   -28.04%
      black(1988) |   0.2056     15.8262     15.8017    -0.15%    11.3842   -28.07%
   perc1519(1986) |   0.0000      8.2175      8.1799    -0.46%     7.9243    -3.57%
------------------------------------------------------------------------------------
Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
      "Synthetic Control" is the weighted average of donor units with optimal weights.
      "Average Control" is the simple average of all control units with equal weights.
```

Optimal Unit Weights:

Unit	U.weight
Louisiana	0.2530
NewYork	0.1770
NewMexico	0.1500
Idaho	0.1330
Massachusetts	0.1130
Mississippi	0.0650
Nevada	0.0420
RhodeIsland	0.0260
Utah	0.0200
Iowa	0.0100
DistrictofColumbia	0.0090

Note: The unit Alabama Alaska Arizona Arkansas California Colorado Connecticut Delawar
> e Florida
Georgia Hawaii Illinois Indiana Kansas Kentucky Maine Maryland Michigan Minnesot
> a Missouri
Montana Nebraska NewHampshire NewJersey NorthCarolina NorthDakota Ohio Oklahoma
> Oregon
Pennsylvania SouthCarolina SouthDakota Tennessee Vermont Virginia Washington Wes
> tVirginia
Wisconsin Wyoming in the donor pool get a weight of 0.

Prediction results in the posttreatment periods:

Time	Actual Outcome	Synthetic Outcome	Treatment Effect
1993	2770.3533	2240.5728	529.7805
1994	3748.4478	2269.4971	1478.9507
1995	5009.6675	2369.8767	2639.7908
1996	4920.5317	2529.5552	2390.9766
1997	5049.5547	2557.2539	2492.3008
1998	5068.4648	2609.4714	2458.9934
1999	5083.7988	2669.9778	2413.8210
2000	5330.9468	2890.2456	2440.7012
Mean	4622.7207	2517.0563	2105.6644

Note: The average treatment effect over the posttreatment period is 2105.6644.

Implementing placebo test using fake treatment time 1989...

In-time placebo test results using fake treatment time 1989:

Time	Actual Outcome	Synthetic Outcome	Treatment Effect
1989	1994.5311	1932.4376	62.0935
1990	2284.2805	1989.3435	294.9370
1991	2301.0017	2102.7502	198.2515
1992	2673.3281	2145.8306	527.4976
1993	2770.3533	2360.8313	409.5220
1994	3748.4478	2408.3486	1340.0991
1995	5009.6675	2546.1914	2463.4761
1996	4920.5317	2759.9353	2160.5964
1997	5049.5547	2737.8032	2311.7515
1998	5068.4648	2789.6602	2278.8047
1999	5083.7988	2845.7522	2238.0466
2000	5330.9468	3025.8926	2305.0542
Mean	3852.9089	2470.3981	1382.5108

Note: The average treatment effect over the posttreatment period is 1382.5108.

```
file set3_bias.gph saved
file set3_weight_vars.gph saved
file set3_weight_unit.gph saved
file set3_pred.gph saved
file set3_eff.gph saved
file set3_pred_pboTime1989.gph saved
file set3_eff_pboTime1989.gph saved

Finished.

.
.         // see relevant graphs
.
.         graph combine "set3_pred_pboTime1989.gph" "set3_eff_pboTime1989.gph" ///
>                 , rows(1) ysize(4) xsize(8) ///
>                 name(synth2_set3, replace) altshrink

.         graph export synth2_set3.png, as(png) replace
file synth2_set3.png saved as PNG format

.
.
.         // ************************************************
.         // "Leave one out" (LOO) robustness test.
.         // ************************************************
.
.         label define statefip 11 "DC", modify

.
.         synth2 bmprate bmprate(1988) bmprate(1991) bmprate(1992) ///
>                 alcohol(1990) aidscapita(1990) aidscapita(1991) income ur ///
>                 poverty black(1990) black(1991) black(1992) perc1519(1990), ///
>                 trunit(48) trperiod(1993) mspeperiod(1985(1)1992) ///
>                 preperiod(1985(1)1992) postperiod(1993(1)2000) ///
>                 xperiod(1985(1)1992) /* nested allopt*/ ///
>                 loo savegraph(set4, replace)
Fitting results in the pretreatment periods:
------------------------------------------------------------------------------
 Treated Unit             :      Texas     Treatment Time           :       1993
------------------------------------------------------------------------------
 Number of Control Units  =         50     Root Mean Squared Error  =   67.42838
 Number of Covariates     =         13     R-squared                =    0.96543
------------------------------------------------------------------------------

Covariate balance in the pretreatment periods:
------------------------------------------------------------------------------
     Covariate    |  V.weight    Treated    Synthetic Control     Average Control
                  |                          Value          Bias   Value        Bias
------------------+-----------------------------------------------------------
    bmprate(1988) |   0.0028   1764.5443   1775.8312     0.64%  1903.8403     7.89%
    bmprate(1991) |   0.0013   2301.0017   2349.9358     2.13%  2351.1624     2.18%
    bmprate(1992) |   0.0012   2673.3281   2585.7208    -3.28%  2449.8657    -8.36%
    alcohol(1990) |   0.0000      2.4700      2.4078    -2.52%     2.5040     1.38%
 aidscapita(1990) |   0.0009     13.5899     13.5291    -0.45%     8.7631   -35.52%
 aidscapita(1991) |   0.0007     14.8350     14.7723    -0.42%    10.1259   -31.74%
           income |   0.0000  16108.6250  16204.1307     0.59% 17080.3450     6.03%
               ur |   0.0000      7.4260      7.0739    -4.74%     6.1534   -17.14%
          poverty |   0.0000     17.2000     16.2830    -5.33%    13.3922   -22.14%
      black(1990) |   0.2166     16.1546     16.1601     0.03%    11.2884   -30.12%
      black(1991) |   0.6479     16.2998     16.2984    -0.01%    11.4180   -29.95%
      black(1992) |   0.1285     16.4595     16.4159    -0.27%    11.5657   -29.73%
   perc1519(1990) |   0.0000      7.7030      7.2955    -5.29%     7.1928    -6.62%
------------------------------------------------------------------------------
Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
      "Synthetic Control" is the weighted average of donor units with optimal weights.
      "Average Control" is the simple average of all control units with equal weights.
```

Optimal Unit Weights:

Unit	U.weight
Tennessee	0.1910
Oklahoma	0.1390
Wisconsin	0.1290
Montana	0.1100
WestVirginia	0.1090
DC	0.1020
Arkansas	0.1010
Illinois	0.0670
NewYork	0.0440
Louisiana	0.0070

Note: The unit Alabama Alaska Arizona California Colorado Connecticut Delaware Florida
> Georgia Hawaii
Idaho Indiana Iowa Kansas Kentucky Maine Maryland Massachusetts Michigan Minneso
> ta Mississippi
Missouri Nebraska Nevada NewHampshire NewJersey NewMexico NorthCarolina NorthDak
> ota Ohio Oregon
Pennsylvania RhodeIsland SouthCarolina SouthDakota Utah Vermont Virginia Washing
> ton Wyoming in
the donor pool get a weight of 0.

Prediction results in the posttreatment periods:

Time	Actual Outcome	Synthetic Outcome	Treatment Effect
1993	2770.3533	2710.5056	59.8477
1994	3748.4478	2899.9797	848.4680
1995	5009.6675	3043.0000	1966.6675
1996	4920.5317	3234.2971	1686.2346
1997	5049.5547	3337.7361	1711.8186
1998	5068.4648	3605.2271	1463.2378
1999	5083.7988	3752.2852	1331.5137
2000	5330.9468	3735.8499	1595.0969
Mean	4622.7207	3289.8601	1332.8606

Note: The average treatment effect over the posttreatment period is 1332.8606.

Implementing leave-one-out robustness test that excludes one control unit with a nonze
> ro weight Tennesse
> e...Oklahoma...Wisconsin...Montana...WestVirginia...DC...Arkansas...Illinois...NewYo
> rk...Louisiana...

Leave-one-out robustness test results in the posttreatment period:

Time	Outcome		Synthetic Outcome (LOO)	
	Actual	Synthetic	Min	Max
1993	2770.3533	2710.5056	2676.3572	2750.7424
1994	3748.4478	2899.9797	2838.8118	2942.6436
1995	5009.6675	3043.0000	2970.3525	3083.1494
1996	4920.5317	3234.2971	3155.6206	3287.3594
1997	5049.5547	3337.7361	3174.4460	3521.4102
1998	5068.4648	3605.2271	3398.6040	3830.2195
1999	5083.7988	3752.2852	3573.4690	3902.6680
2000	5330.9468	3735.8499	3558.1514	3908.9856

Note: The last two columns report the minimum and maximum synthetic outcomes when one
> control unit
with a nonzero weight is excluded at a time.

```
-----------------------------------------------------
 Time |    Treatment Effect   Treatment Effect (LOO)
      |                              Min          Max
------+----------------------------------------------
 1993 |            59.8477       19.6108       93.9961
 1994 |           848.4680      805.8042      909.6360
 1995 |          1966.6675     1926.5181     2039.3149
 1996 |          1686.2346     1633.1724     1764.9111
 1997 |          1711.8186     1528.1445     1875.1086
 1998 |          1463.2378     1238.2454     1669.8608
 1999 |          1331.5137     1181.1309     1510.3298
 2000 |          1595.0969     1421.9612     1772.7954
-----------------------------------------------------
Note: The last two columns report the minimum and maximum treatment effects when one c
> ontrol unit with
      a nonzero weight is excluded at a time.

file set4_bias.gph saved
file set4_weight_vars.gph saved
file set4_weight_unit.gph saved
file set4_pred.gph saved
file set4_eff.gph saved
file set4_pred_loo.gph saved
file set4_eff_loo.gph saved

Finished.

.
.         // see relevant graphs (LOO)
.
.         graph combine "set4_pred_loo.gph" "set4_eff_loo.gph" ///
>                 , rows(1) ysize(4) xsize(8) ///
>                 name(synth2_set4, replace) altshrink

.         graph export synth2_set4.png, as(png) replace
file synth2_set4.png saved as PNG format

.
.
. // Close log and convert to PDF
.         capture log close
```