PCW Session 21

2023-11-15

Contents

```
library(Synth)
library(lattice)
lattice.options(default.theme =
                    modifyList(standard.theme(color = FALSE),
                               list(strip.background = list(col = "transparent"))))
#### load dataset (adjust the path to the files on your computer)
scdata <- read.csv("https://tinyurl.com/y59uro4l")
scdata$country <- as.character(scdata$country)
head(scdata)
```

```
Euro12 <- c('Germany','Netherlands','Greece','Spain','Portugal','Italy',
            'Finland','France','Luxembourg','Belgium','Austria','Ireland')
Euro17 <- c('Germany','Netherlands','Greece','Spain','Portugal','Italy','
            Finland','France','Luxembourg','Belgium','Austria','Ireland',
            'Slovakia','Cyprus','Malta','Slovenia','Estonia')
donor <- c("Germany","Netherlands","Belgium","Austria","Finland","France")
recipient <- c("Portugal","Spain","Greece","Italy","Ireland")
```

```
pred <- names(scdata)[c(#
  7, # pop65+
  8, # pop15-
  #9,# unemployment (1)
  #10,# system
  11,# yrcurnt
  12,# allhouse
  13,# legelec
  14, # pluralty
  15, # pr
  #16, # checks
  #17, # fri
  #18,# GDP growth
  #19,# growth in multi factor productivity
  20,# labor productivity annual growth
  21, # health expenditure/GDP
  22,# GDP expenditure approach
  #23,# tax revenue %GDP (general)
  24,# taxrev %GDP, no Social Security
  25, # CO2 emissions
  #26, # FDI
  #27, # GDP growth
  #28,# Gini index
  #29,#,# Inflation (Consumer Prices)
  #30, # Poverty
```

```
  31,#, # unemployment (World Bank)
  ##32, #Population
  #33,#, #openness (PWT)
  34,#,# openness (expenditure)
  #35, # Expenditure on Families %GDP
  36, # PolconIII
  #37, # PolconV
  38,  # Potrafke ideology
  39, # Majority margin
  #40, # Herfindahl Index Government
  41, #lag debt/gdp (RR)
  42#,# Rae Fractionalisation index (government)
  #43 # Rae Fractionalisation Index (total)
)]

# We then define countries used for synthetic control group
contr <- sort(unique(scdata$ccode[is.element(scdata$country,setdiff(scdata$country,c(Euro12,"Euro 11","S

# The following countries have to be excluded due to data constraints (missing values)
contr <- setdiff(contr, c(1111,2222,70,155,225,269,290,310,316,317,349,355,360,366,666,732,sort(unique(s

# Show countries that are available for Synthetic Greece
country <- sort(unique(scdata$country[scdata$ccode %in% contr]))
country
```

```
##  [1] "Australia"      "Canada"         "Denmark"        "Iceland"
##  [5] "Japan"          "New Zealand"    "Norway"         "Sweden"
##  [9] "United Kingdom" "United States"
```

Fill in `unit.variable` as `ccode` (country code) and `time.variable` as `Year` to start the analysis.

```
sdata <- dataprep(foo = scdata[scdata$ccode %in% contr | scdata$country == "Euro 11",],
                  predictors = pred,
                  dependent = names(scdata[6]),
                  unit.variable = "ccode",
#A scalar identifying the column number or column-name character string associated unit numbers. The un
                  time.variable = "Year",
#A scalar identifying column number or column-name character string associated with period (time) data.
                  treatment.identifier = 0,
                  controls.identifier = contr,
                  time.predictors.prior = c(1983:1998),
                  time.optimize.ssr = c(1983:1999),
                  unit.names.variable = "country",
# A scalar or column-name character string identifying the column with the names of the units. This var
                  time.plot = 1983:2010)
```

```
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
```

```
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1990
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1991
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1992
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1993
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1994
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: deltaLP ; for period: 1995
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: healthexp ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
```

```
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: CO2em ; for period: 1990
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: unemployment ; for period: 1990
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
```

```
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data- treated unit; predictor: polconiii ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1986
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1987
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1988
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 2 ; predictor: deltaLP ; for period: 1989
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 20 ; predictor: deltaLP ; for period: 1983
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 20 ; predictor: deltaLP ; for period: 1984
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
##
##  Missing data - control unit: 20 ; predictor: deltaLP ; for period: 1985
##  We ignore (na.rm = TRUE) all missing values for predictors.op.
```

Run the synthetic control analysis

```
synth.out <- synth(data.prep.obj = sdata, method = "BFGS")
```

```
##
## X1, X0, Z1, Z0 all come directly from dataprep object.
##
##
## ****************
##  searching for synthetic control unit
##
##
## ****************
## ****************
## ****************
```

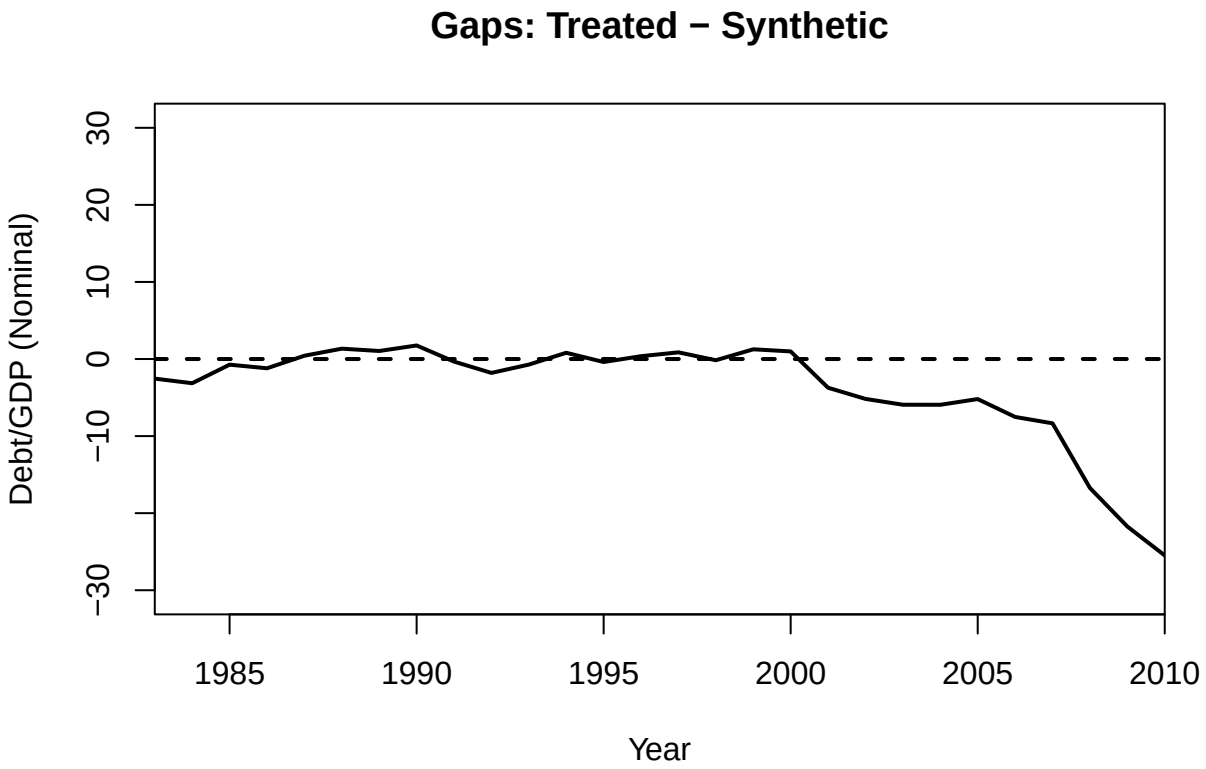
```
##
## MSPE (LOSS V): 1.862064
##
## solution.v:
##  0.0006207751 0.008142894 0.0122538 0.007831886 0.0004420972 0.0004248656 0.02915853 0.068096 0.0001
##
## solution.w:
##  0.3446195 0.1701341 1.3918e-06 0.0001645637 2.2388e-06 3.06215e-05 0.1727985 0.2015009 0.1105471 0.0
```

```
gaps <- sdata$Y1plot - (sdata$Y0plot %*% synth.out$solution.w)
synth.tables <- synth.tab(dataprep.res = sdata, synth.res=synth.out)
```

Plot the gap

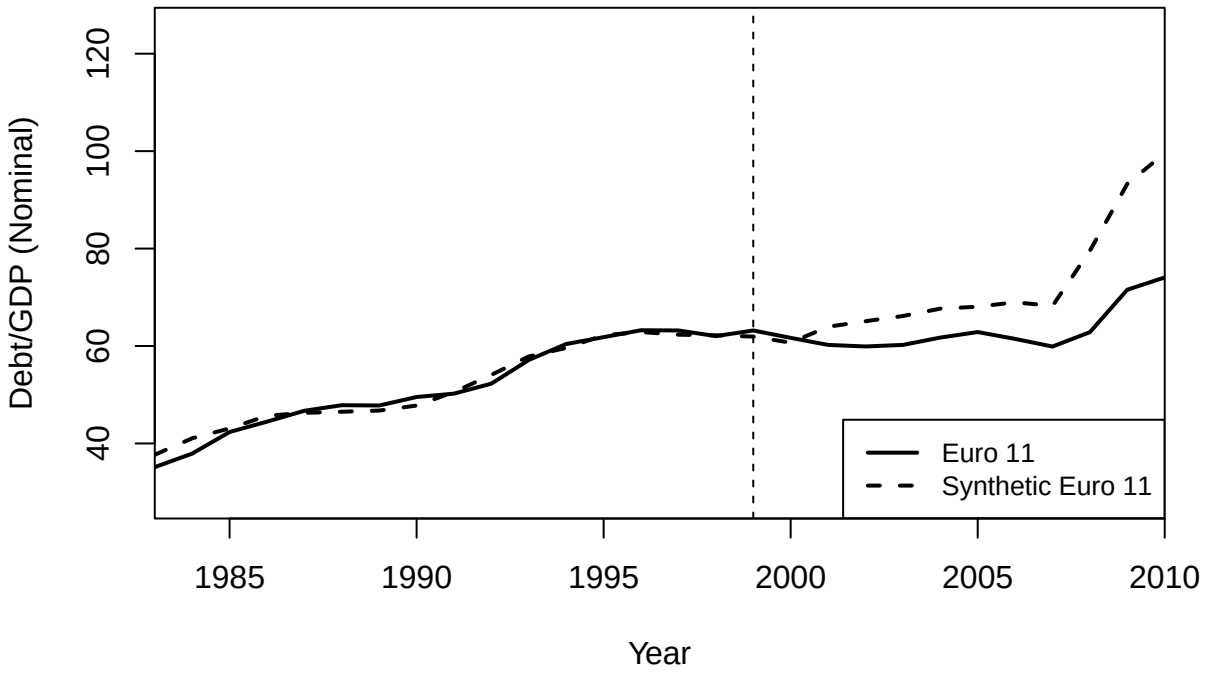
```
gaps.plot(synth.res = synth.out,
          dataprep.res = sdata,
          Ylab="Debt/GDP (Nominal)",
          Xlab="Year",

)
```



Plot the Path of the Debt to GDP ratio for the Euro 11 and the Synthetic control

```
path.plot(synth.res = synth.out,
          dataprep.res = sdata,
          Ylab="Debt/GDP (Nominal)",
          Xlab="Year",
          Legend=c("Euro 11","Synthetic Euro 11"),
          Legend.position="bottomright", abline(v=1999,lty="dashed")
)
```



Extract country weights from synthetic control

```
synth.out$solution.w
```

```
##         w.weight
## 2   3.446195e-01
## 20  1.701341e-01
## 200 1.391830e-06
## 380 1.645637e-04
## 385 2.238844e-06
## 390 3.062150e-05
## 395 1.727985e-01
## 740 2.015009e-01
## 900 1.105471e-01
## 920 2.010289e-04
```

```
unique(scdata[, c("ccode", "country")])
```