Macroeconometrics - Homework 4

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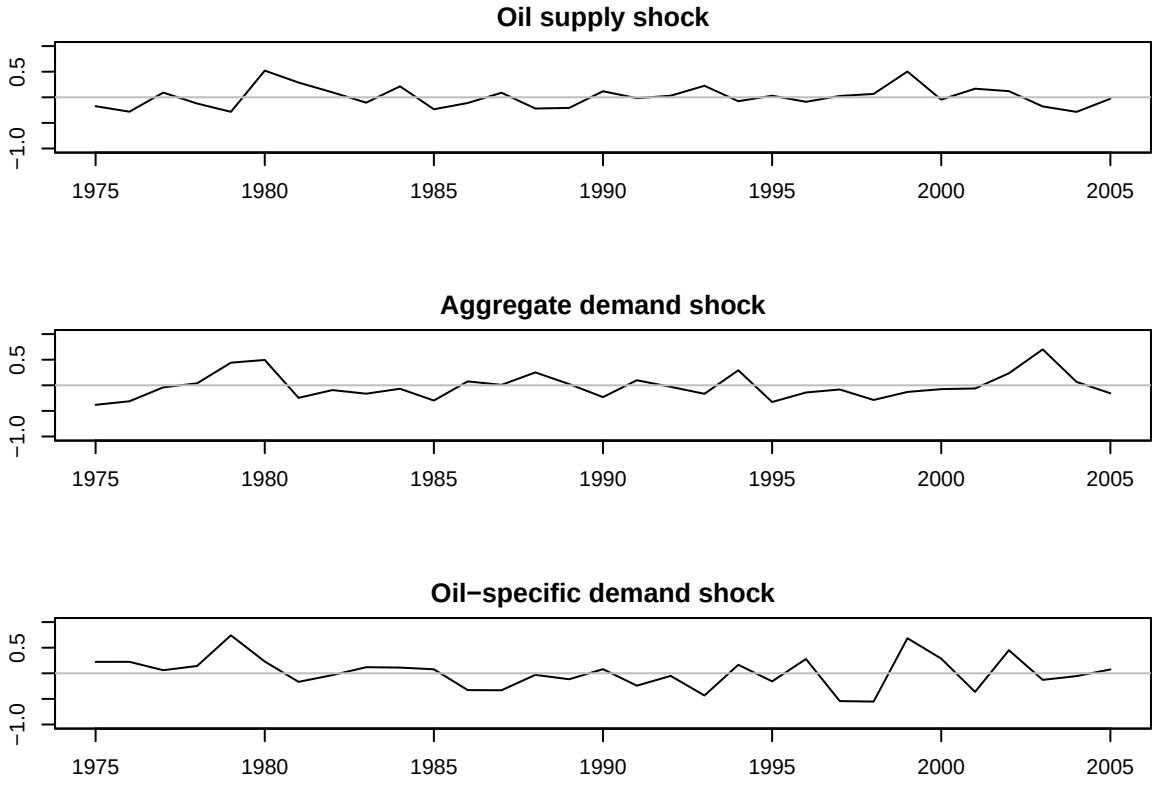
Exercise 2:

- *Using the code for the Bayesian VAR, estimate the VAR described in section II.A.1*

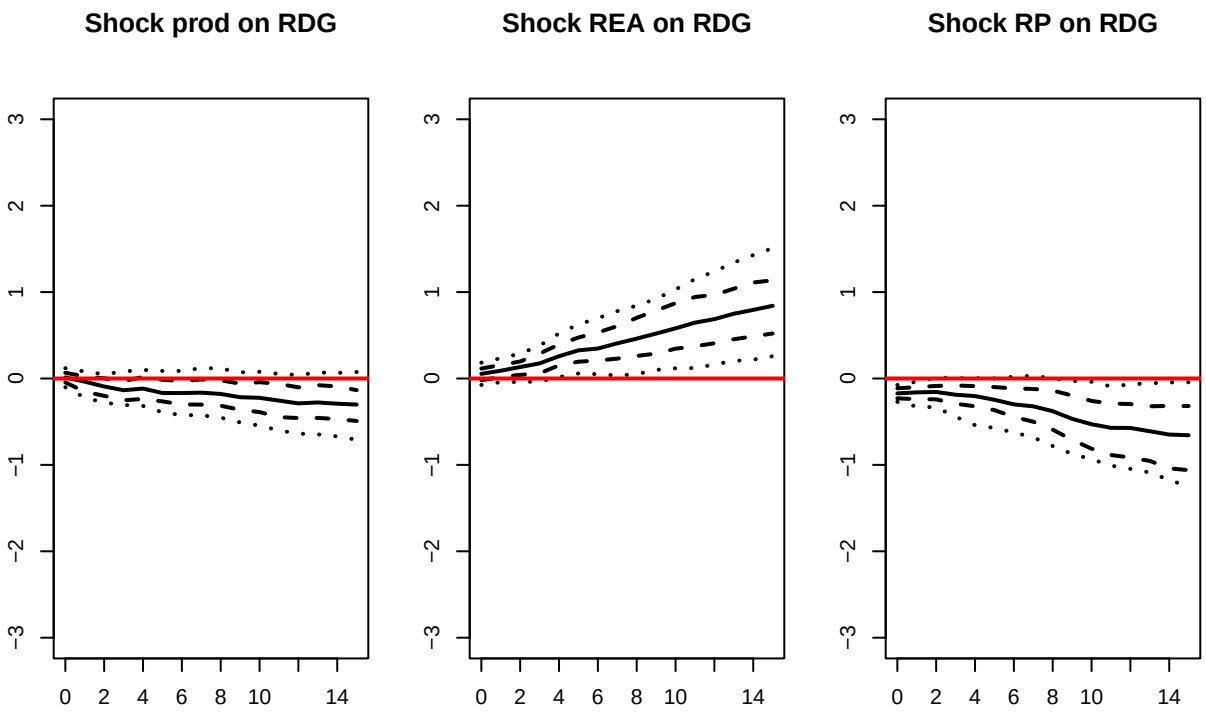
We used the provided code and increased the λ_1 to 0.6 to account for higher frequency of the data. The lag shrinkage in the formula of V in Minnesota prior is given by 1/k where k is lag. This shrinkage is specific to quarterly or yearly data so for monthly data less aggressive lag shrinkage like 6/k is appropriate. To implement this we simply set λ_1 to 0.6 instead of 0.1.

- *Replicate figures 2 and 3 of Kilian, 2009 by recovering the structural form of the model by recursive ordering of variables.*

Below we replicate figure 2.



Below we replicate the lower panel of figure 3. The IRFs remind of those in the paper by Kilian, but are more smooth with values pushed more towards zero due to our prior. If we wanted to get IRFs which correspond more to those in the paper, we could increase the value of λ_1.



Think of reasonable sign restrictions to identify the model at hand; discuss and implement them. Recreate figure 3 using these restrictions and discuss differences to the one identified by recursive ordering. Briefly discuss potential shortcomings of both identifcation schemes.

We propose the following sign restrictions, where the 3x3 upper left submatrix is based on Kilian & Murphy (2012)

```
sign_matrix <- matrix(c(
  "-", "+", "+", "+",
  "-", "+", "-", "+",
  "+", "+", "+", "-",
  "-", "+", "-", "+"),
  nrow = 4,
  ncol = 4,
  byrow = TRUE)

sign_matrix
```

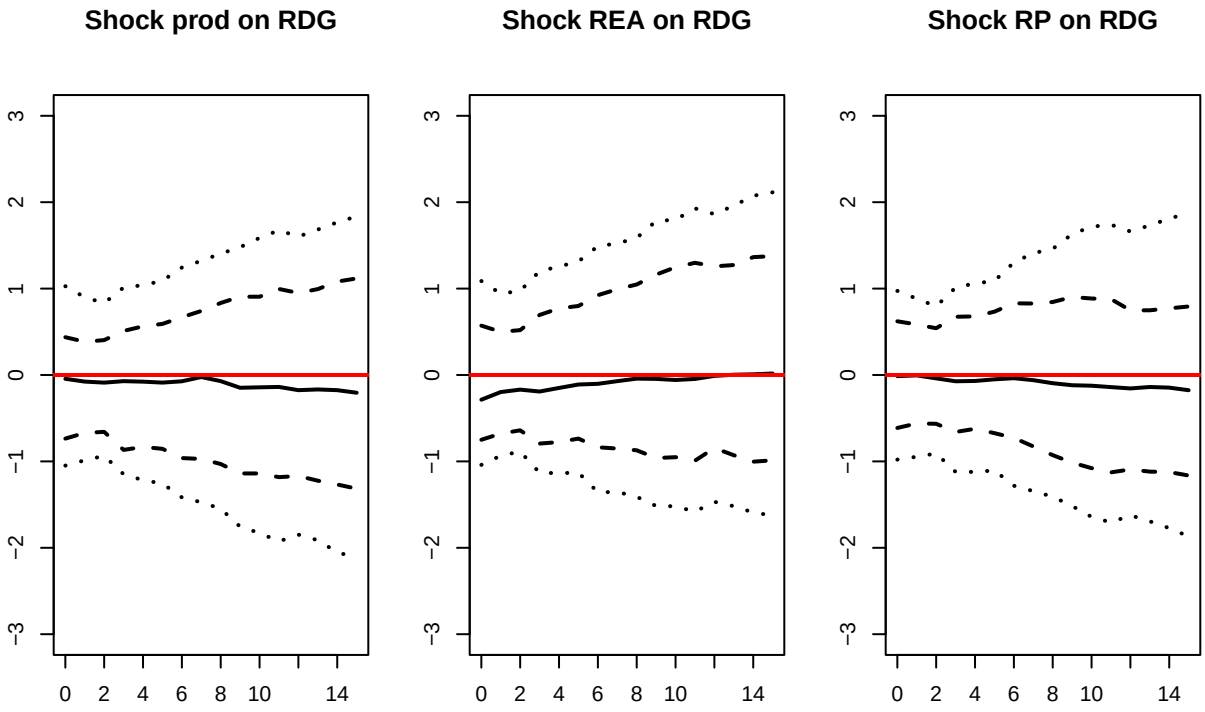
```
##      [,1] [,2] [,3] [,4]
## [1,] "-"  "+"  "+"  "+"
## [2,] "-"  "+"  "-"  "+"
## [3,] "+"  "+"  "+"  "-"
## [4,] "-"  "+"  "-"  "+"
```

The shortcoming of both identifications schemes comes from their definition. Zero short run restrictions assume that some variables do not react contemporaneously to a shock to other variables. The sign restrictions assume that reaction of some of the variables to a shock to other variables are positive or negative. Additionally when using sign restrictions the causal coefficients are set identified, which gives rise to larger confidence bands.

```
# Code for replication sign restriction
#New storage for cumulative IRFs
IRFsign_store2 <- IRFsign_store

for (i in 1:4) {
IRFsign_store2[, 4, i, ] <- t(apply(IRFsign_store[, 4, i, ], 1, cumsum))
}
#Quantiles over the first dimension (number of saved draws)
IRFsign_low.68 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.16,na.rm=TRUE)
IRFsign_high.68 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.84,na.rm=TRUE)
IRFsign_low.95 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.025,na.rm=TRUE)
IRFsign_high.95 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.975,na.rm=TRUE)
IRFsign_median2 <- apply(IRFsign_store2, c(2,3,4), median, na.rm=TRUE)
#Start plotting the IRFs w.r.t. different shocks

par(mfrow=c(1,3),mar=c(6,2,6,2))
sign.list <- c(-1,1,1)
main.list <- c("Oil supply shock", "Aggregate demand shock", "Oil-specific demand shock")
for(jj in seq_along(sign.list)){
for(ii in 4:4){
plot.ts(sign.list[jj]*IRFsign_median2[ii,jj,], ylab="", main=paste0("Shock ",colnames(Y)[jj], " on ",co
lines(sign.list[jj]*IRFsign_low.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFsign_high.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFsign_low.95[ii,jj,], lty = 3, lwd=2)
lines(sign.list[jj]*IRFsign_high.95[ii,jj,], lty = 3, lwd=2)
abline(h=0,col="red",lwd=2)
axis(1, at = seq(1, nhor, by = 2), labels = seq(0, nhor - 1, by = 2))
}}
```


Shock prod on RDG
Shock REA on RDG
Shock RP on RDG
3
2
1
0
−1
−2
−3
0
2
4
6
8
10
14

• *Think of other variables that might be influenced by oil market shocks and collect data that fits the frequency and time period of the provided data. Transform the additional data appropriately and estimate the reduced form of a suitable VAR model. Identify the different shocks (using recursive ordering and sign restrictions), compute impulse responses and discuss your results.*

We decided to use the Variable "S.P.500" from the dataset "current.csv" and as a measure for the CPI the Variable "CPIAUCSL".

```
FRED <- read.csv("current.csv",sep = ",", dec = ".")[-1,]
data.SP.CPI.raw <- ts(FRED[c("S.P.500","CPIAUCSL")], start=c(1959,1),frequency=12)
data.SP.CPI <- window(data.SP.CPI.raw, start = c(1973, 1), end = c(2006, 12))
data.returns.inf <- diff(log(data.SP.CPI)) * 100
SP.RR <- (1 + data.returns.inf[,1]) / (1 + data.returns.inf[,2]) - 1

data.returns <- ts(data.frame(data.kilian[,1:3], SP.RR), start = c(1972, 12), frequency=12)

Traw <- nrow(data.returns)
Yraw <- data.returns
```

We again estimate the VAR and the impulse response functions:

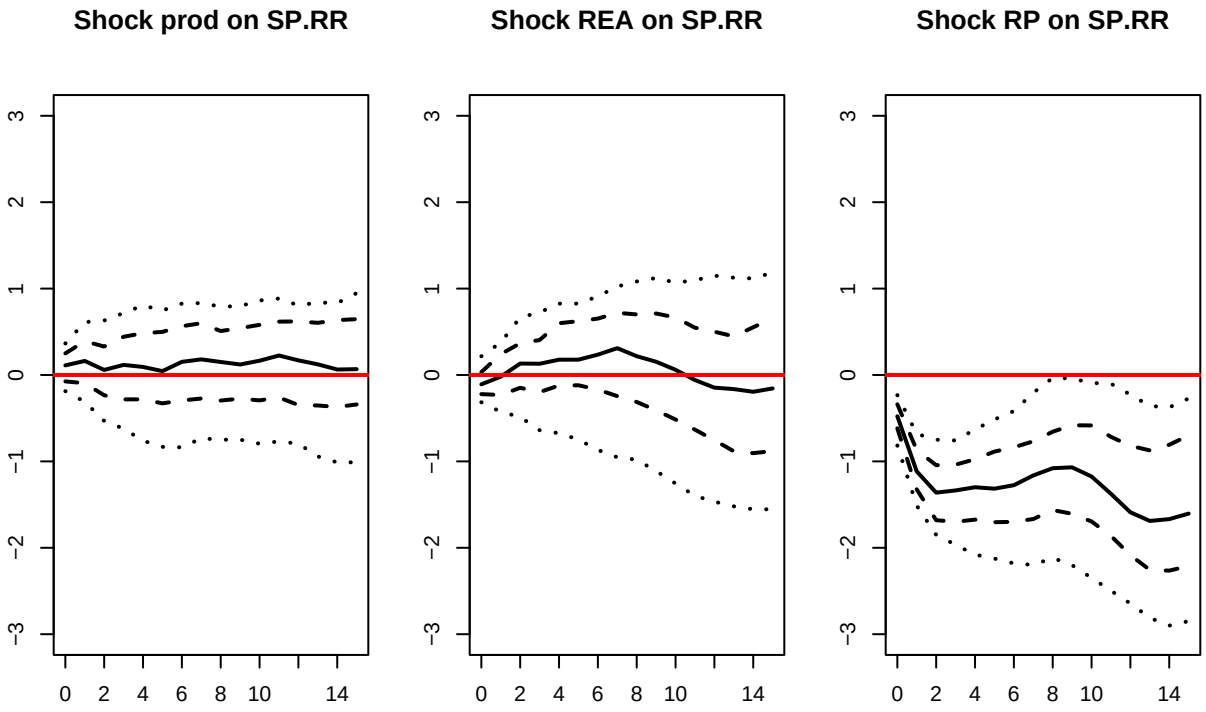
```
# Code for replication of figure 3:

#New storage for cumulative IRFs
IRFchol_store2 <- IRFchol_store

for (i in 1:4) {
IRFchol_store2[, 4, i, ] <- t(apply(IRFchol_store[, 4, i, ], 1, cumsum))
}
#Quantiles over the first dimension (number of saved draws)
IRFchol_low.68 <- apply(IRFchol_store2, c(2,3,4), quantile, 0.16,na.rm=TRUE)
IRFchol_high.68 <- apply(IRFchol_store2, c(2,3,4), quantile, 0.84,na.rm=TRUE)
IRFchol_low.95 <- apply(IRFchol_store2, c(2,3,4), quantile, 0.025,na.rm=TRUE)
IRFchol_high.95 <- apply(IRFchol_store2, c(2,3,4), quantile, 0.975,na.rm=TRUE)
IRFchol_median2 <- apply(IRFchol_store2, c(2,3,4), median, na.rm=TRUE)
#Start plotting the IRFs w.r.t. different shocks

par(mfrow=c(1,3),mar=c(6,2,6,2))
sign.list <- c(-1,1,1)
for(jj in seq_along(sign.list)){
for(ii in 4:4){
plot.ts(sign.list[jj]*IRFchol_median2[ii,jj,], ylab="", main=paste0("Shock ",colnames(Y)[jj], " on ",co
lines(sign.list[jj]*IRFchol_low.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFchol_high.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFchol_low.95[ii,jj,], lty = 3, lwd=2)
lines(sign.list[jj]*IRFchol_high.95[ii,jj,], lty = 3, lwd=2)
abline(h=0,col="red",lwd=2)
axis(1, at = seq(1, nhor, by = 2), labels = seq(0, nhor - 1, by = 2))

}}
```



Sign restrictions:

```
# Code for replication sign restriction
#New storage for cumulative IRFs
IRFsign_store2 <- IRFsign_store

for (i in 1:4) {
IRFsign_store2[, 4, i, ] <- t(apply(IRFsign_store[, 4, i, ], 1, cumsum))
}
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IRFsign_high.68 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.84,na.rm=TRUE)
IRFsign_low.95 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.025,na.rm=TRUE)
IRFsign_high.95 <- apply(IRFsign_store2, c(2,3,4), quantile, 0.975,na.rm=TRUE)
IRFsign_median2 <- apply(IRFsign_store2, c(2,3,4), median, na.rm=TRUE)
#Start plotting the IRFs w.r.t. different shocks

par(mfrow=c(1,3),mar=c(6,2,6,2))
sign.list <- c(-1,1,1)
main.list <- c("Oil supply shock", "Aggregate demand shock", "Oil-specific demand shock")
for(jj in seq_along(sign.list)){
for(ii in 4:4){
plot.ts(sign.list[jj]*IRFsign_median2[ii,jj,], ylab="", main=paste0("Shock ",colnames(Y)[jj], " on ",co
lines(sign.list[jj]*IRFsign_low.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFsign_high.68[ii,jj,], lty = 2, lwd=2)
lines(sign.list[jj]*IRFsign_low.95[ii,jj,], lty = 3, lwd=2)
```

```
lines(sign.list[jj]*IRFsign_high.95[ii,jj,], lty = 3, lwd=2)
abline(h=0,col="red",lwd=2)
axis(1, at = seq(1, nhor, by = 2), labels = seq(0, nhor - 1, by = 2))

}}
```