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**Industrial Organization/Homework 2**

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# 1 Question 1

## 1.1 (a) (b) (c)

I estimate the equation in problem 1 (a) by including only second lags (specification 1) and by including second and third lags (specification 2). Specification 3 is autocorrelated transmitted shocks without fixed effects (the selected $\rho = 0.758$) and specification 4 (the selected $\rho = 1.159$) is autocorrelated transmitted shocks with fixed effects.

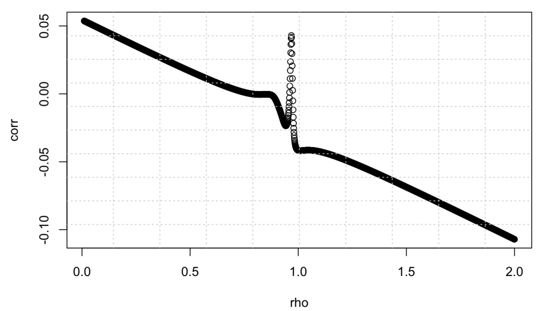



Figure 1: Moment Condition vs $\rho$ for (b)

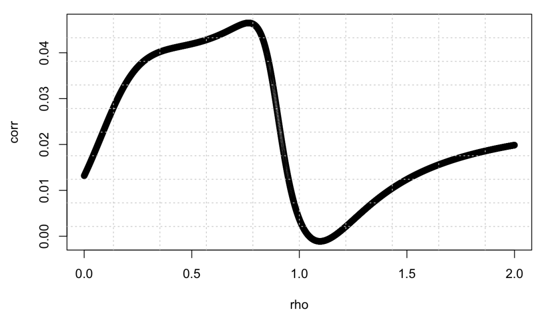



Figure 2: Moment Condition vs $\rho$ for (c)

## 1.2 (d)

As we can see from Table 1, specifications (1) and (2) do not make much sense: in specification (1), the coefficient on R&D capital is negative, while in specification (2) the coefficient on capital is negative. The first stage of both

| | (1) IV Regressions with 2L | (2) IV Regressions with 3L | (3) AR Shocks | (4) AR Shocks+FE |
|---|---|---|---|---|
| lemp | 0.221 | 0.661 | 0.517*** | -1.076 |
| | (0.68) | (1.85) | (3.65) | (-0.25) |
| ldnpt | 0.869** | -0.269 | 0.439*** | 4.013 |
| | (2.78) | (-0.68) | (4.54) | (0.56) |
| ldrst | -0.555 | 0.409 | 0.0963 | 0.221 |
| | (-1.70) | (1.34) | (1.32) | (0.03) |
| d73 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| d78 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| d83 | -0.633*** | 0 | -0.390*** | 0 |
| | (-4.46) | (.) | (-11.21) | (.) |
| d88 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| d357_73 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| d357_78 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| d357_83 | 1.471*** | 0 | 0.853*** | 0 |
| | (13.80) | (.) | (16.92) | (.) |
| d357_88 | 1.087*** | 0.903*** | 0.810*** | -0.798 |
| | (10.69) | (8.71) | (15.09) | (-0.75) |
| _cons | 0.474*** | 0.161 | 0.820*** | 1.959 |
| | (4.66) | (1.66) | (10.55) | (0.68) |
| *N* | 682 | 214 | 682 | 214 |

*t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Question 1

these regressions suggests that the instruments might be weak: the F-statistic of the first stage is around 10 in specification (1) and much lower than 10 in specification (2).

The results of specification (3) seem much more reasonable compared to specifications (1) and (2), suggesting that the assumption of no autocorrelation in the transmitted shock is restrictive. The estimated autocorrelation is $\rho = 0.758$, which is a high coefficient, so ignoring it results in a seriously biased estimates.

The results of specification (4) are also not reasonable: they suggest that nothing is significant. Including fixed effects forces us to (i) use only a balanced panel for estimation, reducing the sample size threefold, and (ii) use higher-order lags for estimation which makes them weaker instruments. That is, on this sample, accounting for fixed effects creates more problems than it solves.

# 2 Question 2

## 2.1 (a) & (b) & (c)

| | (1) | (2) | (3) |
|---|---|---|---|
| | h | P | h& $P$ |
| beta2 | | | |
| _cons | 0.379*** | 0.412*** | 0.385*** |
| | (125.92) | (59.01) | (82.07) |
| beta3 | | | |
| _cons | 0.0414*** | 0.0446** | 0.0516*** |
| | (12.56) | (3.12) | (6.78) |
| b1 | | | |
| _cons | 1.426*** | 9.858*** | -0.337* |
| | (71.99) | (121.42) | (-2.01) |
| b2 | | | |
| _cons | -0.131*** | -7.579*** | 0.173 |
| | (-21.72) | (-44.23) | (1.30) |
| b3 | | | |
| _cons | | | 1.554*** |
| | | | (30.35) |
| b4 | | | |
| _cons | | | -0.160*** |
| | | | (-12.35) |
| $N$ | 1502 | 682 | 682 |

$t$ statistics in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 2: NLSS

| | (1) |
|---|---|
| | lemp and dummies |
| lemp | 0.584*** |
| | (44.18) |
| d73 | -0.169*** |
| | (-7.53) |
| d78 | -0.153*** |
| | (-7.35) |
| d83 | -0.220*** |
| | (-10.17) |
| d88 | 0 |
| | (.) |
| d357_73 | -3.245*** |
| | (-38.88) |
| d357_78 | -2.037*** |
| | (-35.87) |
| d357_83 | -0.757*** |
| | (-13.16) |
| d357_88 | 0.408*** |
| | (8.70) |
| $N$ | 2971 |

$t$ statistics in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3: For lemp and Dummies

## 2.2 (d)

As we can see from Table 2, the results do not change much between specifications. This suggests that the additional information brought from exit decisions can substitute for the usual inversion of the investment decision function. Moreover, the results in Tables 2 and 3 are reasonable: the coefficient on labor is 0.58, and the coefficient on capital is around 0.38. These results are very similar to the results from specification (3) from Problem 1 — the specification that modeled transmitted shocks as AR processes. We can conclude that allowing for a more general process than AR does not add much. And as we have seen in problem 1, allowing for fixed effects even creates additional problems.

# 3 Appendix

Figure 3: Scan for Codes of Homework 2 in Github!

```

* UPenn - Fall 2022 - Industrial Organization
* Homework 2
* September 22th, 2022

clear all
cls
cd "/Users/mahdishahrabi/Library/Mobile Documents/com~apple~CloudDocs/PhD/Year 2 - 2022/Term 3/IO/UPenn_IO_Fall_2022/HW2"

* Reading Data
use "/Users/mahdishahrabi/Library/Mobile Documents/com~apple~CloudDocs/PhD/Year 2 - 2022/Term 3/IO/UPenn_IO_Fall_2022/HW2/GMdata.dta"
gen d357 = (sic3==357)
sort index
by index: gen cnt = (_N)

xtset index yr, delta(5)


*** Modifying Data
* Sector and Time Dummy
gen d357_73 = (sic3==357) & (yr==73)
gen d357_78 = (sic3==357) & (yr==78)
gen d357_83 = (sic3==357) & (yr==83)
gen d357_88 = (sic3==357) & (yr==88)
gen d73 = (yr==73)
gen d78 = (yr==78)
gen d83 = (yr==83)
gen d88 = (yr==88)

* Making Lagged Values for using as IV
sort index yr
gen l1_lemp = L1.lemp
gen l2_lemp = L2.lemp
gen l3_lemp = L3.lemp

gen l1_ldnpt = L1.ldnpt
gen l2_ldnpt = L2.ldnpt
gen l3_ldnpt = L3.ldnpt

gen l1_ldrst = L1.ldrst
gen l2_ldrst = L2.ldrst
gen l3_ldrst = L3.ldrst

gen l1_ldinv = L1.ldinv

* Making Diff Values
gen d1_ldsal = D1.ldsal
gen d1_lemp = D1.lemp
```

```
gen d1_ldnpt = D1.ldnpt
gen d1_ldrst = D1.ldrst

***********************     Question 1     *****************************

* Making panel balances
preserve
keep if cnt==4
sort index yr

****     (a)     ****

* Regressions with 2 lagged variables as IV
ivregress gmm  D1.ldsal d73 d78 d83 d88 d357_73 d357_78 d357_83 d357_88 (D1.(lemp ldnpt ldrst) = l2_lemp l2_ldrst l2_ldnpt), first
eststo IV_2L, title("IV Regressions with 2L")

* Regressions with 3 lagged variables as IV
ivregress gmm  D1.ldsal d73 d78 d83 d88 d357_73 d357_78 d357_83 d357_88 (D1.(lemp ldnpt ldrst) = l2_lemp l2_ldrst l2_ldnpt l3_lemp l3_ldrst l3_ldnpt), first
eststo IV_3L, title("IV Regressions with 3L")

esttab IV_2L IV_3L, replace mtitle


***********************     Question 2     *****************************
restore


****     (a)     ****
****     (i)

reg ldsal lemp d73 d78 d83 d88 d357_73 d357_78 d357_83 d357_88 c.(ldnpt ldrst ldinv)##c.(ldnpt ldrst ldinv)
eststo q2_a_i, title("lemp and dummies")
esttab q2_a_i, mtitle

****     (ii)
matrix b = e(b)
gen pi_hat = (_b[ldnpt]*ldnpt) + (_b[ldrst]*ldrst) + (_b[ldinv]*ldinv) + (_b[ldnpt#ldnpt]*ldnpt*ldnpt) + (_b[ldnpt#ldrst]*ldnpt*ldrst) + (_b[ldnpt#ldinv]*ldnpt*ldinv) + (_b[ldrst#ldrst]*ldrst*ldrst) + (_b[ldrst#ldinv]*ldinv*ldrst) + (_b[ldinv#ldinv]*ldinv*ldinv) + (_b[_cons])

gen l1_pi_hat = L1.pi_hat
preserve
* Dropping values which are missing

drop if missing(l1_ldnpt)

* NLLS
nl (pi_hat={beta2}*ldnpt + {beta3}*ldrst + {b1}*(l1_pi_hat-{beta2}*l1_ldnpt-{beta3}*l1_ldrst) + {b2}*(l1_pi_hat-{beta2}*l1_ldnpt-{beta3}*l1_ldrst)^2 )
eststo q2_a_ii, title("h^")


****     (b)     ****
restore
sort index yr
by index: gen next_period = yr[_n+1]
replace next_period = 0 if missing(next_period[_n])
```

```
replace next_period = 1 if next_period[_n]>0
replace next_period = . if yr[_n]==88


* Probit
probit next_period l1_ldnpt l1_ldrst l1_ldinv
predict P_hat
gen l1_P_hat = L1.P_hat
preserve


* NLLS: P_hat
drop if missing(l1_P_hat)
nl (pi_hat={beta2}*ldnpt + {beta3}*ldrst + {b1}*(l1_P_hat) + {b2}*(l1_P_hat^2))
eststo q2_b, title("P^")

****    (c)    ****


nl (pi_hat={beta2}*ldnpt + {beta3}*ldrst + {b1}*(l1_P_hat) + {b2}*(l1_P_hat^2)+{b3}*(
    l1_pi_hat-{beta2}*l1_ldnpt-{beta3}*l1_ldrst) + {b4}*(l1_pi_hat-{beta2}*l1_ldnpt-{beta3}*
    l1_ldrst)^2)

eststo q2_c, title("h^ & P^")

esttab q2_a_ii q2_b q2_c, mtitle
```

# IO_HW2

Mahdi Shahrabi (Collaborated with Anna Shchetkina)

9/22/2022

## Question 1

```r
library(haven)
library(plm)
library(stargazer)
```

```
##
## Please cite as:
##  Hlavac, Marek (2018). stargazer: Well-Formatted Regression and Summary Statistics Tables.
##  R package version 5.2.2. https://CRAN.R-project.org/package=stargazer
```

```r
library(AER)
```

```
## Loading required package: car
## Loading required package: carData
## Loading required package: lmtest
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
## Loading required package: sandwich
## Loading required package: survival
```

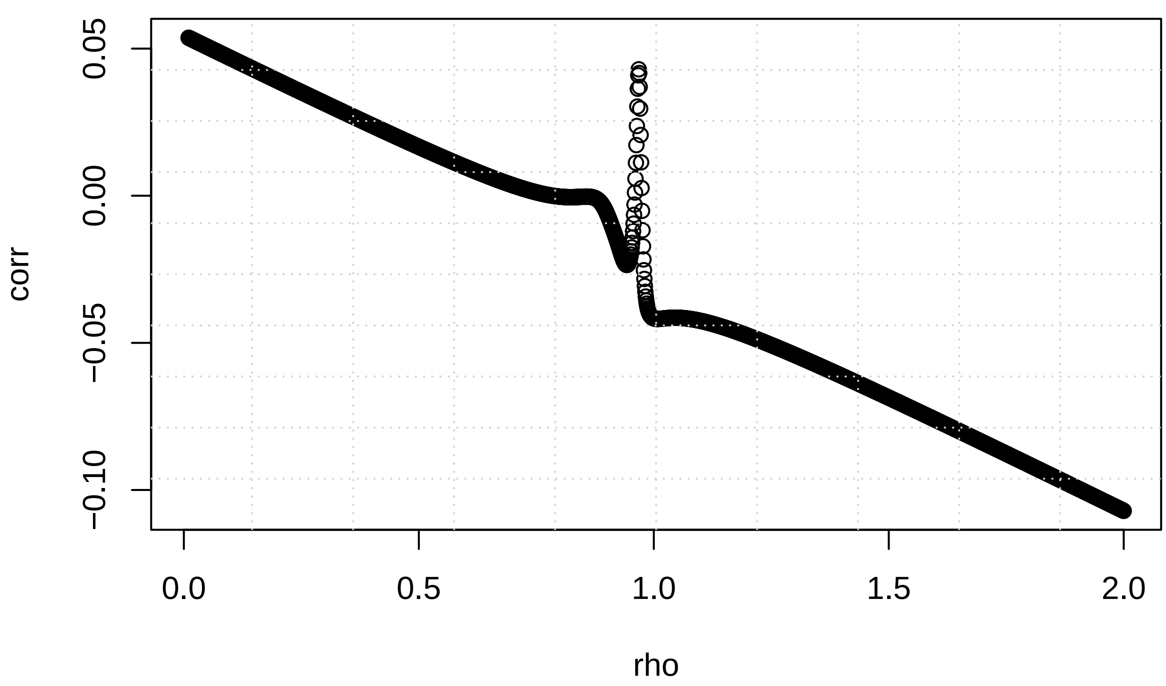
### (B)

```r
# Reading Data
df<-read_dta('GMdata.dta')
# Set it as panel
data <- pdata.frame(df, index=c("index","yr"))
# Make it balanced
# bdata <- make.pbalanced(data,("shared.individuals"))
bdata <- data

# Making Lagged Values
bdata$L1ldsal <- lag(bdata$ldsal, 5)
```

```r
bdata$L2ldsal <- lag(bdata$ldsal, 10)
bdata$L3ldsal <- lag(bdata$ldsal, 15)

bdata$L1lemp <- lag(bdata$lemp, 5)
bdata$L2lemp <- lag(bdata$lemp, 10)
bdata$L3lemp <- lag(bdata$lemp, 15)

bdata$L1ldnpt <- lag(bdata$ldnpt, 5)
bdata$L2ldnpt <- lag(bdata$ldnpt, 10)
bdata$L3ldnpt <- lag(bdata$ldnpt, 15)


bdata$L1ldrst <- lag(bdata$ldrst, 5)
bdata$L2ldrst <- lag(bdata$ldrst, 10)
bdata$L3ldrst <- lag(bdata$ldrst, 15)

# Making time-industry Dummy
bdata$d357_73 <- ifelse(bdata$yr==73 & bdata$sic3==357,1,0)
bdata$L1d357_73<- lag(bdata$d357_73, 5)
bdata$L2d357_73 <- lag(bdata$d357_73, 10)

bdata$d357_78 <- ifelse(bdata$yr==78 & bdata$sic3==357,1,0)
bdata$L1d357_78<- lag(bdata$d357_78, 5)
bdata$L2d357_78 <- lag(bdata$d357_78, 10)

bdata$d357_83 <- ifelse(bdata$yr==83 & bdata$sic3==357,1,0)
bdata$L1d357_83<- lag(bdata$d357_83, 5)
bdata$L2d357_83 <- lag(bdata$d357_83, 10)

bdata$d357_88 <- ifelse(bdata$yr==88 & bdata$sic3==357,1,0)
bdata$L1d357_88 <- lag(bdata$d357_88, 5)
bdata$L2d357_88 <- lag(bdata$d357_88, 10)

# Making Time dummies
bdata$d73 <- ifelse(bdata$yr==73,1,0)
bdata$L1d73<- lag(bdata$d73, 5)
bdata$L2d73 <- lag(bdata$d73, 10)

bdata$d78 <- ifelse(bdata$yr==78,1,0)
bdata$L1d78<- lag(bdata$d78, 5)
bdata$L2d78 <- lag(bdata$d78, 10)

bdata$d83 <- ifelse(bdata$yr==83,1,0)
bdata$L1d83<- lag(bdata$d83, 5)
bdata$L2d83 <- lag(bdata$d83, 10)

bdata$d88 <- ifelse(bdata$yr==88,1,0)
bdata$L1d88<- lag(bdata$d88, 5)
bdata$L2d88 <- lag(bdata$d88, 10)
```

```r
R<-seq(0.01,2,0.001)
out<-data.frame()
# bdata<-bdata[!is.na(bdata$L1ldnpt),]
for (rho in R) {
```

```
bdata$ldsal_rho <- (bdata$ldsal - rho*bdata$L1ldsal)
bdata$lemp_rho <- (bdata$lemp - rho*bdata$L1lemp)
bdata$ldnpt_rho <- (bdata$ldnpt - rho*bdata$L1ldnpt)
bdata$ldrst_rho <- (bdata$ldrst - rho*bdata$L1ldrst)

bdata$d73_rho <- (bdata$d73-rho*bdata$L1d73)
bdata$d78_rho <- (bdata$d78-rho*bdata$L1d78)
bdata$d83_rho <- (bdata$d83-rho*bdata$L1d83)
bdata$d88_rho <- (bdata$d88-rho*bdata$L1d88)

bdata$d357_73_rho <- (bdata$d357_73-rho*bdata$L1d357_73)
bdata$d357_78_rho <- (bdata$d357_78-rho*bdata$L1d357_78)
bdata$d357_83_rho <- (bdata$d357_83-rho*bdata$L1d357_83)
bdata$d357_88_rho <- (bdata$d357_88-rho*bdata$L1d357_88)

fit_model <- ivreg(ldsal_rho~lemp_rho+ldnpt_rho+ldrst_rho+d73_rho+d78_rho+d83_rho+d88_rho+d357_73_rho+d3
bdata$epsilon <- resid(fit_model)


mc <- cov(na.omit(bdata[c("epsilon","L2ldsal")]))[1,2]
temp <- na.omit(bdata[c("epsilon","L2ldsal")])
mc2 <- abs(mean(temp$epsilon*temp$L2ldsal))

out <- rbind( out,data.frame(rho=rho,corr=mc,corr_abs=abs(mc),mc2=mc2))

}

plot(out[c("rho","corr")])
grid(10,10)
```



```r
final<-out[out$corr_abs==min(out$corr_abs),]
final
```

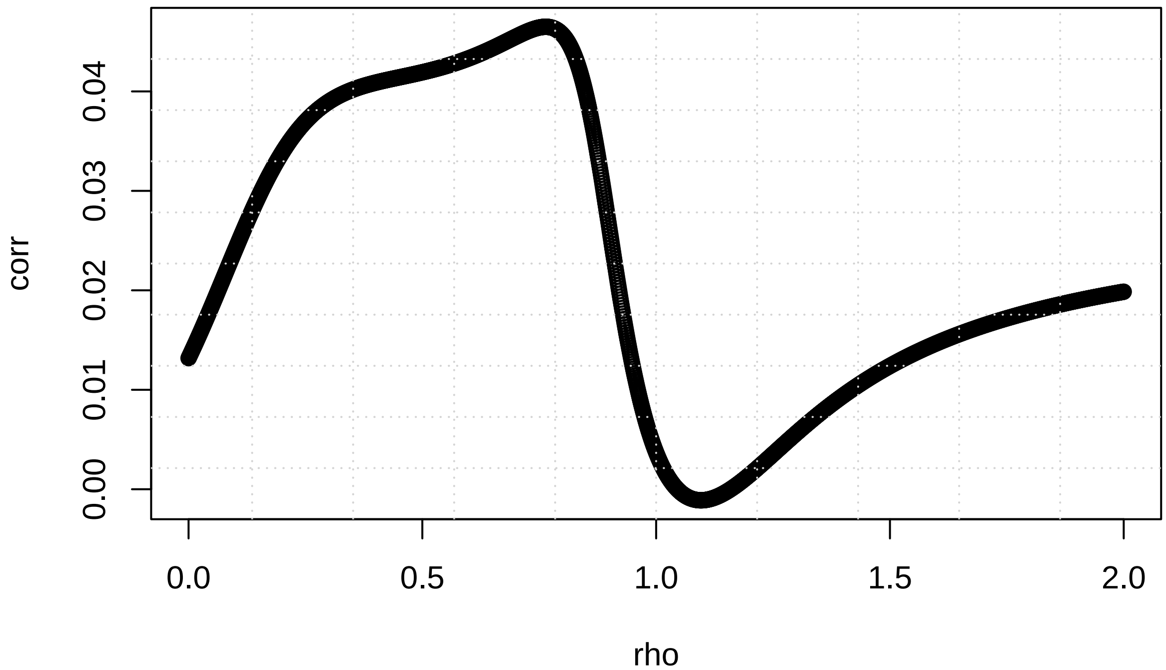
```
##       rho          corr     corr_abs          mc2
## 776 0.785 -7.05121e-07 7.05121e-07 7.040871e-07
```

```r
rho<-0.785
bdata$ldsal_rho <- (bdata$ldsal - rho*bdata$L1ldsal)
bdata$lemp_rho <- (bdata$lemp - rho*bdata$L1lemp)
bdata$ldnpt_rho <- (bdata$ldnpt - rho*bdata$L1ldnpt)
bdata$ldrst_rho <- (bdata$ldrst - rho*bdata$L1ldrst)

bdata$d73_rho <- (bdata$d73-rho*bdata$L1d73)
bdata$d78_rho <- (bdata$d78-rho*bdata$L1d78)
bdata$d83_rho <- (bdata$d83-rho*bdata$L1d83)
bdata$d88_rho <- (bdata$d88-rho*bdata$L1d88)

bdata$d357_73_rho <- (bdata$d357_73-rho*bdata$L1d357_73)
bdata$d357_78_rho <- (bdata$d357_78-rho*bdata$L1d357_78)
bdata$d357_83_rho <- (bdata$d357_83-rho*bdata$L1d357_83)
bdata$d357_88_rho <- (bdata$d357_88-rho*bdata$L1d357_88)

fit_model <- ivreg(ldsal_rho~lemp_rho+ldnpt_rho+ldrst_rho+d73_rho+d78_rho+d83_rho+d88_rho+d357_73_rho+d3

summary(fit_model)
```

```
##
## Call:
## ivreg(formula = ldsal_rho ~ lemp_rho + ldnpt_rho + ldrst_rho +
##     d73_rho + d78_rho + d83_rho + d88_rho + d357_73_rho + d357_78_rho +
##     d357_83_rho + d357_88_rho | d73_rho + d78_rho + d83_rho +
##     d88_rho + d357_73_rho + d357_78_rho + d357_83_rho + d357_88_rho +
##     bdata$L2ldsal + bdata$L2lemp + bdata$L2ldnpt + bdata$L2ldrst,
##     data = bdata, na.action = na.exclude)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.696640 -0.130528 -0.006865  0.113970  1.152163
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.82049    0.07577  10.829  < 2e-16 ***
## lemp_rho     0.51703    0.13694   3.776 0.000174 ***
## ldnpt_rho    0.43938    0.08724   5.037 6.09e-07 ***
## ldrst_rho    0.09630    0.06944   1.387 0.165999
## d78_rho      0.49663    0.04306  11.533  < 2e-16 ***
## d357_78_rho -2.40128    0.12369 -19.414  < 2e-16 ***
## d357_83_rho -1.03204    0.07461 -13.832  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2161 on 675 degrees of freedom
## Multiple R-Squared: 0.8589,  Adjusted R-squared: 0.8576
## Wald test: 424.9 on 6 and 675 DF,  p-value: < 2.2e-16
```

## (C)

```
R<-seq(0,2,0.001)
out<-data.frame()

for (rho in R) {


bdata$ldsal_rho2 <- (bdata$ldsal - rho*bdata$L1ldsal) - (bdata$L1ldsal - rho*bdata$L2ldsal)
bdata$lemp_rho2 <- (bdata$lemp - rho*bdata$L1lemp) - (bdata$L1lemp - rho*bdata$L2lemp)
bdata$ldnpt_rho2 <- (bdata$ldnpt - rho*bdata$L1ldnpt) - (bdata$L1ldnpt - rho*bdata$L2ldnpt)
bdata$ldrst_rho2 <- (bdata$ldrst - rho*bdata$L1ldrst) - (bdata$L1ldrst - rho*bdata$L2ldrst)


bdata$d73_rho2 <- (bdata$d73-rho*bdata$L1d73)-(bdata$L1d73-rho*bdata$L2d73)
bdata$d78_rho2 <- (bdata$d78-rho*bdata$L1d78)-(bdata$L1d78-rho*bdata$L2d78)
bdata$d83_rho2 <- (bdata$d83-rho*bdata$L1d83)-(bdata$L1d83-rho*bdata$L2d83)
bdata$d88_rho2 <- (bdata$d88-rho*bdata$L1d88)-(bdata$L1d88-rho*bdata$L2d88)

bdata$d357_73_rho2 <- (bdata$d357_73-rho*bdata$L1d357_73)-(bdata$L1d357_73-rho*bdata$L2d357_73)
bdata$d357_78_rho2 <- (bdata$d357_78-rho*bdata$L1d357_78)-(bdata$L1d357_78-rho*bdata$L2d357_78)
bdata$d357_83_rho2 <- (bdata$d357_83-rho*bdata$L1d357_83)-(bdata$L1d357_83-rho*bdata$L2d357_83)
bdata$d357_88_rho2 <- (bdata$d357_88-rho*bdata$L1d357_88)-(bdata$L1d357_88-rho*bdata$L2d357_88)


fit_model <- ivreg(ldsal_rho2~lemp_rho2+ldnpt_rho2+ldrst_rho2+d73_rho2+d78_rho2+d83_rho2+d88_rho2+d357_
bdata$epsilon2 <- resid(fit_model)

mc <- cor(na.omit(bdata[c("epsilon2","L3ldsal")]))[1,2]
temp <- na.omit(bdata[c("epsilon2","L3ldsal")])

out <- rbind( out,data.frame(rho=rho,corr=mc,corr_abs=abs(mc)))
}

plot(out[c("rho","corr")])
grid(10,10)
```




```r
final<-out[out$corr_abs==min(out$corr_abs),]
final
```

```
##        rho          corr     corr_abs
## 1160 1.159 -4.061012e-06 4.061012e-06
```

```r
rho<-1.159
bdata$ldsal_rho2 <- (bdata$ldsal - rho*bdata$L1ldsal) - (bdata$L1ldsal - rho*bdata$L2ldsal)
bdata$lemp_rho2 <- (bdata$lemp - rho*bdata$L1lemp) - (bdata$L1lemp - rho*bdata$L2lemp)
bdata$ldnpt_rho2 <- (bdata$ldnpt - rho*bdata$L1ldnpt) - (bdata$L1ldnpt - rho*bdata$L2ldnpt)
bdata$ldrst_rho2 <- (bdata$ldrst - rho*bdata$L1ldrst) - (bdata$L1ldrst - rho*bdata$L2ldrst)


bdata$d73_rho2 <- (bdata$d73-rho*bdata$L1d73)-(bdata$L1d73-rho*bdata$L2d73)
bdata$d78_rho2 <- (bdata$d78-rho*bdata$L1d78)-(bdata$L1d78-rho*bdata$L2d78)
bdata$d83_rho2 <- (bdata$d83-rho*bdata$L1d83)-(bdata$L1d83-rho*bdata$L2d83)
bdata$d88_rho2 <- (bdata$d88-rho*bdata$L1d88)-(bdata$L1d88-rho*bdata$L2d88)

bdata$d357_73_rho2 <- (bdata$d357_73-rho*bdata$L1d357_73)-(bdata$L1d357_73-rho*bdata$L2d357_73)
bdata$d357_78_rho2 <- (bdata$d357_78-rho*bdata$L1d357_78)-(bdata$L1d357_78-rho*bdata$L2d357_78)
bdata$d357_83_rho2 <- (bdata$d357_83-rho*bdata$L1d357_83)-(bdata$L1d357_83-rho*bdata$L2d357_83)
bdata$d357_88_rho2 <- (bdata$d357_88-rho*bdata$L1d357_88)-(bdata$L1d357_88-rho*bdata$L2d357_88)


fit_model <- ivreg(ldsal_rho2~lemp_rho2+ldnpt_rho2+ldrst_rho2+d73_rho2+d78_rho2+d83_rho2+d88_rho2+d357_



summary(fit_model)
```

```
##
## Call:
## ivreg(formula = ldsal_rho2 ~ lemp_rho2 + ldnpt_rho2 + ldrst_rho2 +
##     d73_rho2 + d78_rho2 + d83_rho2 + d88_rho2 + d357_73_rho2 +
```

```
##     d357_78_rho2 + d357_83_rho2 + d357_88_rho2 | d73_rho2 + d78_rho2 +
##     d83_rho2 + d88_rho2 + d357_73_rho2 + d357_78_rho2 + d357_83_rho2 +
##     d357_88_rho2 + bdata$L3ldsal + bdata$L3lemp + bdata$L3ldnpt +
##     bdata$L3ldrst, data = bdata, na.action = na.exclude)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -11.98337  -0.94682  -0.02479   1.06170   6.32130
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.8973     2.7739   0.684    0.495
## lemp_rho2     -0.7363     3.7953  -0.194    0.846
## ldnpt_rho2     3.8581     6.7006   0.576    0.565
## ldrst_rho2    -0.5971     6.1459  -0.097    0.923
## d357_78_rho2  -0.6458     0.9895  -0.653    0.515
##
## Residual standard error: 2.021 on 209 degrees of freedom
## Multiple R-Squared: -9.679,  Adjusted R-squared: -9.883
## Wald test: 1.109 on 4 and 209 DF,  p-value: 0.3534
```