ECON 762: Vector Autoregression Example

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STATA `do` and `log` files and graphs are attached. They contain commands and output for a VAR model fit to quarterly data on West German income and consumption. The variables `dlincome` and `dlconsumption` are the first differences of the logs of income and consumption.

The `varbasic` output contains the usual coefficient estimates, t-statistics, etc. for all $m = 2$ of the VAR equations. The `lags(1 2)` option specifies which lags enter in the VAR equations ($p = 2$). The second `varbasic` command has `lags(1 2 3)` so it estimates a VAR with three lags ($p = 3$). The `irf` option creates impulse response function plots, which can then be exported and/or printed with postestimation commands. The IRFs for the $p = 2$ VAR were printed and are included on the last page.

`varlmar` tests for autocorrelation. Evidence of the presence of autocorrelation may indicate that a greater number of lags is needed. The null hypothesis of no autocorrelation is accepted in every case at the 5% level since the P-values exceed .05.

`varwle` tests for the joint significance of the VAR coefficients at various lags. The first two tables give results for the two equations separately. The last table gives tests for the joint significance of the coefficients at a given lag across all of the equations. It will then be testing m^2 restrictions and have m^2 degrees of freedom. When $p = 3$ the third-lag coefficients are just barely jointly significant at the 5% level. When $p = 2$ the second-lag coefficients are strongly jointly significant at the 5% level, although the ones in the `dlincome` equation are not significant when tested separately from the ones in the `dlconsumption` equation.

`vargranger` does Granger causality tests. When $p = 2$, the P-value equals 0.000 in the row "dlincome excluded" for the "dlconsumption" equation. This strongly rejects the null hypothesis that income does not cause consumption. In the jargon: "income Granger-causes consumption". To see how a one-time-only one-unit increase in `dlincome` (the "impulse") affects `dlconsumption` (the "response"), consult the lower-left panel of the impulse response function plots.

The `reg` output shows that the OLS and VAR coefficients are the same. This `reg` estimates the consumption equation of the VAR that sets $p = 2$. The OLS standard errors and t-ratios are slightly different from the VAR ones because the VAR uses n rather than $n - k$ in the denominators when estimating the error variances.

```
*****************************************************************************
**     var_1.do :     January 2008
*****************************************************************************

clear
capture log using "C:\Documents and Settings\courses\761 and
762\w08\VAR\var_1.log", replace
use "C:\Documents and Settings\courses\761 and 762\w08\VAR\lutkepohl.dta"

summarize
tsset

* graph twoway tsline lconsumption lincome
tsline lconsumption lincome,lpattern(solid dash)
graph export "C:\Documents and Settings\courses\761 and 762\w08\VAR\var_1.eps",
replace
* graph print

graph twoway tsline dlconsumption dlincome,lpattern(solid dash)
graph export "C:\Documents and Settings\courses\761 and 762\w08\VAR\var_2.eps",
replace
* graph print

varbasic dlconsumption dlincome , lags(1 2) irf
* graph print
graph export "C:\Documents and Settings\courses\761 and 762\w08\VAR\var_3.eps",
replace
varlmar
varwle
vargranger

varbasic dlconsumption dlincome , lags(1 2 3)
varlmar
varwle
vargranger

reg dlconsumption L.dlconsumption L2.dlconsumption L.dlincome L2.dlincome

log close
```

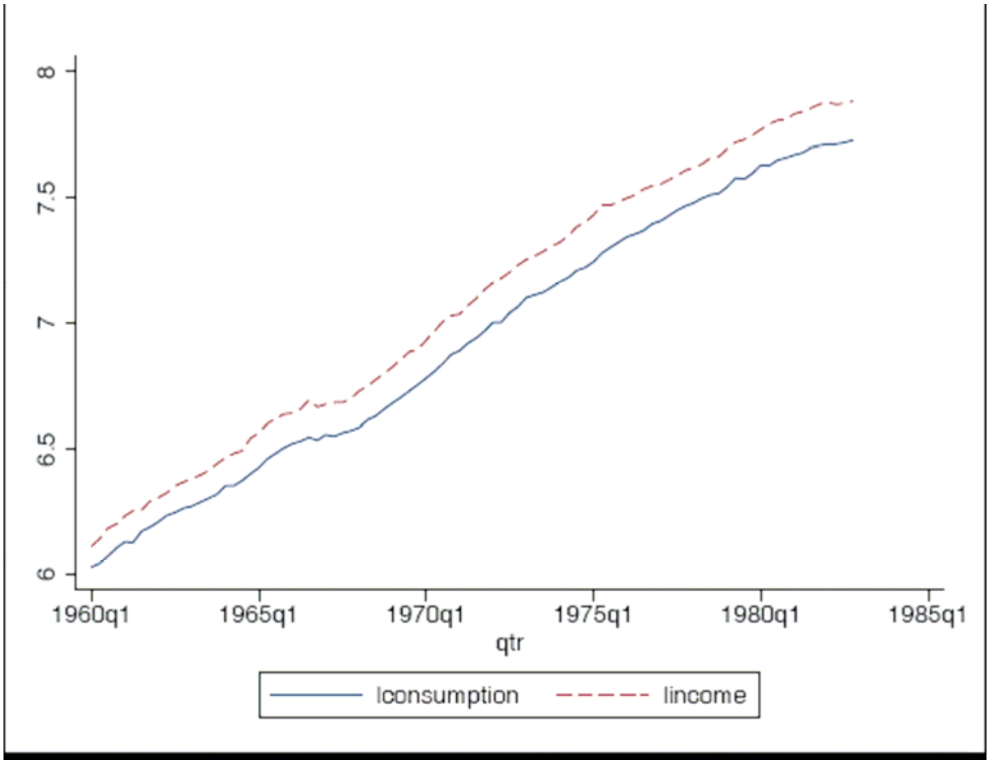
```
. use "C:\Documents and Settings\courses\761 and 762\w08\VAR\lutkepohl.dta"
(Quarterly SA West German macro data, Bil DM, from Lutkepohl 1993 Table E.1)

.
. summarize

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
  investment |        92     471.913    210.7467        179        870
      income |        92    1355.087    698.9288        451       2651
 consumption |        92    1166.674    590.9236        415       2271
         qtr |        92        45.5    26.70206          0         91
 linvestment |        92    6.052299    .4688109   5.187386   6.768493
-------------+--------------------------------------------------------
dlinvestment |        91    .0167964    .0447898  -.1401839   .1935849
     lincome |        92    7.070305    .5463459   6.111467   7.882692
    dlincome |        91     .019464    .0119361  -.0288782   .0502319
lconsumption |        92    6.928083    .5289602   6.028278   7.727975
dlconsumpt~n |        91     .018678    .0109604  -.0129967   .0448313

. tsset
        time variable:  qtr, 1960q1 to 1982q4

.
. * graph twoway tsline lconsumption lincome
. tsline lconsumption lincome,lpattern(solid dash)

. graph export "C:\Documents and Settings\courses\761 and
762\w08\VAR\var_1.eps", replace
(note: file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_1.eps not
found)
(file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_1.eps written
in EPS format)

. * graph print
.
. graph twoway tsline dlconsumption dlincome,lpattern(solid dash)

. graph export "C:\Documents and Settings\courses\761 and
762\w08\VAR\var_2.eps", replace
(note: file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_2.eps not
found)
(file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_2.eps written
in EPS format)

. * graph print
.
. varbasic dlconsumption dlincome , lags(1 2) irf

Vector autoregression

Sample:  1960q4   1982q4                          No. of obs      =        89
Log likelihood =   578.277                        AIC             = -12.77027
FPE            =  9.75e-09                        HQIC            = -12.65756
Det(Sigma_ml)  =  7.79e-09                        SBIC            = -12.49065

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
dlconsumption        5      .01005   0.2037   22.76921   0.0001
dlincome             5     .011472   0.0918   9.000554   0.0611
----------------------------------------------------------------
```

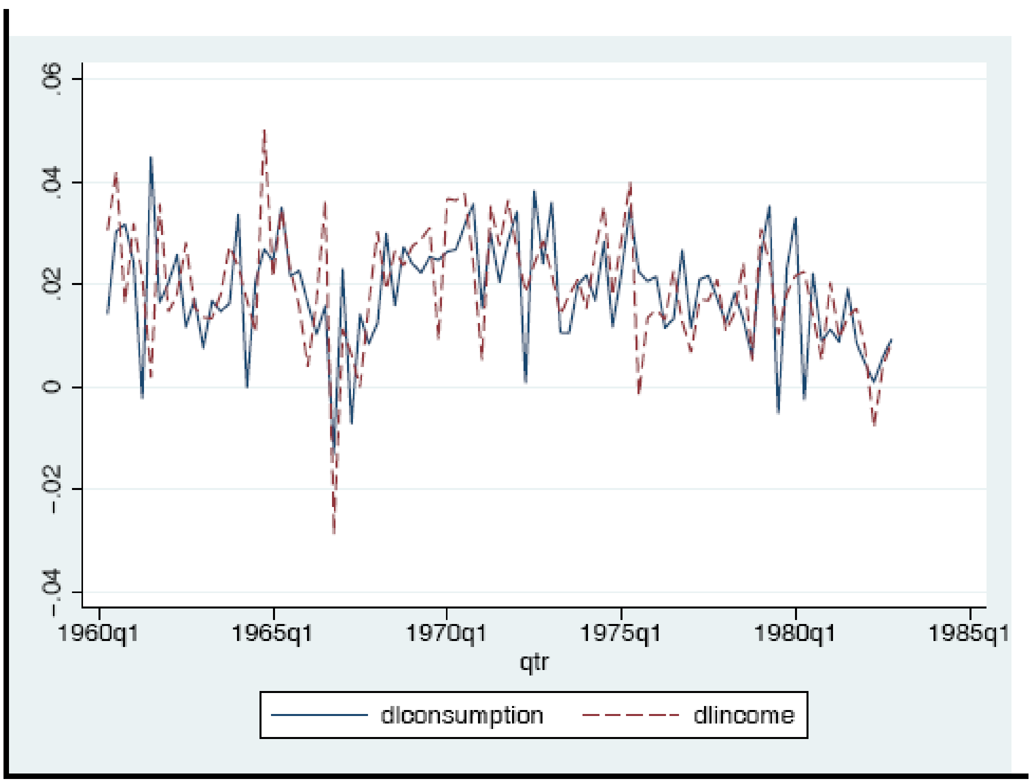
```
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dlconsumpt~n |
dlconsumpt~n |
         L1. |  -.3030441   .1193358    -2.54   0.011    -.5369379   -.0691502
         L2. |  -.0599513   .1195437    -0.50   0.616    -.2942527    .1743501
    dlincome |
         L1. |   .3231097   .1086299     2.97   0.003     .1101991    .5360203
         L2. |   .3607425   .1070401     3.37   0.001     .1509477    .5705373
       _cons |   .0120202   .0028726     4.18   0.000     .0063901    .0176503
-------------+----------------------------------------------------------------
dlincome     |
dlconsumpt~n |
         L1. |   .3433416   .1362228     2.52   0.012     .0763498    .6103334
         L2. |   .1476759   .1364602     1.08   0.279    -.1197812     .415133
    dlincome |
         L1. |   -.101226   .1240019    -0.82   0.414    -.3442653    .1418133
         L2. |   .0137257   .1221872     0.11   0.911    -.2257569    .2532083
       _cons |   .0115223   .0032791     3.51   0.000     .0050955    .0179492
------------------------------------------------------------------------------

. * graph print
. graph export "C:\Documents and Settings\courses\761 and
762\w08\VAR\var_3.eps", replace
(note: file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_3.eps not
found)
(file C:\Documents and Settings\courses\761 and 762\w08\VAR\var_3.eps written
in EPS format)

. varlmar

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |    7.5940     4     0.10763   |
  |   2  |    5.2539     4     0.26223   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varwle

   Equation: dlconsumption
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  9.938547     2     0.007    |
  |   2 |  13.89996     2     0.001    |
  +------------------------------------+

   Equation: dlincome
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |   6.88775     2     0.032    |
  |   2 |  1.873546     2     0.392    |
  +------------------------------------+
```

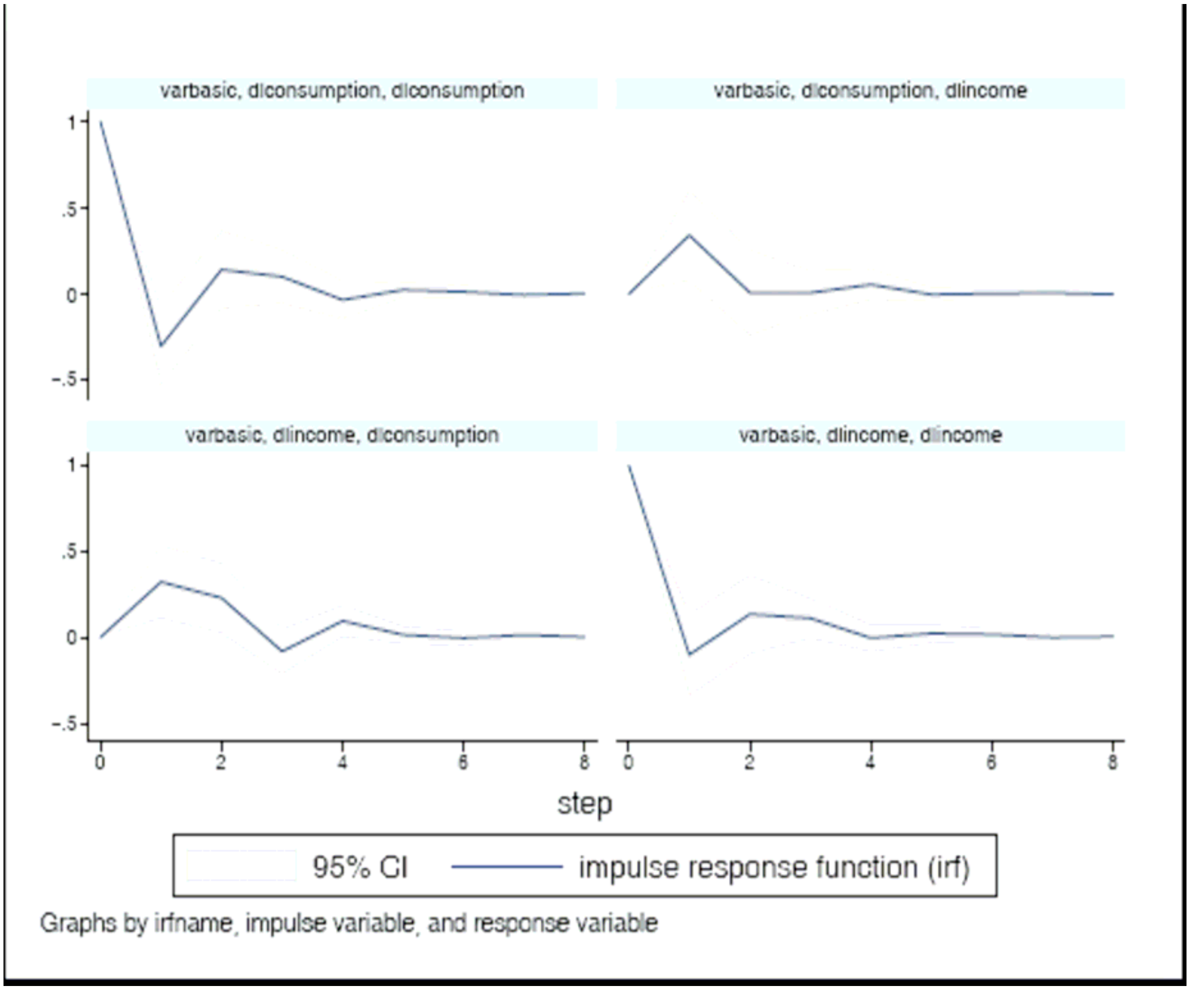
```
   Equation: All
  +----------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+----------------------------|
  |   1 |  34.54276     4     0.000    |
  |   2 |  19.44093     4     0.001    |
  +----------------------------------+

. vargranger

   Granger causality Wald tests
  +------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+---------------------------|
  |     dlconsumption            dlincome |  16.677     2    0.000    |
  |     dlconsumption                 ALL |  16.677     2    0.000    |
  |--------------------------------------+---------------------------|
  |          dlincome      dlconsumption |   6.392     2    0.041    |
  |          dlincome                 ALL |   6.392     2    0.041    |
  +------------------------------------------------------------------+

.
. varbasic dlconsumption dlincome , lags(1 2 3)

Vector autoregression

Sample:  1961q1   1982q4                         No. of obs      =        88
Log likelihood =   575.888                       AIC             = -12.77018
FPE            =  9.76e-09                       HQIC            =  -12.6114
Det(Sigma_ml)  =  7.09e-09                       SBIC            = -12.37606

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
dlconsumption         7     .009724   0.2692   32.42134   0.0000
dlincome              7     .011455   0.1263   12.72378   0.0476
----------------------------------------------------------------
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dlconsumpt~n |
dlconsumpt~n |
         L1. |  -.4062951   .1249992    -3.25   0.001     -.651289   -.1613012
         L2. |  -.0847416    .132317    -0.64   0.522    -.3440781     .174595
         L3. |   .1469838   .1162897     1.26   0.206    -.0809398    .3749074
    dlincome |
         L1. |   .3340556   .1096068     3.05   0.002     .1192303    .5488809
         L2. |   .3448315   .1146321     3.01   0.003     .1201566    .5695064
         L3. |   .1867138   .1131151     1.65   0.099    -.0349876    .4084153
       _cons |   .0079044     .00313     2.53   0.012     .0017697     .014039
-------------+----------------------------------------------------------------
dlincome     |
dlconsumpt~n |
         L1. |   .2426113   .1472609     1.65   0.099    -.0460147    .5312373
         L2. |   .0725911   .1558819     0.47   0.641    -.2329319    .3781141
         L3. |   .0297413   .1370003     0.22   0.828    -.2387743    .2982569
    dlincome |
         L1. |  -.0575474   .1291271    -0.45   0.656     -.310632    .1955371
         L2. |   .0492578   .1350475     0.36   0.715    -.2154304    .3139461
         L3. |    .190733   .1332602     1.43   0.152    -.0704523    .4519183
       _cons |   .0089405   .0036874     2.42   0.015     .0017133    .0161677
------------------------------------------------------------------------------
```

```
. varlmar

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |    2.3386     4     0.67376   |
  |   2  |    2.7948     4     0.59274   |
  +--------------------------------------+
   H0: no autocorrelation at lag order

. varwle

   Equation: dlconsumption
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  12.55432     2     0.002    |
  |   2 |  11.89194     2     0.003    |
  |   3 |  9.155036     2     0.010    |
  +------------------------------------+

   Equation: dlincome
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  3.125902     2     0.210    |
  |   2 |  .9674237     2     0.616    |
  |   3 |  3.393348     2     0.183    |
  +------------------------------------+

   Equation: All
  +------------------------------------+
  | lag |    chi2      df  Prob > chi2 |
  |-----+------------------------------|
  |   1 |  30.75707     4     0.000    |
  |   2 |  14.59868     4     0.006    |
  |   3 |  9.632386     4     0.047    |
  +------------------------------------+

. vargranger

   Granger causality Wald tests
  +------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+---------------------------|
  |     dlconsumption            dlincome |  14.144     3    0.003    |
  |     dlconsumption                 ALL |  14.144     3    0.003    |
  |--------------------------------------+---------------------------|
  |          dlincome      dlconsumption |  2.8223     3    0.420    |
  |          dlincome                 ALL |  2.8223     3    0.420    |
  +------------------------------------------------------------------+

.
. reg dlconsumption L.dlconsumption L2.dlconsumption L.dlincome L2.dlincome

      Source |       SS       df       MS              Number of obs =      89
-------------+------------------------------           F(  4,    84) =    5.37
       Model |  .002170557     4  .000542639           Prob > F      =  0.0007
    Residual |  .008484247    84  .000101003           R-squared     =  0.2037
-------------+------------------------------           Adj R-squared =  0.1658
       Total |  .010654804    88  .000121077           Root MSE      =  .01005
```

```
------------------------------------------------------------------------------
dlconsumpt~n |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
dlconsumpt~n |
         L1. |  -.3030441   .1228361    -2.47   0.016    -.5473171    -.058771
         L2. |  -.0599513   .1230502    -0.49   0.627    -.3046501    .1847475
    dlincome |
         L1. |   .3231097   .1118162     2.89   0.005      .100751    .5454684
         L2. |   .3607425   .1101798     3.27   0.002     .1416379    .5798471
       _cons |   .0120202   .0029568     4.07   0.000     .0061402    .0179002
------------------------------------------------------------------------------

.
. log close
       log:  C:\Documents and Settings\courses\761 and 762\w08\VAR\var_1.log
  log type:  text
 closed on:  16 Jan 2008, 15:42:19
-------------------------------------------------------------------------------
----------------------------
```


8
7.5
7
6.5
6
1960q1
1965q1
1970q1
1975q1
1980q1
1985q1
qtr
lconsumption
lincome


.06
.04
.02
0
−.02
−.04
1960q1
1965q1
1970q1
1975q1
1980q1
1985q1
qtr
dlconsumption
dlincome


varbasic, dlconsumption, dlconsumption
varbasic, dlconsumption, dlincome
varbasic, dlincome, dlconsumption
varbasic, dlincome, dlincome
1
.5
0
-.5
0
2
4
6
8
step
95% CI
impulse response function (irf)
Graphs by irfname, impulse variable, and response variable