Feb, 15 2020 Stata IV, 2SLS, GMM

February 15, 2020

- Name: Jikhan Jeong
- Part 1: IV (2SLS base just-identified and over-identified)
- Ref: http://www3.grips.ac.jp/~yamanota/yamanoCourses.htm (lecture, code, data source) **iverg** IV 2SLS, 2SLS applied and se is fixed
- Part 2: 2SLS and GMM
- Ref: https://www.soderbom.net/metrix2.htm (lcture, code source) : iverg2 2sls and GMM
- Ref: https://kylebarron.dev/stata_kernel/ (stata kernel)
-

0.1 Data: CARD.dta | Wooldridge probm 5.4-6.1

0.2 # Data Preparing

[1]:
```
use "card.dta", clear
```

[4]:
```
%head 1
```

```
     +-------------------------------------------------------------------------------------------
  1. | id | nearc2 | nearc4 | educ | age | fatheduc | motheduc | weight | momdad14 | sinmom14
     |  2 |      0 |      0 |    7 |  29 |        . |        . | 158413 |        1 |        0
     |-------------------------------------------------------------------------------------------
     |                    married                     |                   libcrd14
     |                          1                     |                          0
     +-------------------------------------------------------------------------------------------
```

[5]:
```
sum
```

```
    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          id |      3,010    2581.749    1500.539          2       5225
      nearc2 |      3,010    .4408638    .4965731          0          1
      nearc4 |      3,010    .6820598    .4657535          0          1
        educ |      3,010    13.26346    2.676913          1         18
```

```
         age |      3,010     28.1196    3.137004         24         34
-------------+---------------------------------------------------------
    fatheduc |      2,320    10.00345    3.720737          0         18
    motheduc |      2,657    10.34814    3.179671          0         18
      weight |      3,010    321185.3    170645.8      75607    1752340
    momdad14 |      3,010    .7893688    .4078247          0          1
    sinmom14 |      3,010    .1006645    .3009339          0          1
-------------+---------------------------------------------------------
      step14 |      3,010    .0388704    .1933182          0          1
      reg661 |      3,010    .0465116    .2106253          0          1
      reg662 |      3,010    .1607973     .367405          0          1
      reg663 |      3,010    .1956811      .39679          0          1
      reg664 |      3,010    .0641196    .2450066          0          1
-------------+---------------------------------------------------------
      reg665 |      3,010    .2083056     .406164          0          1
      reg666 |      3,010    .0960133    .2946584          0          1
      reg667 |      3,010    .1099668    .3129003          0          1
      reg668 |      3,010    .0282392     .165683          0          1
      reg669 |      3,010    .0903654    .2867522          0          1
-------------+---------------------------------------------------------
     south66 |      3,010    .4142857    .4926801          0          1
       black |      3,010    .2335548    .4231624          0          1
        smsa |      3,010    .7129568    .4524571          0          1
       south |      3,010    .4036545    .4907113          0          1
     smsa66 |      3,010    .6495017    .4772053          0          1
-------------+---------------------------------------------------------
        wage |      3,010    577.2824    262.9583        100       2404
      enroll |      3,010    .0923588    .2895799          0          1
         KWW |      2,963    33.54067    8.611619          4         56
          IQ |      2,061    102.4498    15.42376         50        149
     married |      3,003    2.271395    2.066823          1          6
-------------+---------------------------------------------------------
    libcrd14 |      2,997     .674341    .4686987          0          1
       exper |      3,010    8.856146    4.141672          0         23
       lwage |      3,010    6.261832    .4437976    4.60517   7.784889
     expersq |      3,010    95.57907    84.61831          0        529
```

0.2.1 IV

- **educ** is endogeneous variable
-

0.3 x = correlated with error, E(Xe)= non-zero

[6]:
```
reg lwage educ
```

```
      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(1, 3008)      =    329.54
       Model |  58.5153704         1  58.5153704   Prob > F        =    0.0000
    Residual |  534.126274     3,008  .177568575   R-squared       =    0.0987
-------------+----------------------------------   Adj R-squared   =    0.0984
       Total |  592.641645     3,009  .196956346   Root MSE        =    .42139

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0520942   .0028697    18.15   0.000     .0464674     .057721
       _cons |   5.570882   .0388295   143.47   0.000     5.494747    5.647017
------------------------------------------------------------------------------
```

[12]:
```
corr educ nearc4
```

```
(obs=3,010)

             |     educ   nearc4
-------------+------------------
        educ |   1.0000
      nearc4 |   0.1442   1.0000
```

[13]:
```
reg educ nearc4
```

```
      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(1, 3008)      =     63.91
       Model |  448.604204         1  448.604204   Prob > F        =    0.0000
    Residual |  21113.4759     3,008  7.01910767   R-squared       =    0.0208
-------------+----------------------------------   Adj R-squared   =    0.0205
       Total |  21562.0801     3,009  7.16586243   Root MSE        =    2.6494

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      nearc4 |    .829019   .1036988     7.99   0.000     .6256912    1.032347
       _cons |   12.69801   .0856416   148.27   0.000     12.53009    12.86594
------------------------------------------------------------------------------
```

[17]:
```
ivreg lwage (educ=nearc4)
```

```
Instrumental variables (2SLS) regression

      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(1, 3008)      =     51.17
       Model |  -340.11155         1  -340.11155   Prob > F        =    0.0000
    Residual |  932.753194     3,008  .310090823   R-squared       =         .
-------------+----------------------------------   Adj R-squared   =         .
       Total |  592.641645     3,009  .196956346   Root MSE        =    .55686

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1880626   .0262913     7.15   0.000     .1365118    .2396135
       _cons |   3.767472   .3488617    10.80   0.000      3.08344    4.451503
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   nearc4
------------------------------------------------------------------------------
```

OLS (educ = endo variable)

-

0.4 edu coefficient: .074009 edu sd: .0035054 adR: 0.2891

[18]:
```
reg lwage educ exper expersq black smsa south
```

```
      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(6, 3003)      =    204.93
       Model |  172.165628         6  28.6942714   Prob > F        =    0.0000
    Residual |  420.476016     3,003  .140018653   R-squared       =    0.2905
-------------+----------------------------------   Adj R-squared   =    0.2891
       Total |  592.641645     3,009  .196956346   Root MSE        =    .37419

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |    .074009   .0035054    21.11   0.000     .0671357    .0808823
       exper |   .0835958   .0066478    12.57   0.000     .0705612    .0966305
     expersq |  -.0022409   .0003178    -7.05   0.000    -.0028641   -.0016177
       black |  -.1896315   .0176266   -10.76   0.000    -.2241929   -.1550702
        smsa |    .161423   .0155733    10.37   0.000     .1308876    .1919583
       south |  -.1248615   .0151182    -8.26   0.000    -.1545046   -.0952184
       _cons |   4.733664   .0676026    70.02   0.000     4.601112    4.866216
------------------------------------------------------------------------------
```

[19]:
```
ivreg lwage (educ= nearc2 nearc4) exper expersq black smsa south
```

```
Instrumental variables (2SLS) regression

      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(6, 3003)      =    110.30
       Model |  86.2367703         6  14.3727951   Prob > F        =    0.0000
    Residual |  506.404874     3,003  .168632992   R-squared       =    0.1455
-------------+----------------------------------   Adj R-squared   =    0.1438
       Total |  592.641645     3,009  .196956346   Root MSE        =    .41065

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1608487   .0486291     3.31   0.001      .065499    .2561984
       exper |   .1192112   .0211779     5.63   0.000     .0776866    .1607358
     expersq |  -.0023052   .0003507    -6.57   0.000    -.0029928   -.0016177
       black |  -.1019726   .0526187    -1.94   0.053    -.2051449    .0011997
        smsa |   .1165736   .0303135     3.85   0.000     .0571362    .1760109
       south |  -.0951187   .0234721    -4.05   0.000    -.1411418   -.0490956
       _cons |   3.272102   .8192563     3.99   0.000     1.665742    4.878462
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq black smsa south nearc2 nearc4
------------------------------------------------------------------------------
```

[20]:
```
ivreg lwage (educ= nearc2 nearc4 fatheduc motheduc) exper expersq black smsa␣
↪south
```

```
Instrumental variables (2SLS) regression

      Source |       SS           df       MS      Number of obs   =     2,220
-------------+----------------------------------   F(6, 2213)      =     83.66
       Model |  108.419494         6  18.0699157   Prob > F        =    0.0000
    Residual |  320.580009     2,213  .144862182   R-squared       =    0.2527
-------------+----------------------------------   Adj R-squared   =    0.2507
       Total |  428.999503     2,219  .193330105   Root MSE        =    .38061

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1000713     .01263     7.92   0.000     .0753034    .1248392
       exper |   .0989441    .009482    10.43   0.000     .0803496    .1175385
     expersq |   -.002449   .0004013    -6.10   0.000    -.0032359   -.0016621
       black |  -.1504635   .0259113    -5.81   0.000    -.2012765   -.0996505
        smsa |    .150854   .0195975     7.70   0.000     .1124226    .1892854
```

```
       south |  -.1072406   .0180661    -5.94   0.000    -.1426688   -.0718123
       _cons |    4.26178    .216812    19.66   0.000     3.836604    4.686956
------------------------------------------------------------------------------
Instrumented:  educ
Instruments:   exper expersq black smsa south nearc2 nearc4 fatheduc
               motheduc
------------------------------------------------------------------------------
```

1. down load user written package: iverg2

[22]:
```
ssc install ivreg2
ssc install ranktest
```

```
checking ivreg2 consistency and verifying not already installed…
installing into /home/jikhan.jeong/ado/plus/…
installation complete.

checking ranktest consistency and verifying not already installed…
installing into /home/jikhan.jeong/ado/plus/…
installation complete.
```

[23]:
```
tabstat lwage educ nearc2 , s(mean N min max p50)
```

```
   stats |     lwage      educ    nearc2
---------+------------------------------
    mean |  6.261832  13.26346  .4408638
       N |      3010      3010      3010
     min |   4.60517         1         0
     max |  7.784889        18         1
     p50 |  6.286928        13         0
----------------------------------------
```

[25]:
```
reg lwage educ
```

```
      Source |       SS           df       MS      Number of obs   =     3,010
-------------+----------------------------------   F(1, 3008)      =    329.54
       Model |  58.5153704         1  58.5153704   Prob > F        =    0.0000
    Residual |  534.126274     3,008  .177568575   R-squared       =    0.0987
-------------+----------------------------------   Adj R-squared   =    0.0984
       Total |  592.641645     3,009  .196956346   Root MSE        =    .42139

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .0520942   .0028697    18.15   0.000     .0464674     .057721
```

```
       _cons |   5.570882   .0388295   143.47   0.000     5.494747    5.647017
------------------------------------------------------------------------------
```

result

- (1stage) nearc2 | .2552584 .0981804 2.60 p-value 0.009 1st, Y= educ (=endo var)
- (IV) `educ |  .3432739  .1274114  2.69  p-value 0.007`
- (OLS) educ | coef |.0520942 « (IV) educ|coeff |.3432739
-

0.5 (OLS) educ | sd |.0028697 « (IV) educ|coeff |.1274114

[29]:
```
ivreg2 lwage ( educ = nearc2 ), first
```

```
First-stage regressions
-----------------------


First-stage regression of educ:

Statistics consistent for homoskedasticity only
Number of obs =                  3010
------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      nearc2 |   .2552584   .0981804     2.60   0.009     .0627509    .4477659
       _cons |   13.15092   .0651894   201.73   0.000      13.0231    13.27874
------------------------------------------------------------------------------
F test of excluded instruments:
  F(  1,  3008) =     6.76
  Prob > F      =   0.0094
Sanderson-Windmeijer multivariate F test of excluded instruments:
  F(  1,  3008) =     6.76
  Prob > F      =   0.0094



Summary results for first-stage regressions
-------------------------------------------

                                          (Underid)             (Weak id)
Variable     | F(  1,  3008)  P-val | SW Chi-sq(  1) P-val | SW F(  1,  3008)
educ         |       6.76    0.0094 |        6.76   0.0093 |        6.76
```

```
Stock-Yogo weak ID F test critical values for single endogenous regressor:
                                 10% maximal IV size             16.38
                                 15% maximal IV size              8.96
                                 20% maximal IV size              6.66
                                 25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Sanderson-Windmeijer F statistic.

Underidentification test
Ho: matrix of reduced form coefficients has rank=K1-1 (underidentified)
Ha: matrix has rank=K1 (identified)
Anderson canon. corr. LM statistic       Chi-sq(1)=6.75     P-val=0.0094

Weak identification test
Ho: equation is weakly identified
Cragg-Donald Wald F statistic                                    6.76

Stock-Yogo weak ID test critical values for K1=1 and L1=1:
                                 10% maximal IV size             16.38
                                 15% maximal IV size              8.96
                                 20% maximal IV size              6.66
                                 25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.

Weak-instrument-robust inference
Tests of joint significance of endogenous regressors B1 in main equation
Ho: B1=0 and orthogonality conditions are valid
Anderson-Rubin Wald test           F(1,3008)=     29.20     P-val=0.0000
Anderson-Rubin Wald test           Chi-sq(1)=     29.21     P-val=0.0000
Stock-Wright LM S statistic        Chi-sq(1)=     28.93     P-val=0.0000

Number of observations               N  =       3010
Number of regressors                 K  =          2
Number of endogenous regressors      K1 =          1
Number of instruments                L  =          2
Number of excluded instruments       L1 =          1

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =     3010
                                                      F(  1,  3008) =     7.25
                                                      Prob > F      =   0.0071
Total (centered) SS     =  592.6416447                Centered R2   =  -2.9860
Total (uncentered) SS   =  118616.3653                Uncentered R2 =   0.9801
```

```
Residual SS               =  2362.280102                 Root MSE      =     .8859

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .3432739   .1274114     2.69   0.007     .0935522    .5929956
       _cons |   1.708834   1.689992     1.01   0.312     -1.60349    5.021158
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):           6.749
                                                      Chi-sq(1) P-val =    0.0094
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):                6.759
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           0.000
                                                     (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         educ
Excluded instruments: nearc2
------------------------------------------------------------------------------
```

[30]:
```
tabstat lwage educ, s(mean) by(nearc2)
```

```
Summary statistics: mean
  by categories of: nearc2 (=1 if near 2 yr college, 1966)

  nearc2 |     lwage      educ
---------+--------------------
       0 |  6.223202  13.15092
       1 |  6.310825  13.40618
---------+--------------------
   Total |  6.261832  13.26346
------------------------------
```

- IV coef with wald estimator : when # of IV = # endo var = 1 and dummy
- [E(y|IV=1)-E(y|IV=0)] / [E(x|IV=1)-E(x|IV=0)] = 6.310825 - 6.223202)/(13.40618-13.15092) = 0.34326960745 = (IV) educ$coeff 0.3432739

[37]:
```
ivreg2 lwage (educ=nearc2 nearc4) exper expersq black south smsa reg661 reg662␣
↪reg663 reg664 reg665 reg666 reg667 reg668 south66
```

```
Warning - collinearities detected
```

```
Vars dropped:       south66

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =      3010
                                                      F( 14,  2995) =     48.20
                                                      Prob > F      =    0.0000
Total (centered) SS     =  592.6416447                Centered R2   =    0.1320
Total (uncentered) SS   =  118616.3653                Uncentered R2 =    0.9957
Residual SS             =  514.4136847                Root MSE      =     .4134

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |    .168382   .0508209     3.31   0.001     .0687747    .2679892
       exper |   .1234909   .0221606     5.57   0.000     .0800569     .166925
     expersq |   -.002363   .0003543    -6.67   0.000    -.0030575   -.0016685
       black |  -.1133767   .0510411    -2.22   0.026    -.2134154   -.0133381
       south |  -.1409819   .0288211    -4.89   0.000    -.1974701   -.0844936
        smsa |   .1044526    .031661     3.30   0.001     .0423983     .166507
      reg661 |  -.1014153   .0442295    -2.29   0.022    -.1881034   -.0147271
      reg662 |   .0025296   .0342178     0.07   0.941     -.064536    .0695952
      reg663 |   .0492832   .0331164     1.49   0.137    -.0156238    .1141902
      reg664 |  -.0574669   .0398466    -1.44   0.149    -.1355648    .0206311
      reg665 |   .0536101    .048416     1.11   0.268    -.0412835    .1485037
      reg666 |   .0710579   .0543492     1.31   0.191    -.0354647    .1775804
      reg667 |   .0414306   .0506196     0.82   0.413     -.057782    .1406432
      reg668 |    -.20171   .0532987    -3.78   0.000    -.3061736   -.0972464
     south66 |          0  (omitted)
       _cons |   3.151123   .8666924     3.64   0.000     1.452437    4.849809
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):          17.577
                                                      Chi-sq(2) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):                8.793
Stock-Yogo weak ID test critical values: 10% maximal IV size             19.93
                                         15% maximal IV size             11.59
                                         20% maximal IV size              8.75
                                         25% maximal IV size              7.25
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           1.227
                                                      Chi-sq(1) P-val =    0.2679
------------------------------------------------------------------------------
```

```
Instrumented:         educ
Included instruments: exper expersq black south smsa reg661 reg662 reg663
                      reg664 reg665 reg666 reg667 reg668
Excluded instruments: nearc2 nearc4
Dropped collinear:    south66
------------------------------------------------------------------------------
```

[33]:
```
ivreg2 lwage (educ=nearc2 nearc4 motheduc fatheduc ) exper expersq black south␣
↪smsa reg661 reg662 reg663 reg664 reg665 reg666 reg667 reg668␣
↪south66,endog(educ)
```

```
Warning - collinearities detected
Vars dropped:       south66

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =     2220
                                                      F( 14,  2205) =    37.33
                                                      Prob > F      =   0.0000
Total (centered) SS     =  428.9995035                Centered R2   =   0.2580
Total (uncentered) SS   =  88133.52217                Uncentered R2 =   0.9964
Residual SS             =  318.3363362                Root MSE      =    .3787

------------------------------------------------------------------------------
       lwage |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1033048   .0126463     8.17   0.000     .0785185    .1280912
       exper |   .1011632   .0094696    10.68   0.000     .0826032    .1197231
     expersq |  -.0024937   .0003997    -6.24   0.000    -.0032772   -.0017103
       black |  -.1549154   .0261189    -5.93   0.000    -.2061075   -.1037234
       south |  -.1210386   .0314149    -3.85   0.000    -.1826106   -.0594666
        smsa |   .1407334   .0200711     7.01   0.000     .1013947     .180072
      reg661 |  -.0810944   .0460838    -1.76   0.078    -.1714171    .0092282
      reg662 |   .0055485   .0322823     0.17   0.864    -.0577237    .0688207
      reg663 |   .0402969   .0316206     1.27   0.203    -.0216783    .1022721
      reg664 |  -.0561783   .0406292    -1.38   0.167    -.1358101    .0234535
      reg665 |   .0079115   .0424746     0.19   0.852    -.0753372    .0911602
      reg666 |   .0219974   .0488073     0.45   0.652    -.0736632     .117658
      reg667 |   .0129433   .0463937     0.28   0.780    -.0779866    .1038732
      reg668 |  -.1615825   .0524362    -3.08   0.002    -.2643555   -.0588094
     south66 |          0  (omitted)
       _cons |   4.214819   .2213337    19.04   0.000     3.781013    4.648625
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):         232.919
```

```
                                                    Chi-sq(4) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):                64.528
Stock-Yogo weak ID test critical values:  5% maximal IV relative bias    16.85
                                         10% maximal IV relative bias    10.27
                                         20% maximal IV relative bias     6.71
                                         30% maximal IV relative bias     5.34
                                         10% maximal IV size             24.58
                                         15% maximal IV size             13.96
                                         20% maximal IV size             10.26
                                         25% maximal IV size              8.31
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           6.997
                                                    Chi-sq(3) P-val =    0.0720
-endog- option:
Endogeneity test of endogenous regressors:                               4.919
                                                    Chi-sq(1) P-val =    0.0266
Regressors tested:    educ
------------------------------------------------------------------------------
Instrumented:         educ
Included instruments: exper expersq black south smsa reg661 reg662 reg663
                      reg664 reg665 reg666 reg667 reg668
Excluded instruments: nearc2 nearc4 motheduc fatheduc
Dropped collinear:    south66
------------------------------------------------------------------------------
```

[35]:
```
ivreg2 lwage (educ=nearc2 nearc4 motheduc fatheduc ) exper expersq black south␣
↪smsa reg661 reg662 reg663 reg664 reg665 reg666 reg667 reg668 south66, robust␣
↪endog(educ)
```

```
Warning - collinearities detected
Vars dropped:       south66

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity

                                                    Number of obs =     2220
                                                    F( 14,  2205) =    41.01
                                                    Prob > F      =   0.0000
Total (centered) SS     =  428.9995035              Centered R2   =   0.2580
Total (uncentered) SS   =  88133.52217              Uncentered R2 =   0.9964
Residual SS             =  318.3363362              Root MSE      =    .3787

------------------------------------------------------------------------------
```

```
             |               Robust
       lwage |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1033048   .0131855     7.83   0.000     .0774616     .129148
       exper |   .1011632   .0097034    10.43   0.000     .0821449    .1201814
     expersq |  -.0024937   .0004125    -6.05   0.000    -.0033021   -.0016853
       black |  -.1549154   .0264311    -5.86   0.000    -.2067194   -.1031114
       south |  -.1210386   .0342771    -3.53   0.000    -.1882204   -.0538568
        smsa |   .1407334   .0194177     7.25   0.000     .1026753    .1787914
      reg661 |  -.0810944   .0456122    -1.78   0.075    -.1704927    .0083038
      reg662 |   .0055485   .0335724     0.17   0.869    -.0602521    .0713492
      reg663 |   .0402969   .0324657     1.24   0.215    -.0233347    .1039284
      reg664 |  -.0561783   .0410666    -1.37   0.171    -.1366673    .0243107
      reg665 |   .0079115    .045164     0.18   0.861    -.0806083    .0964313
      reg666 |   .0219974   .0490511     0.45   0.654    -.0741409    .1181357
      reg667 |   .0129433   .0479546     0.27   0.787     -.081046    .1069326
      reg668 |  -.1615825    .055361    -2.92   0.004     -.270088    -.053077
     south66 |          0  (omitted)
       _cons |   4.214819   .2296524    18.35   0.000     3.764708    4.664929
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):           163.546
                                                   Chi-sq(4) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              64.528
                         (Kleibergen-Paap rk Wald F statistic):        54.902
Stock-Yogo weak ID test critical values:  5% maximal IV relative bias    16.85
                                         10% maximal IV relative bias    10.27
                                         20% maximal IV relative bias     6.71
                                         30% maximal IV relative bias     5.34
                                         10% maximal IV size             24.58
                                         15% maximal IV size             13.96
                                         20% maximal IV size             10.26
                                         25% maximal IV size              8.31
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         6.602
                                                   Chi-sq(3) P-val =    0.0857
-endog- option:
Endogeneity test of endogenous regressors:                               4.161
                                                   Chi-sq(1) P-val =    0.0414
Regressors tested:    educ
------------------------------------------------------------------------------
Instrumented:         educ
Included instruments: exper expersq black south smsa reg661 reg662 reg663
                      reg664 reg665 reg666 reg667 reg668
Excluded instruments: nearc2 nearc4 motheduc fatheduc
Dropped collinear:    south66
```

[36]:
```
ivreg2 lwage (educ=nearc2 nearc4 motheduc fatheduc ) exper expersq black south␣
↪smsa reg661 reg662 reg663 reg664 reg665 reg666 reg667 reg668 south66, gmm2s␣
↪robust endog(educ)
```

```
Warning - collinearities detected
Vars dropped:       south66

2-Step GMM estimation
---------------------

Estimates efficient for arbitrary heteroskedasticity
Statistics robust to heteroskedasticity

                                                      Number of obs =     2220
                                                      F( 14,  2205) =    41.36
                                                      Prob > F      =   0.0000
Total (centered) SS     =  428.9995035                Centered R2   =   0.2593
Total (uncentered) SS   =  88133.52217                Uncentered R2 =   0.9964
Residual SS             =  317.7482854                Root MSE      =    .3783

------------------------------------------------------------------------------
             |               Robust
       lwage |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        educ |   .1019251   .0131539     7.75   0.000     .0761439    .1277063
       exper |   .1005025    .009696    10.37   0.000     .0814987    .1195062
     expersq |  -.0024961   .0004124    -6.05   0.000    -.0033044   -.0016877
       black |  -.1581387   .0263309    -6.01   0.000    -.2097464   -.1065311
       south |  -.1178039   .0342158    -3.44   0.001    -.1848655   -.0507422
        smsa |   .1418818   .0193754     7.32   0.000     .1039068    .1798568
      reg661 |  -.0856218   .0454736    -1.88   0.060    -.1747484    .0035047
      reg662 |   .0045187    .033528     0.13   0.893    -.0611949    .0702323
      reg663 |   .0386119   .0324063     1.19   0.233    -.0249033    .1021271
      reg664 |  -.0576173   .0410222    -1.40   0.160    -.1380193    .0227847
      reg665 |   .0030289   .0451069     0.07   0.946    -.0853789    .0914368
      reg666 |   .0115389   .0487421     0.24   0.813    -.0839939    .1070716
      reg667 |   .0070103   .0478721     0.15   0.884    -.0868174     .100838
      reg668 |  -.1677087   .0552444    -3.04   0.002    -.2759856   -.0594317
     south66 |          0  (omitted)
       _cons |   4.240126   .2290215    18.51   0.000     3.791253       4.689
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):           163.546
                                                   Chi-sq(4) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              64.528
                         (Kleibergen-Paap rk Wald F statistic):        54.902
```

```
Stock-Yogo weak ID test critical values:  5% maximal IV relative bias    16.85
                                         10% maximal IV relative bias    10.27
                                         20% maximal IV relative bias     6.71
                                         30% maximal IV relative bias     5.34
                                         10% maximal IV size             24.58
                                         15% maximal IV size             13.96
                                         20% maximal IV size             10.26
                                         25% maximal IV size              8.31
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         6.602
                                                    Chi-sq(3) P-val =    0.0857
-endog- option:
Endogeneity test of endogenous regressors:                               4.161
                                                    Chi-sq(1) P-val =    0.0414
Regressors tested:    educ
------------------------------------------------------------------------------
Instrumented:         educ
Included instruments: exper expersq black south smsa reg661 reg662 reg663
                      reg664 reg665 reg666 reg667 reg668
Excluded instruments: nearc2 nearc4 motheduc fatheduc
Dropped collinear:    south66
------------------------------------------------------------------------------
```