```
--------------------------------------------------------------------------
--------------------------------------------------------------------------
------------
      name:  <unnamed>
       log:  C:\Users\nw\Documents\HILDA Project\Training\Melbourne Nov
2011\Exercises\ex5.log
  log type:  text
 opened on:   8 Nov 2011, 09:31:29

.
. *************************************************************
. * Load the panel data and tell Stata it is panel data         *
. * then, only keep males to reduce the sample size and increase*
. * the speed of estimation.
*
. *************************************************************
. use "`working'\panelex5.dta",replace

. tsset id wave
       panel variable:  id (unbalanced)
        time variable:  wave, 1 to 9, but with gaps
                delta:  1 unit

. tab2 wave sex

-> tabulation of wave by sex

           |          Sex
      wave |  [1] Male  [2] Femal |     Total
-----------+----------------------+----------
         1 |     3,380      3,306 |     6,686 
         2 |     3,245      3,137 |     6,382 
         3 |     3,223      3,148 |     6,371 
         4 |     3,175      3,083 |     6,258 
         5 |     3,283      3,319 |     6,602 
         6 |     3,372      3,415 |     6,787 
         7 |     3,344      3,472 |     6,816 
         8 |     3,380      3,446 |     6,826 
         9 |     3,488      3,491 |     6,979 
-----------+----------------------+----------
     Total |    29,890     29,817 |    59,707 


. sort id wave

. keep if sex==1
(29817 observations deleted)

.
.
. ************************************************************
. * We continue with the estimation of a linear earnings model.*
. * However, we are now concerned with another additional      *
. * problem:                                                   *
. * - that there might exist important unobserved factors      *
. *   (such as motivation, ability, etc.) that affect wages    *
. *   (already seen - this is controlled for in the FE model); *
. * - that job tenure might be affected by the same            *
```

```
. *   unobserved factors (already seen - this is controlled    *
. *   for in the FE model as long as these factors are time-   *
. *   invariant);                                               *
. * - that job tenure is correlated with the error terms       *
. *   epsilon(it) (seen in last exercise);                      *
. * - that there may be slow adjustment of earnings to changes *
. *   in circumstances (new).                                   *
. * In order to address all these issues, we will estimate a   *
. * dynamic wage equation.                                      *
. *************************************************************
. *************************************************************
. * We will firstly estimate dynamic models with one lag using *
. * the pooled OLS estimator, the fixed effect estimator, the  *
. * random effect estimator, and the first-difference estimator*
. * and we will compare them to the static wage models. Recall *
. * that the standard Least Square Dummy Variable estimator is *
. * inconsistent in a normal panel setting when N is large and *
. * T is fixed (Nickell, [1981]).                               *
. * Note: lags and first-differences can be created directly   *
. * within the syntax of a command in Stata 9, with no need to *
. * create them in advance using the "generate" command, and   *
. * the "l." and the "d." operators. We will also create linear*
. * splines of age, rather than using age and agesq, with knots*
. * at 20, 30, 40 and 50. Also use dummy variables for year.   *
. *************************************************************
.
. list id wave lwage_hr l.lwage_hr l2.lwage_hr in 1/10

     +---------------------------------------------------+
     |                                     L.        L2.|
     |     id   wave   lwage_hr   lwage_hr   lwage_hr |
     |---------------------------------------------------|
  1. | 100001      2   2.822461          .          . |
  2. | 100001      3   2.995732   2.822461          . |
  3. | 100001      4   2.931194   2.995732   2.822461 |
  4. | 100003      7   2.779509          .          . |
  5. | 100003      9   3.149883          .   2.779509 |
     |---------------------------------------------------|
  6. | 100014      1   3.378241          .          . |
  7. | 100014      2   3.530826   3.378241          . |
  8. | 100014      3   3.658666   3.530826   3.378241 |
  9. | 100014      4   3.635748   3.658666   3.530826 |
 10. | 100014      5   3.672678   3.635748   3.658666 |
     +---------------------------------------------------+

. mkspline age1 20 age2 30 age3 40 age4 50 age5 =hgage

.
. /*NB: cluster() implies robust; specifying robust cluster()*/
. /*is equivalent to typing cluster() by itself.*/
.
. * create binary variable w1- w7 *
. recode wave(1=1) (else=0), gen(w1)
(26510 differences between wave and w1)

. recode wave(2=1) (else=0), gen(w2)
(29890 differences between wave and w2)
```

```
. recode wave(3=1) (else=0), gen(w3)
(29890 differences between wave and w3)

. recode wave(4=1) (else=0), gen(w4)
(29890 differences between wave and w4)

. recode wave(5=1) (else=0), gen(w5)
(29890 differences between wave and w5)

. recode wave(6=1) (else=0), gen(w6)
(29890 differences between wave and w6)

. recode wave(7=1) (else=0), gen(w7)
(29890 differences between wave and w7)

. recode wave(8=1) (else=0), gen(w8)
(29890 differences between wave and w8)

. recode wave(9=1) (else=0), gen(w9)
(29890 differences between wave and w9)

.
.
. * Dynamic pooled OLS estimator *
. reg lwage_hr l.lwage_hr age2-age5 jbemp tucov permanent nsw ///
>  w1-w9, cl(id)
note: w1 omitted because of collinearity
note: w4 omitted because of collinearity

Linear regression                                      Number of obs =
21421
                                                       F( 16,  4830) =
1087.14
                                                       Prob > F      =
0.0000
                                                       R-squared     =
0.5955
                                                       Root MSE      =
.32466

                                  (Std. Err. adjusted for 4831 clusters
in id)
--------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .6968933   .0126734    54.99   0.000     .6720477
.7217389
             |
        age2 |   .0119925   .0012587     9.53   0.000      .009525
.01446
        age3 |   .0003756   .0009016     0.42   0.677     -.001392
.0021432
```

```
        age4 |  -.0013663   .0009745    -1.40   0.161    -.0032768
.0005442
        age5 |   .0001102   .0013864     0.08   0.937    -.0026078
.0028281
      jbempt |   .0012374   .0003768     3.28   0.001     .0004988
.0019761
       tucov |   .0189416   .0053118     3.57   0.000     .0085281
.0293551
   permanent |  -.0067281   .0066064    -1.02   0.309    -.0196797
.0062234
         nsw |   .0090174   .0055169     1.63   0.102    -.0017982
.0198329
          w1 |  (omitted)
          w2 |  -.0302597   .0087858    -3.44   0.001     -.047484   -
.0130355
          w3 |  -.0161759   .0096115    -1.68   0.092    -.0350189
.0026671
          w4 |  (omitted)
          w5 |   .0188238   .0092425     2.04   0.042     .0007044
.0369433
          w6 |   .0361382   .0083313     4.34   0.000      .019805
.0524714
          w7 |   .0643318   .0085909     7.49   0.000     .0474896
.0811739
          w8 |    .066388   .0087427     7.59   0.000     .0492484
.0835276
          w9 |   .0697705   .0089367     7.81   0.000     .0522505
.0872904
       _cons |   .8553246   .0309531    27.63   0.000     .7946424
.9160067
--------------------------------------------------------------------------
-----

.
. * Dynamic RE estimator *
. xtreg lwage_hr l.lwage_hr age2-age5 jbemp tucov permanent nsw ///
>  w1-w9, re cl(id)
note: w1 omitted because of collinearity
note: w9 omitted because of collinearity

Random-effects GLS regression                   Number of obs      =
21421
Group variable: id                              Number of groups   =
4831

R-sq:  within  = 0.1982                         Obs per group: min =
1
       between = 0.6294                                        avg =
4.4
       overall = 0.5482                                        max =
8

                                                Wald chi2(16)      =
9589.69
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =
0.0000
```

```
                                  (Std. Err. adjusted for 4831 clusters
in id)
--------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+------------------------------------------------------------
-----
    lwage_hr |
         L1. |    .398135   .0153086    26.01   0.000     .3681307
.4281393
             |
        age2 |   .0309413   .0015981    19.36   0.000     .0278091
.0340735
        age3 |   .0025211   .0011601     2.17   0.030     .0002474
.0047948
        age4 |  -.0013234   .0012247    -1.08   0.280    -.0037238
.0010769
        age5 |  -.0017407   .0017339    -1.00   0.315    -.0051391
.0016577
      jbempt |   .0019689   .0005274     3.73   0.000     .0009353
.0030025
       tucov |   .0347616   .0070544     4.93   0.000     .0209352
.0485881
   permanent |  -.0132309   .0070376    -1.88   0.060    -.0270244
.0005625
         nsw |   .0233081   .0091798     2.54   0.011     .0053161
.0413001
          w1 |  (omitted)
          w2 |  -.2139693    .009825   -21.78   0.000    -.2332259   -
.1947127
          w3 |  -.1859635     .00963   -19.31   0.000     -.204838   -
.1670891
          w4 |  -.1571971   .0087967   -17.87   0.000    -.1744383   -
.1399558
          w5 |  -.1243144   .0084979   -14.63   0.000      -.14097   -
.1076588
          w6 |  -.0904175   .0080016   -11.30   0.000    -.1061003   -
.0747347
          w7 |  -.0468241   .0072647    -6.45   0.000    -.0610627   -
.0325855
          w8 |  -.0235518   .0077749    -3.03   0.002    -.0387903   -
.0083133
          w9 |  (omitted)
       _cons |   1.709485   .0418107    40.89   0.000     1.627537
1.791433
-------------+------------------------------------------------------------
-----
     sigma_u |   .2000063
     sigma_e |  .25222695
         rho |  .38604663   (fraction of variance due to u_i)
--------------------------------------------------------------------------
-----

.
. * Dynamic FE estimator *
. xtreg lwage_hr l.lwage_hr age2-age5 jbemp tucov permanent nsw ///
```

```
>  w1-w9, fe cl(id)
note: w1 omitted because of collinearity
note: w2 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =
21421
Group variable: id                              Number of groups   =
4831

R-sq:  within  = 0.2875                         Obs per group: min =
1
       between = 0.0885                                        avg =
4.4
       overall = 0.0450                                        max =
8

                                                F(16,4830)         =
258.55
corr(u_i, Xb)  = -0.9659                        Prob > F           =
0.0000

                                   (Std. Err. adjusted for 4831 clusters
in id)
------------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+----------------------------------------------------------------
-----
    lwage_hr |
         L1. |     .02967   .0148089     2.00   0.045     .0006378
.0587022
             |
        age2 |   -.095134   .0091958   -10.35   0.000    -.1131619    -
.077106
        age3 |  -.1259262    .008767   -14.36   0.000    -.1431135    -
.108739
        age4 |  -.1363629   .0087253   -15.63   0.000    -.1534685   -
.1192574
        age5 |  -.1417049   .0091042   -15.56   0.000    -.1595532   -
.1238566
      jbempt |   .0001848   .0008221     0.22   0.822    -.0014269
.0017966
       tucov |   .0392642   .0099627     3.94   0.000     .0197328
.0587957
   permanent |  -.0419392   .0081455    -5.15   0.000    -.0579081   -
.0259703
         nsw |   .0376911   .0291235     1.29   0.196    -.0194041
.0947864
          w1 |  (omitted)
          w2 |  (omitted)
          w3 |   .1814797   .0113095    16.05   0.000     .1593079
.2036515
          w4 |   .3590308   .0189392    18.96   0.000     .3219013
.3961603
          w5 |   .5446367   .0271792    20.04   0.000     .4913531
.5979203
```

```
          w6 |   .7347863   .0355698    20.66   0.000     .6650532
.8045193
          w7 |   .9345034   .0442141    21.14   0.000     .8478236
1.021183
          w8 |   1.117941   .0529174    21.13   0.000     1.014198
1.221683
          w9 |   1.299532   .0614092    21.16   0.000     1.179142
1.419922
       _cons |   4.438944   .1416821    31.33   0.000     4.161183
4.716706
-------------+----------------------------------------------------------
-----
     sigma_u |  1.8826131
     sigma_e |  .25222695
         rho |  .98236667   (fraction of variance due to u_i)
------------------------------------------------------------------------
-----

.
. * First-difference estimator
. reg d.lwage_hr ld.lwage d.age2 d.age3 d.age4 d.age5 ///
>     d.jbemp d.tucov d.permanent d.nsw d.w2 d.w3 d.w4 ///
>     d.w5 d.w6 d.w7 d.w8 d.w9, cl(id) noconstant
note: _delete omitted because of collinearity

Linear regression                                      Number of obs =
15966
                                                       F( 16,  3834) =

158.66
                                                       Prob > F      =

0.0000
                                                       R-squared     =

0.2088
                                                       Root MSE      =

.29246

                                  (Std. Err. adjusted for 3835 clusters
in id)
------------------------------------------------------------------------
-----
             |               Robust
  D.lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+----------------------------------------------------------
-----
    lwage_hr |
         LD. |  -.3803641   .0133773   -28.43   0.000    -.4065913   -
.3541368
             |
        age2 |
         D1. |   -.098604    .013198    -7.47   0.000    -.1244798   -
.0727281
             |
        age3 |
         D1. |  -.1481024   .0127252   -11.64   0.000    -.1730513   -
.1231536
             |
        age4 |
```

```
         D1. |   -.160278    .012597   -12.72   0.000    -.1849755   -
.1355805
             |
        age5 |
         D1. |  -.1608587   .0129052   -12.46   0.000    -.1861604   -
.1355571
             |
      jbempt |
         D1. |  -.0005206   .0006735    -0.77   0.440    -.0018411
.0007999
             |
       tucov |
         D1. |    .034354   .0088714     3.87   0.000     .0169609
.0517471
             |
   permanent |
         D1. |  -.0323504   .0070266    -4.60   0.000    -.0461268   -
.0185741
             |
         nsw |
         D1. |    .021837   .0350111     0.62   0.533    -.0468052
.0904792
             |
          w2 |
         D1. |  (omitted)
             |
          w3 |
         D1. |   .2239701   .0140693    15.92   0.000     .1963861
.2515541
             |
          w4 |
         D1. |   .4476052   .0260958    17.15   0.000     .3964422
.4987683
             |
          w5 |
         D1. |   .6795914   .0381034    17.84   0.000     .6048865
.7542964
             |
          w6 |
         D1. |   .9136215    .050182    18.21   0.000     .8152355
1.012007
             |
          w7 |
         D1. |   1.159318   .0621733    18.65   0.000     1.037422
1.281214
             |
          w8 |
         D1. |    1.39919   .0741113    18.88   0.000     1.253889
1.544492
             |
          w9 |
         D1. |   1.626343   .0862368    18.86   0.000     1.457269
1.795418
--------------------------------------------------------------------------
-----

.
. /* note ld. or dl. creates the first lad of the first-diff */
```

```
.
. **************************************************************
. * Note: the size of the coefficient on the lagged dependent  *
. * variable in the different specifications is as predicted by*
. * the theory. In particular, the coefficient in the first-   *
. * difference model is even negative, due to the negative     *
. * correlation between the differenced lagged wage and the    *
. * differenced error term.                                    *
. **************************************************************
.
. **************************************************************
. * Now we estimate the dynamic wage equation using the simple *
. * Anderson-Hsiao [1982] estimator. This involves first time- *
. * differencing the data, and then using the observations on  *
. * wages lagged two periods (as one is used up in the         *
. * differencing process) [or more] as instrument for the first*
. * difference. This estimator is consistent, but inefficient, *
. * as it does not make use of all the available information.  *
. **************************************************************
. ivreg d.lwage_hr ld.lwage d.age2 d.age3 d.age4 d.age5 ///
>     d.jbemp d.tucov d.permanent d.nsw d.w2 d.w3 d.w4 ///
>     d.w5 d.w6 d.w7 d.w8 d.w9 (ld.lwage_hr=l2.lwage_hr), ///
>     first cl(id) noconstant

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

      Source |       SS       df       MS              Number of obs =
15966
-------------+------------------------------           F( 17, 15949) =
.
       Model |  1924.12636    17  113.183903           Prob > F      =
.
    Residual |           0 15949           0           R-squared     =
1.0000
-------------+------------------------------           Adj R-squared =
1.0000
       Total |  1924.12636 15966   .12051399           Root MSE      =
0

------------------------------------------------------------------------------
 LD.lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+----------------------------------------------------------------
    lwage_hr |
         LD. |          1          .        .       .            .
.
             |
        age2 |
         D1. |   1.02e-16          .        .       .            .
.
             |
        age3 |
         D1. |   6.95e-17          .        .       .            .
.
             |
```

```
        age4 |
         D1. |   6.23e-17          .        .       .            .
.
             |
        age5 |
         D1. |   6.56e-17          .        .       .            .
.
             |
      jbempt |
         D1. |   1.07e-19          .        .       .            .
.
             |
       tucov |
         D1. |   5.50e-19          .        .       .            .
.
             |
   permanent |
         D1. |   5.56e-18          .        .       .            .
.
             |
         nsw |
         D1. |  -3.07e-18          .        .       .            .
.
             |
          w2 |
         D1. |   3.31e-15          .        .       .            .
.
             |
          w3 |
         D1. |   2.86e-15          .        .       .            .
.
             |
          w4 |
         D1. |   2.39e-15          .        .       .            .
.
             |
          w5 |
         D1. |   1.93e-15          .        .       .            .
.
             |
          w6 |
         D1. |   1.45e-15          .        .       .            .
.
             |
          w7 |
         D1. |   9.76e-16          .        .       .            .
.
             |
          w8 |
         D1. |   4.90e-16          .        .       .            .
.
             |
          w9 |
         D1. |  (omitted)
             |
    lwage_hr |
         L2. |   1.28e-16          .        .       .            .
.
```

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

Instrumental variables (2SLS) regression               Number of obs =
15966
                                                       F( 16,  3834) =
158.66
                                                       Prob > F      =
0.0000
                                                       R-squared     =
.
                                                       Root MSE      =
.29246

                                  (Std. Err. adjusted for 3835 clusters
in id)
------------------------------------------------------------------------------
-----
             |               Robust
  D.lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+----------------------------------------------------------------
-----
    lwage_hr |
         LD. |  -.3803641   .0133773   -28.43   0.000    -.4065913   -
.3541368
         LD. |  (omitted)
             |
        age2 |
         D1. |   -.098604    .013198    -7.47   0.000    -.1244798   -
.0727281
             |
        age3 |
         D1. |  -.1481024   .0127252   -11.64   0.000    -.1730513   -
.1231536
             |
        age4 |
         D1. |   -.160278    .012597   -12.72   0.000    -.1849755   -
.1355805
             |
        age5 |
         D1. |  -.1608587   .0129052   -12.46   0.000    -.1861604   -
.1355571
             |
      jbempt |
         D1. |  -.0005206   .0006735    -0.77   0.440    -.0018411
.0007999
             |
       tucov |
         D1. |    .034354   .0088714     3.87   0.000     .0169609
.0517471
             |
   permanent |
         D1. |  -.0323504   .0070266    -4.60   0.000    -.0461268   -
.0185741
             |
         nsw |
```

```
         D1. |    .021837   .0350111     0.62   0.533    -.0468052
.0904792
             |
          w2 |
         D1. |  (omitted)
             |
          w3 |
         D1. |   .2239701   .0140693    15.92   0.000     .1963861
.2515541
             |
          w4 |
         D1. |   .4476052   .0260958    17.15   0.000     .3964422
.4987683
             |
          w5 |
         D1. |   .6795914   .0381034    17.84   0.000     .6048865
.7542964
             |
          w6 |
         D1. |   .9136215    .050182    18.21   0.000     .8152355
1.012007
             |
          w7 |
         D1. |   1.159318   .0621733    18.65   0.000     1.037422
1.281214
             |
          w8 |
         D1. |    1.39919   .0741113    18.88   0.000     1.253889
1.544492
             |
          w9 |
         D1. |   1.626343   .0862368    18.86   0.000     1.457269
1.795418
--------------------------------------------------------------------------
-----
Instrumented:  LD.lwage_hr
Instruments:   LD.lwage_hr D.age2 D.age3 D.age4 D.age5 D.jbempt D.tucov
               D.permanent D.nsw D.w2 D.w3 D.w4 D.w5 D.w6 D.w7 D.w8 D.w9
               L2.lwage_hr
--------------------------------------------------------------------------
-----

.
. ************************************************************
. * The "canned" Stata routine for linear dynamic panel data   *
. * models is xtabond. However, this command can only perform  *
. * the Arellano-Bond [1991] estimator. So, we will first use  *
. * it for its simplicity, and we will then show how to use a  *
. * more advanced user-written command, xtabond2.              *
. ************************************************************
.
. ************************************************************
. * First estimate the dynamic wage equation with only one lag *
. * using the A-B estimator, and compare the estimate of the   *
. * coefficient on the wage in the previous period to those    *
. * from the OLS, RE and FE estimators used above: is the sign *
. * of the bias as predicted by the theory?                    *
. * Now check the diagnostics:                                 *
```

```
. * - what does the Sargan test of overidentifying restrictions*
. *   suggest?                                                 *
. * - is there any evidence of first- or second-order          *
. *   autocorrelation? Is this problematic?                    *
. *************************************************************
.
. * One-step A-B estimator with one lag *
. xtabond lwage_hr age2-age5 jbemp tucov permanent nsw ///
>          w1-w9, lags(1)
note: w1 dropped from div() because of collinearity
note: w1 dropped because of collinearity
note: w4 dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs         =
15966
Group variable: id                           Number of groups      =
3835
Time variable: wave
                                             Obs per group:    min =
1
                                                               avg =
4.163233
                                                               max =
7

Number of instruments =     44               Wald chi2(16)         =
4207.76
                                             Prob > chi2           =
0.0000
One-step results
------------------------------------------------------------------------------
-----
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+----------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .0954983   .0133694     7.14   0.000     .0692947
.1217019
             |
        age2 |  -.0645156   .0093825    -6.88   0.000    -.0829049   -
.0461263
        age3 |  -.0994718   .0088425   -11.25   0.000    -.1168027   -
.0821409
        age4 |  -.1066205     .00882   -12.09   0.000    -.1239074   -
.0893337
        age5 |  -.1078009   .0090147   -11.96   0.000    -.1254695   -
.0901324
      jbempt |  -.0008499   .0007508    -1.13   0.258    -.0023215
.0006217
       tucov |   .0288931   .0100001     2.89   0.004     .0092931
.048493
   permanent |   -.035712   .0076383    -4.68   0.000    -.0506828   -
.0207412
         nsw |   .0316156   .0261638     1.21   0.227    -.0196645
.0828957
          w2 |  -.2986033   .0185429   -16.10   0.000    -.3349467   -
.2622599
```

```
          w3 |   -.149319   .0110846   -13.47   0.000    -.1710443   -
.1275937
          w5 |   .1548815   .0110928    13.96   0.000     .1331401
.1766229
          w6 |   .3069325   .0186825    16.43   0.000     .2703154
.3435496
          w7 |   .4749845   .0268068    17.72   0.000     .4224442
.5275249
          w8 |   .6246617   .0352177    17.74   0.000     .5556362
.6936872
          w9 |   .7726672   .0434684    17.78   0.000     .6874707
.8578637
       _cons |   4.129476    .157372    26.24   0.000     3.821032
4.437919
---------------------------------------------------------------------------
-----
Instruments for differenced equation
        GMM-type: L(2/.).lwage_hr
        Standard: D.age2 D.age3 D.age4 D.age5 D.jbempt D.tucov
D.permanent D.nsw D.w2 D.w3 D.w4 D.w5 D.w6 D.w7 D.w8 D.w9
Instruments for level equation
        Standard: _cons

.
. * One-step A-B estimator with two lags *
. xtabond lwage_hr age2-age5 jbemp tucov permanent nsw ///
>           w1-w9, lags(2)
note: w1 dropped from div() because of collinearity
note: w2 dropped from div() because of collinearity
note: w1 dropped because of collinearity
note: w2 dropped because of collinearity
note: w3 dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs         =
11952
Group variable: id                           Number of groups      =
3094
Time variable: wave
                                             Obs per group:    min =
1
                                                               avg =
3.862961
                                                               max =
6

Number of instruments =     42               Wald chi2(16)         =
2954.38
                                             Prob > chi2           =
0.0000
One-step results
---------------------------------------------------------------------------
-----
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+-------------------------------------------------------------
-----
    lwage_hr |
```

```
         L1. |   .1537381   .0235419     6.53   0.000     .1075969
.1998793
         L2. |   .0622678    .013614     4.57   0.000     .0355849
.0889507
             |
        age2 |  -.0554004   .0139392    -3.97   0.000    -.0827207   -
.0280801
        age3 |   -.076711   .0137109    -5.59   0.000     -.103584   -
.0498381
        age4 |  -.0882888   .0137442    -6.42   0.000    -.1152269   -
.0613507
        age5 |  -.0900198   .0139551    -6.45   0.000    -.1173712   -
.0626683
      jbempt |   -.000812   .0008202    -0.99   0.322    -.0024195
.0007955
       tucov |    .038379    .011434     3.36   0.001     .0159688
.0607892
   permanent |  -.0307553   .0089465    -3.44   0.001    -.0482901   -
.0132204
         nsw |   .0175135   .0291983     0.60   0.549    -.0397141
.074741
          w4 |   .1297879   .0157477     8.24   0.000      .098923
.1606528
          w5 |   .2603455   .0290157     8.97   0.000     .2034758
.3172152
          w6 |   .3828229   .0429822     8.91   0.000     .2985795
.4670664
          w7 |   .5220487   .0569948     9.16   0.000      .410341
.6337564
          w8 |   .6484401   .0711732     9.11   0.000     .5089431
.7879371
          w9 |   .7747644   .0852334     9.09   0.000       .60771
.9418187
       _cons |   3.458177   .2646553    13.07   0.000     2.939462
3.976892
--------------------------------------------------------------------------
-----
Instruments for differenced equation
        GMM-type: L(2/.).lwage_hr
        Standard: D.age2 D.age3 D.age4 D.age5 D.jbempt D.tucov
D.permanent D.nsw D.w3 D.w4 D.w5 D.w6 D.w7 D.w8 D.w9
Instruments for level equation
        Standard: _cons

.
. ***************************************************************
. * Note: by explicitly modelling the dynamics of earnings with*
. * the addition of a second lag we can no longer reject the   *
. * null hypothesis of no second-order serial correlation in   *
. * the differenced residuals. What about three lags?          *
. ***************************************************************
. ***************************************************************
. * Note: The one-step estimator is recommended for inference, *
. * the two-step estimator is recommended to evaluate the      *
. * Sargan test and the specification of the model, as its     *
. * standard errors are known to have poor finite sample       *
. * properties.                                                *
. ***************************************************************
```

```
. * two-step A-B estimator with three lags *
. xtabond lwage_hr age2-age5 jbemp tucov permanent nsw ///
>           w1-w9, lags(3) twostep
note: w1 dropped from div() because of collinearity
note: w2 dropped from div() because of collinearity
note: w3 dropped from div() because of collinearity
note: w1 dropped because of collinearity
note: w2 dropped because of collinearity
note: w3 dropped because of collinearity
note: w4 dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs         =
8823
Group variable: id                           Number of groups      =
2536
Time variable: wave
                                             Obs per group:    min =
1
                                                               avg =
3.479101
                                                               max =
5

Number of instruments =     39               Wald chi2(16)         =
1804.79
                                             Prob > chi2           =
0.0000
Two-step results
---------------------------------------------------------------------------
-----
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+-------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .2520954   .0450209     5.60   0.000     .1638561
.3403348
         L2. |   .1423514   .0264557     5.38   0.000     .0904991
.1942037
         L3. |     .03196   .0181309     1.76   0.078    -.0035759
.0674959
             |
        age2 |  -.0760488   .0309955    -2.45   0.014    -.1367989   -
.0152986
        age3 |  -.0911472   .0311254    -2.93   0.003    -.1521518   -
.0301426
        age4 |  -.0976093   .0313948    -3.11   0.002    -.1591419   -
.0360766
        age5 |  -.0979276    .031759    -3.08   0.002    -.1601742    -
.035681
      jbempt |   -.000479   .0010975    -0.44   0.663    -.0026302
.0016721
       tucov |     .04155   .0144995     2.87   0.004     .0131315
.0699686
   permanent |  -.0225235   .0124983    -1.80   0.072    -.0470197
.0019728
         nsw |   .0681906   .0544617     1.25   0.211    -.0385523
.1749335
```

```
          w5 |   .1301089   .0338283     3.85   0.000     .0638066
.1964111
          w6 |   .2521842   .0664608     3.79   0.000     .1219234
.3824449
          w7 |   .3872871   .0989889     3.91   0.000     .1932724
.5813018
          w8 |   .5171124   .1321057     3.91   0.000       .25819
.7760348
          w9 |   .6385908   .1650019     3.87   0.000     .3151931
.9619886
       _cons |   3.275822   .6491967     5.05   0.000     2.003419
4.548224
------------------------------------------------------------------------------
-----
Warning: gmm two-step standard errors are biased; robust standard
         errors are recommended.
Instruments for differenced equation
        GMM-type: L(2/.).lwage_hr
        Standard: D.age2 D.age3 D.age4 D.age5 D.jbempt D.tucov
D.permanent D.nsw D.w4 D.w5 D.w6 D.w7 D.w8 D.w9
Instruments for level equation
        Standard: _cons


.
.
. ************************************************************
. * Now we install xtabond2, and we show how to use it first   *
. * to implement the A-B estimator (i.e. to replicate xtabond's*
. * results), and then to implement the more efficient Blundell*
. * -Bond [1998] estimator. For the replication example, we    *
. * choose a one-step version with two lags, job tenure treated*
. * as endogenous and tucov treated as predetermined (recall   *
. * that predetermined variables are correlated with past      *
. * errors, while endogenous ones are correlated with past and *
. * present errors).                                           *
. * Warning: difference in syntax! xtabond2 is more complicated*
. * but you have fuller control of the instrument matrix. In   *
. * addition, for one-step robust estimation (and for all two- *
. * step estimations), xtabond2 reports the Hansen J statistic,*
. * which is robust to heteroskedasticity and autocorrelation. *
. ************************************************************
.
. ssc inst xtabond2, replace
checking xtabond2 consistency and verifying not already installed...
all files already exist and are up to date.


.
. mata: mata set matafavor speed // to speed up computation


.
. ************************************************************
. * The latest version of xtabond2 uses the Mata programming   *
. * language available in Stata 9. To use it with earlier     *
. * versions of Stata, include the nomata option.             *
. ************************************************************
.
. * Replicate A-B results (one-step estimator with two lags)
. xtabond lwage_hr age2-age5 w1-w9, lags(2) ///
```

```
>         pre(jbemp, endog) pre(tucov) robust small nocons
small is a deprecated option
note: w1 dropped from div() because of collinearity
note: w9 dropped from div() because of collinearity
note: w1 dropped because of collinearity
note: w2 dropped because of collinearity

Arellano-Bond dynamic panel-data estimation  Number of obs         =
11952
Group variable: id                           Number of groups      =
3094
Time variable: wave
                                             Obs per group:    min =
1
                                                               avg =
3.862961
                                                               max =
6

Number of instruments =     97               Wald chi2(14)         =
2184.33
                                             Prob > chi2           =
0.0000
One-step results
                                     (Std. Err. adjusted for clustering
on id)
-------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+-----------------------------------------------------------
-----
    lwage_hr |
         L1. |   .1437217   .0324417     4.43   0.000     .0801371
.2073063
         L2. |   .0567555   .0186272     3.05   0.002     .0202469
.0932641
             |
      jbempt |  -.0136771   .0068039    -2.01   0.044    -.0270126   -
.0003416
       tucov |   .0748146    .021221     3.53   0.000     .0332221
.116407
        age2 |   -.055443   .0195159    -2.84   0.004    -.0936934   -
.0171926
        age3 |   -.075088   .0193822    -3.87   0.000    -.1130765   -
.0370995
        age4 |  -.0868559   .0194515    -4.47   0.000    -.1249801   -
.0487317
        age5 |  -.0868297   .0198158    -4.38   0.000     -.125668   -
.0479913
          w3 |  -.8075558   .1207021    -6.69   0.000    -1.044128    -
.570984
          w4 |  -.6723289   .1010585    -6.65   0.000    -.8703999   -
.4742579
          w5 |  -.5353715   .0809895    -6.61   0.000    -.6941079    -
.376635
```

```
         w6 |  -.4092353   .0610725    -6.70   0.000    -.5289351   -
.2895354
         w7 |  -.2650086   .0412566    -6.42   0.000      -.34587   -
.1841472
         w8 |  -.1312016   .0211052    -6.22   0.000    -.1725669   -
.0898362
         w9 |  (omitted)
------------------------------------------------------------------------------
-----
Instruments for differenced equation
        GMM-type: L(2/.).lwage_hr L(2/.).jbempt L(1/.).tucov
        Standard: D.age2 D.age3 D.age4 D.age5 D.w2 D.w3 D.w4 D.w5 D.w6
D.w7 D.w8

.
.
. xtabond2 lwage_hr l.lwage_hr l2.lwage_hr age2-age5 jbemp tucov ///
>         w1-w9, gmm(l.lwage_hr l2.lwage_hr l.jbemp ///
>         tucov) iv(age2-age5 w1-w9) noleveleq robust ///
>         nomata small
w1 dropped because of collinearity.
w2 dropped because of collinearity.
w3 dropped because of collinearity.
Building GMM instruments.....
24 instrument(s) dropped because of collinearity.
Estimating.
Performing specification tests.

Dynamic panel-data estimation, one-step difference GMM
------------------------------------------------------------------------------
-----
Group variable: id                              Number of obs      =
11952
Time variable : wave                            Number of groups   =
3094
Number of instruments = 97                      Obs per group: min =
1
F(12, 3093)   =    125.36                                      avg =
3.86
Prob > F      =     0.000                                      max =
6
------------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      t    P>|t|     [95% Conf.
Interval]
-------------+----------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .1442774   .0320473     4.50   0.000     .0814413
.2071135
         L2. |   .0563361   .0183284     3.07   0.002     .0203991
.0922732
             |
        age2 |  -.0561894   .0195301    -2.88   0.004    -.0944827   -
.0178961
        age3 |  -.0769754   .0193545    -3.98   0.000    -.1149243   -
.0390264
```

```
        age4 |  -.0892159     .01943    -4.59   0.000    -.1273128   -
.0511189
        age5 |  -.0893204   .0197795    -4.52   0.000    -.1281027   -
.0505381
      jbempt |   -.010995   .0070569    -1.56   0.119    -.0248316    
.0028417
       tucov |   .0761218   .0210374     3.62   0.000     .0348732    
.1173704
          w4 |   .1345165   .0210708     6.38   0.000     .0932023    
.1758306
          w5 |   .2725963   .0405267     6.73   0.000     .1931344    
.3520582
          w6 |   .3995247   .0602225     6.63   0.000     .2814445    
.5176049
          w7 |   .5455146   .0800483     6.81   0.000     .3885613    
.7024679
          w8 |   .6800264   .1006314     6.76   0.000     .4827152    
.8773376
          w9 |   .8116474   .1203502     6.74   0.000     .5756731    
1.047622
--------------------------------------------------------------------------
-----
Instruments for first differences equation
  Standard
    D.(age2 age3 age4 age5 w1 w2 w3 w4 w5 w6 w7 w8 w9)
  GMM-type (missing=0, separate instruments for each period unless 
collapsed)
    L(1/.).(L.lwage_hr L2.lwage_hr L.jbempt tucov)
--------------------------------------------------------------------------
-----
Arellano-Bond test for AR(1) in first differences: z = -13.71  Pr > z = 
0.000
Arellano-Bond test for AR(2) in first differences: z =   1.85  Pr > z = 
0.064
--------------------------------------------------------------------------
-----
Sargan test of overid. restrictions: chi2(83)   = 115.40  Prob > chi2 = 
0.011
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(83)   =  95.49  Prob > chi2 = 
0.165
  (Robust, but can be weakened by many instruments.)

.
.
. ************************************************************
. * Mind the syntax: xtabond uses by default T_i-prelags-1     *
. * lagged levels as instruments for predetermined variables   *
. * and T_i-prelags-2 lagged levels as instruments for         *
. * endogenous variables, here the option gmm() in xtabond2    *
. * specifies that all available lags of the listed variables  *
. * dated t-1 and earlier should be used as instruments for the*
. * first-differenced equation.                                *
. ************************************************************
.
. ************************************************************
. * To speed up computation, we have used a more parsimonious  *
. * model in the last two examples. However, the output        *
```

```
. * is not completely satisfactory: can you spot what is the   *
. * problem?                                                    *
. **************************************************************
.
.
. * Blundell-Bond or System GMM *
. * NB there's an unknown problem that causes xtabond2 to crash
. * in these examples if it uses mata - so we use the nomata
. * option henceforth
.
.
. xtabond2 lwage_hr l.lwage_hr l2.lwage_hr l3.lwage_hr age2-age5 jbemp
///
>         tucov w1-w9, nomata gmm(l.lwage_hr l2.lwage_hr l3.lwage_hr
l.jbemp, ///
>         lag(2 .)) gmm(tucov, lag(1 .))  iv(age2-age5) ///
>         iv(w1-w9, eq(level)) robust
w1 dropped because of collinearity.
w2 dropped because of collinearity.
w3 dropped because of collinearity.
w5 dropped because of collinearity.
Building GMM instruments......
29 instrument(s) dropped because of collinearity.
Estimating.
Performing specification tests.

Dynamic panel-data estimation, one-step system GMM
----------------------------------------------------------------------------
-----
Group variable: id                              Number of obs      =
11952
Time variable : wave                            Number of groups   =
3094
Number of instruments = 109                     Obs per group: min =
1
Wald chi2(13) =   4828.22                                      avg =
3.86
Prob > chi2   =     0.000                                      max =
6
----------------------------------------------------------------------------
-----
             |               Robust
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+--------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .5123337   .0874584     5.86   0.000     .3409184
.683749
         L2. |   .1373627   .0364613     3.77   0.000     .0658998
.2088256
         L3. |   .0460692   .0228968     2.01   0.044     .0011923
.0909461
             |
        age2 |   .0069257   .0030346     2.28   0.022      .000978
.0128734
        age3 |    .001403   .0013593     1.03   0.302    -.0012612
.0040671
```

```
        age4 |  -.0016427   .0015414    -1.07   0.287    -.0046638
.0013785
        age5 |  -.0001815   .0015308    -0.12   0.906    -.0031818
.0028188
      jbempt |  -.0012053   .0019604    -0.61   0.539    -.0050477
.0026371
       tucov |   .0478626   .0140229     3.41   0.001     .0203783
.0753469
          w4 |  -.0212496   .0087697    -2.42   0.015     -.038438   -
.0040612
          w6 |   .0102836    .008671     1.19   0.236    -.0067112
.0272784
          w7 |   .0410452   .0097272     4.22   0.000     .0219802
.0601103
          w8 |   .0499574    .011745     4.25   0.000     .0269377
.0729771
          w9 |   .0606115   .0133995     4.52   0.000      .034349
.086874
       _cons |   .9484843   .1320921     7.18   0.000     .6895886
1.20738
--------------------------------------------------------------------------
-----
Instruments for first differences equation
  Standard
    D.(age2 age3 age4 age5)
  GMM-type (missing=0, separate instruments for each period unless
collapsed)
    L(2/.).(L.lwage_hr L2.lwage_hr L3.lwage_hr L.jbempt)
    L(1/.).tucov
Instruments for levels equation
  Standard
    _cons
    age2 age3 age4 age5
    w1 w2 w3 w4 w5 w6 w7 w8 w9
  GMM-type (missing=0, separate instruments for each period unless
collapsed)
    DL.(L.lwage_hr L2.lwage_hr L3.lwage_hr L.jbempt)
    D.tucov
--------------------------------------------------------------------------
-----
Arellano-Bond test for AR(1) in first differences: z =  -7.10  Pr > z =
0.000
Arellano-Bond test for AR(2) in first differences: z =   2.05  Pr > z =
0.041
--------------------------------------------------------------------------
-----
Sargan test of overid. restrictions: chi2(94)   = 194.34  Prob > chi2 =
0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(94)   = 124.16  Prob > chi2 =
0.020
  (Robust, but can be weakened by many instruments.)

.
. /*The wave dummies are used as instruments for the equations*/
. /*in levels only. This treatment ensures that the correct*/
. /*number of moment conditions is used.*/
.
```

```
. *---------------------------------------------------------------*
. * Both xtabond and xtabond2 have one- and two-step variants. *
. * But though asymptotically more efficient, the two-step     *
. * estimates of the standard errors tend to be severely down- *
. * ward biased. To compensate, xtabond2, unlike xtabond, makes*
. * available a finite-sample correction to the two-step       *
. * covariance matrix derived by Windmeijer [2005]. This can   *
. * make two-step robust more efficient than onestep robust,   *
. * especially for system GMM.                                 *
. *---------------------------------------------------------------*
.
. * System GMM (two-step version with Windmeijer's correction)
. xtabond2 lwage_hr l.lwage_hr l2.lwage_hr l3.lwage_hr age2-age5 jbemp
///
>         tucov w1-w9, nomata gmm(l.lwage_hr l2.lwage_hr l3.lwage_hr
l.jbemp, ///
>         lag(2 .)) gmm(tucov, lag(1 .)) iv(age2-age5) ///
>         iv(w1-w9, eq(level)) robust twostep
w1 dropped because of collinearity.
w2 dropped because of collinearity.
w3 dropped because of collinearity.
w5 dropped because of collinearity.
Building GMM instruments......
29 instrument(s) dropped because of collinearity.
Estimating.
Computing Windmeijer finite-sample
correction...............................................................
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Performing specification tests.

Dynamic panel-data estimation, two-step system GMM
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Group variable: id                              Number of obs      =
11952
Time variable : wave                            Number of groups   =
3094
Number of instruments = 109                     Obs per group: min =
1
```

```
Wald chi2(13) =   4819.87                                     avg =
3.86
Prob > chi2   =     0.000                                     max =
6
---------------------------------------------------------------------------
-----
             |              Corrected
    lwage_hr |      Coef.   Std. Err.      z    P>|z|     [95% Conf.
Interval]
-------------+-------------------------------------------------------------
-----
    lwage_hr |
         L1. |   .5511699   .1170175     4.71   0.000     .3218198
.7805201
         L2. |   .1345223   .0486306     2.77   0.006     .0392081
.2298366
         L3. |   .0366828   .0265402     1.38   0.167     -.015335
.0887005
             |
        age2 |   .0047876   .0032515     1.47   0.141    -.0015852
.0111604
        age3 |   .0012063   .0013852     0.87   0.384    -.0015086
.0039211
        age4 |  -.0023532   .0014924    -1.58   0.115    -.0052783
.0005719
        age5 |   .0000402   .0014872     0.03   0.978    -.0028746
.002955
      jbempt |  -.0002781   .0018428    -0.15   0.880    -.0038898
.0033337
       tucov |   .0495333   .0150794     3.28   0.001     .0199782
.0790884
          w4 |  -.0136618   .0089974    -1.52   0.129    -.0312965
.0039728
          w6 |    .013295   .0087194     1.52   0.127    -.0037947
.0303846
          w7 |   .0465572   .0096441     4.83   0.000     .0276551
.0654593
          w8 |   .0515586   .0131738     3.91   0.000     .0257384
.0773787
          w9 |   .0617432   .0153899     4.01   0.000     .0315796
.0919068
       _cons |   .8743483   .1608825     5.43   0.000     .5590243
1.189672
---------------------------------------------------------------------------
-----
Instruments for first differences equation
  Standard
    D.(age2 age3 age4 age5)
  GMM-type (missing=0, separate instruments for each period unless
collapsed)
    L(2/.).(L.lwage_hr L2.lwage_hr L3.lwage_hr L.jbempt)
    L(1/.).tucov
Instruments for levels equation
  Standard
    _cons
    age2 age3 age4 age5
    w1 w2 w3 w4 w5 w6 w7 w8 w9
```

```
  GMM-type (missing=0, separate instruments for each period unless
collapsed)
    DL.(L.lwage_hr L2.lwage_hr L3.lwage_hr L.jbempt)
    D.tucov
---------------------------------------------------------------------------
-----
Arellano-Bond test for AR(1) in first differences: z =  -5.24  Pr > z =
0.000
Arellano-Bond test for AR(2) in first differences: z =   1.63  Pr > z =
0.103
---------------------------------------------------------------------------
-----
Sargan test of overid. restrictions: chi2(94)   = 194.34  Prob > chi2 =
0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(94)   = 124.16  Prob > chi2 =
0.020
  (Robust, but can be weakened by many instruments.)

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. clear mata

. *-----------------------------------------------------------*
. * Additional material]: An alternative to the               *
. * traditional GMM estimators when N is only moderately large *
. * is the LSDV estimator corrected for the bias. Bruno [2005] *
. * has extended the bias approximation formula by Bun and    *
. * Kiviet [2003] and Kiviet [1995] to unbalanced panels, and  *
. * has implemented a Stata code for the LSDVC estimator. Monte*
. * Carlo experiments have shown that the LSDVC estimator      *
. * outperforms consistent IV-GMM estimators in small samples. *
. * This estimator is downloadable as xtlsdvc from ssc and it  *
. * has a very simple syntax!                                  *
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. * End of session! Now clear up and close the log-file.       *
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. set more on

. log c
      name:  <unnamed>
       log:  C:\Users\nw\Documents\HILDA Project\Training\Melbourne Nov
2011\Exercises\ex5.log
  log type:  text
 closed on:   8 Nov 2011, 09:34:31
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