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************************************
* A Practical Guide to Using Panel Data
* Simonetta Longhi and Alita Nandi
* ISER, University of Essex
* Chapter 9
************************************

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      name:  <unnamed>
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  log type:  text
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.
. * 9.1. Introduction
. *-------------------
.
. use "$dir/DataFile", clear

.
. * 9.2.1. Pooled Estimations
.
. generate LnW = ln(paygu)
(118881 missing values generated)

. generate age2 = age^2
(9 missing values generated)

. recode sex (1 = 0) (2 = 1), gen(Female)
(236902 differences between sex and Female)

.
. label list rmastat
rmastat:
          -9 missing or wild
          -8 inapplicable
          -2 refused
          -1 not answered
           0 child under 16
           1 married
           2 living as couple
           3 widowed
           4 divorced
           5 separated
           6 never married
           7 civil partnership
           8 dissolved civil part
           9 sep from civil part
          10 survive from civ par

. tabulate mastat

       marital status |      Freq.     Percent        Cum.
----------------------+-----------------------------------
        child under 16 |        523        0.22        0.22
               married |    127,836       53.50       53.72
living as couple       |     25,213       10.55       64.27
               widowed |     18,304        7.66       71.93
        divorced       |     12,636        5.29       77.22
        separated      |      4,042        1.69       78.91
        never married  |     50,332       21.06       99.98
civil partnership      |         47        0.02      100.00
dissolved civil part   |          1        0.00      100.00
sep from civil part    |          2        0.00      100.00
survive from civ par   |          2        0.00      100.00
                    98 |          4        0.00      100.00
----------------------+-----------------------------------
                 Total |    238,942      100.00

. generate Married = 1 if mastat == 1 | mastat == 2 | mastat == 7
(85900 missing values generated)
```

```
. replace Married = 0 if (mastat >= 3 & mastat <= 6 ) ///
>         | (mastat >= 8 & mastat <= 10)
(85319 real changes made)

.
. tabulate qfachi, gen(Q)

       highest academic |
        qualification   |      Freq.     Percent        Cum.
------------------------+-----------------------------------
        higher degree   |      5,279        2.34        2.34
        1st degree      |     21,343        9.48       11.82
hnd,hnc,teaching        |     14,773        6.56       18.38
                a level |     40,771       18.10       36.48
                o level |     57,600       25.57       62.05
                cse     |     11,461        5.09       67.14
        none of these   |     74,010       32.86      100.00
------------------------+-----------------------------------
                  Total |    225,237      100.00

.
. tabulate region, gen(R)

   region / metropolitan area   |      Freq.     Percent        Cum.
--------------------------------+-----------------------------------
                inner london    |      5,422        2.28        2.28
                outer london    |     10,168        4.28        6.56
        r. of south east        |     32,392       13.63       20.18
                south west      |     16,013        6.74       26.92
                east anglia     |      7,419        3.12       30.04
                east midlands   |     14,674        6.17       36.21
west midlands conurbation       |      6,214        2.61       38.83
        r. of west midlands     |      8,895        3.74       42.57
        greater manchester      |      6,698        2.82       45.38
                merseyside      |      3,673        1.55       46.93
        r. of north west        |      8,038        3.38       50.31
                south yorkshire |      4,636        1.95       52.26
                west yorkshire  |      5,783        2.43       54.69
r. of yorks & humberside        |      5,773        2.43       57.12
                tyne & wear     |      3,916        1.65       58.77
                r. of north     |      6,669        2.81       61.57
                        wales   |     32,012       13.47       75.04
                scotland        |     36,685       15.43       90.47
        northern ireland        |     22,654        9.53      100.00
--------------------------------+-----------------------------------
                         Total  |    237,734      100.00

. * Note that the BHPS has two variables for regions
. * We have included in the dataset the variable region (Chapter 4)
. * while we have used region2 in Chapter 7
. * For the purpose of this analysis either of the two variable is ok
.
. tabulate wave, gen(Y)

       wave |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |     10,264        4.29        4.29
          2 |      9,845        4.12        8.41
          3 |      9,600        4.02       12.43
          4 |      9,481        3.97       16.40
          5 |      9,249        3.87       20.27
          6 |      9,438        3.95       24.22
          7 |     11,193        4.68       28.90
          8 |     10,906        4.56       33.46
          9 |     15,623        6.54       40.00
         10 |     15,603        6.53       46.53
         11 |     18,867        7.89       54.42
         12 |     16,597        6.94       61.37
         13 |     16,238        6.79       68.16
         14 |     15,791        6.61       74.77
         15 |     15,617        6.53       81.30
         16 |     15,392        6.44       87.74
         17 |     14,873        6.22       93.97
```

```
        18 |     14,419        6.03      100.00
-----------+-----------------------------------
     Total |    238,996      100.00

.
. regress LnW age age2 Female Married Q1-Q6 R1-R6 R8-R19 Y1-Y17, vce(cluster pid)

Linear regression                                       Number of obs =  118152
                                                        F( 45, 19871) =  445.51
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.4225
                                                        Root MSE      =   .6555

                                (Std. Err. adjusted for 19872 clusters in pid)
------------------------------------------------------------------------------
             |               Robust
         LnW |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .1286478   .0021357    60.24   0.000     .1244617    .1328339
        age2 |  -.0014963   .0000273   -54.82   0.000    -.0015498   -.0014428
      Female |  -.5954364   .0091211   -65.28   0.000    -.6133144   -.5775583
     Married |   .0836218   .0098885     8.46   0.000     .0642395    .1030042
          Q1 |   .8557859   .0279069    30.67   0.000      .801086    .9104858
          Q2 |   .7732293   .0175421    44.08   0.000     .7388454    .8076133
          Q3 |   .5802515   .0199772    29.05   0.000     .5410944    .6194086
          Q4 |   .3825897   .0155647    24.58   0.000     .3520816    .4130977
          Q5 |   .2548843   .0149192    17.08   0.000     .2256414    .2841273
          Q6 |   .1472545   .0230412     6.39   0.000     .1020918    .1924172
          R1 |   .2970708   .0396943     7.48   0.000     .2192668    .3748749
          R2 |   .2263073   .0353401     6.40   0.000     .1570378    .2955767
          R3 |   .1021207   .0293211     3.48   0.000     .0446489    .1595926
          R4 |  -.0436032   .0322146    -1.35   0.176    -.1067466    .0195402
          R5 |  -.0055331     .03947    -0.14   0.889    -.0828976    .0718314
          R6 |  -.0247404   .0315187    -0.78   0.432    -.0865196    .0370388
          R8 |  -.0279208   .0351009    -0.80   0.426    -.0967214    .0408798
          R9 |   .0842424   .0380873     2.21   0.027     .0095882    .1588967
         R10 |  -.0263422   .0493077    -0.53   0.593    -.1229894    .0703049
         R11 |   .0316676   .0374119     0.85   0.397    -.0416629     .104998
         R12 |  -.0308426   .0409949    -0.75   0.452     -.111196    .0495109
         R13 |   .0164125   .0388481     0.42   0.673    -.0597331    .0925581
         R14 |  -.0463138   .0395713    -1.17   0.242    -.1238768    .0312492
         R15 |  -.0033512   .0420943    -0.08   0.937    -.0858596    .0791572
         R16 |   -.029627   .0373852    -0.79   0.428    -.1029051    .0436512
         R17 |  -.0489442   .0289624    -1.69   0.091    -.1057129    .0078246
         R18 |  -.0021935    .028497    -0.08   0.939    -.0580499     .053663
         R19 |  -.0143744   .0294386    -0.49   0.625    -.0720765    .0433277
          Y1 |  -.5855048    .012819   -45.67   0.000    -.6106311   -.5603784
          Y2 |  -.5477336   .0129656   -42.25   0.000    -.5731472     -.52232
          Y3 |  -.5481992   .0130754   -41.93   0.000    -.5738282   -.5225703
          Y4 |  -.5180352   .0127153   -40.74   0.000    -.5429583    -.493112
          Y5 |  -.4791176   .0125175   -38.28   0.000    -.5036529   -.4545823
          Y6 |  -.4516823   .0121378   -37.21   0.000    -.4754734   -.4278912
          Y7 |   -.420277   .0115062   -36.53   0.000    -.4428301   -.3977239
          Y8 |  -.3742127   .0110053   -34.00   0.000     -.395784   -.3526414
          Y9 |  -.3230846   .0097569   -33.11   0.000    -.3422089   -.3039602
         Y10 |  -.2685679    .009325   -28.80   0.000    -.2868457     -.25029
         Y11 |  -.2337255   .0089328   -26.16   0.000    -.2512345   -.2162165
         Y12 |  -.1913069   .0089027   -21.49   0.000    -.2087568   -.1738569
         Y13 |  -.1667044    .008593   -19.40   0.000    -.1835474   -.1498613
         Y14 |  -.1338277   .0081453   -16.43   0.000    -.1497931   -.1178622
         Y15 |  -.0895816   .0077205   -11.60   0.000    -.1047144   -.0744488
         Y16 |  -.0649495   .0072949    -8.90   0.000    -.0792482   -.0506509
         Y17 |  -.0349726   .0062894    -5.56   0.000    -.0473002   -.0226449
       _cons |   4.566722   .0480048    95.13   0.000     4.472628    4.660815
------------------------------------------------------------------------------

. estimates store R_OLS

.
. * 9.2.2. Individual Unobserved Heterogeneity
.
. xtset pid wave, yearly
       panel variable:  pid (unbalanced)
```

```
        time variable:  wave, 1 to 18, but with gaps
                delta:  1 year

.
. xtreg LnW age age2 Female Married Q1-Q6 R1-R6 R8-R19 Y1-Y17, fe
note: Female omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =    118152
Group variable: pid                             Number of groups   =     19872

R-sq:  within  = 0.3508                         Obs per group: min =         1
       between = 0.1748                                        avg =       5.9
       overall = 0.2167                                        max =        18

                                                F(44,98236)        =   1206.16
corr(u_i, Xb)  = -0.3043                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         LnW |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .1043769   .0050235    20.78   0.000     .0945309    .1142229
        age2 |  -.0014225   .0000159   -89.19   0.000    -.0014538   -.0013913
      Female |          0  (omitted)
     Married |   .0373734   .0055088     6.78   0.000     .0265762    .0481707
          Q1 |   1.054823   .0301618    34.97   0.000     .9957057    1.113939
          Q2 |   1.037349   .0230481    45.01   0.000     .9921752    1.082523
          Q3 |   .6134338   .0260674    23.53   0.000      .562342    .6645257
          Q4 |   .4656101   .0211402    22.02   0.000     .4241755    .5070447
          Q5 |   .0375515   .0207659     1.81   0.071    -.0031495    .0782525
          Q6 |   .1839919   .0347039     5.30   0.000     .1159726    .2520111
          R1 |   .3573327   .0389471     9.17   0.000     .2809969    .4336684
          R2 |   .1641015   .0361541     4.54   0.000     .0932399    .2349631
          R3 |   .0430553    .034205     1.26   0.208    -.0239861    .1100968
          R4 |  -.0661992   .0366243    -1.81   0.071    -.1379824     .005584
          R5 |   .0538388   .0423362     1.27   0.203    -.0291396    .1368172
          R6 |  -.0898597   .0371989    -2.42   0.016    -.1627692   -.0169503
          R8 |  -.1039312   .0323787    -3.21   0.001     -.167393   -.0404694
          R9 |  -.0349196   .0445485    -0.78   0.433    -.1222342    .0523949
         R10 |  -.1301058     .05559    -2.34   0.019    -.2390616     -.02115
         R11 |  -.1198608   .0419321    -2.86   0.004    -.2020473   -.0376743
         R12 |  -.1481722   .0486429    -3.05   0.002    -.2435118   -.0528327
         R13 |  -.0275654   .0451999    -0.61   0.542    -.1161567    .0610259
         R14 |  -.0448888   .0437644    -1.03   0.305    -.1306666     .040889
         R15 |   -.020225    .053568    -0.38   0.706    -.1252177    .0847677
         R16 |  -.1797217   .0466593    -3.85   0.000    -.2711735     -.08827
         R17 |  -.1987599   .0407997    -4.87   0.000    -.2787269    -.118793
         R18 |  -.0961883   .0444866    -2.16   0.031    -.1833814   -.0089951
         R19 |   .2378655   .2321373     1.02   0.306    -.2171208    .6928519
          Y1 |  -1.009186   .0832306   -12.13   0.000    -1.172317   -.8460551
          Y2 |  -.9493102   .0785741   -12.08   0.000    -1.103315   -.7953058
          Y3 |  -.9138993   .0737813   -12.39   0.000     -1.05851   -.7692888
          Y4 |  -.8566489   .0688263   -12.45   0.000    -.9915477   -.7217502
          Y5 |  -.8054709   .0639372   -12.60   0.000    -.9307869   -.6801548
          Y6 |  -.7548958   .0592681   -12.74   0.000    -.8710606   -.6387309
          Y7 |  -.6938853   .0543871   -12.76   0.000    -.8004833   -.5872873
          Y8 |  -.6204205   .0496326   -12.50   0.000    -.7176999   -.5231411
          Y9 |  -.5504062    .045033   -12.22   0.000    -.6386704    -.462142
         Y10 |  -.4698368   .0403718   -11.64   0.000    -.5489651   -.3907084
         Y11 |  -.4067139   .0350909   -11.59   0.000    -.4754918   -.3379361
         Y12 |   -.356345    .030347   -11.74   0.000    -.4158248   -.2968652
         Y13 |  -.3035338   .0253745   -11.96   0.000    -.3532675   -.2538001
         Y14 |   -.240812   .0206943   -11.64   0.000    -.2813726   -.2002515
         Y15 |  -.1790856   .0161667   -11.08   0.000    -.2107721   -.1473991
         Y16 |  -.1278049   .0119928   -10.66   0.000    -.1513107   -.1042991
         Y17 |  -.0609691   .0084542    -7.21   0.000    -.0775392   -.0443989
       _cons |   5.326766    .226376    23.53   0.000     4.883072    5.770461
-------------+----------------------------------------------------------------
     sigma_u |  .80208526
     sigma_e |  .39939095
         rho |  .80131736   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(19871, 98236) =    14.33        Prob > F = 0.0000
```

```
. estimates store R_FE

.
. xtreg LnW age age2 Female Married Q1-Q6 R1-R6 R8-R19 Y1-Y17, re

Random-effects GLS regression                   Number of obs      =    118152
Group variable: pid                             Number of groups   =     19872

R-sq:  within  = 0.3482                         Obs per group: min =         1
       between = 0.4166                                        avg =       5.9
       overall = 0.4136                                        max =        18

                                                Wald chi2(45)      =  66766.15
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         LnW |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |    .131641   .0011158   117.98   0.000     .1294541     .133828
        age2 |   -.001501   .0000136  -110.31   0.000    -.0015276   -.0014743
      Female |  -.5743116   .0089137   -64.43   0.000    -.5917821   -.5568411
     Married |   .0592975   .0050105    11.83   0.000     .0494771    .0691178
          Q1 |   .9202418   .0195094    47.17   0.000     .8820041    .9584796
          Q2 |   .9201056   .0131105    70.18   0.000     .8944095    .9458016
          Q3 |   .5776996   .0153609    37.61   0.000     .5475927    .6078065
          Q4 |   .4199272   .0117058    35.87   0.000     .3969843      .44287
          Q5 |   .1487272   .0113168    13.14   0.000     .1265467    .1709077
          Q6 |   .1917453   .0182883    10.48   0.000      .155901    .2275896
          R1 |   .3230331   .0272785    11.84   0.000     .2695682     .376498
          R2 |    .183807   .0249526     7.37   0.000     .1349009    .2327132
          R3 |   .0523071   .0227156     2.30   0.021     .0077853    .0968288
          R4 |  -.0627845   .0246848    -2.54   0.011    -.1111657   -.0144033
          R5 |   .0241421    .028872     0.84   0.403    -.0324459    .0807301
          R6 |  -.0546337   .0248438    -2.20   0.028    -.1033267   -.0059407
          R8 |  -.0741594    .024461    -3.03   0.002     -.122102   -.0262167
          R9 |   .0322476   .0293488     1.10   0.272     -.025275    .0897703
         R10 |  -.0496769   .0362682    -1.37   0.171    -.1207612    .0214074
         R11 |  -.0357758   .0282174    -1.27   0.205     -.091081    .0195294
         R12 |  -.0766626   .0328599    -2.33   0.020    -.1410668   -.0122584
         R13 |  -.0166528   .0299627    -0.56   0.578    -.0753785     .042073
         R14 |  -.0376158   .0295663    -1.27   0.203    -.0955648    .0203331
         R15 |  -.0313594   .0345605    -0.91   0.364    -.0990967    .0363779
         R16 |  -.1207815   .0300735    -4.02   0.000    -.1797245   -.0618385
         R17 |  -.1040635   .0237603    -4.38   0.000    -.1506328   -.0574941
         R18 |  -.0479837   .0234768    -2.04   0.041    -.0939975   -.0019699
         R19 |  -.0445019   .0248392    -1.79   0.073    -.0931858     .004182
          Y1 |   -.642964   .0095854   -67.08   0.000     -.661751    -.624177
          Y2 |   -.608353   .0095023   -64.02   0.000    -.6269771   -.5897288
          Y3 |  -.5972179   .0093759   -63.70   0.000    -.6155943   -.5788415
          Y4 |  -.5633628   .0091774   -61.39   0.000    -.5813502   -.5453754
          Y5 |  -.5317871   .0090278   -58.91   0.000    -.5494812    -.514093
          Y6 |   -.500734   .0088071   -56.86   0.000    -.5179955   -.4834725
          Y7 |  -.4598571   .0084075   -54.70   0.000    -.4763355   -.4433787
          Y8 |  -.4068173   .0082774   -49.15   0.000    -.4230407   -.3905939
          Y9 |   -.354888   .0075734   -46.86   0.000    -.3697316   -.3400445
         Y10 |  -.2955625   .0074517   -39.66   0.000    -.3101675   -.2809575
         Y11 |  -.2563296   .0070853   -36.18   0.000    -.2702165   -.2424426
         Y12 |  -.2251837   .0071101   -31.67   0.000    -.2391191   -.2112483
         Y13 |  -.1947262   .0070562   -27.60   0.000    -.2085562   -.1808962
         Y14 |   -.153633   .0070054   -21.93   0.000    -.1673634   -.1399027
         Y15 |  -.1121079   .0069274   -16.18   0.000    -.1256854   -.0985304
         Y16 |  -.0816536   .0068954   -11.84   0.000    -.0951682   -.0681389
         Y17 |  -.0383292   .0068617    -5.59   0.000    -.0517779   -.0248805
       _cons |   4.486087   .0333283   134.60   0.000     4.420764    4.551409
-------------+----------------------------------------------------------------
     sigma_u |  .57939206
     sigma_e |  .39939095
         rho |  .67788679   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store R_REgls

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```

```
. xtreg LnW age age2 Female Married Q1-Q6 R1-R6 R8-R19 Y1-Y17, mle

Fitting constant-only model:
Iteration 0:   log likelihood = -116742.99
Iteration 1:   log likelihood = -109770.91
Iteration 2:   log likelihood = -108636.63
Iteration 3:   log likelihood = -108569.75
Iteration 4:   log likelihood = -108569.09
Iteration 5:   log likelihood = -108569.09

Fitting full model:
Iteration 0:   log likelihood = -82924.503
Iteration 1:   log likelihood = -82147.409
Iteration 2:   log likelihood = -82133.495
Iteration 3:   log likelihood = -82133.464

Random-effects ML regression                    Number of obs      =    118152
Group variable: pid                             Number of groups   =     19872

Random effects u_i ~ Gaussian                   Obs per group: min =         1
                                                               avg =       5.9
                                                               max =        18

                                                LR chi2(45)        =  52871.26
Log likelihood  = -82133.464                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         LnW |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .1317102   .0011134   118.30   0.000     .1295281    .1338924
        age2 |  -.0015021   .0000136  -110.53   0.000    -.0015287   -.0014754
      Female |  -.5744593   .0087992   -65.29   0.000    -.5917054   -.5572131
     Married |    .059763   .0050119    11.92   0.000     .0499399     .069586
          Q1 |   .9184231   .0194128    47.31   0.000     .8803748    .9564715
          Q2 |   .9180993   .0130387    70.41   0.000     .8925439    .9436548
          Q3 |   .5773005   .0152535    37.85   0.000     .5474041    .6071969
          Q4 |   .4191413   .0116211    36.07   0.000     .3963644    .4419182
          Q5 |   .1504781    .011246    13.38   0.000     .1284364    .1725199
          Q6 |   .1915279   .0181309    10.56   0.000      .155992    .2270638
          R1 |   .3225755   .0271457    11.88   0.000      .269371     .37578
          R2 |    .184399    .024825     7.43   0.000     .1357429     .233055
          R3 |   .0526578   .0225819     2.33   0.020     .0083981    .0969176
          R4 |  -.0626644   .0245414    -2.55   0.011    -.1107646   -.0145642
          R5 |   .0237758   .0287096     0.83   0.408     -.032494    .0800456
          R6 |  -.0541727    .024699    -2.19   0.028    -.1025819   -.0057635
          R8 |  -.0736903   .0243591    -3.03   0.002    -.1214333   -.0259473
          R9 |   .0330614   .0291706     1.13   0.257    -.0241119    .0902346
         R10 |  -.0489076   .0360398    -1.36   0.175    -.1195443     .021729
         R11 |  -.0347786   .0280571    -1.24   0.215    -.0897695    .0202123
         R12 |  -.0757364   .0326711    -2.32   0.020    -.1397706   -.0117021
         R13 |  -.0165098   .0297857    -0.55   0.579    -.0748886    .0418691
         R14 |  -.0377106   .0294022    -1.28   0.200    -.0953378    .0199166
         R15 |  -.0313821   .0343467    -0.91   0.361    -.0987004    .0359361
         R16 |  -.1197889   .0298876    -4.01   0.000    -.1783674   -.0612103
         R17 |  -.1032801   .0235988    -4.38   0.000    -.1495329   -.0570272
         R18 |  -.0473448   .0233114    -2.03   0.042    -.0930342   -.0016553
         R19 |     -.0441   .0246423    -1.79   0.074     -.092398    .0041981
          Y1 |   -.642835    .009559   -67.25   0.000    -.6615702   -.6240997
          Y2 |  -.6083017   .0094809   -64.16   0.000    -.6268838   -.5897195
          Y3 |  -.5972574   .0093589   -63.82   0.000    -.6156005   -.5789142
          Y4 |  -.5634353   .0091641   -61.48   0.000    -.5813966   -.5454739
          Y5 |  -.5318161   .0090184   -58.97   0.000    -.5494918   -.5141405
          Y6 |  -.5007482   .0088005   -56.90   0.000    -.5179969   -.4834995
          Y7 |  -.4598554   .0084027   -54.73   0.000    -.4763244   -.4433865
          Y8 |   -.406805   .0082759   -49.16   0.000    -.4230254   -.3905845
          Y9 |  -.3548396   .0075718   -46.86   0.000    -.3696801   -.3399991
         Y10 |  -.2955327   .0074532   -39.65   0.000    -.3101406   -.2809248
         Y11 |  -.2563086   .0070886   -36.16   0.000    -.2702019   -.2424153
         Y12 |  -.2251007   .0071167   -31.63   0.000    -.2390491   -.2111522
         Y13 |  -.1946462   .0070652   -27.55   0.000    -.2084937   -.1807986
         Y14 |  -.1535624   .0070163   -21.89   0.000    -.1673141   -.1398107
         Y15 |  -.1120081   .0069398   -16.14   0.000    -.1256098   -.0984064
         Y16 |  -.0815579   .0069088   -11.80   0.000    -.0950989   -.0680169
```

```
         Y17 |  -.0382984    .006876    -5.57   0.000    -.0517751   -.0248218
       _cons |   4.484729   .0331138   135.43   0.000     4.419827    4.549631
-------------+----------------------------------------------------------------
    /sigma_u |   .5719682   .0034628                      .5652213    .5787957
    /sigma_e |   .4012448   .0009103                      .3994645     .403033
         rho |   .6701854   .0029402                      .6644027    .6759277
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01)= 7.1e+04 Prob>=chibar2 = 0.000

. estimates store R_REmle

.
. foreach var of varlist LnW age age2 Married Q1-Q6 R1-R6 R8-R19 Y1-Y17 {
  2.         generate D`var' = `var' - L.`var'
  3.         }
(145312 missing values generated)
(36339 missing values generated)
(36339 missing values generated)
(36870 missing values generated)
(48920 missing values generated)
(48920 missing values generated)
(48920 missing values generated)
(48920 missing values generated)
(48920 missing values generated)
(48920 missing values generated)
(37935 missing values generated)
(37935 missing values generated)
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(37935 missing values generated)
(37935 missing values generated)
(36331 missing values generated)
(36331 missing values generated)
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(36331 missing values generated)
(36331 missing values generated)
(36331 missing values generated)

. regress DLnW Dage Dage2 DMarried DQ1-DQ6 DR1-DR6 DR8-DR19 DY1-DY17
note: DY1 omitted because of collinearity

      Source |       SS       df       MS              Number of obs =   91923
-------------+------------------------------           F( 43, 91879) =   67.25
       Model |  387.815299    43  9.01896043           Prob > F      =  0.0000
    Residual |  12321.2552 91879  .134103062           R-squared     =  0.0305
-------------+------------------------------           Adj R-squared =  0.0301
       Total |  12709.0705 91922  .138259291           Root MSE      =   .3662

------------------------------------------------------------------------------
        DLnW |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
------------+----------------------------------------------------------------
       Dage |   .1331102   .0049892    26.68   0.000     .1233313     .142889
      Dage2 |  -.0017975   .0000472   -38.10   0.000      -.00189    -.001705
   DMarried |   .0033711    .006088     0.55   0.580    -.0085614    .0153036
        DQ1 |   .7137446   .0416376    17.14   0.000     .6321353    .7953539
        DQ2 |   .6409457   .0303156    21.14   0.000     .5815273     .700364
        DQ3 |   .3733625   .0323761    11.53   0.000     .3099057    .4368194
        DQ4 |   .2838695   .0259466    10.94   0.000     .2330144    .3347245
        DQ5 |   .0750255   .0250244     3.00   0.003     .0259779     .124073
        DQ6 |   .0651361   .0432938     1.50   0.132    -.0197194    .1499916
        DR1 |   .1395594   .0503673     2.77   0.006     .0408399    .2382788
        DR2 |   .0727132   .0477255     1.52   0.128    -.0208283    .1662547
        DR3 |   .0819732   .0455083     1.80   0.072    -.0072227     .171169
        DR4 |  -.0846344   .0478141    -1.77   0.077    -.1783496    .0090808
        DR5 |    .009749   .0586625     0.17   0.868    -.1052289    .1247269
        DR6 |  -.0240123   .0491453    -0.49   0.625    -.1203367    .0723121
        DR8 |  -.0070046   .0431904    -0.16   0.871    -.0916573    .0776481
        DR9 |  -.1377335   .0581497    -2.37   0.018    -.2517063   -.0237607
       DR10 |   .0148363   .0744814     0.20   0.842    -.1311465    .1608191
       DR11 |  -.1175415   .0556486    -2.11   0.035    -.2266121   -.0084709
       DR12 |  -.1487156   .0663633    -2.24   0.025    -.2787869   -.0186443
       DR13 |  -.0024974   .0583953    -0.04   0.966    -.1169517    .1119569
       DR14 |   .0130233   .0573066     0.23   0.820    -.0992971    .1253436
       DR15 |   .0452634   .0723602     0.63   0.532    -.0965619    .1870886
       DR16 |  -.0941739   .0638836    -1.47   0.140    -.2193851    .0310372
       DR17 |  -.0997041   .0544131    -1.83   0.067    -.2063532    .0069451
       DR18 |  -.0972452    .059679    -1.63   0.103    -.2142154     .019725
       DR19 |   .2954113   .3687729     0.80   0.423    -.4273798    1.018202
        DY1 |          0  (omitted)
        DY2 |   .0010837   .0055945     0.19   0.846    -.0098814    .0120487
        DY3 |  -.0249957   .0076651    -3.26   0.001    -.0400192   -.0099722
        DY4 |  -.0178592   .0089998    -1.98   0.047    -.0354987   -.0002198
        DY5 |  -.0152741   .0098998    -1.54   0.123    -.0346776    .0041293
        DY6 |  -.0166616   .0104689    -1.59   0.111    -.0371806    .0038574
        DY7 |  -.0048622   .0107676    -0.45   0.652    -.0259665    .0162422
        DY8 |   .0063962   .0108193     0.59   0.554    -.0148096     .027602
        DY9 |   .0264765   .0107088     2.47   0.013     .0054873    .0474657
       DY10 |   .0422829   .0104481     4.05   0.000     .0218048     .062761
       DY11 |   .0477717   .0100706     4.74   0.000     .0280334    .0675099
       DY12 |   .0406726    .009622     4.23   0.000     .0218137    .0595316
       DY13 |   .0305542   .0090539     3.37   0.001     .0128086    .0482997
       DY14 |   .0290517   .0083326     3.49   0.000       .01272    .0453834
       DY15 |   .0248109   .0074144     3.35   0.001     .0102787    .0393431
       DY16 |   .0120924   .0062442     1.94   0.053    -.0001462    .0243311
       DY17 |   .0119696    .004551     2.63   0.009     .0030497    .0208896
      _cons |   .0795707   .0037685    21.11   0.000     .0721844    .0869569
------------------------------------------------------------------------------

. estimates store R_FD

.
. * 9.2.3. Choosing the Right Estimator
.
. hausman R_FE R_REgls

Note: the rank of the differenced variance matrix (43) does not equal the number of coefficients
being tested (44); be sure this is what
       you expect, or there may be problems computing the test.  Examine the output of your
estimators for anything unexpected and
       possibly consider scaling your variables so that the coefficients are on a similar
scale.

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      R_FE       R_REgls       Difference          S.E.
-------------+----------------------------------------------------------------
         age |    .1043769      .131641       -.0272641         .004898
        age2 |   -.0014225     -.001501        .0000784        8.32e-06
     Married |    .0373734     .0592975        -.021924        .0022896
          Q1 |    1.054823     .9202418        .1345807        .0230026
          Q2 |    1.037349     .9201056        .1172437        .0189561
          Q3 |    .6134338     .5776996        .0357342        .0210607
          Q4 |    .4656101     .4199272        .0456829        .0176035
```

```
          Q5 |    .0375515     .1487272       -.1111757        .0174114
          Q6 |    .1839919     .1917453       -.0077534        .0294941
          R1 |    .3573327     .3230331        .0342995        .0277985
          R2 |    .1641015      .183807       -.0197055        .0261627
          R3 |    .0430553     .0523071       -.0092517        .0255731
          R4 |   -.0661992    -.0627845       -.0034147        .0270556
          R5 |    .0538388     .0241421        .0296967        .0309639
          R6 |   -.0898597    -.0546337        -.035226        .0276865
          R8 |   -.1039312    -.0741594       -.0297718        .0212141
          R9 |   -.0349196     .0322476       -.0671672        .0335144
         R10 |   -.1301058    -.0496769        -.080429        .0421292
         R11 |   -.1198608    -.0357758       -.0840851        .0310174
         R12 |   -.1481722    -.0766626       -.0715096        .0358659
         R13 |   -.0275654    -.0166528       -.0109127        .0338418
         R14 |   -.0448888    -.0376158        -.007273         .032267
         R15 |    -.020225    -.0313594        .0111344        .0409281
         R16 |   -.1797217    -.1207815       -.0589402        .0356746
         R17 |   -.1987599    -.1040635       -.0946965        .0331672
         R18 |   -.0961883    -.0479837       -.0482046        .0377875
         R19 |    .2378655    -.0445019        .2823675        .2308045
          Y1 |   -1.009186     -.642964       -.3662221        .0826768
          Y2 |   -.9493102     -.608353       -.3409572        .0779974
          Y3 |   -.9138993    -.5972179       -.3166814        .0731831
          Y4 |   -.8566489    -.5633628       -.2932861        .0682117
          Y5 |   -.8054709    -.5317871       -.2736837        .0632966
          Y6 |   -.7548958     -.500734       -.2541618        .0586101
          Y7 |   -.6938853    -.4598571       -.2340282        .0537333
          Y8 |   -.6204205    -.4068173       -.2136032        .0489376
          Y9 |   -.5504062     -.354888       -.1955181        .0443916
         Y10 |   -.4698368    -.2955625       -.1742743        .0396782
         Y11 |   -.4067139    -.2563296       -.1503844        .0343682
         Y12 |    -.356345    -.2251837       -.1311613        .0295023
         Y13 |   -.3035338    -.1947262       -.1088076        .0243736
         Y14 |    -.240812     -.153633        -.087179        .0194725
         Y15 |   -.1790856    -.1121079       -.0669777        .0146073
         Y16 |   -.1278049    -.0816536       -.0461513        .0098124
         Y17 |   -.0609691    -.0383292       -.0226399        .0049387
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(43) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      955.43
                Prob>chi2 =      0.0000


.
.
. * 9.4. Further Estimators
.
. foreach var of varlist age age2 Married Q1-Q6 R1-R6 R8-R19 Y1-Y17 {
  2.         bysort pid: egen M`var' = mean(`var')
  3.         }
(1 missing value generated)
(1 missing value generated)
(63 missing values generated)
(4866 missing values generated)
(4866 missing values generated)
(4866 missing values generated)
(4866 missing values generated)
(4866 missing values generated)
(4866 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
```

```
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)
(52 missing values generated)

. xtreg LnW age age2 Female Married Q1-Q6 R1-R6 R8-R19 Y1-Y17   ///
>         Mage Mage2 MMarried MQ1-MQ6 MR1-MR6 MR8-MR19 MY1-MY17, re

Random-effects GLS regression                   Number of obs      =    118152
Group variable: pid                             Number of groups   =     19872

R-sq:  within  = 0.3507                         Obs per group: min =         1
       between = 0.4326                                        avg =       5.9
       overall = 0.4245                                        max =        18

                                                Wald chi2(89)      =  68364.17
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         LnW |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .1032705   .0049623    20.81   0.000     .0935446    .1129964
        age2 |  -.0014314   .0000157   -91.18   0.000    -.0014622   -.0014006
      Female |  -.5753681    .008888   -64.74   0.000    -.5927883    -.557948
     Married |   .0374408   .0054677     6.85   0.000     .0267243    .0481573
          Q1 |   1.041676   .0298135    34.94   0.000     .9832426    1.100109
          Q2 |   1.022393     .02272    45.00   0.000     .9778625    1.066923
          Q3 |   .6020909   .0257224    23.41   0.000     .5516759    .6525058
          Q4 |   .4521557   .0208003    21.74   0.000     .4113879    .4929235
          Q5 |   .0320919   .0204283     1.57   0.116     -.007947    .0721307
          Q6 |   .1791409   .0342209     5.23   0.000     .1120692    .2462127
          R1 |   .3599292   .0385575     9.33   0.000     .2843579    .4355006
          R2 |   .1675731   .0358235     4.68   0.000     .0973604    .2377858
          R3 |   .0433318   .0338888     1.28   0.201     -.023089    .1097525
          R4 |   -.064945   .0362788    -1.79   0.073    -.1360502    .0061602
          R5 |    .057362   .0418818     1.37   0.171    -.0247248    .1394487
          R6 |  -.0834021   .0368585    -2.26   0.024    -.1556435   -.0111607
          R8 |  -.1049773   .0321456    -3.27   0.001    -.1679814   -.0419732
          R9 |  -.0245838   .0441085    -0.56   0.577     -.111035    .0618674
         R10 |  -.1207107   .0550036    -2.19   0.028    -.2285158   -.0129057
         R11 |  -.1218096   .0415127    -2.93   0.003    -.2031731   -.0404462
         R12 |  -.1400972   .0482604    -2.90   0.004    -.2346859   -.0455086
         R13 |  -.0196453    .044788    -0.44   0.661    -.1074282    .0681377
         R14 |  -.0374905   .0433997    -0.86   0.388    -.1225524    .0475714
         R15 |   -.018895   .0529683    -0.36   0.721    -.1227109     .084921
         R16 |  -.1711241   .0462181    -3.70   0.000      -.26171   -.0805382
         R17 |  -.1998358   .0403675    -4.95   0.000    -.2789546    -.120717
         R18 |  -.0961071   .0440034    -2.18   0.029    -.1823522    -.009862
         R19 |   .2946758   .2207271     1.34   0.182    -.1379412    .7272929
          Y1 |  -1.032076   .0822263   -12.55   0.000    -1.193236   -.8709151
          Y2 |  -.9723991   .0776267   -12.53   0.000    -1.124545   -.8202536
          Y3 |  -.9377657   .0728941   -12.86   0.000    -1.080636   -.7948958
          Y4 |   -.878063   .0679982   -12.91   0.000    -1.011337    -.744789
          Y5 |  -.8245562   .0631702   -13.05   0.000    -.9483675   -.7007449
          Y6 |  -.7730871   .0585574   -13.20   0.000    -.8878574   -.6583167
          Y7 |  -.7092784   .0537357   -13.20   0.000    -.8145985   -.6039583
          Y8 |  -.6345921   .0490402   -12.94   0.000    -.7307092    -.538475
          Y9 |  -.5628877   .0444984   -12.65   0.000    -.6501031   -.4756724
         Y10 |  -.4813004   .0398928   -12.06   0.000    -.5594888   -.4031119
         Y11 |  -.4169403   .0346746   -12.02   0.000    -.4849012   -.3489794
         Y12 |  -.3644081   .0299893   -12.15   0.000    -.4231861   -.3056301
         Y13 |  -.3101202   .0250778   -12.37   0.000    -.3592718   -.2609687
         Y14 |  -.2464287   .0204577   -12.05   0.000    -.2865251   -.2063323
         Y15 |  -.1818486   .0159891   -11.37   0.000    -.2131866   -.1505106
         Y16 |  -.1290248   .0118717   -10.87   0.000    -.1522929   -.1057567
         Y17 |  -.0614513   .0083867    -7.33   0.000    -.0778889   -.0450137
       Mage |   .0242785   .0053383     4.55   0.000     .0138156    .0347414
      Mage2 |  -.0000534    .000028    -1.91   0.056    -.0001083    1.47e-06
   MMarried |   .1330876   .0135267     9.84   0.000     .1065757    .1595995
```

```
         MQ1 |   -.197232   .0418176    -4.72   0.000     -.279193   -.1152711
         MQ2 |  -.2423658   .0288866    -8.39   0.000    -.2989825   -.1857491
         MQ3 |  -.0309197   .0326673    -0.95   0.344    -.0949465    .0331071
         MQ4 |  -.0947991   .0256821    -3.69   0.000    -.1451351    -.044463
         MQ5 |   .2428248   .0247197     9.82   0.000      .194375    .2912746
         MQ6 |  -.0039737   .0404012    -0.10   0.922    -.0831586    .0752112
         MR1 |  -.0833994   .0568195    -1.47   0.142    -.1947636    .0279648
         MR2 |   .0968522   .0517744     1.87   0.061    -.0046239    .1983282
         MR3 |   .0551221   .0462965     1.19   0.234    -.0356173    .1458616
         MR4 |   .0187147   .0498661     0.38   0.707     -.079021    .1164504
         MR5 |  -.0401287   .0582863    -0.69   0.491    -.1543678    .0741103
         MR6 |   .0712318   .0504843     1.41   0.158    -.0277156    .1701793
         MR8 |   .0808045   .0495484     1.63   0.103    -.0163087    .1779176
         MR9 |   .1174451   .0598444     1.96   0.050     .0001523     .234738
        MR10 |   .1198042   .0736671     1.63   0.104    -.0245806     .264189
        MR11 |   .1702146   .0572452     2.97   0.003     .0580161    .2824131
        MR12 |   .1267789   .0666927     1.90   0.057    -.0039364    .2574942
        MR13 |   .0284034   .0611557     0.46   0.642    -.0914596    .1482665
        MR14 |  -.0052219   .0606914    -0.09   0.931    -.1241747     .113731
        MR15 |  -.0079391   .0710263    -0.11   0.911    -.1471481    .1312699
        MR16 |   .1257831   .0619263     2.03   0.042     .0044097    .2471565
        MR17 |   .1795631   .0514651     3.49   0.000     .0786934    .2804328
        MR18 |   .1222159   .0539736     2.26   0.024     .0164297    .2280021
        MR19 |  -.2526131   .2231571    -1.13   0.258     -.689993    .1847669
         MY1 |   .7379662   .0981476     7.52   0.000     .5456004    .9303319
         MY2 |   .7283766   .1013752     7.18   0.000     .5296849    .9270684
         MY3 |   .6854077   .1033294     6.63   0.000     .4828859    .8879296
         MY4 |   .4895264   .0996061     4.91   0.000      .294302    .6847508
         MY5 |   .5388479   .1002171     5.38   0.000     .3424259    .7352699
         MY6 |   .5608501   .0936498     5.99   0.000     .3772998    .7444004
         MY7 |   .4301485   .0844071     5.10   0.000     .2647137    .5955833
         MY8 |   .4475121   .0883688     5.06   0.000     .2743125    .6207118
         MY9 |   .5028144   .0716887     7.01   0.000     .3623072    .6433216
        MY10 |   .3710919   .0735963     5.04   0.000     .2268459     .515338
        MY11 |   .3412066   .0641701     5.32   0.000     .2154356    .4669777
        MY12 |   .4226067   .0705945     5.99   0.000      .284244    .5609694
        MY13 |   .3683734   .0724085     5.09   0.000     .2264555    .5102914
        MY14 |    .361565   .0760546     4.75   0.000     .2125009    .5106292
        MY15 |   .3043497   .0716977     4.24   0.000     .1638248    .4448747
        MY16 |   .2413729   .0724207     3.33   0.001     .0994309    .3833149
        MY17 |   .0419114   .0825858     0.51   0.612    -.1199537    .2037765
       _cons |   4.267563    .060562    70.47   0.000     4.148863    4.386262
-------------+----------------------------------------------------------------
     sigma_u |  .57877845
     sigma_e |  .39939095
         rho |  .67742387   (fraction of variance due to u_i)
------------------------------------------------------------------------------

.
.
. .
. * Save the results in a table *
. * See Chapter 14              *
. ******************************
.
. * Table 9.1
. quietly estout R_OLS R_FE R_FD R_RE*                                        ///
>         using "$dir\Wages.out",                                                    ///
>         cells(b(star fmt(%9.3f)) se(par fmt(%9.3f)))           ///
>         style(tab) stats(r2 N, fmt(%9.3f %9.0g)                       ///
>         labels(R2 Observations)) label collabels(, none)       ///
>         starlevels(+ 0.05 * 0.01)                                          ///
>         postfoot("St.err. in parenthesis; + Significant 5%, * Significant 1%")  ///
>         replace

.
. log close
      name:  <unnamed>
       log:  C:\My Documents\Example_Chapter9.log
  log type:  text
 closed on:  29 Jul 2014, 17:46:37
-------------------------------------------------------------------------------------------------
-----------------------------------------
```