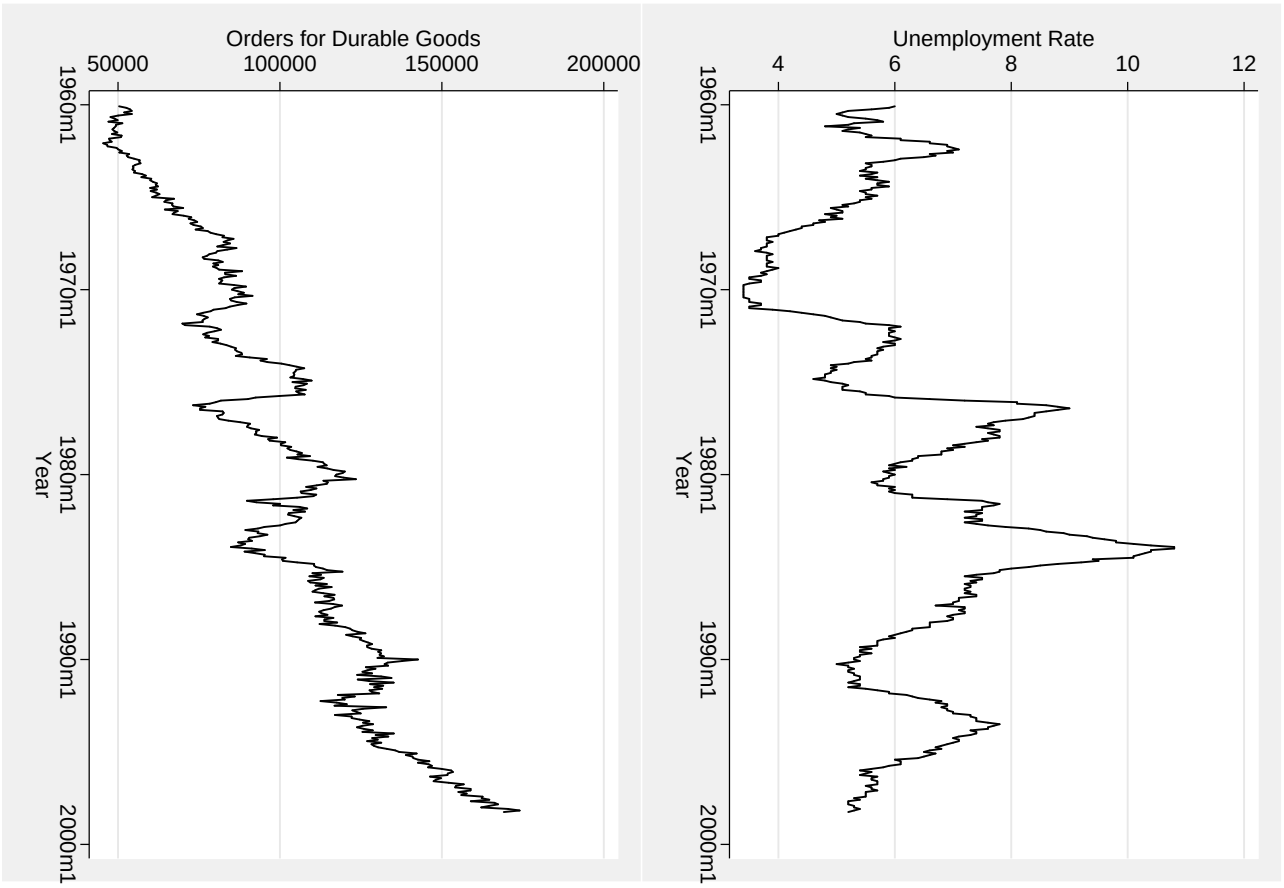
Serial Correlation in the Disturbances: A Macroeconomic Example

Economics 321

April 26, 2005

This example makes use of the statistical package STATA, which along with MATLAB is one of the leading software packages used by professional statisticians and econometricians.

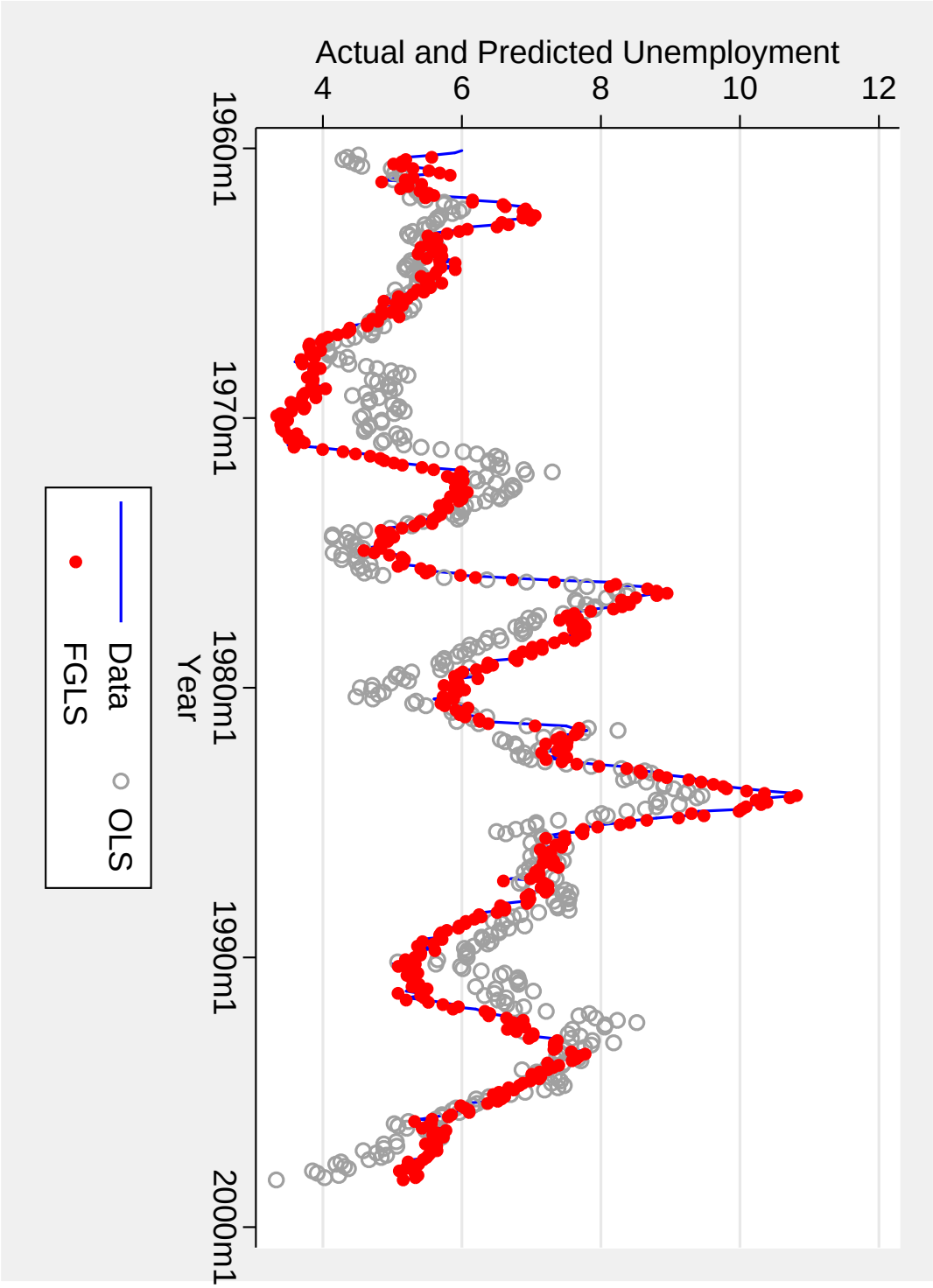
```
. regress unemp time timesq Lag_durables Lag2_durables          ;

      Source |       SS       df       MS              Number of obs =     457
-------------+------------------------------           F(  4,   452) =  282.61
       Model |  713.004141     4  178.251035            Prob > F      =  0.0000
    Residual |  285.091577   452  .630733578            R-squared     =  0.7144
-------------+------------------------------           Adj R-squared =  0.7118
       Total |  998.095718   456   2.1888064           Root MSE      =  .79419

------------------------------------------------------------------------------
       unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0384187   .0013762    27.92   0.000     .0357143    .0411232
      timesq |  -.0000248   2.39e-06   -10.37   0.000    -.0000295   -.0000201
Lag_durables |  -.0000459   .0000111    -4.14   0.000    -.0000677   -.0000241
Lag2_durab~s |  -.0000658   .0000112    -5.88   0.000    -.0000877   -.0000438
       _cons |   10.12264   .2421332    41.81   0.000     9.646789    10.59848
------------------------------------------------------------------------------

. predict P_OLS, xb                              ;
```


Unemployment Rate
4
6
8
10
12
1960m1
1970m1
1980m1
1990m1
2000m1
Year
Orders for Durable Goods
50000
100000
150000
200000
1960m1
1970m1
1980m1
1990m1
2000m1
Year

```
.  ********************************************;
. * Conduct BPG test for AR(1) disturbances      ;
. ********************************************;

. regress resid time timesq Lag_durables Lag2_durables reslag          ;

      Source |       SS       df       MS              Number of obs =     456
-------------+------------------------------           F(  5,   450) =  808.56
       Model |  255.471397     5  51.0942795           Prob > F      =  0.0000
    Residual |  28.4363245   450  .063191832           R-squared     =  0.8998
-------------+------------------------------           Adj R-squared =  0.8987
       Total |  283.907722   455  .623973015           Root MSE      =  .25138

------------------------------------------------------------------------------
       resid |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0004261   .0004375    -0.97   0.331     -.001286    .0004338
      timesq |  -1.11e-08   7.61e-07    -0.01   0.988    -1.51e-06    1.48e-06
Lag_durables |   .0000206   3.53e-06     5.83   0.000     .0000136    .0000275
Lag2_durab~s |  -.0000181   3.55e-06    -5.10   0.000    -.0000251   -.0000111
      reslag |   .9568439   .0150494    63.58   0.000     .9272681    .9864198
       _cons |  -.1484529   .0768981    -1.93   0.054    -.2995768     .002671
------------------------------------------------------------------------------

. ********************************************;
. * Cochrane-Orcutt AR(1) model                 ;
. *  with first observation dropped and rho     ;
. *  estimated iteratively.                     ;
. ********************************************;
. prais unemp time timesq Lag_durables Lag2_durables, corc          ;


Cochrane-Orcutt AR(1) regression -- iterated estimates

      Source |       SS       df       MS              Number of obs =     456
-------------+------------------------------           F(  4,   451) =    9.86
       Model |  1.32092388     4   .33023097           Prob > F      =  0.0000
    Residual |  15.0981951   451  .033477151           R-squared     =  0.0805
-------------+------------------------------           Adj R-squared =  0.0723
       Total |   16.419119   455  .036085976           Root MSE      =  .18297

------------------------------------------------------------------------------
       unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0448665   .0232794     1.93   0.055     -.000883     .090616
```

```
      timesq |  -.0000622   .0000382    -1.63   0.104    -.0001373    .0000129
Lag_durables |  -.0000121   2.62e-06    -4.61   0.000    -.0000172   -6.93e-06
Lag2_durab~s |  -.0000125   2.62e-06    -4.78   0.000    -.0000177   -7.39e-06
       _cons |   1.87683   3.305553     0.57   0.570    -4.619368    8.373028
-------------+----------------------------------------------------------------
         rho |   .9855006
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.110379
Durbin-Watson statistic (transformed) 2.076439

. ***********************************************;
. * NOTE:  See how close the estimate of rho     ;
. *  is to 1?  This may not be a stationary      ;
. *  model!!!                                    ;
. ***********************************************;

. ***********************************************;
. * Same model, estimated by the Prais-Winsten   ;
. *  approach that retains first observation.    ;
. * As you'll see, in this case the result       ;
. *  is hardly affected at all.                  ;
. ***********************************************;

. prais unemp time timesq Lag_durables Lag2_durables  ;
Prais-Winsten AR(1) regression -- iterated estimates

      Source |       SS       df       MS              Number of obs =     457
-------------+------------------------------           F(  4,   452) =   13.90
       Model |  1.86484936     4  .466212339           Prob > F      =  0.0000
    Residual |  15.1624498   452  .033545243           R-squared     =  0.1095
-------------+------------------------------           Adj R-squared =  0.1016
       Total |  17.0272992   456  .037340568           Root MSE      =  .18315

------------------------------------------------------------------------------
       unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |     .01419   .0107769     1.32   0.189    -.0069891     .035369
      timesq |  -.0000153   .0000221    -0.69   0.490    -.0000588    .0000282
Lag_durables |  -.0000122   2.62e-06    -4.64   0.000    -.0000173   -7.00e-06
Lag2_durab~s |  -.0000126   2.62e-06    -4.81   0.000    -.0000178   -7.47e-06
       _cons |   6.411423   1.181257     5.43   0.000     4.089986    8.732861
-------------+----------------------------------------------------------------
         rho |    .987859
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.110379
Durbin-Watson statistic (transformed) 2.086361
```

```
* Now create predicted values that make use of the lagged residual ;

. scalar Rho = e(rho)                              ;
. predict P_FGLS, xb                               ;
. predict Resid, residual                          ;
. gen LaggedResid = L.Resid                        ;
. gen NewPred = P_FGLS + Rho*LaggedResid           ;

. ***********************************************;
. * Graph naive and Prais-Winsten predicted      ;
. * values against data                          ;
. ***********************************************;
```


Actual and Predicted Unemployment
4
6
8
10
12
1960m1
1970m1
1980m1
1990m1
2000m1
Year
Data
FGLS
OLS