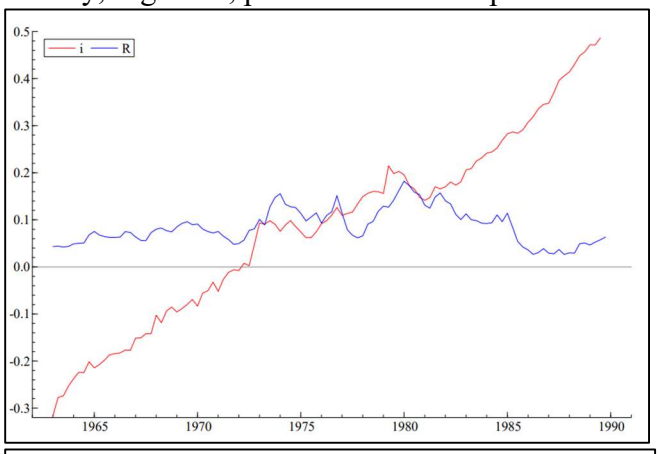
The demand for money in the UK[1] Jacob Somer

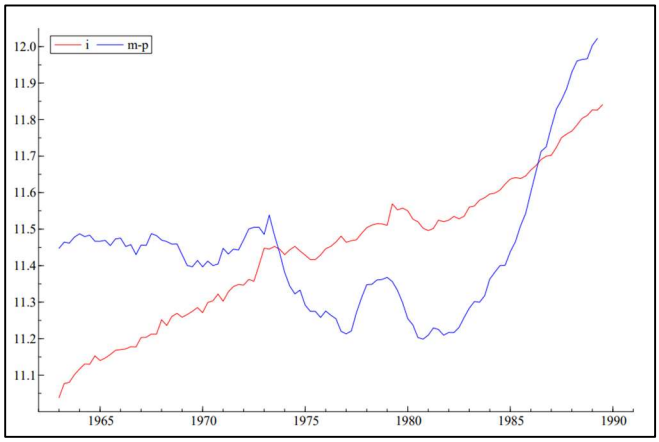
Generate a measure of velocity. Click on Model, Algebra. Enter the following:
c=i+p-m;
Don't forget the semicolon. Click on Run.

Graph m and p, m-p and I, R and Dp, c and R, c and R scatterplot.

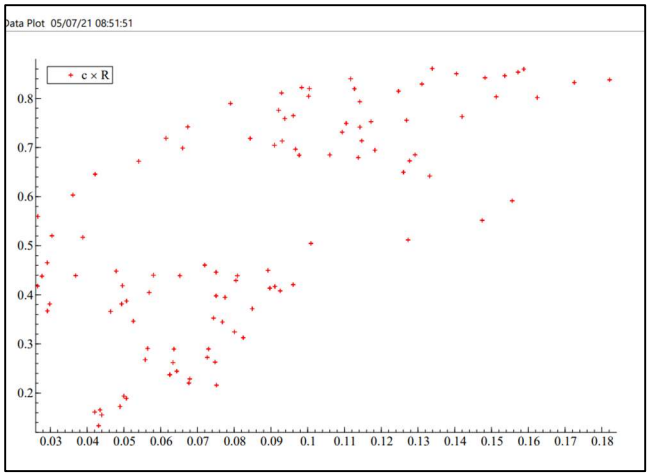
To do this, click on Model, Graphics, in the right hand panel click on m and p (hold down the control key), click on the << button, click on Actual Series. The graph will look silly, click on the graph using the **right mouse button**, and click on Edit Graph, click on the plus sign next to Regression, Scale, under m x (time), click on the plus sign next to Scaling, click on the … next to Match by, click on the down arrow, click on Means. Click done.

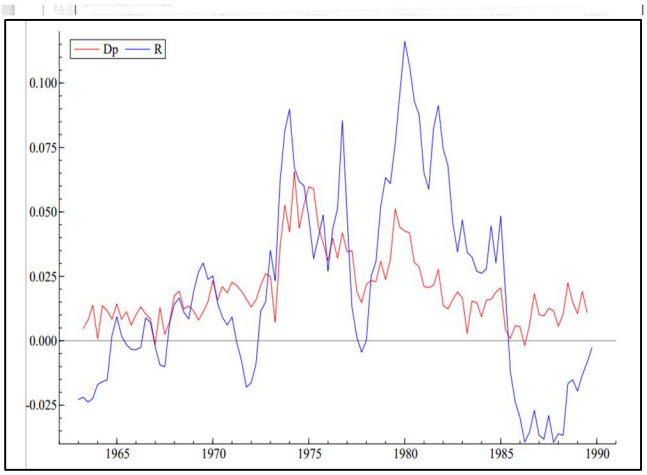
Do the same for the other graphs. Compare your graphs of m and p and m-p and i with Hendry, Fig. 16.1, p. 579 and 16.4 on p. 587.





[1] This assignment assumes Oxmetrics 6.





1. Do the graphs match?
   Yes they do.

Copy and paste the graphs into your report. [While on the Graphics page, click on Edit, Copy Metafile to Clipboard. Then go to your word processor and paste into your report.]

You can go to the Results page by clicking on Results in the left hand panel. If you are in the Results page you can go to the Graphics page by clicking on the relevant graph in the Graphics folder in the left hand panel.

Now do ADF unit root tests.

Click on Model, Model, Category: other models, descriptive statistics, formulate, select m-p, i, Dp, R; OK, unit root tests, OK, OK.

The default in PcGive is to report the ADF tests assuming no trend. If none of the tests are significant, then you are done. If any are significant, repeat the tests with trend included: Model, Model, formulate, OK. Click on the plus sign next to Unit Root Settings. Click on “Trend (and constant).”

2. Do any of these series have unit roots?
   None of them have unit roots except for maybe income.

Estimate a system (VAR)

Estimate a VAR with 4 variables and 4 lags. The four variables are m-p, i, Dp, and R. Include a constant and trend. Also include the two dummy variables Do and Dy. \

Click on Model, Model, Category: Models for time series data, Multiple equation dynamic modeling using PcGive; Formulate. Select 4 lags. Click on m-p, i, Dp, and R clicking on the << button each time. Click on the Trend, click on <<.

Now we need to add the two dummies. Change the number of lags to zero. Click on Dy and Do holding down the Control key. Click on << to add them to the model. **Right-click** on Dy. Click on "Unrestricted" Repeat for Do.

3. Is the model generally data coherent?
   No, the standard errors are all over the place.
4. Are the last two lags significant?
   No, they are not.

Now reduce the model from 4 lags to 2 lags. Click on Model, Model, Formulate. Click on all the lags greater than two, holding down the control key, and then click on the >> button.

Click on OK, OK, OK.

5. Are the residual correlations similar to those reported in Table 16.1?
   Yes, they are close. I have pasted them below for reference.

```
correlation of URF residuals (standard deviations on diagonal)
                  i          m-p           Dp            R           Dy
i          0.012933    -0.068326   -0.0098666      0.15743      0.60031
m-p       -0.068326     0.015778     -0.49415     -0.48394     0.072559
Dp       -0.0098666     -0.49415    0.0069502      0.34010    -0.030580
R           0.15743     -0.48394      0.34010     0.013353     0.011771
Dy          0.60031     0.072559    -0.030580     0.011771      0.16795
Do        0.0033121     -0.18054      0.29426      0.22542     -0.12593
```

6. Compare your results with Table 16.2 on 593 in Hendry. Are your results close to his?

Yes, they are quite close, but they are not exactly the same.

Click on Model, Test, Test Summary to see the regression diagnostics. Concentrate on the individual equation test statistics.

7. Is the model generally data coherent?
   Yes, the model is generally data coherent with only a handful of failed tests.

Now check to see if the reduction is justified. Click on Model, Model, Progress, OK.

8. Is this reduction consistent with the data (at the 5% level)?
   Yes, this reduction is justified.

Cointegration analysis: Johansen maximum likelihood method

Click on Model, Test, Dynamic Analysis and Cointegration Tests, OK, choose I(1) Cointegration analysis, OK.

9. Are the alpha and beta matrices similar to the ones reported in Table 16.6? (The beta matrix is reported with the cointegrating vectors down the columns, not across the rows.)
The alpha matrix is certainly similar. The beta matrix is slightly less similar, but the values still lead to the same conclusion.

The trace test is the only test reported by PcGive.

10. According to the trace test (the only one reported by PcGive, how many cointegrating vectors are there?

There are None.

11. What is the value of the likelihood ratio test of these restrictions?
LR test of restrictions: Chi^2(2) = 2.4333 [0.2962]

12. Can we reject the null hypothesis that these coefficients are zero?
No, we cannot reject the null at the 5 % level.

13. Can we conclude that income, interest rates, and inflation are long run weakly exogenous with respect to the parameters of the money demand equation?

No, we cannot make this conclusion given the evidence.

14. Is this joint hypothesis consistent with the data?
No.

15. How do you know?
LR test of restrictions: Chi^2(2) = 6.8081 [0.6571]

16. What are the values of the parameters in the long run demand for money? (Remember that the vector is expressed implicitly.)
The interest rate and price level are the key parameters in the long run demand for money.

Simultaneous equation modeling: PVAR

Click on Model, Algebra. In the algebra editor, define the two restricted cointegrating vectors.

```
c1=m-p-i+7*Dp+7*R;
c2=i-.0063*trend()-3.4*Dp+1.8*R;
```

17. Are the means the same as used by Hendry on p.599, equation (16.9)?

Yes, they are with .21 and 11.2 respectively.

18. Are the results similar to those reported in Table 16.7 in Hendry?

Yes, I got remarkably similar results in my table.

Estimating the econometric model

We are now ready to specify and estimate a parsimonious, interpretable simultaneous equation model of the demand for money. Even though we know that the demand for money equation is weakly exogenous, we are going to assume simultaneity for the moment, to illustrate the process of estimating such a model.

Mathematically, we have specified a set of reduced form equations, called the "system" (PVAR, also known as the Unrestricted Reduced Form). According to Hendry's method, we reduce the system to a model by multiplying through by a matrix B_0, which has a bunch of zeroes (and maybe other restrictions) in it. This multiplication produces the model. (Multiplying the model by B_0^{-1} will reverse the process and generate the reduced form.)

In practice we specify the B_0 matrix implicitly by selecting the variables to enter each equation of the model (which means we are omitting the variables that do not belong in the equation, by constraining their coefficients to zero).

Hendry claims that the coefficients on Dm-p_1 and Di_1 were found to be negatives of each other. He combined them into a velocity variable D(m-p-i). You can replicate this by setting

&1=-&0;

Don't forget the semicolon. OK, OK.

18. Are the results approximately the same as Table 16.8 in Hendry?

Yes, the results are similar. I have posted them below to demonstrate this.

```
Equation for: Dm-p
                  Coefficient  Std.Error  t-value  t-prob
c1_1               -0.0751655   0.006658    -11.3  0.0000
Dm-p_1              0.0751655        ---
Di_1                 0.150279     0.1078     1.39  0.1666
DR                  -0.702290     0.4187    -1.68  0.0968
Constant           0.00980352   0.001792     5.47  0.0000
DDp                 -0.922860     0.3954    -2.33  0.0217

sigma = 0.0140252

Equation for: Di
                  Coefficient  Std.Error  t-value  t-prob
Constant           0.00636130   0.002705     2.35  0.0208
c2_1               0.000122907  0.0005839    0.210  0.8337
Di_1                -0.134414    0.08309    -1.62  0.1091
Dy                   0.0437828   0.006890     6.35  0.0000

sigma = 0.0120186

Equation for: DR
                  Coefficient  Std.Error  t-value  t-prob
c2_1              -0.000289938  0.0002881    -1.01  0.3168
DR_1                 0.133172    0.08958     1.49  0.1405
Do                   0.0262551   0.007553     3.48  0.0008

sigma = 0.013127

Equation for: DDp
                  Coefficient  Std.Error  t-value  t-prob
DDp_1               -0.326668    0.08295    -3.94  0.0002
Do                   0.0248315   0.004152     5.98  0.0000
Dm-p_1               0.0446478    0.02802     1.59  0.1144
c2_1              -0.000247859  0.0001636    -1.51  0.1332
```

19. Are the results generally data coherent (especially with respect to serial correlation)?

Yes, the data does seem coherent with respect to serial correlation. I am basing this off the correlation of the structural residuals along with the single equation diagnostics.

20. Does the model parsimoniously encompass the system? That is, is the model a valid reduction from the system?

The model is data coherent and provides a convincing explanation of the relationships in the data. Looking at the one-dimensional projections of the full-sample likelihood in Figure 16.14, we can see that the optimum for each parameter is likely to have been achieved.

Single Equation Modeling

21. Is the model data coherent? How do you know?

The data is not data coherent, but there are outliers. Even though the average t-test for each coefficient does not reject the null, there is still the variable i_1 which rejects the null hypothesis at the .01% level. There is clearly something going on.

22, Is there a significant long run relation?

No. We do not reject the null of the Wald with a p-value of .9789.

23. What is the implied long run solution from this single equation technique?

24. Is it similar to that found by the Johansen multiple equation method above?

Yes, it is similar as the Johansen test demonstrated that there was no cointegrating vector I(0).

25. Is this what would happen if i, Dp, and R are weakly exogenous in the money demand equation?

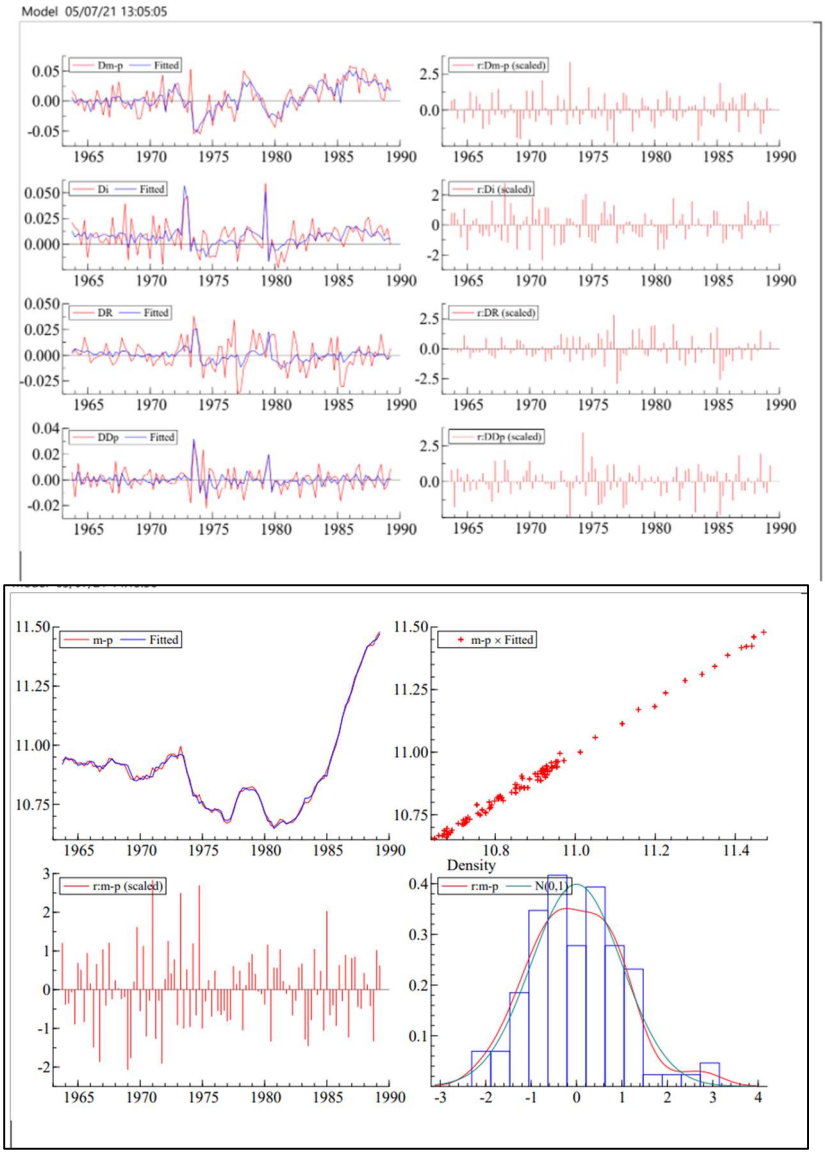
Yes.

Equilibrium Correction Model

To estimate an error correction model, you need to define the ECM (error correction mechanism). In Algebra, enter the following equation derived from the implied long run solution with the coefficients rounded to one significant digit.

```
ECM=m-p-i +.5 +7*Dp +7*R;
```

Click on Model, Model, Formulate, Clear>>. Set lags equal to 1. Select the variables that are reported in equation (16.14) on page 611 in Hendry. The screen should look like this.



26. Are the results approximately the same as equation (16.14) in Hendry?

Yes, they are.

27. Is the model data coherent? [Model, Test, Test Summary]

Yes, the model is data coherent. The residuals show no ARCH affects and the volatility of the interest rate/inflation are correctly reflected in the model.

28. Is this a valid reduction from the GUM? [Click on Model, Model, Progress, OK.]

Yes.

29. Is the majority of the variance of money demand explained by this very simple model?

30. Do the graphs look like Fig 16.18 in Hendry? Do the fitted values track the actuals? Any significant autocorrelations? Are the residuals approximately normal? (Why do we care?)

Yes, they do. There are not any significant autocorrelations. The residuals are approximately normal.

31. Is the model structural?

Yes, it is structural, as shocks in one variable seem to be simultaneous with others.

32. How do the graphs compare with those in Figure 16.19, p. 614 in Hendry?
They look similar, but his data does seem to be more centered around zero. That could just be the scaling, however.

33. Is this model consistent with theory?

Yes, this model with the 'target-bounds' model according to Hendry.
34. Is it consistent with the data?

Yes, this is consistent with the data, which shows a strong yet complex relationship between data points. There does not seem to be a major long-term trend, but the series can still be forecasted with an ecm in the short run.
35. Is it a valid reduction from the unrestricted reduced form (system)?

Yes, it is more interpretable, and it achieves higher accuracy and certainty with respect to coefficients.

36. Is it structural?
It is structural. There definitely is a relationship between these variables, but it is evidently more complex than the model we have before us. I am someone who believes human behavior can be modeled just like the weather and water. We just need enough fine-grained data and powerful computers to succeed. With the advent of new, highly granular data sources, I believe we can learn the true structural relationships in our economy.

37. Is this model satisfactory?

The model is not satisfactory because we need to be able to tell how the interest rate will directly affect other areas of the economy. We know that inflation and the interest rate are

directly tied, but it still seems hard at this point to know how a macroeconomic policy is going to seriously change long-run demand.