

Exercise 7

To examine the quantity theory of money, Brumm (2005) [“Money Growth, Output Growth, and Inflation: A Reexamination of the Modern Quantity Theory’s Linchpin Prediction,” *Southern Economic Journal*, 71(3), 661–667] specifies the equation:

$$\text{Inflation} = \beta_0 + \beta_1 * \text{Money} + \beta_2 * \text{Output} + u$$

where *INFLAT* is the growth rate of the general price level, *MONEY* is the growth rate of the money supply, and *OUTPUT* is the growth rate of national output. According to theory we should observe that $\beta_0 = 0$, $\beta_1 = 1$, and $\beta_2 = -1$. The data used in this paper is contained in the file *brumm.gdt*. It consists of 1995 year data on 76 countries.

- a) Estimate the model by OLS and interpret all the parameters.

ols Inflation const Money Output

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Model 1: OLS, using observations 1-76
Dependent variable: Inflation

      coefficient   std. error   t-ratio   p-value
-----
const    -0.234214    0.979925   -0.2390   0.8118
Money     1.03313         0.00904221 114.3     4.65e-084 ***
Output    -1.66201         0.250566   -6.633    4.95e-09 ***

Mean dependent var   25.35395   S.D. dependent var   58.94767
Sum squared resid    1356.034   S.E. of regression   4.309966
R-squared             0.994797   Adjusted R-squared   0.994654
F(2, 73)             6978.325   P-value(F)           4.41e-84
Log-likelihood        -217.3396   Akaike criterion     440.6792
Schwarz criterion     447.6714   Hannan-Quinn         443.4736
    
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- b) Test the joint hypothesis that $\beta_0 = 0$, $\beta_1 = 1$ and $\beta_2 = -1$. What do you conclude?

restrict

b[1] = 0

b[2] = 1

b[3] = -1

end restrict

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Restriction set
1: b[const] = 0
2: b[Money] = 1
3: b[Output] = -1

Test statistic: F(3, 73) = 10.5158, with p-value = 7.88962e-006

Restricted estimates:

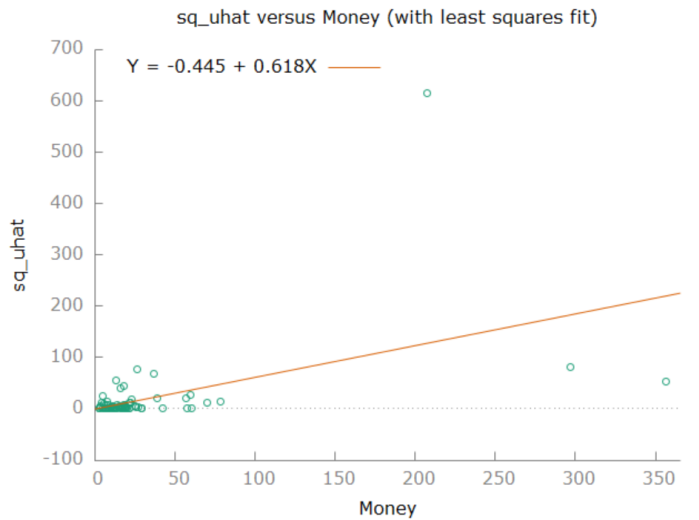
      coefficient   std. error   t-ratio   p-value
-----
const    0.000000    0.000000    NA        NA
Money     1.000000    0.000000    NA        NA
Output    -1.000000    0.000000    NA        NA

Standard error of the regression = 5.05503
    
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- c) Examine the least squares residuals for the presence of heteroskedasticity related to the variable *Money*.

series resid=\$uhat

gnuplot resid_sq Money



modtest --white

- d) Obtain robust standard errors for the model and compare them to the OLS standard errors. Does your conclusion change in part (b) after using robust standard errors?

ols Inflation const Money Output --robust

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Model 3: OLS, using observations 1-76
Dependent variable: Inflation
Heteroskedasticity-robust standard errors, variant HCL1

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	coefficient	std. error	t-ratio	p-value
const	-0.234214	0.619615	-0.3780	0.7065
Money	1.03313	0.0236942	43.60	5.08e-054 ***
Output	-1.66201	0.175914	-9.448	2.71e-014 ***

```

Mean dependent var 25.35395 S.D. dependent var 58.94767
Sum squared resid 1356.034 S.E. of regression 4.309966
R-squared 0.994797 Adjusted R-squared 0.994654
F(2, 73) 956.8215 P-value(F) 4.26e-53
Log-likelihood -217.3396 Akaike criterion 440.6792
Schwarz criterion 447.6714 Hannan-Quinn 443.4736

```

Conclusion does not change – they are jointly not equal to the theoretical parameters

- e) It is argued that *Output* may be endogenous. Four instrumental variables are proposed, *INITIAL* = initial level of real GDP, *SCHOOL* = a measure of the population's educational attainment, *INVEST* = average investment as a share of GDP, and *POPRATE* = average

population growth rate. Using these instruments, obtain instrumental variables (2SLS) estimates of the inflation equation (do the two stage procedure).

First stage:

ols Output const initial poprate school invest Money

series Output_hat=\$yhat

Second stage:

ols Inflation const Money Output_hat

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Model 5: OLS, using observations 1-76
Dependent variable: Inflation

-----
                coefficient   std. error   t-ratio   p-value
-----
const          -1.54267       2.10357     -0.7334   0.4657
Money           1.04166       0.0110451   94.31     5.12e-078 ***
yhat           -1.30970       0.646320    -2.026    0.0464   **

Mean dependent var   25.35395   S.D. dependent var   58.94767
Sum squared resid   2057.570   S.E. of regression   5.309039
R-squared            0.992105   Adjusted R-squared   0.991889
F(2, 73)             4586.595   P-value(F)           1.79e-77
Log-likelihood       -233.1841   Akaike criterion     472.3683
Schwarz criterion    479.3605   Hannan-Quinn         475.1627

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- f) Are the instruments strong? **Only invest predicts the Output significantly, other variables are weak instruments. The theoretical parameters are again jointly rejected. The impact of output on the inflation is now lower than before.**