Problem 1

Model 1: OLS, using observations 1971:1-2017:4 (T = 188)
Dependent variable: pc_ULC
Heteroskedasticity-robust standard errors, variant HC0

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	5.46301	0.777503	7.026	<0.0001	***
URX	−54.6935	6.75980	−8.091	<0.0001	***
pc_HICP	0.817799	0.0568496	14.39	<0.0001	***

Mean dependent var	4.599564	S.D. dependent var	4.390001
Sum squared resid	404.9935	S.E. of regression	1.479579
R-squared	0.887623	Adjusted R-squared	0.886408
F(2, 185)	474.6597	P-value(F)	1.41e-73
Log-likelihood	−338.8988	Akaike criterion	683.7976
Schwarz criterion	693.5069	Hannan-Quinn	687.7314
rho	0.795582	Durbin-Watson	0.385229

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 20.5268
with p-value = P(Chi-square(5) > 20.5268) = 0.000994885

In the Gretl output above you can find the estimation output of the regression of the percentage growth rate (year-on-year) of the EURO AREA unit labor cost, pc_ULC, on the period 1971:Q1-2017:Q4 (quarterly observations) on the following variables:

URX = the Euro Area unemployment rate (tot # of unemployment/tot labor force);

pc_HICP = year-on-year percentage growth rate of the index of consumer prices, i.e. the inflation rate.

a) Explain and comment the results reported in the Table. In particular, discuss the economic interpretation of the estimated coefficients.
b) Are the standard errors valid? Why?
c) What is the F(2,185) reported in the Table? Explain which is the underlying theory.
d) Is this estimated model correctly specified? Motivate your answer
e) Suppose that we are interested in testing the null hypothesis:
   H0: $\beta_{URX} = -50, \beta_{pcHICP} = 1$ Write this null hypothesis in the form $R\beta = r$
f) The test in e) has produced the following output:

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Restriction set
 1: b[URX] = -50
 2: b[pc_HICP] = 1

Test statistic: Robust F(2, 185) = 8.04736, with p-value = 0.000445474
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Explain the results and the underlying theory.

g) The Q-stat test for the autocorrelation of the residuals associated with the estimated model produces the following output:

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LAG      ACF          PACF         Q-stat. [p-value]

  1   0.7941  ***   0.7941 ***    120.4653  [0.000]
  2   0.5495  ***  -0.2197 ***    178.4534  [0.000]
  3   0.2899  ***  -0.1932 ***    194.6749  [0.000]
  4   0.0203       -0.2270 ***    194.7548  [0.000]
  5  -0.0996        0.2026 ***    196.6913  [0.000]
  6  -0.1734  **   -0.0819        202.5913  [0.000]
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Explain and interpret the results.

h) In light of your comment in (g), is it necessary to amend the specification of the model and if the answer is yes how would you amend it?

i) Discuss whether URX and pc_HICP are possibly endogenous regressors and in case they can be how would you address the estimation of this model?

j) Consider the Gretl ouput of model 2 in the Table below. pc_COMM denotes the year-on-year percentage change in the prices of commodities, including OIL. (pc_COMM_1 and pc_COMM_2 denote the first and second lag of the variable). This variable, with first and second lag, is used as an instrument for pc_HICP. Comment on the results reported in the Table. In particular, according to the results of the three tests below, what can we conclude about the Instrumental Variable strategy employed, the validity of the instruments and the endogeneity of pc_HICP?

Model 2: TSLS, using observations 1971:3-2017:4 (T = 186)
Dependent variable: pc_ULC
Instrumented: pc_HICP
Instruments: const URX pc_COMM pc_COMM_1 pc_COMM_2
Heteroskedasticity-robust standard errors, variant HC0

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	1.57761	6.49972	0.2427	0.8085	
URX	−22.5371	52.6860	−0.4278	0.6693	
pc_HICP	1.11664	0.533862	2.092	0.0379	**

Mean dependent var	4.529674	S.D. dependent var	4.359946
Sum squared resid	444.0499	S.E. of regression	1.557723
R-squared	0.877393	Adjusted R-squared	0.876053
F(2, 183)	551.7854	P-value(F)	3.17e-78
rho	0.813620	Durbin-Watson	0.370151

Hausman test -
Null hypothesis: OLS estimates are consistent
Asymptotic test statistic: Chi-square(1) = 0.64422
with p-value = 0.422187

Sargan over-identification test -
Null hypothesis: all instruments are valid
Test statistic: LM = 19.7819
with p-value = P(Chi-square(2) > 19.7819) = 5.0631e-005

Weak instrument test -
First-stage F-statistic (3, 181) = 2.159

Problem 2

Discuss the problem of testing linear hypotheses in a regression model in small samples. Discuss a practical (concrete) example.