UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4160 – Econometrics: Modelling and Systems Estimation**

Date of exam: Monday, November 26, 2018 **Grades are given:** December 17, 2018

Time for exam: 09.00 a.m. – 12.00 noon

The problem set covers 7 pages

Resources allowed:
- Open book exam. All written and printed resources, in addition to one out of two different calculators is allowed.

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

Exam in: ECON 4160: Econometrics: Modelling and Systems Estimation

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Time of day: 09:00—12:00

This is a 3 hour school exam.

Guidelines:
In the grading, question A gets 33 %, B 33 % and C 33 %.

Question A (1/3)

1. Use the information in Table 1 to decide the order of integration of the two equity price indices LPA (Norway) and $LPAW$ (world), both measured in natural logarithms.

2. In this question you can take for granted that $LPAW_t$ is a strongly exogenous variable in the conditional model for $DLPA_t$ shown in Table 2.

   (a) Based on the mis-specification tests reported, is there any indication that statistical inference based on the *t-values* will be unreliable?

   (b) Assume that the test situation is:

   $$H_0 : \text{No relationship between } DLPA_t \text{ and } DLPAW_t$$

   against

   $$H_1 : \text{There is a relationship between } DLPA_t \text{ and } DLPAW_t.$$

   Based on the information in the table, what is your conclusion?

   (c) A business school student says that the column labelled *t-prob* (which contains *p-values*) supports that there is a long-run relationship between LPA_t and $LPAW_t$, because the *p-values* of both LPA_{t-1} and $LPAW_{t-1}$ show that the coefficients are significantly different from zero when a 10 % significance level is used.

Explain why this test method can lead to a spurious relationship.

(d) Explain why the ECM-test is a valid test of the H_0 of absence of cointegration between LPA_t and $LPAW_t$, and why that test will not reject H_0 at the 10 % level of significance (see Table 2 for critical calues).

(e) Assume that the outcome of the test of the H_0 of absence of cointegration between LPA_t and $LPAW_t$ was different: that the H_0 had been rejected by the ECM-test. In this case, what would the estimated long-run elasticity of PA_t with respect to PAW_t be?

Question B (1/3)

Assume that the time series variable Y_t is generated by the linear difference equation:

$$Y_t = \phi_0 + \phi_1 Y_{t-1} + \varepsilon_t, \quad (1)$$

where ε_t is a Gaussian white noise variable with variance σ^2, hence $\varepsilon_t \sim N(0, \sigma^2)$ for all t.

1. Under which condition on ϕ_1 can the stable solution for Y_t be written in terms of a past value Y_{t-1-j} (initial condition), and the white noise terms: ε_t,ε_{t-1}, ..., ε_{t-j}?

2. Under the stability condition in QB1, derive the solution for Y_t when $j = 2$.

3. Under the stability condition in QB1, what is the expression for the solution for Y_t when $j \to \infty$?

4. Assume that we are interested in estimating the parameters ϕ_0 and ϕ_1.

   - Explain why Y_{t-1} is a pre-determined variable in (1).
   - Denote the OLS estimator by $\hat{\phi}_1$. Explain why $\hat{\phi}_1$ is a biased estimator in any finite sample, but that $plim(\hat{\phi}_1 - \phi_1) = 0$ under the stability condition.

5. Assume that we are interested in forecasting Y_{T+h}, using (1). For simplicity, we assume that ϕ_0, ϕ_1, σ^2 and Y_T are known numbers. Since we do not know the future white noise variables, the forecast is made by replacing ε_{T+1},ε_{T+2}, ..., ε_{T+h} by zeros (expected values). Denote the sequence of (point) forecasts by Y^f_{T+h}, $h = 1, 2, .., H$.

   Show that:

$$Y^f_{T+h|T} \rightarrow \frac{\phi_0}{1-\phi_1} \text{ as } h \rightarrow \infty \tag{2}$$

   under the stability condition.

6. Assume that right after you published your forecast, there is a structural break so that (1) changes to:

$$Y_{t+h} = (\phi_0 + d) + \phi_1 Y_{t+h-1} + \varepsilon_{t+h}, \text{ for } t = T \text{ and } h = 1, 2, ..., H$$

   (a) Assume that $d > 0$. How will the forecast-error $(Y_{T+1} - Y^f_{T+1|T})$ be affected by this structural break?

   (b) Will (2) still hold in this case?

Question C (1/3)

Consider the macro model:

$$C_t = c_0 + c_1 GDP_t + c_2 C_{t-1} + \epsilon_{Ct}, \tag{3}$$

$$J_t = d_0 + d_1 GDP_t + d_2 GDP_{t-1} + d_3 J_{t-1} + \epsilon_{Jt}, \tag{4}$$

$$GDP_t = C_t + J_t + G_t. \tag{5}$$

The endogenous variables are: C_t (private consumption), GDP_t (gross domestic product), J_t (private investment). G_t (public expenditure) is determined outside the system, it is an exogenous variable.

Assume that the coefficients of the model are different from zero. Assume that the two error-terms are Gaussian white noise variables. We assume that the covariance matrix of the error terms (ie $\mathbf{\Omega}$) is invertible, but it is not necessarily a diagonal matrix.

1. What are the conditions for stationarity of the time series variable GDP_t is this model? (No derivations are required in the answer)

2. Explain why the OLS estimator of c_1 is an inconsistent estimator.

3. Are (3) and (4) identified on the order condition?

4. Explain why 2SLS is a more efficient method of estimation than IV for an over-identified structural equation.

5. Imagine that you have been able to estimate the SEM (3)-(5) by FIML. Will the estimates be identical to the 2SLS estimates? If not why?

6. Assume that you are interested in testing the hypothesis H_0: $d_2 = -d_1$ (the restriction implying that J_t depends on ΔGDP_t). Explain in words how you can test this hypothesis by the use of FIML or 2SLS estimation.

Tables

Unit-root tests
The dataset is: C:\SW20\ECON4160\H2018\Exam\MODobligexam.in7
The sample is: 1973(2) - 2018(2) (185 observations and 4 variables)

LPA: ADF tests (T=181, Constant; 5%=-2.88 1%=-3.47)

D-lag	t-adf	beta Y_1	sigma	t-DY_lag	t-prob
3	-1.093	0.99148	0.1065	2.481	0.0140
2	-0.9773	0.99228	0.1080	-1.636	0.1037
1	-1.083	0.99142	0.1085	4.241	0.0000
0	-0.8944	0.99259	0.1135		

LPAW: ADF tests (T=181, Constant; 5%=-2.88 1%=-3.47)

D-lag	t-adf	beta Y_1	sigma	t-DY_lag	t-prob
3	-0.6086	0.99715	0.05602	1.564	0.1197
2	-0.5399	0.99746	0.05625	-2.180	0.0306
1	-0.6487	0.99692	0.05684	5.691	0.0000
0	-0.3780	0.99806	0.06162		

DLPA: ADF tests (T=181, Constant; 5%=-2.88 1%=-3.47)

D-lag	t-adf	beta Y_1	sigma	t-DY_lag	t-prob
3	-6.544**	0.25367	0.1056	2.025	0.0444
2	-6.222**	0.35127	0.1065	-2.436	0.0158
1	-8.997**	0.20990	0.1080	1.705	0.0900
0	-9.868**	0.29873	0.1086		

DLPAW: ADF tests (T=181, Constant; 5%=-2.88 1%=-3.47)

D-lag	t-adf	beta Y_1	sigma	t-DY_lag	t-prob
3	-6.093**	0.34188	0.05601	0.6527	0.5148
2	-6.466**	0.37264	0.05592	-1.542	0.1249
1	-8.687**	0.29101	0.05613	2.216	0.0280
0	-8.853**	0.39075	0.05674		

Table 1: Test results for LPA_t, the natural logarithm of the Oslo Stock Exchange Index, and LPAW, the log of a world equity price index.

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EQ(1)  Modelling DLPA by OLS
      The dataset is: C:\SW20\ECON4160\H2018\Exam\MODobligexam.in7
      The estimation sample is: 1985(1) - 2018(2)

                   Coefficient  Std.Error  t-value  t-prob
DLPA_1                0.118291    0.04598     2.57  0.0113
LPA_1               -0.0355075    0.01952    -1.82  0.0713
LPAW_1               0.0432321    0.02383     1.81  0.0721
DLPAW                 0.899811    0.09305     9.67  0.0000
DLSPOILUSD            0.153493    0.03232     4.75  0.0000
DVOLUSA            -0.00389039   0.001015    -3.83  0.0002
DPADUM                0.975029     0.1063     9.17  0.0000
Constant            0.00718436   0.007280    0.987  0.3256

sigma                0.0491035  RSS              0.303805505
R^2                   0.799467  F(7,126) =    71.76 [0.000]**
Adj.R^2               0.788327  log-likelihood       217.839
no. of observations        134  no. of parameters          8

AR 1-5 test:      F(5,121)  =   1.3873  [0.2338]
ARCH 1-4 test:    F(4,126)  =   0.68241 [0.6054]
Normality test:   Chi^2(2)  =   1.5245  [0.4666]
Hetero-X test:    F(34,99)  =   1.3095  [0.1536]

Critical values of ECM-test: -3.21 (5 %), -2.91 (10 %)
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Table 2: Estimation results for a model of DLPA which is the first difference of LPA_t. DLPAW is the first difference of LPAW. The other variables are the change in the log of the oil price ($DLSPOILUSD$) , a measure of volatily ($DVOLUSA$) and a dummy ($DPADUM$).