UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Postponed exam: **ECON4325 – Monetary Policy**

Date of exam: Monday, June 13, 2016

Time for exam: 09:00 a.m. – 12:00 noon

The problem set covers 5 pages

Resources allowed:

- No written or printed resources – or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

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

The exam consists of three parts, 1, 2 and 3. In the grading, problem 1 is given 30 per cent weight, problem 2 is given 20 per cent weight, and problem 3 is given 50 per cent weight. The max page limit should be respected, but is <u>not</u> required (i.e. a shorter answer may be just as good).

Problem 1a

Imagine that you are working as a senior advisor in Norges Bank in May 2016, and the next monetary policy meeting is one week away. The interest rate is now 0,75 per cent after a 25 basis points interest rate cut at the last meeting.

The economic development since the last meeting can be described as follows:

- Negative impulses from the oil sector to the ***real economy*** have been much stronger than expected. No improvement is expected any time soon.
- ***The unemployment rate*** is now 4,2 per cent and higher than the «natural» level of unemployment. Norges Bank is very uncertain about further development in the unemployment rate.
- ***Inflation***, measured by 12-month growth in CPI-ATE, is 3,3 per cent and is kept up by strong growth in imported inflation (which has a 1/3 weight in CPI-ATE) after a long-lasting depreciation of the ***Norwegian Krone***. Expected yearly growth in CPI-ATE is 3 per cent for 2016 and 2,1 percent for 2017.
- ***Nominal wage growth*** is expected to be approximately 2,5 per cent in 2016.
- ***House price growth*** has been higher than expected.

- ***Foreign interest rates and interest rate expectations*** have dropped more than expected. The expected rise in foreign rates has been postponed to late 2018, at the earliest.

In the following, it is taken for granted that you are familiar with Norges Bank's forward guidance strategy and the three criteria for an appropriate interest rate path, to the extent that we have covered it in this course.

Based on the information given above, you are asked to write a recommendation on what to do with the interest rate at the next meeting. Your draft should make use of what you have learned in this course in general and the information given above, in particular.

The Governor asks for your personal opinion and your draft should therefore give an independent and intuitive explanation for your choice of interest rate decision. In your answer, you should also sketch three interest paths: (i) your chosen one, (ii) how the path would have looked like if only criterion 1 was considered, and (iii) how the path would have looked like if only criteria 1 and 2 were considered. Briefly explain the difference between the paths. The paths should cover the time period from the day of the meeting and two years ahead.

Your written answer should exceed one page, but be no more than four pages long.

Problem 1b

The Norges Bank Watch 2016 report recommends that Norges Bank opens up for a discussion of whether the ***central bank mandate*** should be changed. Give two examples of how the mandate could be changed and provide arguments both in favor of and against both examples. Next, provide a recommendation and explain your choice. Your answer should be no more than two pages long.

Problem 1c

What are the three types of inefficiencies in the New Keynesian model used in this course? In your opinion; are these inefficiencies realistic? In your answer, which should not be more than two pages long, you can assume that wages are flexible.

Problem 1d

Briefly describe what is meant by the Taylor principle in general and its role in the New Keynesian model applied in the course. Then describe, again briefly, the role of the Taylor principle in a Fisherian model with Markov switching between an active and passive monetary policy regime as described in Davig and Leeper (2007). Does the duration of a stay in a passive regime matter for the results? Explain. Your answer should be no more than one page long.

Problem 2

It can be shown that the first order conditions for the household maximization problem in the real business cycle model described in this course are:

$$\frac{W_t}{P_t} = \Omega_t = \frac{N_t^{\varphi}}{C_t^{-\sigma}} = \frac{-\partial U / \partial N_t}{\partial U / \partial C_t} \quad (1)$$

$$Q_t = \beta E_t \left\{ \frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}} \frac{P_t}{P_{t+1}} \right\} = \beta E_t \left\{ \frac{\partial U / \partial C_{t+1}}{\partial U / \partial C_t} \Pi_{t+1}^{-1} \right\} \quad (2)$$

where Ω_t is the real wage; N_t is hours worked; C_t is consumption; $\frac{1}{\varphi}$ is the Frisch elasticity, which measures how willing the household is to substitute leisure for hours worked when the real wage changes; $\frac{1}{\sigma}$ is the intertemporal elasticity of substitution, which measures how willing the household is to substitute consumption over time when the real interest rate changes (it is also a measure of how valuable consumption is to the household); U denotes the utility function; P_t denotes the aggregate consumption price level; Q_t denotes the aggregate bond price level; $0 < \beta < 1$ is the discount factor and Π_{t+1} denotes the gross inflation rate in period t+1. All subscripts t denote period t. It is assumed that the one period risk free nominal bond, which is bought at price Q_t pays one nominal unit of money on maturity.

Problem 2a

Give an intuitive interpretation of equations (1) and (2) above. In your answer you should state the difference between the intratemporal and the intertemporal optimality conditions. Your answer should be no more than two pages long.

Problem 2c

It can be shown that the log-linearized equilibrium solutions for output and unemployment in the real business cycle model as discussed in this course can be presented in the following way:

$$y_t^* = \frac{1+\varphi}{\sigma(1-\alpha)+\alpha+\varphi} a_t + \frac{(1-\alpha)\log(1-\alpha)}{\sigma(1-\alpha)+\alpha+\varphi} = \psi_{ya} a_t + \xi_y \quad (3)$$

$$n_t^* = \frac{1-\sigma}{\sigma(1-\alpha)+\alpha+\varphi} a_t + \frac{\log(1-\alpha)}{\sigma(1-\alpha)+\alpha+\varphi} = \psi_{na} a_t + \xi_n \quad (4)$$

$$\omega_t^* = \frac{\sigma+\varphi}{\sigma(1-\alpha)+\varphi+\alpha} a_t + \frac{[\sigma(1-\alpha)+\varphi]\log(1-\alpha)}{\sigma(1-\alpha)+\varphi+\alpha} = \psi_{\omega a} a_t + \xi_\omega \quad (5)$$

where a_t describes technology, which is expected to follow a stationary AR(1) process; y_t^* denotes equilibrium output; n_t^* denotes equilibrium employment; ω_t^* denotes equilibrium real wage and $0 < \alpha < 1$ is a measure of decreasing return to scale. The log-linearized production function for the firm in this model is:

$$y_t = a_t + (1-\alpha)n_t \qquad (6)$$

Based on the information given above, and on your knowledge of the real business cycle model as discussed in this course, explain how the equilibrium real wage, output and employment (given by equations (3)-(5)) will change in the presence of a positive technology shock. In your answer, you should assume that $\varphi > 1$ and that $\sigma > 1$. The more of the parameters in ψ_{ya} and ψ_{na} that are interpreted, the higher is the score. The parameters included in ξ_y , ξ_n and ξ_ω need not be interpreted, but you should state the signs and explain their effect on the equilibrium variables.

Your answer should be no more than three pages long.

Problem 3

In the New Keynesian Model used in this course, inflation is a result of aggregate consequences of carefully reasoned price-setting decisions made by firms based on their current and future cost conditions. The non-policy block of equilibrium behavior in the model can be explained by the following two equations:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa\tilde{y}_t \qquad 0 < \beta < 1\ ,\ 0 < \kappa < 1 \qquad (1)$$

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \frac{1}{\sigma}\left[i_t - E_t\{\pi_{t+1}\} - \rho\right] + e_t, \qquad 0 < \sigma < 1 \qquad (2)$$

$$e_t = \mu e_{t-1} + \hat{e}_t, \qquad 0 < \mu < 1$$

Where π_t is inflation, $\tilde{y}_t = \left(y_t - y_t^{natural}\right)$ is the output gap in period t, i_t is the nominal interest rate, e_t is the demand shock and $\hat{e}_t$ is white noise. e_t is known when monetary policy is determined and is the only shock in this economy. Introducing monetary policy, the central bank is committed to the following Taylor rule:

$$i_t = \rho + \phi_\pi \pi_t + \phi_{\tilde{y}}\tilde{y}_t, \qquad (3)$$

where $\phi_\pi, \phi_{\tilde{y}}$ are non-negative parameters, set by the central bank. ρ equals the natural interest rate (in the absence of technology shocks) and is, together with all other parameters $(\kappa, \sigma, \mu, \beta)$ given by "nature".

Problem 3a

Use the method of undetermined coefficients (with the following guess parameters: α and ψ for the effect on the output gap and inflation in period *t*, respectively) to find the equilibrium solutions for inflation and the output gap in this economy in the presence of a positive demand shock. Your answer should include

i) Your calculation of the equilibrium solutions for inflation and output gap in the presence of the shock.

ii) An interpretation of the economic mechanisms (the more effects interpreted, the higher is the score).

In your calculation, you do not have to insert for κ, but may consider κ a measure of price stickiness only. Also, you do not have to simplify the solutions. For instance, the solution for the full effect of a demand shock on the output gap can look like this:

$$\alpha e_t = \frac{1}{1-\mu+\frac{\kappa\phi_\pi}{\sigma(1-\beta\mu)}+\frac{\phi_{\tilde{y}}}{\sigma}-\frac{\kappa\mu}{\sigma(1-\beta\mu)}} e_t$$

Problem 3b

Briefly explain (in words only) why the equilibrium solutions for inflation and the output gap found in 3b are not a result of optimal monetary policy. Your answer should be no more than ½ page long.

Problem 3c

Use what you have learned in the course and derive the equilibrium solutions for inflation and the output gap under optimal monetary policy without commitment when the economy is explained by equations (1) and (2), agents have rational expectations and the central bank wants to stabilize both inflation and the output gap, but does not try to boost output above its natural level. Your answer should include a mathematical solution and an interpretation of your solutions. Your answer should be no more than three pages long.

Hint: Under optimal monetary policy without commitment, the central bank may re-optimize in every period and therefore has to take expectations as given in its optimization problem.

Problem 3d

Show that the optimal response with the interest rate is:

$$i_t = \rho + \sigma e_t$$

Interpret the solution and briefly explain (in words only) why it differs from the solution found in 3b.

Problem 3e

Briefly explain how the solutions found in 3d would change in the presence of a cost push shock. Your answer should not exceed one page.