UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4325 – Monetary policy and business fluctuations**

Date of exam: Wednesday, May 28, 2008 **Grades are given: Friday, June 13**

Time for exam: 9:00 a.m. – 12:00 noon

The problem set covers 6 pages (incl. cover sheet)

Resources allowed:

- No resources allowed

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

4325 – Monetary Policy and Business Fluctuations

Exam, May 28, 2008

Before you start, please read the following:

- You can answer in either English or Norwegian.
- Answer all questions and write brief and concise answers!
- Allocate time spent on each question wisely.
- Good style will not matter for grades, but please write clearly.
- Good luck!

1 : True or false? (20%)

For each of the statements, true or false, explain why. *Be brief and concise!*

1. Gjefsen, Krogh and Lerbak (2008) and Kydland and Prescott (1990) document that for Norwegian and U.S. time series, respectively, output and price level are contemporaneously positively correlated with a coefficient of about 0.6.
2. In the model economy of Gavin and Kydland (1999), changes in montary policy have large effects on the cyclical behavior of nominal variables, but hardly any effect on the cyclical behavior of real variables, like output, consumption and investments.
3. According to Michael Woodford, monetary policy affects inflation and output mainly through agents' expectations.
4. Mankiw (2006) claims that new Keynesian research has had strong impact on "practical macroeconomists who are charged with the messy task of conducting actual monetary and fiscal policy".
5. If the central bank is uncertain about how a change in output affects inflation, it should respond more aggressively to inflation shocks ("cost-push" shocks).

2 : Inflation and output (35%)

1. Assume that output is given by

$$y_t = \gamma\left(\pi_t - \pi_t^e\right) + u_t$$

where y_t is the log of output, measured as a deviation from potential output, π_t is the rate of inflation at period t, and π_t^e is the rate of inflation at period t expected by the private sector at period $t-1$. u_t is supply shock, which we assume is white noise, and γ is a positive constant. The private sector has rational expectations, such that

$$\pi_t^e = E_{t-1}\pi_t$$

The society has preferences over inflation and output, which are represented by the following loss function:

$$L = \frac{1}{2}\left[(\pi_t - \pi^*)^2 + \lambda\left(y_t - y^*\right)^2\right],$$

where $\lambda > 0$ and $y^* > 0$.

   (a) Explain why it may give a sub-optimal outcome if the central bank minimizes the society's loss function.

   (b) If the central bank is not able to commit, how should the central bank's loss function be specified in order to achieve a better outcome? (Hint: you might consider different values of π^*, y^*, and λ than in the society's loss function, or you might consider adding a new term to the loss function).

2. What is the 'Taylor principle'? What happens if the Taylor principle is not satisfied? Explain the economic mechanisms.

3 : Theory and measurement (45%)

1. In order to distill business cycle facts from the data we need to distinguish between the trend of the real variable and the deviation from the trend.

   (a) The Hodrick-Prescott filter is an algorithm that "smooths" the original time series y_t to estimate its trend component, τ_t. The

cyclical component, c_t, is the difference between the original series and its trend, i.e.,

$$y_t = \tau_t + c_t$$

where τ_t is constructed from optimizing the objective function

$$\min_{\{\tau_t\}_{t=1}^{T}} \sum_{t=1}^{T} \left(y_t - \tau_t\right)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(\tau_{t+1} - \tau_t\right) - \left(\tau_t - \tau_{t-1}\right)\right]^2$$

In order to simplify this problem, assume $T = 3$. Derive the first order conditions of the objective function. Combine them using matrix notation. Show how you can solve for the trend and cycle components.

(b) The bandpass filter is an alternative to the Hodrick-Prescott-filter. Describe *very briefly* how the bandpass filter differ from the Hodrick-Prescott filter.

(c) Table 1 displays the business cycle statistics for five Norwegian macroeconomic time series, as computed and reported by Gjefsen, Krogh and Lerbak. Describe the series in terms of volatility, pro-/counter-cyclicality, and lead/lag.

2. Consider a prototypical business cycle model where expected discounted additive separable utility over consumption and leisure is maximized subject to a set of accounting constraints:

$$\max_{\{c_t, x_t, n_t\}_{t=0}^{\infty}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, 1 - n_t\right)$$

subject to

$$\text{Product approach to output:} \qquad y_t = e^{z_t} f\left(k_t, n_t\right). \tag{1}$$

$$\text{Income approach to output:} \qquad y_t = r_t k_t + w_t n_t. \tag{2}$$

$$\text{Expenditure approach to output:} \qquad y_t = c_t + x_t. \tag{3}$$

$$\text{Law of motion for capital:} \qquad k_{t+1} = (1 - \delta) k_t + x_t. \tag{4}$$

$$\text{Total factor productivity:} \qquad z_t = \rho z_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \sigma^2), \tag{5}$$

where the exogenous stochastic process, specified in Equation (5), is computed, in final samples, from $\{\tilde{z}_t\}_{t=0}^{T}$ where each $\tilde{z}_t$ is given by

$\tilde{z}_t = \ln \tilde{y}_t - \alpha \ln \tilde{k}_t - (1-\alpha) \ln \tilde{n}_t$. $u(\cdot)$ is the utility function, t is time, c is consumption, n is supplied labor (total available time is normalized to 1), y is output, z is total factor productivity, $f(\cdot)$ is the production function, k is capital stock, r is return on capital, w is return on supplied labor, δ is the depreciation rate of capital, x is investment, and ρ is the autoregressive coefficient. The usual assumptions on functional forms applies. The first welfare theorem applies.

Assume total factor productivity (z) is constant and equal to its unconditional expectation.

(a) Write up the social planner's problem for this deterministic model economy.

Reformulate it as a Langrangian problem.

(b) Derive the intertemporal optimality condition (the Euler equation) and the intratemporal optimality condition.

Give a brief intuitive explanation for each of these two optimality conditions.

3. (a) Taking the model economy to measurements, are the "Final consumption expenditure" series reported by Statistics Norway the matching the theoretical concept of "Consumption" in the previous question? Why or why not?

(b) On May 22nd, Anatole Kaletsky, the principal economic commentator and associate editor of The Times of London wrote:

"Commodity inflation is far more lethal than a credit crunch [...]. It prevents central banks in advanced economies from cutting interest rates."

Comment on this statement, and in particular the measurement of inflation given a standard New Keynesian model economy.

Table 1: Business cycle statistics, selected variables

Variable x	% Std.dev.	Cross-correlation of real GNP with x_{t-5}	x_{t-4}	x_{t-3}	x_{t-2}	x_{t-1}	x_t	x_{t+1}	x_{t+2}	x_{t+3}	x_{t+4}	x_{t+5}
GNP	1.12	0.038	0.165	0.375	0.656	0.904	1.000	0.904	0.656	0.375	0.165	0.038
Final consumption, households	1.65	0.032	0.163	0.311	0.478	0.625	0.702	0.690	0.608	0.495	0.385	0.292
— goods	2.58	0.053	0.191	0.346	0.515	0.658	0.733	0.719	0.643	0.535	0.421	0.307
Final consumption, govn't	0.95	-0.419	-0.340	-0.202	-0.006	0.210	0.388	0.516	0.560	0.546	0.505	0.460
NIBOR nom. interest rates	0.79	-0.228	-0.337	-0.465	-0.586	-0.658	-0.661	-0.621	-0.523	-0.377	-0.195	-0.000