Written Exam for the M.Sc. in Economics Summer 2010

# Monetary Economics: Macro Aspects

Master's Course

June 16

(3-hour closed-book exam)

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by "eksamen på dansk" in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students' self-service system.

This set contains three pages (beginning with this page)
All questions must be answered
Questions 1 and 2 each weigh 25 % while question 3 weighs 50 %. These weights, however, are only indicative for the overall evaluation.

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## QUESTION 1:

Evaluate whether the following statements are true or false. Explain your answers.

(i) In the simple New-Keynesian model, optimal stabilization of inflation shocks requires that the central bank can credibly commit not to affect private-sector expectations.

(ii) Under strict inflation targeting, in the Svensson (1997) sense, the optimal nominal interest-rate rule should only depend on inflation.

(iii) When an explicit shopping-time motive is introduced as a way of indirectly having money in the utility function, the Friedman rule is never optimal.

## QUESTION 2:

### Monetary policy and an "output target conservative" central banker

Consider the following log-linear AS curve in a closed economy:

$$y_t = a\left(\pi_t - \mathrm{E}_{t-1}\pi_t\right) + \varepsilon_t, \qquad a > 0, \tag{1}$$

where $y_t$ is output, $\pi_t$ is inflation and $\varepsilon_t$ is a mean-zero, serially uncorrelated shock. $\mathrm{E}_{t-1}$ is the rational expectations operator conditional upon all information up to and

including period $t-1$. For simplicity $\pi_t$ is taken to be the instrument of monetary policy. The aim of policy is to minimize

$$V = \frac{1}{2}\sum_{t=0}^{\infty}\beta^t\left[\lambda\left(y_t - k\right)^2 + \pi_t^2\right], \qquad k > 0, \quad \lambda > 0, \quad 0 < \beta < 1. \tag{2}$$

(i) Discuss (1) and (2) with focus on the underlying economic mechanisms, and derive the optimal time-consistent outcomes for output and inflation. What is the inefficiency of the solution? Explain.

(ii) Society now delegates monetary policymaking to a central banker who aims at an output level lower than the social optimal. Hence, it has a loss function given by

$$V^c = \frac{1}{2}\sum_{t=0}^{\infty}\beta^t\left[\lambda\left(y_t - k^c\right)^2 + \pi_t^2\right], \qquad k^c < k. \tag{3}$$

Show formally how the time-consistent outcomes change relative to those derived in (i), and assess whether delegation of this form will always be beneficial.

(iii) Discuss the relationship between this form of delegation and Walsh's linear inflation contract.

## QUESTION 3:

### Cash and credit goods and monetary policy

Assume a model of a closed economy formulated in discrete time, where representative individuals have utility functions

$$U = \sum_{t=0}^{\infty}\beta^t\left[u\left(c_t\right) + w\left(d_t\right)\right], \qquad 0 < \beta < 1, \tag{1}$$

and budget constraints

$$f\left(k_{t-1}\right) + \tau_t + \left(1-\delta\right)k_{t-1} + \frac{1}{1+\pi_t}m_{t-1} = c_t + d_t + k_t + m_t, \tag{2}$$

where $c_t$ is consumption of "cash goods", $d_t$ is consumption of "credit goods," $m_t$ is real money balances at the end of period $t$, $k_{t-1}$ is physical capital at the end of

period $t-1$, $\tau_t$ are monetary transfers by the government, $0 < \delta < 1$ is capital's rate of depreciation and $\pi_t$ is the inflation rate. The functions $u$, $w$ and $f$ are increasing and strictly concave.

Purchases of cash goods are subject to a cash-in-advance constraint, which is modelled by the constraint

$$c_t \leq \tau_t + \frac{1}{1+\pi_t} m_{t-1} \equiv a_t. \tag{3}$$

(i) Discuss the model given by (1), (2) and (3).

(ii) Derive the relevant first-order conditions for optimal individual behavior, For this purpose, use the value function

$$V(k_{t-1}, a_t) = \max \left\{ u(c_t) + w(d_t) + \beta V(k_t, a_{t+1}) - \mu_t \left( c_t - \tau_t - \frac{1}{1+\pi_t} m_{t-1} \right) \right\},$$

where $\mu_t$ is the multiplier on (3), and where the maximization is over $c_t$, $d_t$, $m_t$ and $k_t$ and subject to (2). [Hint: Simplify the problem by using (2) to substitute out $k_t$ in the value function]

(iii) Interpret the first-order conditions and show that they (along with the expressions for the partial derivatives of the value function derived using the Envelope Theorem) can be combined into the following system:

$$\begin{aligned} \frac{u'(c_t)}{w'(d_t)} &= \frac{\lambda_t + \mu_t}{\lambda_t}, \\ \lambda_t &= \frac{\beta}{1+\pi_{t+1}} V_a(k_t, a_{t+1}), \\ \beta^{-1}\lambda_{t-1} &= \lambda_t R_{t-1}, \\ V_a(k_{t-1}, a_t) &= \lambda_t + \mu_t, \end{aligned}$$

where $R_{t-1} \equiv 1 + f'(k_{t-1}) - \delta$ is the gross real interest rate and $\lambda_t \equiv \beta V_k(k_t, a_{t+1})$.

(iv) Show whether different monetary policies (here, different inflation rates) have steady-state effects on output, $y^{ss} = f(k^{ss})$. Explain.

(v) Is monetary policy steady-state superneutral in the sense that no real variables are affected by inflation? Assess this formally and explain. [Hint: For this purpose, show that $\lambda_t = \beta \frac{\lambda_{t+1} + \mu_{t+1}}{1+\pi_{t+1}}$.]