Written Exam for the B.Sc. or M.Sc. in Economics 2009-II

Monetary Economics: Macro Aspects

Master's Course

Date: 15 June

(4-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 four pages (beginning with this page)
All questions must be answered
In the evaluation, the three main questions will be weighted equally

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Spring 2009

QUESTION 1:

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

(i) In the simple New-Keynesian model with monopolistic competition and sticky prices, a monetary policy implementing the Friedman rule is optimal as it eliminates any relative demand distortions.

(ii) Under a nominal interest-rate targeting procedure, monetary policymaking performed without knowledge of the realizations of current shocks can be improved by using the money stock as an intermediate target whenever money-market shocks are predominant in the economy.

(iii) A country's nominal interest rate policy was for a period shown to follow a Taylor-type rule like $i_t = 1.5\pi_t + 0.5x_t$, where i_t is the nominal interest rate, π_t is the inflation rate and x_t is the output gap. In a subsequent period, where a new central bank governor took office, monetary policy was characterized by $i_t = 2.5\pi_t + 0.5x_t$. As this was the only structural change in the economy, the new central bank governor had the same preferences for inflation and output stability as the old one.

(iv) In a simple money-in-the-utility-function model, superneutrality of money only fails when money shocks create unanticipated inflation.

QUESTION 2:

Monetary policy and a "conservative" central banker

Consider the following model of inflation determination in a closed economy:

$$\pi_t = \mathrm{E}_{t-1}\pi_t + \kappa x_t + \varepsilon_t, \qquad \kappa > 0, \tag{1}$$

where π_t is inflation, x_t is the output gap and ε_t is a mean-zero, serially uncorrelated shock with variance σ^2. E_{t-1} is the rational expectations operator conditional upon all information up to and including period $t-1$. The central bank is assumed to affect aggregate demand through monetary policy, and for simplicity x_t is taken to be the instrument of monetary policy. The aim of monetary policy is to maximize

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

(i) Discuss (1) and (2) with focus on the underlying economic mechanisms, and derive the optimal time-consistent outcomes for output and inflation [Hint: Maximize (2) w.r.t. x_t subject to (1), which is a sequence of one-period problems, taking as given $\mathrm{E}_{t-1}\pi_t$; from the first-order condition derive $\mathrm{E}_{t-1}\pi_t$ and the solutions]. What is the inefficiency of the solution? Explain.

(ii) Society now delegates monetary policymaking to a "conservative" central banker with a utility function given by

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

Show formally how the time-consistent outcomes change relative to those derived in (i)? Will delegation of this form always be beneficial?

Assume now that (1) is replaced by

$$\pi_t = \beta\mathrm{E}_t\pi_{t+1} + \kappa x_t + \varepsilon_t. \tag{4}$$

(iii) Derive the optimal time-consistent outcomes for output and inflation [Hint: Maximize (2) w.r.t. x_t subject to (4), which is a sequence of one-period problems, taking as given $\mathrm{E}_t\pi_{t+1}$; use the first-order condition together with (4) and derive π_t and thus x_t.] Discuss the solution, and point out similarities and differences with the solution when equation (1) applies.

(iv) Discuss whether delegation to a conservative central banker is beneficial when (4) applies.

QUESTION 3:

Investment under a cash-in-advance constraint

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

$$U = \sum_{t=0}^{\infty} \beta^t u(c_t), \qquad 0 < \beta < 1, \tag{1}$$

with

$$u(c_t) \equiv \frac{(c_t)^{1-\sigma} - 1}{1-\sigma}, \qquad \sigma > 0,$$

and budget constraints

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

where c_t is consumption, m_t is real money balances at the end of period t, k_{t-1} is physical capital at the end of period $t-1$, τ_t are monetary transfers by the government, $0 < \delta < 1$ is capital's rate of depreciation and π_t is the inflation rate. The function f is defined as $f(k_{t-1}) \equiv k_{t-1}^{\alpha} f(k_{t-1}) \equiv k_{t-1}^{\alpha}$, $0 < \alpha < 1$.

Purchases of consumption goods, as well as investment in physical capital, are subject to a cash-in-advance constraint. This is modelled as

$$c_t + k_t - (1-\delta)k_{t-1} \le \tau_t + \frac{1}{1+\pi_t}m_{t-1}. \tag{3}$$

(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

$$\begin{aligned} V\left(k_{t-1}, m_{t-1}\right) &= \max\left\{u\left(c_t\right) + \beta V\left(k_t, m_t\right)\right., \\ &\quad \left. -\mu_t\left[c_t + k_t - (1-\delta)\,k_{t-1} - \tau_t - \left(1/\left(1+\pi_t\right)\right)m_{t-1}\right]\right\} \end{aligned}$$

where μ_t is the multiplier on (3), and where the maximization is over c_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 steady-state relationships:

$$\left(c^{ss}\right)^{-\sigma} = \beta V_k\left(k^{ss}, m^{ss}\right), \tag{4}$$

$$V_k\left(k^{ss}, m^{ss}\right) = \beta V_k\left(k^{ss}, m^{ss}\right)(1-\delta) + \beta V_m\left(k^{ss}, m^{ss}\right)\alpha\left(k^{ss}\right)^{\alpha-1}, \tag{5}$$

$$V_m\left(k^{ss}, m^{ss}\right) = \beta V_k\left(k^{ss}, m^{ss}\right)\frac{1}{1+\pi^{ss}} \tag{6}$$

where superscript "ss" denotes steady-state values.

(iv) By use of (5) and (6), derive the steady-state value of k, and show formally whether or not the model exhibits superneutrality. Explain the result and discuss the characteristics of the optimal rate of inflation.