Written Exam for the M.Sc. in Economics August 2011

Monetary Economics: Macro Aspects

Master's Course

August 19

(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 four 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) A shopping-time model of money demand provides a foundation for the Cash-in-Advance approach.

(ii) In the simple New-Keynesian model with price rigidities only, absence of any exogenous fluctuations in firms' desired markup, implies that the central bank can achieve the efficient allocation when an appropriate labor subsidy is in place.

(iii) In the Barro and Gordon model where the monetary policymaker's utility function is $U = -(\lambda/2)(y-k)^2 - (1/2)\pi^2$, $k > 0$, where y is output given by $y = \pi - \pi^e + \varepsilon$, and where π, π^e, and ε are inflation, inflation expectations and a supply shock, respectively, a linear inflation contract of the form $t(\pi) = -C\pi$ where C is some constant, will eliminate the inflation bias but distort shock stabilization.

QUESTION 2:

Cash in advance, labor supply and interest rates
Consider an infinite-horizon economy in discrete time, where utility of the representative agent is given by

$$U=\sum_{t=0}^{\infty}\beta^{t}u\left(c_{t},1-n_{t}\right),\qquad 0<\beta<1, \tag{1}$$

with

$$u\left(c_{t},1-n_{t}\right)\equiv\frac{\left(c_{t}\right)^{1-\sigma}}{1-\sigma}+\Psi\frac{\left(1-n_{t}\right)^{1-\eta}}{1-\eta},\qquad \eta,\sigma,\Psi>0$$

where c_t is consumption and n_t is the fraction of time spent working. Purchases of consumption goods are subject to a cash-in-advance constraint

$$c_{t}\leq\frac{m_{t-1}}{1+\pi_{t}}+\tau_{t}-b_{t}, \tag{2}$$

where m_{t-1} is real money balances at the end of period t, π_t is the inflation rate, τ_t are real monetary transfers from the government, and b_t are real bonds traded on financial markets before the goods market open.

Agents maximize utility subject to (2) and the budget constraint

$$f\left(k_{t-1},n_{t}\right)+\left(1-\delta\right)k_{t-1}+\frac{m_{t-1}}{1+\pi_{t}}+\tau_{t}+i_{t}b_{t}=c_{t}+k_{t}+m_{t},\qquad 0<\delta<1, \tag{3}$$

where k_{t-1} is physical capital, i_t is the nominal interest rate and function f is given by $f\left(k_{t-1},n_{t}\right)=y_{t}=k_{t-1}^{\alpha}n_{t}^{1-\alpha}$, with y_t denoting output.

(i) Derive the relevant first-order conditions for optimal behavior [Hint: Set up the value function $V\left(k_{t-1},b_{t-1},m_{t-1}\right)=\max\left\{u\left(c_{t},1-n_{t}\right)+\beta V\left(k_{t},b_{t},m_{t}\right)\right\}$ and eliminate k_t by the budget constraint, and maximize over c, m, n and b subject to (2)—let μ_t denote the Lagrange multiplier on (2)]. Interpret the first-order conditions intuitively.

(ii) Show that the Envelope theorem along with the first-order conditions lead to the following conditions

$$\frac{\beta V_k\left(k_{t+1}, b_{t+1}, m_{t+1}\right)+\mu_{t+1}}{1+\pi_{t+1}}=V_k\left(k_t, b_t, m_t\right), \tag{4}$$

$$V_k\left(k_t, b_t, m_t\right)=\beta\left[\alpha\left(y_{t+1}/k_t\right)-\delta\right] V_k\left(k_{t+1}, b_{t+1}, m_{t+1}\right), \tag{5}$$

$$i_t=\frac{\mu_t}{\beta V_k\left(k_t, b_t, m_t\right)}. \tag{6}$$

Furthermore, discuss whether superneutrality holds in steady state.

(iii) Show that in steady state, the consumption-leisure choice is determined by

$$\frac{\left(c^{ss}\right)^{-\sigma}}{\Psi\left(1-n^{ss}\right)^{-\eta}}=\frac{1+i^{ss}}{(1-\alpha)\left(y^{ss}/n^{ss}\right)},$$

and discuss if and why the nominal interest rate affects steady-state labour supply.

QUESTION 3:

Monetary policymaking and cost shocks

Consider the following log-linear model of a closed economy:

$$\begin{aligned} x_t &= \mathrm{E}_t x_{t+1}-\sigma^{-1}\left(i_t-\mathrm{E}_t \pi_{t+1}-r_t^n\right), \qquad \sigma>0, & (1)\\ \pi_t &= \beta \mathrm{E}_t \pi_{t+1}+\kappa x_t+e_t, \qquad 0<\beta<1, \quad \kappa>0, & (2)\end{aligned}$$

where x_t is the output gap, i_t is the nominal interest rate (the monetary policy instrument), π_t is goods price inflation, r_t^n is the natural rate of interest, which is assumed to be a mean-zero, serially uncorrelated shock, and u_t is a mean-zero serially uncorrelated "cost" shock. E_t is the rational expectations operator conditional on all information up to and including period t.

(i) Discuss the micro-foundations behind equations (1) and (2).

(ii) The monetary authority wants to minimize the loss function

$$L = \frac{1}{2}\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\lambda x_t^2 + \pi_t^2\right], \qquad \lambda > 0. \tag{3}$$

Discuss the micro-economic rationale for this loss function.

(iii) Assume that $r_t^n = 0$ for all t. Show that the optimal values of x_t and π_t under discretionary policymaking are

$$\begin{aligned} x_t &= -\frac{\kappa}{\kappa^2 + \lambda} e_t, \\ \pi_t &= \frac{\lambda}{\kappa^2 + \lambda} e_t. \end{aligned}$$

Discuss.

(iv) Continue to assume that $r_t^n = 0$ for all t. Now assume that the monetary policymaker follows a rule for nominal interest-rate setting given as

$$i_t = \phi \pi_t, \qquad \phi > 1. \tag{4}$$

Derive the solutions for x_t and π_t for the system (1), (2) and (4). [Hint: Conjecture that the solutions are linear functions of the period's cost shock]. Discuss the differences between these solutions and the ones obtained under discretionary policymaking. Can the monetary policy rule (4) be parameterized such that it will "deliver" the outcomes under discretionary policymaking?

(v) Discuss how the introduction of shocks to the natural rate of interest, $r_t^n \neq 0$, may potentially alter the answer to (iv).

(vi) Will an ability to conduct optimal policy under commitment be advantageous in this setting? Will the answer depend on whether e_t is a persistent shock or not? Discuss.