

***UNIVERSITY OF OSLO***  
***DEPARTMENT OF ECONOMICS***

Exam: **ECON4310 – Macroeconomic Theory**

Date of exam: Wednesday, December 5, 2012

**Grades are given: December 19, 2012**

Time for exam: 2:30 p.m. – 5:30 p.m.

The problem set covers 4 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.

# Exam in ECON4310

## December 2012

### 1 Growth and business cycles (80%)

Consider a closed economy inhabited by representative infinitely-lived households. The population size is constant and equal to one. Each household maximizes discounted lifetime utility

$$\max \sum_{t=0}^{\infty} \beta^t \left[ \ln c_t - \frac{1}{2} (h_t)^2 \right], \quad (1)$$

where  $h_t$  is hours worked and  $c_t$  is consumption for the household in period  $t$ . Moreover, the discount factor  $\beta$  is between zero and one ( $0 < \beta < 1$ ). The households cannot run Ponzi schemes and their budget constraint is

$$c_t + a_{t+1} = (1 + r_t) a_t + w_t h_t,$$

where  $w_t$  and  $r_t$  are, respectively, the hourly wage rate and net return on savings in period  $t$ .  $a_t$  is the household's financial wealth.

Firms rent labor and capital from the households. They have access to a constant-return-to-scale production function that takes labor and capital as inputs

$$Y_t = K_t^\alpha (z_t H_t)^{1-\alpha},$$

where  $z_t$  reflects the the number of efficiency units per hour worked,  $H_t$  is the aggregate number of hours worked in the economy, and  $K_t$  is aggregate capital. Output is used for either aggregate consumption  $C$  or investment  $I_t$ , so

$$Y_t = C_t + I_t. \quad (2)$$

Capital depreciates at a constant rate  $\delta$ , so the law of motion for capital is

$$K_{t+1} = (1 - \delta) K_t + I_t \quad (3)$$

$z_t$  grows at a constant rate  $g$ , which reflects labor-augmenting technical change

$$z_{t+1} = (1 + g) z_t.$$

1. Define a competitive equilibrium (that is, write down the equilibrium conditions).
2. Solve the household's problem (while taking prices  $w_t$  and  $r_t$  as given). To this end, write down the Lagrangian for the household's problem and derive first-order conditions with respect to  $c_t$ ,  $n_t$  and  $a_{t+1}$ . Combine the first-order conditions to obtain the Euler equation and the intratemporal optimality condition. Give a brief interpretation.

3. Explain (briefly) why we could obtain the competitive equilibrium by solving a social planner problem maximizing (1) subject to the resource constraints (2)-(3) and initial  $K_0$ .
4. Steady state:
  - (a) Define a steady state for this economy and show that, in steady state, wages grow at rate  $g$ .
  - (b) Explain why the steady-state interest rate must be positive ( $r > 0$ ).
  - (c) How does optimal labor supply  $h_t$  react to such long-run wage growth?
5. Explain how you would calibrate the model to make it exhibit  $r = 0.01$  in steady state.
6. To get a prototypical RBC model, one could make the technology shock  $z_t$  in this model stochastic. Figures 1 and 2 contain the impulse-response functions for output, employment, and  $z_t$ , after a one percentage point shock to  $z_t$ . One of the figures is for an RBC model with divisible labor supply (as in the model just discussed). The other figure is for an RBC model where labor supply is indivisible (i.e., labor supply for household  $i$  in period  $t$  is either  $h_{it} = 0$  or  $h_{it} = \bar{h}$ ), and where household can participate in labor lotteries. Except from this difference, both alternative economies have the same technology (i.e., production function and law of motion for capital and  $z_t$ ), and the same preferences for individual households. **Explain which plot belongs to which model.**
7. Explain, by the use of a phase diagram, how a deterministic version of this economy (i.e., with  $z_t$  fixed over time) will behave if the initial capital stock is smaller than its steady state level [hint: use the intertemporal optimality condition to help find expressions for the phase diagram that depend only on  $k$  and  $c$ ].

## 2 Debt crisis (20%)

Imagine you get a job as an advisor in the Ministry of Finance. After a lot of hard work, you get assigned to assist the Minister at a summit in Brussels where they discuss the debt crisis in Europe. The Minister has heard from Greek representatives that their high interest rate on sovereign debt is due to speculative attacks. She wants to understand if this argument is theoretically sound.

**Use the debt crisis model from class (and Romer's textbook) to help the Minister understand the dynamics of a debt crisis. Make sure to highlight how both fundamentals and market sentiments matter (only intuition, no math).**

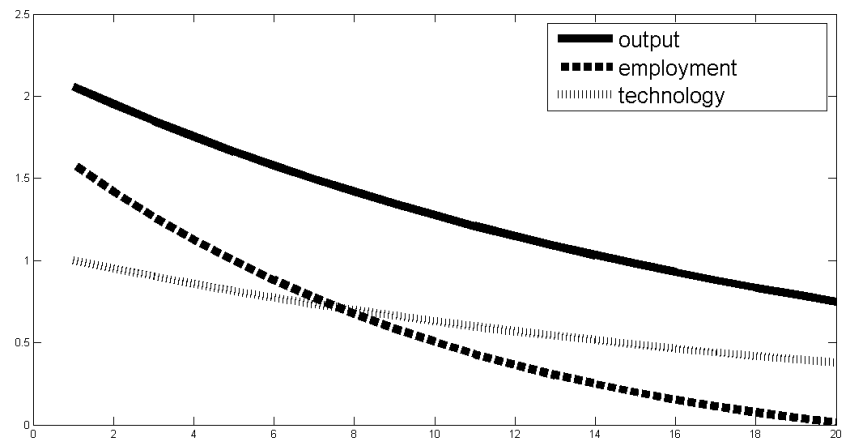


Figure 1: Impulse-response plot for a shock to technology

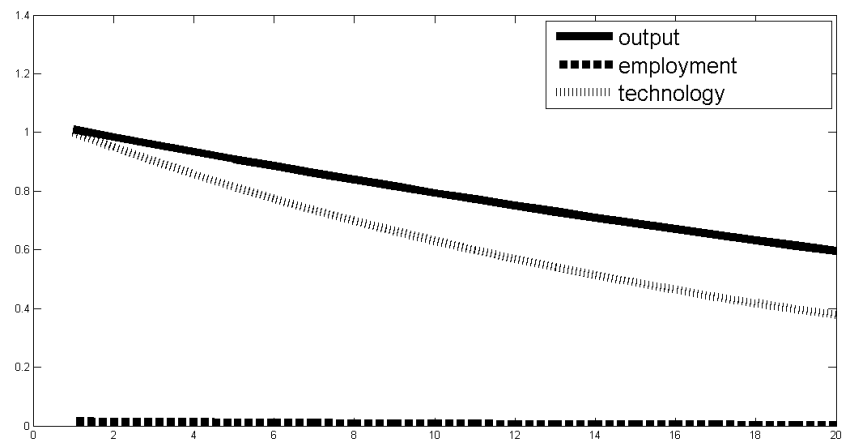


Figure 2: Impulse-response plot for a shock to technology