Lent 2004
Paper 2, Part 2B
Toke Aidt

Problems

The problems cover business cycles, growth and monetary policy. For the supervision/class you should try and solve the first four ones. Non of the questions require more math than you learned in the first year. The challange is to go through the logical steps that lead to a solution AND to provide an interpretation of the that solution.

1 Question 1 (RBC and dynamic macroeconomics).

Consider the following model, adapted from Blanchard and Quah (1989) and Fischer (1977):

$$Y_t = M_t - P_t + a\theta_t \tag{1}$$

$$Y_t = N_t + \theta_t \tag{2}$$

$$P_t = W_t - \theta_t \tag{3}$$

$$W_t = W \left| \{E_{t-1}N_t = \overline{N}\} \right. \tag{4}$$

The variables Y, N and θ denote the log of real output, employment and productivity respectively; $\overline{N}$ is full employment. The log of the price level, the nominal wage and the money supply are denoted P, W and M. The economy is being hit by two types of shocks: money shocks and productivity shocks. Assume that productivity and the money stock follow a random walk, i.e.,

$$M_t = M_{t-1} + \eta_t \tag{5}$$

$$\theta_t = \theta_{t-1} + \varepsilon_t \tag{6}$$

where η_t and ε_t are serially uncorrelated (and orthogonal) disturbances.

1. Interprent the model.
2. Solve the model to give an expression for output at time t. What is driving the business cycle?
3. Show that money shocks can affect output only in the short-run.
4. Does the available empirical evidence support the model?

Specific references:

- **Blanchard and Quah, 1989, The dynamic effects of aggregate demand and supply disturbances, AER 79, 655-673.
- **Muellbauer J., 1997, The assessment: business cycles, Oxford Review of Economic Policy, 1997, vol. 13, no. 3, pp. 1-18(18)
- Cooley and Hansen, 1998, The role of monetary shocks in equilibrium business cycle theory: three examples, EER 42, 605-617.
- Cogley and Nason (1995), Output dynamics in real-business-cycle models, AER 85, 492-511.

2 Question 2 (New Keynesian Macroeconomics)

Consider the following macroeconomic model of imperfect competition. Aggregate demand Y is determined by a vertical LM curve $Y = M/P$, where M is the money supply and P the aggregate price level. Each firm i faces the following downward sloping demand curve:

$$Q_i^D = Y \left(\frac{P_i}{P} \right)^{-2} \quad ,$$

where P_i is the price charged by firm i. Firm i produces Q_i unit of goods using L_i units of labour only, and it is assumed that all firms behave identically. Labour supply is assumed to be a simple increasing function of the real wage:

$$L^S = \frac{W}{P}$$

1. Compute the optimal real price charged by any firm i, P_i/P, as a function of the real wage W/P, and comment briefly on the resulting pricing policy.
2. Using the equilibrium condition on the market for goods, find the equilibrium real wage W/P as a function of M and P. Use this relation to compute the optimal pricing policy of a typical firm, P_i^*, as a function of M.

3. From now onwards, natural logarithms, denoted by lower case letters, should be used. Compute p^* (the aggregate price level under flexible prices), y^* (output under flexible prices), and comment briefly on their properties.

4. Suppose now that, following a monetary shock, a share $1-\lambda$ of firms are prevented from changing their price and keep them at some pre-determined price level $\bar{p}$. The price index after the monetary shock is therefore $p = \lambda p^* + (1-\lambda)\,\bar{p}$. Express p and y as functions of m, and use these relations to compute the proportional change in P and Y following a 1% increase in M. Check that your answer in 3. is a limiting case of that in 4.

Specific readings

- Heijdra van der Ploegh (2002, chapter 13.2) and Romer (2001, chapter 6 part C).

3 Question 3 (growth)

- Tripos 2003, question 2 (get a copy from the faculty webpage).
- Specfic readings: Jones,'s text book.

4 Question 4 (Economic policy)

- Tripos, 2003, question 9.

5 Extra questions (not covered in supervision)

5.1 Question (dynamic macroeconomics and RBC).

Consider an economy consisting of a constant population of infinitely lived individuals. The representative individual maximises the expected value of $\sum_{t=0}^{\infty} \beta^t C_t$, where $\beta \in (0,1)$ is the discount factor. Labour is supplied inelastically, and total labour is normalised to 1. The production function is given by

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha} \quad ,$$

where $\alpha \in (0,1)$ and Z_t is a time-varying productivity parameter. Z_t is assumed to follow the process:

$$Z_t = (Z_{t-1})^{\mu} \times \Psi_t \quad ,$$

where $\mu \in (0,1)$ and $\{\Psi_t\}_{t=0}^{\infty}$ is a white noise process with mean 1 (so that $E_t(\Psi_{t+1}) = 1$ for all t). Capital depreciates at rate $\delta \in (0,1)$, so that the aggregate resource constraint is:

$$K_{t+1} = Y_t - C_t + (1-\delta) K_t$$

1. Derive the Euler equation associated with this optimisation problem using the Lagrange method.

2. Compute the steady state of the model ($\bar{K}$,$\bar{Y}$,$\bar{C}$) as a function of α, β and δ.

3. Use the Euler equation to express K_{t+1} and Y_t as functions of Z_t and Z_{t-1}.

4. Let lower case letters denote logarithms of the corresponding capital letters. Write down the process for z_t. Derive an expression similar to that in (2) for k_{t+1} and y_t (that is, express them as functions of z_t and z_{t-1}).

5. Set $\beta = 0.98$ and $\alpha = 0.3$. Consider the following three scenarios for μ: $\mu = 0$, $\mu = 0.5$ and $\mu = 0.95$. Using Microsoft Excel, simulate the dynamic response of a technology shock $\psi = 1$ on k, y and c in the three scenarios, where those variables are originally set to their steady state values (Hint: From the resource constraint, we have $c_t = \log\left[e^{y_t} + (1-\delta)e^{k_t} - e^{k_{t+1}}\right]$). Where does the persitence in y, c and k come from?

- Tripos 2002: Question 8 (policy)
- Tripos 2002: Question 2 (growth)