Macroeconomics, Part IIB
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Supervision 5

Real Business Cycle Theory

Problems

1. Consider a competitive economy with an infinitely lived representative agent that maximizes the expected value of lifetime utility

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} C_s$$

where C_t is consumption in period t and β the intertemporal discount factor ($0 < \beta < 1$). The agent supplies a constant amount of labor $L_t = 1$, and produces according to the production function

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

where K_t denotes capital in period t and Z_t the level of technology, with $0 < \alpha < 1$. Capital accumulation is described by

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

where δ denotes the rate of depreciation, with $0 < \delta < 1$. Technology is stochastic and follows the process

$$Z_t = \Psi_t Z_{t-1}^{\mu}$$

where Ψ_t is a technology shock such that $\mathrm{E}[\Psi_t] = 1$ and $\mathrm{Var}[\Psi_t] = \sigma^2$, and $0 < \mu < 1$. Assume that $C_t \geq 0$ for all technology shocks.

(a) Derive the Euler equation associated with the representative agent's optimization problem. Interpret the result.

(b) Compute the steady state values of capital $\bar{K}$, output $\bar{Y}$ and consumption $\bar{C}$. [Hint: At the steady state, random variables are at their unconditional mean.]

(c) Use the Euler equation to express $k_{t+1} \equiv \ln K_{t+1}$ in terms of $z_t \equiv \ln Z_t$, and $y_t \equiv \ln Y_t$ in terms of $z_{t-1} \equiv \ln Z_{t-1}$ and $\psi_t \equiv \ln \Psi_t$. Explain intuitively how an unanticipated technology shock ψ_t affects future output y_{t+1}.

(d) Let $z_0 = 0$. Explain how the dynamic response of output y_t to a one-period technology shock $\psi_1 = 1$ depends on the persistence of technology shocks μ.

2. Consider the basic real business cycle model with inelastic labor supply, log utility of consumption and full capital depreciation. The equilibrium in this economy is described by the expressions: [cf Tripos 2007]

$$\begin{aligned} \frac{1}{C_t} &= \alpha\beta \, \mathrm{E}_t \left[\frac{1}{C_{t+1}} Z_{t+1} K_{t+1}^{\alpha-1} \right] \\ K_{t+1} &= Y_t - C_t \\ Y_t &= Z_t K_t^{\alpha} \\ Z_t &= \rho Z_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim iid\left(0, \sigma^2\right) \end{aligned}$$

where C, K, Y and Z are consumption, capital, output and an exogenous technological shock, respectively. The parameters α and β are the capital share and the discount factor, respectively, with $0 < \alpha < 1$, $0 < \beta < 1$ and $0 \leq \rho < 1$.

   (a) Give a brief interpretation of these four expressions.

   (b) Work out the dynamic laws of motion for K_{t+1}, C_t and Y_t in terms of K_t, Z_t and the model parameters.

   (c) What are the sources of persistence in this model?

Essay question (1000 words max)

3. Assess the empirical plausibility of the Real Business Cycle model. [Tripos 2009]

Main readings

- Abel, Bernanke and Croushore (2013), *Macroeconomics*, chapter 10.
- Sørensen and Whitta-Jacobsen (2005), *Introducing Advanced Macroeconomics: Growth and Business Cycles*, chapter 14, 17-19

Supplementary references

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- Romer and Romer (1989), “Does monetary policy matter? A new test in the spirit of Friedman and Schwarz”, *NBER Macroeconomics Annual* 4
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