

ECON 330 Take-Home Assignment

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Time Allowed: 5 hours

Question 1: RBC model [60 points]

Consider the basic RBC model studied in class. Assume that Household objective function is:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t (c_t, l_t)$$

Where the utility function is:

$$U(c_t, l_t) = \log(c_t) + \log(l_t)$$

Subject to a resource constraint

$$c_t + k_{t+1} = z_t k_t^\alpha n_t^{1-\alpha} + (1 - \delta)k_t$$

and a constraint on the time endowment is:

$$n_t + l_t = 1$$

Log technology follows an AR(1):

$$\log(z_{t+1}) = \rho \log(z_t) + \varepsilon_{t+1}$$

Parameters of the model are: annual real long-term interest rate is 8%, capital's share in national output is 40%, annual depreciation rate of physical capital is 16%, serial correlation of technology shock is 0.97. Keep in mind that RBC is a quarterly model.

- (15 points) Derive the first-order conditions associated with the infinitely-lived household's utility maximization problem.
- (15 points) Find the analytically solved steady states.
- (20 points) Use your answers to compute the effect of a one-time and 1% positive shock to the level of productivity. Trace out the effects on productivity, consumption, employment, investment and output. Graph your answers for $t = 0, 1, \dots, 50$.
- (10 points) Briefly explain your answers.

Question 2: NKM [40 points]

Recall the log-linear equations of the basic NKM model:

$$\text{NK.1 } c_t = -\sigma(i_t - E_t\pi_{t+1}) + E_t c_{t+1} + (1 - \rho_c)\sigma g_t$$

$$\text{NK.2 } rw_t = \sigma_L l_t + \frac{1}{\sigma} c_t$$

$$\text{NK.3 } y_t = a_t + l_t$$

$$\text{NK.4 } \pi_t = \beta E_t \pi_{t+1} + \frac{(1 - \theta)(1 - \beta\theta)}{\theta} mc_t$$

$$\text{NK.5 } mc_t = rw_t - a_t$$

$$\text{NK.6 } i_t = \phi_\pi \pi_t + \phi_y y_t + z_t$$

$$\text{NK.7 } y_t = c_t$$

$$\text{NK.8 } a_t = \rho_a a_{t-1} + \varepsilon_{a,t}$$

$$\text{NK.9 } g_t = \rho_g g_{t-1} + \varepsilon_{g,t}$$

$$\text{NK.10 } z_t = \rho_z z_{t-1} + \varepsilon_{z,t}$$

The model is already log-linearized, so variables are already expressed as log deviations from their steady state.

Calibration of the model is the following: Prices held rigid for an average of two quarters, unitary intertemporal elasticity, unitary inverse elasticity of labor supply, real annual interest rate of 2%, reaction of the Monetary Policy rate to inflation and GDP are 1.5 and 0.5. Persistence coefficients are $\rho_a = 0.9$, $\rho_g = 0.8$, $\rho_z = 0.7$ and the standard deviation contractionary monetary policy shock is 0.25. Keep in mind that NKM is a quarterly model.

- (10 points) Include an ex-ante real interest rate and modify the dynare code of the basic NKM model.
- (20 points) Compare the responses to a contractionary monetary policy shock of baseline and new (with real interest rate) NKMs using comparison.m file. Trace out the effects on real and nominal interest rate, output, real wages and inflation. Graph your answers for $t = 0, 1, \dots, 50$.
- (10 points) Briefly explain your answers.

(Note: Print the mod files and the figures and make them a part of your answer booklet).

