Department of Economics The Ohio State University

Economics 8823
Advanced Macroeconomics
**Project 2**
Professor Sanjay Chugh
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You will implement a "shooting algorithm" via a first-order approximation, in the context of discovering how the fluctuations of a partial equilibrium labor search and matching model differ in terms of some key parameters.

The partial, symmetric equilibrium is defined as state-contingent sequences for labor and real wages $\{n_{t+1}, \theta_t, w_t\}_{t=0}^{\infty}$ that satisfy the representative firm's vacancy posting condition

$$\frac{\gamma}{k_t^f} = \left(\frac{1}{1+r}\right) E_t \left\{ z_{t+1} - w_{t+1} + \frac{(1-\rho_x)\gamma}{k_{t+1}^f} \right\},$$

the perceived law of motion for labor

$$n_{t+1} = (1-\rho_x) n_t + v_t k_t^f \ ,$$

and the generalized Nash bargaining condition

$$w_t = \eta[z_t + \gamma\theta_t] + (1-\eta)b\,,$$

(with $\theta \equiv v/u$ denoting labor-market tightness), subject to the exogenous law of motion for aggregate labor productivity

$$\ln z_{t+1} = (1-\rho_z)\ln \bar{z} + \rho_z \ln z_t + \varepsilon_{t+1}^z,$$

in which $\varepsilon_t^z \sim$ i.i.d. $N(0, \sigma_z^2)$ and initial labor $n_0$.

For each of the two variants of the model you will study (described further below), set the following parameters to be identical: $\gamma = 0.50$ is the vacancy posting cost, $r = 0.01$ is the net real interest rate, $\rho_x = 0.10$ is the exogenous separation rate, $\bar{z} = 1$, and $\rho_z = 0.95$ and $\sigma_z = 0.007$ characterize the exogenous labor productivity process. The matching technology is $m(u_t, v_t) = \psi \cdot u_t^{\alpha} v_t^{1-\alpha}$ in every period, with $\alpha = 0.40$ and the "matching efficiency" parameter is $\psi = 0.77$.

**Model Variant 1**

Set the Nash bargaining parameter $\eta = 0.05$ and the non-employment payoff $b$ = 0.95. This defines the initial deterministic steady state.

**Model Variant 2**

Set the Nash bargaining parameter $\eta = 0.40$ and the non-employment payoff $b$ = 0.5. This defines the final deterministic steady state.

**TO DO**

- For each of the model variants above, compute the deterministic steady state.

- Simulate the model for $T^{initial}$ periods (it is up to you to decide $T^{initial}$) around the initial deterministic steady state. Calculate and report the business-cycle volatility for $u$, $v$, $\theta$, and $w$ (including how you treated the simulated data).

- In period $T$, a "once-and-for-all shock" occurs in the parameters $\eta$ and $b$ (which defines the final deterministic steady state, aka Model Variant 2).

- Compute a linearization around the steady state (which of the two deterministic steady states to approximate around is left up to you). Display the $g_x$ and $h_x$ matrices.

- Using the linearized decision rules from above, determine (and report) how many periods $S$ it takes to converge from the initial deterministic steady state to the final deterministic steady state.

- Simulate the model for $T^{final}$ (it is up to you to decide $T^{final}$) periods around the final deterministic steady state. Calculate and report the business-cycle volatility for $u$, $v$, $\theta$, and $w$ (including how you treated the simulated data).

**What To Submit**

- A clear, concise definition of the (dynamic stochastic) private-sector equilibrium.

- The state vector $x_t$ and the co-state vector $y_t$.

- The $g_x$ and $h_x$ matrices that characterize the transition.

- One clearly-organized, easy-to-interpret graph that shows both the deterministic transition (i.e., absent exogenous shocks) and the stochastic (i.e., including exogenous shocks) transition.

- Include your code (i.e., all the relevant files that one would need to replicate your results).