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Problem Set 2
Macroeconomics I
Due November 18, 2024

Recall the single-sector neoclassical model with search from class. In the first problem set, we solved this model using a linear approximation to the model around its non-stochastic steady state.

Now, we are going to solve the non-linear model for a case of perfect foresight using a shooting algorithm.

The parameters you should use in this problem set are listed below, they are the same as in Problem Set 1.

Table 1: Numerical Parameter Values

Concept	Symbol	Value
Discount factor	β	0.99
Inverse IES	σ	2.00
Capital share	α	0.30
Capital Depreciation	δ_k	0.03
Labor separation	δ_n	0.10
Vacancy cost	ϕ_n	0.50
Matching Function Level	χ	1.00
Matching Function Elasticity	ε	0.25
log(A) persistence	ρ	0.95
log(A) disturbance	σ_a	0.01

1. **Shooting Method:**

   Recall that because we log-linearized our model, our impulse response in PS1 part (d) is equivalent to a perfect foresight solution of the approximate linearized model.

   (a) Generate a function called `residual`. The function should accept three input arguments. The first argument is `XYv`, a (vectorized) candidate path for all of the endogenous variables in $[X(t+1), Y(t)]$ for periods 1 through 500. The second argument is the vector steady-state values of `XYss`. The third is the object containing the model parameters, `param`.

   The output of the function should be a residual vector, `resid`, that evaluates each model equation $F(\cdot)$ along the history, under the assumption that $X(1)$ is at steady-state and $Y(501)$ is also at steady-state.

The `numel(XYv)` should be the same as the `numel(resid)` of the return vector `resid`.

(b) Create a function handle to your `residual` function, which fixes arguments 2-3. Using your linearized solutions from PS1, generate a "guess" for the path of X_t and Y_t – the inputs to your `residual` function – in response to a 1.0% initial increase in TFP. Your loss function at this initial guess should evaluate to

$$\texttt{sum(abs(resid0(:)))} = 0.046897755265797$$

(c) Use the matlab command `fsolve` to find a path for the endogenous variables that (numerically exactly) satisfies the model equations at each point in time, based on this initial disturbance.

(d) Generate a 2x3 figure in Matlab. In each subplot, plot the impulse response of one the six main model variables according to the linearized approximate and exact perfect foresight model solution. Use a solid line for the former and a dashed line with $\times$'s for the later.

(e) Now, increase the size of the initial productivity shock from 1% to 10%, and generate the same figure as in 2(c). Compare the quality of the linearization for the smaller and larger shocks.

(f) *Can you find a parameterization that generates large non-linear effects even when the shock size is 1%? What are the main key parameters you need to change, and their values? Describe some intuition for why these parameters are important for this.