Assignment
Accuracy tests for standard DSGE models

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1 Idea

The idea of this assignment is two fold

- Learn the standard Euler-equation accuracy test and the dynamic version
- Learn that you use high standards before claiming that your solution is accurate. In fact, you should always do more than just a formal accuracy test (like obtain your solution in different ways and check whether the answers are robust).

2 Model

The standard growth model characterized by the following equations

$$\begin{aligned}
c_t^{-\nu} &= \mathrm{E}_t\left[\beta c_{t+1}^{-\nu}\left(\alpha \exp(z_{t+1})k_t^{\alpha-1}+1-\delta\right)\right] \\
c_t + k_t &= \exp(z_t)k_{t-1}^{\alpha}+(1-\delta)k_{t-1} \\
z_{t+1} &= \rho z_t + \sigma\varepsilon_{t+1} \qquad \varepsilon_{t+1}\sim N(0,1)
\end{aligned}$$

The parameters are as follows

case	A	B
α	0.36	0.36
ρ	0.95	0.95
β	0.99	0.99
δ	0.10	0.10
ν	1	5
σ	0.01	0.005

The numerical solutions considered for case A are as follows

A1 $\ln k_t = 1.851103 + 0.200382\, z_t + 0.891778\, \left(\ln k_{t-1} - \ln \bar{k}\right)$

A2 $\ln k_t = 1.855 + 0.200382\, z_t + 0.891778\, \left(\ln k_{t-1} - \ln \bar{k}\right)$

A3 $\ln k_t = 1.851103 + 0.200382\, z_t + 0.8\, \left(\ln k_{t-1} - \ln \bar{k}\right)$

and for case B they are

B1 $\ln k_t = 1.851103 + 0.177018\, z_t + 0.952506\, \left(\ln k_{t-1} - \ln \bar{k}\right)$

B2 $\ln k_t = 1.855 + 0.177018\, z_t + 0.952506\, \left(\ln k_{t-1} - \ln \bar{k}\right)$ and for case Band for

B3 $\ln k_t = 1.851103 + 177018\, z_t + 0.7\, \left(\ln k_{t-1} - \ln \bar{k}\right)$

case B they are given by

The first numerical solution is the first-order perturbation solution and the others are (slight) modifications.

3 Questions

1. Simulate time series for capital using the alternative approximations. You'll see that the generated series are quite different.

2. Plot the policy functions. In particular, for each case plot the choice for $\ln k$ as a function of $\ln k_{-1}$ keeping z_t equal to its steady state value (which is equal to zero) and plot the choice for $\ln k$ as a function of $\ln z$ keeping $\ln k_{-1}$ equal to its steady state value (which is equal to $\ln \bar{k} = 1.851103$).

3. Calculate the *maximium* Euler equation error (expressed as percentage difference of the two outcomes for consumption) on a grid of z and $\ln k$. For z you can use a

grid that covers the range $\left(-3\sqrt{(\sigma^2/(1-\rho^2))}, 3\sqrt{(\sigma^2/(1-\rho^2))}\right)$ for $\ln k$ you can use the simulated series to get an idea.

4. Again simulate a time series for $\ln k$ and now plot this in a graph together with the series implied by the dynare Euler equation accuracy test

5. Compare the results from question 1 with the results for the accuracy test. You'll find that the accuracy tests are clearly bad for case B. But what I want you get out of this exercise is that (i) the standard Euler equation test doesn't realize that errors can accumulate and (ii) maximum errors of less than 1% does not ensure accuracy, you may need to be tougher. Having said this there are also cases when a large maximum error is misleading. Therefore, you should always look at the graphs and understand the inaccuracies of your numerical solution.