Econ 210C Homework 1

Instructor: Johannes Wieland

Due: 4/12/2020, 11:59PM PST, on Canvas. Submit both pdf and code.

1. Business Cycle Facts

1. Download data for real GDP, real consumption, real investment, employment, real capital, and total hours worked. The first four series you can get from FRED. Most statistical packages have an API to download directly. (Non-residential fixed) capital you can get from NIPA fixed asset tables 1.1 and 1.2.[1] Total hours for nonfarm business you can get from the BLS productivity and costs release.

2. Plot all six data series. A good habit is to always look at data first before you do anything with it.

3. Perform the following manipulations on the data:

   (a) Log all series.

   (b) The capital stock data is annual. Linearly interpolate the log capital stock it to obtain a quarterly series.

   (c) Construct the Solow Residual using a capital share of $\alpha = 0.33$

   (d) Plot all logged series. (GDP, C, I, employment, hours, capital, Solow Residual)

4. For each logged series (GDP, C, I, employment, hours, capital, Solow Residual):

   (a) Filter the series using the HP filter with smoothing parameters $\lambda = 1600$, $\lambda = 10000$, and a linear trend.

   (b) Put all the filtered series on one graph to compare.

   (c) For each filter, compute the standard deviation, relative standard deviation to output, autocorrelation, and correlation with output.

   (d) Summarize and explain your results.

2. RBC Model

For this exercise you will use Dynare, which largely automates the computation of DSGE models.

1. Write up the first order condition and market clearing conditions for the RBC model in King and Rebelo (2000).

2. Solve analytically for the steady state.

[1] You can use the chain-type quantity index and re-index it to the value of the current cost net stock in the base year of your other series.

3. Plot the IRF using the parameters in table 2. For this step you must code up the model in Dynare.
4. Now instead of using an IES of 1, let the preferences be

$$\frac{C_t^{1-\gamma}}{1-\gamma} + \theta \log L_t$$

with $\gamma = 4$.

   (a) Repeat steps 1-2 for this model.
   (b) Recalibrate θ such that steady state hours are equal to 0.2. (Other parameters remain the same.)
   (c) Plot the IRFs.
   (d) Explain how the IRFs for this model differ from those of the baseline King-Rebelo model.

5. Now let the preferences be

$$\ln C_t + \theta e^{\epsilon_t^L} \log L_t$$

where ϵ_t^L is a shock to the disutility of labor, which follows an AR(1) process

$$\epsilon_t^L = \rho_L \epsilon_{t-1}^L + e_t^L$$

For the calibration, assume $\rho_L = 0.95$ and $SD(e_t^L) = 0.01$.

   (a) Repeat steps 1-2 for this model.
   (b) Plot the IRF for the disutility of labor shock.
   (c) Explain why or why not shocks to the disutility of labor could be important in driving the business cycle in the data.

3. Practice log-linearization.

Log-linearize the following equations

1. $Y = C + I + G + NX$ (resource constraint; assume $NX = 0$ in the steady state).
2. $Y = (\alpha K^\rho + (1-\alpha)(AL)^\rho)^{1/\rho}$ (CES production function; A is the level of technology; L is labor; K is capital; ρ, α are constants).
3. $K_t = (1-\delta)K_{t-1} + I_t - \psi\left(\frac{I_t}{K_{t-1}} - \delta\right)^2 I_t$ (capital adjustmentcost; I is investment; ψ, δ are constants).
4. $K_t = (1-\delta)K_{t-1} + I_t - \psi\left(\frac{I_t}{K_{t-1}} - \delta\right)^2 I_t - \phi\left(\frac{I_t}{I_{t-1}} - 1\right)^2 I_t$ (capital adjustmentcost; I is investment; ψ, δ, ϕ are constants).
5. $\exp(i_t) = \left(\frac{P_t}{P_{t-1}}\right)^{\phi_\pi} \left(\frac{Y_t}{Y_{t-1}}\right)^{\phi_y} \exp(\rho i_{t-1})$ (Policy reaction function for interest rate i as a function of prices P and output Y; ϕ_π, ϕ_y, ρ are constants).
6. $A \times F(L) = \left(\frac{\partial U(C,1-L)}{\partial L}\right) / \left(\frac{\partial U(C,1-L)}{\partial C}\right)$ (U is a utility function [which could be non-separable in consumption and leisure]; consumption C and leisure $(1-L)$ [where L is the labor supply]; F is a production function; A is the level of technology).

7. $Y_t = K_t^{\alpha_t} L_t^{1-\alpha_t}$ (Cobb-Douglass production function with **variable** capital share α_t).