JEM004 Macroeconomics
IES, Fall 2010
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Macroeconomics - Problem Set #3

Due to December 16 (Thursday) 23:55, submitted via Moodle only (submissions via mail are not accepted). You can only upload one file (.pdf, .doc, .rtf format only).

1. Computation part - Real Business Cycle model:

In the RBC models the cycles are assumed to be consequences of random shocks thus we can not model cycles explicitly, but impulse responses of variables only. The file RBC.xls (or RBC.ods) shows effect of technology shock of 1% on capital, output, labour, consumption, real wages ad real interest rates in the RBC model (very similar to the one in Romer's textbook and lecture augmented for the government purchases).

Notice that the effect eventually dies out, which is the consequence of the stationarity assumption on shocks. The persistence of shocks is given by the parameters $\rho_A$in case of technology(productivity) and ρ_G in case of government expenditures, respectively.

a) Generate impulse responses of 1-unit shock in government expenditures. Compare the new impulse response functions with the impulse responses to the technology shocks.
Hint: 1) set the technology constant, that is A=0 all the time.
2) generate the time series of G. At time t=1 it is equal 1, at time $t = 2, 3, \ldots$ *it is equal to* $\rho_g * G_{t-1}$*, i.e.* $G_2 = \rho_G * G_1 = \rho_G * 1$*, and so on.*

b) Generate a time series of random numbers from the interval $(-0.25; 0.25)$ and suppose that this is a time series of productivity shocks. Then the total productivity shock on technology A at time t is given as $g_t = \rho_A g_{t-1} + \epsilon$, where ϵ is a generated random shock. Suppose that $g_{A,0} = 0$. Now you should see generated business cycle dynamics instead of impulse response functions.

c) Show the generated time series of C and Y. How the consumption behaves according to the output?

d) And how does the employment behave? And the real wage? Is this behavior realistic?

e) If the persistence of shocks is lower – let's say 0.7 – how do the results change? Write what do you expect, or in case you are not sure, it is easy to generate a new plot!

f) Use your previous results from part b (generated series of productivity shocks) and suppose that government wants to smooth the cycle and and thus it increases a government expenditures in case of negative technology shock and lowers government expenditures in case of positive shocks in previous period (suppose that government is wise and it is able to measure it), thus it is given as $G_t = \rho_G G_{t-1} - g_{t-1}$. Did the government smoothed the cycle? Show it on plot of C and Y and compare it with your previous result. How can you interpret your results?

2. Empirical part - Estimation of the Solow Residual and Technology Shocks:

The output is given by Cobb-Douglas production function. The goal is to infer the series of Solow residuals and separate their deterministic and stochastic component:

- the deterministic component represents the trend growth of the productivity (corresponds to the technological progress which is assumed to follow linear growth path), whereas
- the stochastic component causes business cycles according to the RBC theory.

To allow for such decomposition, the production function is assumed as follows:

$$y_t = A_t \, e^{z_t} k_t^{\alpha} n_t^{1-\alpha} \tag{1}$$

where A_t is the deterministic part attributed to trend growth. The SOlow residual now can be calculated from the series of outpu, capital and employment

$$\log SR_t = \log y_t - \alpha \log k_t - (1-\alpha) \log n_t. \tag{2}$$

The parameter α equals to the share of investment on output, here it is assumed to be 0.43 (calibrated based on empirical estimates of the Czech production function). As pointed out before, residual consists of two parts, thus we can write

$$\log SR_t = \log A_t + z_t \tag{3}$$

$$\log A_t = \log A_{t-1} + \log \gamma \tag{4}$$

The stochastic part is the technology shock, which follows AR(1) process

$$z_t = \rho \, z_{t-1} + \epsilon_t \tag{5}$$

Estimate the time series of the Solow residual and the sequence of productivity shocks ϵ_t. Show plots of both series and report the variance of shocks and 1^{st} autocorrelation of the series of Solow residuals ρ. How are these two time series related to the business cycle fluctuations obtained using the Hodrick-Prescott filter (1600)?

To proceed, follow these steps:

1. Calculate the time series $\log(SR_t)$ as in eq.(1) (*resulting time series should be increasing in time*)
2. Subtract the mean, let's call the new series $SR2$ (because the scale of SR_t is rather uncertain).
3. Separate the stochastic and deterministic part from $SR2$: subtract the linear trend of $SR2$, that is fit the regression $SR2 = a + b * time$ and save the residuals. Call them $U1$.
4. The $U1$ should correspond to the part of Solow residual that causes the business cycle. However, it is too volatile, so smooth this series using the Hodrick-Prescott filter with smoothing parameter set to 1. Save the plot of the smoothed series.
5. Now estimate the shocks ϵ_t using the equation 5 applied on the smoothed series, report their variance and show its plot.

Dataset: SolowREsiduals.gdt

Note: If you would like to estimate Solow residuals for different country than the Czech Republic, you can. Note that the time series of capital is usually unobserved and has to be derived. To do that, you need time series of investment and estimate of the depreciation rate and share of capital on output α:

$$\alpha = \Big(\frac{\delta + 0.01}{\delta}\Big)\frac{\bar{i}}{\bar{y}} \tag{6}$$

The $\frac{\bar{i}}{\bar{y}}$ is the average investment output ratio, depreciation rate – find some estimate for your country or use 0.012 for quarterly data (5% per year).

Capital is given recursively by $k_{t+1} = i_t + (1 - \delta)k_t$.

Initial level: It can be proved that $k_0 = \frac{1}{\delta}\frac{\bar{i}}{\bar{y}}y_0$ where the average investment-output ratio is the two year average at the beginning of the sample. This is the so called *perpetual inventory method*.

2. Reading + critical summary:

Bulir, A., Smidkova, K., Kotlan, V. and Navratil, D.(2007). Inflation Targeting and Communication: Should the Public Read Inflation Reports or Tea Leaves? CNB working paper.

This article empirically evaluates the consistency of inflation reports. Questions that should be answered by your essay are:

1. Why is communication crucial if central bank pursues inflation targeting?
2. What methodology do the authors use? What are their main goal?
3. Summarize the results and implications.

Remember, max 2 pages, Times New Roman, 12pt is expected.