

### Macroeconomic theory, Module 3 Problem Set 1

**The due date for this problem set is Wednesday 6.2.2019, collected at the beginning of the exercise/recitation session. Not accepted later.**

1. READ THE WHOLE INSTRUCTION FIRST. Redo the calculations reported in "Table 1: Business Cycle Statistics for the US economy" in the Lecture 1-2 notes for an other country than the US. You can choose any country the name of which is the same as the first letter of your last name (e.g. for "Jones" admissible countries are Japan, Jamaica, Jordan etc.). You should report results for the series  $Y$ ,  $C$ ,  $I$ ,  $N$ ,  $\frac{Y}{N}$  and  $A$  (ignore  $w$  and  $r$ ). Data on consumption may be total consumption (including durables), if a split to non-durables, durables and services is not available. Compute all 4 moments reported in the table. Use Matlab whenever possible. Please document carefully every step you make and submit your Matlab code (think of somebody who would want to reproduce your results from scratch). Plot the series, original (in logs), log-differences, 2-sided HP-filtered (filter the series in logs of levels) and 1-sided HP-filtered (as before). Comment on your results. Are they similar to the "stylized facts" for the U.S.? Does using the 1-sided HP filter change things relative to the 2-sided filter?

Work with most up-to-date data. Obtain as long series as possible for your country. Make sure your data is real and seasonally adjusted. If necessary, seasonal adjustment may be done in e.g. Eviews. If you cannot obtain seasonally adjusted data or cannot use Eviews, use the BK filter instead of HP. If you can only get annual data (this may be the case for hours worked), interpolate annual values into quarterly values using your preferred interpolation method. The Matlab HP-filter function should be readily available in Matlab but it can also be easily found online.

The more complicated part will involve obtaining the series for capital (necessary to compute TFP). If you are lucky, you may find a source for quarterly capital stock data. If so, use it and report the reference and basic description of what "capital" is meant by in the source. However, data on capital stock is frequently incomplete, at only annual frequency, shorter than the series for  $I$  or non-existent at all. To construct capital stock series at quarterly frequency one can use then the "perpetual inventory method". If you have data for  $K$  in a particular year (or quarter) matching the beginning or end of your  $I$  sample, you can use the capital motion equation

$$K_{t+1} = (1 - \delta) K_t + I_t$$

combined with your investment data to recover the quarterly capital stock series. Here, one has to assume some depreciation rate. A common number is  $\delta = 0.025$  quarterly (or 10% annual depreciation). If you cannot get any data on the capital stock to use as a starting point, you may assume that in the first quarter of your available investment series the economy was in the steady state. The corresponding value of capital was then  $K_0 = \frac{I_0}{\delta}$ .

If you find annual capital data but not quarterly, you can interpolate the quarterly values using the capital law of motion and the data for investment. Annual capital stock usually refers to the end of the period (check if this is your case as well) so this annual value would correspond to 4th quarter of that year. The remaining 3 quarters can be obtained by

constructing an easy system of 3 equations with 3 unknowns, using the law of motion, some assumed depreciation rate and the quarterly data on investment (which you know).

Given the series for hours and capital one can obtain the growth rate of the Solow residual (proxy for  $A$ ) by regressing the growth rate of real GDP on the growth rates of capital stock and total hours worked (with the constraint that the two coefficients have to sum up to 1, as in Cobb-Douglas). The trending level of TFP can then be recovered by accumulating these TFP growth rates. Then the series can be used as input to filtering.

Commonly used, freely available, sources macro data include, among others,: IMF eLibrary, Eurostat, OECD, St. Louis FED FRED, ILO (for labor data), IDB Latin Macro Watch (for Latin America), national statistics offices and central banks.