London School of Economics Summer School

Business cycle statistics and their standard errors

1 Objective

The objectives of this exercise are (i) to extract components from data using band-pass (frequency domain) filters, (ii) to compare statistics calculated with the Hodrick-Prescott filter with those calculated with band-pass filters, and (iii) use heteroskedastic and autocorrelation consistent (HAC) estimators to calculate the standard errors of the calculated business cycle statistics. In addition, you'll learn a bit about the cyclical behavior of inventories.

2 Background

Standard inventory theories predict that inventories increase during recessions as firms try to smooth production when demand decreases. The data, however, clearly indicate that inventories are *pro*cyclical. In fact, during economic downturns production drops by *more* than sales. In this assignment, you will investigate the cyclical behavior of inventories. Using band-pass filters you can study the comovement of inventories and sales at business cycle frequencies, but also at other frequencies. Looking at the latter is motivated by the 2005 JME article of Yi Wen which finds that the comovement of inventories and real activity at high frequencies is different from the comovement at business cycle frequencies.

3 Shaded NBER graphs

The zip file includes programs to make graphs that shade the periods with NBER recessions. You don't have to worry about this in this assignment (it is all done for you). But if you want to use them later and possibly modify things a bit, then take a look at the files in the shadenber subdirectory. This subdirectory also contains a file `maximize.m`, which contains a function which will blow up a graph to screen size. For Matlab to use these files you have to add the path to this directory in Matlab.

4 Program overview & assignment

4.1 Read data

The first section reads data for the level of inventories and sales. The data file contains data from 1947Q1 to 2012Q1. You are asked to calculate business cycle statistics for the period from 1967Q1 to 2012Q1. Even though your analysis

focuses on the period starting in 1967Q1, data from before that period will still be used when filtering the data (make sure you understand why it would be bad to ignore all data before 1967Q1).

To do: Make sure you understand variable names and timing (in particular that 1967Q1 is the 81st observation). When you are ready, run the program. It will give a plot of HP-filtered inventories and HP-filtered GDP.

4.2 Generate business cycle data with band-pass filter

The HP-filter roughly isolates that part of the data associated with cycles with a period of less than 32 quarters (we count in quarters since the data are quarterly). Your first objective is to complete the matlab file `bandpass1.m`. This function takes as input data, `input`, two frequencies, `omega1` and `omega2`, and a parameter, `T_lost`. The rows of `input` contain the observations of the original series. The objective of the function is to isolate that part of the series associated with frequencies between `omega1` and `omega2` using a band-pass filter. The ideal band-pass filter is an infinite two-sided filter, which cannot be applied in practice. This function uses a two-sided filter using `2xT_lost+1` observations to filter each observation. Consequently, the first `T_lost` and the last `T_lost` observations of input used cannot be filtered.

To do:

1. Complete `bandpass1.m`. Before using `bandpass1.m` in the main program you may want to try it out by itself. When you have convinced yourself that `bandpass1.m` works, you can go to step 2.

2. Uncomment the commands in section 2 of the program. Choose the values for `omega1` and `omega2` such that the bandpass filter is comparable to the HP filter. (Note that the way the programs are setup, the band-pass filter extracts the cyclical component and the HP filter the trend. For that reason, the output of the HP Matlab function was substracted from the raw data when calculating HP-filtered data.) You also have to choose a value for `T_lost`. Make sure you understand what the tradeoffs are. Finally, you have to indicate which part of the sales and inventories series you give to the band-pass filter. Note that throughout this program, you have to replace XXX with the right values. If you get an error message that XXX is not defined, you forgot to replace XXX at least once.

4.3 Generate high-frequency data with band-pass filter

Next, we want to analyze the comovement between sales and inventories at frequencies associated with cycles less than four quarters.

To do:

1. Uncomment the commands in section 3 of the program and fill in the correct values where you see XXX.

5 Estimate correlation coefficient

Section 4 of the program calculates correlation coefficients and its standard errors. The following three data sets are used (i) data corresponding to high-frequency data, `I_data==1`, data corresponding to business cycle frequency, `I_data==2`, and completely unrelated data, `I_data==3`.

To do:

1. Set `I_data` equal to 1.
2. Uncommend the remainder of the program.
3. Complete the missing parts (indicated with `XXX`). In particular, you have to define $h(x_t;\theta)$, an estimate for D, the kernel used for the kernel-based estimators, the parameters for the VARHAC estimator.
4. Make sure that you understand the others steps of the program.
5. Check whether the three different procedures give you different answers.
6. Repeat the above using data associated with business cycle frequencies, `I_data==2`.
7. Repeat the above with the fake data, , `I_data==3`. Note that you can adjust the number of observations used and the properties of the *dgp*s. Play around with these and see when the different procedures give you different and when they give you the same answers.