Washington University
Department of Economics

Spring 2010
James Morley

Economics 5161

Homework #1
Due on Tuesday 3/23

I would like results to be presented in a concise matter. When I put the number of pages in brackets below, I have in mind that you should be able to present your results for a given question in less than or equal to the number of pages suggested. Part of your grade will be based on the neatness of your presentation. When dealing with data, presentation is a vital skill to develop.

1. Data Collection (20 points)

In this exercise, you will download key macroeconomic variables and transform them for time series analysis. For the U.S. macroeconomy, find the following series from FRED:

- Annual and Quarterly Real Gross Domestic Product
- Monthly Total and Core CPI (seasonally adjusted)
- Monthly Civilian Unemployment Rate (seasonally adjusted)
- Monthly Effective Fed Funds Rate
- Monthly 10-year Treasury Rate
- Monthly US/UK nominal exchange rate

i. For both the annual and quarterly Real GDP series, plot the following: the raw series, growth rates (%), natural logs of the raw series, 100 times the first differences of the natural logs. For each frequency (annual and quarterly), present your results in a figure with four panels. Give the details of the series below the figure, including the sample period. The axes of the graph should also be labeled. Go to the NBER website to obtain recession dates. In the graphs, these recession dates should be shaded (this is easy to do in EViews). (2 pages)

ii. Go to ALFRED and find vintage data for Annual Real Gross Domestic Product. When downloading vintage data, select earliest vintage (it should be 1991). Calculate Real GDP growth using vintage data. Plot and compare Real GDP growth based on the vintage data to Real GDP growth using most recent release of the data. Are there any notable differences? (1 page)

iii. For total and core CPI, construct inflation as i) monthly % change in the CPI and ii) 12-month % change in the CPI. Plot in multiple panels (i.e., keep output to one page). Again, describe data below the figure. Why do

you think the monthly % change is so 'jagged' in the first half of the sample? (1 page)

iv. Compare seasonally-adjusted (SA) CPI inflation to not-seasonally-adjusted (NSA) CPI inflation (also available on FRED). Use the 12-month % change measures. Compare SA personal consumption expenditures to NSA personal consumption expenditures (available on the BEA website). How important is seasonality for the price level? How important is it for expenditures? Is there anything you find odd about the NSA consumption data given economic theory? (1 page)

v. Plot CPI inflation (12-month % change), the unemployment rate, the Fed Funds Rate, and the 10-year bond rate in multiple panels for the common available sample period. What is the most notable common feature of the series? (1 page)

vi. Consider the US/UK exchange rate. Also, obtain U.K. CPI data from the National Statistics Online website for the UK. Plot the exchange rate and the ratio of US/UK price levels for the common available sample. Note that the scale for the ratio of price levels is meaningless (Why?). Does the ratio of prices appear to explain any of the variation in the exchange rate (don't run a regression, just provide your visual impression)? (1 page)

2. Chain Weighting (10 points)

Chain weighting has many benefits in constructing accurate real indices. However, it has the big drawback of non-additivity. For example, constructing a series like Real Consumption of Nondurables and Services is not as simple as subtracting Real Consumption of Durables from Real Consumption. See the article by Karl Whelan (a link is provided on the class website) for more discussion. Whelan suggests using the Tornqvist approximation to address the non-additivity issue.

I want you to construct Real Consumption of Nondurables and Services by i) incorrectly subtracting Real Consumption of Durables from Total Real Consumption (the data are available from FRED) and ii) using the Tornqvist approximation. Here are some details for the Tornqvist approximation:

Let Z be the real series that you want to construct as the real series Y excluding the real series X. Again, non-additivity means that you cannot simply construct Z=Y-X.

The Tornqvist approximation is given as follows:

$$\frac{\Delta Z_t}{Z_{t-1}} \approx \frac{1}{1-\theta_t}\left(\frac{\Delta Y_t}{Y_{t-1}} - \theta_t \frac{\Delta X_t}{X_{t-1}}\right)$$

where θ_t is the average of the ratio of nominal X to nominal Y in periods t and t-1. That is,

$$\theta_t \equiv \left(\frac{X_t^n}{Y_t^n} + \frac{X_{t-1}^n}{Y_{t-1}^n} \right) \Big/ 2,$$

where X^n and Y^n denote nominal values.

Note that you can always find chain-weighted levels given growth rates. That is, in the "base year" nominal values are equal to real values. To be precise, the average of nominal flows for the four quarters of the base year are equal to the average of the real flows. The nominal flows are additive. Thus, the calculation of Nominal Consumption of Nondurables and Services is simply Total Nominal Consumption minus Nominal Consumption of Durables. Then, it is straightforward to calculate the average of Nominal Consumption of Nondurables and Services in the base year. The last thing to do is calculate what Real Consumption of Nondurables and Services must have been in one of the quarters (of your choice) such that average of Real Consumption of Nondurables and Services in the base year is equal to the average of Nominal Consumption of Nondurables and Services in the base year.

Plot the Chain-Weighted Consumption of Nondurables and Services series for both methods (simple subtraction and Tornqvist approximation) on the same graph. How do they differ? What does this imply about the relative price of durables? Explain. (1 page)

3. Serial Correlation (10 points)

Write simple computer code (in GAUSS) that plots the Sample Autocorrelation Function (ACF) from lag 1 to 12 for a given time series. In particular, your code should read in the data series of interest. It should calculate $\hat{\rho}_j$ as in (12.6) of Stock and Watson (p. 435) for $j = 1,...,12$. It should then plot $\hat{\rho}_j$ on the y-axis and j on the x-axis. The program should also write the ACF to an output file.

You should submit your code and report a figure with the ACFs for the following series (presented in four panels): CPI inflation, Unemployment Rate, the 10-year Treasury Rate, and Real GDP Growth. Comment on the relative persistence of the four series. (1 page)