Homework Assignment 1

Deadline: November 1, 2018 (midnight)

Download the following time series for Germany, France and Italy from 1996-01-01 to 2018-01-01 from FRED (`https://fred.stlouisfed.org`):

- Real Gross Domestic Product: billions of chained 2010 euros, quarterly, seasonally adjusted annual rate
- Private Final Consumption Expenditure: chained 2010 euros, quarterly, seasonally adjusted annual rate

1. **(1/4 points)** Load all time series into Matlab. Convert Private Final Consumption Expenditure into **billions of chained 2010 euros**. Name the time series as follows:
   - Real Gross Domestic Product in billions of chained 2010 euros: gdp_de, gdp_fr, gdp_it for Germany, France and Italy, respectively
   - Private Final Consumption Expenditure in billions of chained 2010 euros: con_de, con_fr, con_it for Germany, France and Italy, respectively.
2. **(1/4 points)** Apply the HP-filter to all time series from Problem 1 with smoothing parameter 1600. [Hint: use the function *hp_filter*. Make sure the file *hp_filter* is saved in your current working directory. Type **[y_T,y_C] = hp_filter(y,λ)**, where y is the time series and λ is the smoothing parameter. You will receive the trend series y_T and the cyclical series y_C.]
3. **(1/4 points)** Create two figures with 3 subplots each. The figures should show the following:
   - Figure 1: Real Gross Domestic Product (in billions of chained 2010 euros)
     - Subplot 1: Time series for Germany, France and Italy.
     - Subplot 2: Trend series for Germany, France and Italy.
     - Subplot 3: Cyclical series for Germany, France and Italy.
   - Figure 2: Private Final Consumption Expenditure (in billions of chained 2010 euros)
     - Subplot 1: Time series for Germany, France and Italy.
     - Subplot 2: Trend series for Germany, France and Italy.
     - Subplot 3: Cyclical series for Germany, France and Italy.

   Make sure to provide a legend and a title for each subplot.

4. **(1/2 points)** Repeat Problems 2. and 3. for either λ=0 or $\lambda \to \infty$. Interpret your results for each of the cases.

5. **(1/2 points)** Apply the logarithm to the time series [Hint: type in the command window **help log**] . Name the time series as follows:
   - Real Gross Domestic Product (in billions of chained 2010 euros): lgdp_de, lgdp_fr, lgdp_it for Germany, France and Italy, respectively
   - Private Final Consumption Expenditure (in billions of chained 2010 euros): lcon_de, lcon_fr, lcon_it for Germany, France and Italy, respectively.

   Then, repeat Problems 1. and 2. to the logged time series with λ=1600. Create one figure with 3 subplots. The figure should show the following:
   - Subplot 1: Cyclical series for GDP and consumption for Germany
   - Subplot 2: Cyclical series for GDP and consumption for France
   - Subplot 3: Cyclical series for GDP and consumption for Italy

   Provide an interpretation for the cyclical component. Make sure you label the axes of the graph and provide a legend and a title for each subplot.

6. **(1/2 points)** Compute the standard deviations of the cyclical series from Problem 5 for each country. Compare and discuss the standard deviations for the different time series for Germany, France and Italy. Is consumption or GDP more volatile? [Hint: type in the command window **help std**]

7. **(3/4 points)** Use the logged time series from 5. to solve the following problems:
   (a) Pick one of the time series and cut it, so that it ends in 2009-01-01. Apply the HP-filter to the shorter time series.

   (b) Create one figure with 3 subplots. The figure should show:
   - Subplot 1: Cyclical series from (a) and from Problem 5 for Germany
   - Subplot 2: Cyclical series from (a) and from Problem 5 for France
   - Subplot 3: Cyclical series from (a) and from Problem 5 for Italy

   Explain the so-called "end-point problem" of the HP-filter. Do we observe an "end-point problem"? If yes, describe a situation in which the "end-point-problem"can be a serious issue.

Now, additionally download the following time series for Germany and Italy from 1970-01-01 to 2016-01-01 from FRED:

- Gross Domestic Product: Current U.S. Dollars, annual, not seasonally adjusted
- Gross Domestic Product Per Capita: Current U.S. Dollars, annual, not seasonally adjusted

8. **(1 point)** Solve the following problems:
   (a) Apply the HP-filter on all time series. Choose the value for the smoothing parameter, λ, and explain your choice.
   (b) Use the trend series for gross domestic product and gross domestic product per capita to solve the following problem: Normalize the trend series so that they start at value 1 in 1970-01-01.
   (c) Compute the annual growth rates of the normalized trend series. What is the average growth rate for both series from 1970-01-01 to 2017-01-01 for Germany and Italy, respectively? Do the average growth rates differ for the two series? Do they differ for Germany and Italy? Explain why or why not. [Hint: growth=(yT(2:end)./yT(1:end-1)-1)]
   (d) Plot the normalized trend series for gross domestic product and gross domestic product per capita either for either Germany or Italy in one graph.

General remarks: You need to answer all problems to receive full points. Document all your responses appropriately. Please send your codes as .m-file and your solution (written text and figures) as 1 PDF to flora.budianto@fu-berlin.de