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%%% Macroeconomics assignment 1

title = 'Advanced Macroeconomics 2 Assignment 1';
author = 'Tim Koenders and Max Heinze';
fprintf('%s\n%s\n\n', title, author);

%% Question 1

% Read in macroeconomic data from an Excel file and prepare data
data=readtable("Data_Macro2_France.xlsx");
data.Year=datetime(data.TIME,'InputFormat','uuuu-QQQ','Format','uuuu-QQQ');
data_timetable = table2timetable(data, 'RowTimes', 'Year');
Y = data.GDP;
C = data.HouseholdConsumption;
I = data.CapitalFormation;
G = data.GovernmentConsumption;
Year = data.Year;
C = rmmissing(C);
I = rmmissing(I);
G = rmmissing(G);
% Remove the first 20 years of GDP data to make time series balanced (since they contain n
Y(1:20) = [];
Year(1:20) = [];

%Calculating sample means and plotting the time series
C_Y = C ./ Y;
I_Y = I ./ Y;
G_Y = G ./ Y;
fprintf('Sample means:\n');
fprintf('C/Y: %.4f\n', mean(C_Y));
fprintf('I/Y: %.4f\n', mean(I_Y));
fprintf('G/Y: %.4f\n', mean(G_Y));
figure;
plot(data.Year, data.GDP, data.Year, data.HouseholdConsumption, data.Year, data.CapitalFor
xlabel('Year');
ylabel('Millions of Euros');
legend('GDP', 'Household Consumption', 'Capital Formation', 'Government Consumption');

%% Comment: The time series plot for GDP, household consumption, government expenditure an

%obtaining the stationary (cyclical) component using the HP filter and plot the cyclical c
lambda = 1600; % set the smoothing parameter
Y_cycle = hpfilter(log(Y), lambda);
C_cycle = hpfilter(log(C), lambda);
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I_cycle = hpfilter(log(I), lambda);
G_cycle = hpfilter(log(G), lambda);
plot(Year, Y_cycle, Year, C_cycle, Year, I_cycle, Year, G_cycle);
xlabel('Year');
ylabel('Cyclical Component');
legend('GDP', 'Household Consumption', 'Capital Formation', 'Government Consumption');

%% Comment: The stationary (cyclical) component of GDP, consumption, investment, and gover

%creating summary table of business cycle stylized facts (full sample)
std_Y_cycle = std(Y_cycle);
std_C_cycle = std(C_cycle);
std_I_cycle = std(I_cycle);
std_G_cycle = std(G_cycle);
fprintf('Standard deviations of cyclical components:\n');
fprintf('Y_cycle: %.4f\n', std_Y_cycle);
fprintf('C_cycle: %.4f\n', std_C_cycle);
fprintf('I_cycle: %.4f\n', std_I_cycle);
fprintf('G_cycle: %.4f\n', std_G_cycle);
Y_rsd = std(Y_cycle) / mean(Y_cycle) * 100;
C_rsd = std(C_cycle) / mean(C_cycle) * 100;
I_rsd = std(I_cycle) / mean(I_cycle) * 100;
G_rsd = std(G_cycle) / mean(G_cycle) * 100;
fprintf('Relative Standard Deviations:\n');
fprintf('Y_cycle: %.4f%%\n', Y_rsd);
fprintf('C_cycle: %.4f%%\n', C_rsd);
fprintf('I_cycle: %.4f%%\n', I_rsd);
fprintf('G_cycle: %.4f%%\n', G_rsd);
corr_cyclical = corrcoef([Y_cycle, C_cycle, I_cycle, G_cycle]);
corr_matrix = corrcoef([Y_cycle, C_cycle, I_cycle, G_cycle]);
disp('Contemporaneous Output Correlations of Cyclical Components')
disp('-------------------------------------------------------')
disp('          Y         C         I         G')
disp(corr_matrix)
T = table(std_Y_cycle, std_C_cycle, std_I_cycle, std_G_cycle, Y_rsd, C_rsd, I_rsd, G_rsd,
          corr_matrix(1,1), corr_matrix(1,2), corr_matrix(1,3), corr_matrix(1,4), ...
          corr_matrix(2,1), corr_matrix(2,2), corr_matrix(2,3), corr_matrix(2,4), ...
          corr_matrix(3,1), corr_matrix(3,2), corr_matrix(3,3), corr_matrix(3,4), ...
          corr_matrix(4,1), corr_matrix(4,2), corr_matrix(4,3), corr_matrix(4,4), ...
          'VariableNames', {'Std_Y', 'Std_C', 'Std_I', 'Std_G', 'RSD_Y', 'RSD_C', 'RSD_I',
                            'Corr_Y_Y', 'Corr_Y_C', 'Corr_Y_I', 'Corr_Y_G', ...
                            'Corr_C_Y', 'Corr_C_C', 'Corr_C_I', 'Corr_C_G', ...
                            'Corr_I_Y', 'Corr_I_C', 'Corr_I_I', 'Corr_I_G', ...
                            'Corr_G_Y', 'Corr_G_C', 'Corr_G_I', 'Corr_G_G'});
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disp(T)

%% Comment: The results indicate that the cyclical components of output (Y), consumption (

% Splitting the data into two parts based on the date range
Y_cycle1 = Y_cycle(1:112,:);
C_cycle1 = C_cycle(1:112,:);
I_cycle1 = I_cycle(1:112,:);
G_cycle1 = G_cycle(1:112,:);
Y_cycle2 = Y_cycle(113:end,:);
C_cycle2 = C_cycle(113:end,:);
I_cycle2 = I_cycle(113:end,:);
G_cycle2 = G_cycle(113:end,:);

% Summary table for the "until 2007Q4" sample (hereafter called "subsample 1"
std_Y_cycle1 = std(Y_cycle1);
std_C_cycle1 = std(C_cycle1);
std_I_cycle1 = std(I_cycle1);
std_G_cycle1 = std(G_cycle1);
fprintf('Standard deviations of cyclical components for subsample 1:\n');
fprintf('Y_cycle: %.4f\n', std_Y_cycle1);
fprintf('C_cycle: %.4f\n', std_C_cycle1);
fprintf('I_cycle: %.4f\n', std_I_cycle1);
fprintf('G_cycle: %.4f\n', std_G_cycle1);
Y_rsd1 = std(Y_cycle1) / mean(Y_cycle1) * 100;
C_rsd1 = std(C_cycle1) / mean(C_cycle1) * 100;
I_rsd1 = std(I_cycle1) / mean(I_cycle1) * 100;
G_rsd1 = std(G_cycle1) / mean(G_cycle1) * 100;
fprintf('Relative Standard Deviations for subsample 1:\n');
fprintf('Y_cycle: %.4f%%\n', Y_rsd1);
fprintf('C_cycle: %.4f%%\n', C_rsd1);
fprintf('I_cycle: %.4f%%\n', I_rsd1);
fprintf('G_cycle: %.4f%%\n', G_rsd1);
corr_matrix1 = corrcoef([Y_cycle1, C_cycle1, I_cycle1, G_cycle1]);
disp('Contemporaneous Output Correlations of Cyclical Components for subsample 1')
disp('----------------------------------------------------------------------')
disp('          Y         C         I         G')
disp(corr_matrix1)
T1 = table(std_Y_cycle1, std_C_cycle1, std_I_cycle1, std_G_cycle1, Y_rsd1, C_rsd1, I_rsd1
          corr_matrix1(1,1), corr_matrix1(1,2), corr_matrix1(1,3), corr_matrix1(1,4), ...
          corr_matrix1(2,1), corr_matrix1(2,2), corr_matrix1(2,3), corr_matrix1(2,4), ...
          corr_matrix1(3,1), corr_matrix1(3,2), corr_matrix1(3,3), corr_matrix1(3,4), ...
          corr_matrix1(4,1), corr_matrix1(4,2), corr_matrix1(4,3), corr_matrix1(4,4), ...
          'VariableNames', {'Std_Y', 'Std_C', 'Std_I', 'Std_G', 'RSD_Y', 'RSD_C', 'RSD_I'
                            'Corr_Y_Y', 'Corr_Y_C', 'Corr_Y_I', 'Corr_Y_G', ...
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                             'Corr_C_Y', 'Corr_C_C', 'Corr_C_I', 'Corr_C_G', ...
                             'Corr_I_Y', 'Corr_I_C', 'Corr_I_I', 'Corr_I_G', ...
                             'Corr_G_Y', 'Corr_G_C', 'Corr_G_I', 'Corr_G_G'});
disp(T1)

%% Comment: The subsample analysis shows that cyclical components of output, consumption,

% Summary table for the "from 2008Q1" sample (hereafter called "subsample 2"
std_Y_cycle2 = std(Y_cycle2);
std_C_cycle2 = std(C_cycle2);
std_I_cycle2 = std(I_cycle2);
std_G_cycle2 = std(G_cycle2);
fprintf('Standard deviations of cyclical components for subsample 2:\n');
fprintf('Y_cycle: %.4f\n', std_Y_cycle2);
fprintf('C_cycle: %.4f\n', std_C_cycle2);
fprintf('I_cycle: %.4f\n', std_I_cycle2);
fprintf('G_cycle: %.4f\n', std_G_cycle2);
Y_rsd1 = std(Y_cycle2) / mean(Y_cycle2) * 100;
C_rsd1 = std(C_cycle2) / mean(C_cycle2) * 100;
I_rsd1 = std(I_cycle2) / mean(I_cycle2) * 100;
G_rsd1 = std(G_cycle2) / mean(G_cycle2) * 100;
fprintf('Relative Standard Deviations for subsample 2:\n');
fprintf('Y_cycle: %.4f%%\n', Y_rsd1);
fprintf('C_cycle: %.4f%%\n', C_rsd1);
fprintf('I_cycle: %.4f%%\n', I_rsd1);
fprintf('G_cycle: %.4f%%\n', G_rsd1);
corr_matrix1 = corrcoef([Y_cycle2, C_cycle2, I_cycle2, G_cycle2]);
disp('Contemporaneous Output Correlations of Cyclical Components for subsample 2')
disp('------------------------------------------------------------------------')
disp('          Y         C         I         G')
disp(corr_matrix1)
T2 = table(std_Y_cycle2, std_C_cycle2, std_I_cycle2, std_G_cycle2, Y_rsd1, C_rsd1, I_rsd1
          corr_matrix1(1,1), corr_matrix1(1,2), corr_matrix1(1,3), corr_matrix1(1,4), ...
          corr_matrix1(2,1), corr_matrix1(2,2), corr_matrix1(2,3), corr_matrix1(2,4), ...
          corr_matrix1(3,1), corr_matrix1(3,2), corr_matrix1(3,3), corr_matrix1(3,4), ...
          corr_matrix1(4,1), corr_matrix1(4,2), corr_matrix1(4,3), corr_matrix1(4,4), ...
          'VariableNames', {'Std_Y', 'Std_C', 'Std_I', 'Std_G', 'RSD_Y', 'RSD_C', 'RSD_I'
                             'Corr_Y_Y', 'Corr_Y_C', 'Corr_Y_I', 'Corr_Y_G', ...
                             'Corr_C_Y', 'Corr_C_C', 'Corr_C_I', 'Corr_C_G', ...
                             'Corr_I_Y', 'Corr_I_C', 'Corr_I_I', 'Corr_I_G', ...
                             'Corr_G_Y', 'Corr_G_C', 'Corr_G_I', 'Corr_G_G'});
disp(T2)

%% Comment: For subsample 2, the standard deviations of cyclical components are much lowe
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save('my_workspace.mat')
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