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% ========================================================================
% ======================   PC4: Cointegration ============================
% ========================================================================
%% ------------------------ Exercise 1 ---------------------------------
clear; clc;
% ===== import data from BPdata.xlsx
data  = readtable("BPdata.xlsx");
tfp   = data.tfp;      % total factor productivity
sp    = data.sp;      % stock prices
dates = data.Dates;      % sequence of datetime

%% a) plot time series of tfp and sp
figure
colororder({'k','k'});
yyaxis left
h1 = plot(dates,tfp,'-b','LineWidth',1.5);
recessionplot
ylabel('log of total factor productivity');
yyaxis right
h2 = plot(dates,sp,'-r','LineWidth',1.5);
ylabel('log of capital stock index');
legend([h1 h2],{'total factor productivity','stock prices'})


%% b) ADF test for tfp and sp: function adftest
lags        = 8;
vars        = tfp;
[~,pvalAR]  = adftest(vars,"Model","AR","Lags",1:lags);  % test WITHOUT intercept
and trend
[~,pvalARD] = adftest(vars,"Model","ARD","Lags",1:lags);  % test WITH intercept
[~,pvalTS]  = adftest(vars,"Model","TS","Lags",1:lags);  % test WITH intercept and
trend
% display and save the results
adttab = table((1:lags)',pvalAR',pvalARD',pvalTS','VariableNames',
["lag","AR","ARD","TS"])

%% c) Engel-Granger cointegration test: function egcitest
lags          = 8;
Y             = [tfp, sp];
[~,pegci_nc]  = egcitest(Y,"CReg","nc","Lags",1:lags);    % WITHOUT constant and
trend
[~,pegci_c]   = egcitest(Y,"CReg","c","Lags",1:lags);    % WITH constant and NO
trend
[~,pegci_ct,~,~,reg1,reg2]  = egcitest(Y,"CReg","ct","Lags",1:lags);    % WITH
constant and trend
[~,pegci_ctt] = egcitest(Y,"CReg","ctt","Lags",1:lags);    % WITH constant, trend,
and quadratic trend

% display and save the results
```

```
egcitab =
table((1:lags)',pegci_nc',pegci_c',pegci_ct',pegci_ctt','VariableNames',...
    ["lags","nc","c","ct","ctt"])
```