

Assignment_3_RutgerGeelen_WashantvanDam

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Preparation

Clear workspace and load the required packages:

```
rm(list=ls())
suppressMessages(library("lmtest"))
suppressMessages(library("car"))
library("sandwich")
suppressMessages(library("ggplot2"))
library("rmarkdown")
library("survival")
suppressMessages(library("stargazer"))
library("rbibutils")
library("plm")
library("ivreg")
```

Q1

We analyse annual data on the S&P 500 stock market index and related time series, with observations over the period 1871–2015. The data are given in *SP500.csv*, and the variables are defined as follows:

- *P* S&P 500 index (value-weighted average of stock prices of 500 important US companies)
- *D* Annual (value-weighted average) dividend per share on the stocks in the index
- *Rs* Short-term (one-year) US interest rate
- *Rl* Long-term (10-year) US interest rate
- *CPI* Consumer price index
- $lrp = \ln(P/CPI)$, logarithm of “real” index, i.e., corrected for changes in consumer prices
- $lrd = \ln(D/CPI)$, logarithm of real dividends
- $lpd = \ln(P/D)$, logarithm of price-dividend ratio
- $ret = (Pt + Dt - Pt-1)/Pt-1$, annual return on the index, including dividends
- $TSpr = Rl - Rs$, difference between long- and short-term interest rate (term spread) The file also contains up to 3 lags of the (lower case) variables, indicated by the extension “j”, $j = 1, 2, 3$.

Read data:

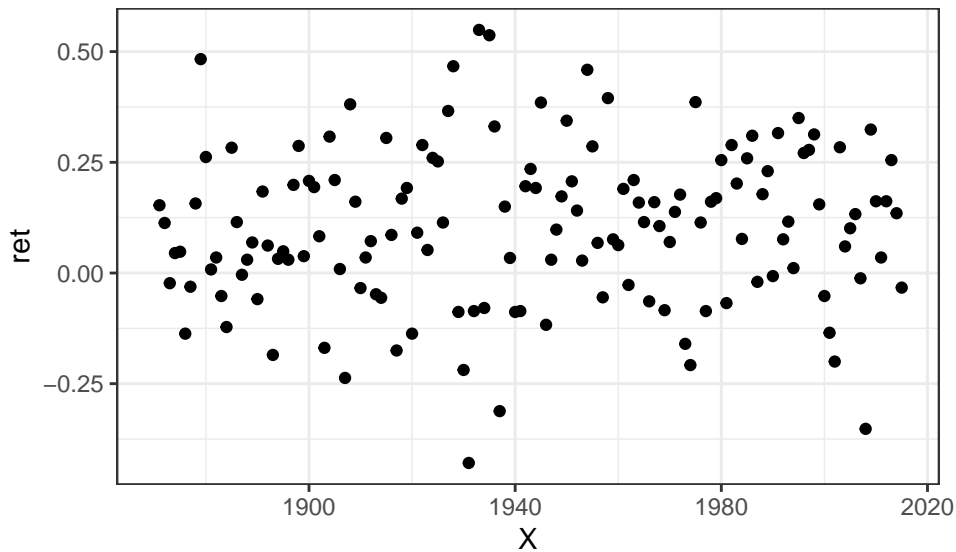
```
MyQ1Data <- read.csv("https://raw.githubusercontent.com/rutgerg/econometrics_assignment_3/master/SP500.csv")
```

Q1A

Test for a unit root in *lrp*, *lrd*, *Rs* and *Rl*. Motivate your choice between either a constant only, or a constant and a linear trend in the test regression. Report and interpret the outcome of the test.

Plot *ret* over time

```
## Warning: Removed 1 rows containing missing values (geom_point).
```



Q1B

Particular financial theories imply that \log (real) stock prices and \log (real) dividends should be cointegrated, with a coefficient of 1. Explain that, under the assumption that both prices and dividends have a unit root, this hypothesis can be tested with a unit root test on the variable lpd , and report and interpret the outcome of this test. (The assumption of a unit root in both series may not be supported by your answer to (a); this would have to be included in your discussion.)

Q1c

We now wish to investigate if the annual returns on the S&P 500 index can be forecasted. First, plot the autocorrelation function of ret , and interpret the outcome. Next, estimate an $AR(2)$ model for ret and test if the lagged returns have zero coefficients (jointly).

Q1D

Estimate an ADL model with ret as the dependent variable, and with three lags of ret and the term spread $TSpr$ as explanatory variables. You may assume that $TSpr$ is stationary). Carry out a Granger-causality test to see if the term spread Granger-causes returns. Interpret the outcome.

Q1E

Select an appropriate lag order p (motivate your choice), and estimate the resulting $VAR(p)$ model for ret and $TSpr$ jointly. Report and interpret the outcomes, focusing in particular on the difference in predictability of the two time series.