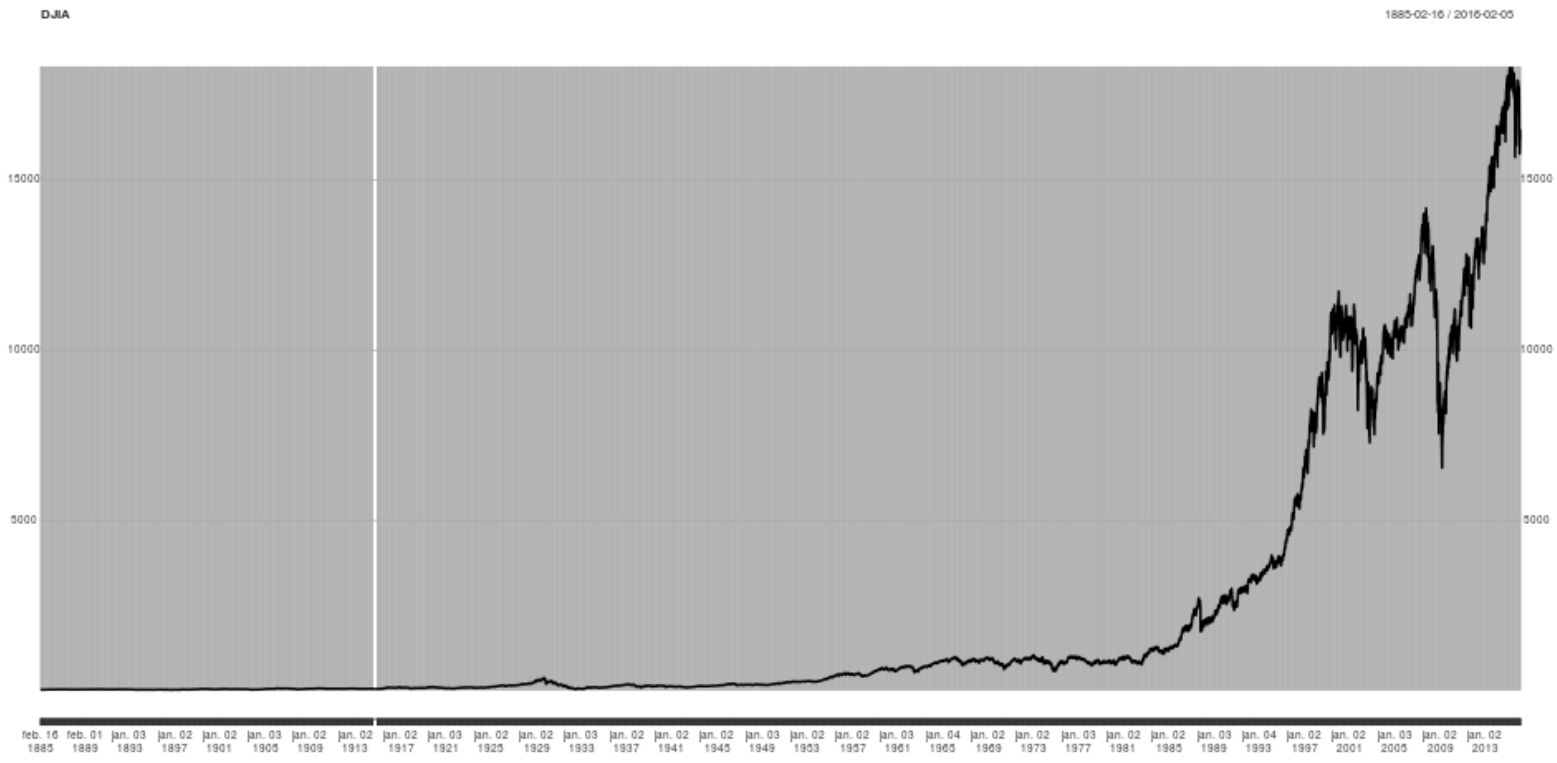
Forecasting the Real Economy with Financial Variables

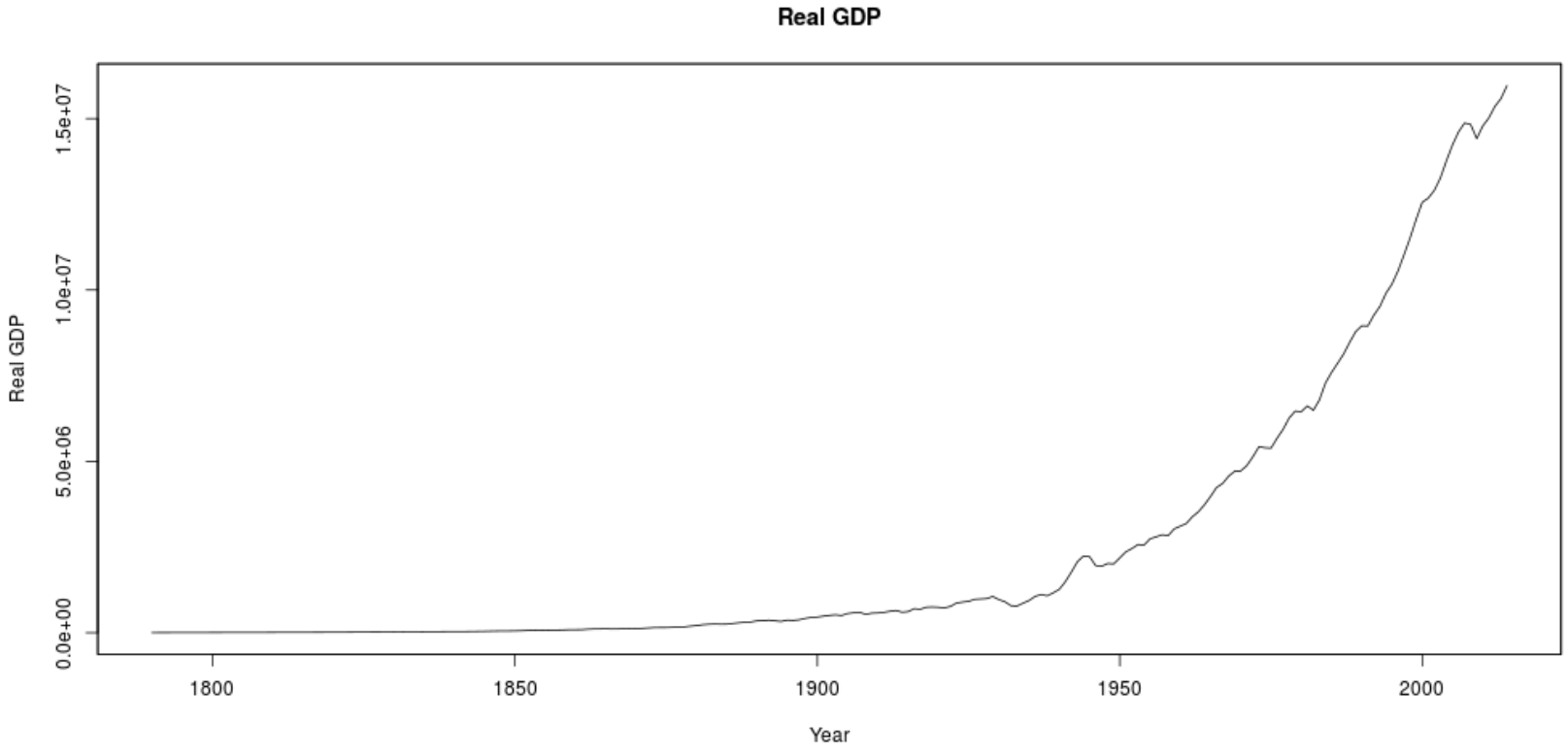
Predicting real economy variables with asset price volatility

Look at the case of US.
As real variable we use (changes in) GDP. The asset price we consider is the stock market, represented with the DJIA. The use of the DJIA is due to the desire to have as long a time series as possible. At the webpage `https://www.measuringworth.com` you will find daily series of DJIA going back to 1885, as well as annual GDP estimates going back to 1790.

DJIA


DJIA
1885-02-16 / 2016-02-05
15000
10000
5000
feb. 16 1885
feb. 01 1889
jan. 03 1893
jan. 02 1897
jan. 02 1901
jan. 03 1905
jan. 02 1909
jan. 02 1913
jan. 02 1917
jan. 03 1921
jan. 02 1925
jan. 02 1929
jan. 03 1933
jan. 02 1937
jan. 02 1941
jan. 02 1945
jan. 03 1949
jan. 02 1953
jan. 02 1957
jan. 03 1961
jan. 04 1965
jan. 02 1969
jan. 02 1973
jan. 03 1977
jan. 02 1981
jan. 02 1985
jan. 03 1989
jan. 04 1993
jan. 02 1997
jan. 02 2001
jan. 03 2005
jan. 02 2009
jan. 02 2013

Real GDP


Real GDP
Real GDP
0.0e+00
5.0e+06
1.0e+07
1.5e+07
1800
1850
1900
1950
2000
Year

let $dGDP$ be the (log) change in GDP, and $\sigma(R_m)$ the annual estimate of stock volatility on the DJIA
We will estimate the relationship

$$dGDP_t = a + b_1 dGDP_{t-1} + b_2 \sigma(R_{m,t-1}) + \varepsilon_t$$

If the change in the stock price volatility predicts the future GDP, the coefficient b_2 will be significant. Let us test this
We do so in a VAR context.

Show some of the R commands.

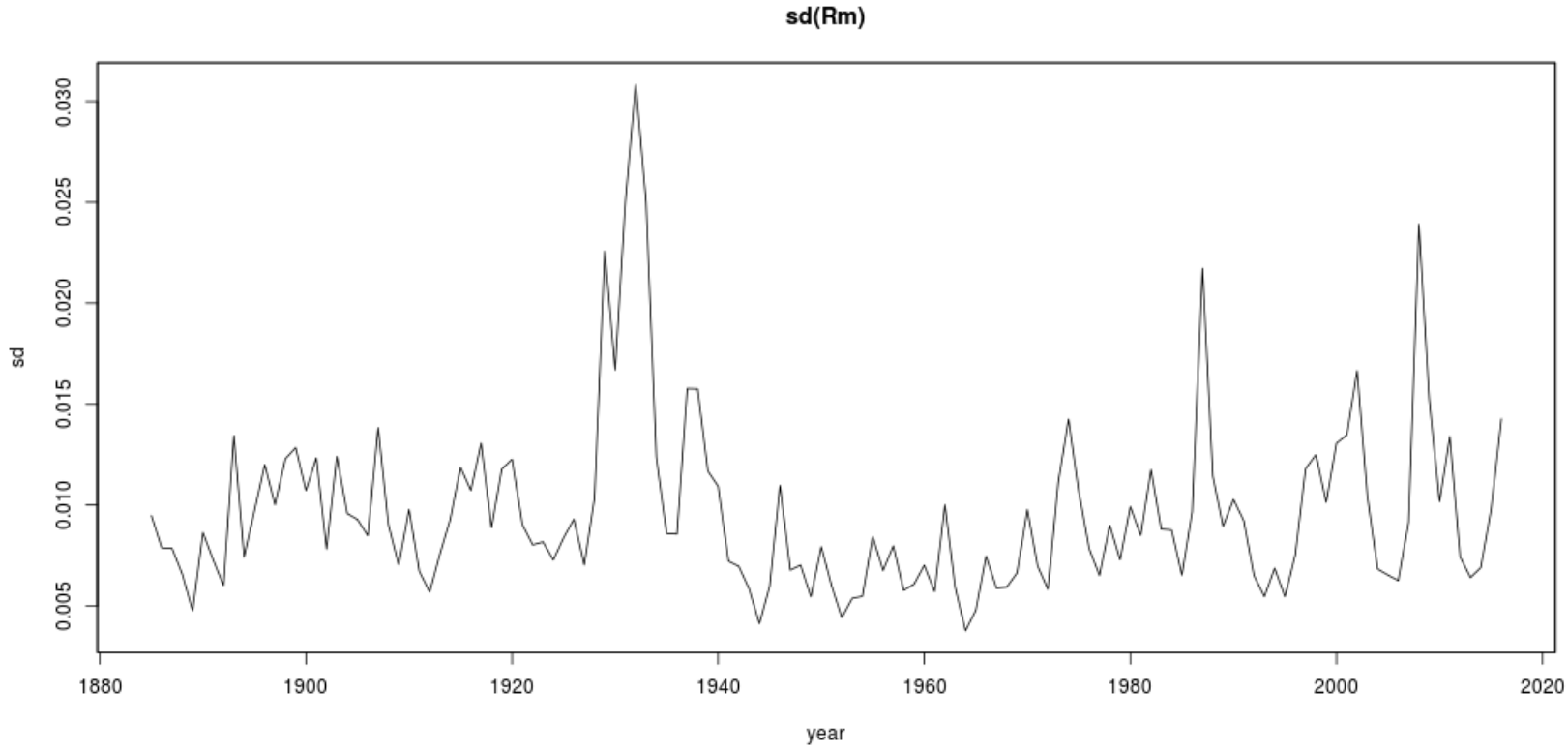
```
library(xts)
library(vars)
source ("~/data/2016/measuringworth/read_gdp.R")
                        # RealGDP is a zooreg(annual)
dGDP <- diff(log(RealGDP))
names(dGDP) <- "dGDP"
source ("~/data/2016/measuringworth/read_dja.R")
head(DJIA)
Rm <- dailyReturn(DJIA)
sigmaRm <- period.apply(Rm,
                        INDEX=endpoints(Rm,on="years"),
                         FUN=sd)
sigmaRm <- zooreg(coredata(sigmaRm),
                  frequency=1,start=1885)
names(sigmaRm) <- "sigmaRm"
```

```
data <- merge(dGDP,sigmaRm,all=FALSE)
reg <- VAR(data)
causality(reg,cause="sigmaRm")
reg.irf <- irf(reg,
               response="dGDP",
                impulse="sigmaRm")
plot(reg.irf)
filename <- paste0(outdir,
                   "irf_impulse_sigmaRm_response_dGDP.eps")
postscript(file=filename, width=10,height=5,horizontal=FALS
plot(reg.irf)
dev.off()
```

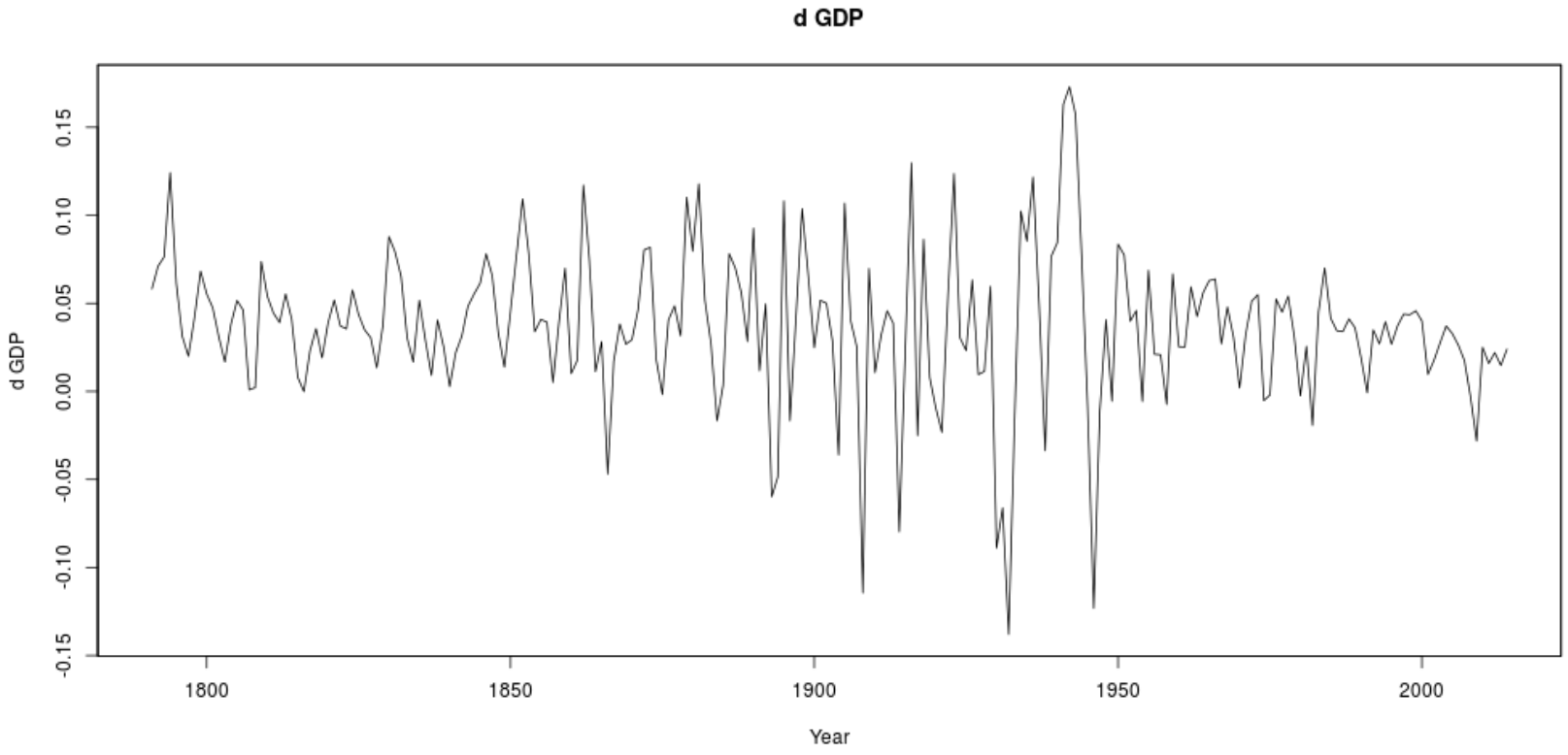
This is the final data we will work with

```
> head(data)
              dGDP      sigmaRm
1885 0.003455458 0.009483220
1886 0.078195630 0.007888869
1887 0.070125639 0.007855014
1888 0.055903941 0.006576621
1889 0.028330104 0.004775508
1890 0.092714255 0.008637905
```

annual sd of DJIA daily returns



(log) Changes in GDP



and then the VAR

```
VAR Estimation Results:
=========================
Endogenous variables: dGDP, sigmaRm
Deterministic variables: const
Sample size: 129
Log Likelihood: 763.632
Roots of the characteristic polynomial:
0.6193 0.1563
Call:
VAR(y = data)
```

```
Estimation results for equation dGDP:
=====================================
dGDP = dGDP.l1 + sigmaRm.l1 + const

            Estimate Std. Error t value Pr(>|t|)
dGDP.l1      0.18996    0.09053   2.098 0.037879 *
sigmaRm.l1 -2.24233    1.02262  -2.193 0.030163 *
const       0.04778    0.01200   3.980 0.000116 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘


Residual standard error: 0.04745 on 126 degrees of freedom
Multiple R-Squared: 0.1033,Adjusted R-squared: 0.0891
F-statistic:  7.26 on 2 and 126 DF,  p-value: 0.001037
```

```
Estimation results for equation sigmaRm:
========================================
sigmaRm = dGDP.l1 + sigmaRm.l1 + const

             Estimate Std. Error t value Pr(>|t|)
dGDP.l1    -0.0064530  0.0066917  -0.964    0.337
sigmaRm.l1  0.5856172  0.0755854   7.748 2.69e-12 ***
const       0.0041828  0.0008873   4.714 6.32e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘

Residual standard error: 0.003508 on 126 degrees of freedom
Multiple R-Squared: 0.3784,Adjusted R-squared: 0.3685
F-statistic: 38.34 on 2 and 126 DF,  p-value: 9.839e-14
```

```
Covariance matrix of residuals:
               dGDP    sigmaRm
dGDP      2.252e-03 -4.215e-05
sigmaRm -4.215e-05  1.230e-05

Correlation matrix of residuals:
            dGDP sigmaRm
dGDP      1.0000 -0.2532
sigmaRm -0.2532  1.0000
```

```
> causality(reg, cause="sigmaRm")
$Granger

Granger causality H0: sigmaRm do not Granger-cause dGDP

data:  VAR object reg
F-Test = 4.8081, df1 = 1, df2 = 252, p-value = 0.02924


$Instant

H0: No instantaneous causality between: sigmaRm and dGDP

data:  VAR object reg
Chi-squared = 7.7737, df = 1, p-value = 0.005301
```

and an impulse response plot

```
> reg.irf <- irf(reg,response="dGDP",impulse="sigmaRm")
> plot(reg.irf)
```