Introduction to the Course

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Financial Econometrics

Real-time decision making on the financial markets is based on the ability of the financial analyst to extract relevant information from financial data.

As financial analyst you should be able to answer questions like:

- How do I allocate my wealth in a portfolio of risky assets?
- How do I determine the risk of a financial investment?
- What is the probability of loosing more than x% on my investment?
- What is the fair-price of a derivative contract?

Financial Econometrics

In order to answer this kind of question you need:

1. Definition of the problem
2. Econometric model
3. Analyze the financial data
4. Interpretation of the results
5. Extract coherent strategies
6. Economic-financial theory
7. Programming skills

Points 6 and 7 are not the goals of this course.

Step 1: Analyse the data

- Read the original data file
- Make a first set of plots, look at it
- Transform as necessary (aggregate, logs, first differences, combine with other data sets)
- Calculate statistics
- Save a file in a convenient format for later analysis

Step 2: Analyse and Estimate the Model

- Can you simulate data from the model?
- Does it look 'similar' to empirical data?
- Is it 'the same' type of input?
- Take input (either empirical or simulated data)
- Implement model estimation
- Prepare useful outcome

Step 3: Extract results

- Use estimated model parameters
- Create tables/graphs

Specific to the content of this course:

- Take investment decisions
- Predict the amount of risk related to an investment
- Assign the correct probability to extreme events
- Policy?

Course Objectives

The main goals of this course are:

- Provide the the students with the practical tools in quantitative finance that are in demand in the finance industry.
- Learn to use a computational tool (R) for the implementation of financial econometric methods.
- Work with real data to solve real world problems.
- Apply econometric methods in analyzing and predicting financial time series like asset prices and returns, volatility, and correlations.
- Evaluate and reflect upon empirical studies using financial data.

Course Content

- Learning programming in R
  1. Basic Functions
  2. Handling data sets
  3. Numerical optimization
  4. Simulation
- Implement econometric techniques
  1. Maximum Likelihood
  2. Multivariate distributions and tails
- Financial Modelling
  1. Volatility Modelling
  2. Correlation Modelling
  3. Risk Management
  4. Portfolio Allocation
  5. Systemic Risk

Not part of this course

- Review of basic probability concepts (random variables, probability distributions)
- Review of basic econometric concepts (OLS, GLS, p-value)
- Review of time series concepts (AR, MA, unit roots, cointegration)
- Review of financial theories (no-arbitrage, EMH)

Practicalities

Lectures take place in 2624-E1 on:

- Monday, 12:00 - 14:00
- Thursday, 12:00 - 14:00

Evaluation

The final exam is

- 4 days TAKE-HOME ASSIGNMENT

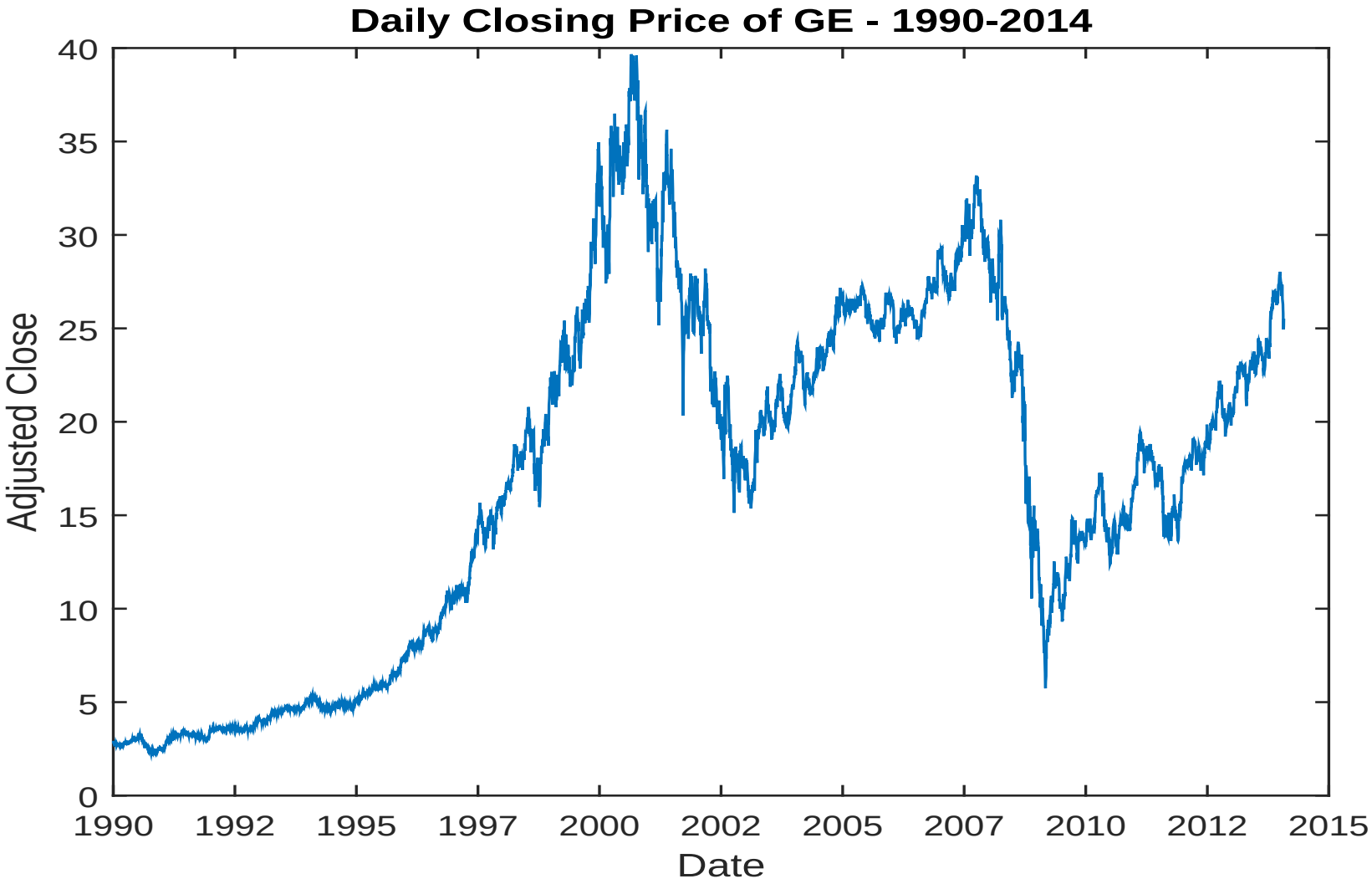
During the course, I will provide you with assignments. Solutions to the assignments will be provided. You are encouraged to solve the assignments before looking at the solutions.

Teaching Material

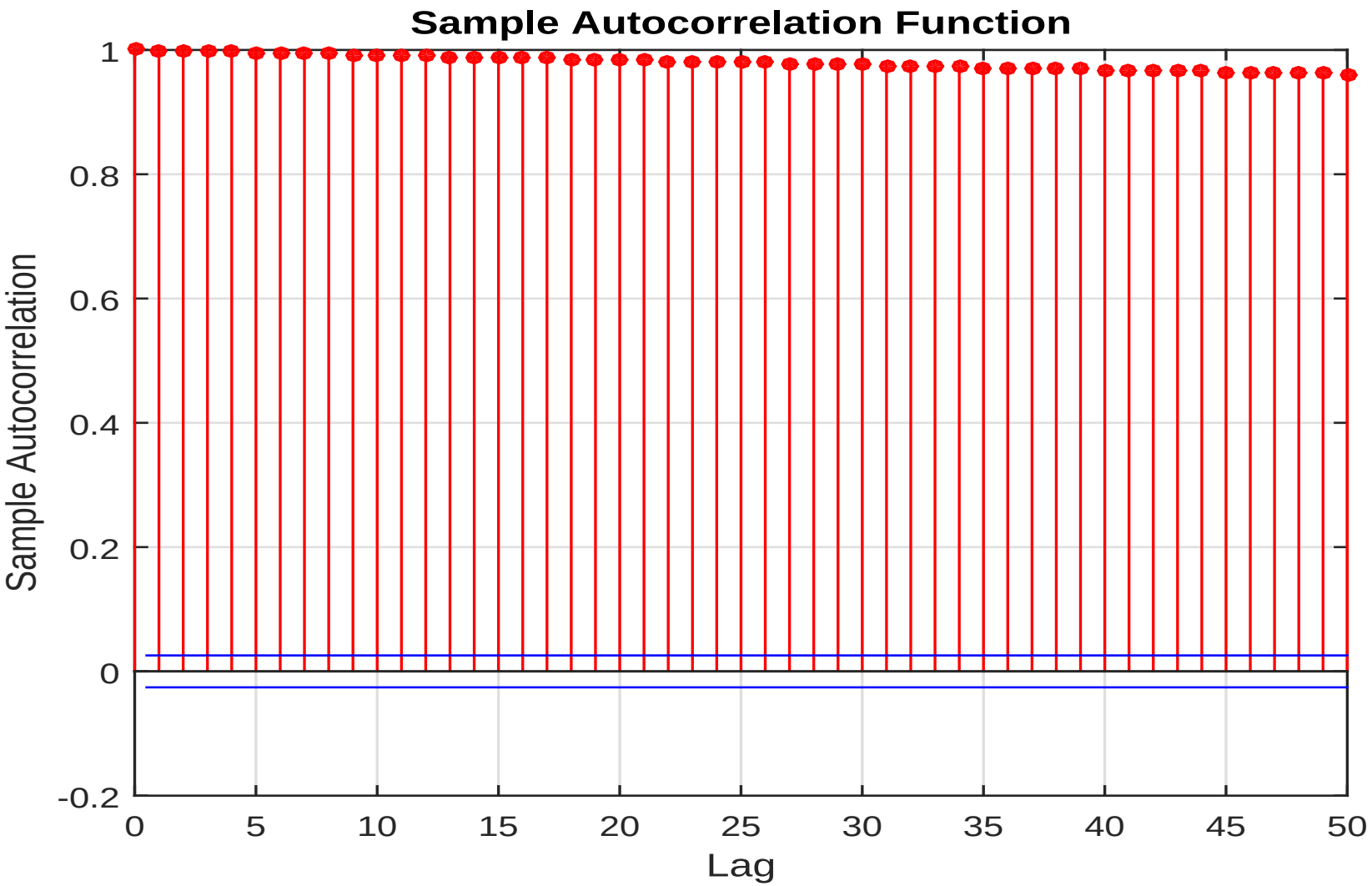
There is no book that matches 100% the topics of this course. The teaching material is

- Jondeau, Poon and Rockinger, Financial Modeling Under Non-Gaussian Distributions, (2007), Springer
- Published articles
- Slides
- Alexios Ghalanos: Introduction to the rugarch package. Free.

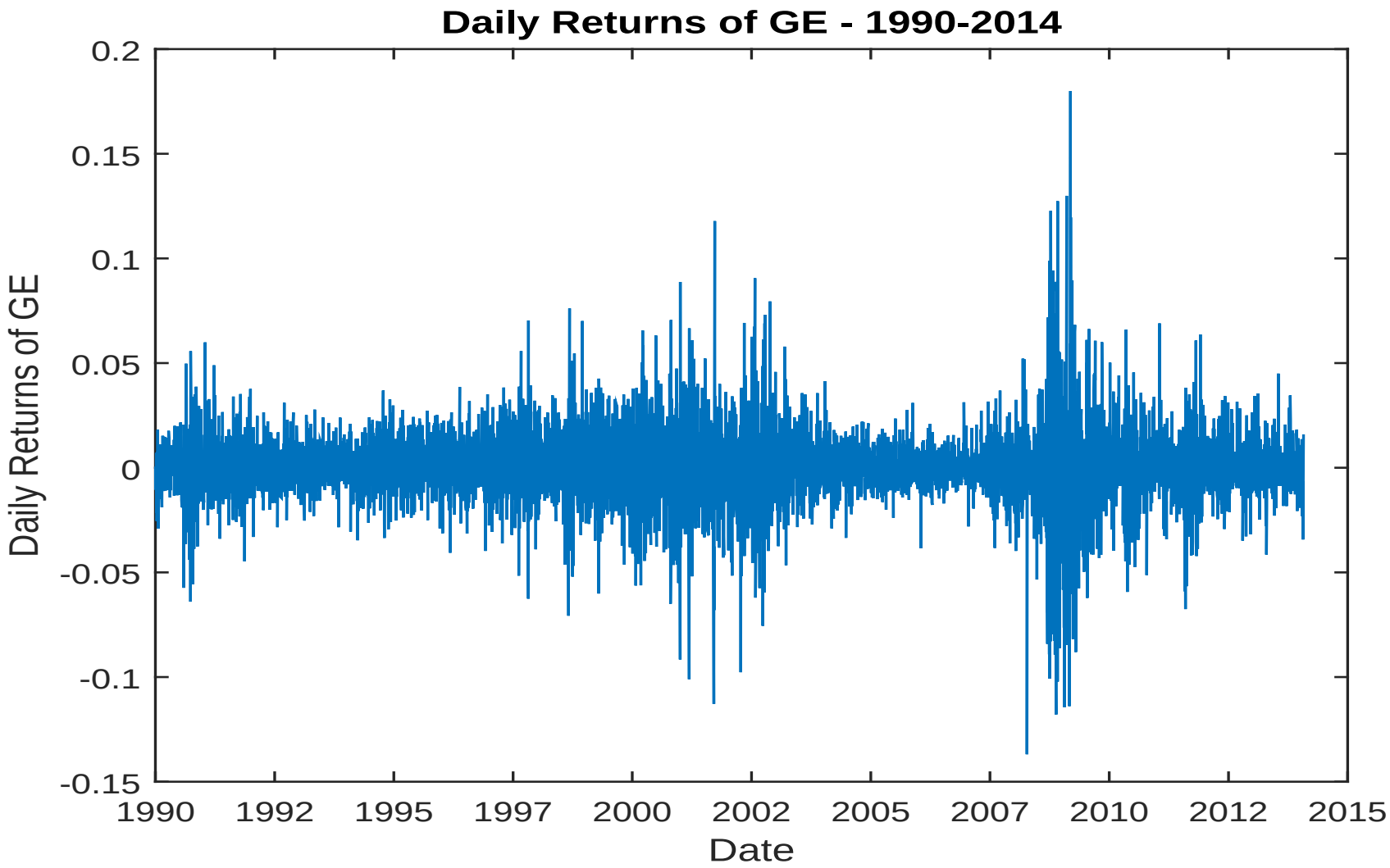
Let's take a look at the daily stock prices of General Electrics...



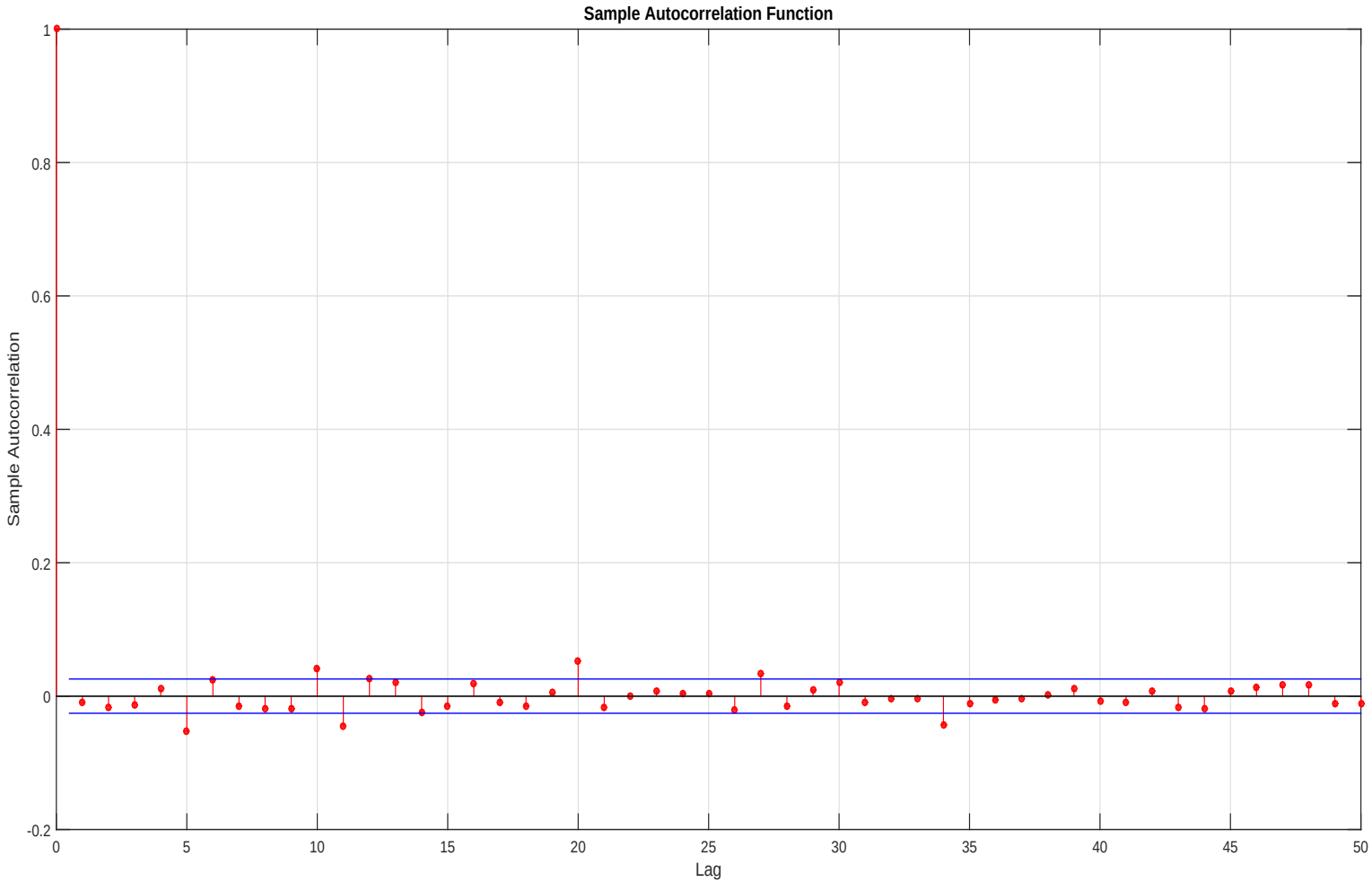
...their ACF...


Sample Autocorrelation Function
Sample Autocorrelation
Lag
1
0.8
0.6
0.4
0.2
0
-0.2
0
5
10
15
20
25
30
35
40
45
50

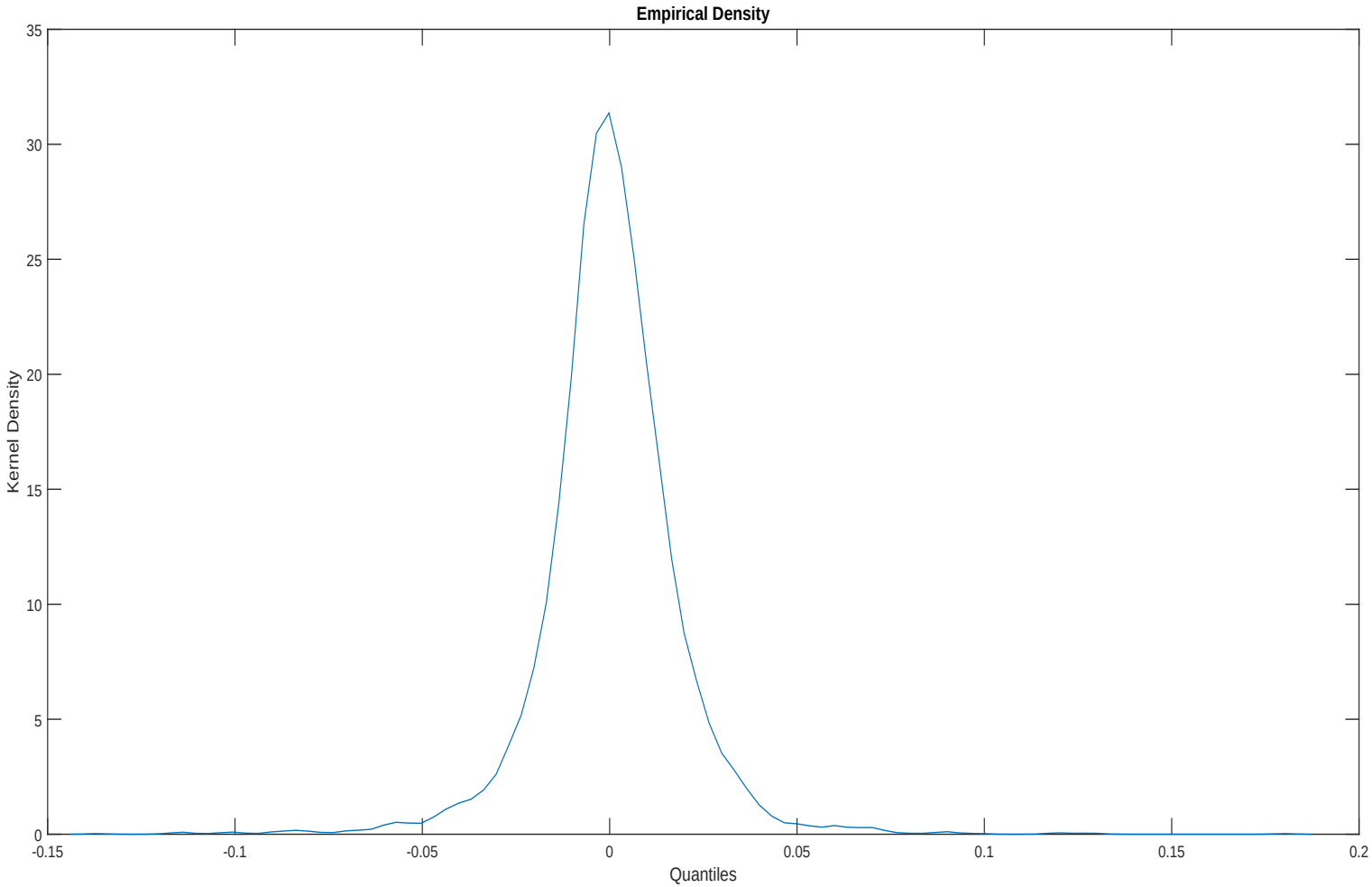
...and their associated log-returns...



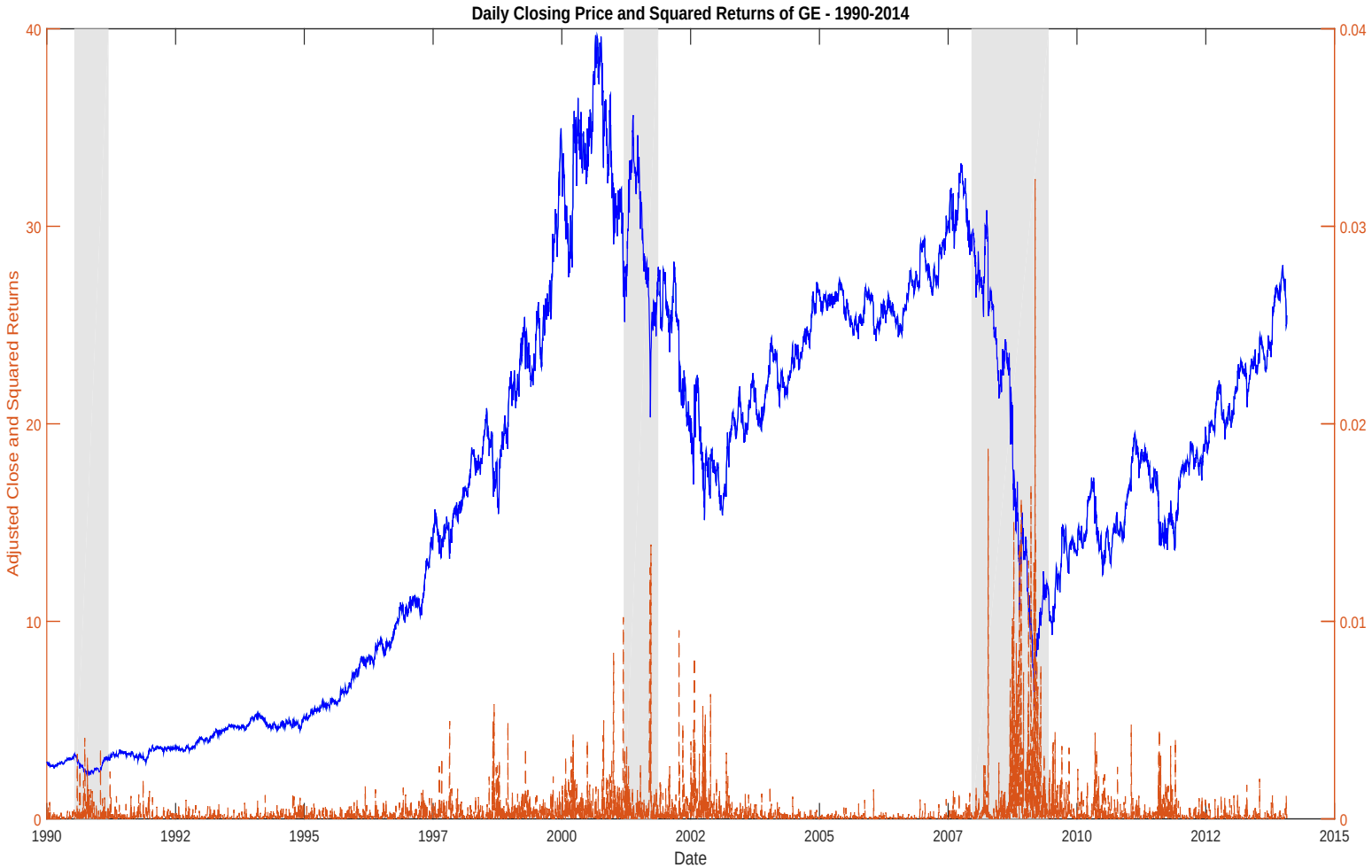
...the ACF of the log-returns...



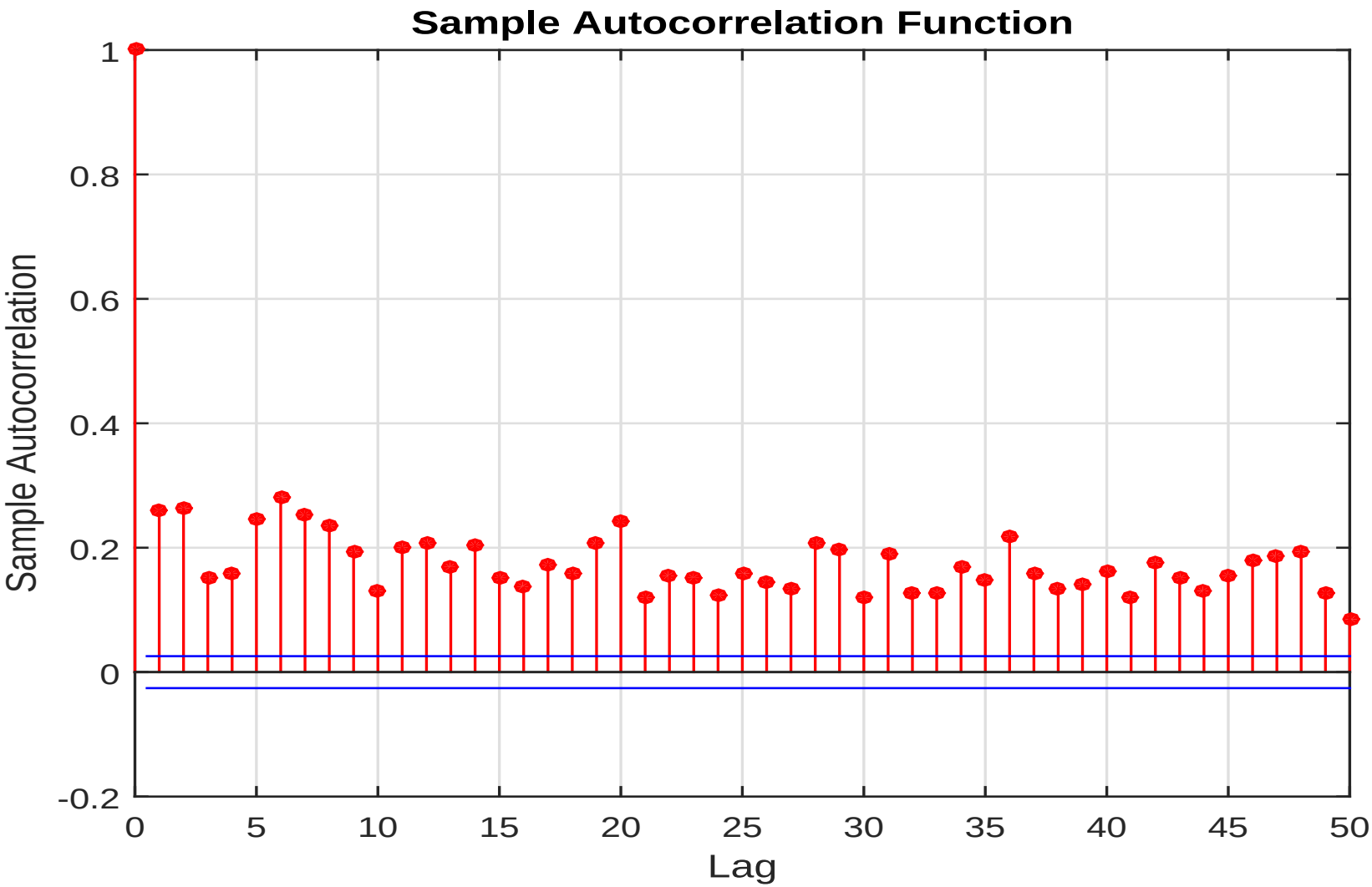
Their distribution?



What about the squares of log-returns?



...and their ACF?



Summarizing...

- If we look at the dynamics:
  1. Daily stock prices are highly persistent (they are I(1) variables)
  2. Daily log-returns are uncorrelated...
  3. ... but their squares are highly correlated
  4. Variations are more pronounced and are higher during financial crises
- The empirical distribution of daily log-returns is skewed and has fat-tails
  1. Under Gaussianity the probability of a return smaller than -10% is 1.9094e-08 (one event every 14500 years)
  2. It happened 9 times in the sample (between 1990 and 2014)
- More stylized facts about the multivariate distribution of returns will also be discussed:
  1. Correlation
  2. Dependence in the tail events