# PHYSICS AND FINANCE

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# STYLIZED FACTS

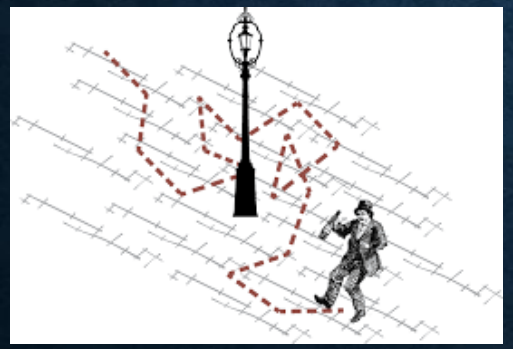
- Financial Services Industry fast growth (6 times more tan any other in the last 10 years)

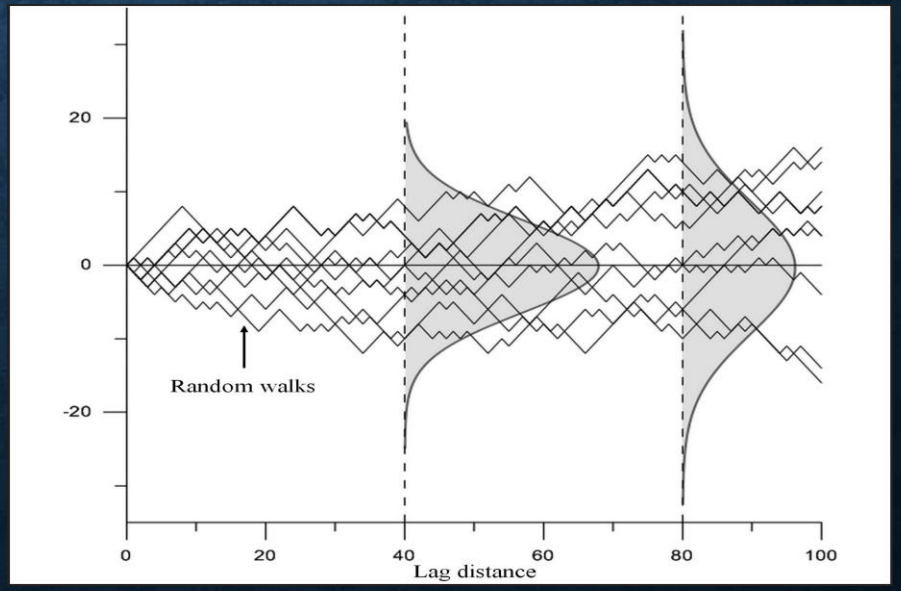
- Best money manager in the world is Jim Simons (physicist, Chern-Simons theory): His main fund obtained 2480% return from 1988-1998 (George Soros fund "only" earned 1700%)

- Renaissance Technology, Simons' Company only hires Physicists and Mathematicians with no financial background

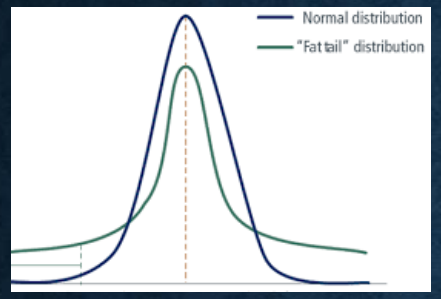
# HISTORY

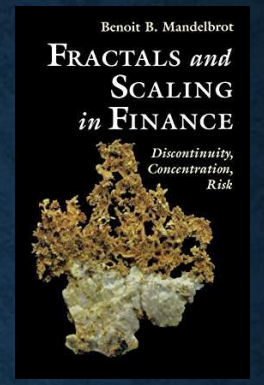
- Physics and Economics
  - Economic Equilibrium from Thermodynamics (1890)
  - Paul Samuelson (Nobel Prize in Economics 1970)
  - Open questions: Transient states, Path-dependent variables, Critical phenomena…
- Physics and Finance
  - Brownian motion/Random walk: Louis Bachelier (1900) applied it to stock prices



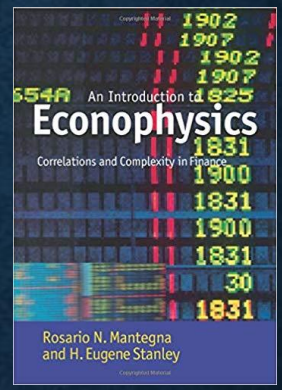


- Mandelbrot (1963): Fat tails distributions for cotton prices

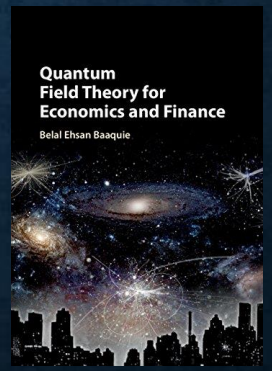


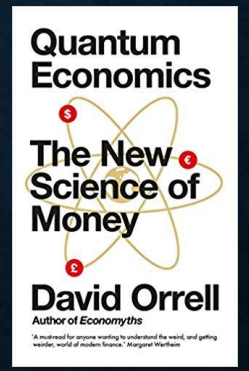




- Econophysics (1990s)
  - Power Laws Distributions
  - Universality
  - Theory of Bubbles and Crashes




- Quantum approach (2010s)
  - Schrödinger equation for pricing
  - Quantum computation



# BLACK-SCHOLES MODEL

- Widely used for 40+ years for asset pricing

- Assumed Normal distributions for financial assets (Continuous random walk), instant trading, stationary processes…(not always all are true)

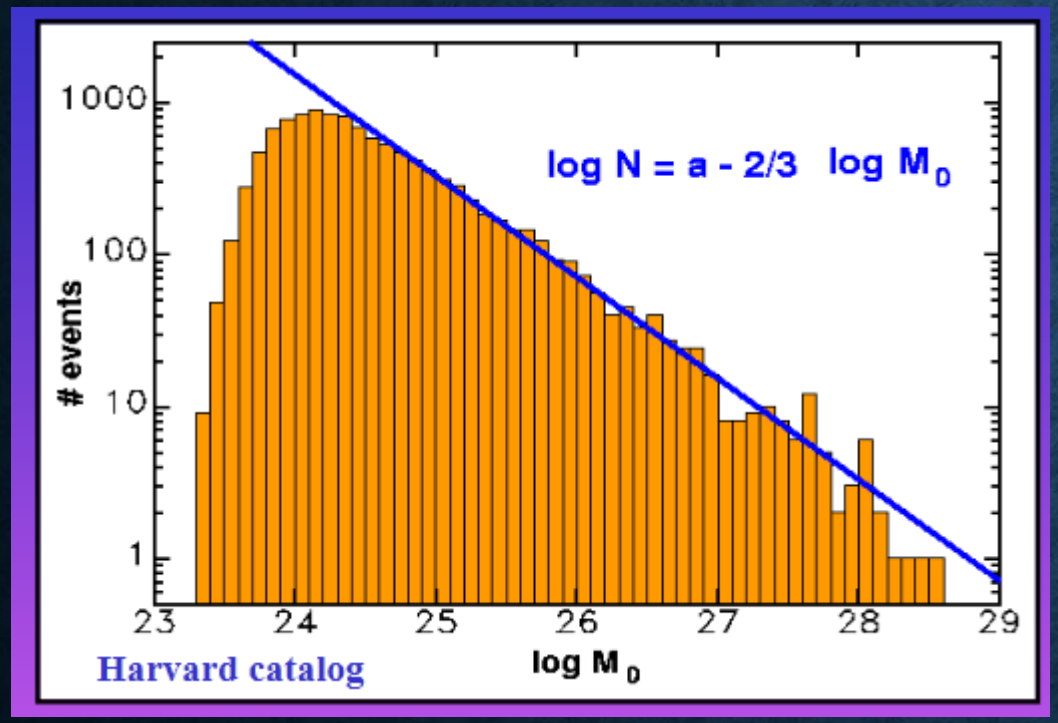
- Stochastic calculus: Ito's Lemma, PDE

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$$

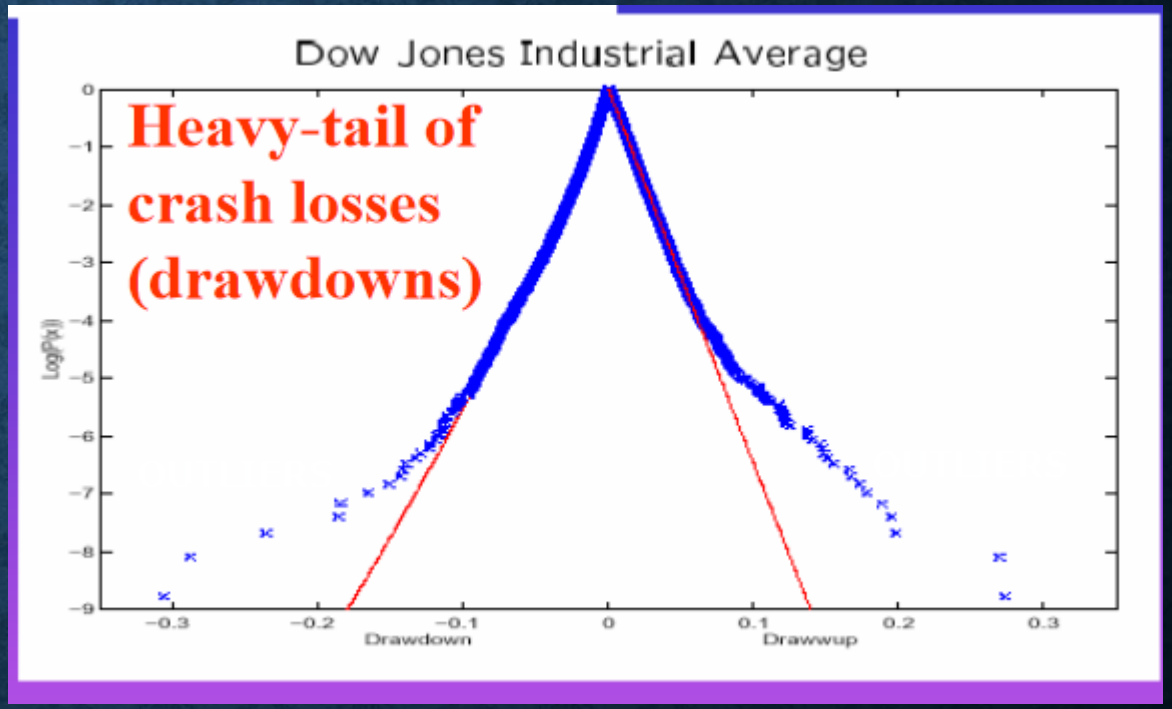
- 1987 Financial Crisis: Volatility Smile

# ECONOPHYSICS: AN EXAMPLE

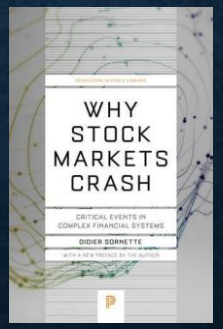
Earthquakes distribution




Stock Returns distribution




Plots by Didier Sordette and collaborators

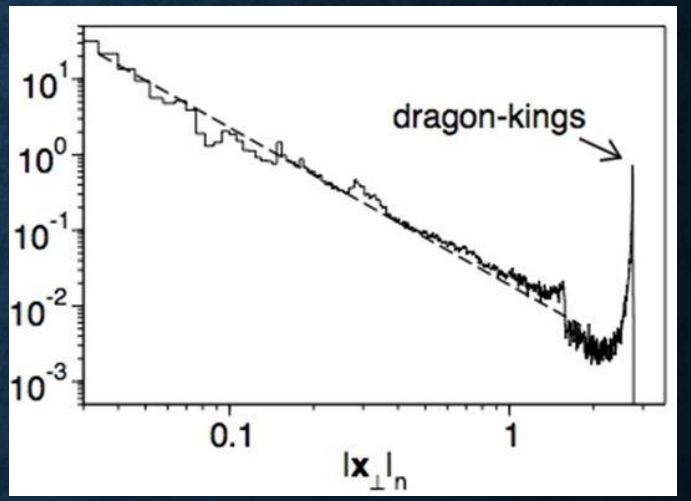


# BESTIARY OF UNPREDICTABILITY

Black Swans (Taleb)


They are part of the distribution.
Unpredictable by definition

King Dragons (Sornette)




They belong to another distribution
and can be predictable

# WORKING IN FINANCE

- Everything can be learnt if you are motivated
- Finance laws are not like Physics laws
- Need to "sell" your ideas (marketing)
- Appetite for physicists (uk-Jobs webpage around 100 open positions including "physics" and "finance")
- Different profiles: Techncal (programming), Risk management, Strategy, Quantitative Trading, Research…

- Financial background not required (but recommended)
- Many Master level degrees available (choose a good one)
- Networking usually works well
- Data Science/ Machine learning profiles highly demanded (Coursera).
- Programming skills: Python, Spark, SQL,…

# MY TRANSITION TO FINANCE

- After a B.Sc and M. Sc. In Physics a University of Valencia, I studied a Master in Finance and Economics at CEMFI (Bank of Spain, Madrid)

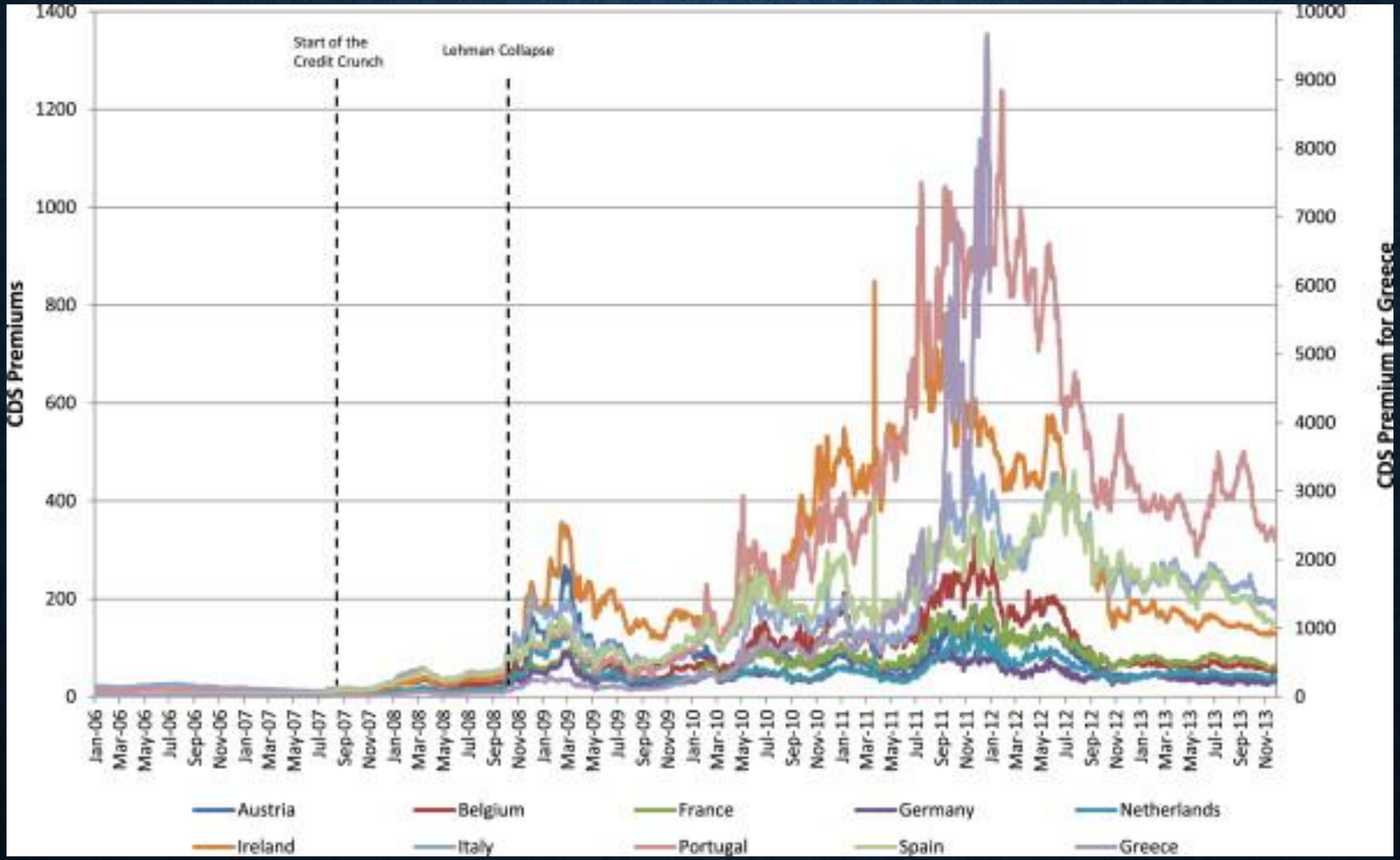
- More general tan usual (both academic and industry focus). Attended courses on Microeconomics (Game Theory), Macroeconomics, Finance and Econometrics (Time Series)

- Networking. I made 5-6 interviews (Banks and consulting firms) before getting a job at BBVA (Senior Analyst)

- Classmates now working at Banco Santander, Oliver Wyman,  Bank of Spain, Bank of Italy, Telefónica,…

# MY EXPERIENCE IN BBVA

- 2nd largest bank in Spain, 1st in Mexico. Also present in USA (Compass), Turkey, Argentina…
- Credit Risk Management Team (Corporate)
- Risk Calculator using CDS (Credit Default Swap= Bond Insurance) Data
- Risk Managers around the world (South America, USA, Mexico)
- VBA and SQL Programming


Start of the Credit Crunch
Lehman Collapse
CDS Premiums
CDS Premium for Greece
1400
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800
600
400
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Austria
Belgium
France
Germany
Netherlands
Ireland
Italy
Portugal
Spain
Greece

# FURTHER READING