Volatility in financial markets

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Outline

- Volatility—stylized facts
- Market-Econophysics
Stylized facts in financial market

- Fat tails, excess kurtosis
- Volatility clustering
- Time varying volatility
- Long-term memory
- Spill over effects
- Leverage effects
Fat-tail
While returns themselves are uncorrelated, absolute return or squares display a positive, significant and slowly decaying in autocorrelation function.
Time-varying Conditional Variance

图 4 上面部分：1995 年 5 月 16 日到 2003 年 4 月 29 日标准普尔 500 股票指数日对数收益率
下面部分：用一阶 GARCH 模型 (3 - 4) 估计得到的标准普尔 500 指数的条件方差
Long-term memory
(Mandelbrot 1971)

- Hurst exponent (Hurst, 1951);
  R/S analysis (Mandelbrot, 1968, 1972; Lo);
  DFA (Peng et al, 1994); GPH

- Models: ARFIMA (Granger, 1980); FI(E)GARCH (Bollerslev &ikkelsen, 1996); LMSV (Beidt et al. 1998)
Spillover effect

- Transmission Among markets/sections/countries/
- Granger Causality—conditional second moment
- ARCH—M
- Networks
Leverage effect

- Leverage: the observed tendency of an asset’s volatility to be negatively correlated with the asset’s returns. Typically, rising asset prices are accompanied by declining volatility, and vice versa. (See Black 1976; Christie 1982; French 1987)

- Asymmetric: declines in stock prices are accompanied by larger increases in volatility than the decline in volatility that accompanies rising stock markets (see, e.g., Nelson, 1991; and Engle and Ng, 1993).
EGARCH: (Nelson, 1991)
TARCH (Threshold ARCH) - (Zakoian, 1994)
GJR—GARCH: (Glosten, 1993)
APARCH (asymmetric power ARCH) (Ding, 1993)
VS-GARCH: (Fornari & Mele, 1997)
Market

- Efficiency Market Hypothesis (EMH)
  - Bachelier (1900)
  - Samuelson (1965)
  - Fama (1970)

- Fractal Market Hypothesis (FMH)
  - Peters (1990, 1994)
## EMH v. FMH: Principal Differences

<table>
<thead>
<tr>
<th>EMH</th>
<th>FMH</th>
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<tbody>
<tr>
<td>Gaussian statistics</td>
<td>Non-Gaussian statistics</td>
</tr>
<tr>
<td>Stationary process</td>
<td>Non-stationary process</td>
</tr>
<tr>
<td>Economy has no memory (no historical correlations)</td>
<td>Economy has memory (historical correlations exist)</td>
</tr>
<tr>
<td>No repeating patterns at any scale</td>
<td>Many repeating patterns at all scales, e.g. Elliot waves</td>
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<tr>
<td>Continuously stable at all scales</td>
<td>Possible instabilities at any scale, e.g. ‘Levy Flights’ and ‘Black Swans’</td>
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Approaches

**Traditional Methods**
- Homogenous
  - EHM
  - Low frequency
  - Parametric

**New approaches**
- Heterogeneous
  - FHM
  - High frequency
  - Big data
  - Non parametric—Realized Volatility

Monday, February 17, 14
Econo-physics

- Economy
  - Human being-Agent
  - Government vs Market
  - Relationship

- Physics
  - Particles
  - Waves vs Particles
  - Network NonlinearDynamics
Physicists(math) influence Economy

- D. Bernoulli
  - *Expected Utility*
  - *Exposition of a New Theory on the Measurement of Risk*
    ----St. Petersburg paradox

- Léon Walras
  - marginal utility
  - general equilibrium theory

- Pareto
- Irving Fisher (1867-1947)
  - *Monetary Economics, MV=PQ, J.W.Gibbs*
Crucial fields waiting for you
Crucial fields waiting for you
Crucial fields waiting for you
Crucial fields waiting for you

Financial system

Liquidity & Risk Measure

Crisis & Bubble

Risk Contagion
Crucial fields waiting for you
Crucial fields waiting for you

- Financial system
- Liquidity & Risk Measure
- Crisis & Bubble
- Risk Contagion
- Models
Crucial fields waiting for you

Financial system

Liquidity & Risk Measure

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Models

Fat-tail Cascade
Crucial fields waiting for you

Financial system

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Models

Fat-tail Cascade

spillover Joint-distribution
Crucial fields waiting for you

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    - Fat-tail Cascade
  - Crisis & Bubble
  - Risk Contagion
    - spillover Joint-distribution
- Volatility
Return Volatility

- Financial time series volatility features
  - Volatility distribution and joint two-dimensional feature
  - Volatility long memory and aggregation features and their origins
  - Volatility asymmetry feature and its origins
  - Optimal sampling frequency

- Asset price bubble and crisis transmission mechanism (spillover effect, leverage effect)

- Asset price volatility and macroeconomic factors relation

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Thank you!

Happy Valentine's Day!

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