

Volatility in financial markets

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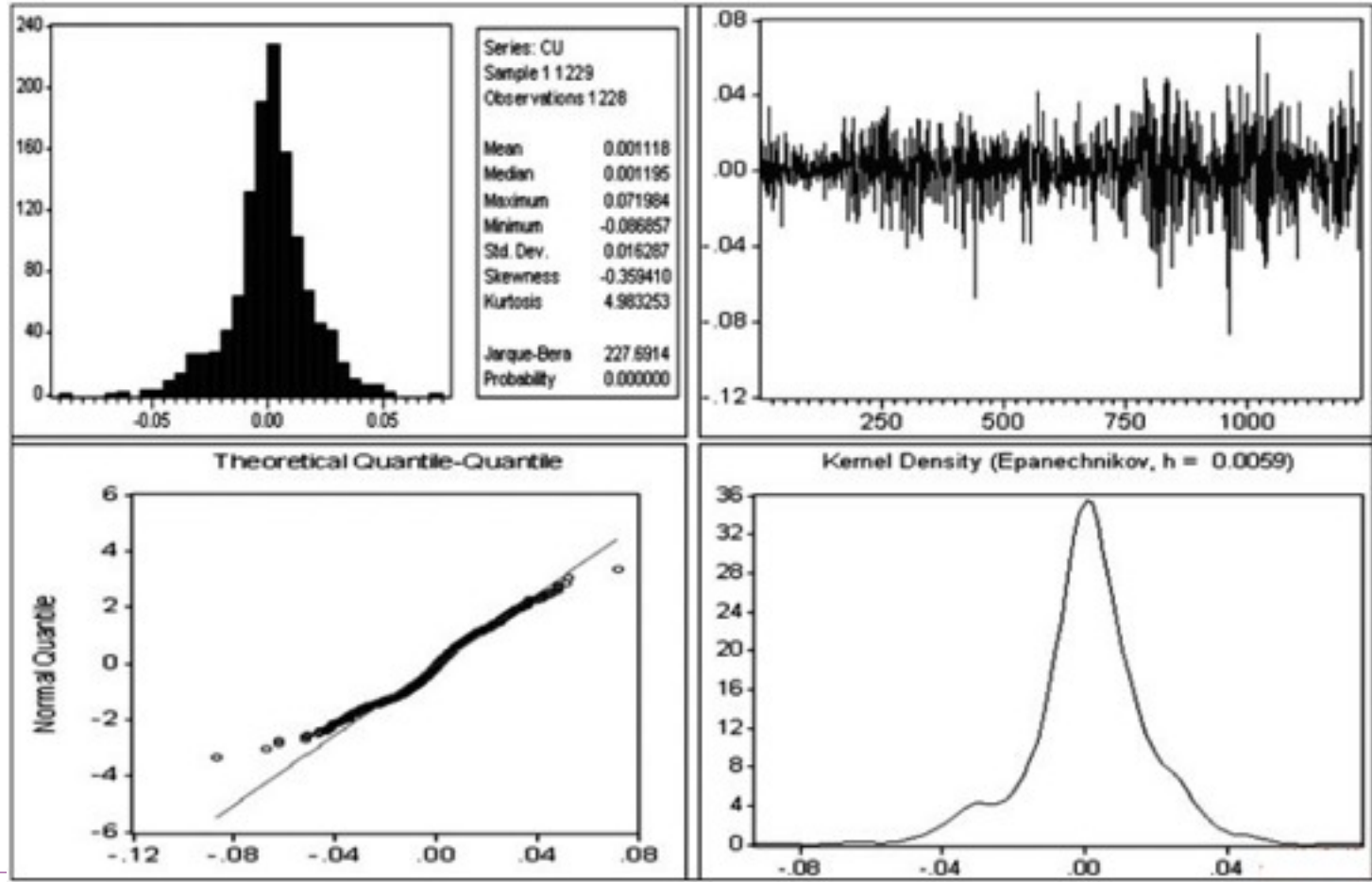
Outline

- Volatility—stylized facts
- Market-Econophysics

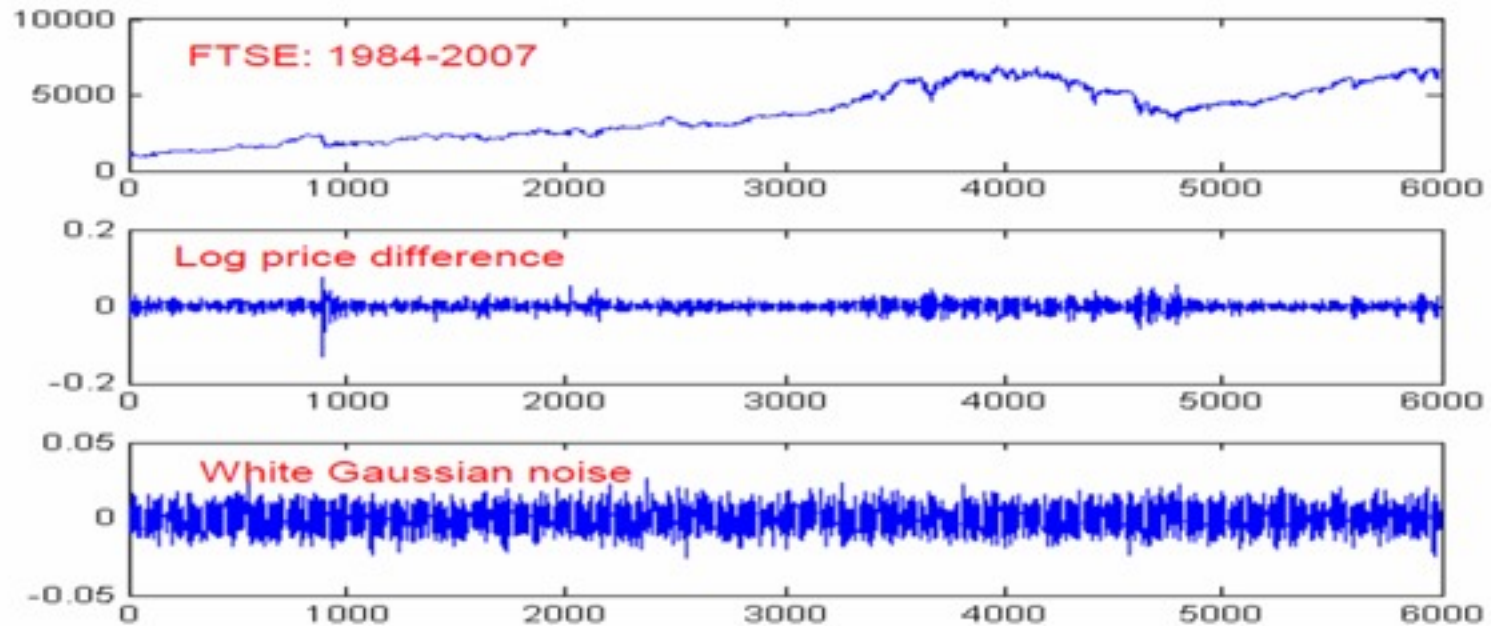
Stylized facts in financial market

- Fat tails, excess kurtosis
- Volatility clustering
- Time varying volatility
- Long-term memory
- Spill over effects
- Leverage effects

Fat-tail



Volatility Cluster



- While returns themselves are uncorrelated, absolute return or squares display a positive, significant and slowly decaying in autocorrelation function

Time-varying Conditional Variance

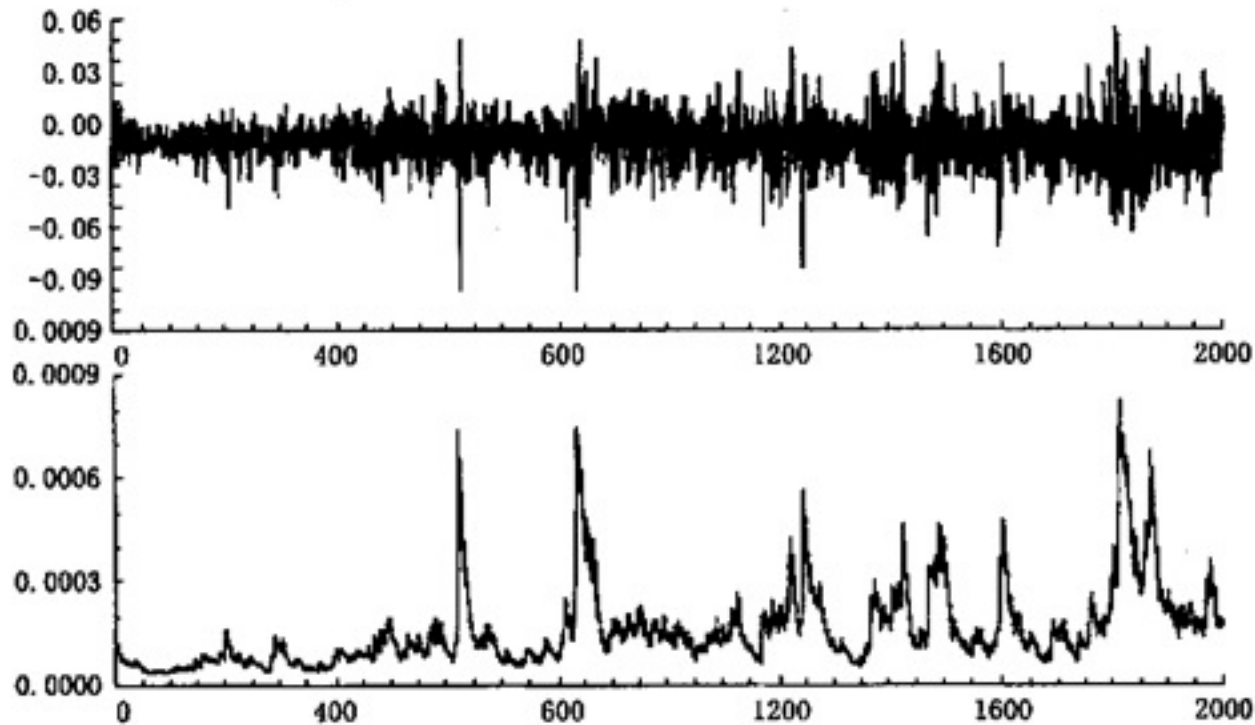
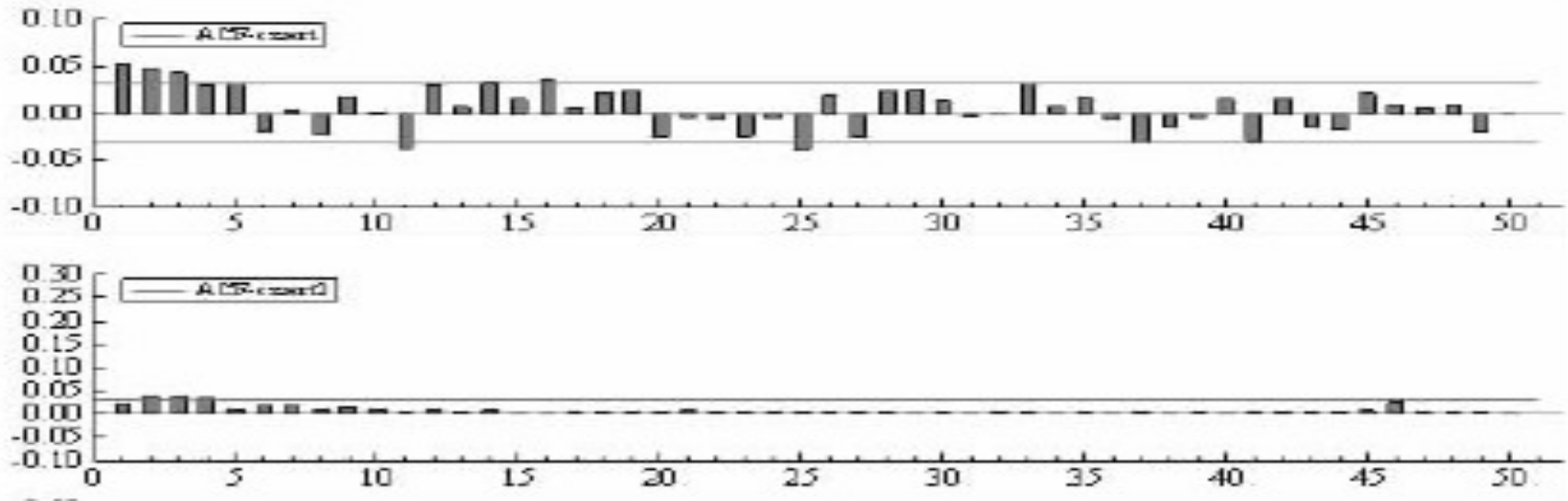


图4 上面部分:1995年5月16日到2003年4月29日标准普尔500股票指数日对数收益率
下面部分:用一阶GARCH模型(3-4)估计得到的标准普尔500指数的条件方差

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,French1987)
 - 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).
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- EGARCH: (Nelson, 1991)
 - TARARCH (Threshold ARCH) - (Zakoian, 1994)
 - GJR—GARCH: (Glosten, 1993)
 - APARCH (asymmetric power ARCH) (Ding, 1993)
 - VS-GARCH: (Fornari & Mele, 1997)
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Market

□ Efficiency Market Hypothesis (EMH)

- Bachelier (1900)

- Samuelson (1965)

- Fama (1970)

$$E \{P_{t+1} | P_0, P_1, \dots, P_t\} = P_t$$

□ Fractal Market Hypothesis (FMH)

- Mandelbrot (1970, 1971)

- Peters (1990, 1994)

EMH .v. FMH: Principal Differences

EMH	FMH
Gaussian statistics	Non-Gaussian statistics
Stationary process	Non-stationary process
Economy has no memory (no historical correlations)	Economy has memory (historical correlations exist)
No repeating patterns at any scale	Many repeating patterns at all scales, e.g. Elliot waves
Continuously stable at all scales	Possible instabilities at any scale, e.g. 'Levy Flights' and 'Black Swans'

Approaches

Traditional Methods

Homogenous

EHM

Low frequency

Parametric

New approaches

Heterogeneous

FHM

High frequency
Big data

Non parametric—
Realized Volatility

Econo-physics

□ Economy

- Human being-Agent
- Government vs Market
- Relationship

□ Physics

- Particles
- Waves vs Particles
- Network NonlinearDynamics

Physicists(math) influence Economy

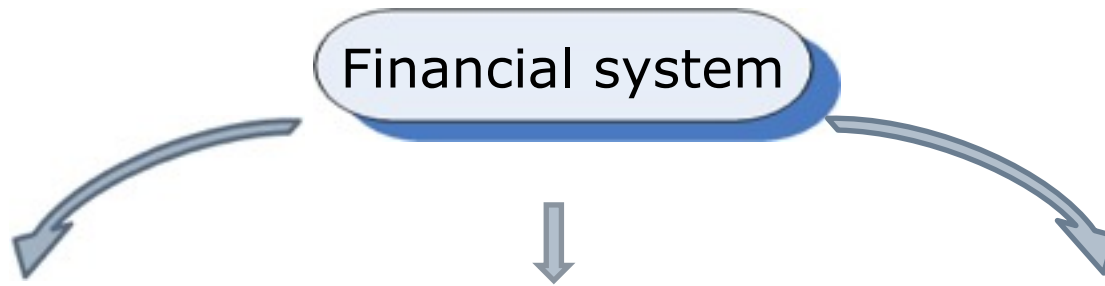
- D. Bernoulli
 - *Expected Utility*
 - *Exposition of a New Theory on the Measurement of Risk*
 - St. Petersburg paradox
 - Léon Walras
 - marginal utility
 - general equilibrium theory
 - Pareto
 - Irving Fisher (1867-1947)
 - Monetary Economics, $MV=PQ$, J.W.Gibbs*
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Crucial fields waiting for you

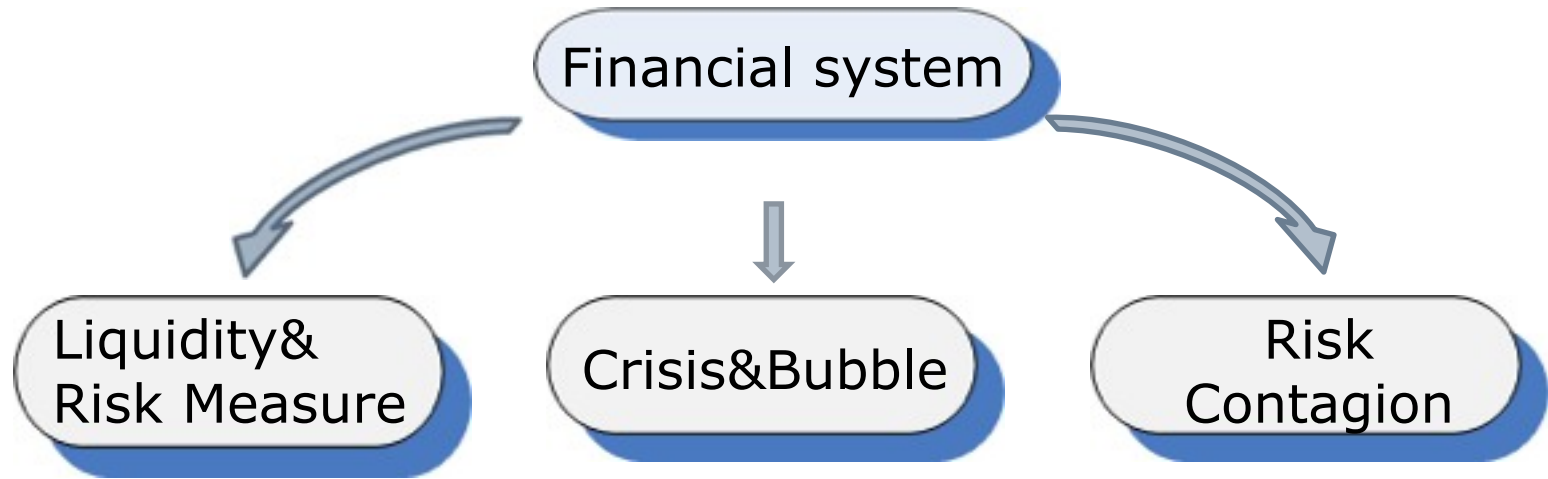
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Financial system

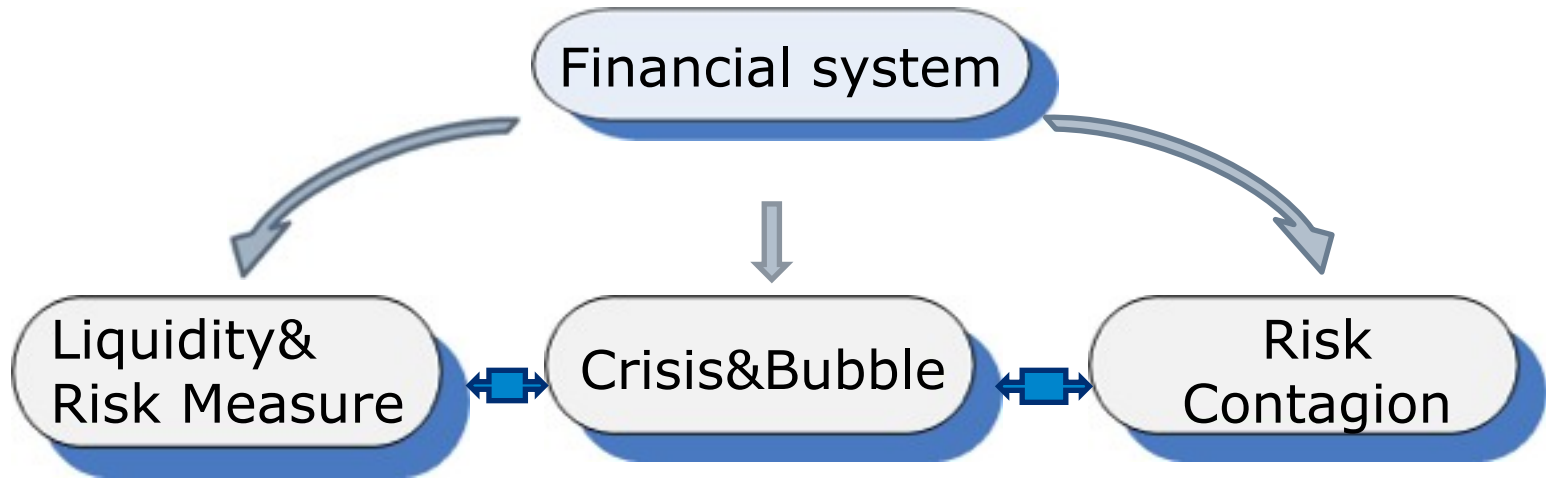
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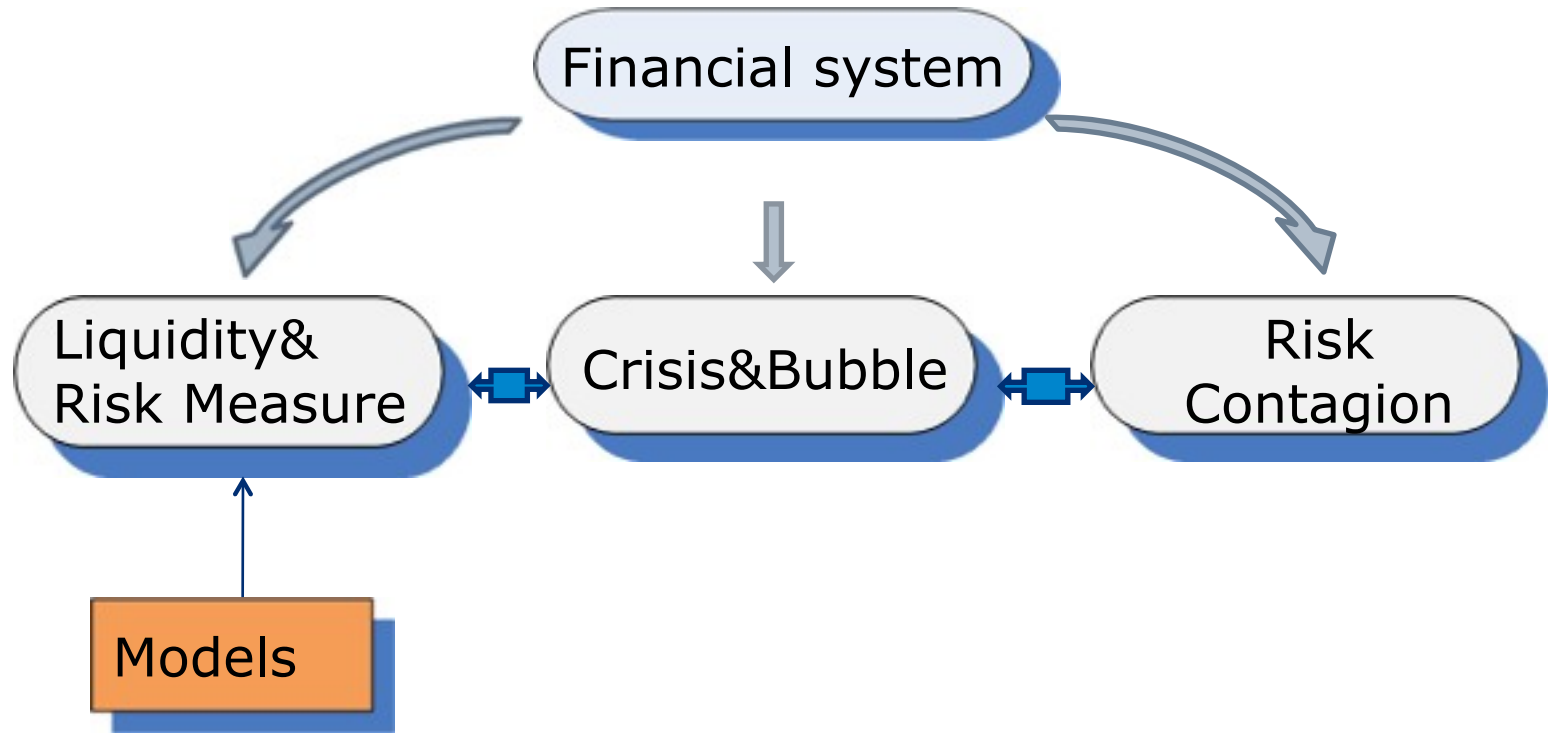
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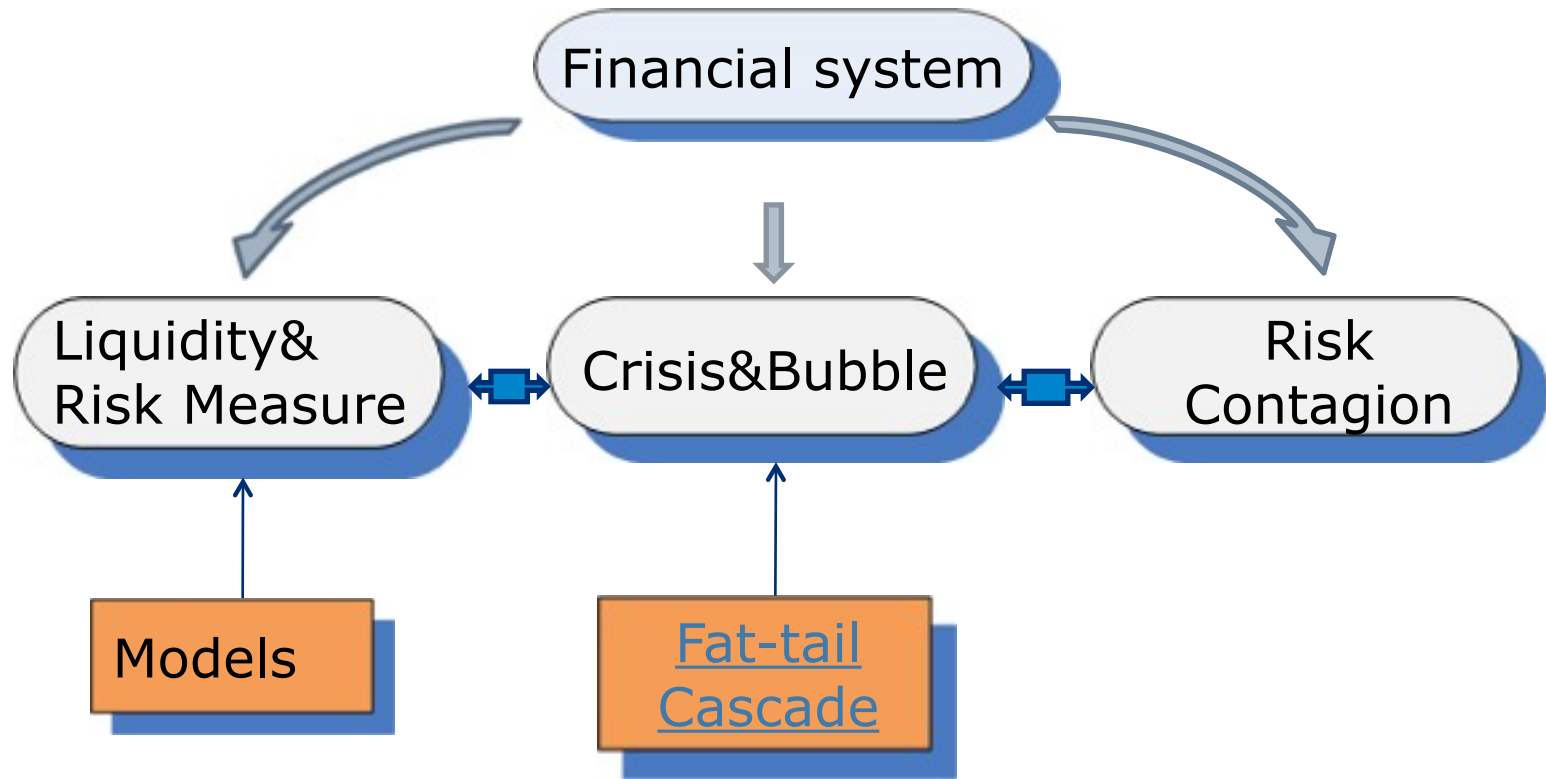
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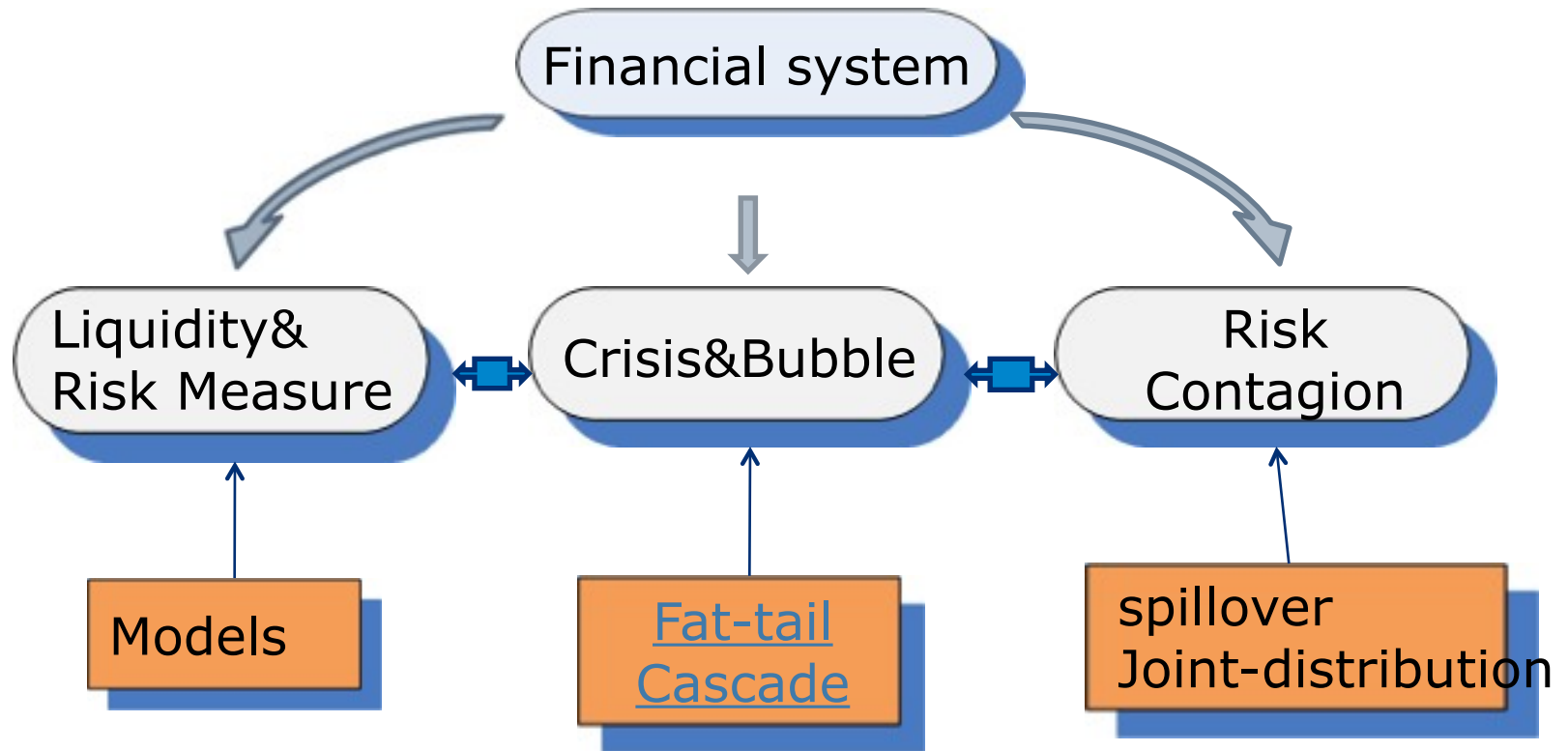
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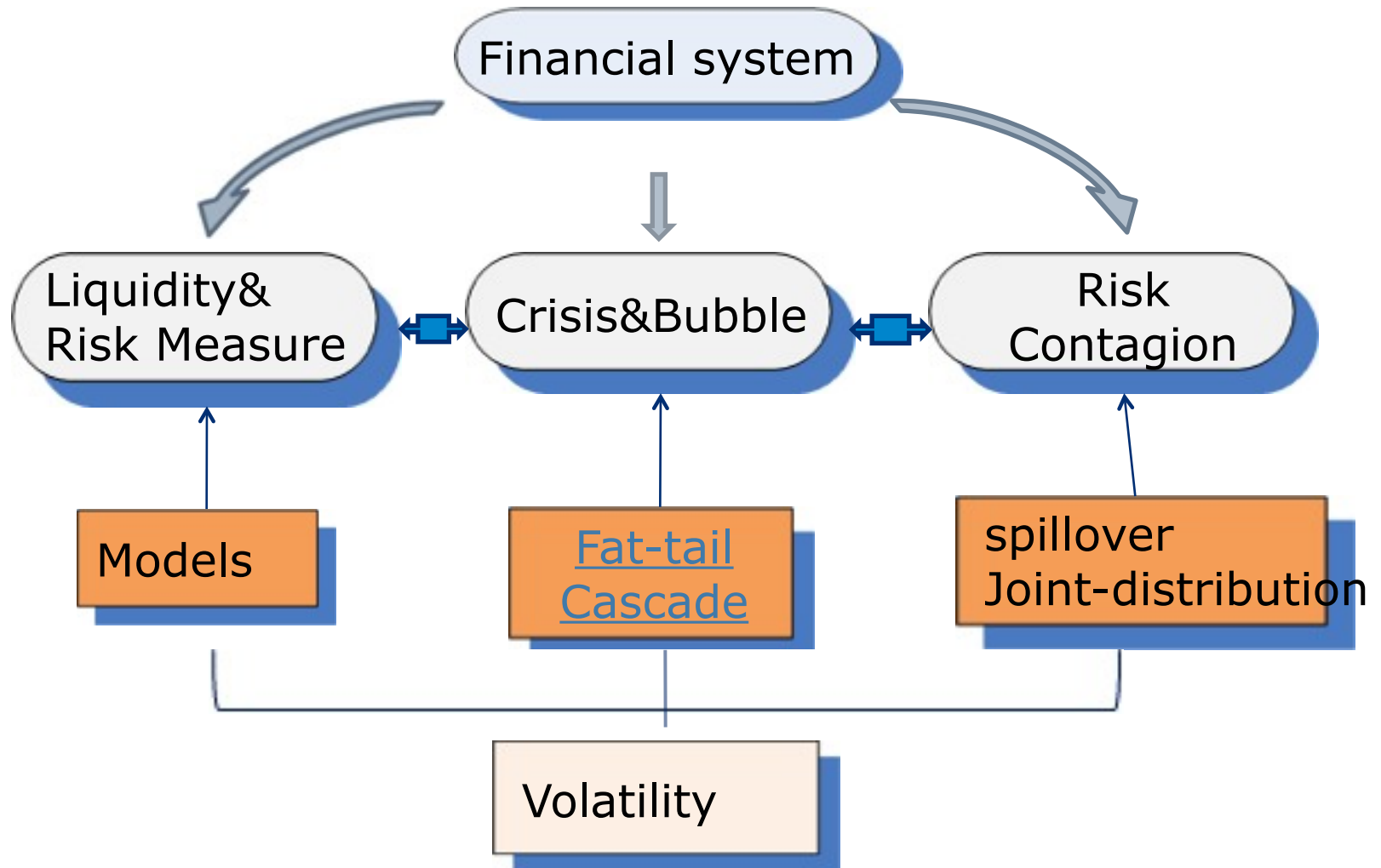
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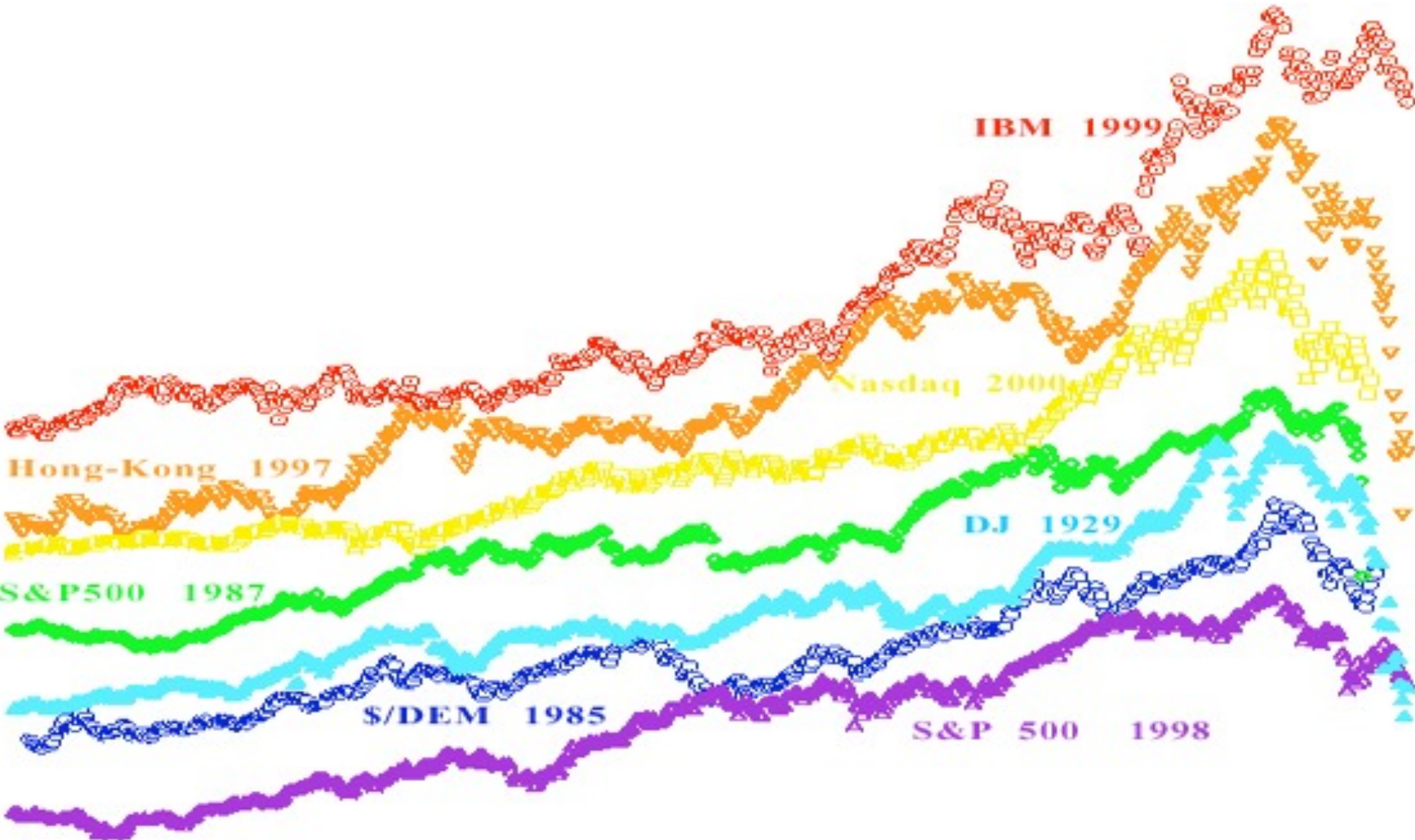
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Crucial fields waiting for you



Return Volatility



Thank you!

Happy Valentine's Day!

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