The illusion of the perpetual money machine: Diagnostic and forecast of future crises

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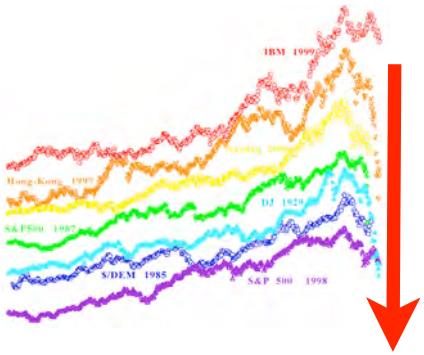
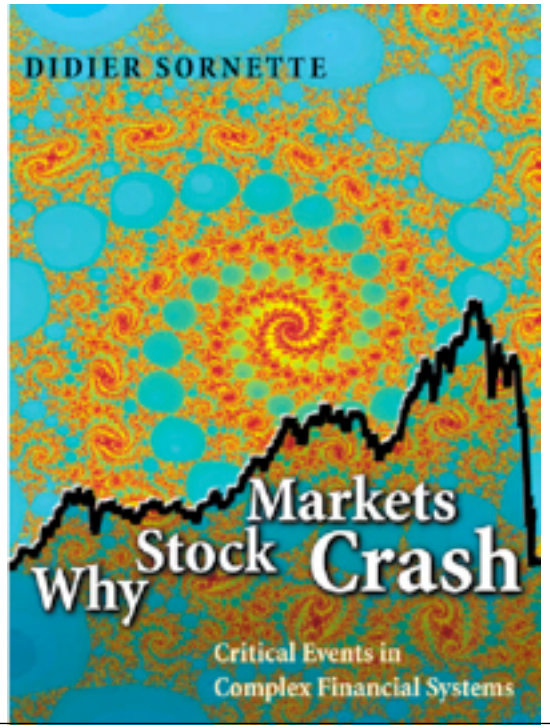
"The budget should be balanced, the Treasury should be refilled, public debt should be reduced, the arrogance of officialdom should be tempered and controlled, and the assistance to foreign lands should be curtailed lest Rome become bankrupt. People must again learn to work instead of living on public assistance."

Cicero - 55 BC





Key Propositions

- Crises are the “norm” rather than the exception
- Most crises are endogenous and are the consequence of excess leverage, i.e., bubbles
- Bubbles are the key drivers as well as signatures
- Bubbles results from procyclical positive feedbacks
- Nonlinear stochastic finite-singular processes
- Possibility of developing probabilistic warning

  1) diagnostic of bubbles

  2) forecast of change of regime (burst)

What is a bubble?

Academic Literature: No consensus on what is a bubble...

Ex: Refet S. Gürkaynak, Econometric Tests of Asset Price Bubbles: Taking Stock.
Can asset price bubbles be detected? This survey of econometric tests of asset price bubbles shows that, despite recent advances, econometric detection of asset price bubbles cannot be achieved with a satisfactory degree of certainty. For each paper that finds evidence of bubbles, there is another one that fits the data equally well without allowing for a bubble. We are still unable to distinguish bubbles from time-varying or regime-switching fundamentals, while many small sample econometrics problems of bubble tests remain unresolved.

Professional Literature: we do not know... only after the crash

The Fed: A. Greenspan (Aug., 30, 2002):
"We, at the Federal Reserve…recognized that, despite our suspicions, it was very difficult to definitively identify a bubble until after the fact, that is, when its bursting confirmed its existence… Moreover, it was far from obvious that bubbles, even if identified early, could be preempted short of the Central Bank inducing a substantial contraction in economic activity, the very outcome we would be seeking to avoid."

What is a bubble?

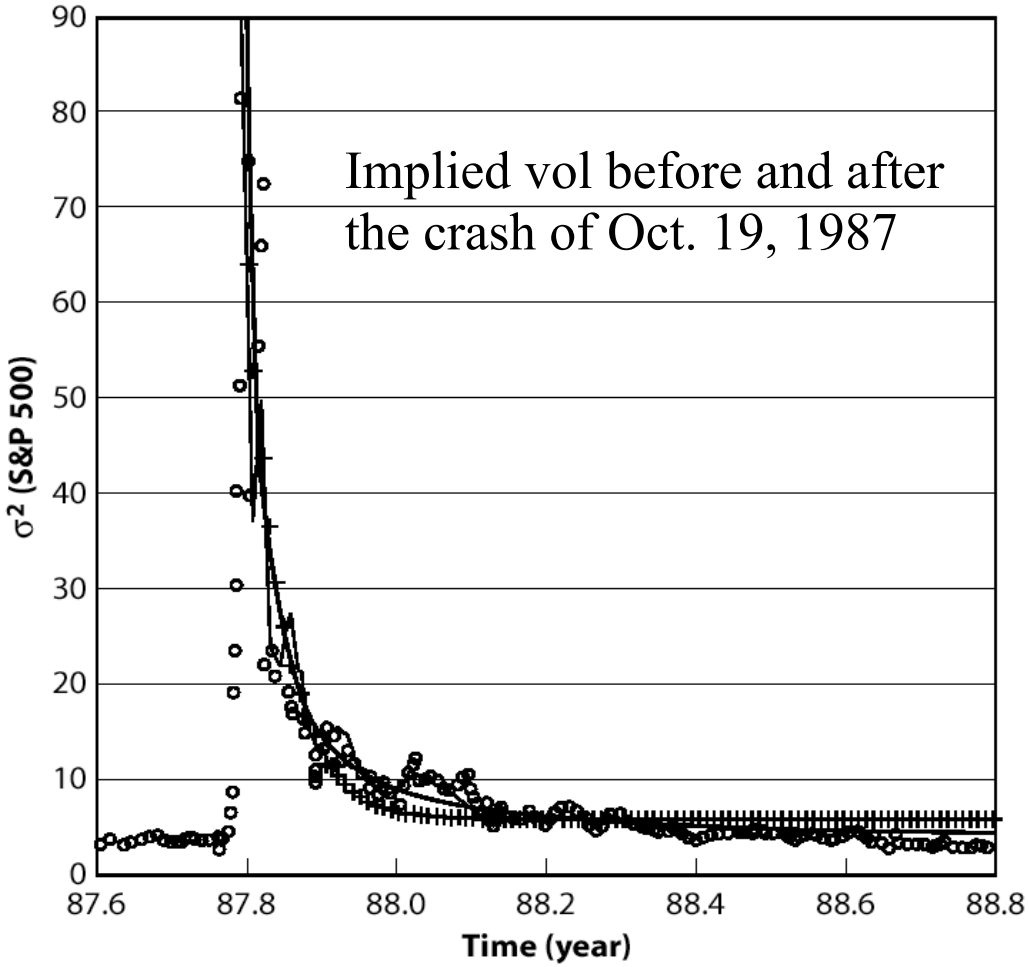
-exponentially “exploding” prices?

-exploding volatility?

What is a bubble?

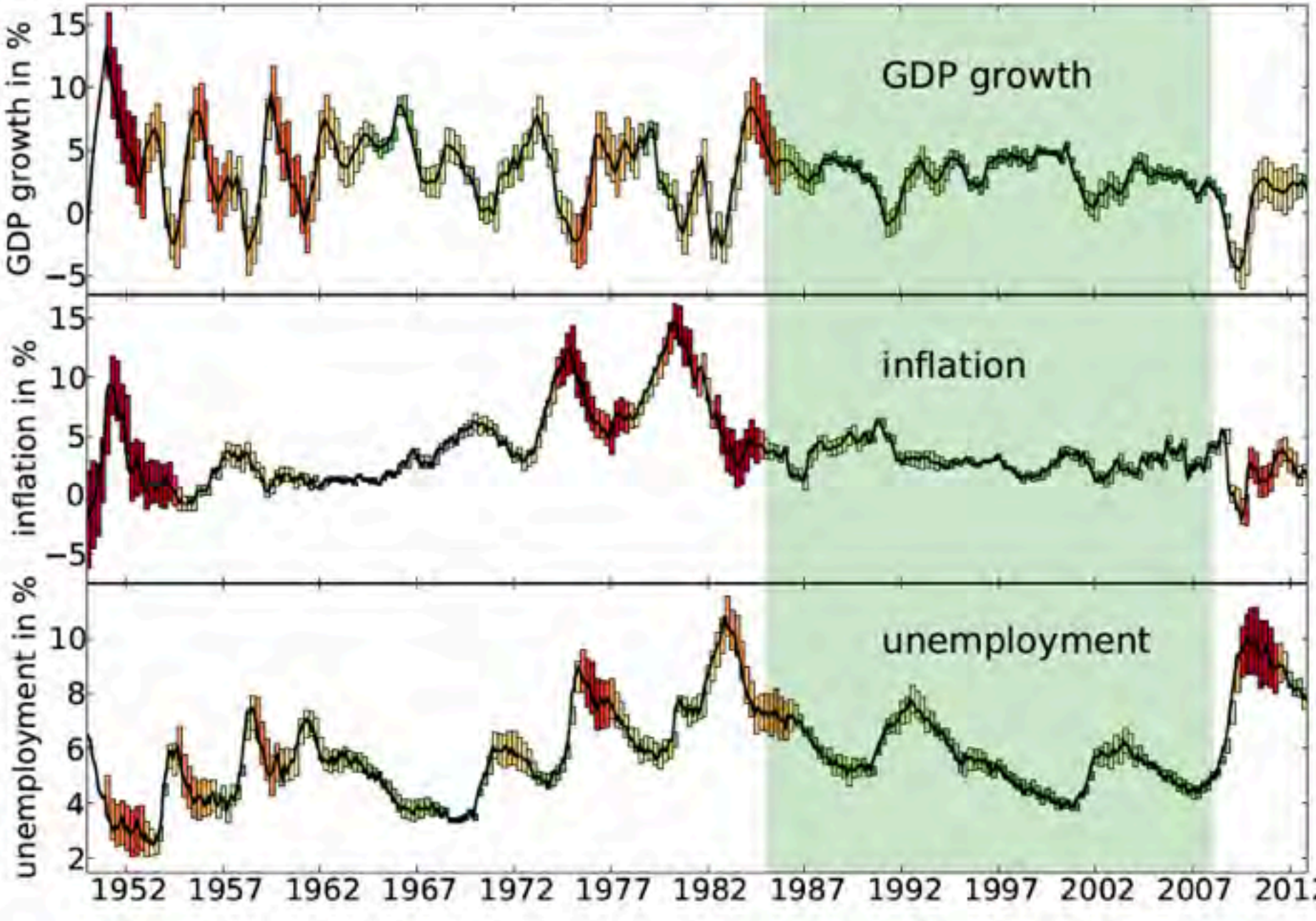
-Positive feedback of price on volatility?

(Jarrow et al.)



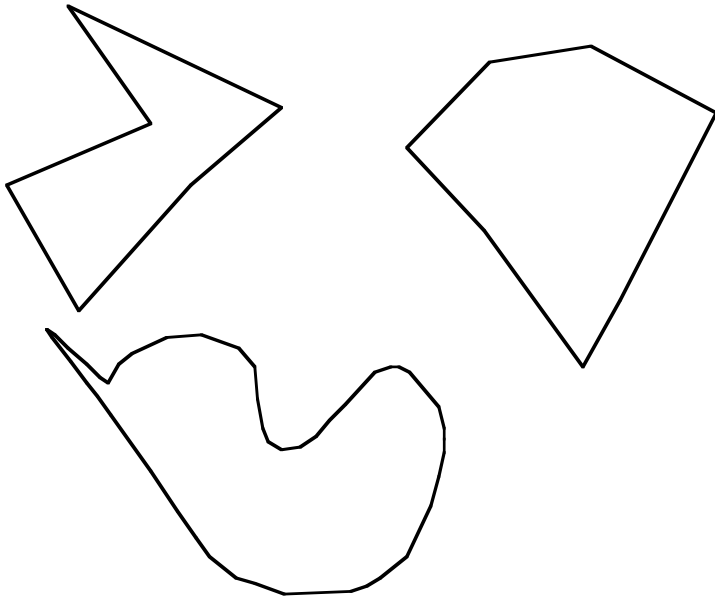
=> **NO ! Volatility is not a predictor**

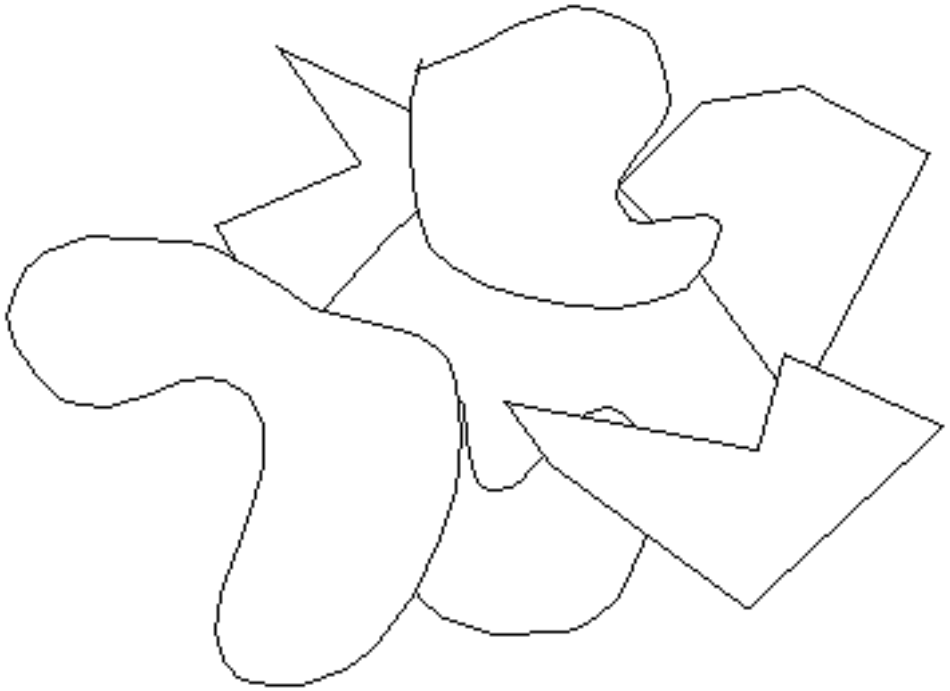
THE GREAT MODERATION

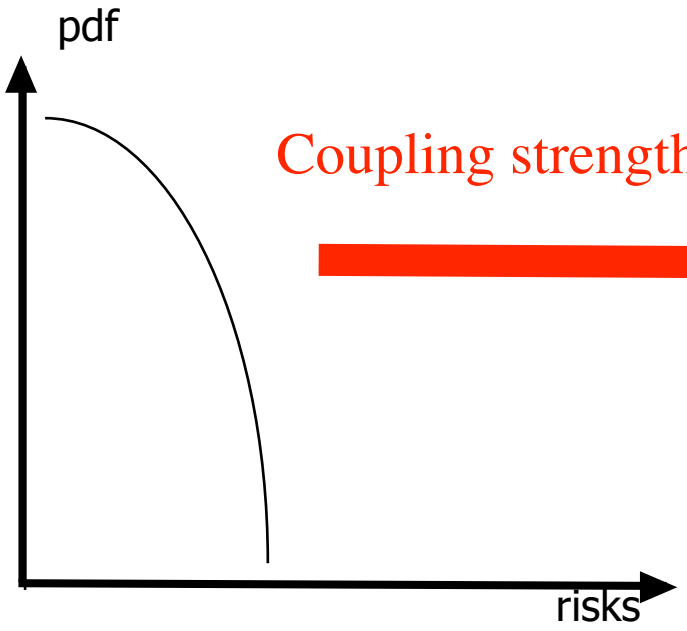


Separation of financial and credit risks

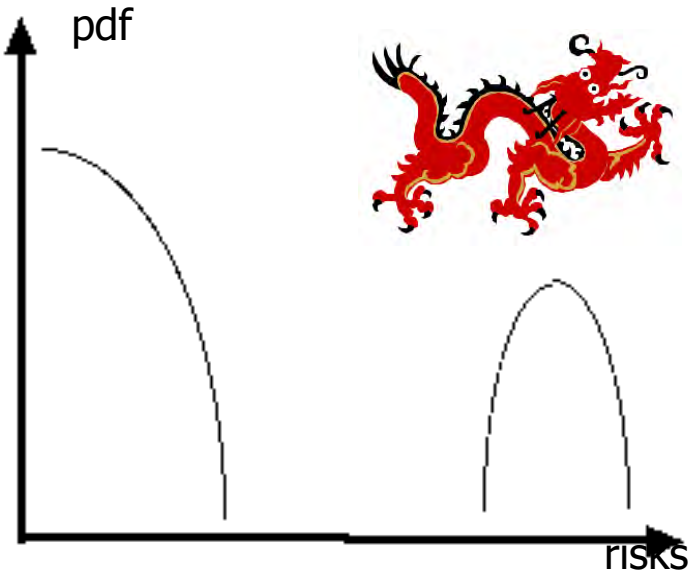
Securitization leads to larger inter-connectivity



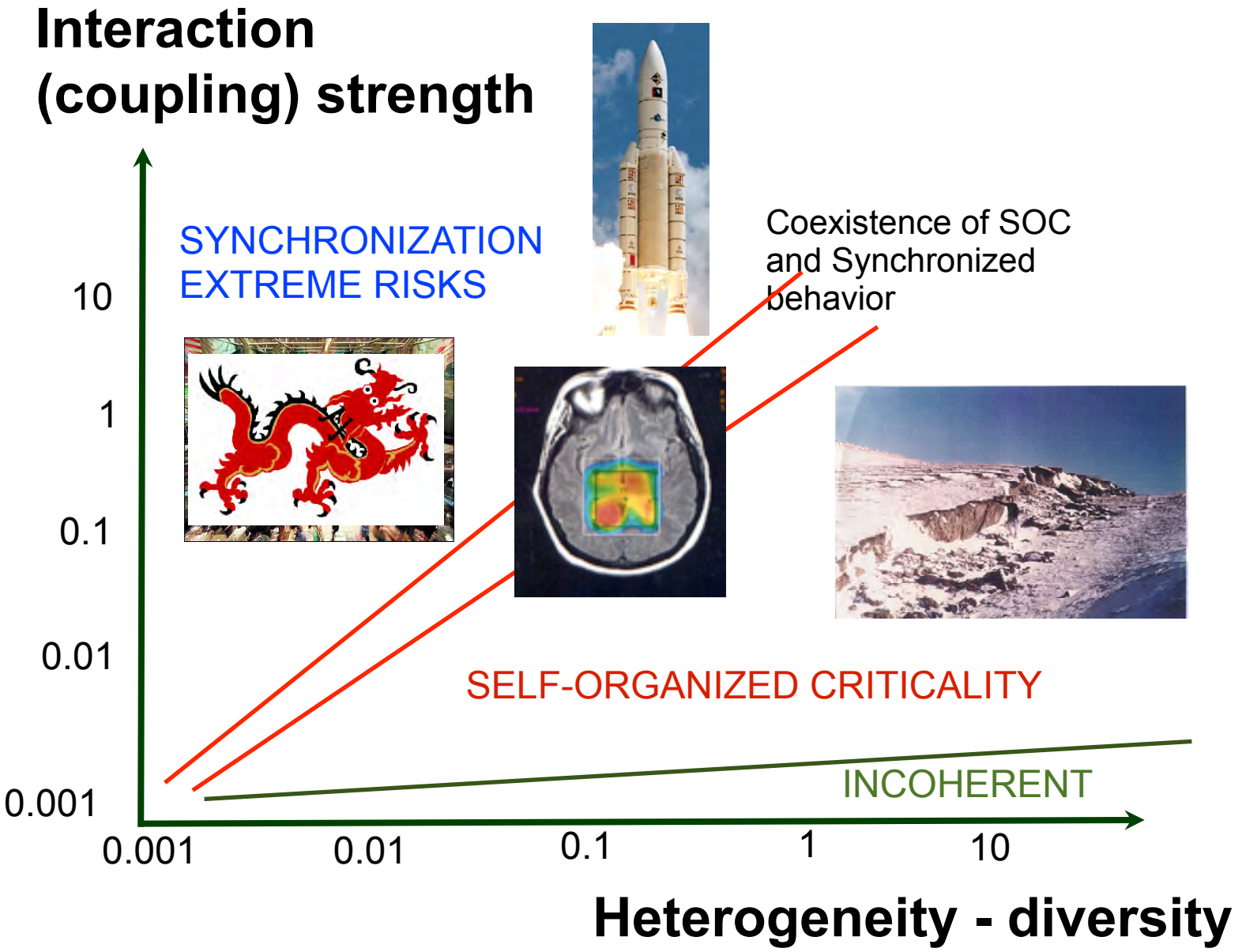




Coupling strength in



Generic diagram for coupled agents with threshold dynamics



Extreme crises: Dragon-Kings vs Black Swans

1. Geosciences of the solid envelop
1.1. Earthquake magnitude.
1.2. Volcanic eruptions.
1.3. Landslides.
1.4. Floods.

2. Meteorological and Climate sciences
2.1. Rains, hurricanes, storms.
2.2. Snow avalanches.

3. Material Sciences and Mechanical Engineering
3.1. Acoustic emissions.
3.2. Hydrodynamic turbulence.

4. Economics : financial drawdowns, distribution of wealth

5. Social sciences: distribution of firm sizes, of city sizes, of social groups...

6. Social sciences : wars, strikes, revolutions, city sizes

7. Medicine: epileptic seizures, epidemics

8. Environmental sciences : extinctions of species, forest fires
8.1. Evolution and extinction of species.
8.2. Forest fires.

Universal bubble scenario => ENDOGENEITY and POSITIVE FEEDBACK

Charles Kindleberger, Manias, Panics and Crashes (1978)
Didier Sornette, Why stock markets crash (2003)

Displacement
↓
Credit creation
↓
Euphoria
↓
Critical stage / Financial distress
↓
Revulsion

Financial bubbles, which we have been observing for over 400 years:

Tulip mania

South Sea bubble

IT bubble

Housing bubble

14 factors to propel a market bubble

1. the capitalist explosion and the ownership society,
2. cultural and political changes favoring business success,
3. new information technology,
4. supportive monetary policy and the Greenspan put,
5. the baby boom and their perceived effects on the markets,
6. an expansion in media reporting of business news,
7. analysts' optimistic forecasts,
8. the expansion of defined contribution pension plans,
9. the growth of mutual funds,
10. the decline of inflation and the effects of money illusion,
11. the expansion of the volume of trade due to discount brokers,
12. day traders,
13. twenty-four-hour trading,
14. the rise of gambling opportunities.

Why bubbles are not arbitraged away?

1. limits to arbitrage caused by noise traders (DeLong et, 1990)

2. limits to arbitrage caused by synchronization risk (Abreu and Brunnermeier, 2002 and 2003; Lin and Sornette, 2011)

3. short-sale constraints (many papers)

4. lack of close substitutes for hedging (many papers)

5. heterogenous beliefs (many papers)

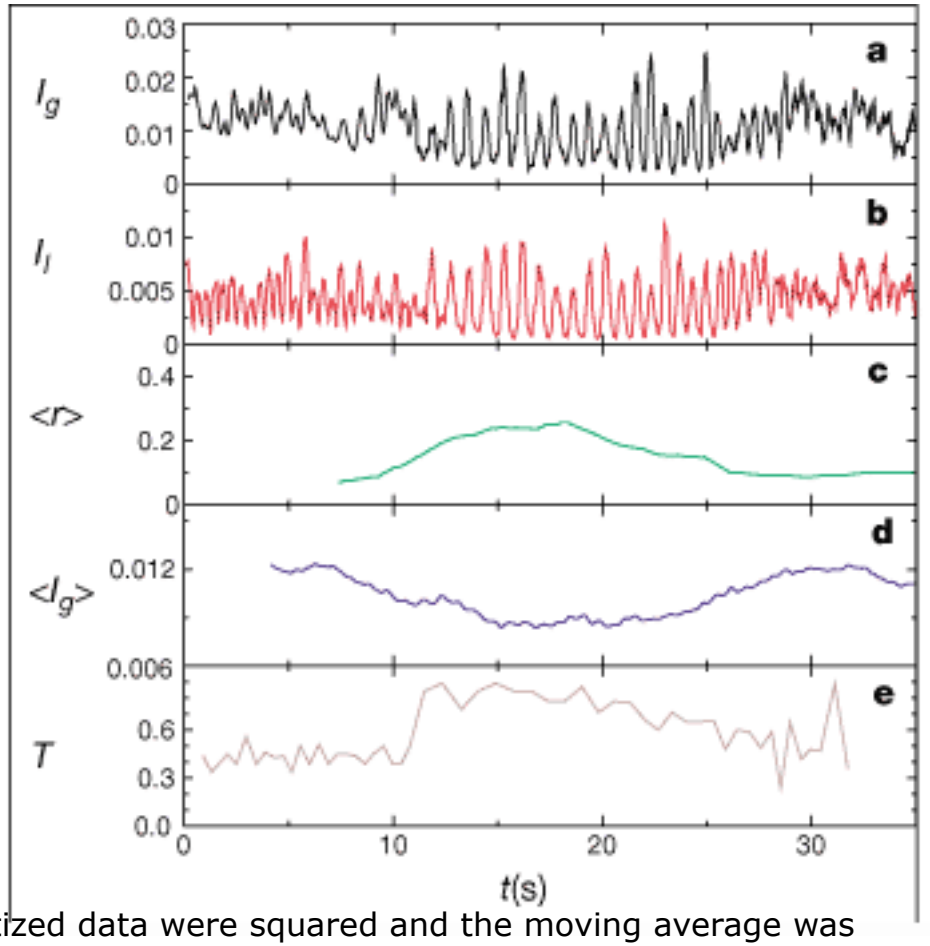
6. lack of higher-order mutual knowledge (Allen, Morris and Postlewaite, 1993)

7. delegated investments (Allen and Gorton, 1993)

8. psychological biases (observed in many experiments)

9. positive feedback bubbles (Sornette et al., 1996-present)

Positive feedbacks: ex. of hand clapping



Global noise intensity (I_g) as a function of time. The digitized data were squared and the moving average was determined over a window of size 0.2 s, several times shorter than the clapping period. A characteristic region indicates the appearance and disappearance of the synchronized clapping. Over several performances, we recorded 50 similar sequences of synchronized clapping (for additional data sets and audio recordings, see http://www.nd.edu/~networks/clap). **b**, Local noise intensity (I_l), measured by a hidden microphone in the vicinity of a spectator. **c**, Order parameter, *r*, defined as the maximum of the normalized correlation between the signal *c(t)* and a harmonic function, $r = [\max_{(t,)} t+T\ t\text{-}Tc(t)\ \sin(2/\ T+)dt]/[t+T\ t\text{-}Tc(t)dt\ ]$, where and *T* span all possible values. **d**, Average noise intensity, obtained by taking a moving average over a 3-s window of the global noise intensity shown in **a**. **e**, The clapping period, *T*, defined as the intervals between the clearly distinguishable maxima.

Z. Néda, E. Ravasz, Y. Brechet, T. Vicsek and A.-L. Barabási, Self-organizing processes: The sound of many hands clapping Nature 403, 849-850 (2000)

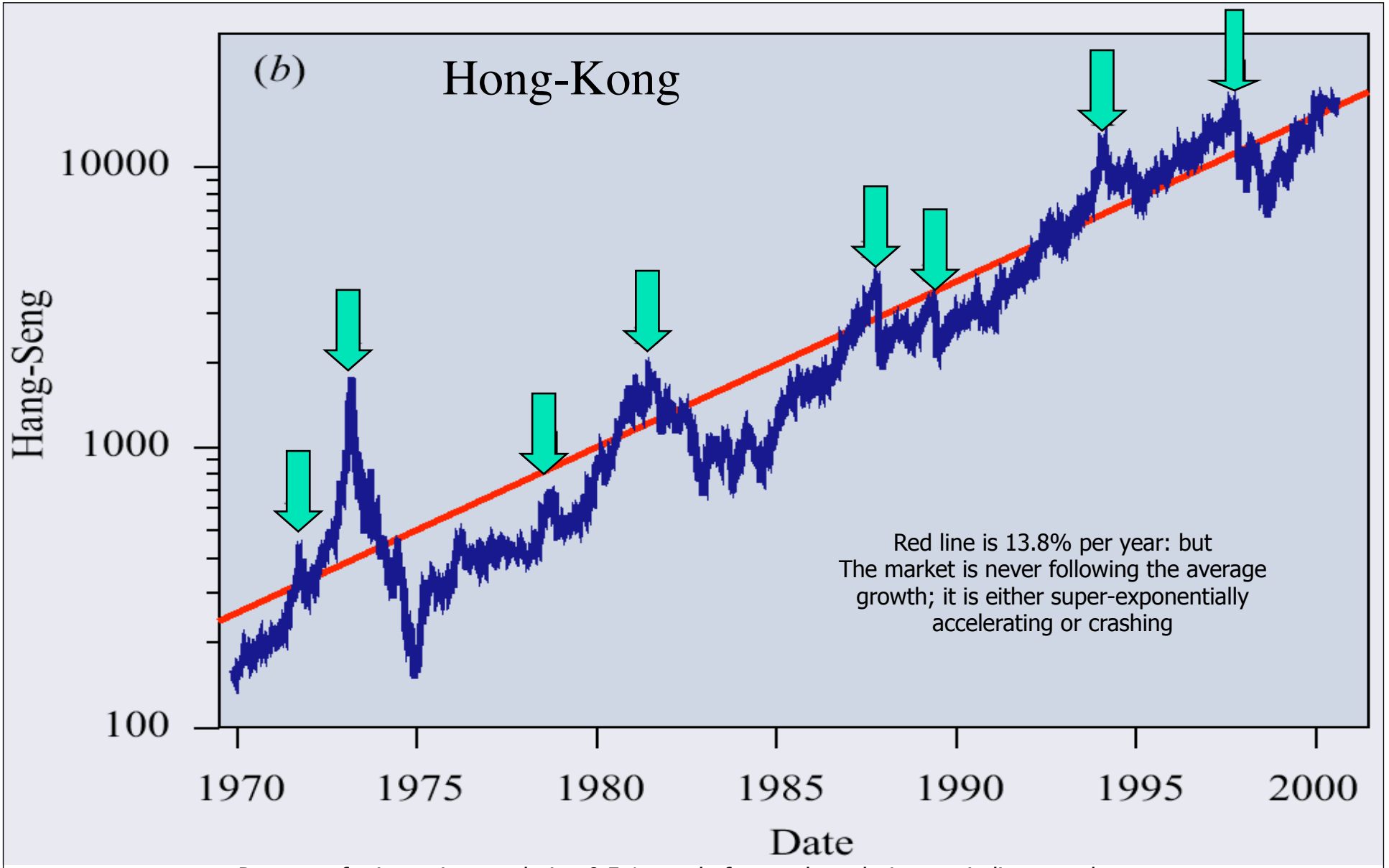
Positive feedbacks and origin of bubbles

positive feedback of enhancing return

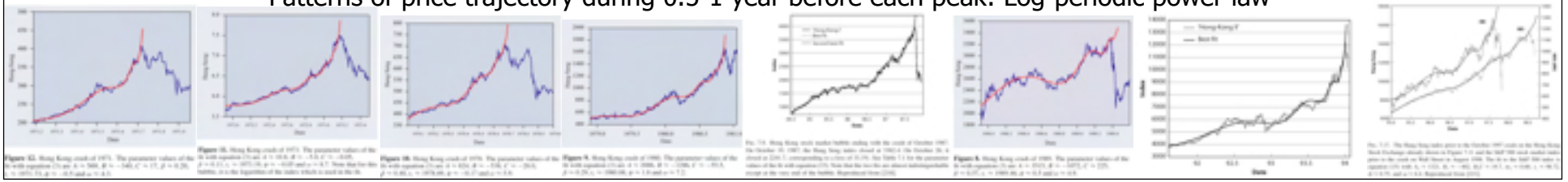
=> growth of the return (and not just of the price)

=> Faster-than-exponential transient unsustainable growth of price

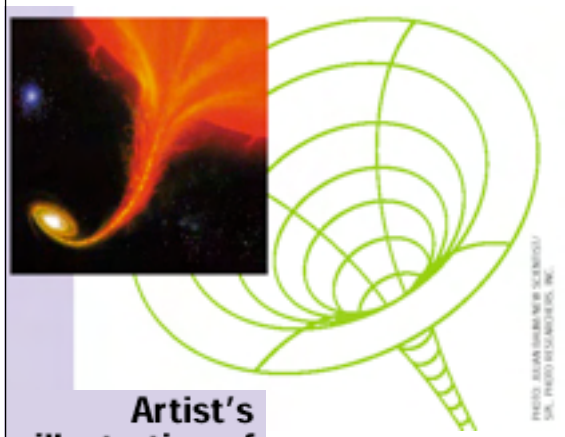
=> Mathematically, this translates into FINITE-TIME SINGULARITY



Patterns of price trajectory during 0.5-1 year before each peak: Log-periodic power law



Finite-time Singularity



Artist's illustration of matter from a red giant star being pulled toward a black hole.

- Planet formation in solar system by run-away accretion of planetesimals
- PDE's: Euler equations of inviscid fluids and relationship with turbulence
- PDE's of General Relativity coupled to a mass field leading to the formation of black holes
- Zakharov-equation of beam-driven Langmuir turbulence in plasma
- rupture and material failure
- Earthquakes (ex: slip-velocity Ruina-Dieterich friction law and accelerating creep)
- Models of micro-organisms chemotaxis, aggregating to form fruiting bodies
- Surface instability spikes (Mullins-Sekerka), jets from a singular surface, fluid drop snap-off
- Euler's disk (rotating coin)
- Stock market crashes...

Mechanisms for positive feedbacks in the stock market

- Technical and rational mechanisms
  1. Option hedging
  2. Insurance portfolio strategies
  3. Market makers bid-ask spread in response to past volatility
  4. Learning of business networks, human capital
  5. Procyclical financing of firms by banks (boom vs contracting times)
  6. Trend following investment strategies
  7. Algorithmic trading
  8. Asymmetric information on hedging strategies
  9. Stop-loss orders
  10. Portfolio execution optimization and order splitting
  11. Deregulation (Grimm act repelling the Glass-Steagal act)

- Behavioral mechanisms:
  1. Breakdown of "psychological Galilean invariance"
  2. Imitation(many persons)
     a) It is rational to imitate
     b) It is the highest cognitive task to imitate
     c) We mostly learn by imitation
     d) The concept of "CONVENTION" (Orléan)
  3. "Social Proof" mechanism

Collective behavioral phenomena

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Imitation

Imitation

Informational cascades

"Well, heck! If all you smart cookies agree, who am I to dissent?"

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Thy Neighbor's Portfolio: Word-of-Mouth Effects in the Holdings and Trades of Money Managers

HARRISON HONG, JEFFREY D. KUBIK, and JEREMY C. STEIN*

ABSTRACT

A mutual fund manager is more likely to buy (or sell) a particular stock in any quarter if other managers in the same city are buying (or selling) that same stock. This pattern shows up even when the fund manager and the stock in question are located far apart, so it is distinct from anything having to do with local preference. The evidence can be interpreted in terms of an epidemic model in which investors spread information about stocks to one another by word of mouth.

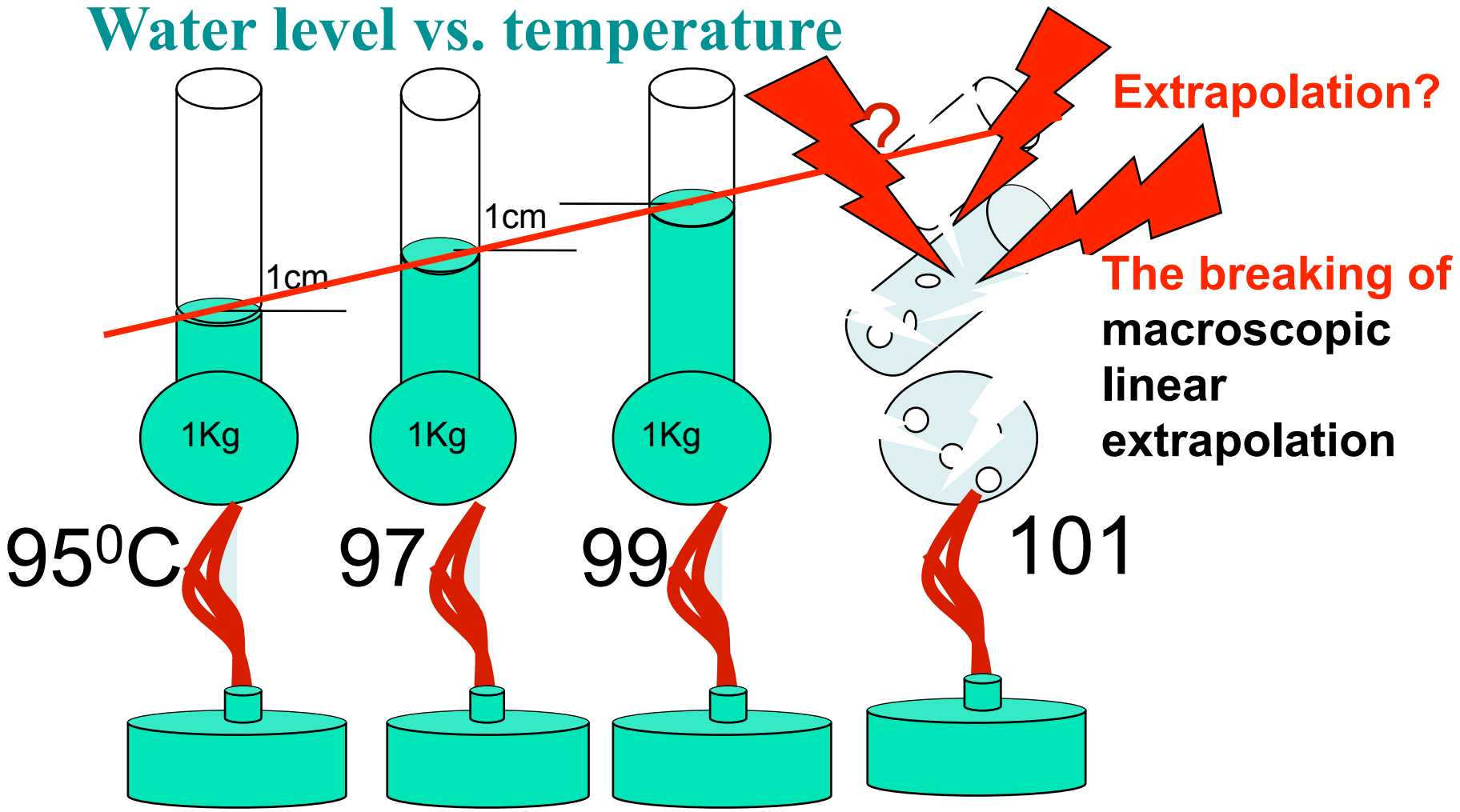
IN THIS PAPER, WE EXPLORE THE HYPOTHESIS that investors spread information and ideas about stocks to one another directly, through word-of-mouth communication. This hypothesis comes up frequently in informal accounts of the behavior of the stock market.[1] For example, in his bestseller *Irrational Exuberance*, Shiller (2000) devotes an entire chapter to the subject of "Herd Behavior and Epidemics," and writes

> A fundamental observation about human society is that people who communicate regularly with one another think similarly. There is at any place and in any time a *Zeitgeist*, a spirit of the times. . . . Word-of-mouth transmission of ideas appears to be an important contributor to day-to-day or hour-to-hour stock market fluctuations. (pp. 148, 155)

Humans Appear Hardwired To Learn By 'Over-Imitation'

ScienceDaily (Dec. 6, 2007) — Children learn by imitating adults--so much so that they will rethink how an object works if they observe an adult taking unnecessary steps when using that object, according to a new Yale study.

Breakdown of linear extrapolation on the approach to a bifurcation



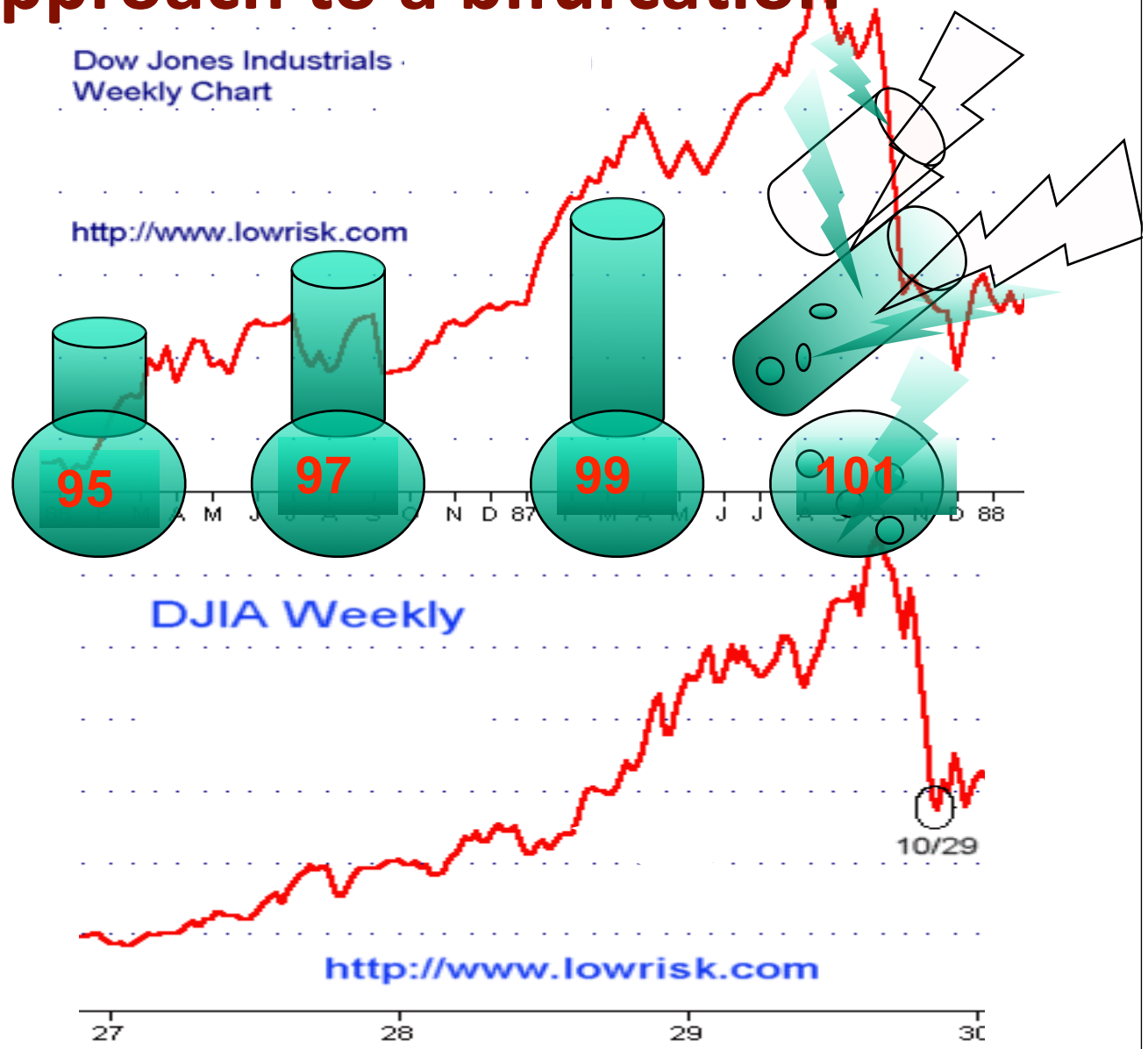
BOILING PHASE TRANSITION

More is different: a single molecule does not boil at 100C⁰

(S. Solomon)

Breakdown of linear extrapolation on the approach to a bifurcation

Instead of
Water Level:
-economic index
(Dow-Jones etc…)



Crash = result of collective behavior of individual traders

DISCRETE HIERARCHY OF THE AGENT NETWORK

Presentation of three different mechanisms leading to discrete scale invariance, discrete hierarchies and log-periodic signatures

- Co-evolution of brain size and group size

  (Why do we have a big Brain?)

  => Discrete hierarchy of group sizes

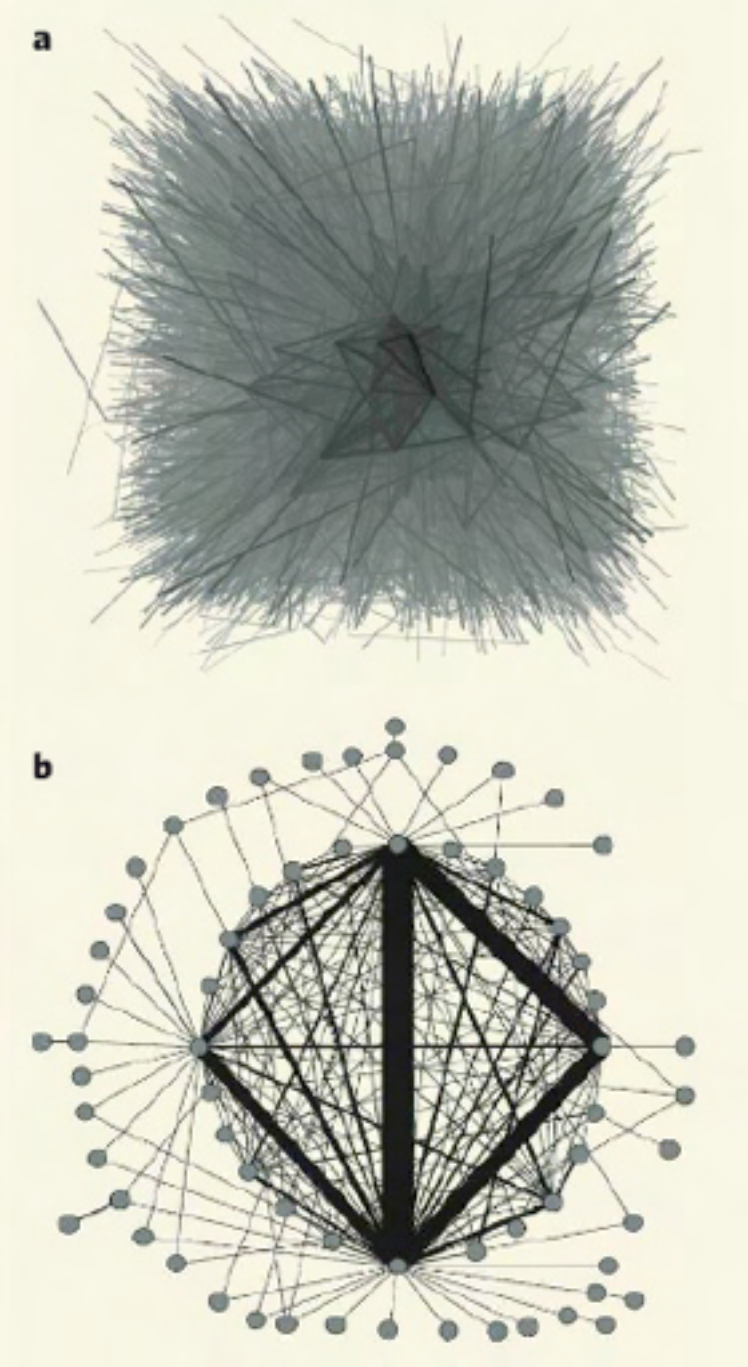
  W.-X. Zhou, D. Sornette, R.A. Hill and R.I.M. Dunbar, Discrete Hierarchical Organization of Social Group Sizes, Proc. Royal Soc. London 272, 439-444 (2005)

- Interplay between nonlinear positive and negative feedbacks and inertia

  K. Ide and D. Sornette, Oscillatory Finite-Time Singularities in Finance, Population and Rupture, Physica A 307 (1-2), 63-106 (2002)

- Technical analysis:Impulse-retracting market wave analysis

  Elliot waves.... => self-fulfilling structures



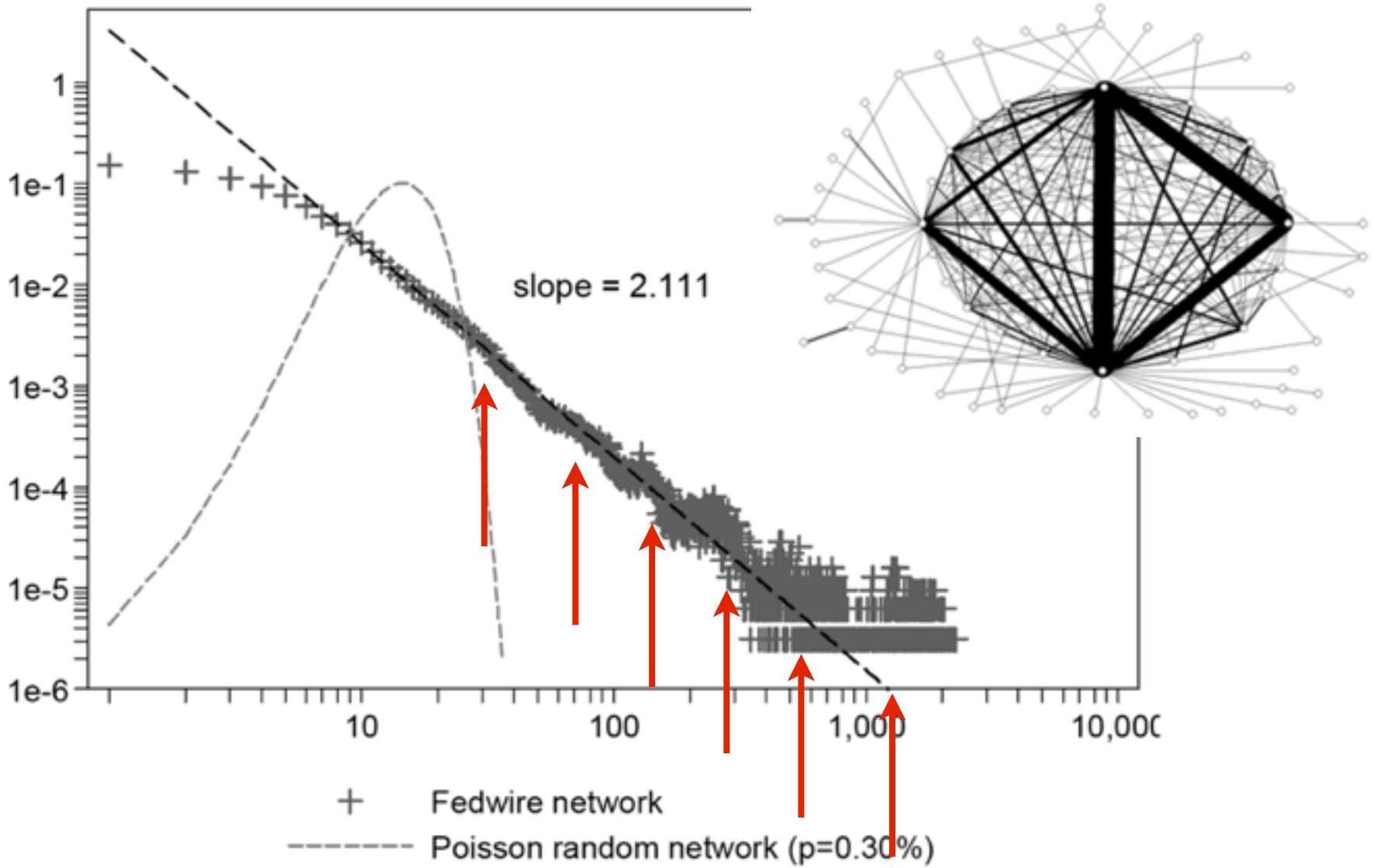
The Fedwire interbank payment network.

a, This ‘furball’ depiction takes in thousands of banks and tens of thousands of links representing US$1.2 trillion in daily transactions.

b, The core of the network, with 66 banks accounting for 75% of the daily value of transfers, and with 25 of the banks being completely connected. Every participating bank, and every transaction, in the full network is known (akin to an ecologist knowing all species in an ecosystem, and all flows of energy and nutrients). So the behavior of the system can be analysed in great detail, on different timescales and, for example, in response to events such as 9/11.

Soramäki, K. *et al. Physica A* 379, 317–333 (2007).

network topology of the interbank payments transferred between commercial banks over the Fedwire® Funds Service



Kimmo Soramäki, Morten L. Bech, Jeffrey Arnold, Robert J. Glass, and Walter E. Beyeler, Physica A 379, 317–333 (2006)

What is the cause of the crash?

- ✓ Proximate causes: many possibilities
- ✓ Fundamental cause: maturation towards an instability

An instability is characterized by

- large or diverging susceptibility to external perturbations or influences
- exponential growth of random perturbations leading to a change of regime, or selection of a new attractor of the dynamics.

Rational expectation bubble models with social interactions

Key idea: **return-risk relationship also holds during bubbles via the no-arbitrage (or close to no-arbitrage) condition.**

Two classes of models:

1) Risk is first (h(t): crash hazard rate controlled by herding noise traders)
and returns have to come to remunerate against the risk

2) Return $\mu(t)$ is first (rate of returns controlled by positive feedbacks from bubble price)
and risk (crash hazard rate) follows.

Log-Periodic Power Law model and Extensions

From the perspective of **economics and econometrics:**

Rational expectation bubble model in the presence of an (unknown) fundamental value

Rational expectation bubble model in the presence of stochastic singularity time

Rational expectation bubble model in the presence of mean-reverting self-consistent residuals

From the perspective of **complex systems**:

Rational expectation models of negative bubbles and anti-bubbles

Rational expectation bubble model with beta-function-type solution of the RG
(RG: renormalization group)

Rational expectation bubble model with higher order solutions of the RG

The **Log-Periodic Power Law** is a combination of

Classical methods of **economics**:
extension of the Blanchard-Watson (1982)
Rational Expectation bubble model

Diffusive dynamics of log-price in the presence of discontinuous jump *j*:

$$\frac{dp}{p} = \mu(t)dt + \sigma(t)dW - \kappa dj$$

Under the no-arbitrage condition

$$E_t[dp] = 0$$

the excess returns are proportional to the hazard rate:

$$\mu(t) = \kappa h(t)$$

Complex systems approach:

The crash is a tipping point (critical point), around which the system exhibits self-similar properties:

$$f(K) = g(K) + \mu^{-1} f[R(K)]$$

The renormalisation group solution has the form:

$$f(K) = \sum_{n=0}^{\infty} \mu^{-n} g[R^{(n)}(K)]$$

Where the log-periodic oscillations for hazard rate are the first order approximation of the RG solution.

$$\mathrm{E}[\ln p(t)] = A + B|t_c - t|^m + C|t_c - t|^m \cos[\omega \ln |t_c - t| - \phi]$$

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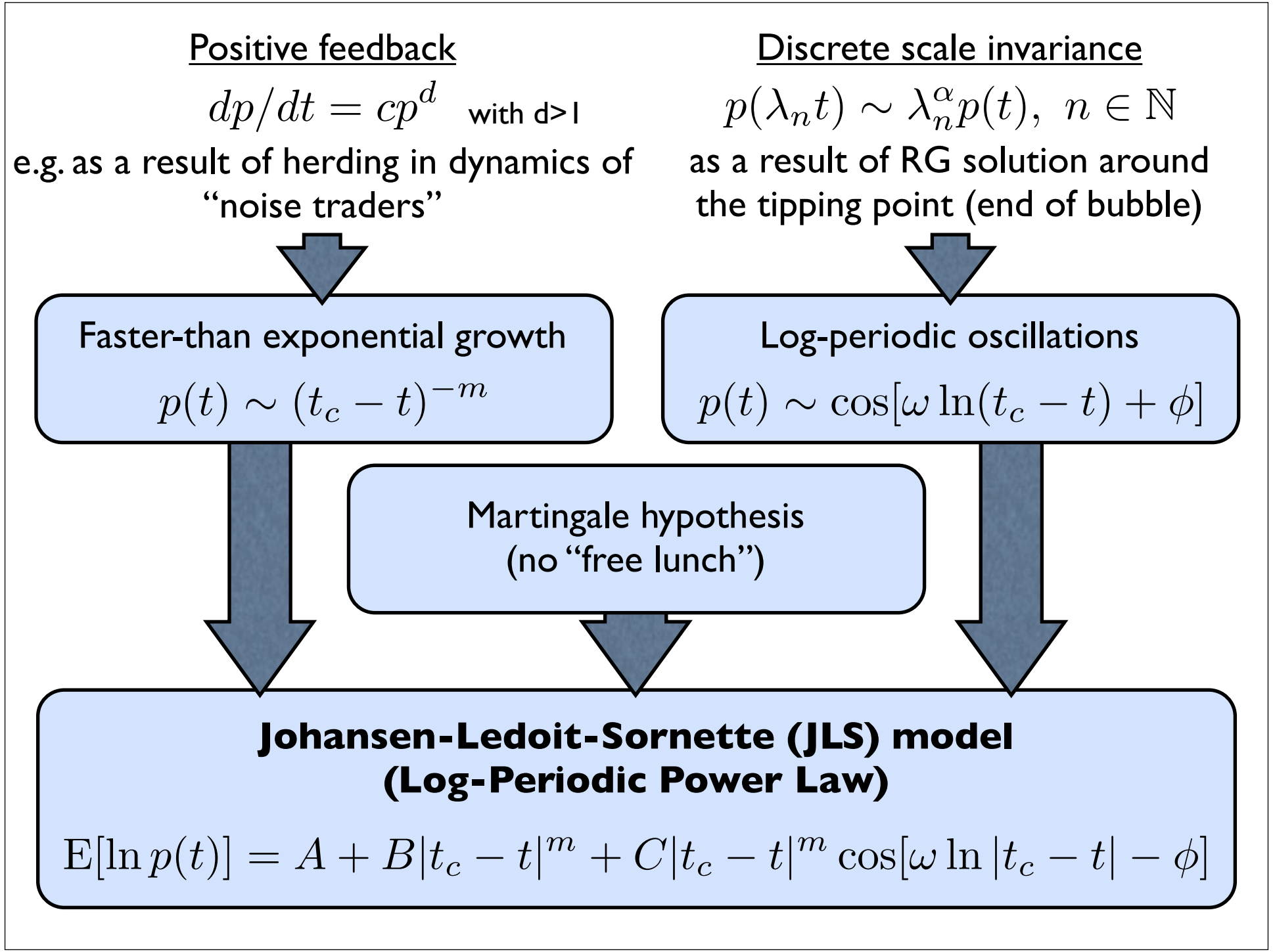
Positive feedback
$dp/dt = cp^d$ with d>1
e.g. as a result of herding in dynamics of "noise traders"
Discrete scale invariance
$p(\lambda_n t) \sim \lambda_n^\alpha p(t),\ n \in \mathbb{N}$
as a result of RG solution around the tipping point (end of bubble)
Faster-than exponential growth
$p(t) \sim (t_c - t)^{-m}$
Log-periodic oscillations
$p(t) \sim \cos[\omega \ln(t_c - t) + \phi]$
Martingale hypothesis
(no "free lunch")
Johansen-Ledoit-Sornette (JLS) model
(Log-Periodic Power Law)
$\mathrm{E}[\ln p(t)] = A + B|t_c - t|^m + C|t_c - t|^m \cos[\omega \ln|t_c - t| - \phi]$

Extensions of the **Log-Periodic Power Law** model

From the perspective of **economics and econometrics:**

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From the perspective of **economics and econometrics:**

addresses the problem of the joint estimation of the fundamental and bubble components

mechanism for bubble survival by lack of synchronization due to heterogenous beliefs on critical

Rational expectation bubble model in the presence of mean-reverting self-consistent residuals

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Construction of alarms

Prices converted in stochastic singular times for crash

$$\widetilde{T}_{c,i}(t) = t_i + \left(\frac{A - \ln p(t)}{B}\right)^{\frac{1}{1-\beta}}, \qquad t = t_i - 899, \cdots, t_i \, .$$

$$T_{c,i} = \frac{1}{750}\sum_{t=1}^{750} \widetilde{T}_{c,i}(t) \qquad \tilde{t}_{c,i}(t) = \widetilde{T}_{c,i}(t) - T_{c,i}$$

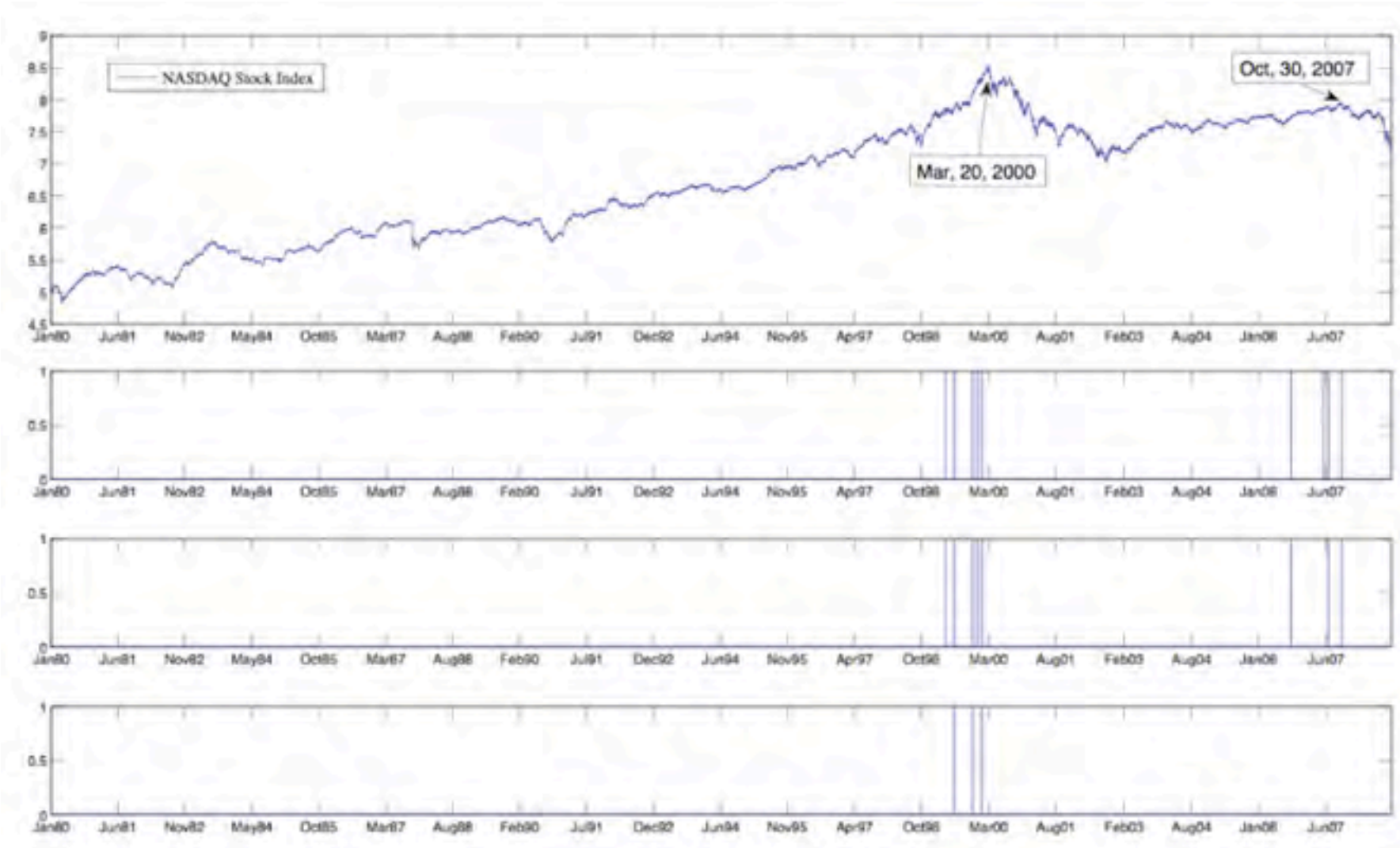
Bubble diagnostic if

(i) $0 < \beta^* < 1$ such that $m > 2$ (the signature of a positive feedback in the momentum price dynamics model) and

(ii) $-25 \leq T_{c,i} - t_i \leq 50$, such that the estimated termination time of the bubble is close to the right side of the time window.

(iii) We further refine the filtering by considering three levels of significance quantified by the value of the exponent m: level 1 ($m > 2$), level 2 ($m > 2.5$) and level 3 ($m > 3$).

(iv) Dickey – Fuller unit – root test is rejected at 99.5% significance level



Li Lin, Didier Sornette, Diagnostics of Rational Expectation Financial Bubbles with Stochastic Mean-Reverting Termination Times, in press in European Journal of Finance (2012) (http://arxiv.org/abs/0911.1921)

Extensions of the **Log-Periodic Power Law** model

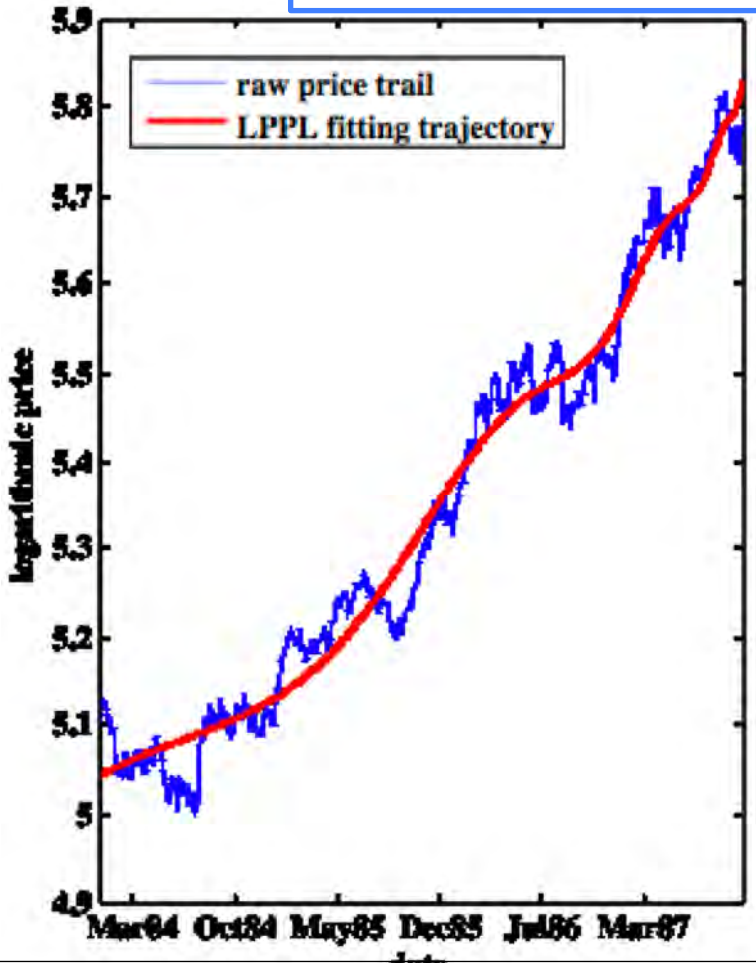
From the perspective of **economics and econometrics:**	From the perspective of **complex systems**:
addresses the problem of the joint estimation of the fundamental and bubble components	Rational expectation models of negative bubbles and anti-bubbles
mechanism for bubble survival by lack of synchronization due to heterogenous beliefs on critical	Rational expectation bubble model with beta-function-type solution of the RG (RG: renormalization group)
addresses the critic of Granger and Newbold (1974) and Phillips (1986) about spurious fits of non-stationary price processes	Rational expectation bubble model with higher order solutions of the RG

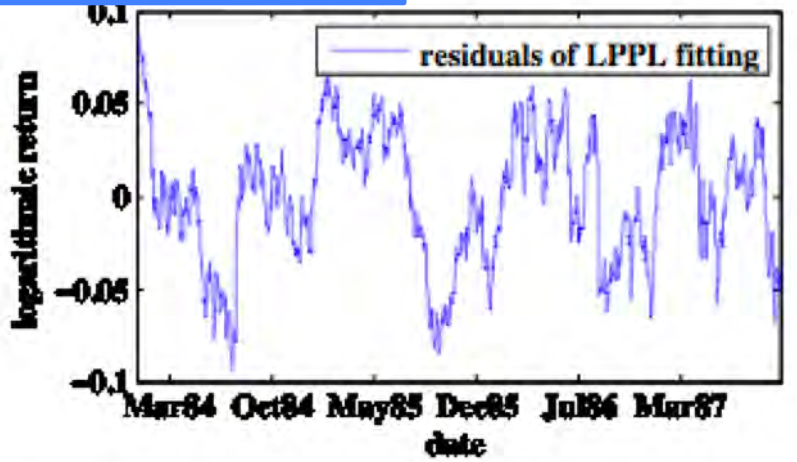
A Consistent Model of 'Explosive' Financial Bubbles With Mean-Reversing Residuals

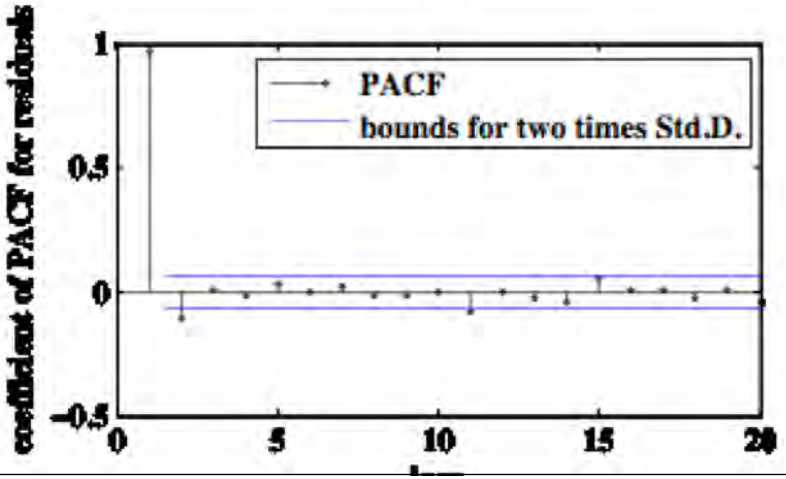
L. Lin, R. E. Ren and D. Sornette (2009)

http://papers.ssrn.com/abstract=1407574

$$\frac{dI}{I} = \mu(t)dt + \sigma_Y dY + \sigma_W dW - \kappa dj$$
$$dY = -\alpha Y dt + dW \ .$$







Rational Expectation formulation

Volatility Confined LPPL= deterministic component +*Ornstein-Uhlenbeck process*

LPPL fitting

Stationary
Mean reversal

- first model: based on Rational Expectation (RE) condition
  - Original price process: $\frac{dp}{p} = \mu(t)dt + \sigma_Y dY + \sigma_W dW - kdj$

    $dY = -\alpha Y dt + dW$
  - Stochastic Discount Factor: $\frac{d\Lambda_t}{\Lambda_t} = -rdt - \rho_Y dY - \rho_W dW$
  - Under no-arbitrage condition:

Belief updating

$$\mu(t) = \text{LPPL component} + \alpha(\sigma_Y - \rho_Y)Y_t^\circ$$

$$r_{i+1} = \ln p_{t_{i+1}} - \ln p_{t_i} \sim N(\Delta H_{t_{i+1},t_i} - \alpha(\ln p_{t_i} - H_{t_i}), \sigma_u^2(t_{i+1} - t_i))$$

$$H_{t_i} = A - B(t_c - t_i)^\beta [1 + \frac{C}{\sqrt{1 + (\frac{\omega}{\beta})^2}} \cos(\omega \ln(t_c - t_i) + \phi)]$$

There is also a Behavioral discount factor formulation.

Bayesian approach

S&P500 1987 and Hong-Kong 1997

(answering to Chang and Feigenbaum, 2006)

- Bayesian Factor
  - $B(\text{model\_1}, \text{model\_2}) = \dfrac{\text{Marginal Likelihood (model\_1)}}{\text{Marginal Likelihood (model\_2)}}$
  - Model_1: Volatility Confined LPPL
  - Prior probability
  - Model_2: Black–Scholes model
- Calculation Results

$$\mathscr{L}_{\text{LPPL}}(2.5\% - 97.5\%) = 3173.546 - 3176.983$$
$$\mathscr{L}_{\text{BS}}(2.5\% - 97.5\%) = 3169.808 - 3170.097$$

LPPL outperform BS here

$$\begin{aligned}
\mu &\sim N(0.0003, (0.01)^2) \\
\tau &\sim \Gamma(1.0, 10^5) \\
\alpha &\sim \Gamma(1.0, 0.05) \\
A &\sim N(6, 0.05) \\
B &\sim \Gamma(1, 0.01) \\
C &\sim U(0, 1) \\
\beta &\sim B(40, 30) \\
\omega &\sim \Gamma(16, 0.4) \\
\phi &\sim U(0, 2\pi) \\
t_c - t_N &\sim \Gamma(1, 30)
\end{aligned}$$

Extensions of the **Log-Periodic Power Law** model

From the perspective of **complex systems**:

Rational expectation models of negative bubbles and anti-bubbles

Rational expectation bubble model with beta-function-type solution of the RG
(RG: renormalization group)

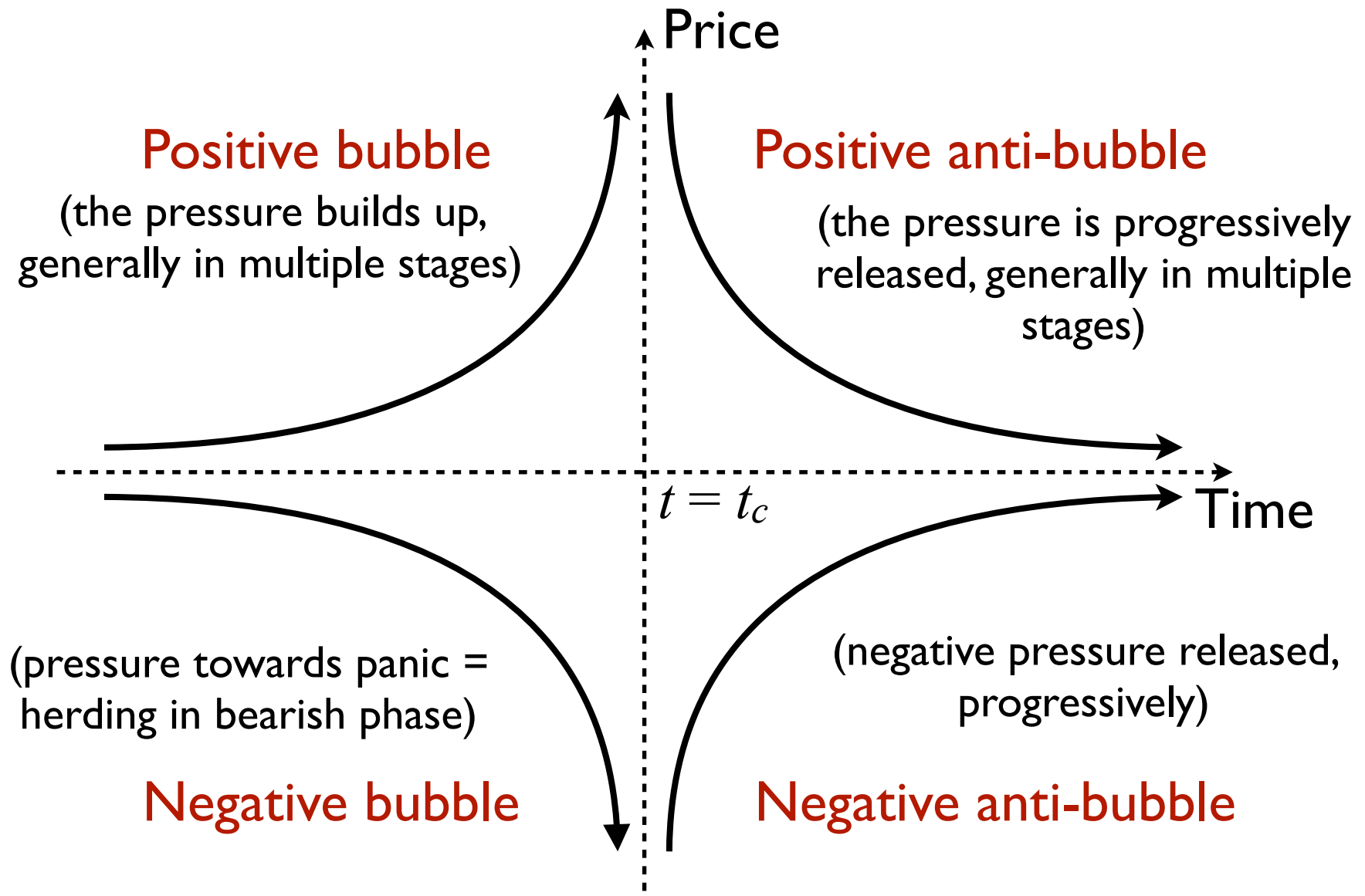
Rational expectation bubble model with higher order solutions of the RG

Extensions of the **Log-Periodic Power Law** model

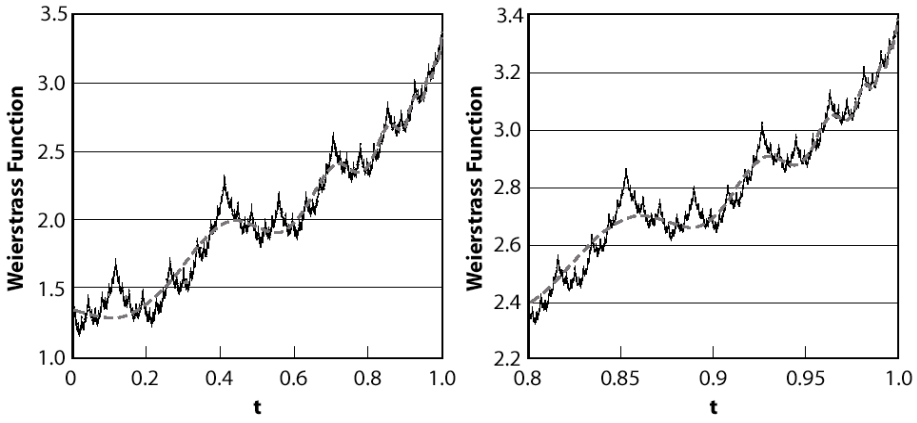
From the perspective of **complex systems**:

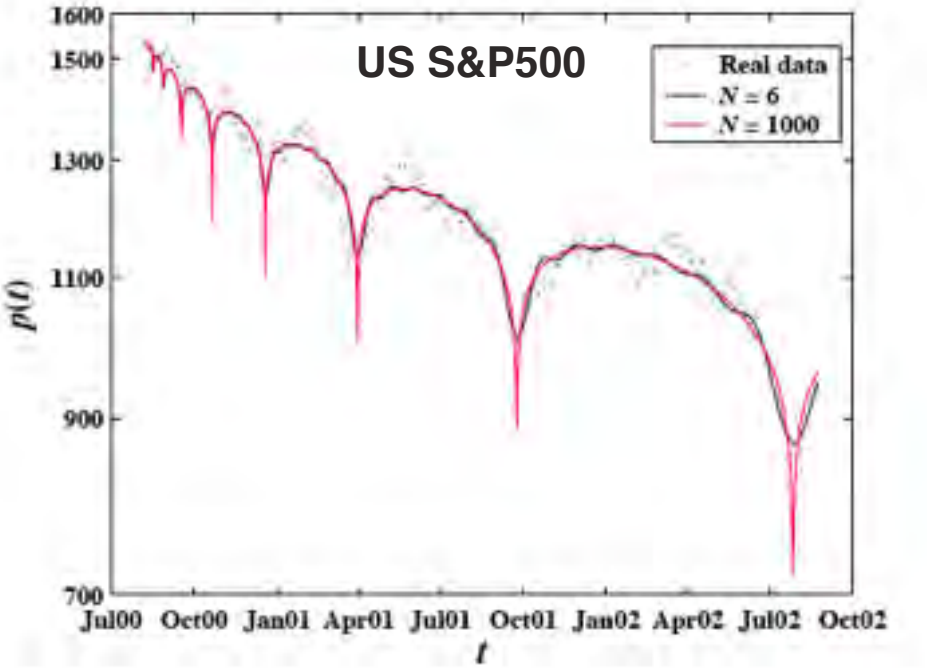
Rational expectation models
of negative bubbles
and anti-bubbles

Rational expectation models **of negative and anti-bubbles**



Extensions of the **Log-Periodic Power Law** model





From the perspective of **complex systems**:

Rational expectation models of negative bubbles and anti-bubbles

generalized Weierstrass functions

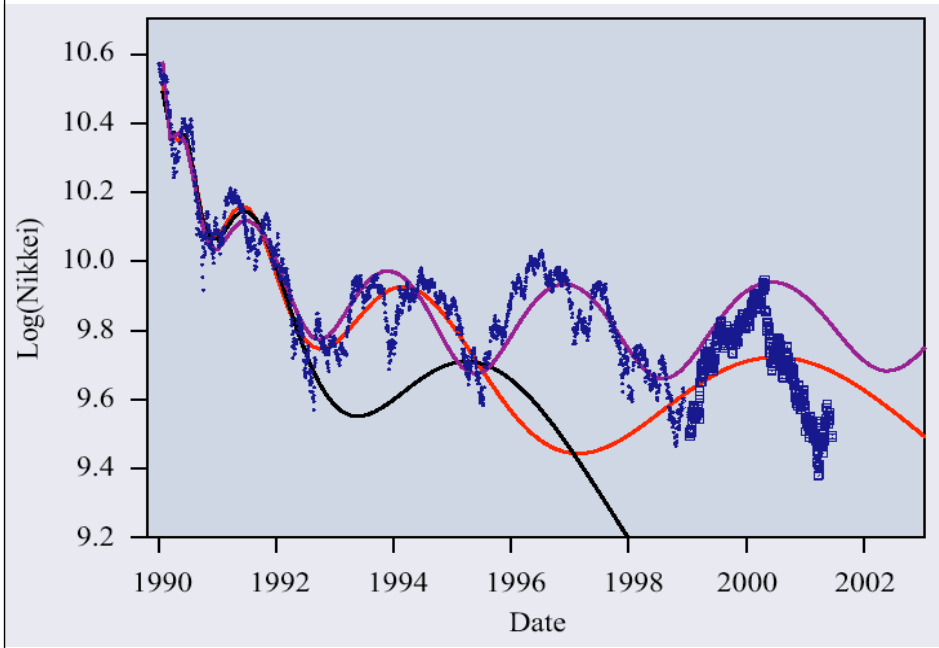
(RG: renormalization group)

Rational expectation bubble model with higher order solutions of the RG

Extensions of the **Log-Periodic Power Law** model

From the perspective of **complex systems**:

Japanese Index: model and prediction



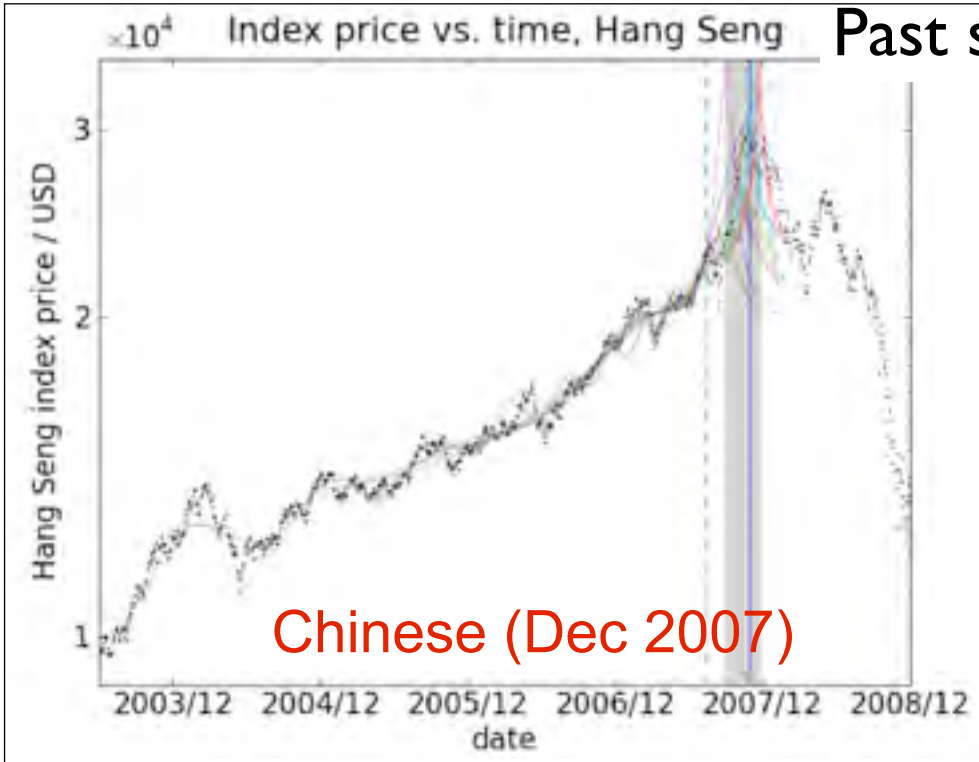
second-order and third-order Landau LPPL

A. Johansen and D. Sornette, Financial "anti-bubbles": log-periodicity in Gold and Nikkei collapses, Int. J. Mod. Phys. C 10(4), 563-575 (1999); Evaluation of the quantitative prediction of a trend reversal on the Japanese stock market in 1999, Int. J. Mod. Phys. C Vol. 11 (2), 359-364 (2000)

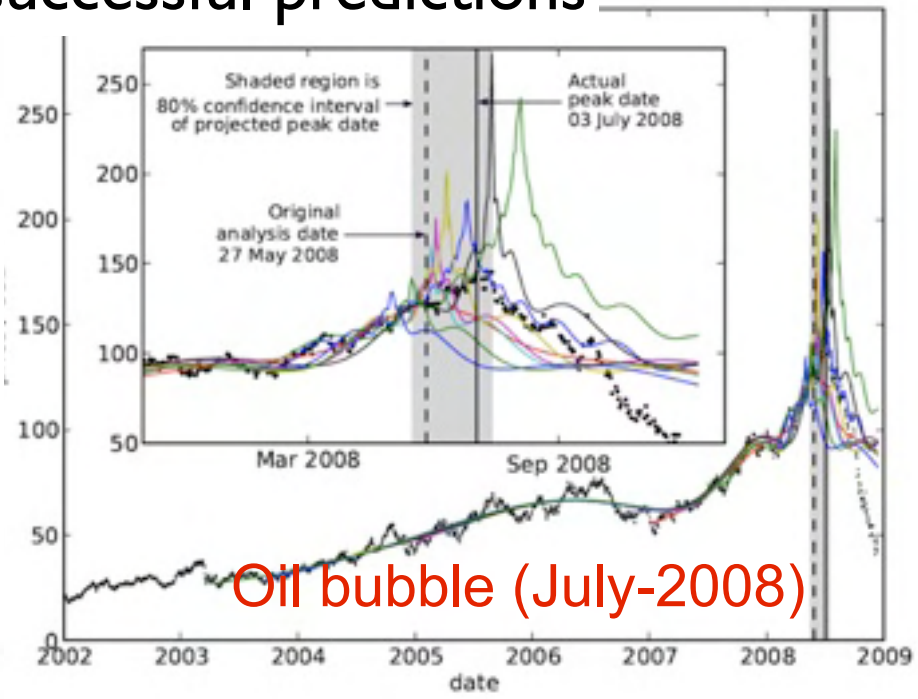
Methodology for diagnosing bubbles

- Positive feedbacks of higher return anticipation
  - Super exponential price
  - Power law “Finite-time singularity”
- Negative feedback spirals of crash expectation
  - Accelerating large-scale financial volatility
  - Log-periodic discrete scale-invariant patterns

Past successful predictions



Chinese (Dec 2007)

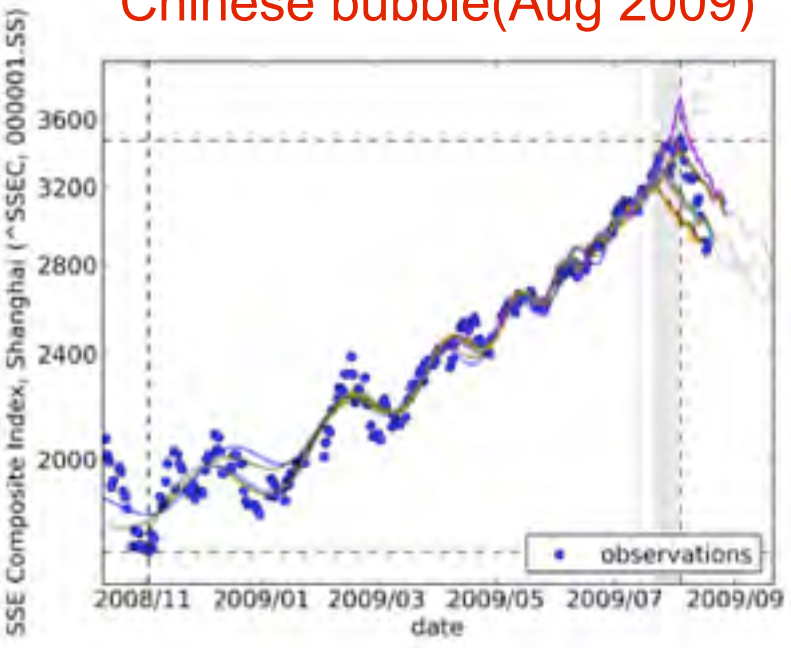


Oil bubble (July-2008)

The Global Bubble (Oct 2007)

PCA first component on a data set containing, emerging markets equity indices, freight indices, soft commodities, base and precious metals, energy, currencies...

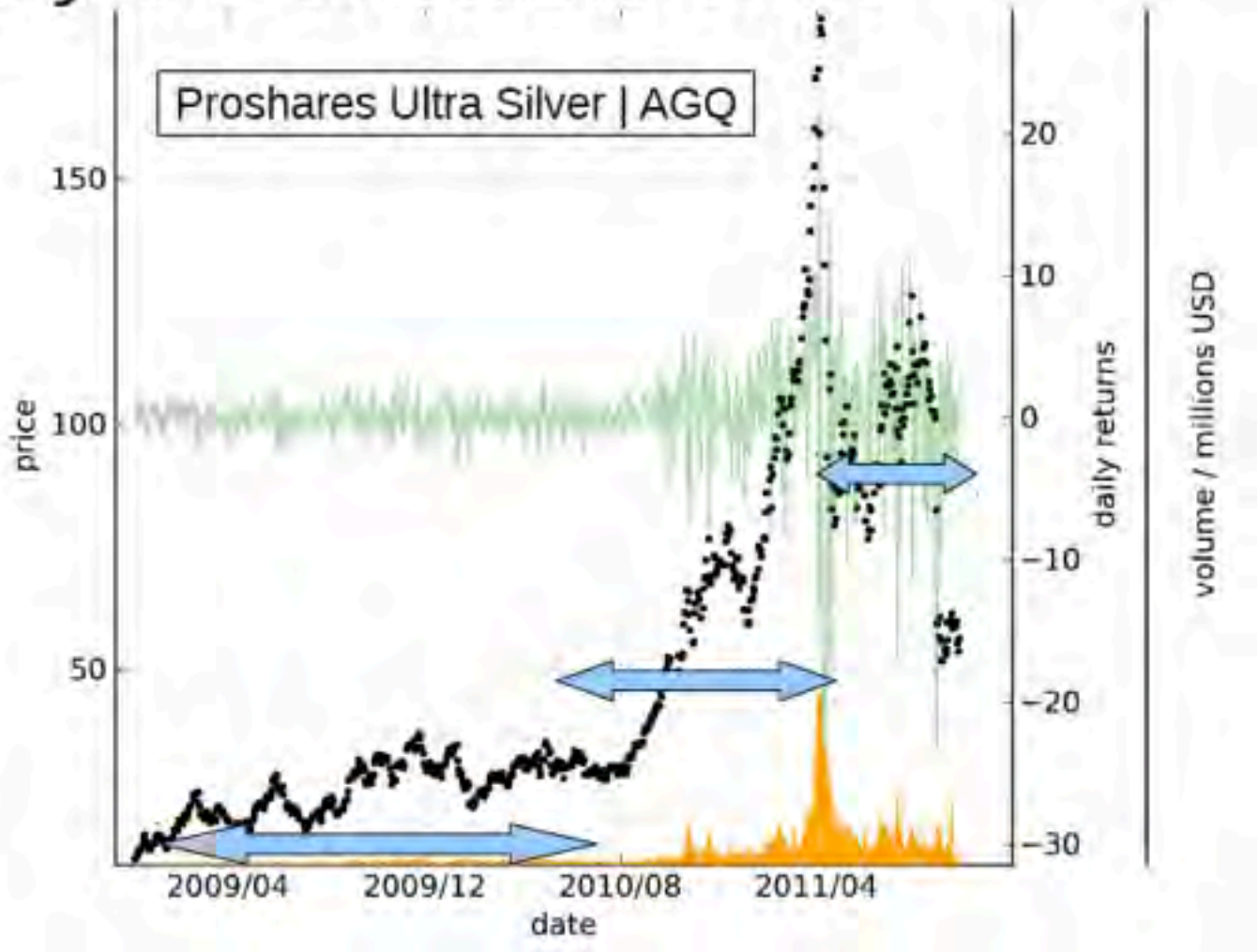
Chinese bubble(Aug 2009)



Our view of the world:
-dynamical regimes change
-we identify the unstable ones

Distinct regimes must be separately identified and understood

A single model for all times is not realistic



Ex-ante forecast of silver bubble

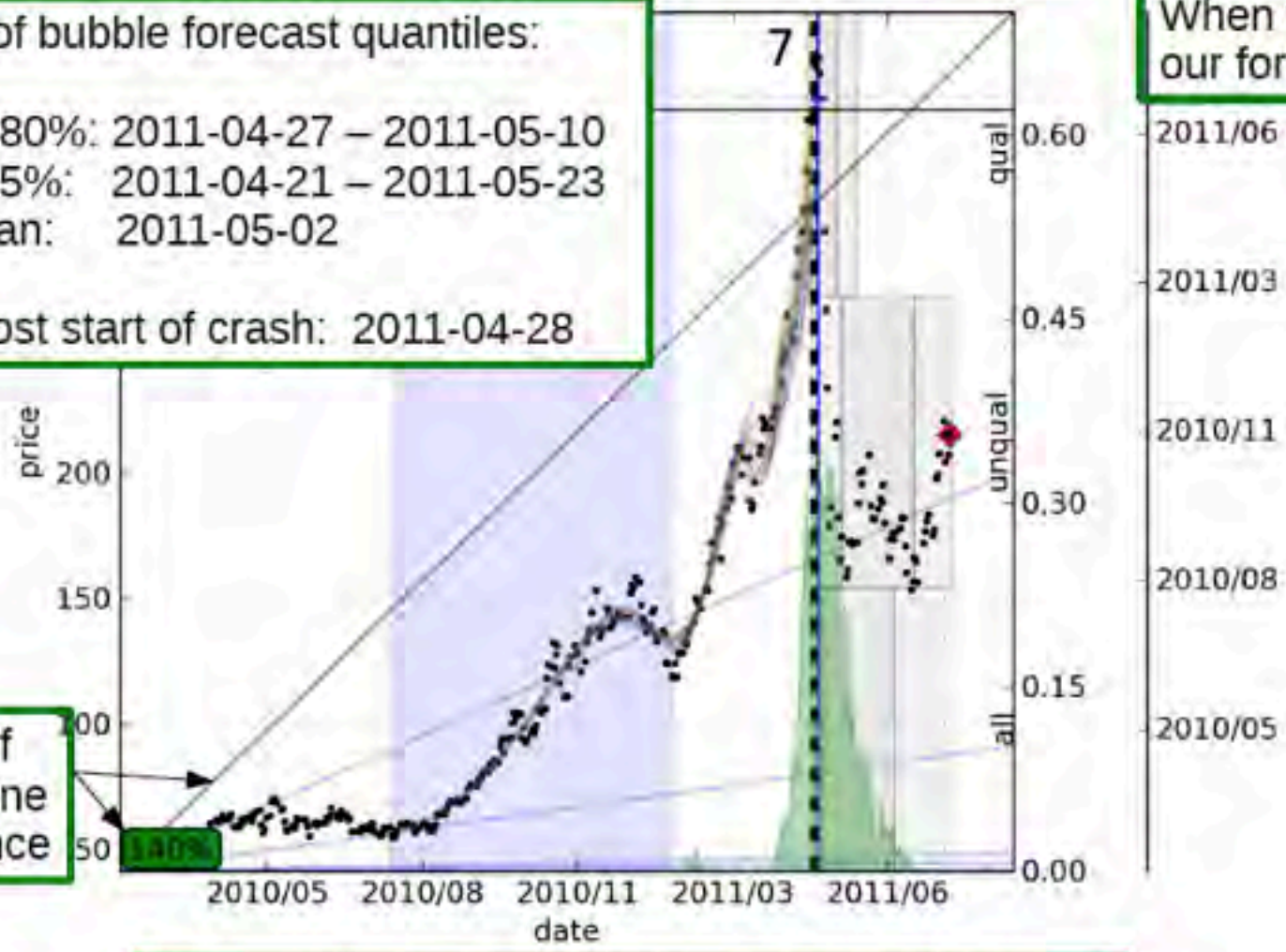
Proshares Ultra Silver | AGQ | t2 = 2011-04-25

When we made our forecast

End of bubble forecast quantiles:

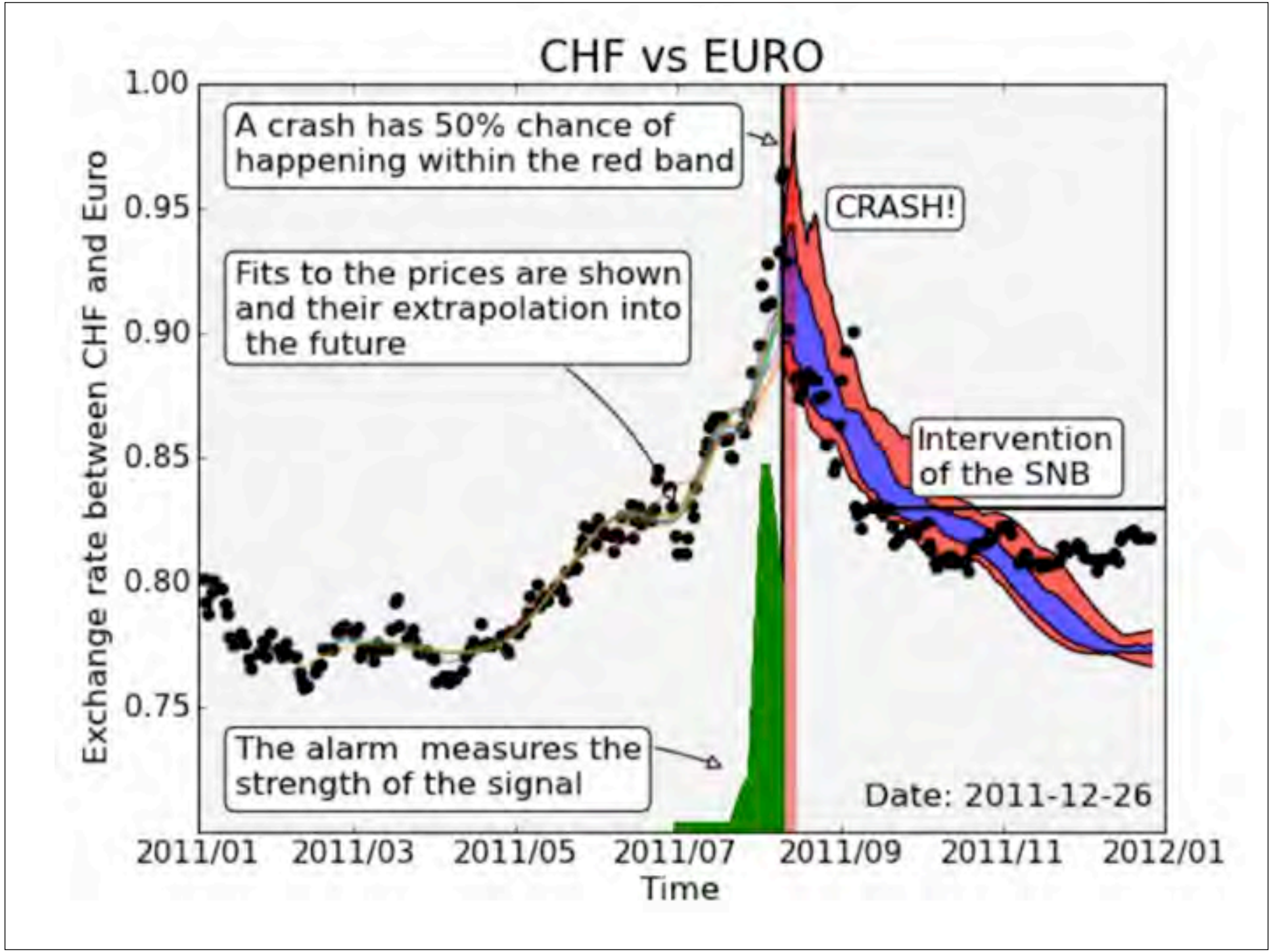
20%/80%: 2011-04-27 – 2011-05-10
5%/95%: 2011-04-21 – 2011-05-23
Median: 2011-05-02

Ex-post start of crash: 2011-04-28



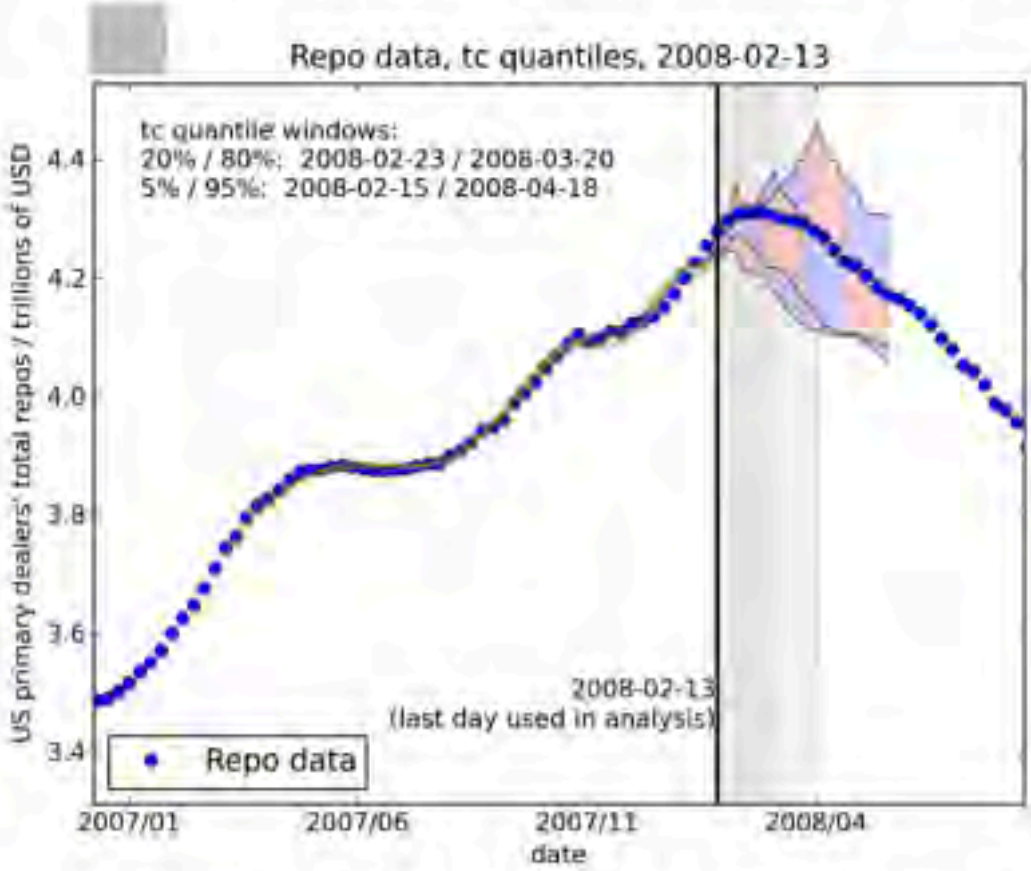
"Return" of diagonal line for reference

We successfully traded on the growth and crash.


CHF vs EURO
A crash has 50% chance of happening within the red band
CRASH!
Fits to the prices are shown and their extrapolation into the future
Intervention of the SNB
The alarm measures the strength of the signal
Date: 2011-12-26
Exchange rate between CHF and Euro
1.00
0.95
0.90
0.85
0.80
0.75
2011/01
2011/03
2011/05
2011/07
2011/09
2011/11
2012/01
Time

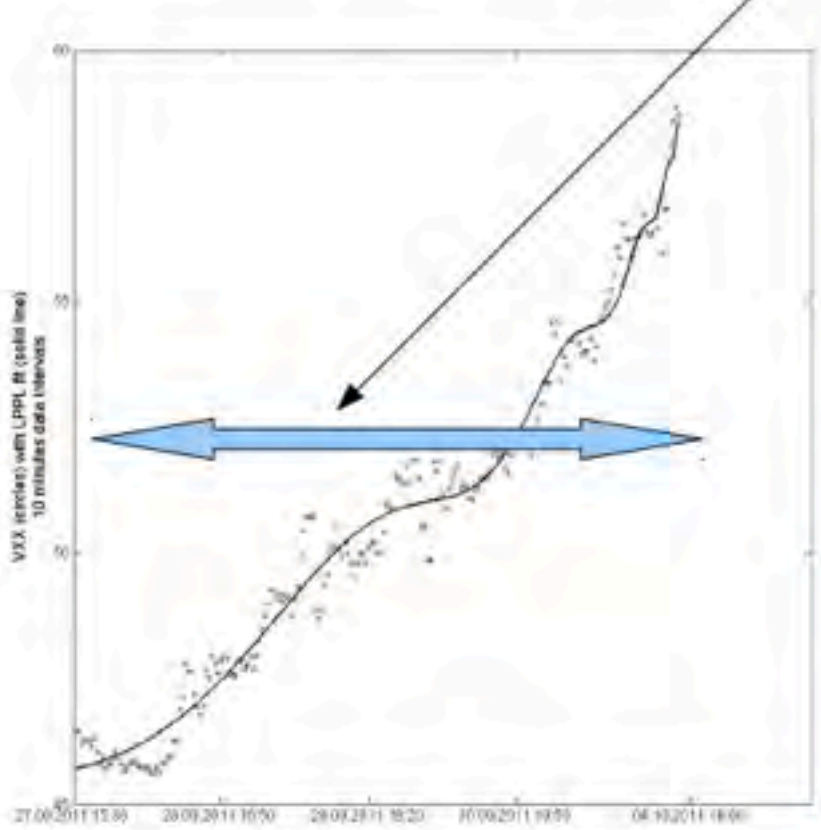
Such dynamics occur on longer timescales (>1 year): example of repos market before 2008 crash

(ex-post)

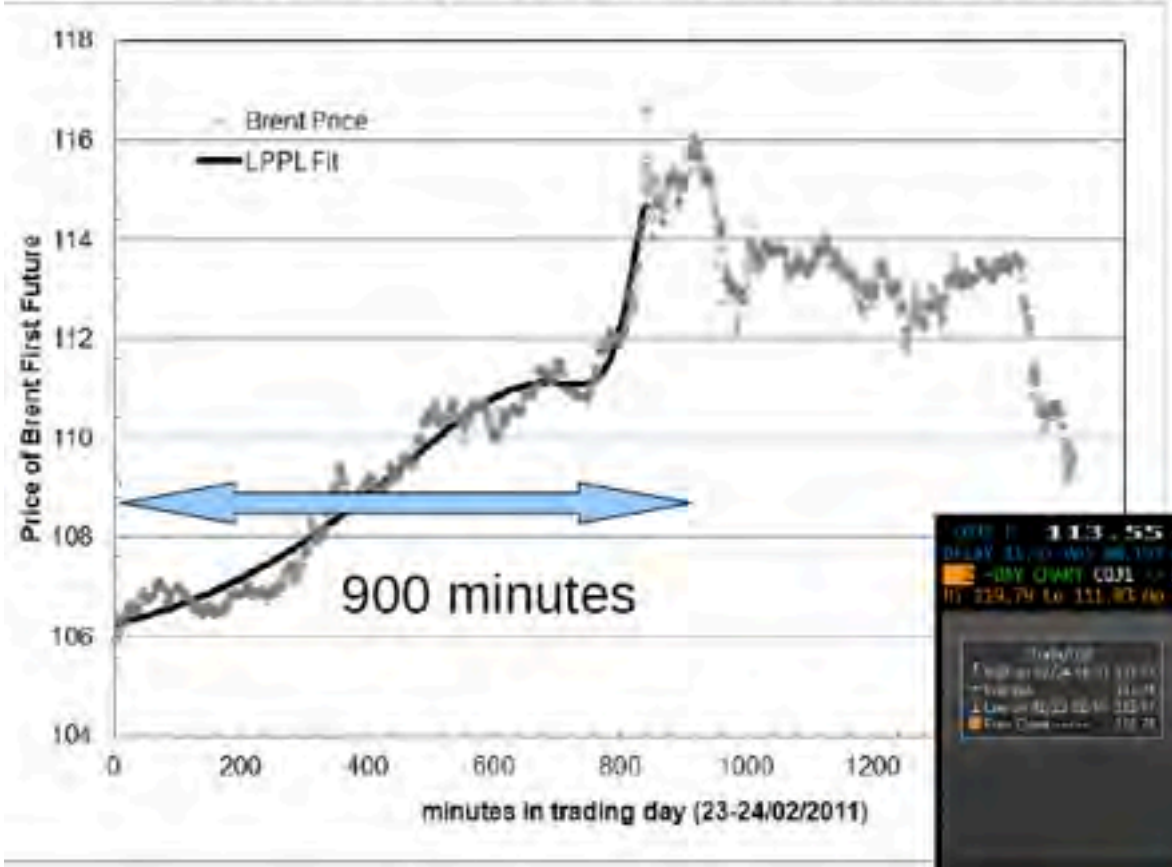


Wanfeng Yan, R.W., D.S., Leverage bubble, Physica A, V. 391, Jan. 2012

Such dynamics also occur on shorter time scales (~1 week): example VXX (27/09-04/10 2011)

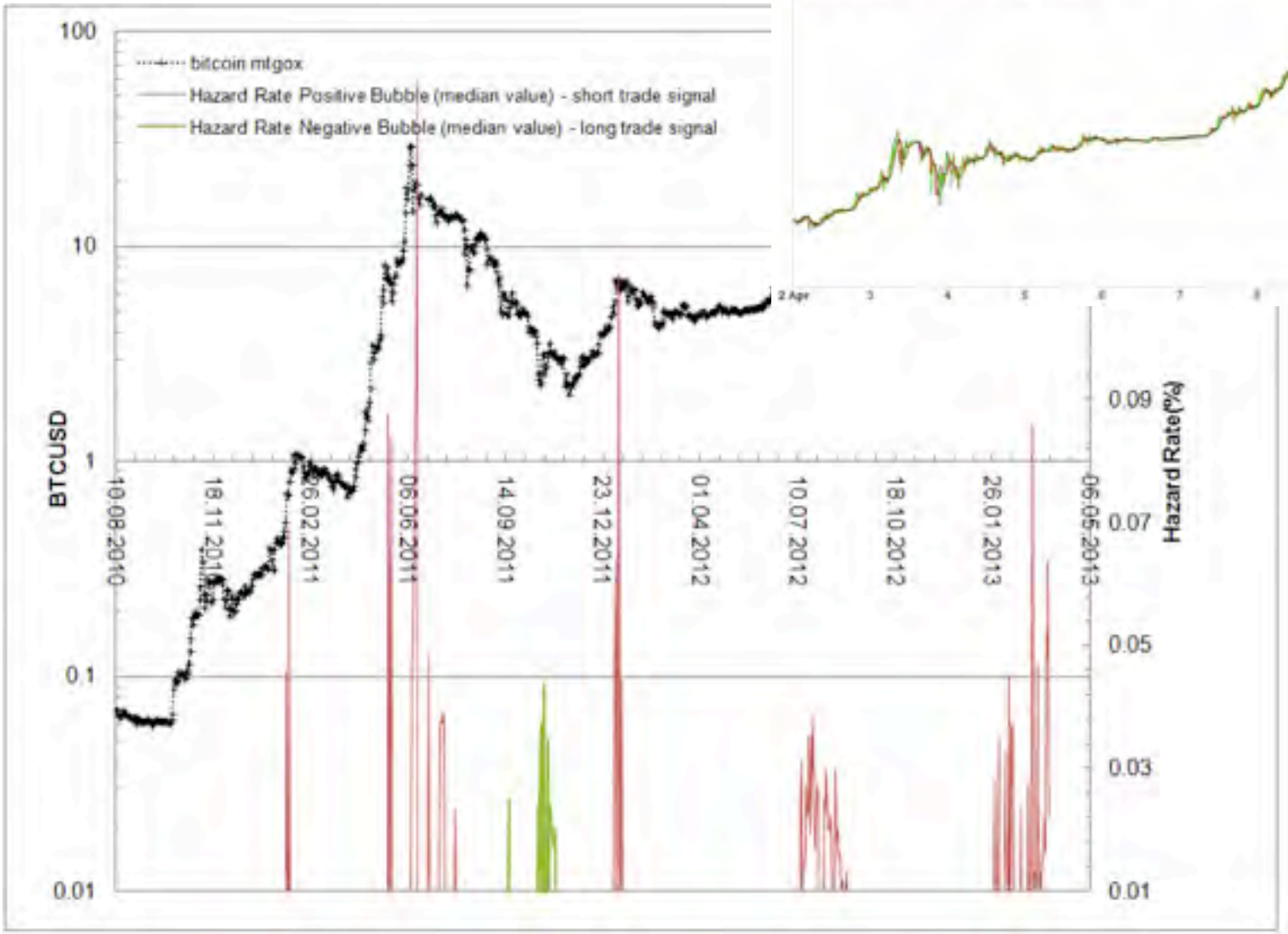


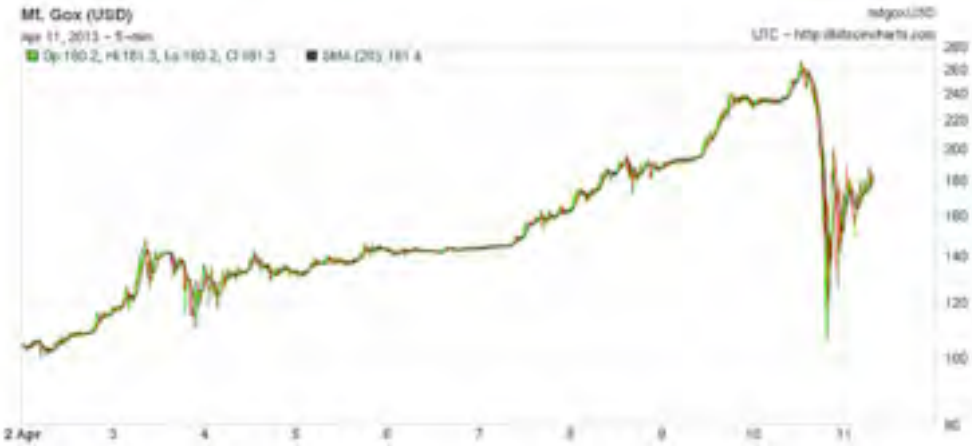
Such dynamics also occur on even shorter time scales (<1 day): examples of oil, market volatility



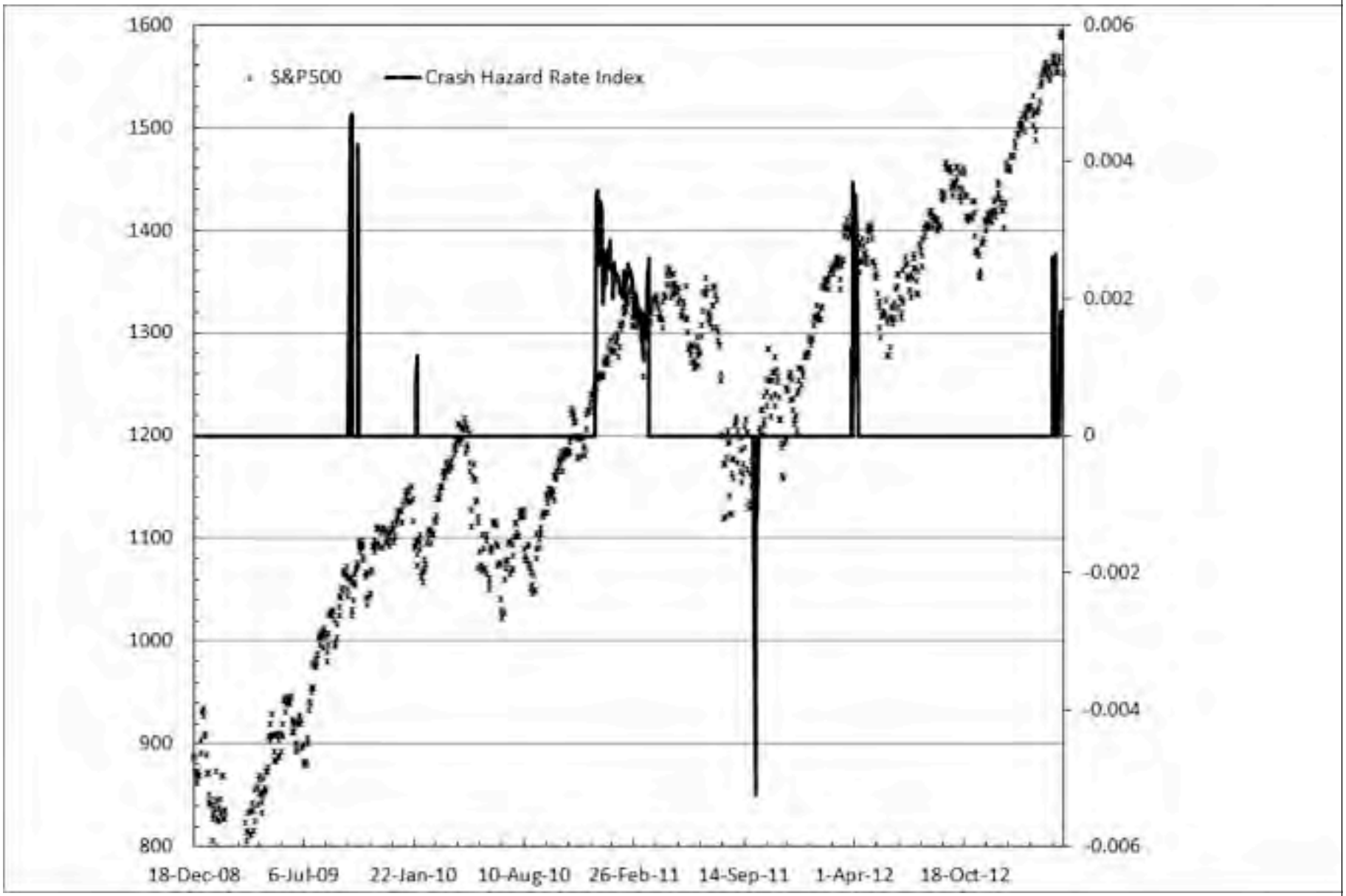
BITCOIN crash (10 April 2013)

Digital Currency Sees ‘BitCrash’ After All-Time High





S&P500 16 April 2013



Central bankers say they are flying blind

Financial Times, 18 April 2013

Lorenzo Bini Smaghi, the former member of the European Central Bank's executive board, captured the mood at the IMF's spring meeting, saying: "**We don't fully understand what is happening in advanced economies.**"

Sir Mervyn King, the outgoing governor of the Bank of England, said that "there is the risk of **appearing to promise too much or allowing too much to be expected of us**".

"Put simply, **we are in uncharted territory**," said Mr Viñals.

How can we be sure "we really are [not] **running the risk of reigniting the problems that led to the financial crisis** in the first place?" Charlie Bean, deputy BoE governor, asked the IMF panel

Fundamental origins of the on-going economic crises

1945-1970: reconstruction boom and consumerism

1971-1980: Bretton Woods system termination and oil shocks / inflation shocks

1981-2007: Illusion of the "perpetual money machine" and virtual financial wealth

2008-2020s: New era of pseudo growth fueled by QEs and other Central Banks+Treasuries actions

- **-very low interest rate for a very long time (decades)**
- **-net erosion even in the presence of apparent low (disguised) inflation**
- **-reassessment of expectation for the social and retirement liabilities**
- **-a turbulent future with many transient bubbles**
- **-need to capture value and be contrarian => exploit herding and fear**

2020s-20xx: Interconnection of many systemic risks

The illusion of the perpetual money machine

1945-1970: reconstruction boom and consumerism

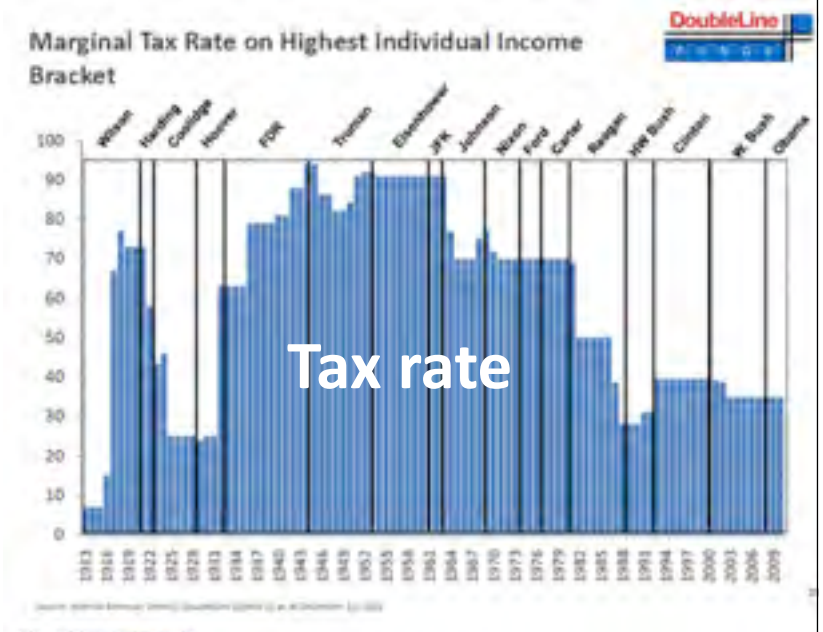
1971-1980: Bretton Woods system termination and oil shocks / inflation shocks

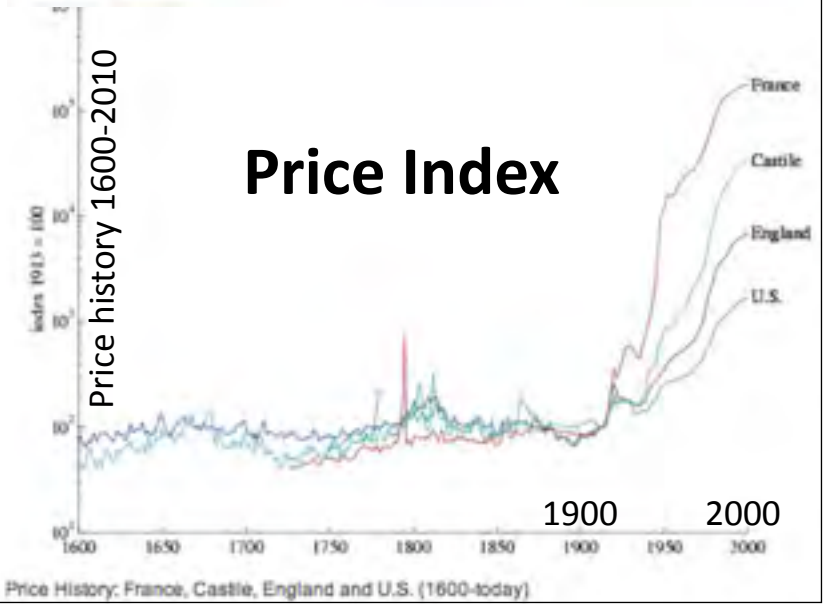
Economic and financial contexts

- Liberalization, deregulation and privatization agenda

- Global pattern in US, UK, Bretton Woods repeal (1971), China (Deng Xiaoping, 1978=>), India (market-oriented reforms, 1991), Japan enormous double bubble burst in 1991, and so on...

- Washington Consensus (promotion of free trade, capital mobility, and financial market deregulation) => South America and Asia.





Price History: France, Castile, England and U.S. (1600-today)

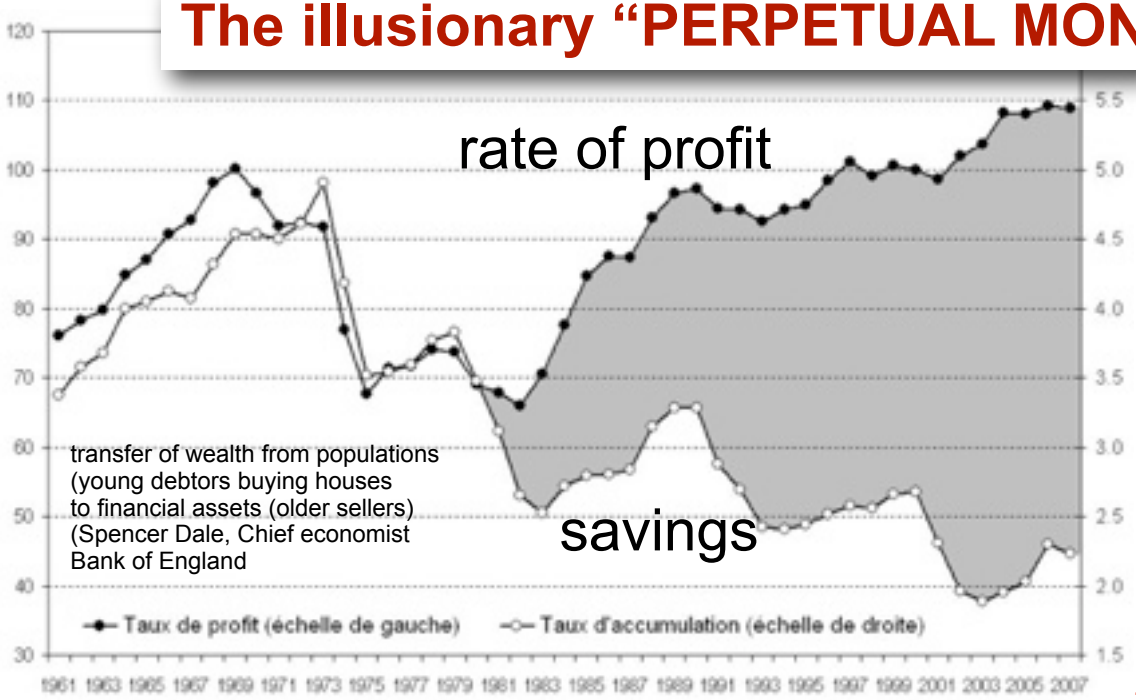
Fundamental origins of the on-going economic crises

1945-1970: reconstruction boom and consumerism

1971-1980: Bretton Woods system termination and oil shocks / inflation shocks

1981-2007: Illusion of the "perpetual money machine" and virtual financial wealth

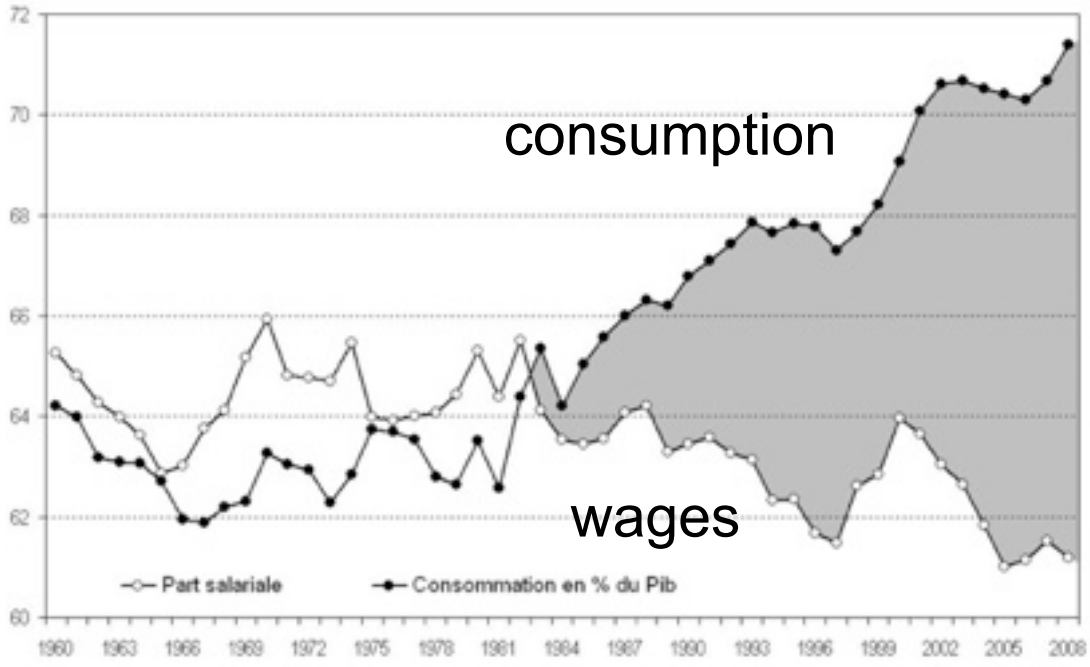
The illusionary "PERPETUAL MONEY MACHINE"



Rate of profit and rate of accumulation: The United States + European Union + Japan

* Rate of accumulation = rate of growth rate of the net volume of capital * Rate of profit = profit/ capital (base: 100 in 2000)

Sources and data of the graphs: http://hussonet.free.fr/toxicap.xls



Thee gap widens between the share of wages and the share of consumption (gray zones), so as to compensate for the difference between profit and accumulation. FINANCE allows increasing debt and virtual wealth growh... which can only be transitory (even if very long).

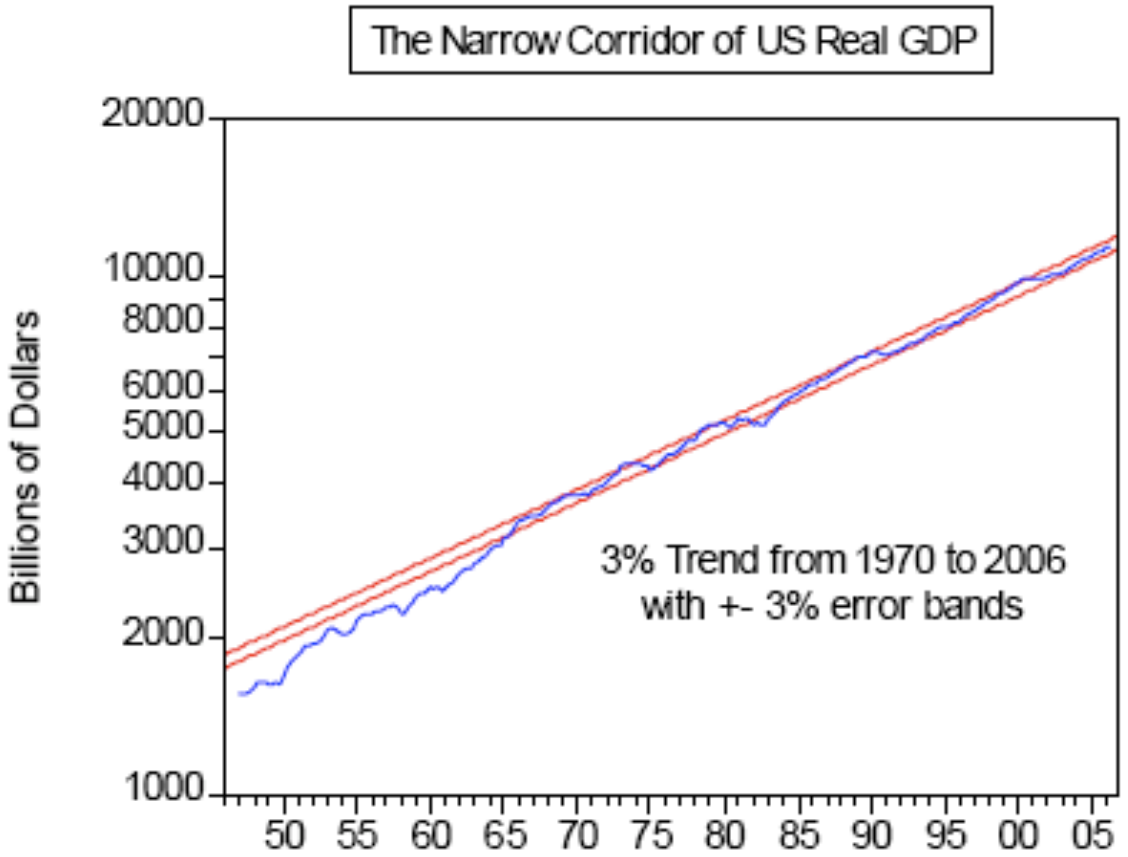
United States Share of wages and of private consumption in Gross Domestic Product (GDP)

Source of data and graphics: http://hussonet.free.fr/toxicap.xls

The illusionary "PERPETUAL MONEY MACHINE"

- An economy which grows at 2 or 3 per cent cannot provide a universal profit of 15 per cent, as some managers of equities claim and many investors dream of.

- Financial assets represent the right to a share of the surplus value that is produced. As long as this right is not exercised, it remains virtual. But as soon as anyone exercises it, they discover that it is subject to the law of value, which means, quite simply, that you cannot distribute more real wealth than is produced.



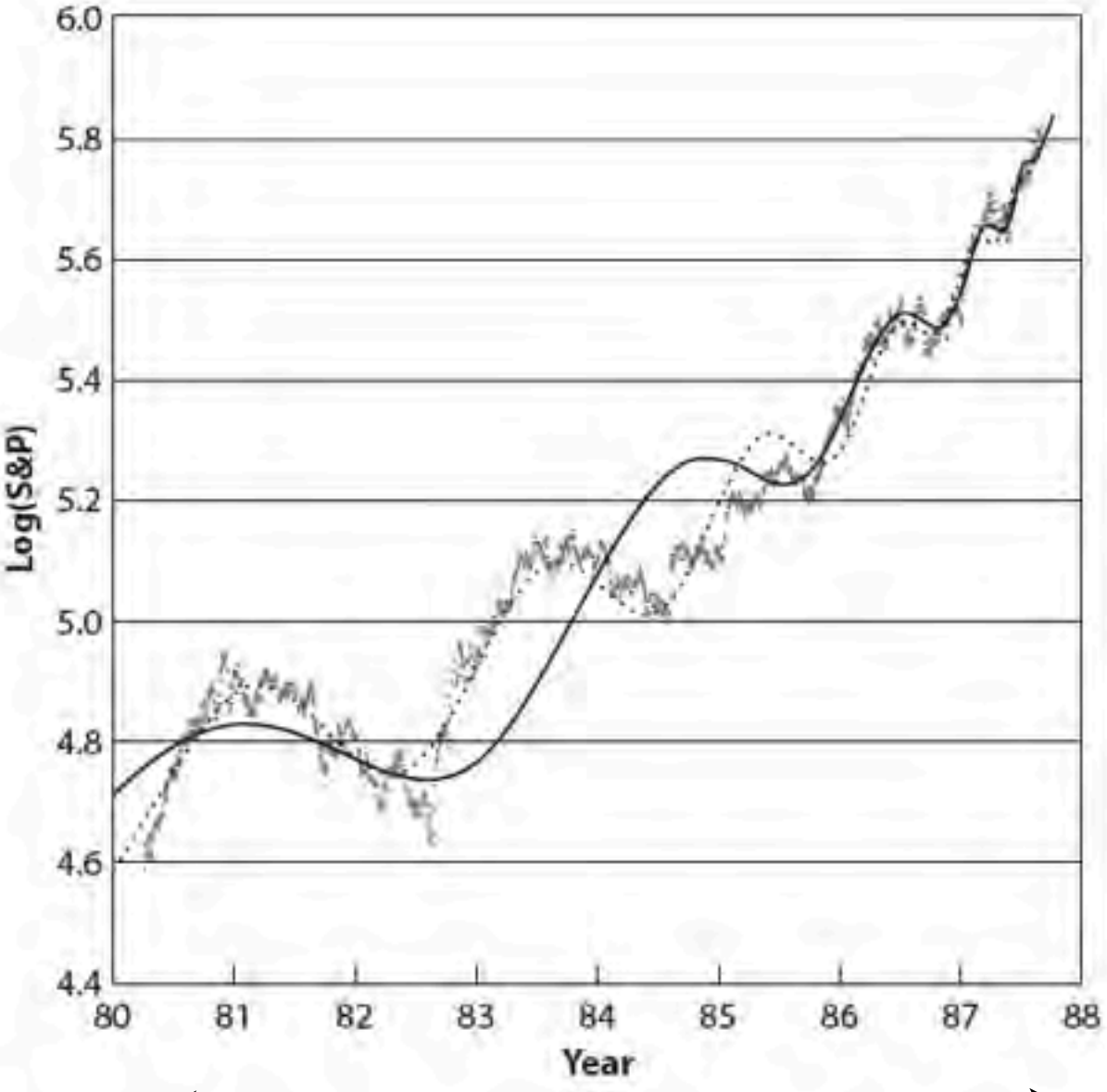
From 1982 until 2007, the U.S. only experienced two shallow recessions that each lasted just 8 months. This stretch of 25 years may be the best 25 years in the US economic history. But much of this prosperity was bought with debt, as the ratio of debt to GDP rose from $1.60 to $3.50 for each $1.00 of GDP.

Predictability of the 2007-XXXX crisis:
30 year History of **bubbles** and of **Endogeneity**

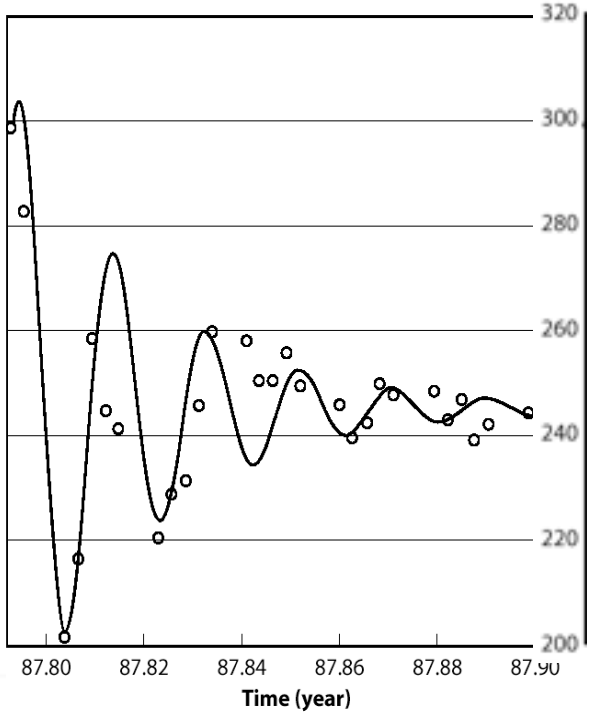
- Worldwide bubble (1980-Oct. 1987)
- The ICT (dotcom) “new economy” bubble (1995-2000)
- Real-estate bubbles (2003-2006)
- MBS, CDOs bubble (2004-2007)
- Stock market bubble (2004-2007)
- Commodities and Oil bubbles (2006-2008)
- Debt bubbles

Didier Sornette and Ryan Woodard Financial Bubbles, Real Estate bubbles, Derivative Bubbles, and the Financial and Economic Crisis (2009)(http://arxiv.org/abs/0905.0220)

THE CRASH OF OCTOBER 1987

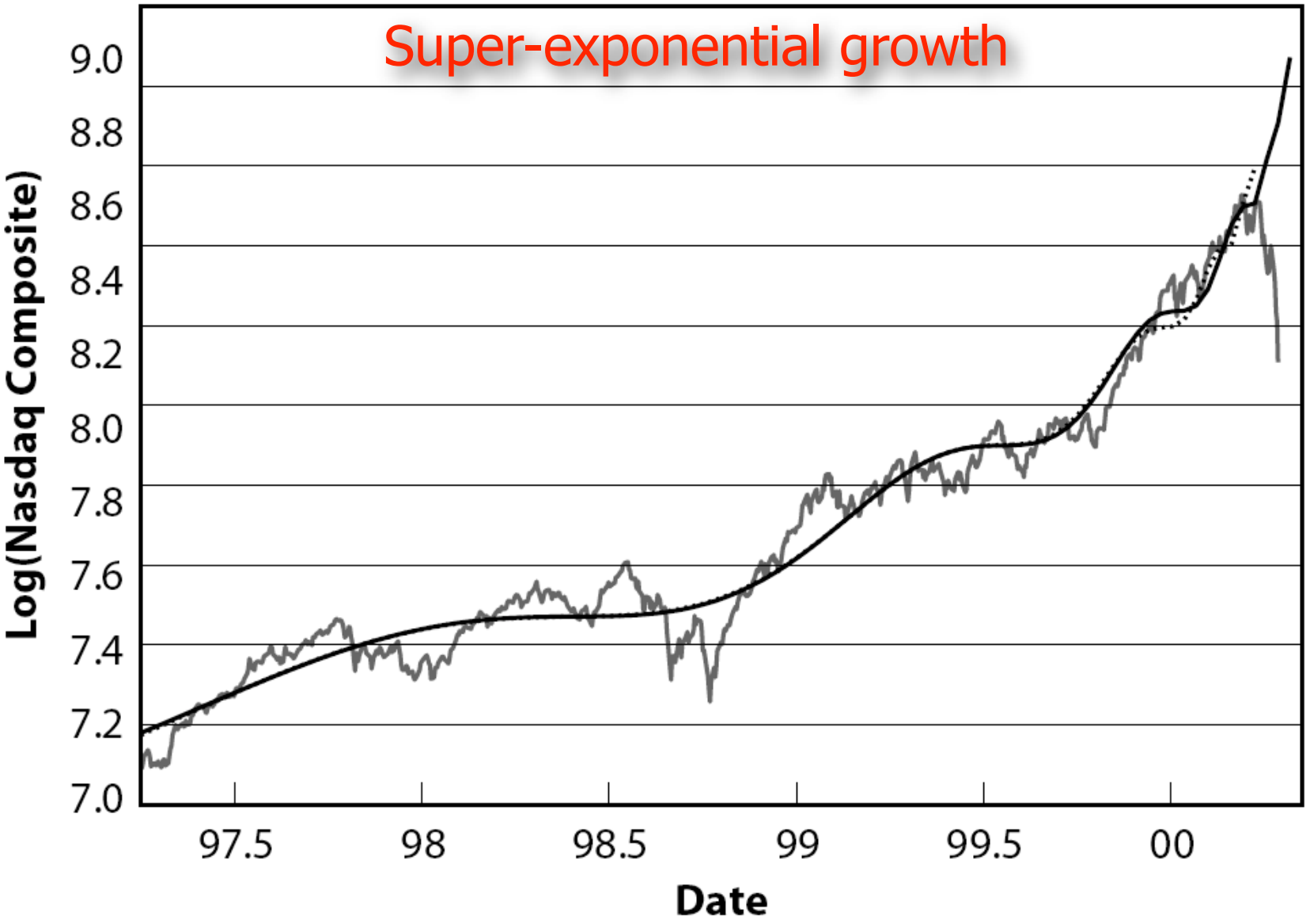


7 years



6 months

THE NASDAQ CRASH OF APRIL 2000



Real-estate in the UK

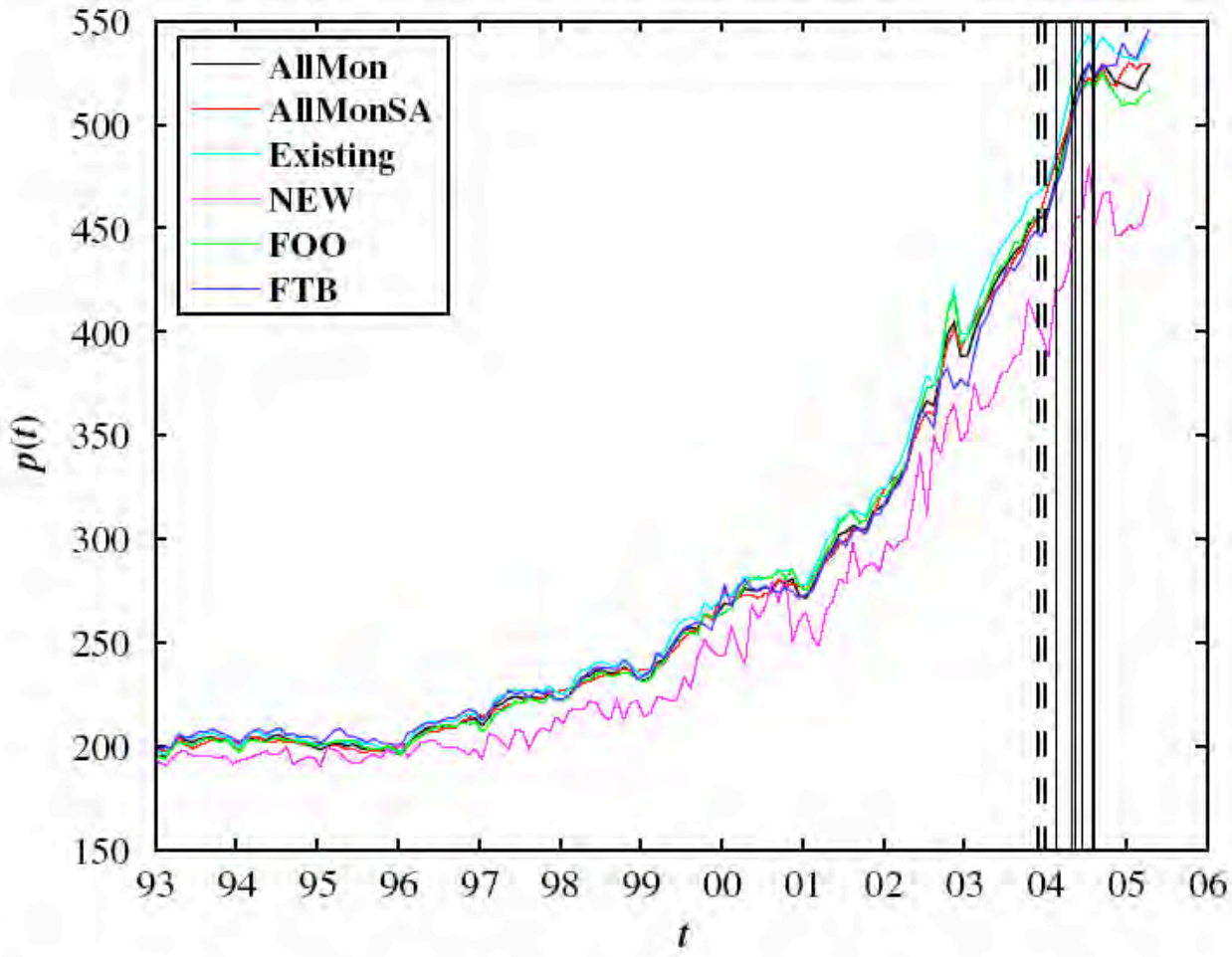


Fig. 1. (Color online) Plot of the UK Halifax house price indices from 1993 to April 2005 (the latest available quote at the time of writing). The two groups of vertical lines correspond to the two predicted turning points reported in Tables 2 and 3 of [1]: end of 2003 and mid-2004. The former (resp. later) was based on the use of formula (2) (resp. (3)). These predictions were performed in February 2003.

W.-X. Zhou, D. Sornette, 2000–2003 real estate bubble in the UK but not in the USA, Physica A 329 (2003) 249–263.

Real-estate in the USA

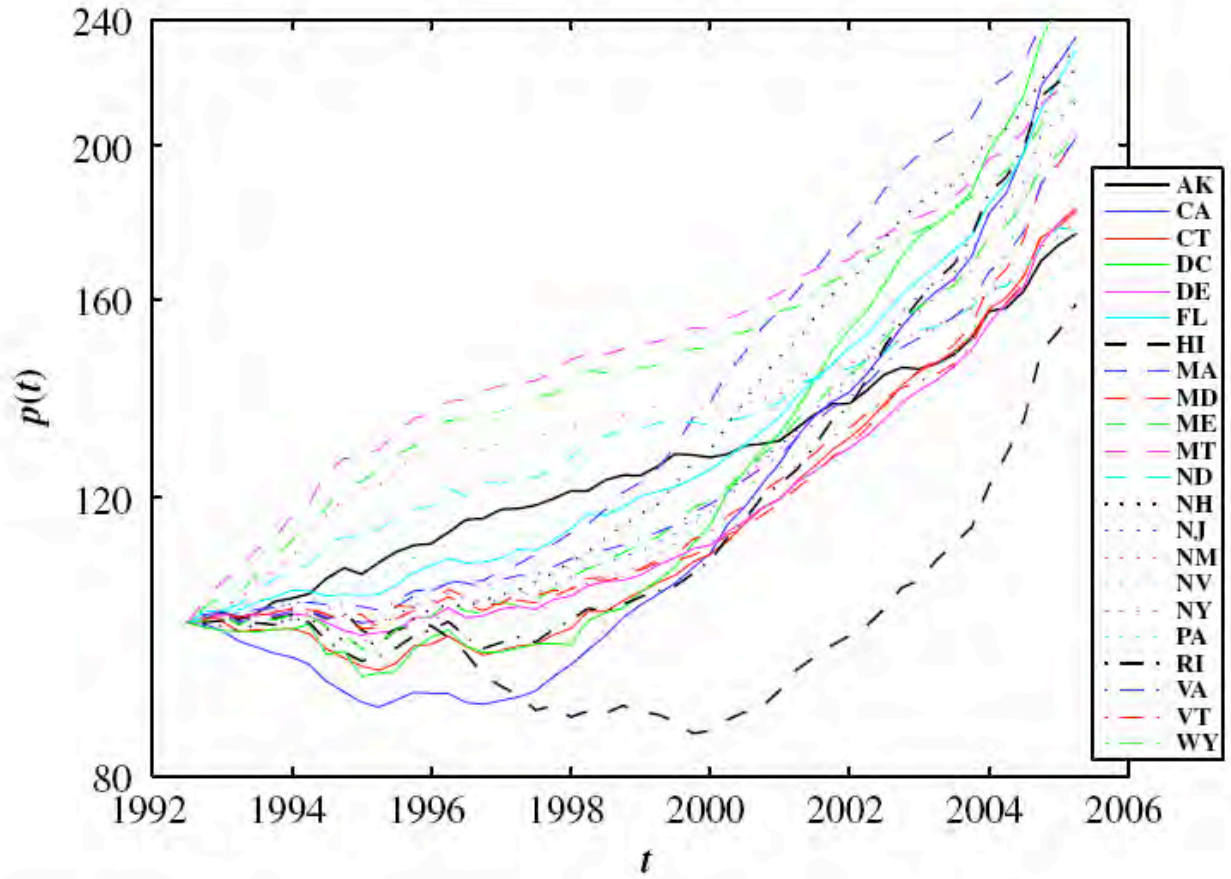
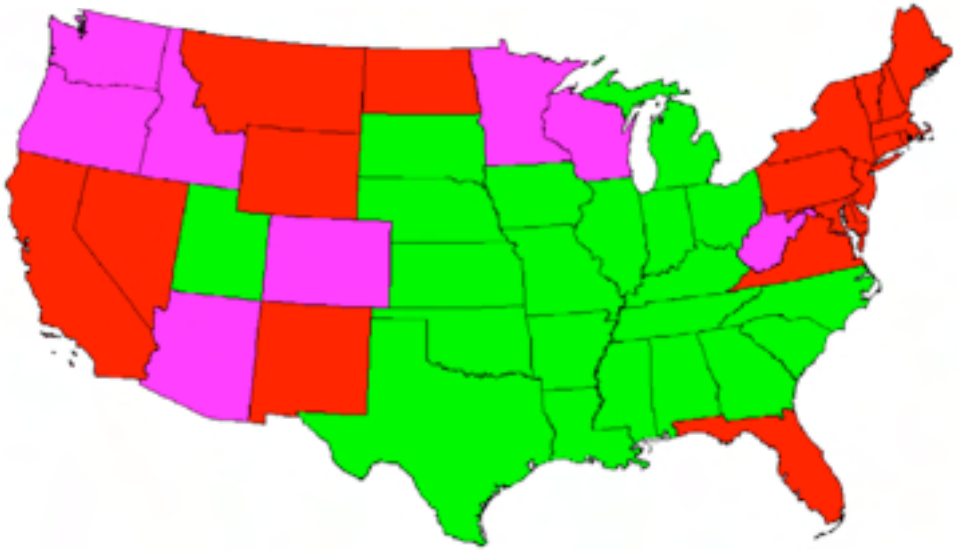


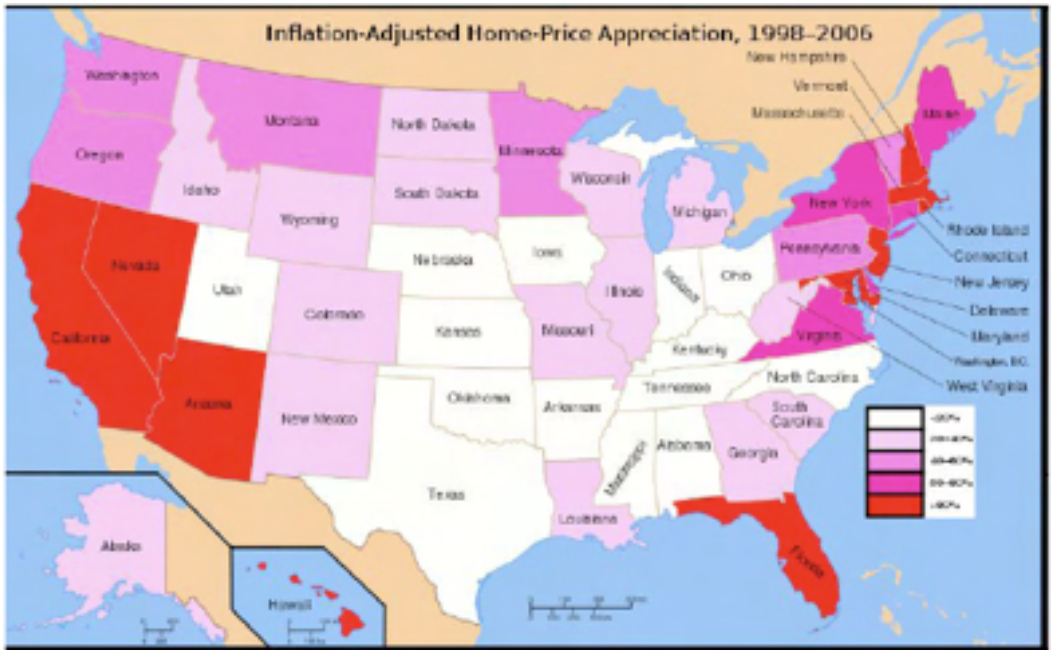
Fig. 5. (Color online) Quarterly average HPI in the 21 states and in the District of Columbia (DC) exhibiting a clear upward faster-than-exponential growth. For better representation, we have normalized the house price indices for the second quarter of 1992 to 100 in all 22 cases. The corresponding states are given in the legend.

W.-X. Zhou, D. Sornette / Physica A 361 (2006) 297–308

Our study in 2005 identifies the bubble states

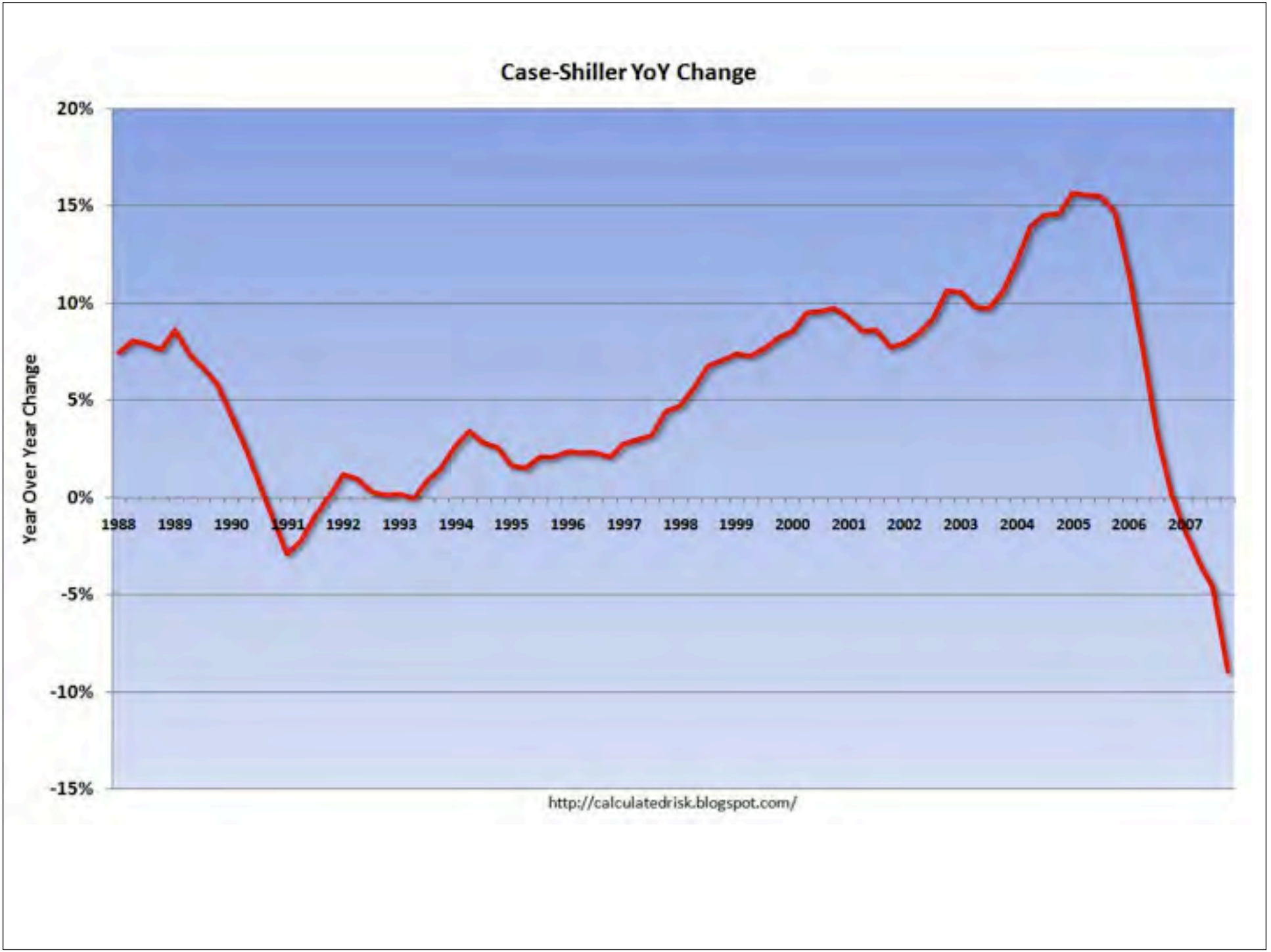


Local bubbles (Froths) of Housing Markets in US, 1998-2006



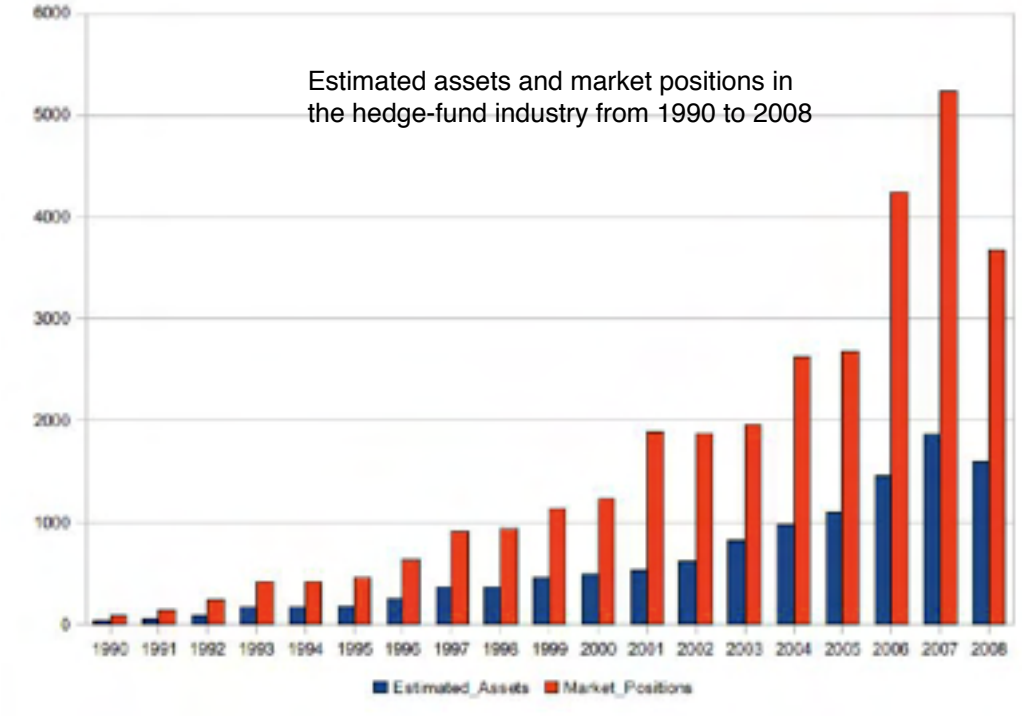
Real-estate in the USA

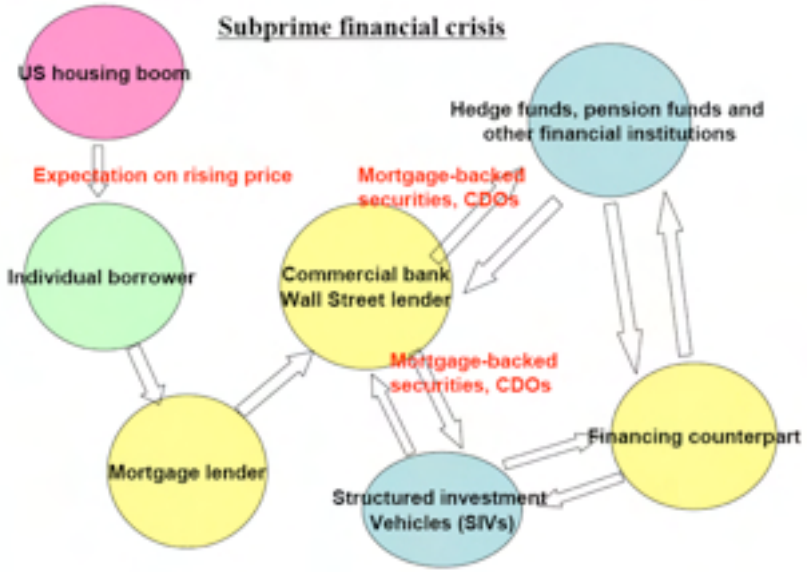
W.-X. Zhou and D. Sornette, Is There a Real-Estate Bubble in the US?
Physica A 361, 297-308 (2006) (http://arxiv.org/abs/physics/0506027)


Case-Shiller YoY Change
20%
15%
10%
5%
0%
-5%
-10%
-15%
Year Over Year Change
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
http://calculatedrisk.blogspot.com/

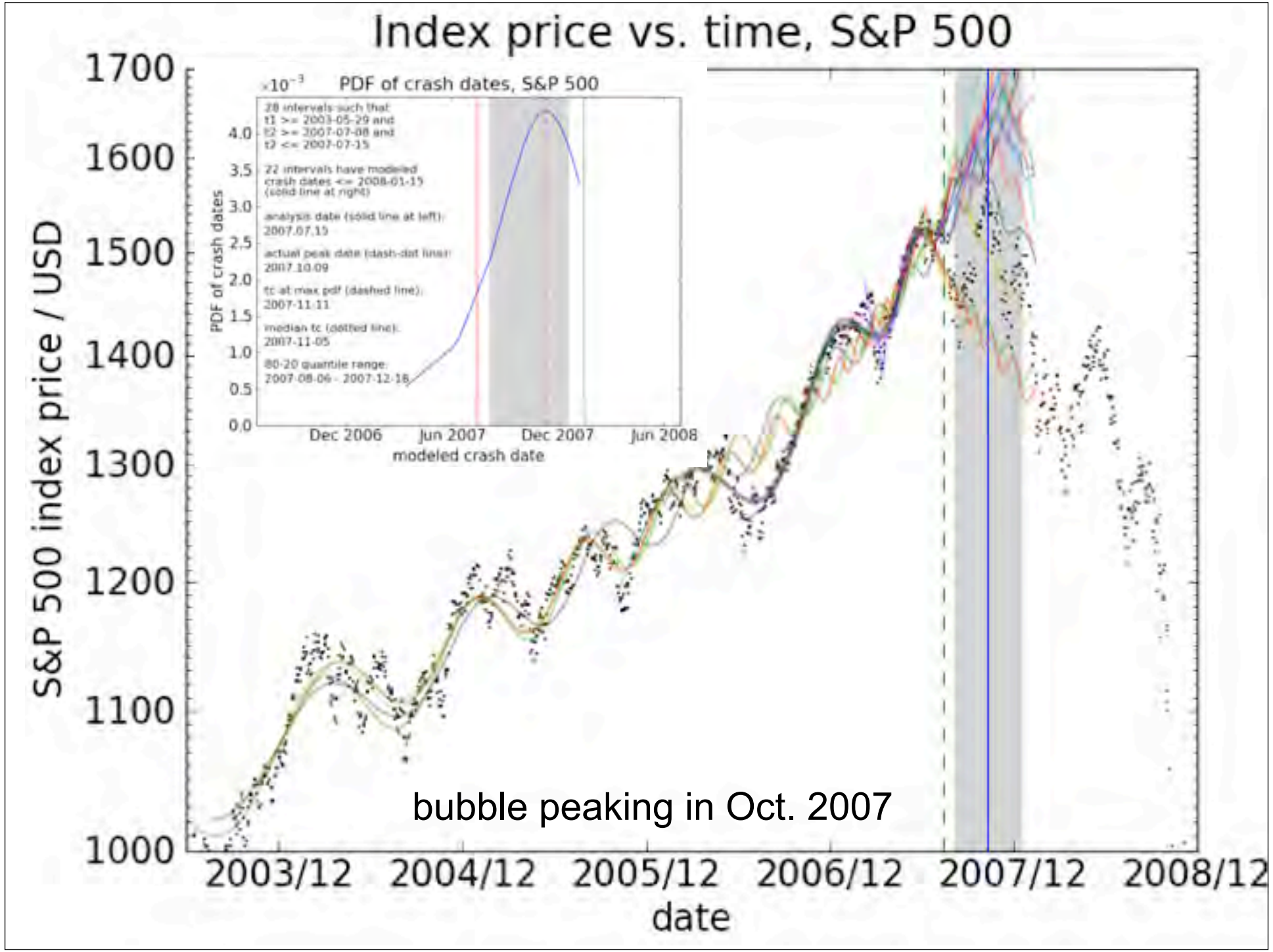
Securitization of non-financial assets (commodities, real-estate, credit)

One prominent financial figure held the greatest sway in debates about the regulation and use of derivatives — exotic contracts that promised to protect investors from losses, thereby stimulating riskier practices that led to the financial crisis. For more than a decade, the former Federal Reserve Chairman Alan Greenspan has fiercely objected whenever derivatives have come under scrutiny in Congress or on Wall Street. "What we have found over the years in the marketplace is that derivatives have been an extraordinarily useful vehicle to transfer risk from those who shouldn't be taking it to those who are willing to and are capable of doing so," Mr. Greenspan told the Senate Banking Committee in 2003. "We think it would be a mistake" to more deeply regulate the contracts, he added.



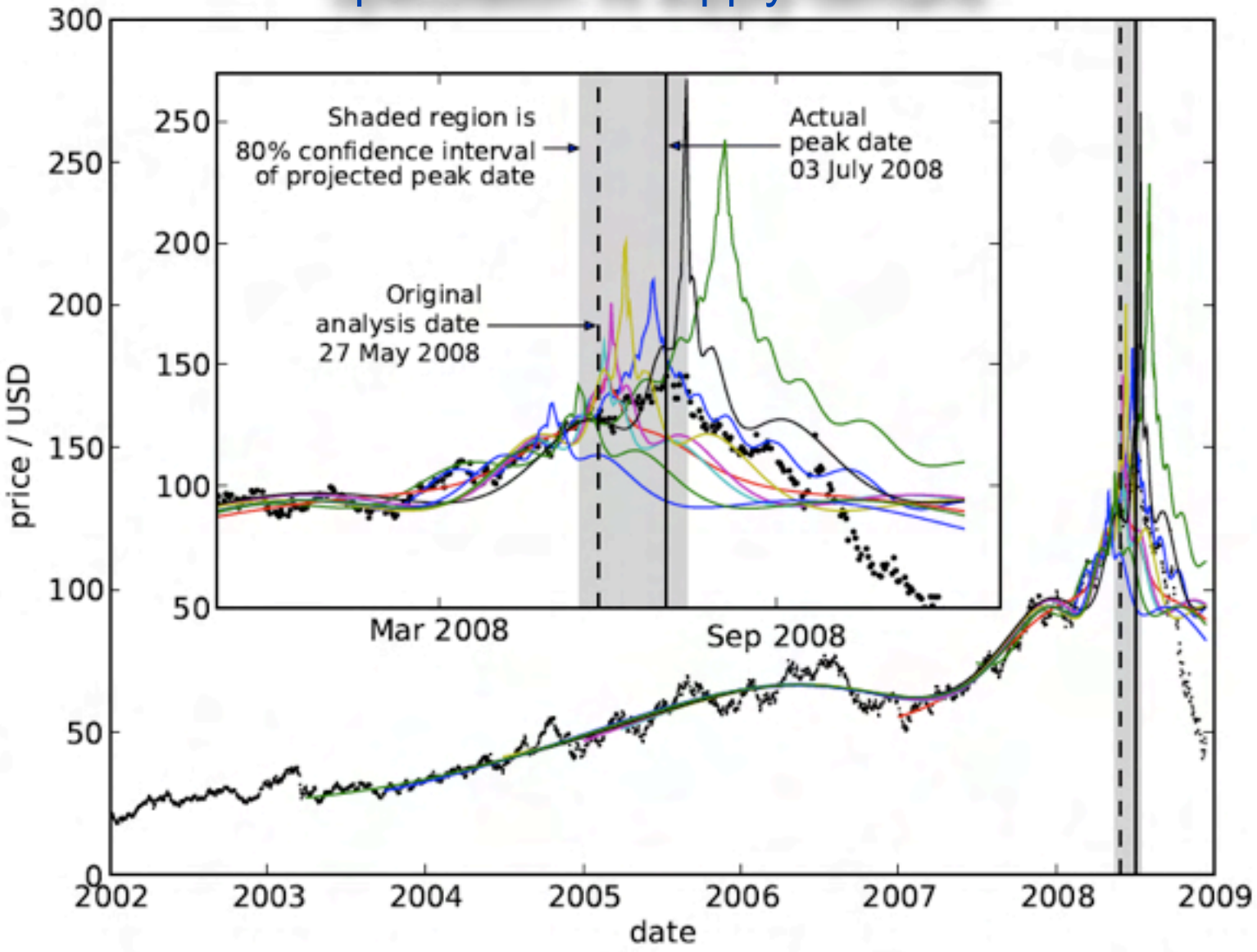


"Not only have individual financial institutions become less vulnerable to shocks from underlying risk factors, but also the financial system as a whole has become more resilient." — Alan Greenspan in 2004


Index price vs. time, S&P 500
S&P 500 index price / USD
1700
1600
1500
1400
1300
1200
1100
1000
2003/12
2004/12
2005/12
2006/12
2007/12
2008/12
date
PDF of crash dates, S&P 500
×10⁻³
PDF of crash dates
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Dec 2006
Jun 2007
Dec 2007
Jun 2008
modeled crash date
28 intervals such that:
t1 >= 2003-05-29 and
t2 >= 2007-07-08 and
t2 <= 2007-07-15
22 intervals have modeled
crash dates <= 2008-01-15
(solid line at right)
analysis date (solid line at left):
2007.07.15
actual peak date (dash-dot line):
2007.10.09
tc at max pdf (dashed line):
2007-11-11
median tc (dotted line):
2007-11-05
80-20 quantile range:
2007-08-06 - 2007-12-18
bubble peaking in Oct. 2007

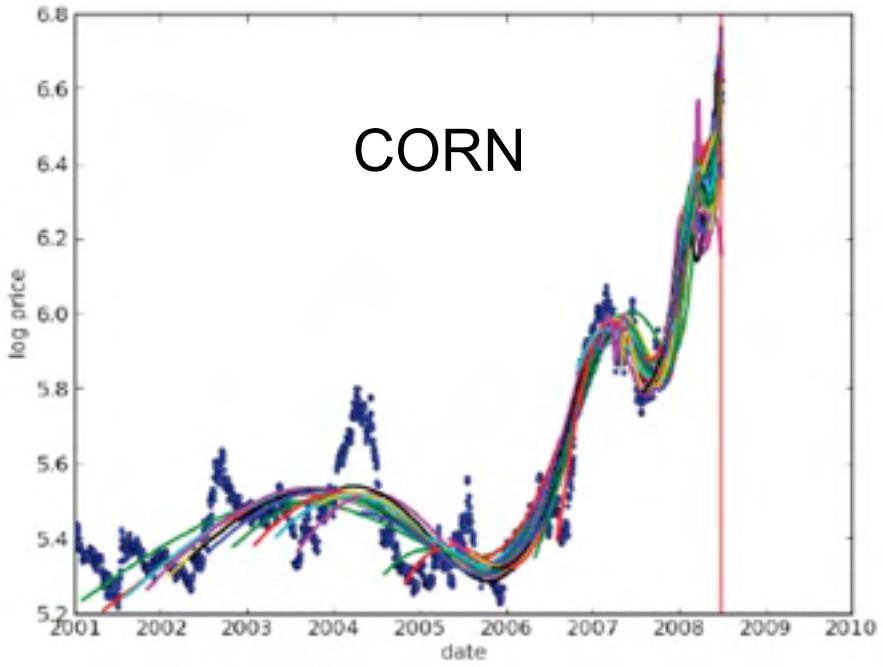
2006-2008 Oil bubble

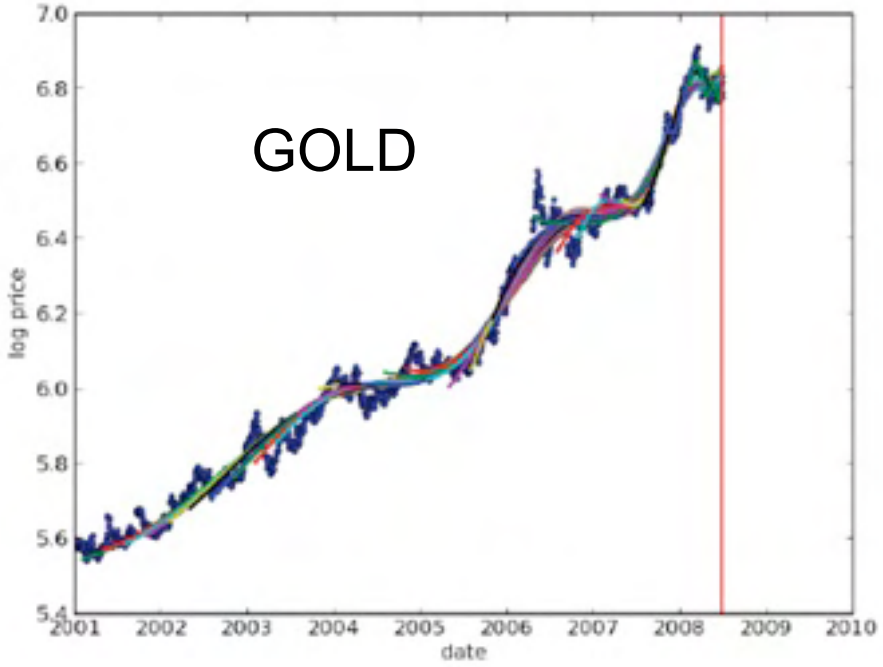
Speculation vs supply-demand



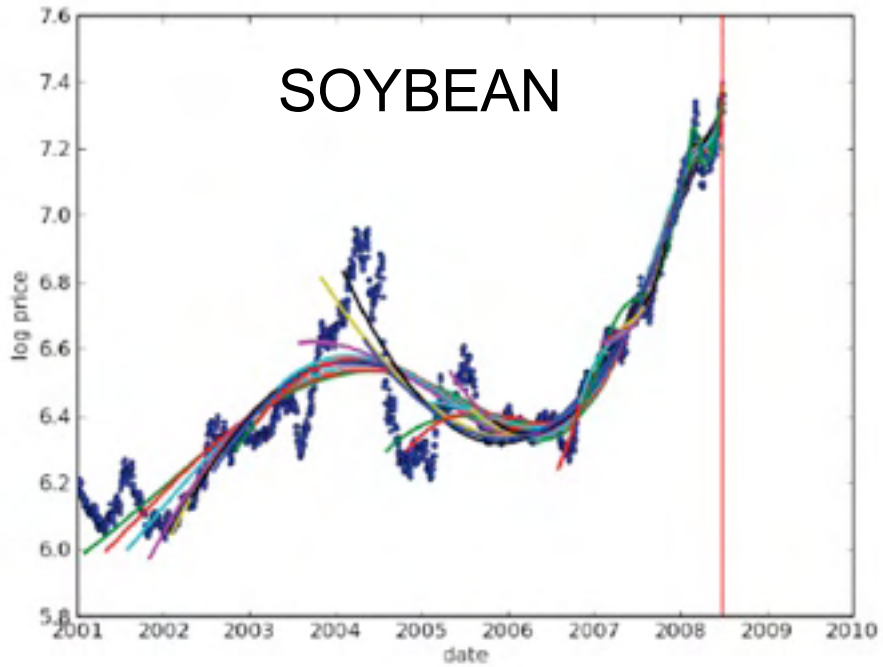
D. Sornette, R. Woodard and W.-X. Zhou, The 2006-2008 Oil Bubble and Beyond, Physica A 388, 1571-1576 (2009) (arXiv.org/abs/0806.1170)

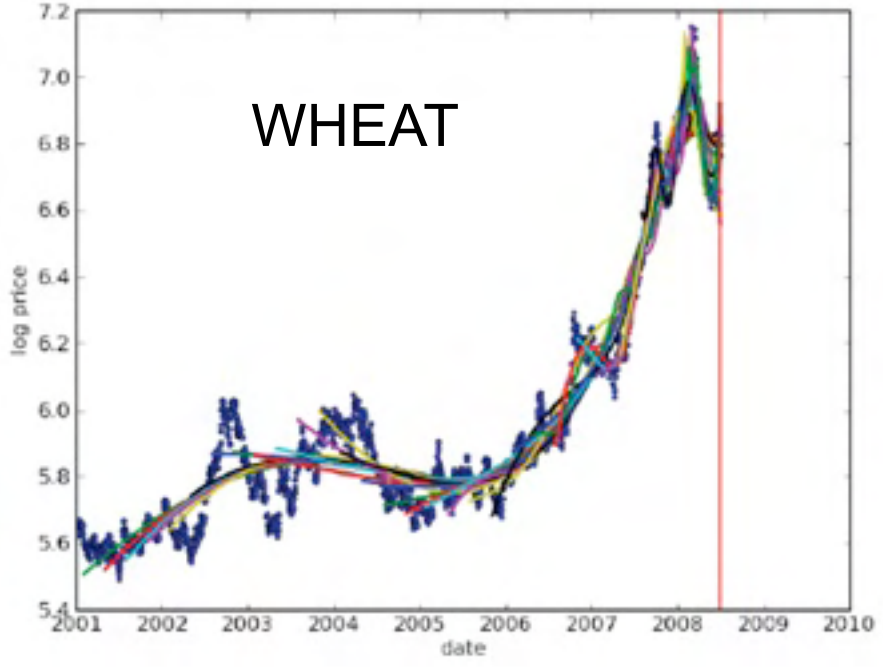
Typical result of the calibration of the simple LPPL model to the oil price in US$ in shrinking windows with starting dates t_{start} moving up towards the common last date t_{last} = May 27, 2008.



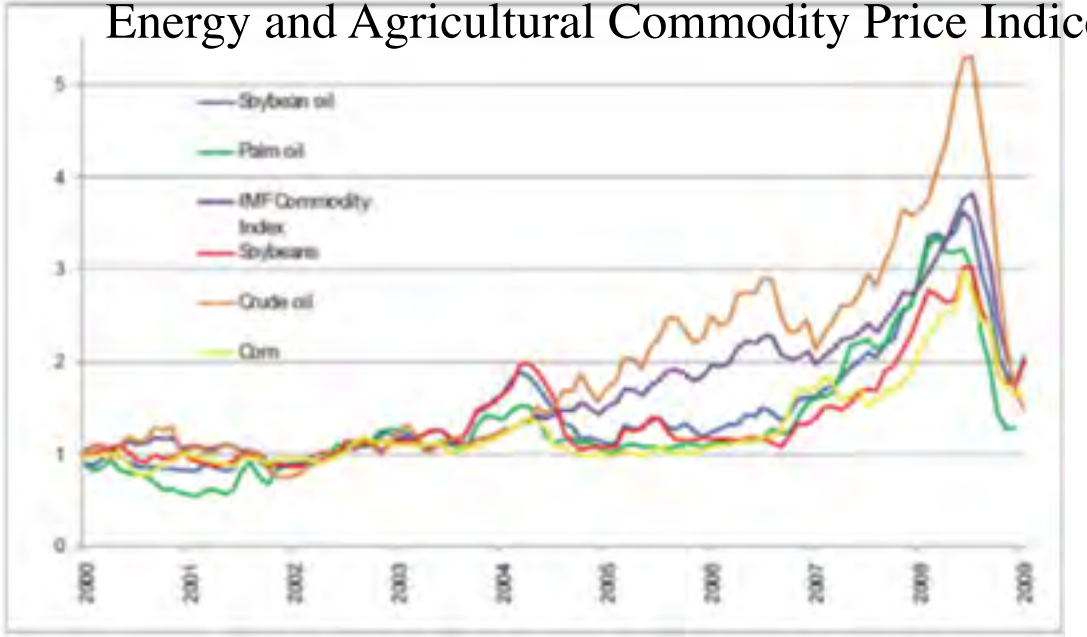


R.Woodard and D.Sornette (2008)

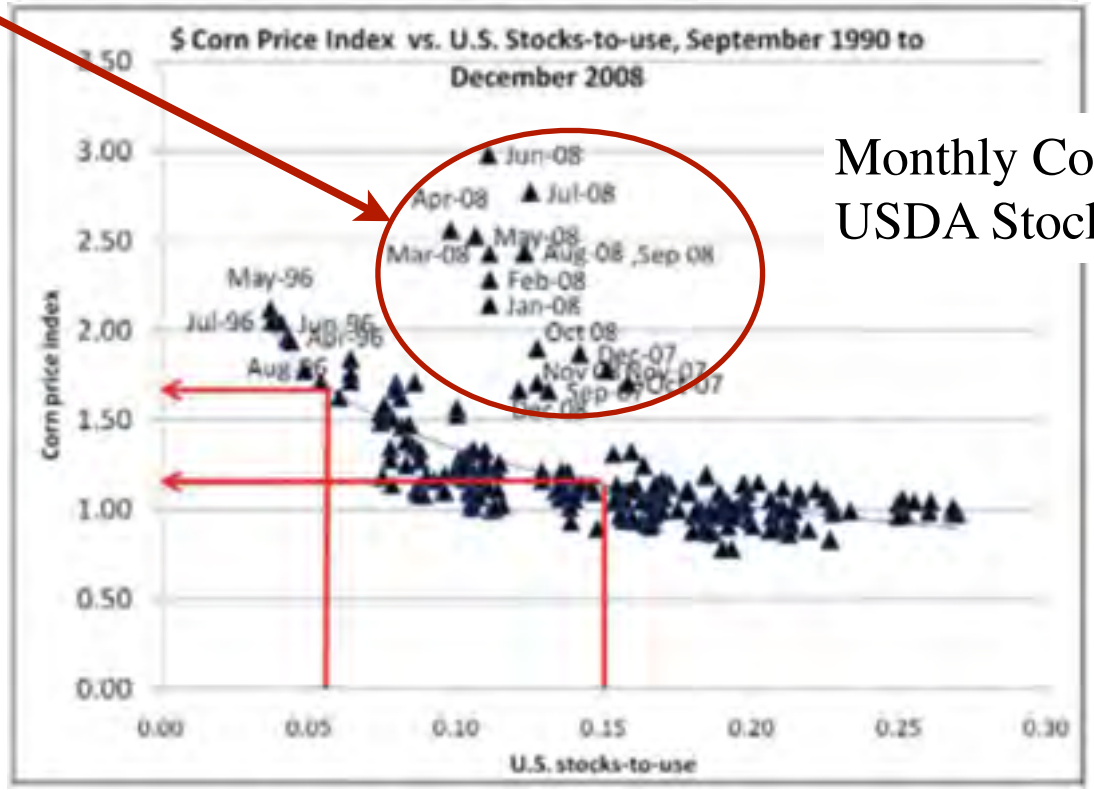




Energy and Agricultural Commodity Price Indices, 2000-2009

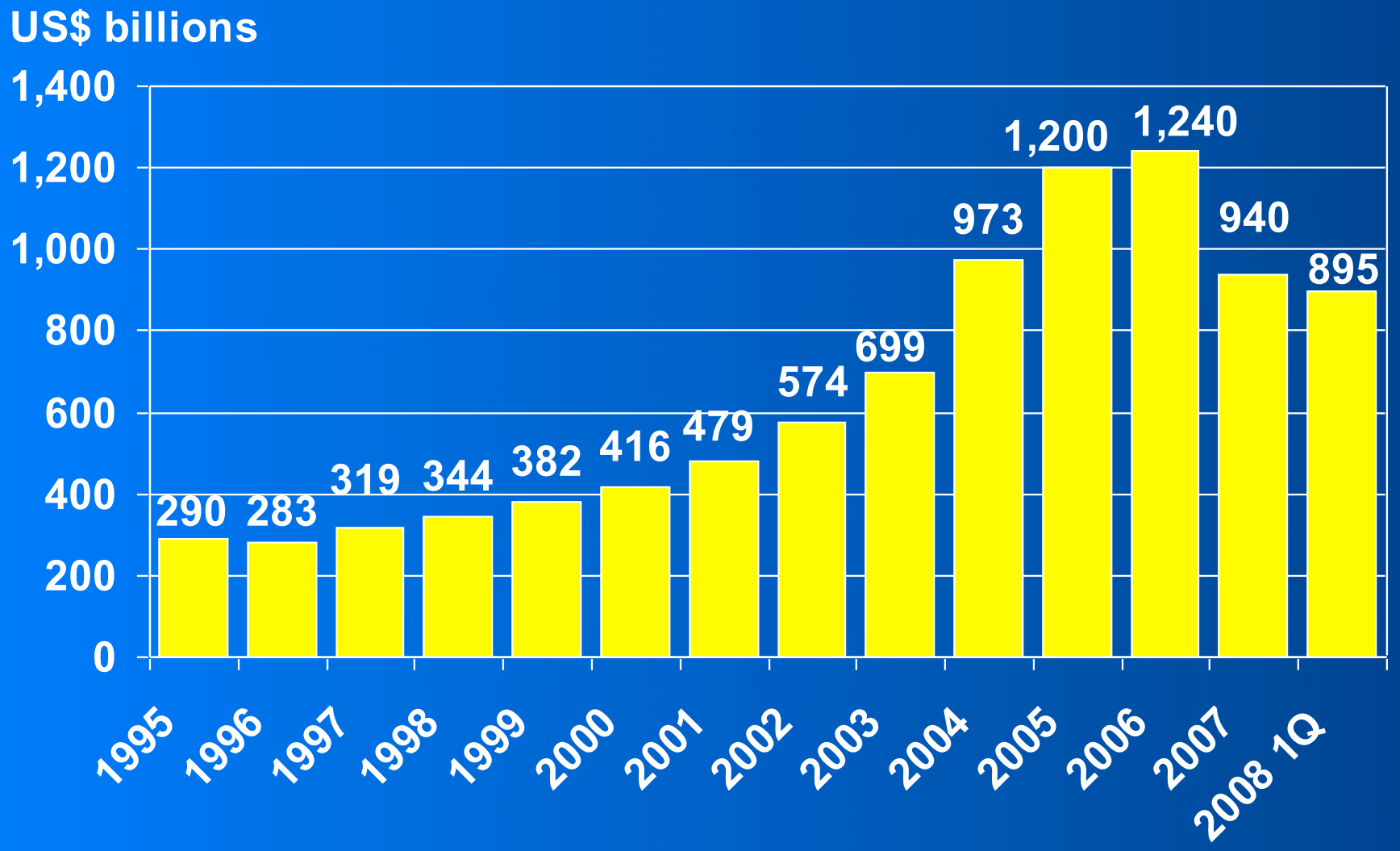


Abnormal relationship signaling a bubble



Monthly Corn Price Index and USDA Stocks

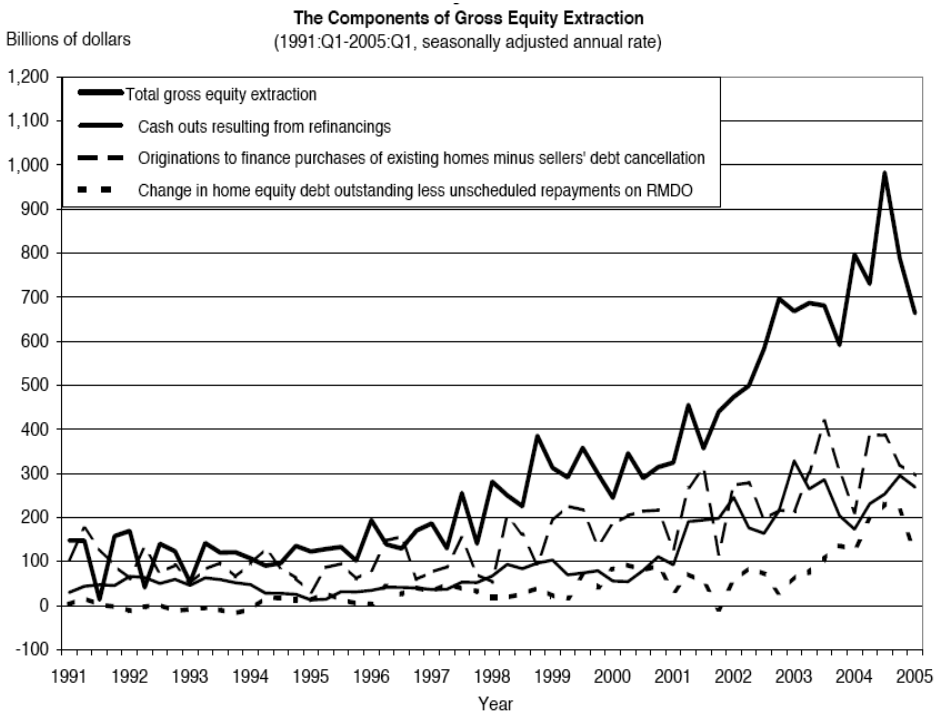
Subprime Mortgage Loans Outstanding



Source: Inside Mortgage Finance.

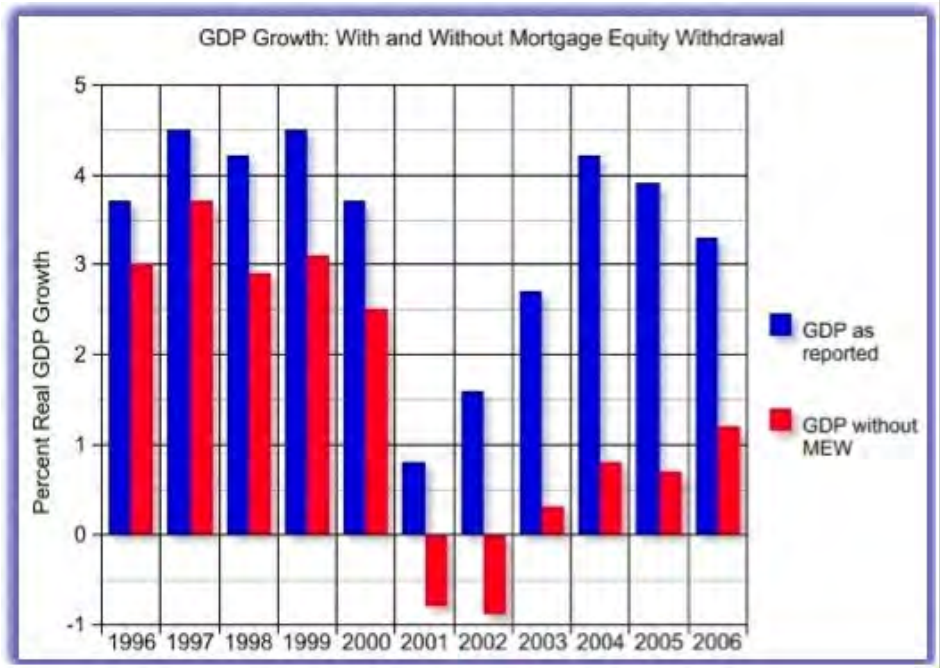
Wealth Extraction

Over the past decade and a half, (B - F) has been closely correlated with realized capital gains on the sale of homes. B-F=change in home equity debt outstanding less unscheduled repayment on RMDO



Alan Greenspan and James Kennedy (Nov. 2005)

Mortgage Equity Withdrawal impact on GDP



source: John Mauldin (April 09)

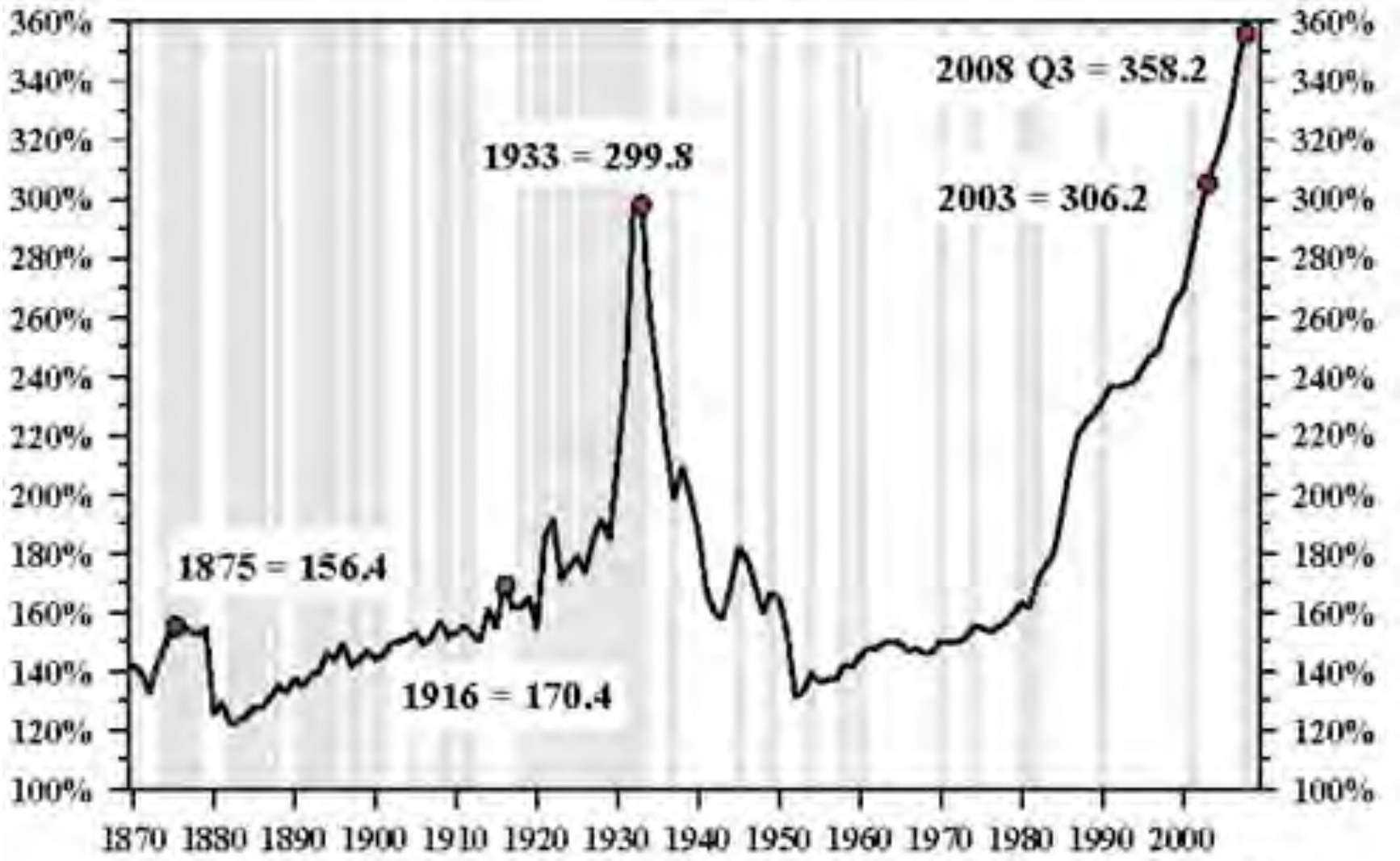
JANUARY 2012
McKinsey Quarterly
mckinsey global institute

US household debt as % of gross disposable income, quarterly, seasonally adjusted

Total U.S. Debt as a % of GDP

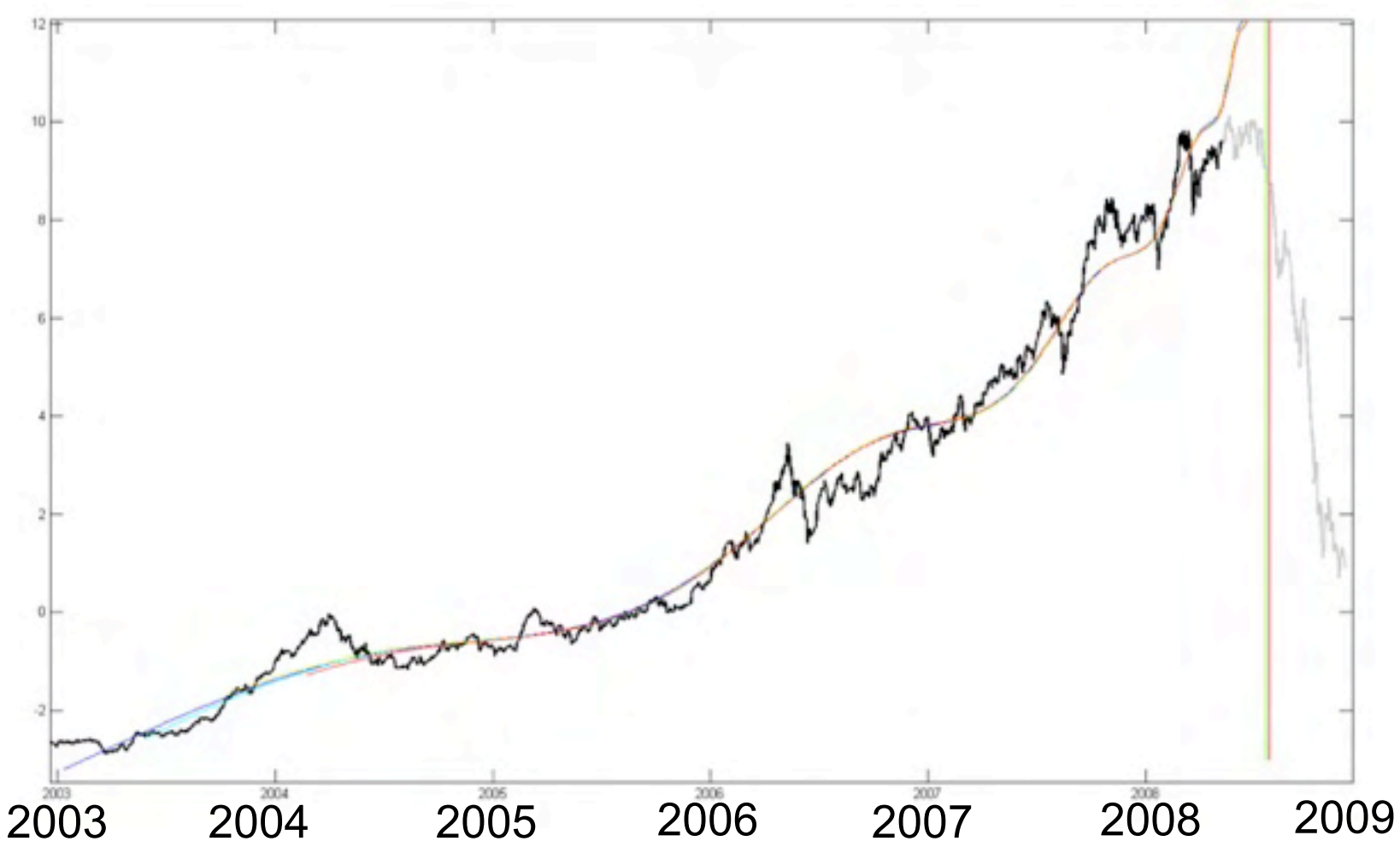
annual

$ 50 trillions



Sources: Bureau of Economic Analysis, Federal Reserve, Census Bureau: Historical Statistics of the United States Colonial Times to 1970. Through Q3 2008.

The Global BUBBLE



PCA first component on a data set containing, emerging markets equity indices, freight indices, soft commodities, base and precious metals, energy, currencies...

(Peter Cauwels FORTIS BANK - Global Markets)

Predictability of the 2007-XXXX crisis:
30 year History of **bubbles** and of **Endogeneity**

- Worldwide bubble (1980-Oct. 1987)
- The ICT (dotcom) “new economy” bubble (1995-2000)
- Real-estate bubbles (2003-2006)
- MBS, CDOs bubble (2004-2007)
- Stock market bubble (2004-2007)
- Commodities and Oil bubbles (2006-2008)
- **Debt bubbles**

Didier Sornette and Ryan Woodard Financial Bubbles, Real Estate bubbles, Derivative Bubbles, and the Financial and Economic Crisis (2009)(http://arxiv.org/abs/0905.0220)

Fundamental origins of the on-going economic crises

1945-1970: reconstruction boom and consumerism

1971-1980: Bretton Woods system termination and oil shocks / inflation shocks

1981-2007: Illusion of the "perpetual money machine" and virtual financial wealth

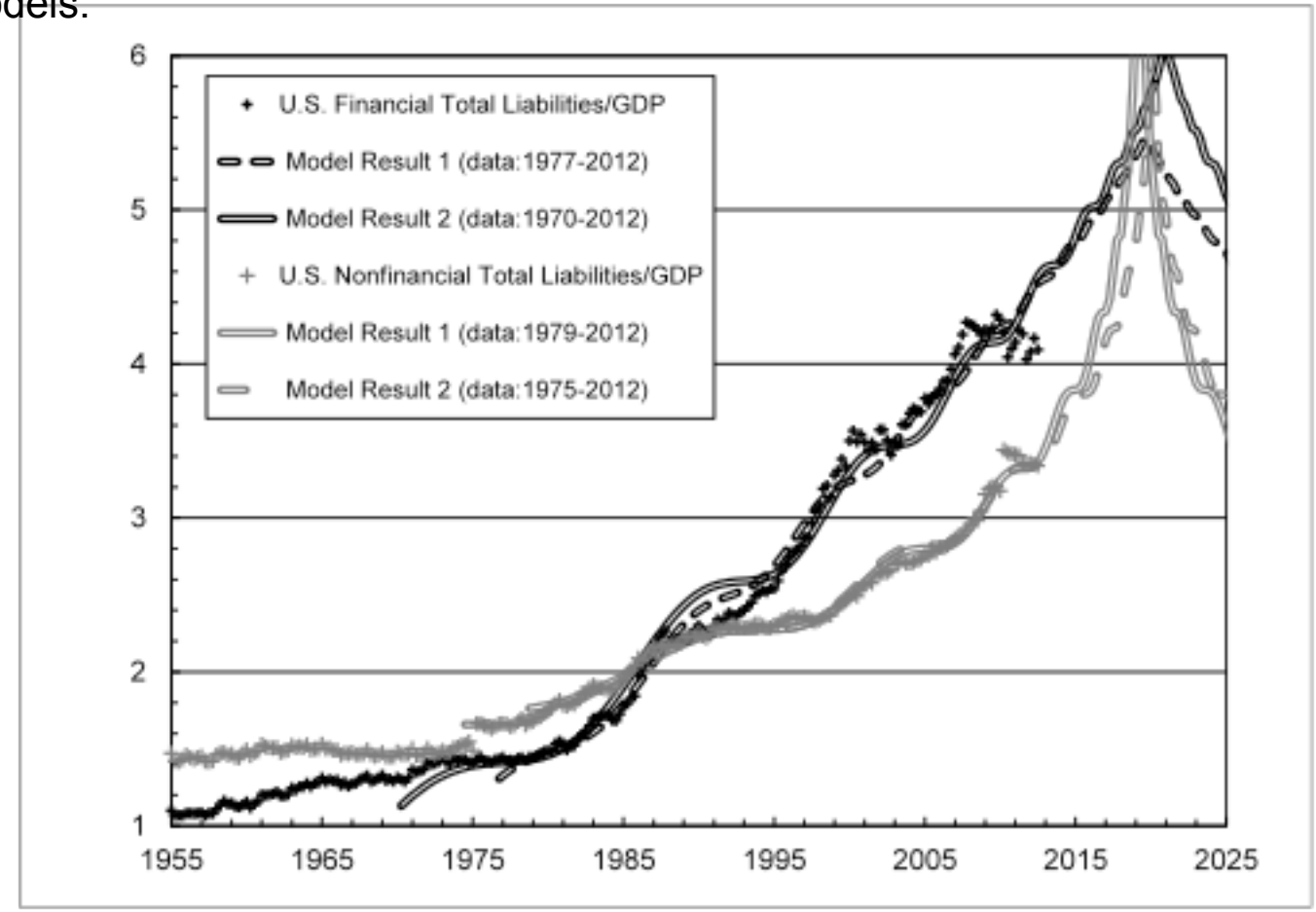
2008-2020s: New era of pseudo growth fueled by QEs and other Central Banks+Treasuries actions

-very low interest rate for a very long time (decades)
-net erosion even in the presence of apparent low (disguised) inflation
-reassessment of expectation for the social and retirement liabilities
-a turbulent future with many transient bubbles
-need to capture value and be contrarian => exploit herding and fear

2020s-20xx: Interconnection of many systemic risks

Total liabilities of the U.S. financial and non- financial sectors divided by the GDP

The data are taken from the Flow of Funds accounts of the U.S. (http://www.federalreserve.gov/releases/z1/), the non-financial sector includes the federal government, government sponsored entities, household and non-profit and non-financial business. The smooth curves show the fits of the models.



D. Sornette and P. Cauwels, The Illusion of the Perpetual Money Machine, Notenstein Academy White Paper Series (Dec. 2012) (http://ssrn.com/abstract=2191509)

This picture demonstrates that debt levels are on unsustainable tracks that, according to our bubble models, are expected to reach a critical point towards the end of the present decade.

Central banks do care about FINANCIAL MARKET RISKS.... A LOT !

Both previous and present Fed chairmen Greenspan and Bernanke have increasingly made clear that the Federal Reserve does care more and more about the evolution of the stock markets.

On Dec. 3rd, 2010, former Federal Reserve Chairman Alan Greenspan told CNBC that rising stock values have played a critical role in the economic recovery. The stock market got a boost from the Fed policy to boost liquidity, which drove interest rates down and pushed investors toward riskier investments like stocks.

“I think we are underestimating and continuing to underestimate how important asset prices, very specifically equity prices, are not only to shareholders but the economy as a whole,” he said.

Equities have risen more than 80% from the lows set during the financial crisis, noted Greenspan, benefiting investors and helping fuel the recovery. [Source: http://www.dailyfinance.com/story/investing/greenspan-rising-stock-markets-are-key-to-recovery/19743325/?icid=sphere_copyright].

On Nov. 3rd., 2010, Bernanke issued the following statement in an opinion article for the Washington Post released hours after the Fed announced the $600 billion of Treasury buying through June in a second round of unconventional monetary stimulus:

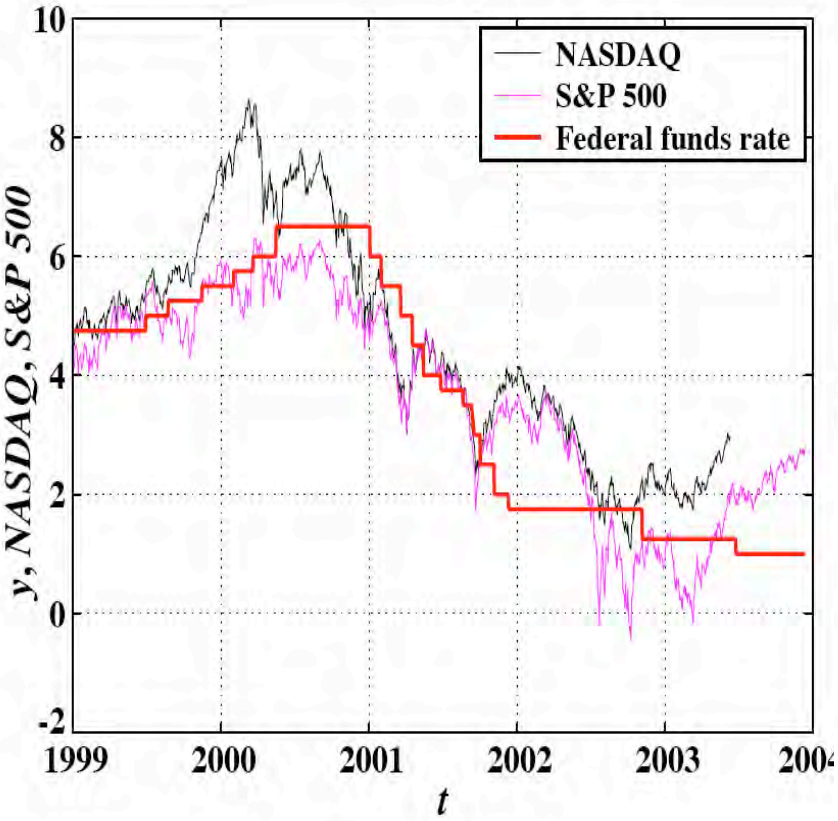
“Resuming large-scale asset purchases should boost economic growth through lower borrowing costs and higher stock prices... Stock prices rose and long-term interest rates fell when investors began to anticipate this additional action... Easier financial conditions will promote economic growth.”

Hidden mandate of the Federal Reserve to steer the stock markets !!!

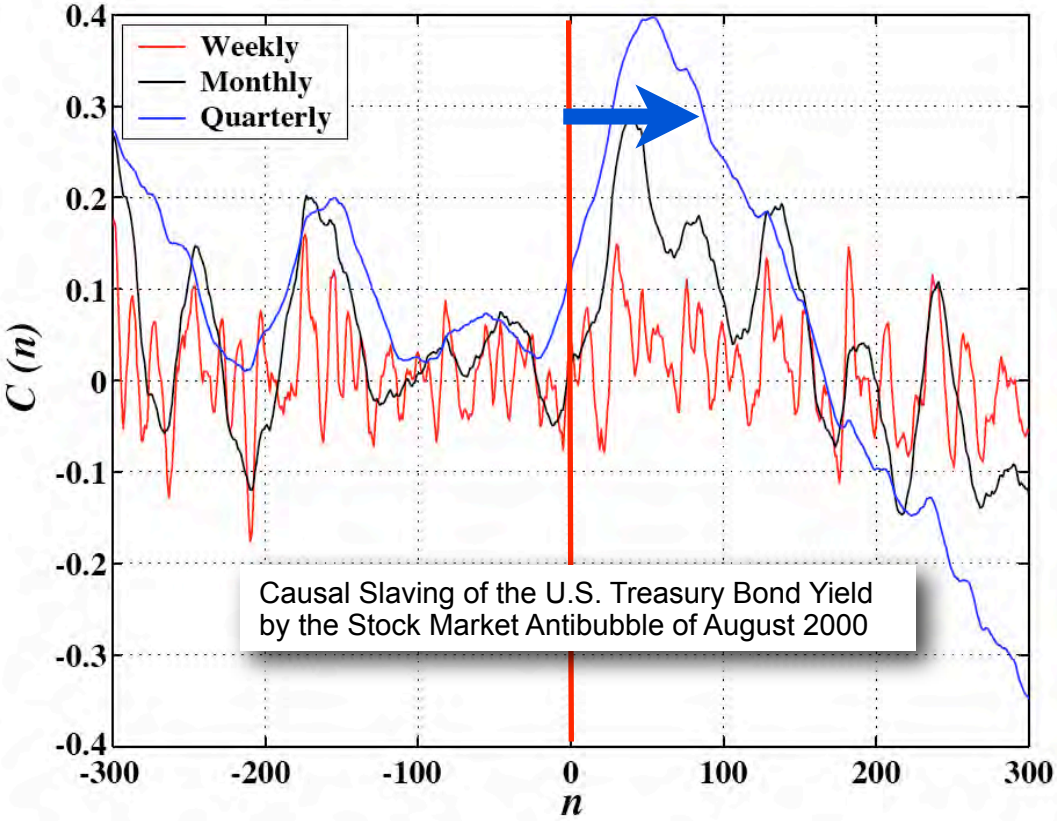
Monetary policy vs economic growth (R. Werner)

"SLAVING OF THE FED TO THE STOCK MARKET

W.-X. Zhou and D. Sornette, Physica A 337, 586-608 (2004)

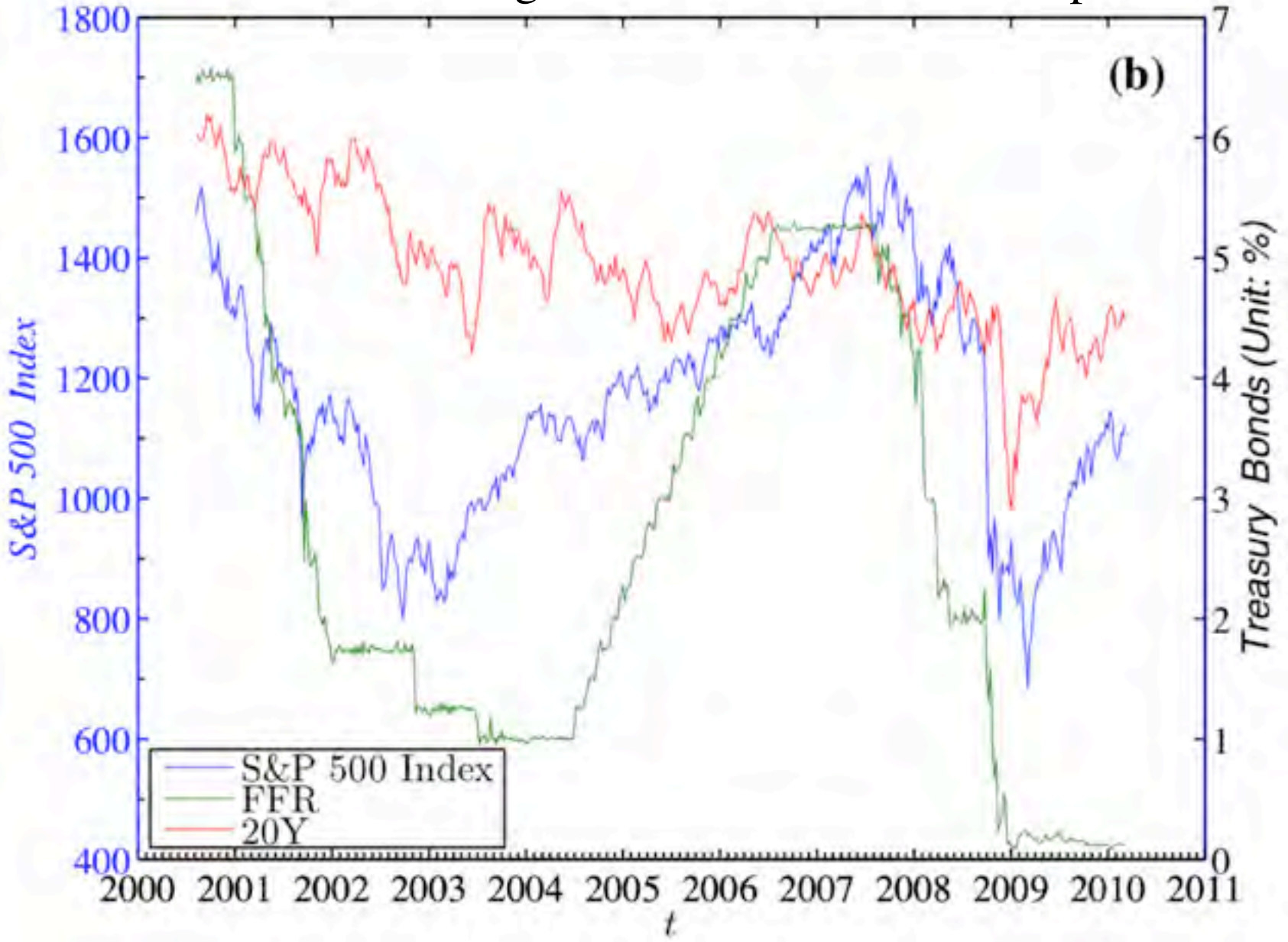


Comparison of the Federal funds rate, the S&P 500 Index x(t), and the NASDAQ composite z(t), from 1999 to mid-2003.



Cross-correlation coefficient C(n) between the increments of the logarithm of the S&P 500 Index and the increments of the Federal funds rate as a function of time lag n in days. The three curves corresponds to three different time steps used to calculate the increments: weekly, monthly and quarterly. A positive lag n corresponds to having the Federal funds rate posterior to the stock market.

S&P 500 and FFR together with the 20Y for comparison.



Kun Guo, Wei-Xing Zhou, Si-Wei Cheng and Didier Sornette, The US stock market leads the Federal funds rate and Treasury bond yields, PLoS ONE 6 (8), e22794 (2011) (http://ssrn.com/abstract=1762788)

Financial Crisis Observatory

www.er.ethz.ch/fco

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CHAIR OF ENTREPRENEURIAL RISKS

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D. Sornette
R. Woodard
P. Cauwels

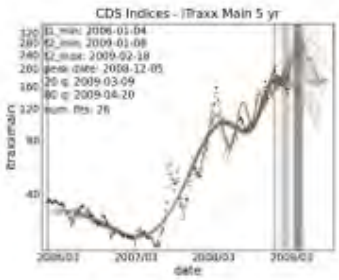
ETH Zurich - D-MTEC - Welcome to the Chair of Entrepreneurial Risks - Financial Crisis Observatory

Financial Crisis Observatory

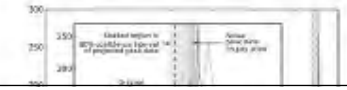
Financial Crisis Observatory
Description
Highlights
Is there an oil bubble?
Pertinent articles
Websites and Blogs
Market Anxiety Measures

The Financial Crisis Observatory (FCO) is a scientific platform aimed at testing and quantifying rigorously, in a systematic way and on a large scale the hypothesis that financial markets exhibit a degree of inefficiency and a potential for predictability, especially during regimes when bubbles develop.

Current analysis and forecasts



CDS (19 February 2009)
Our analysis has been performed on data kindly provided by Amjed Younis of Fortis on 19 February 2009. It consists of 3 data sets: credit default swaps (CDS); German bond futures prices; and spread evolution of several key euro zone sovereigns. The date range of the data is between 4 January 2006 and 18 February 2009. Our log-periodic power law (LPPL) analysis shows that credit default swaps appear bubbly, with a projected crash window of March-May, depending on the index used. German bond futures and European sovereign spreads do not appear bubbly. (See report for more information.)



OIL (27 May 2008)
Oil prices exhibited a record rise followed by a spectacular crash in 2008. The peak of $145.29 per barrel was set on 3 July 2008 and a recent low of $40.81 was scraped on 5 December, a level

Financial Crisis Observatory

Entrepreneurial Risks

Department Management, Technology, and Economics
DMTEC

ETH Zurich
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

- ***Hypothesis H1*: financial (and other) bubbles can be diagnosed in real-time before they end.**

- ***Hypothesis H2*: The termination of financial (and other) bubbles can be bracketed using probabilistic forecasts, with a reliability better than chance (which remains to be quantified).**

The Financial Bubble Experiment

advanced diagnostics and forecasts of bubble terminations

- ***Time@Risk*: Development of dynamical risk management methods**

Concluding remarks

1-All interventions will fail if we do not have better science and better metrics to **monitor and diagnose** (ex: biology, medicine, astronomy, chemistry, physics, evolution, and so on)

2-**Leverage/debt as a key system variable**

3-Need to make policy makers and regulators **endogenous** ("creationist" view of government role, illusion of control of monetary policy and risk management and unintended consequences of regulations)

4-**Fundamental interplay between system instability and growth**; the positive side of (non-financial) bubbles

5-Time to reassess goals (growth vs sustainability vs happiness). In the end, endogenous co-evolution of culture, society and economy

KEY CHALLENGE: genuine trans-disciplinarity by
TRAINING in 2-3 disciplines + CHANGE OF CULTURE

Further Reading

D. Sornette and P. Cauwels, The Illusion of the Perpetual Money Machine,
Notenstein Academy White Paper Series (Dec. 2012)
(http://www.notenstein.ch/en/news/publications/whitepapers)
(http://arxiv.org/abs/1212.2833 and http://ssrn.com/abstract=2191509})

T. Kaizoji and D. Sornette, Market Bubbles and Crashes,
Encyclopedia of Quantitative Finance (Wiley, 2008)
(preprint at http://arxiv.org/abs/0812.2449)

D. Sornette and R. Woodard Financial Bubbles, Real Estate bubbles, Derivative Bubbles, and the Financial and Economic Crisis
(preprint at http://arxiv.org/abs/0905.0220)
Proceedings of APFA7 (Applications of Physics in Financial Analysis),
``New Approaches to the Analysis of Large-Scale Business and Economic Data,"
Misako Takayasu, Tsutomu Watanabe and Hideki Takayasu, eds., Springer (2010)

D. Sornette, Dragon-Kings, Black Swans and the Prediction of Crises,
International Journal of Terraspace Science and Engineering 2(1), 1-18 (2009)
(http://arXiv.org/abs/0907.4290)

Didier Sornette, Why Stock Markets Crash, (Critical Events in Complex Financial Systems)
Princeton University Press, January 2003

Y. Malevergne and D. Sornette, Extreme Financial Risks (From Dependence to Risk Management)
(Springer, Heidelberg, 2006).