

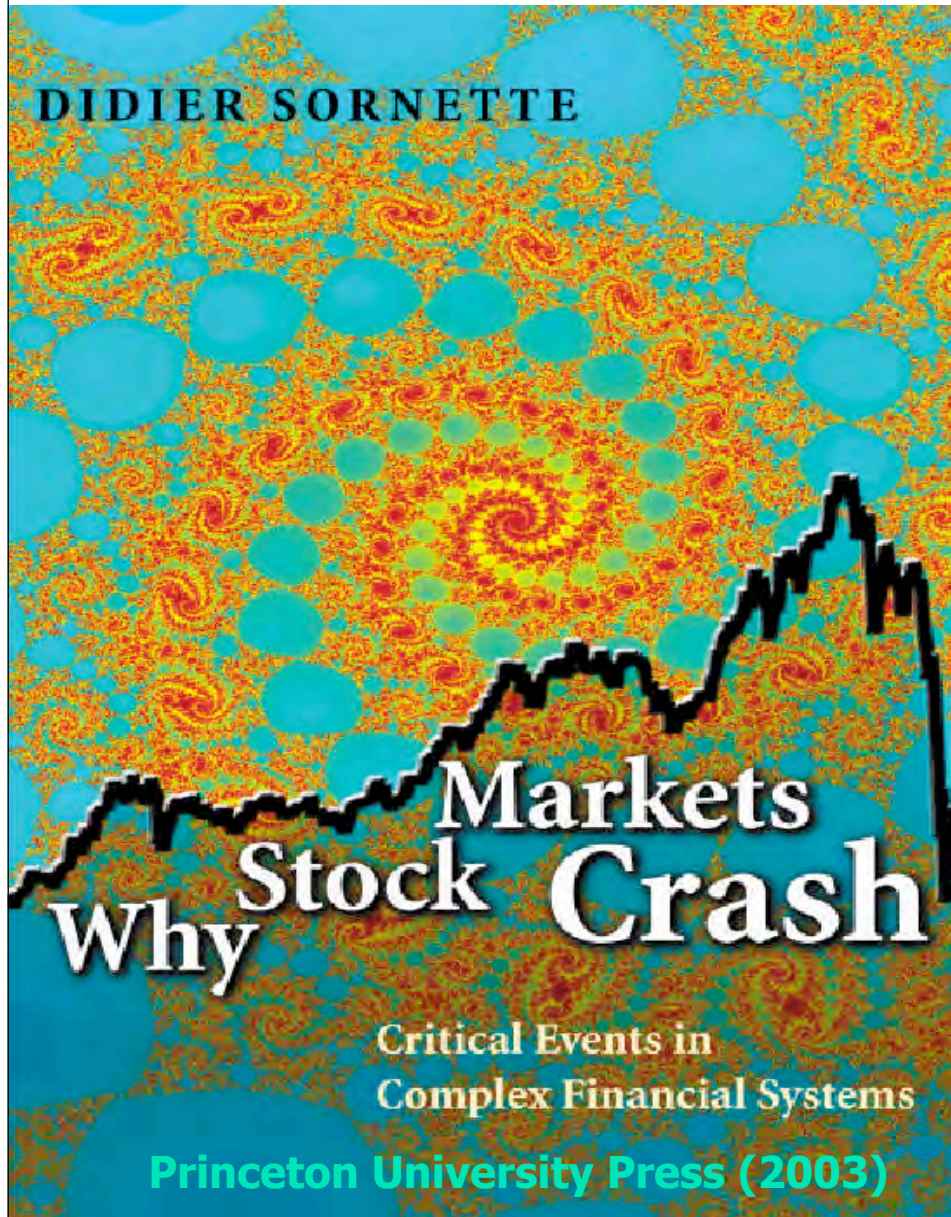
## Séismes et bulles financières : Quelle prévision ?

Avec la participation de :

Didier SORNETTE,  
professeur à l'Institut Polytechnique de Zurich,  
chaire des Risques entrepreneuriaux, professeur de physique et de géophysique.

Paul JORION,  
sociologue et anthropologue, journaliste,  
auteur de plusieurs ouvrages récents sur l'économie et les crises.

# Complex System Approach to Financial Crises



★ Chair of Entrepreneurial Risks

★ Department of Management,  
Technology and Economics, ETH  
Zurich, Switzerland

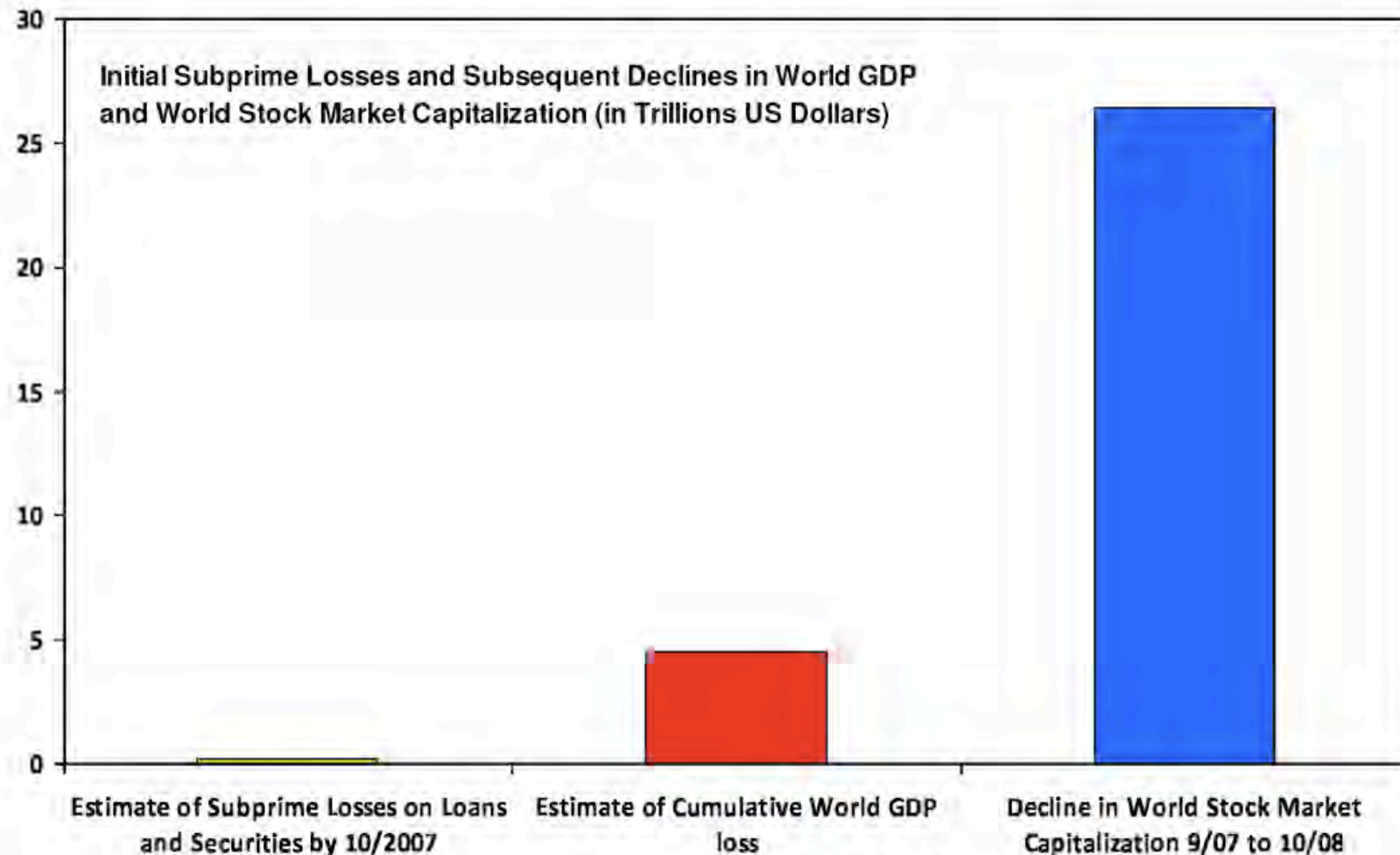
★ Director of the Financial Crisis  
Observatory ([www.er.ethz.ch/fco/  
index](http://www.er.ethz.ch/fco/index))

★ Member of the Swiss Finance  
Institute

★ co-founder of the Competence  
Center for Coping with Crises in  
Socio-Economic Systems, ETH  
Zurich (<http://www.ccss.ethz.ch/>)

# The Paradox of the 2007-20XX Crisis

(trillions of US\$)

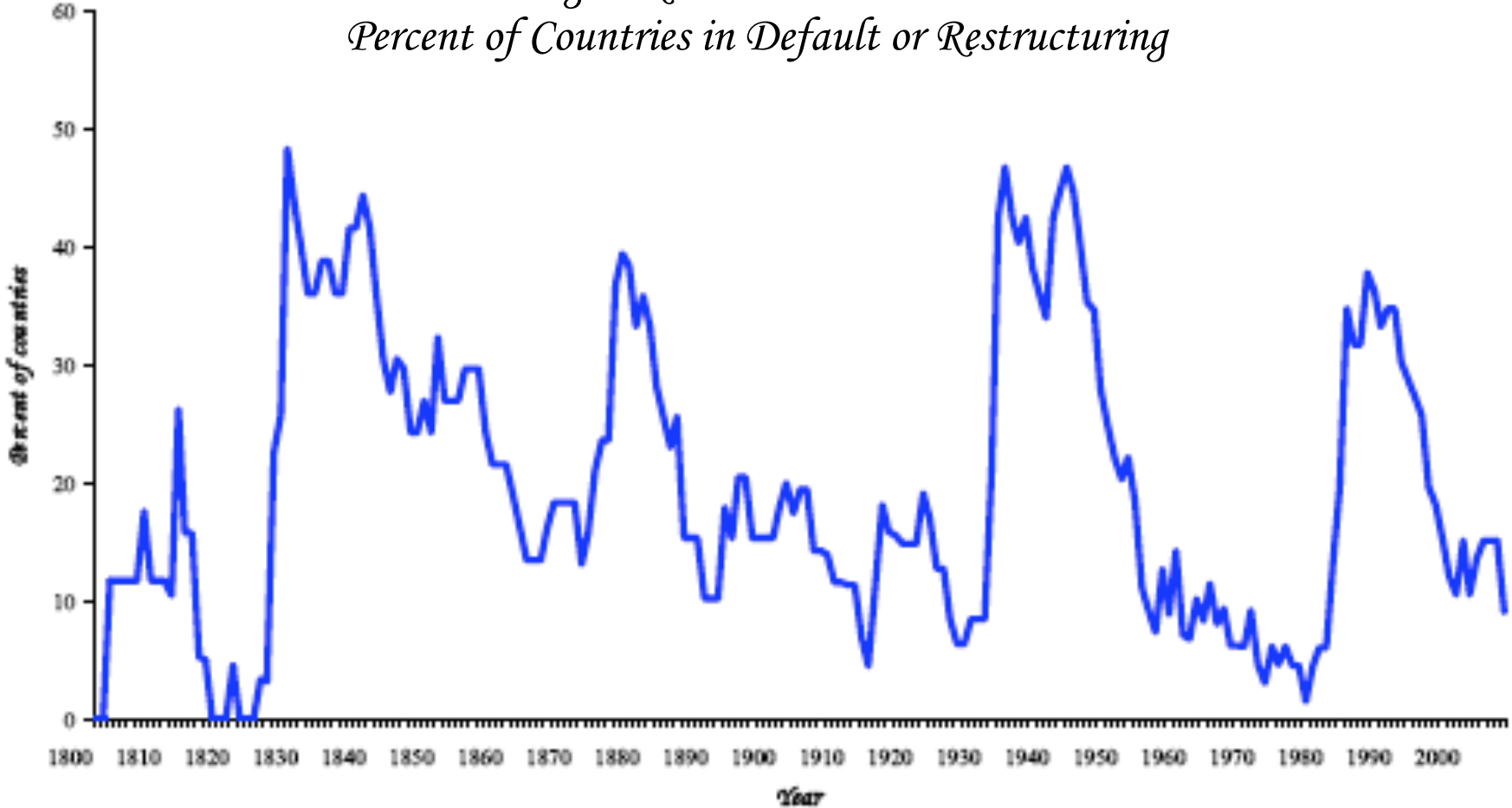


Source: IMF Global Financial Stability Report; World Economic Outlook November update and estimates; World Federation of Exchanges.

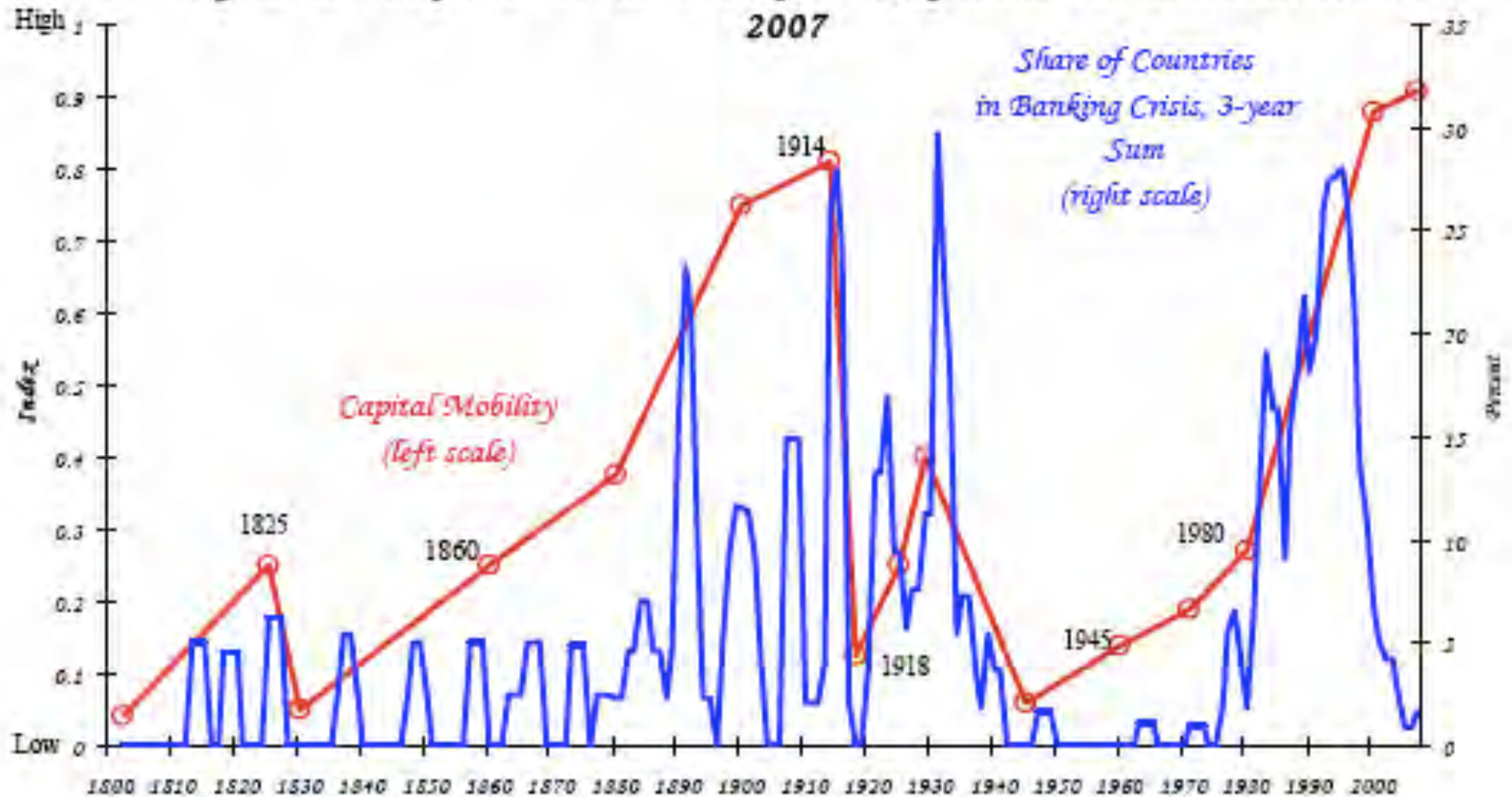


Crises frequently emanate from the financial centers with transmission through interest rate shocks and commodity price collapses. Thus, the recent US sub-prime financial crisis is hardly unique.

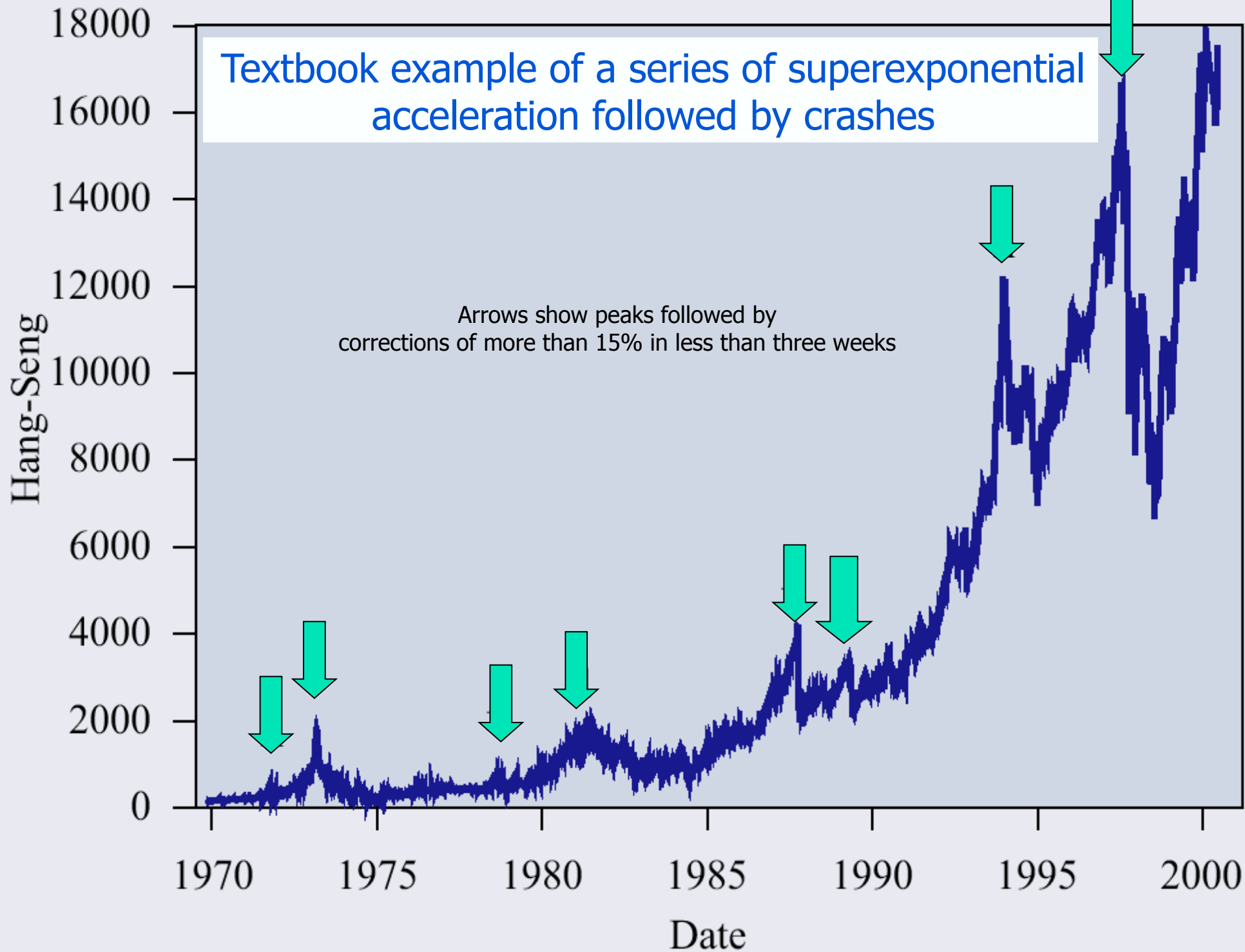
*Sovereign External Debt: 1800-2006*  
*Percent of Countries in Default or Restructuring*

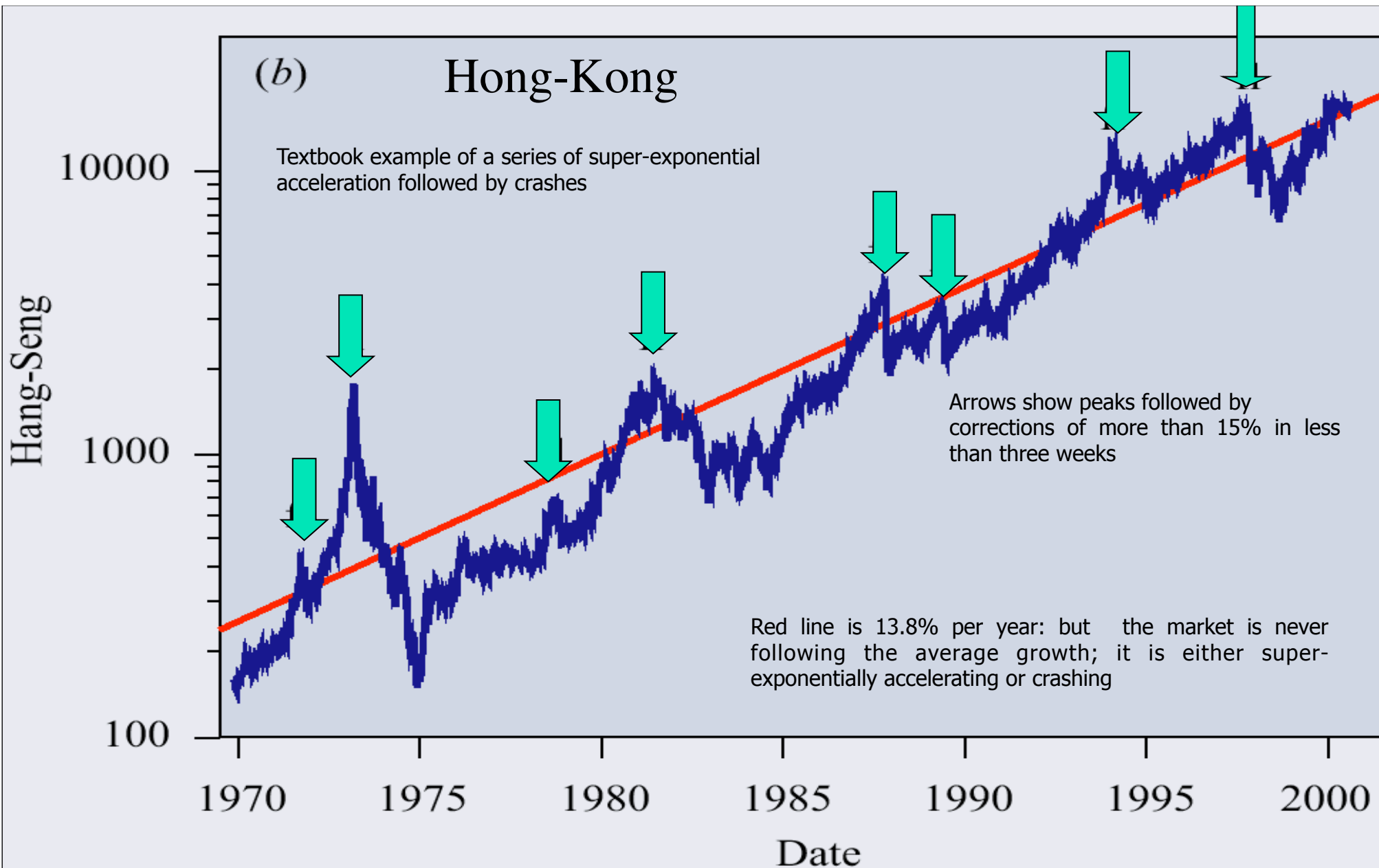


## Capital Mobility and the Incidence of Banking Crisis: All Countries, 1800-2007

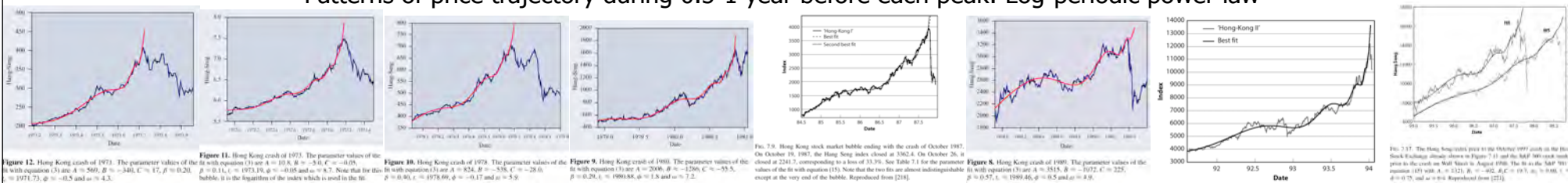


Sources: Bordo et al. (2001), Caprio et al. (2005), Kaminsky and Reinhart (1999), Obstfeld and Taylor (2004), and Carmen M. Reinhart and Kenneth S. Rogoff,





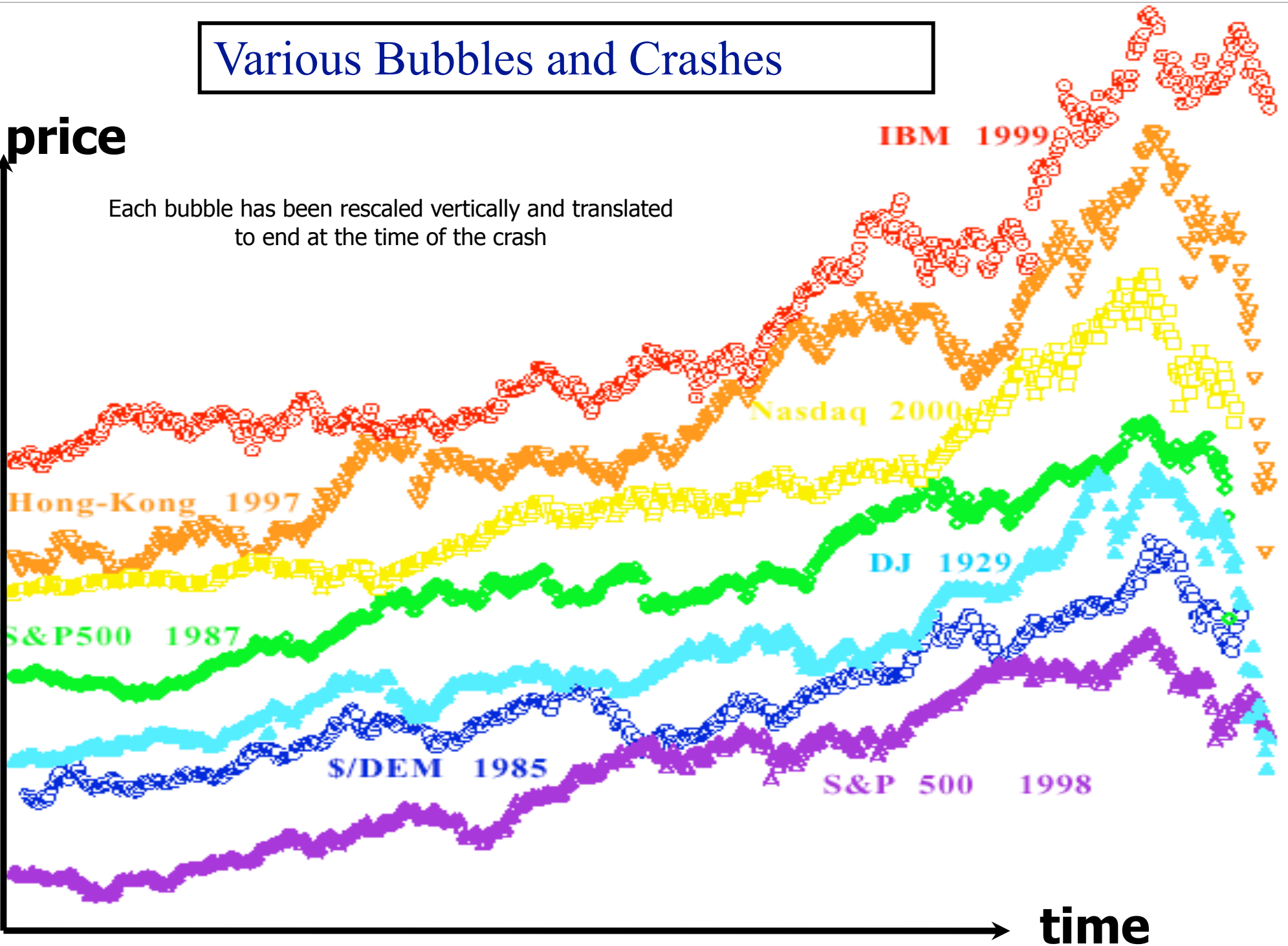
Patterns of price trajectory during 0.5-1 year before each peak: Log-periodic power law



# Various Bubbles and Crashes

price

Each bubble has been rescaled vertically and translated to end at the time of the crash



time



# Financial Instability Hypothesis (Minsky, 1974)

“A fundamental characteristic of our economy is that the financial system swings between robustness and fragility and these swings are an integral part of the process that generates business cycles.”

- **Hedge-finance:** in-flow - out-flow positive over all periods
- **Speculative finance:** in-flow - out-flow negative near term and expected to turn positive long-term
- **Ponzi finance:** in-flow - out-flow negative until the very last period at which a big gain compensates for all the previous losses.

# Complex system approach, cybernetics...

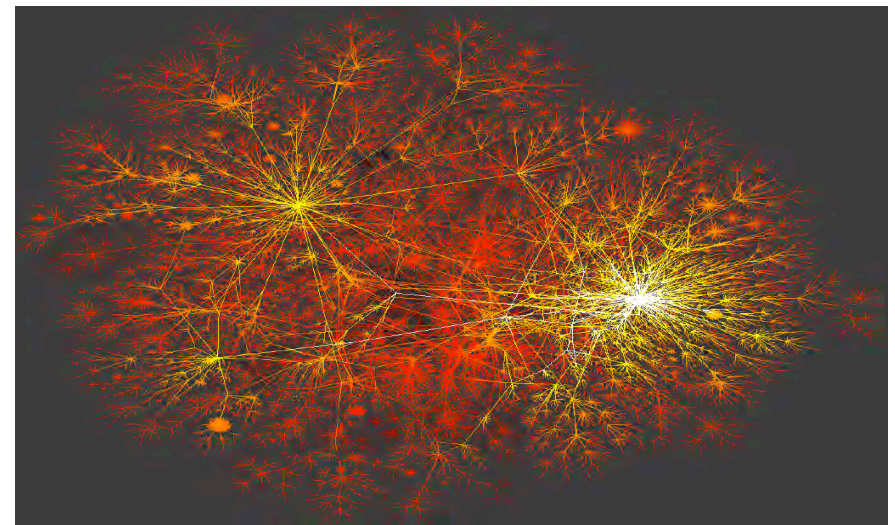
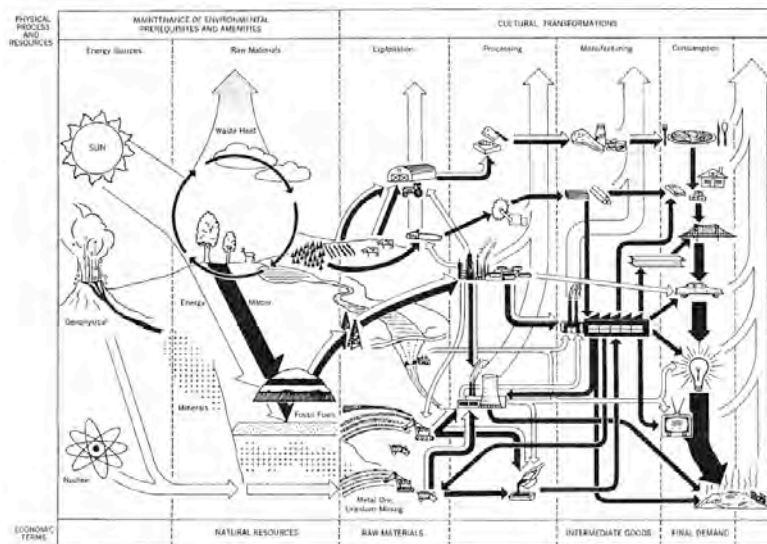
## ECONOMICS

Out-of-equilibrium, frozen heterogeneity, self-organization, phase transitions, bifurcations, catastrophes, “tipping points”,...

- Paul Krugman (1996)  
“Self-organizing economy”
- Brian Arthur (1992)  
Induction, out-of-equilibrium
- Santa Fe Institute (1994-...)
- CSCS Univ Michigan
- CCSS ETH Zurich

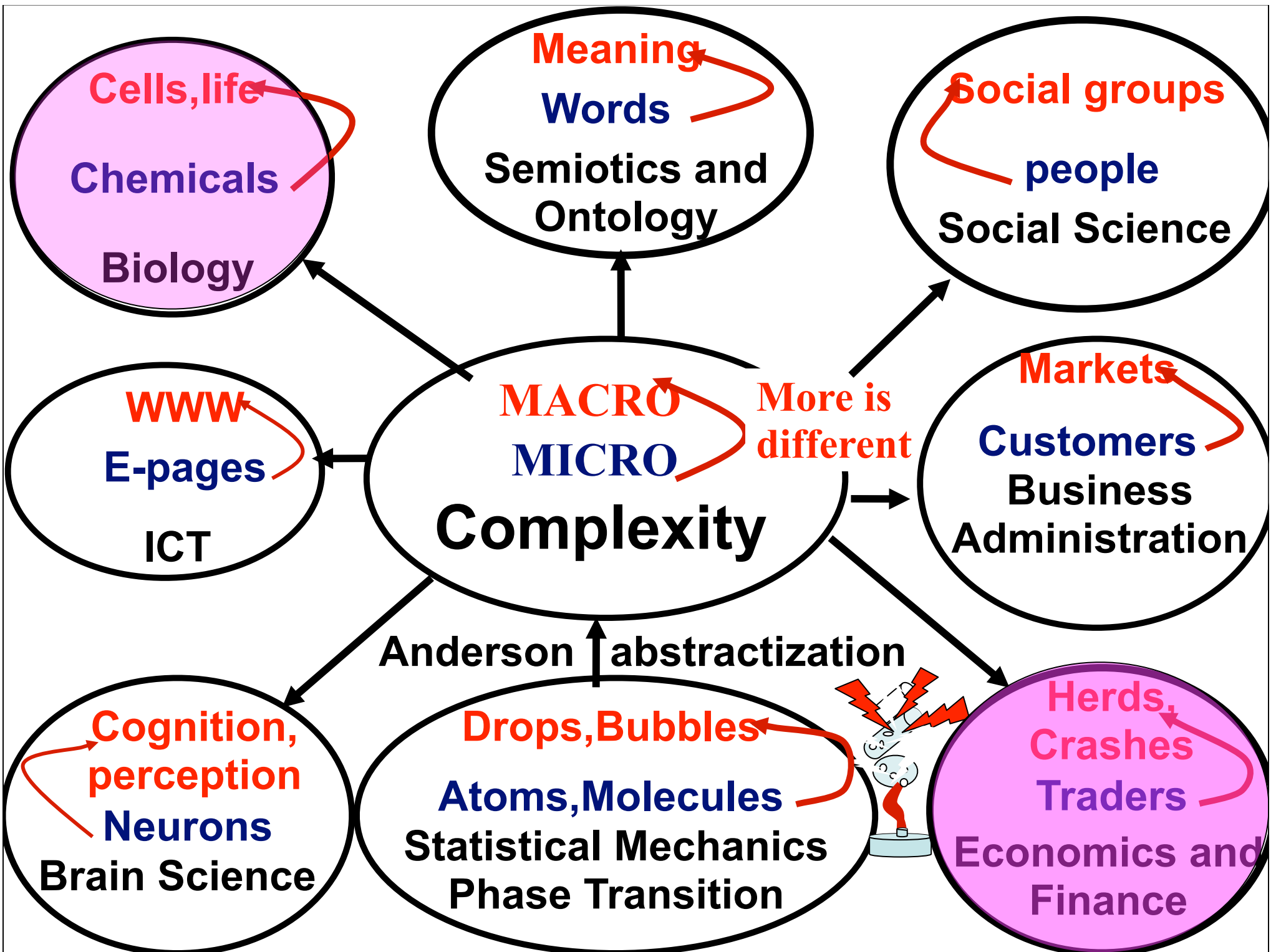
## PHYSICS

- P. W. Anderson (1957)  
“More is different” (1972)
- Out-of-Equilibrium
- frozen heterogeneity  
(spinglasses, glasses, proteins)





- 1945-55 [General Systems Theory](#) (proposed by Ludwig von Bertalanffy and others)
- 1948–55 [Cybernetics](#) (W. Ross Ashby, Norbert Wiener) Mathematical theory of the communication and control of systems through regulatory feedback. Closely related: "control theory"
- 1956 Ludwig von Bertalanffy, Anatol Rapoport, Ralph Garard, Kenneth Boulding establish [Society for the Advancement of General Systems Theory](#)
- 1970 [Catastrophe theory](#) (René Thom, E.C. Zeeman) Branch of mathematics that deals with bifurcations in dynamical systems, classifies phenomena characterized by sudden shifts in behavior arising from small changes in circumstances
- 1980 [Chaos theory](#) (David Ruelle, Edward Lorenz, Mitchell Feigenbaum, Steve Smale, James A. Yorke) Mathematical theory of nonlinear dynamical systems that describes bifurcations, strange attractors, and chaotic motions
- 1960-80 [Dissipative systems and Synergetics](#) (A. Katchalsky, Ilya Prigogine, Hermann Haken, G. Nicolis...) Self-organization of patterns in out-of-equilibrium systems
- 1990 [Complex adaptive systems](#) (CAS) (John H. Holland, Murray Gell-Mann, Harold Morowitz, W. Brian Arthur, Phil Anderson, ...) The "new" science of complexity which describes emergence, adaptation and self-organization, all of which are basic system principles, is based on agents and computer simulations and includes multi-agent systems (MAS) which have become an important tool to study social and complex systems. The study of complex systems today is often subsumed under the term 'complexity theory'. (see for example Edgar Morin, Stuart Kauffman and Steve Wolfram; Santa Fe Institute (SFI))
- 2008 [Competence Center for "Coping with Crises in Socio-Economic Systems"](#) ETH Zurich





# 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 \(2008\)](#)

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.”

**Crises are not black swans but “dragon-kings”**



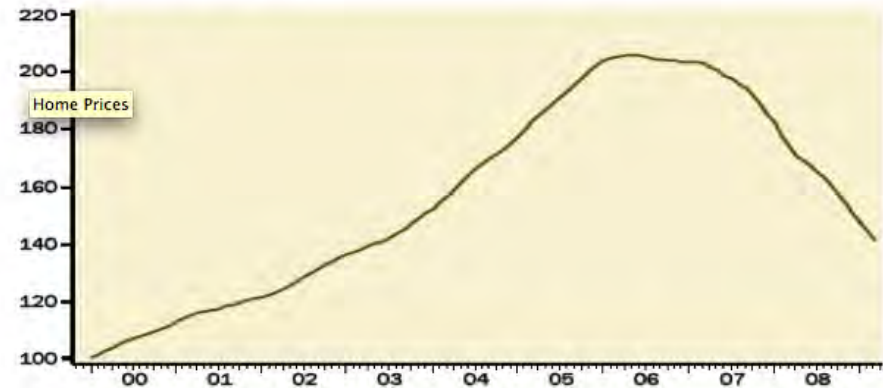
# Black Swan story

- Unknown unknowable event
  - ★ cannot be diagnosed in advance, cannot be quantified, no predictability
- No responsibility (wrath of “God”)
- One unique strategy: long put and insurance

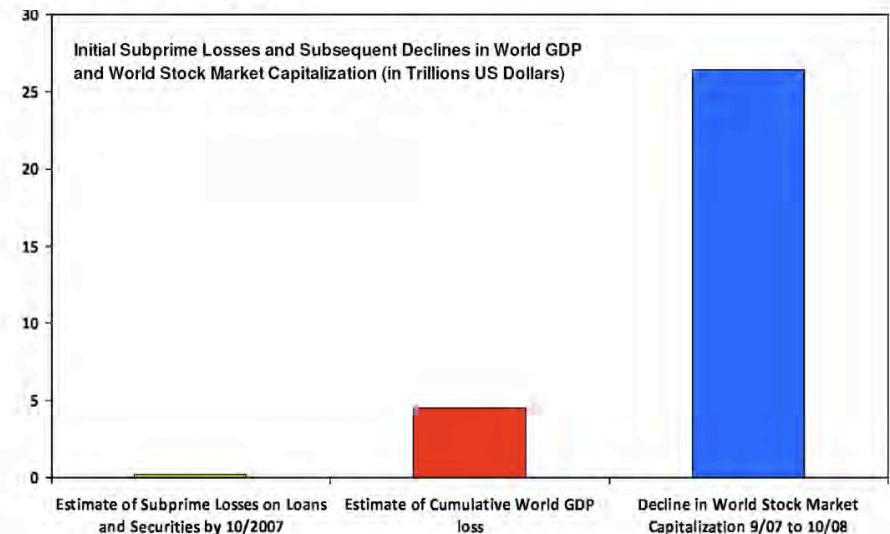
Chart 1: HOME PRICES – STILL DEFLATING AFTER ALL THESE YEARS

United States

S&P/Case-Shiller Home Price Index: Composite 20  
(Jan 2000 = 100, seasonally adjusted)



Source: Haver Analytics, Gluskin Sheff

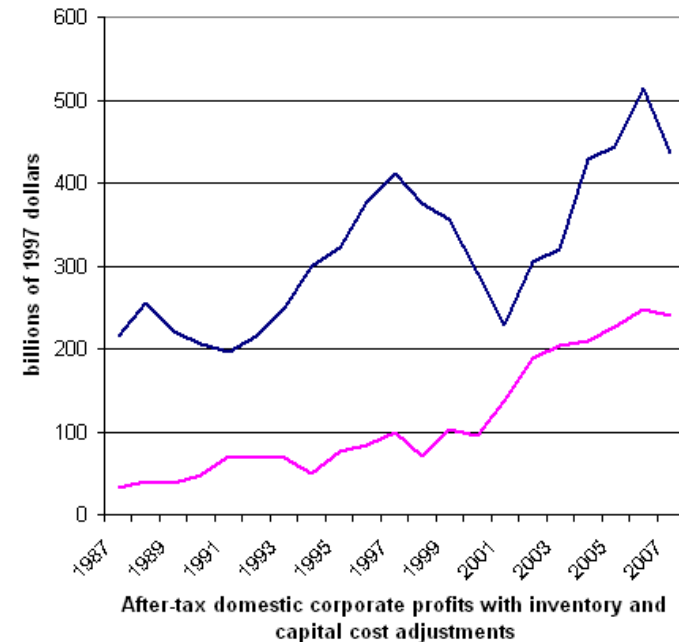


Source: IMF Global Financial Stability Report; World Economic Outlook November update and estimates; World Federation of Exchanges.

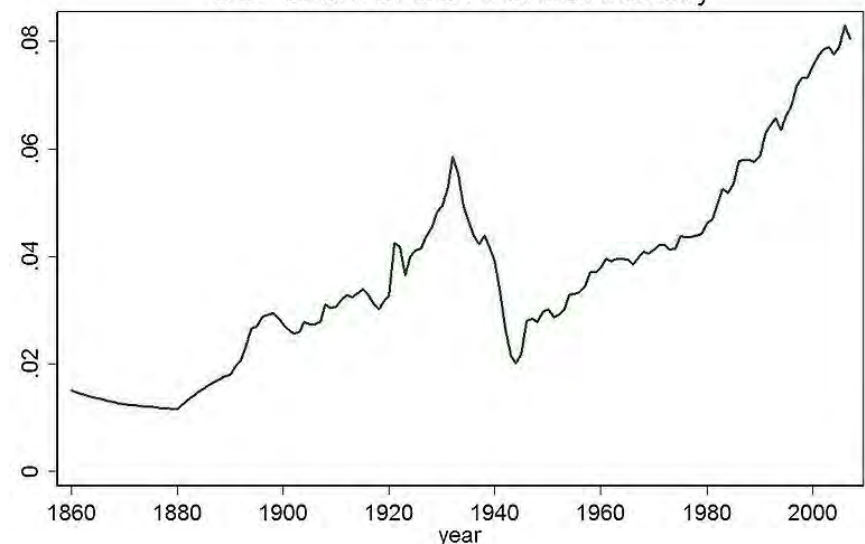
# Dragon-king story

- Most crises are “endogenous”
  - ★ can be diagnosed in advance, can be quantified, (some) predictability
- Moral hazard, conflict of interest, role of regulations
- Responsibility, accountability
- Strategic vs tactical time-dependent strategy
- Weak versus global signals

Real Corporate Profits



GDP share of US Financial Industry





# Dragon-king story

Dragon-king-outlier drawdowns



Require new different mechanism



Follow excesses (“bubbles”)



Bubbles are collective endogenous excesses  
fueled by positive feedbacks



Most crises are “endogenous”

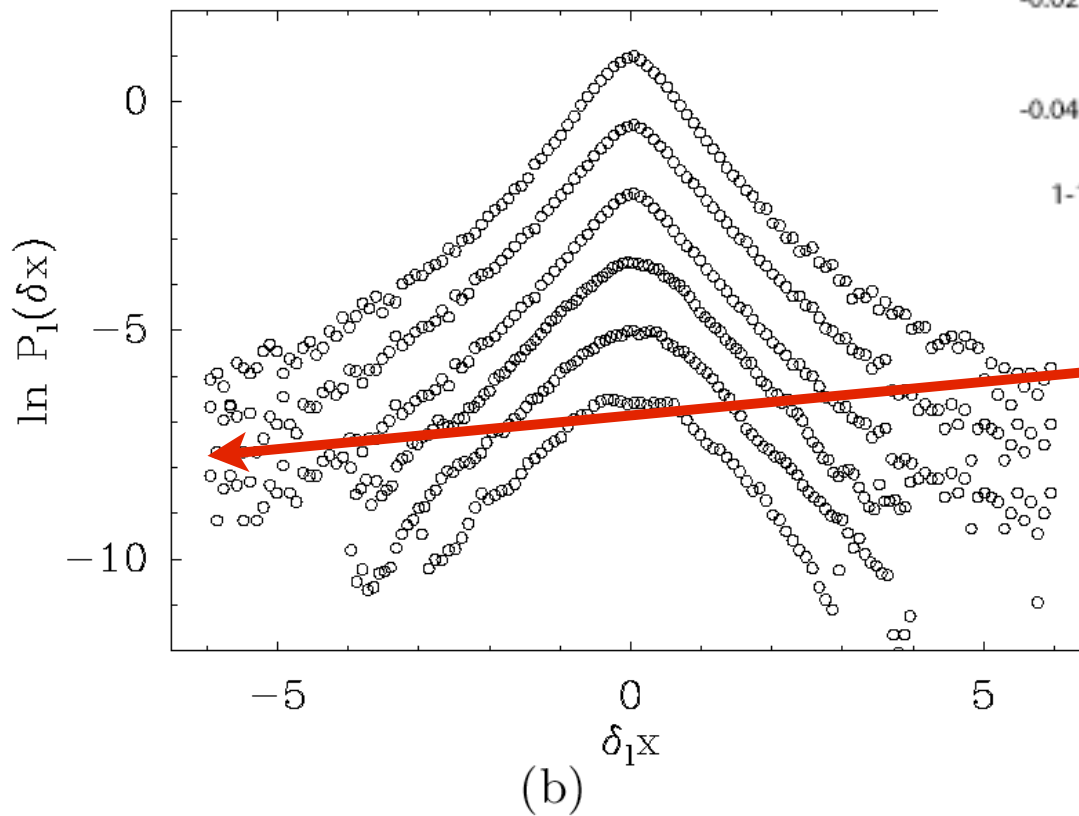
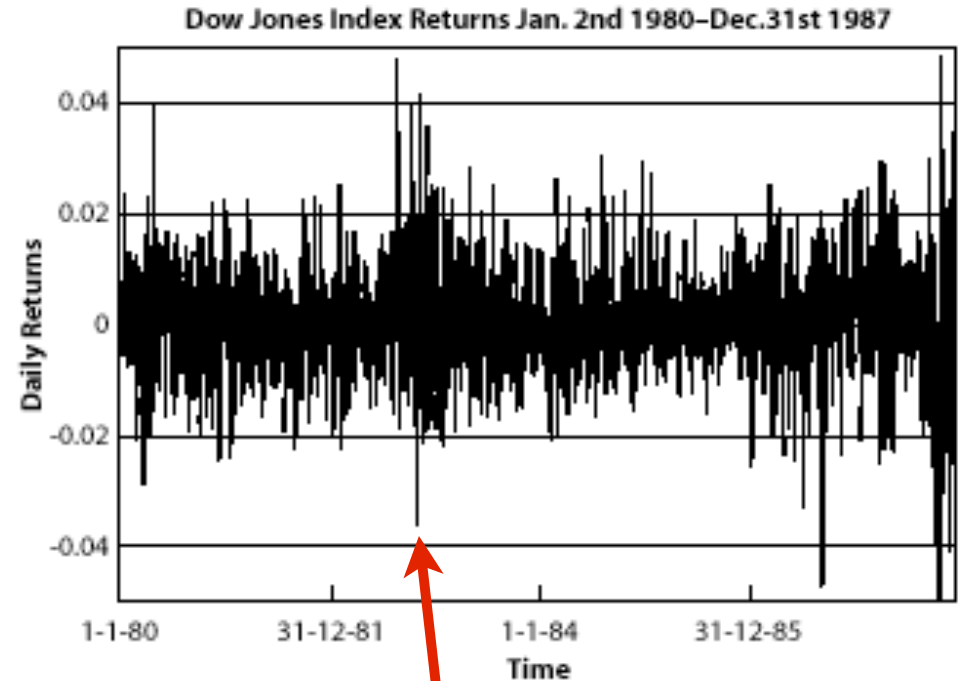


Possible diagnostic and predictions  
via “coarse-grained” metrics (forest versus trees)

# Black Swans in financial markets?

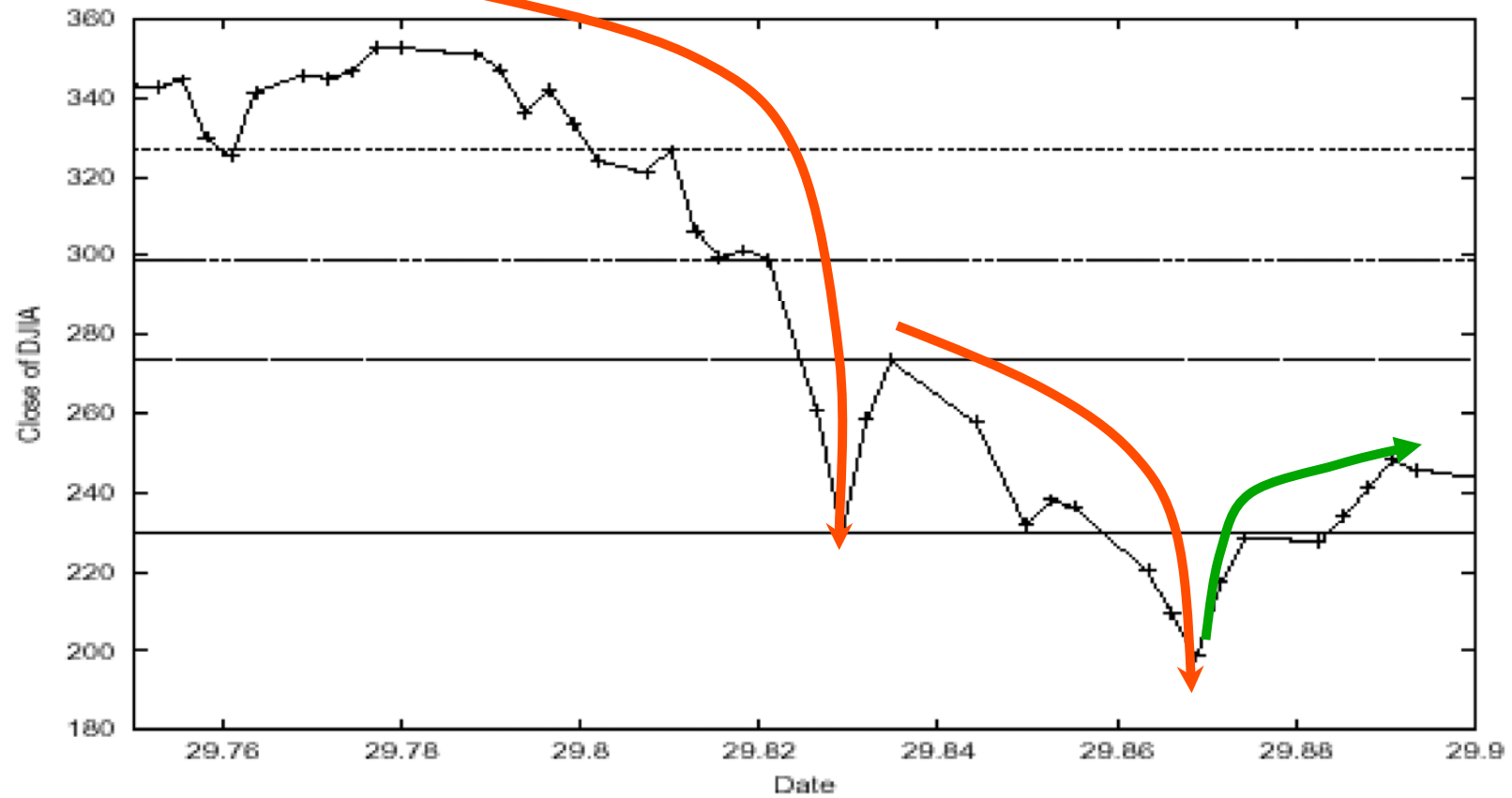


Traditional emphasis on Daily returns do not reveal any anomalous events

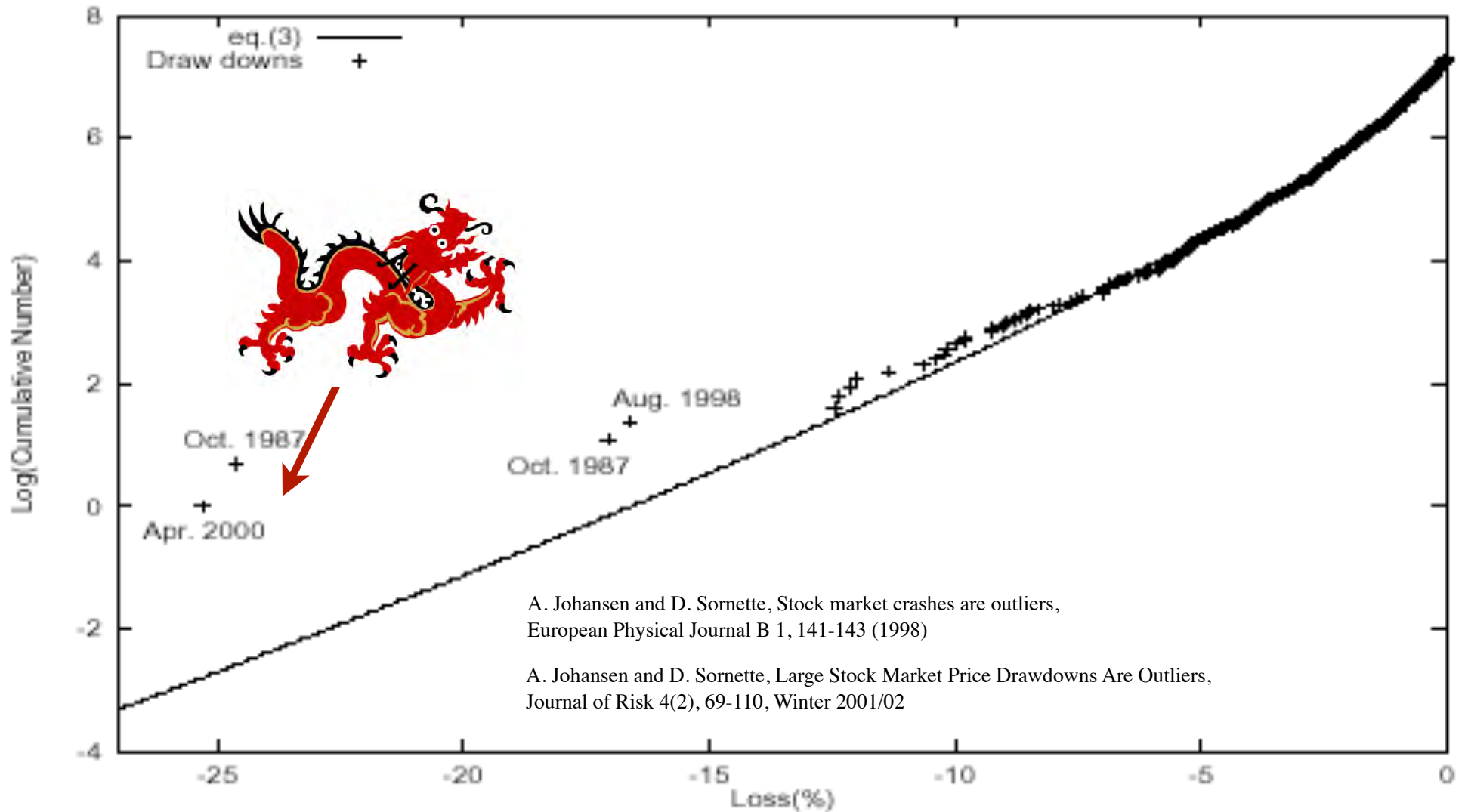


**“Black swans”**

# Better risk measure: drawdowns



# “Dragon-kings” of financial risks

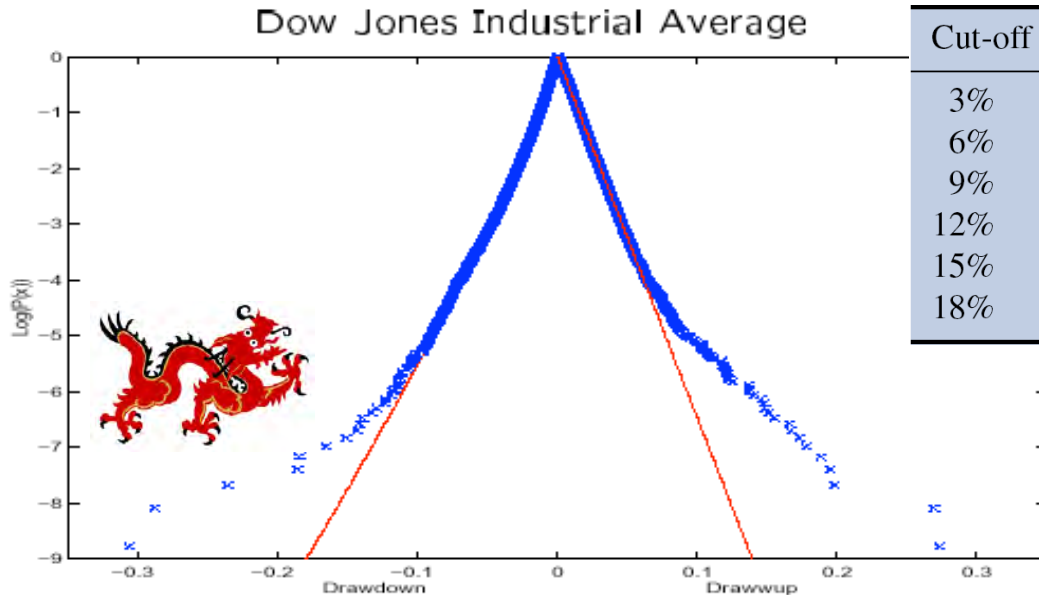


$$N(DD) = A \exp\left(-(|DD|/\chi)^z\right).$$



# “Dragons” of financial risks

(require special mechanism and may be more predictable)



Cut-off $u$	Quantile	$z$	$\ln(L_0)$	$\ln(L_1)$	$T$	Proba
3%	87%	0.916, 0.940	4890.36	4891.16	1.6	20.5%
6%	97%	0.875, 0.915	4944.36	4947.06	5.4	2.0%
9%	99.0%	0.869, 0.918	4900.75	4903.66	5.8	1.6%
12%	99.7%	0.851, 0.904	4872.47	4877.46	10.0	0.16%
15%	99.7%	0.843, 0.898	4854.97	4860.77	11.6	0.07%
18%	99.9%	0.836, 0.890	4845.16	4851.94	13.6	0.02%

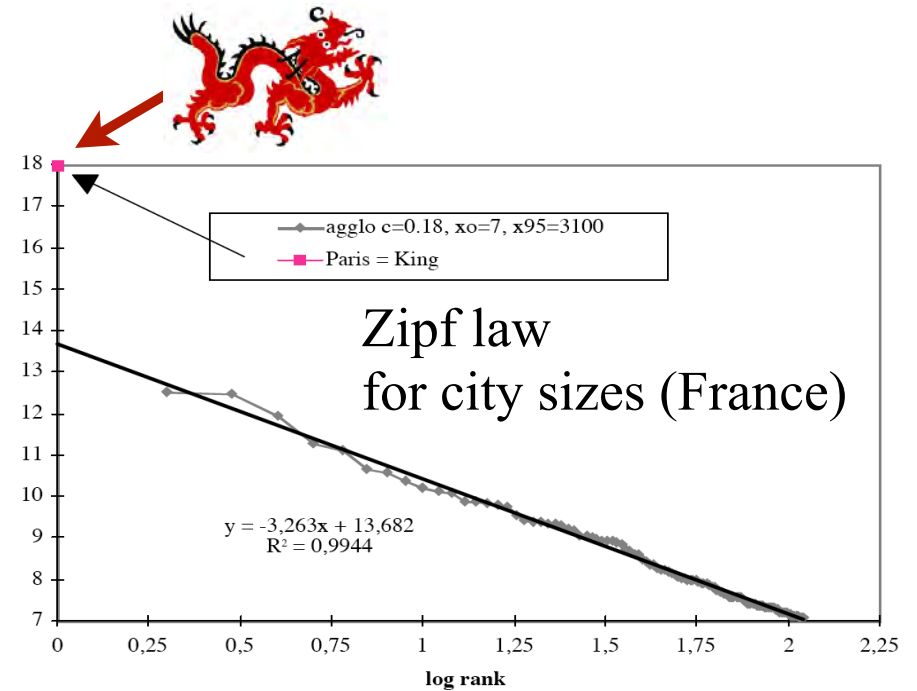
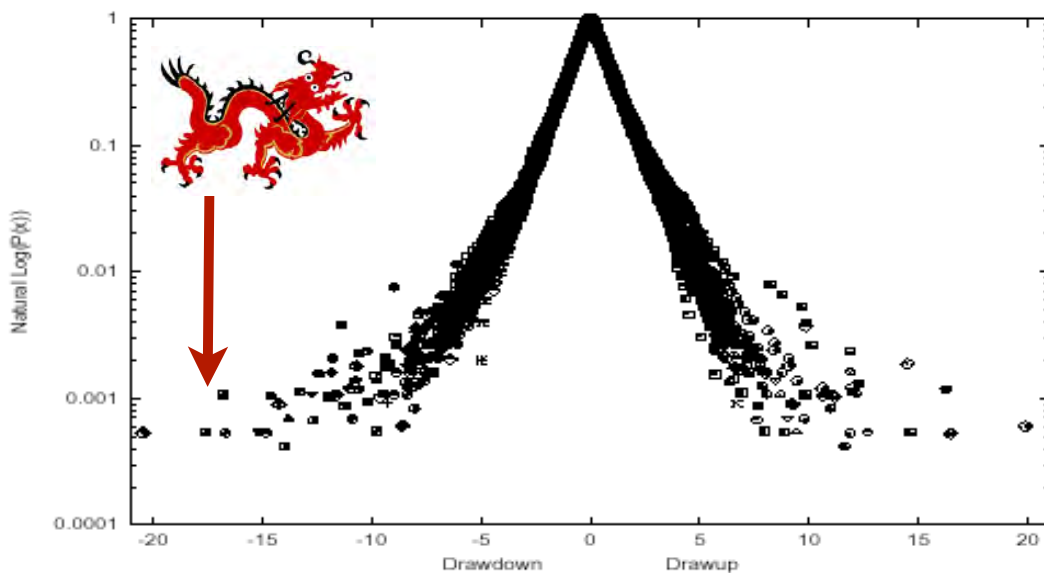


Fig. 7. French agglomerations: stretched exponential and “King effect”.

# Beyond power laws: 6 “Dragons-kings”

**Financial economics:** Outliers and dragons in the distribution of financial drawdowns.

**Population geography:** Paris as the dragon-king in the Zipf distribution of French city sizes.

**Material science:** failure and rupture processes.

**Hydrodynamics:** Extreme dragon events in the pdf of turbulent velocity fluctuations.

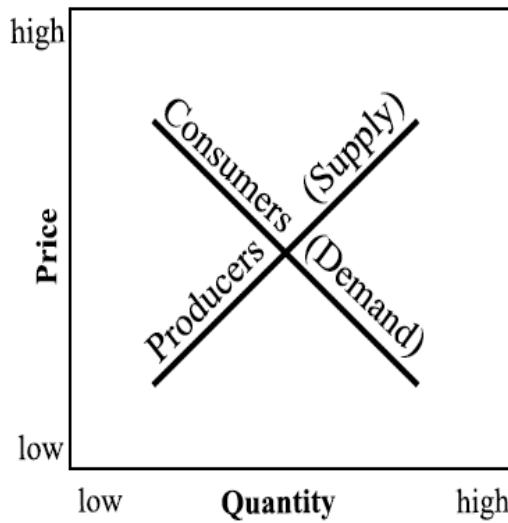
**Brain medicine:** Epileptic seizures

**Geophysics:** Gutenberg-Richter law and characteristic earthquakes.

D. Sornette, Dragon-Kings, Black Swans and the Prediction of Crises,  
International Journal of Terraspace Science and Engineering 1(3), 1-17 (2009)  
(<http://arXiv.org/abs/0907.4290>) and (<http://ssrn.com/abstract=1470006>)

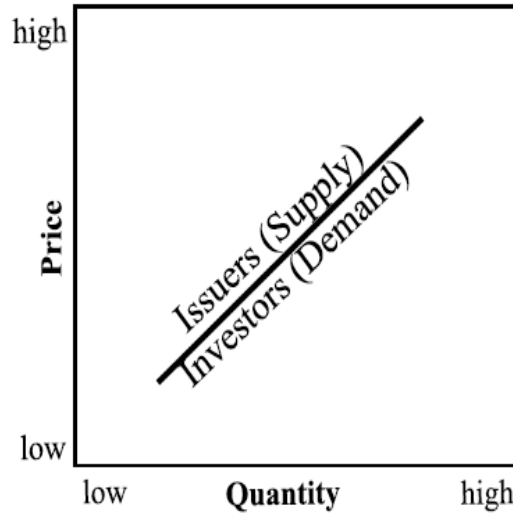
# What is a bubble?

The Law of Supply & Demand in Utilitarian Economics



© 2003 Robert R. Prechter, The Socionomics Institute

Herding Impulse in Finance

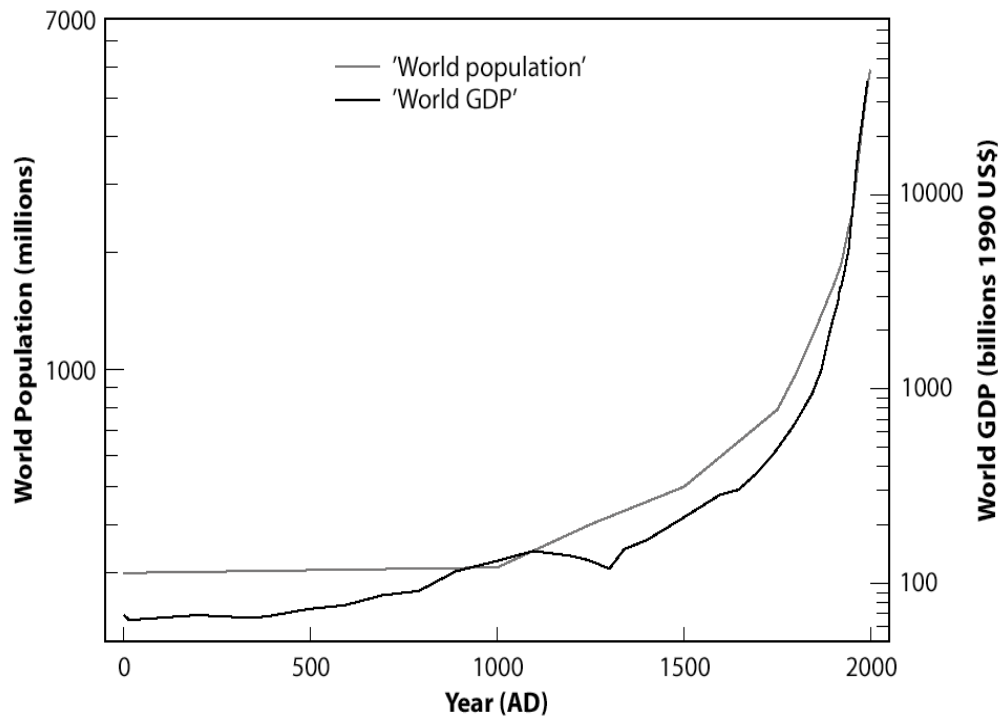


Positive feedbacks

$$\frac{dp}{dt} = cp^d$$

$$p(t) = \left(\frac{c}{m}\right)^{-m} (t_c - t)^{-m}$$

$$m = 1/(d - 1) > 0 \text{ and } t_c = t_0 + mp_0^{1-d}/c.$$



Our proposition:  
**Faster than exponential**  
 transient unsustainable  
 growth of price

# Finite-time Singularity



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

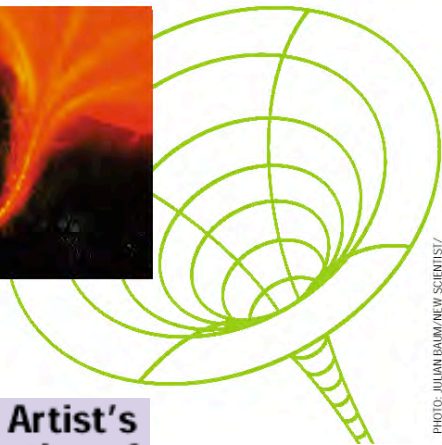


PHOTO: JULIAN DAMIAN/NEW SCIENTIST/  
SPL PHOTO RESEARCHERS, INC.

- 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. Trend following investment strategies
  4. Asymmetric information on hedging strategies
- **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)

# Universal Bubble and Crash Scenario

**Displacement**



**Credit creation**



**Euphoria**



**Critical stage / Financial distress**



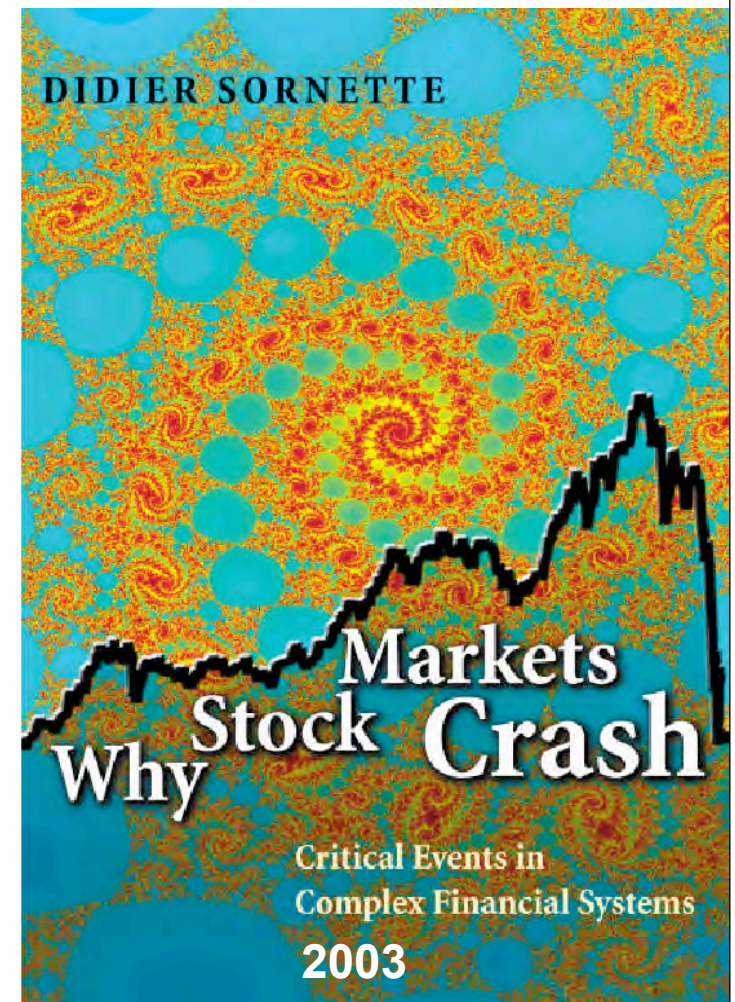
**Revulsion**

Charles Kindleberger, *Manias, Panics and Crashes* (1978)

Didier Sornette, *Why stock markets crash* (2003)

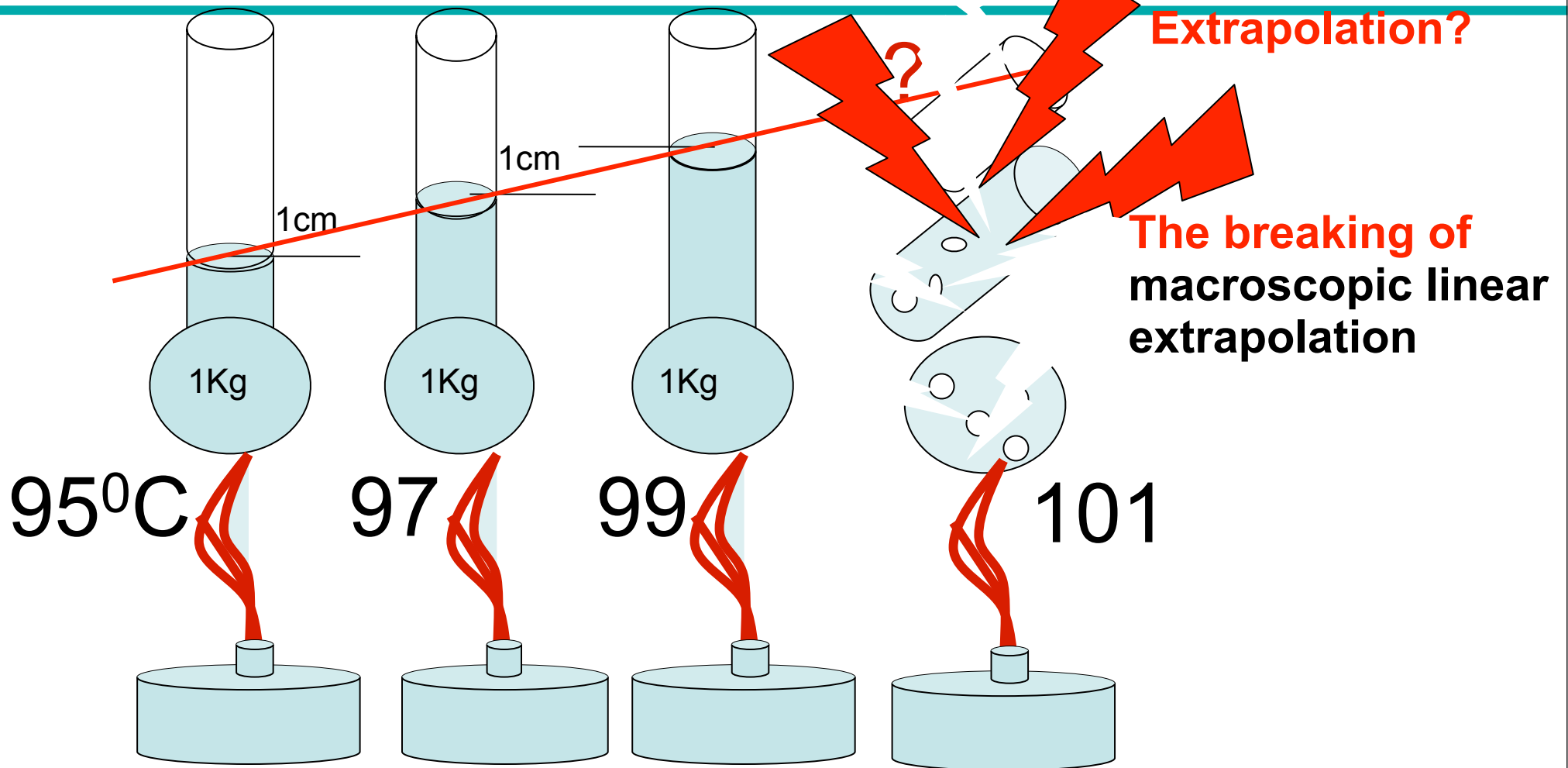
# Many bubbles and crashes

- ❑ Hong-Kong crashes: 1987, 1994, 1997 and many others
- ❑ October 1997 mini-crash
- ❑ August 1998
- ❑ Slow crash of spring 1962
- ❑ Latin-american crashes
- ❑ Asian market crashes
- ❑ Russian crashes
- ❑ Individual companies



**Crash = result of collective behavior of individual traders**

## Water level vs. temperature



## BOILING PHASE TRANSITION

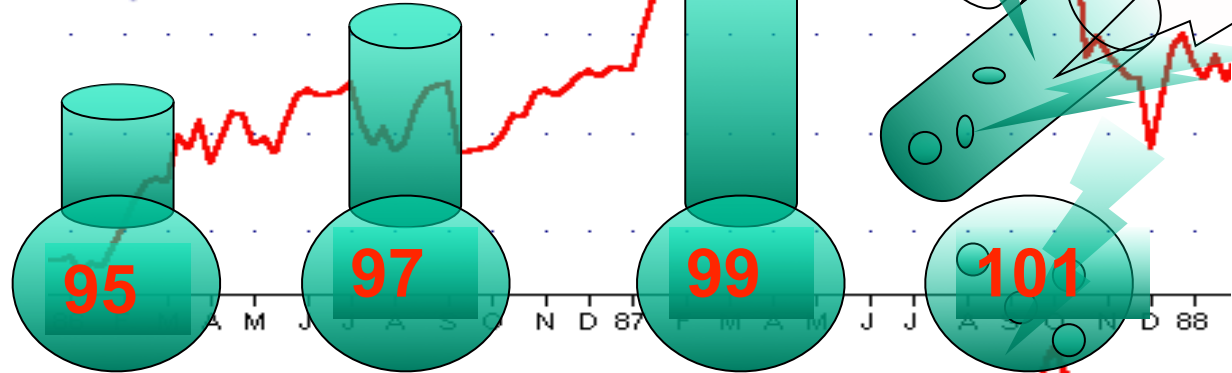
**More is different: a single molecule does not boil at 100°C<sup>0</sup>**

(source: S. Solomon)

# Example of “MORE IS DIFFERENT” transition in Finance:

Dow Jones Industrials  
Weekly Chart

<http://www.lowrisk.com>



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

DJIA Weekly

Crash = result of collective  
behavior of individual traders

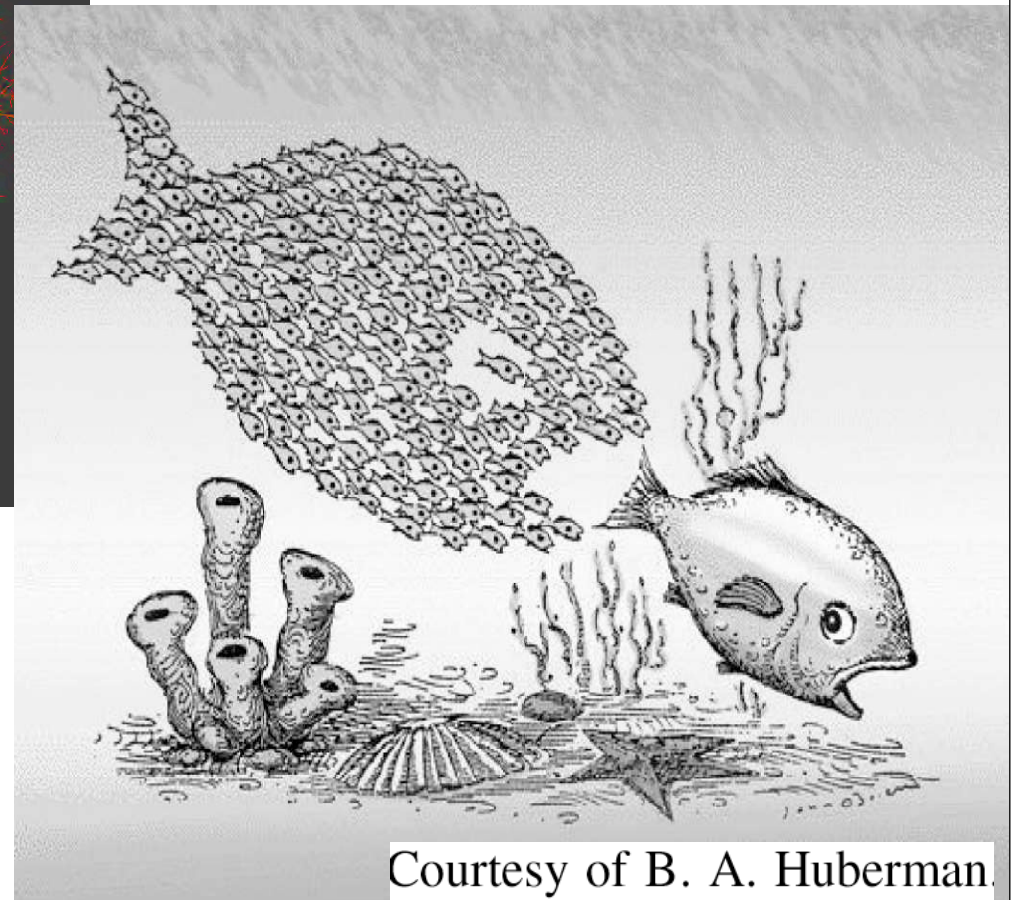
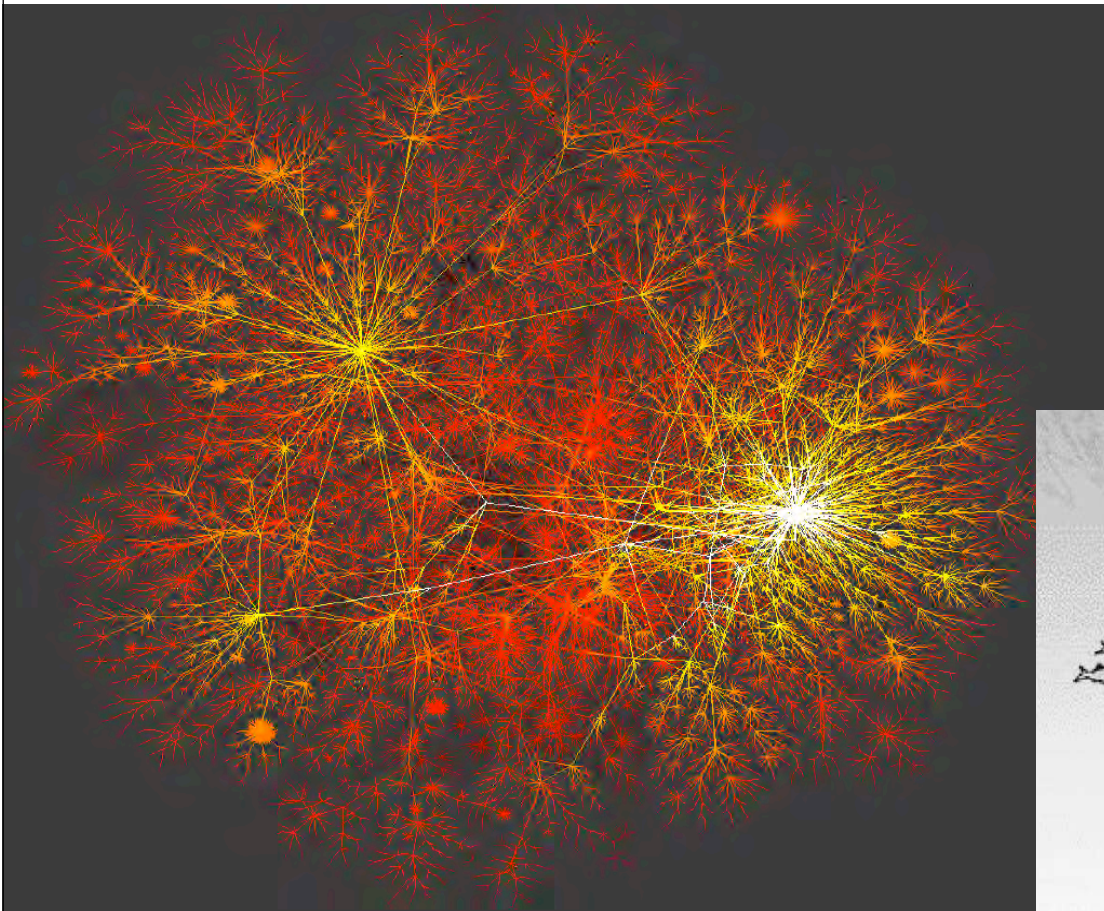


**Apparent unpredictability comes from lack of recognition  
of collective behavior**

(source: S. Solomon)



# Network effects and Collective behavior

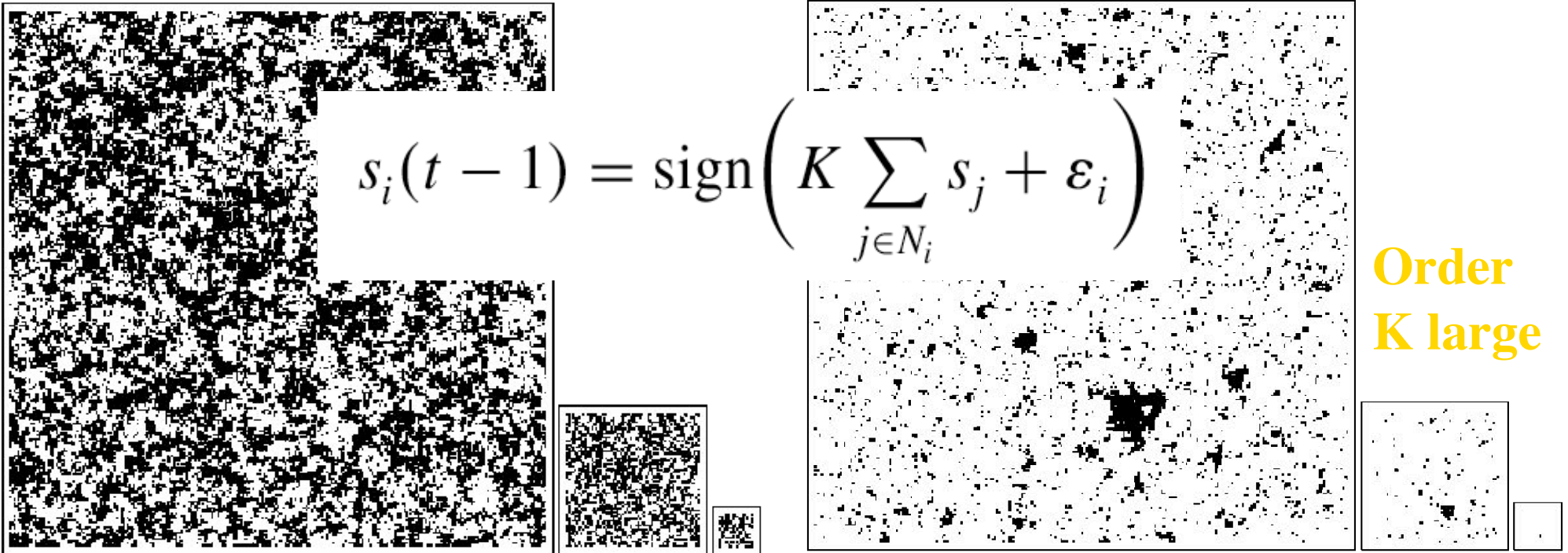


Courtesy of B. A. Huberman.



$$s_i(t - 1) = \text{sign} \left( K \sum_{j \in N_i} s_j + \varepsilon_i \right)$$

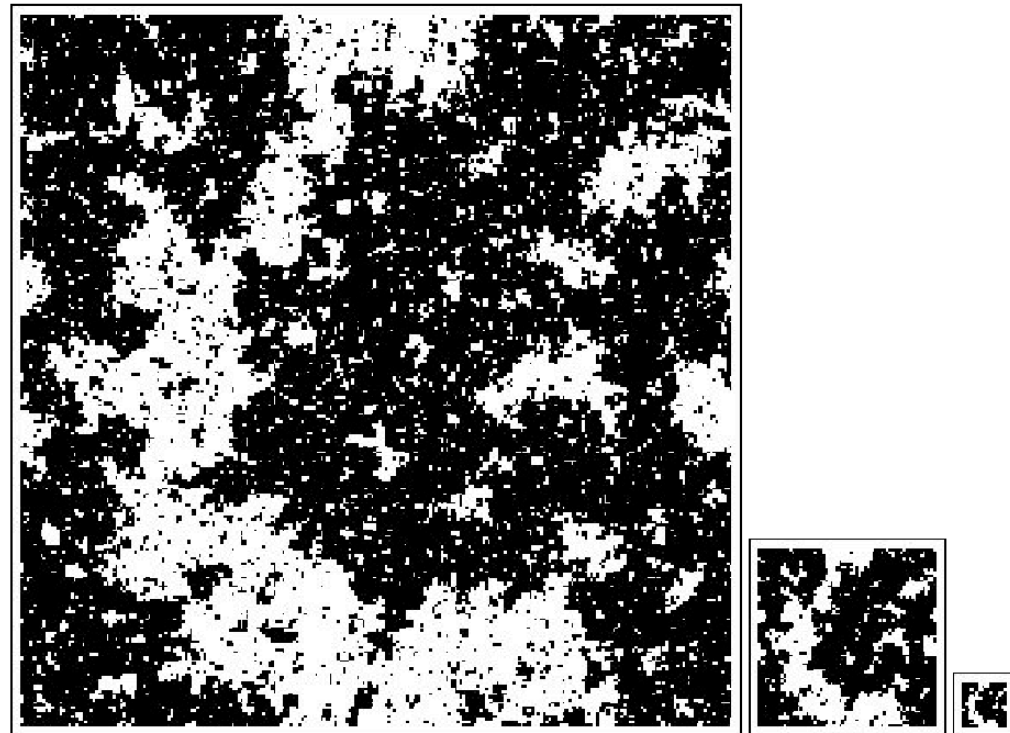
Order  
K large



Disorder : K small

Renormalization group:  
Organization of the  
description scale by scale

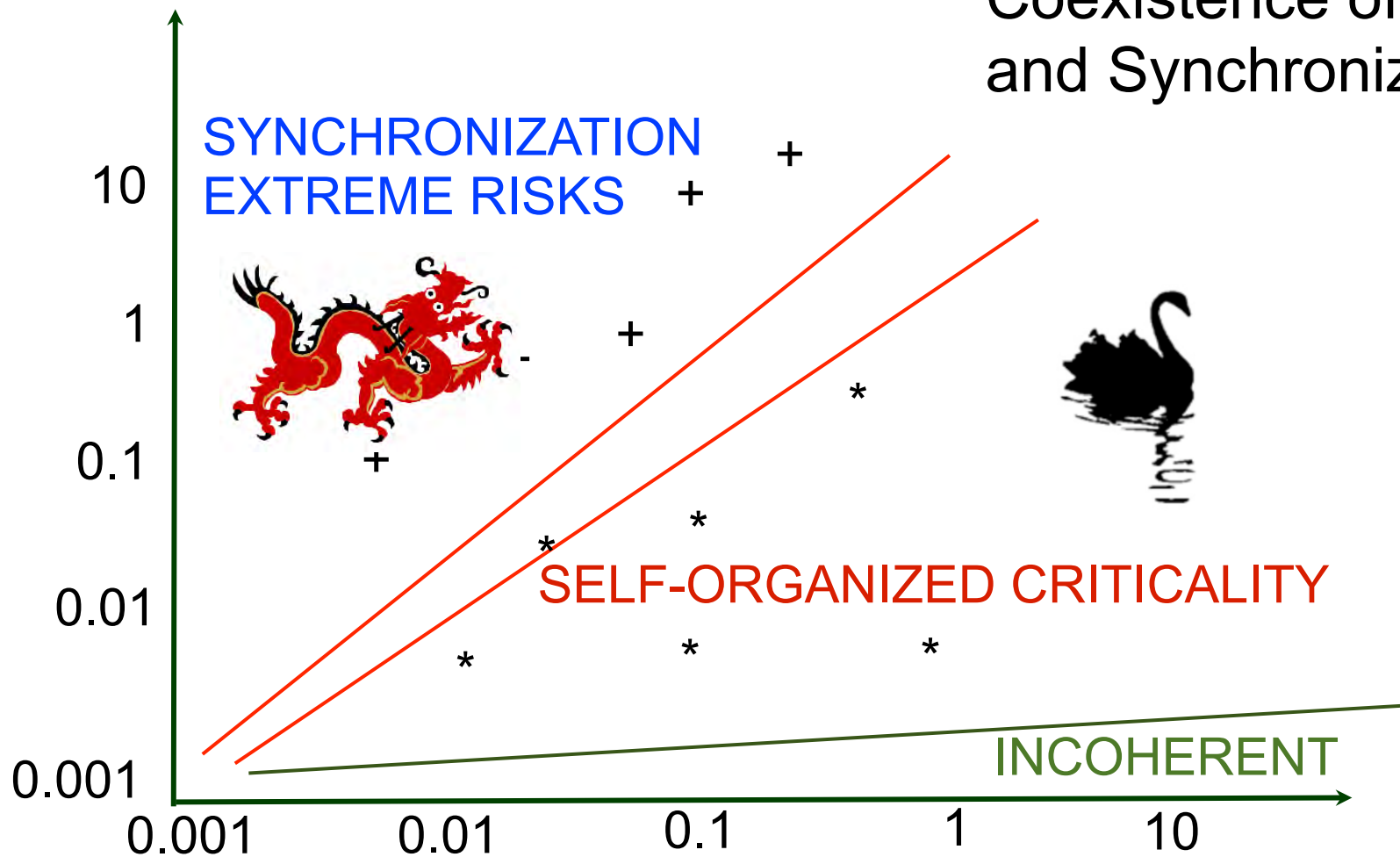
Critical:  
K=critical  
value



# Generic predictability diagram

**Interaction  
(coupling) strength**

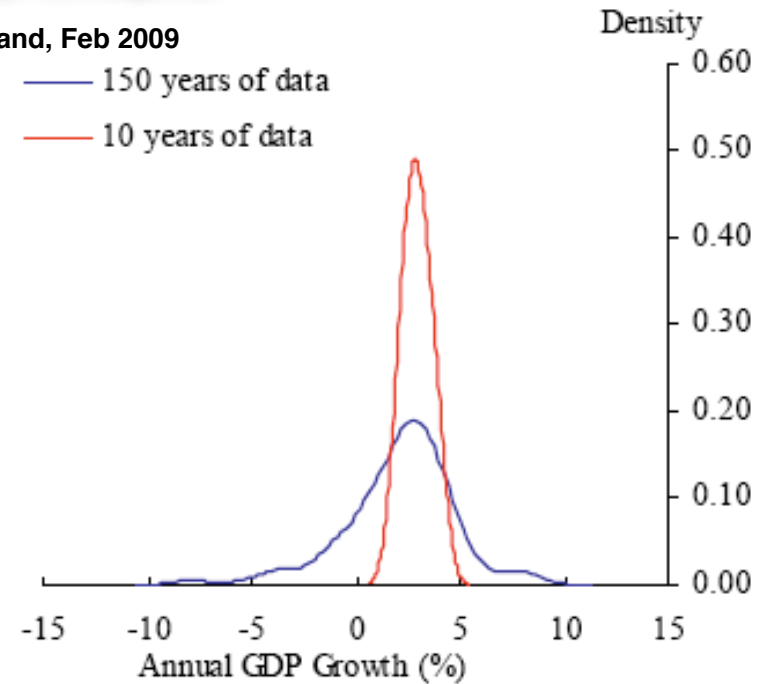
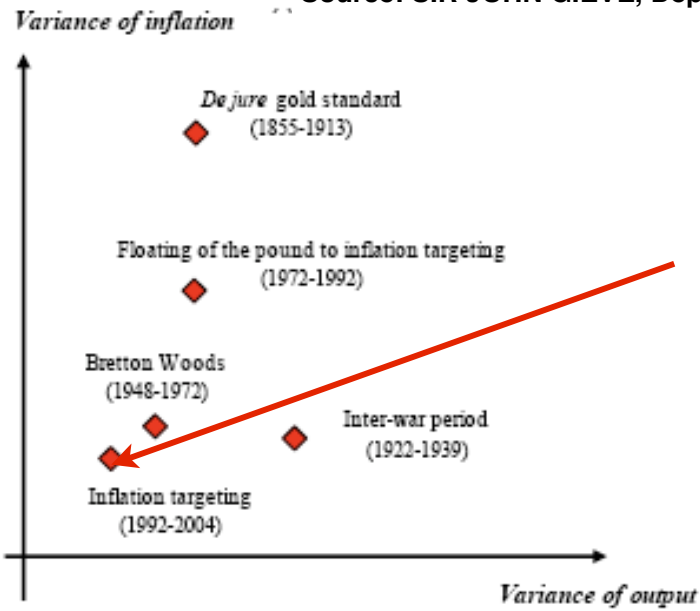
Coexistence of SOC  
and Synchronized behavior



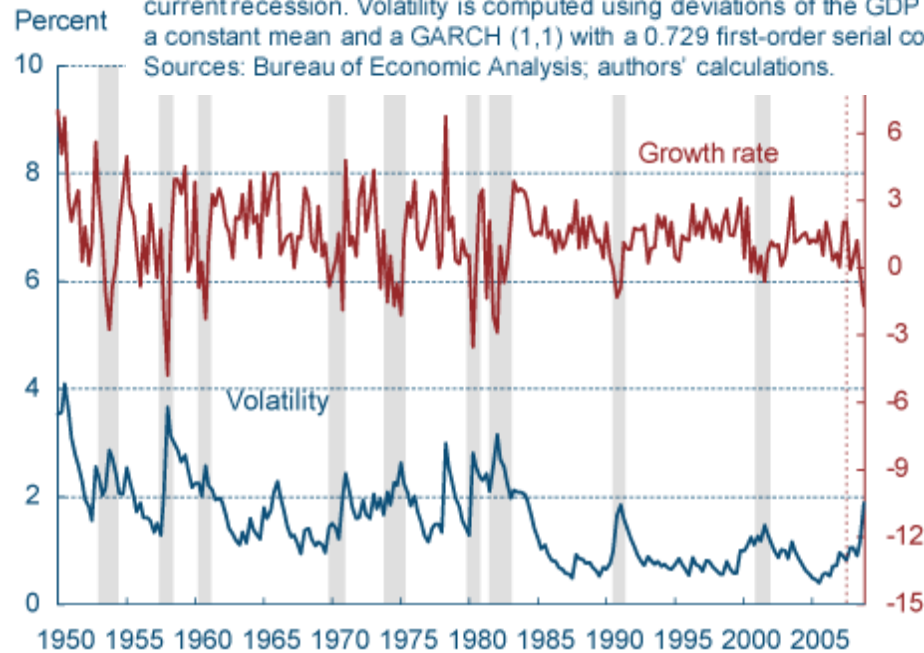
**Heterogeneity; level of compartmentalization**

# THE GREAT MODERATION

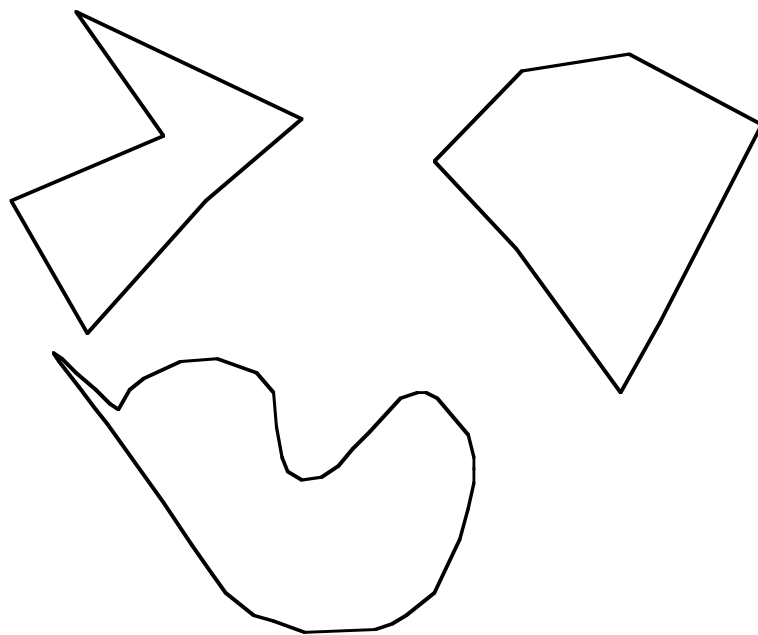
Source: SIR JOHN GIEVE, Deputy Governor, Bank of England, Feb 2009



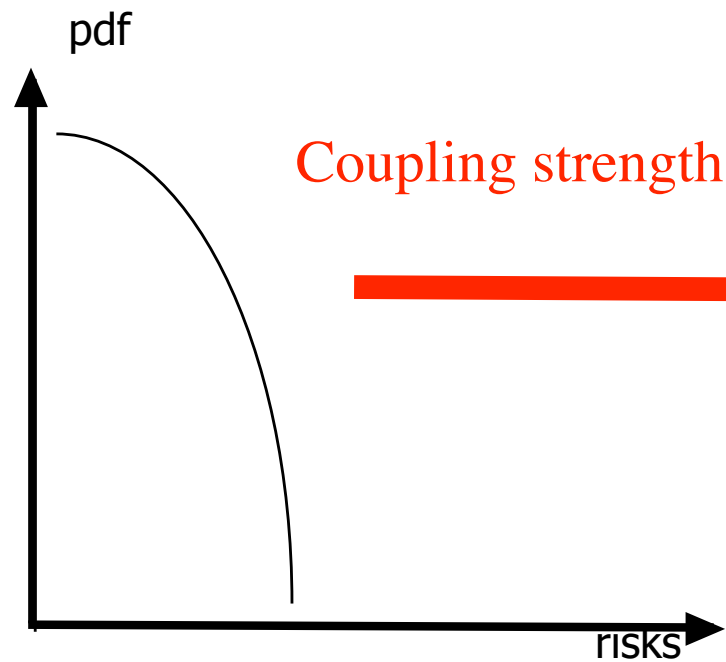
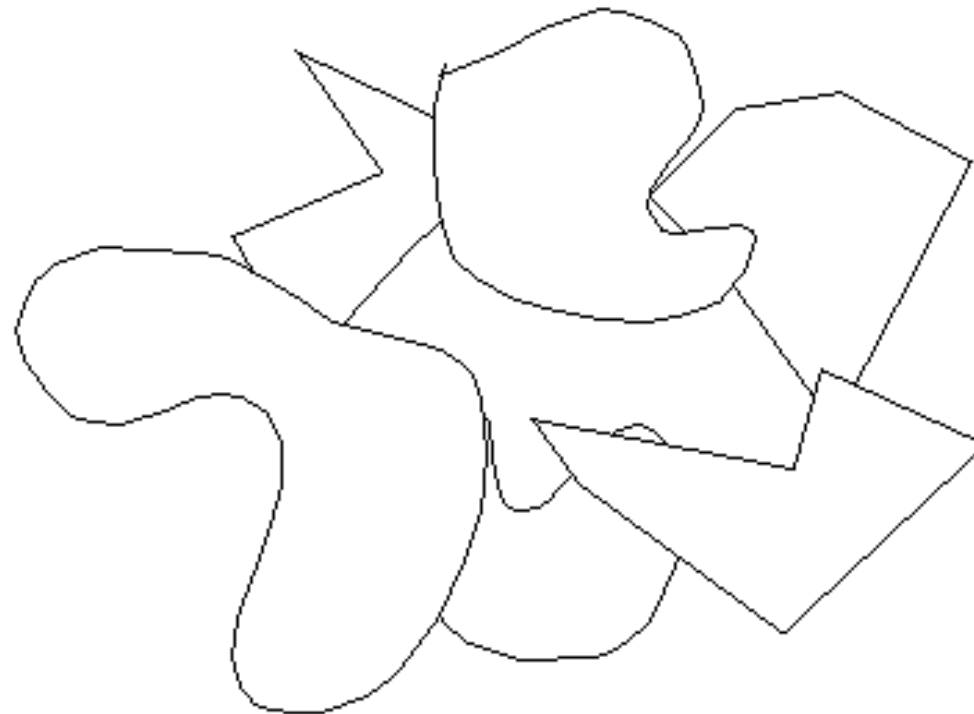
Notes: Shaded bars indicate recessions. The dashed red line indicates the onset of the current recession. Volatility is computed using deviations of the GDP growth rate from a constant mean and a GARCH (1,1) with a 0.729 first-order serial correlation. Sources: Bureau of Economic Analysis; authors' calculations.



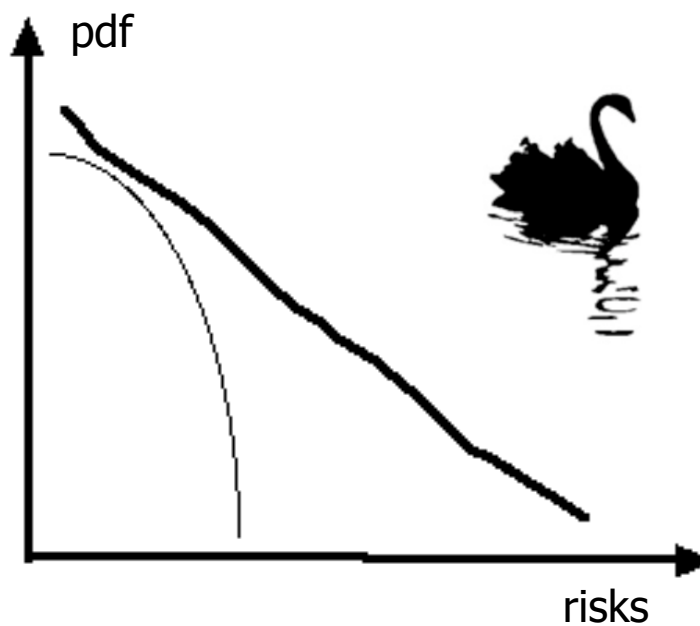
Separation of financial and credit risks



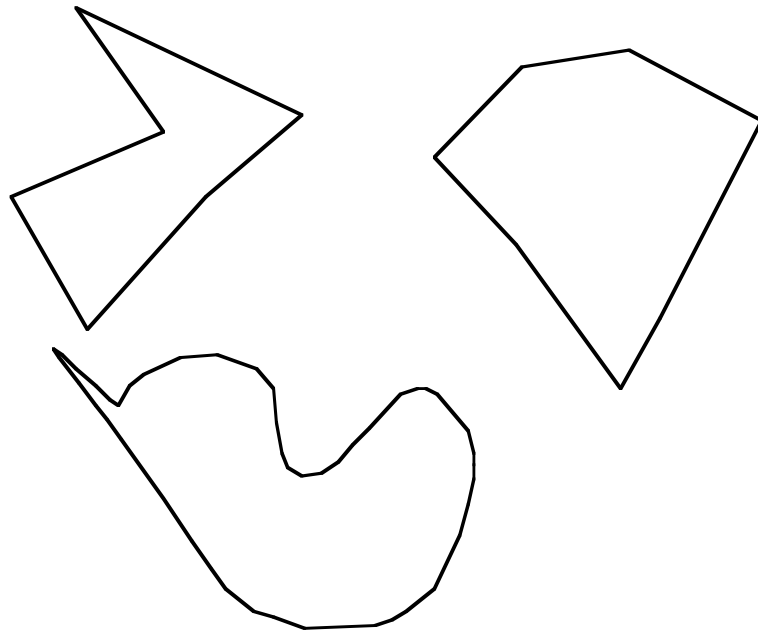
Securitization leads to larger inter-connectivity



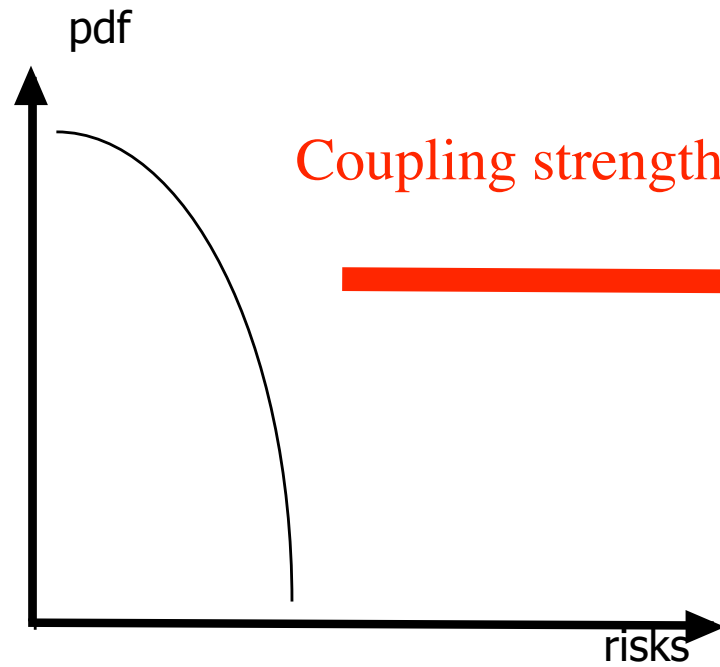
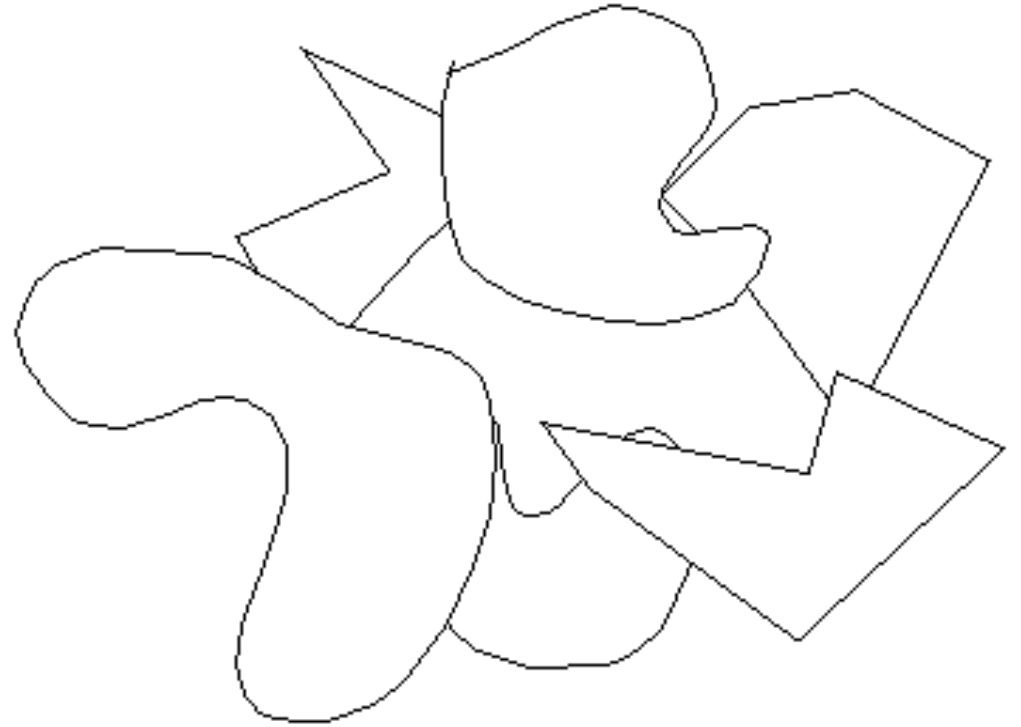
Coupling strength increases



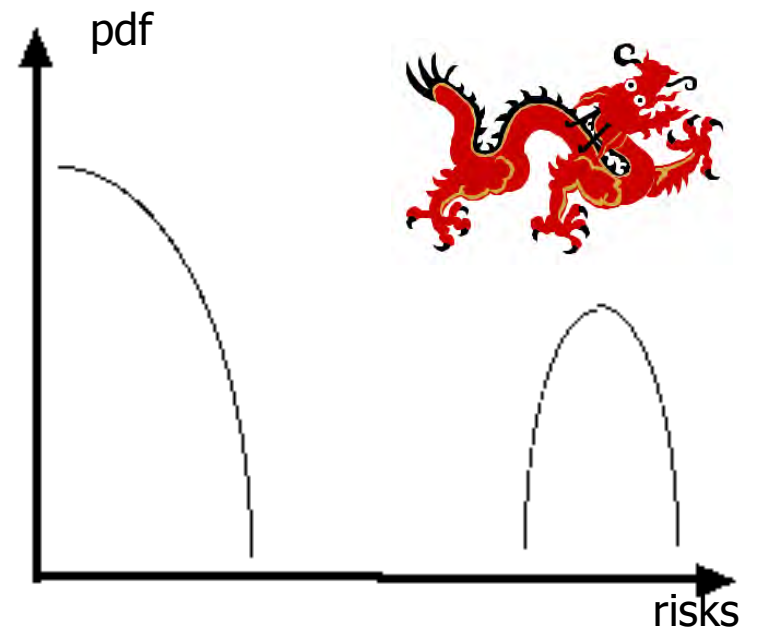
Separation of financial and credit risks



Securitization leads to larger inter-connectivity

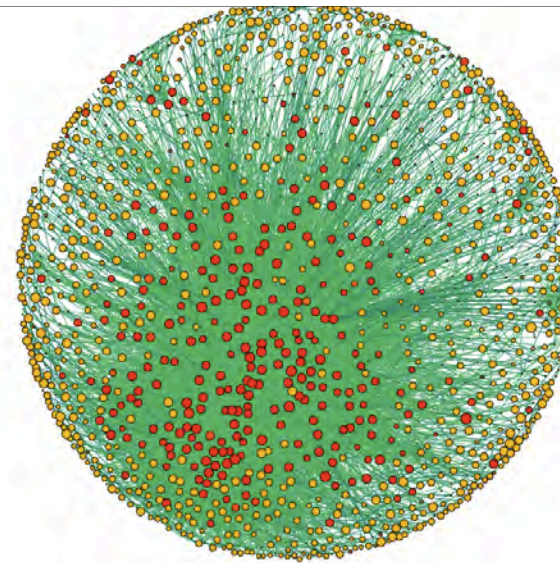


Coupling strength increases

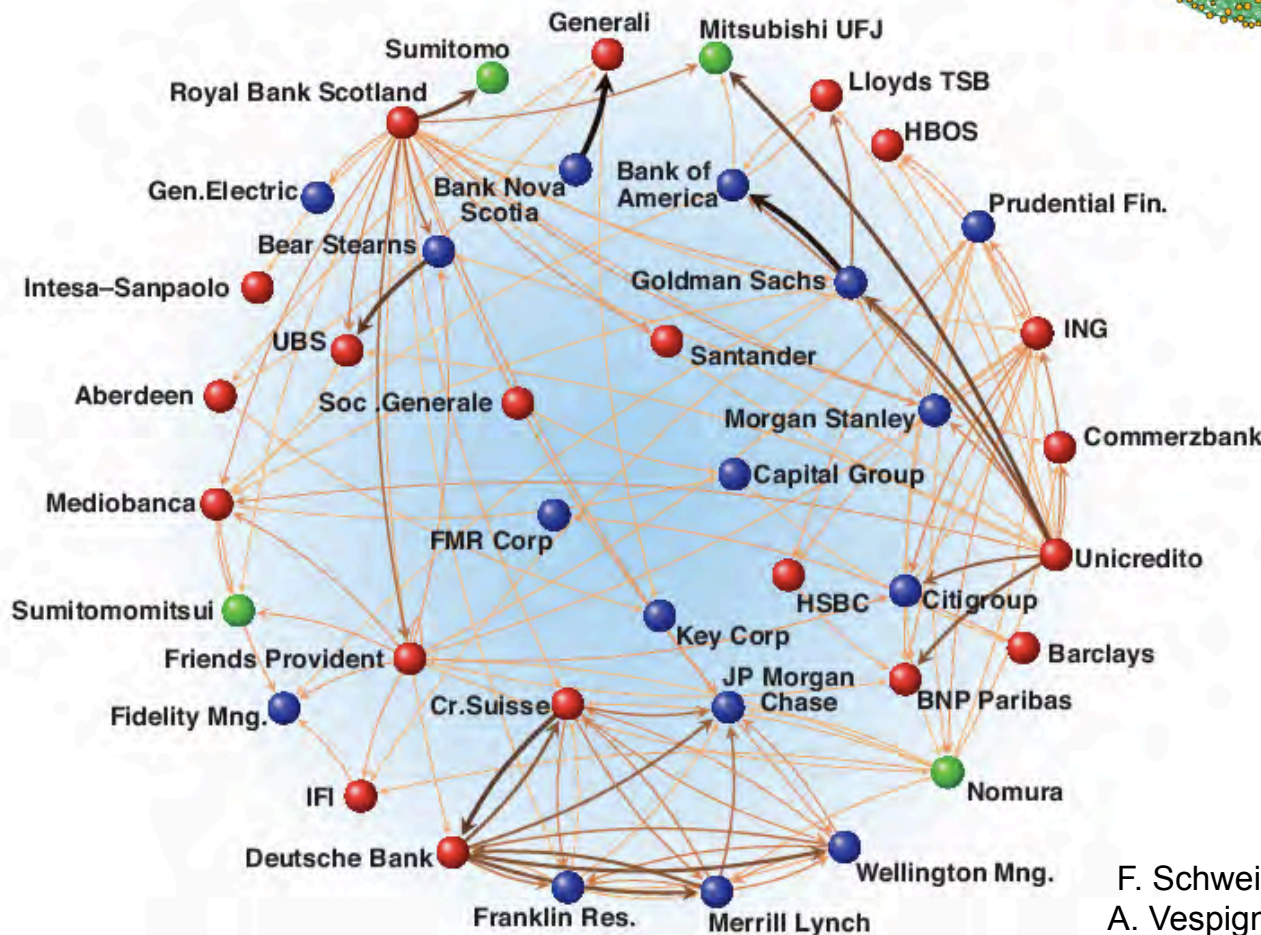




Network layout of the LSCC (1318 nodes and 12191 links). The nodes correspond to the log of operating revenue, the node color to the network control (from yellow to red). The links are colored and scaled by weight.



Stefania Vitali James B. Glattfelder and Stefano Battiston (ETH Zurich)



A sample of the international financial network, where the nodes represent major financial institutions and the links are both directed and weighted and represent the strongest existing relations among them. Node colors express different geographical areas: European Union members (red), North America (blue), other countries (green). Even with the reduced number of links displayed in the figure, relative to the true world economy, the network shows a high connectivity among the financial institutions that have mutual share-holdings and closed loops involving several nodes. This indicates that the financial sector is strongly interdependent, which may affect market competition and systemic risk and make the network vulnerable to instability.

F. Schweitzer, G. Fagiolo, D. Sornette, F. Vega-Redondo, A. Vespignani, and D. R. White, *Economic Networks: The New challenges*, Science 325, 422-424 (2009)

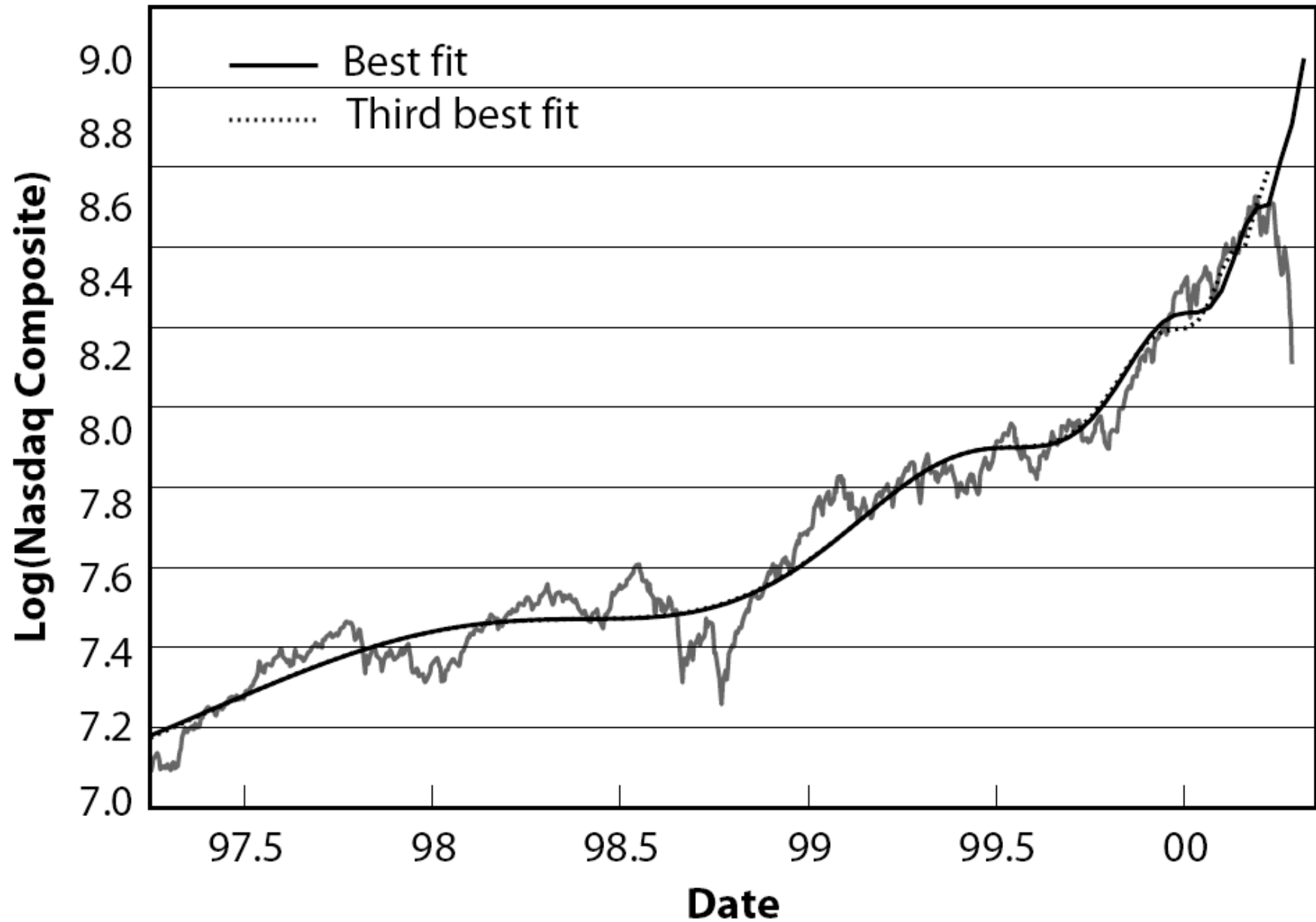


# Predictability of the 2007-XXXX crisis: 15y History of bubbles and Dragons

- The ITC “new economy” bubble (1995-2000)
- Slaving of the Fed monetary policy to the stock market descent (2000-2003)
- Real-estate bubbles (2003-2006)
- MBS, CDOs bubble (2004-2007) and stock market bubble (2004-2007)
- Commodities and Oil bubbles (2006-2008)

# THE NASDAQ CRASH OF APRIL 2000

“New Economy”: ICT



# Real-estate in the UK

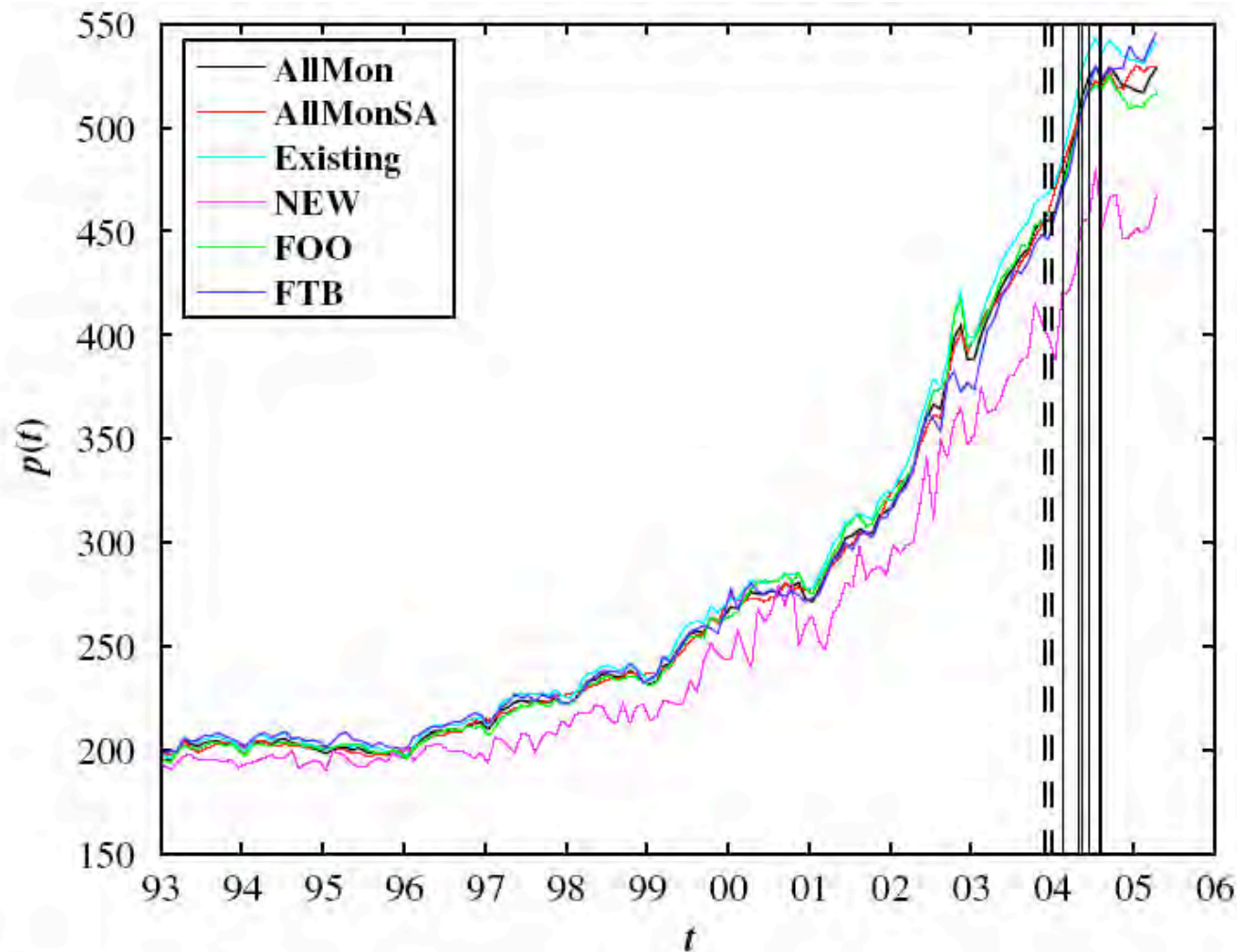


Fig. 1. (Color online) Plot of the UK Halifax house price indices from 1993 to April 2005 (the latest available quote at the time of writing). The two groups of vertical lines correspond to the two predicted turning points reported in Tables 2 and 3 of [1]: end of 2003 and mid-2004. The former (resp.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

# Real-estate in the USA

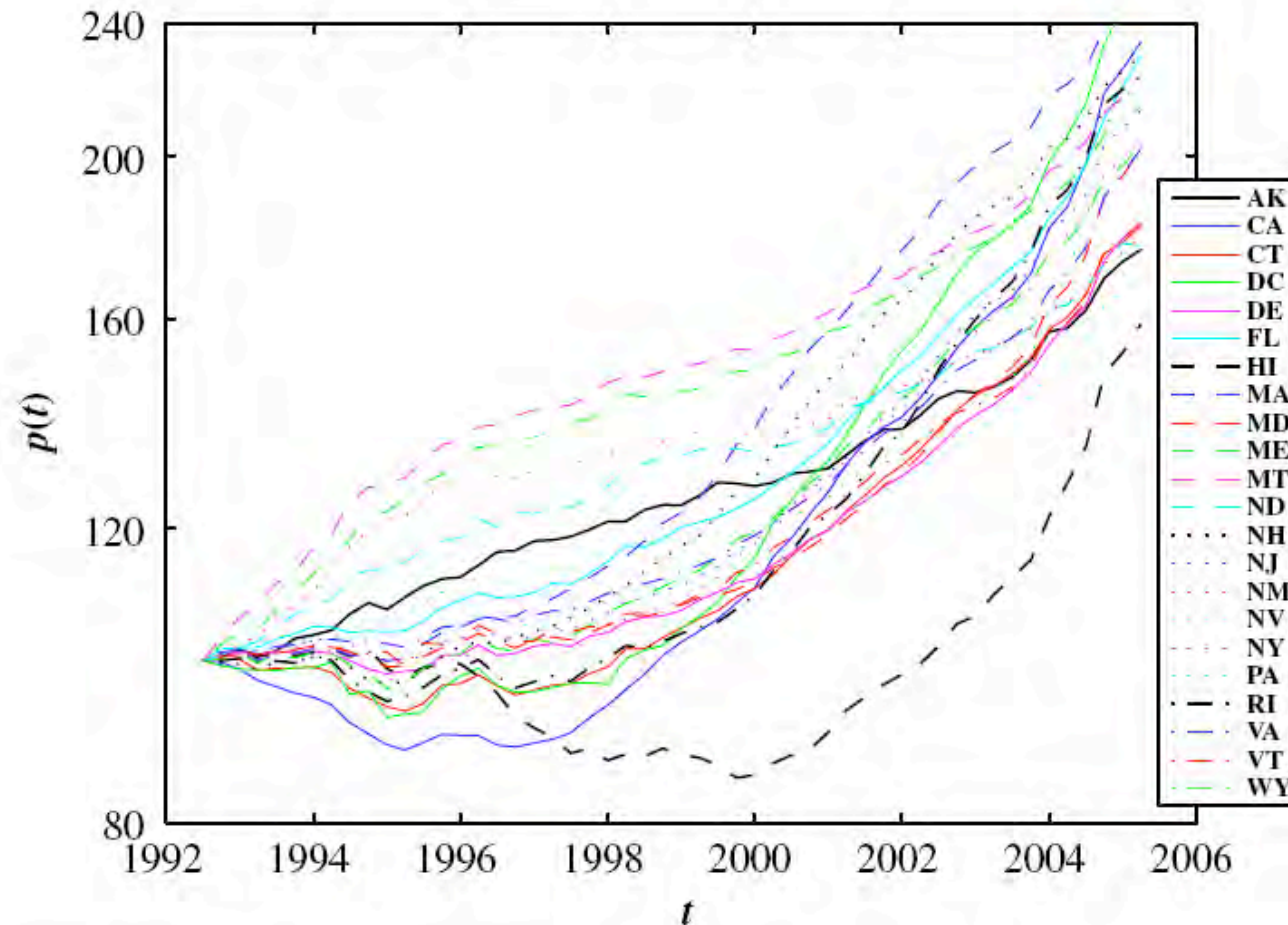
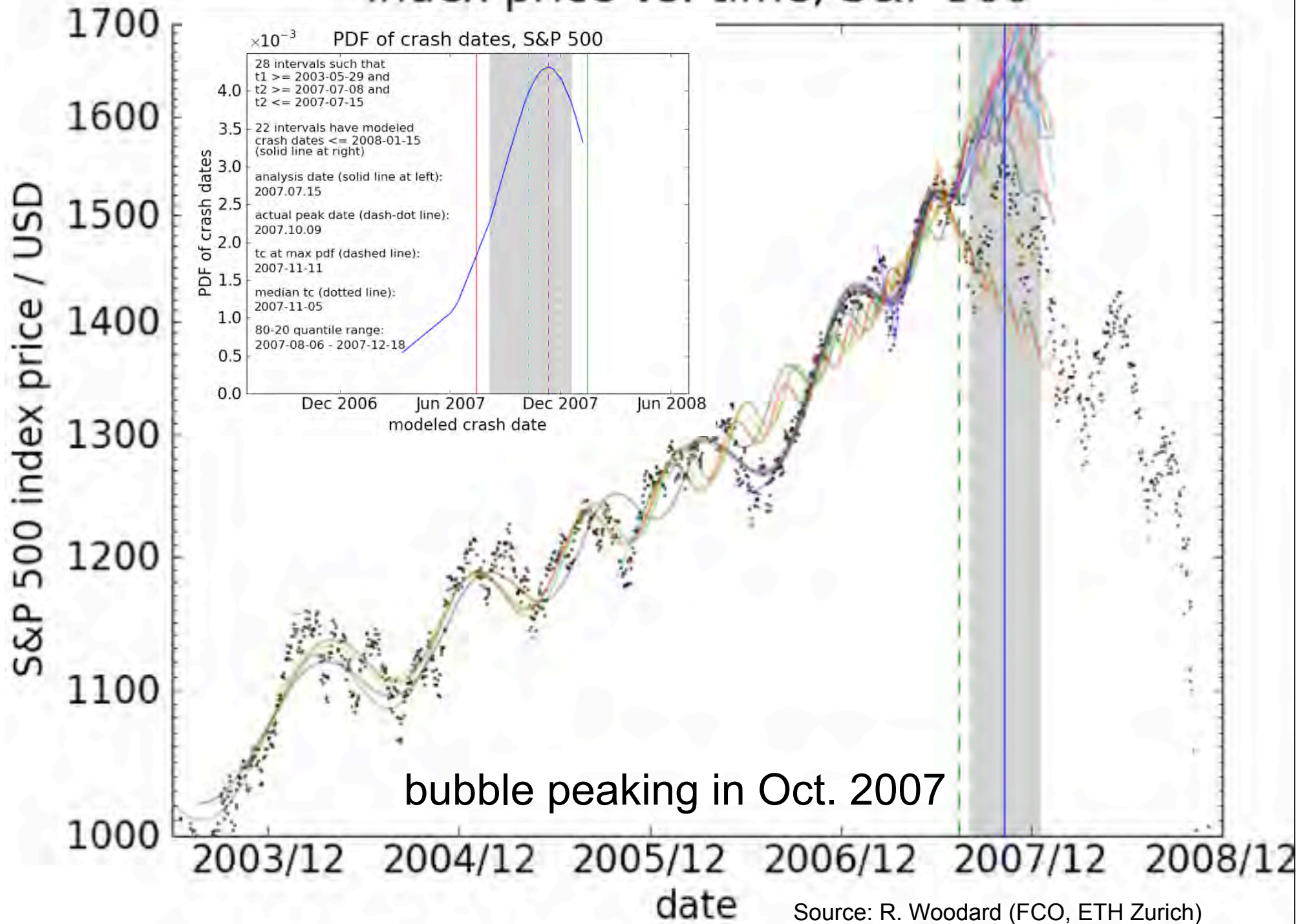


Fig. 5. (Color online) Quarterly average HPI in the 21 states and in the District of Columbia (DC) exhibiting a clear upward faster-than-exponential growth. For better representation, we have normalized the house price indices for the second quarter of 1992 to 100 in all 22 cases. The corresponding states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



# Index price vs. time, S&P 500

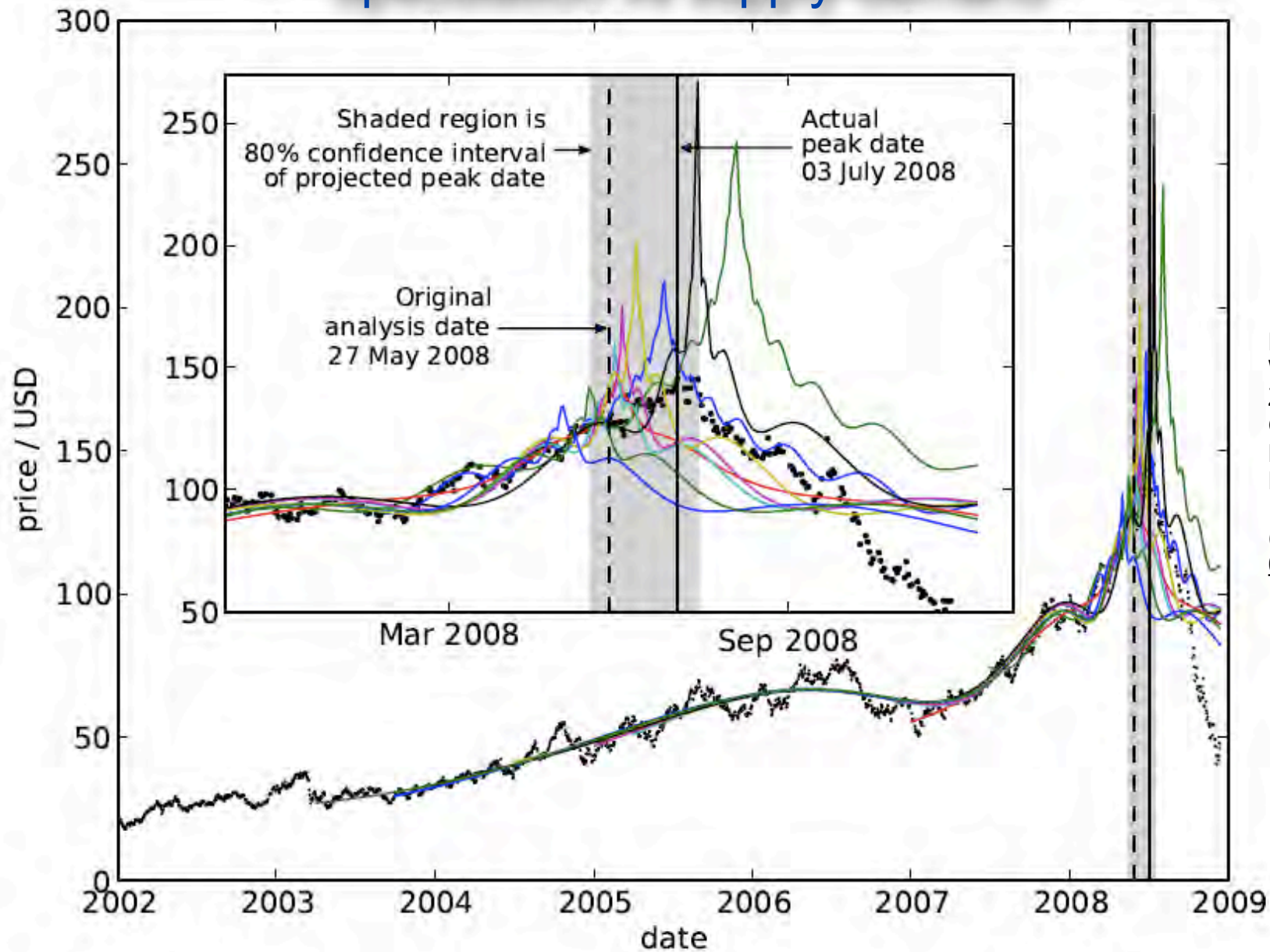


Source: R. Woodard (FCO, ETH Zurich)



# 2006-2008 Oil bubble

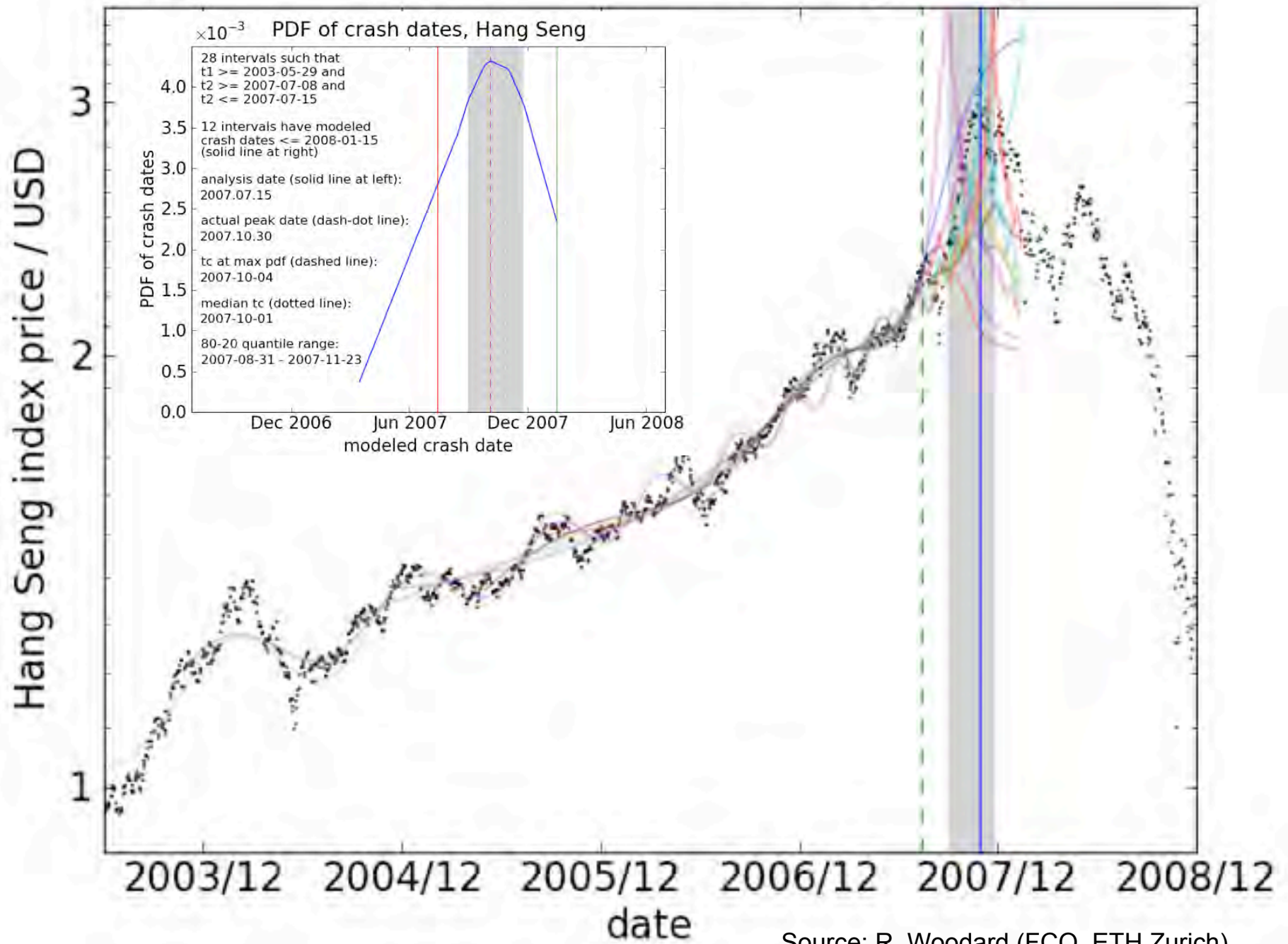
## Speculation vs supply-demand



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](http://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  $t_{\text{start}}$  moving up towards the common last date  $t_{\text{last}} = \text{May } 27, 2008$ .

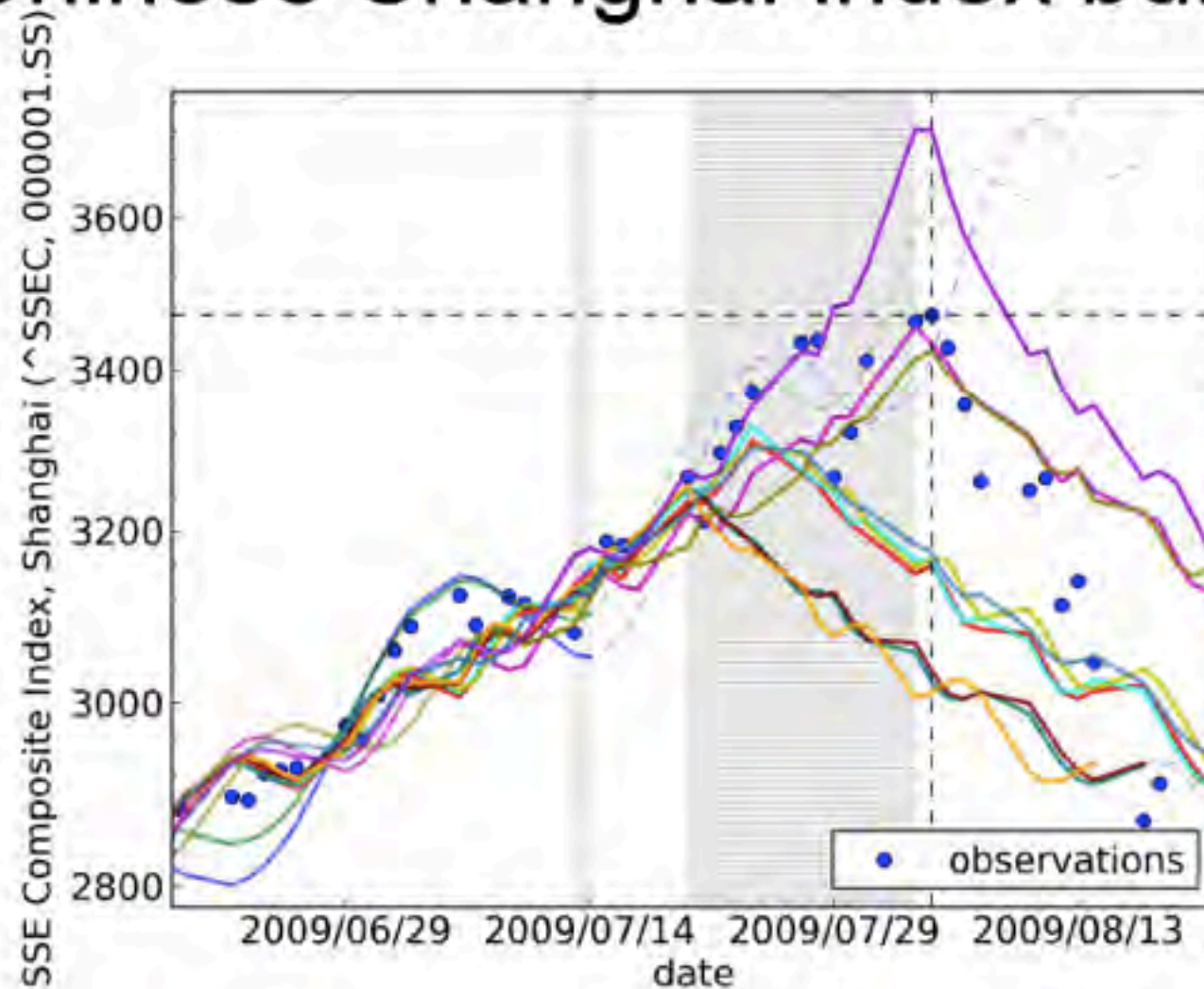
# $\times 10^4$ Index price vs. time, Hang Seng



Source: R. Woodard (FCO, ETH Zurich)

10 July 2009

# Successful forecast of end of Chinese Shanghai index bubble



The Chinese Equity Bubble: Ready to Burst,

K. Bastiaensen, P. Cauwels, D. Sornette, R. Woodard and W.-X. Zhou, July 10, 2009 (<http://arxiv.org/abs/0907.1827>)

# The Financial Bubble Experiment

advanced diagnostics and forecasts of bubble terminations

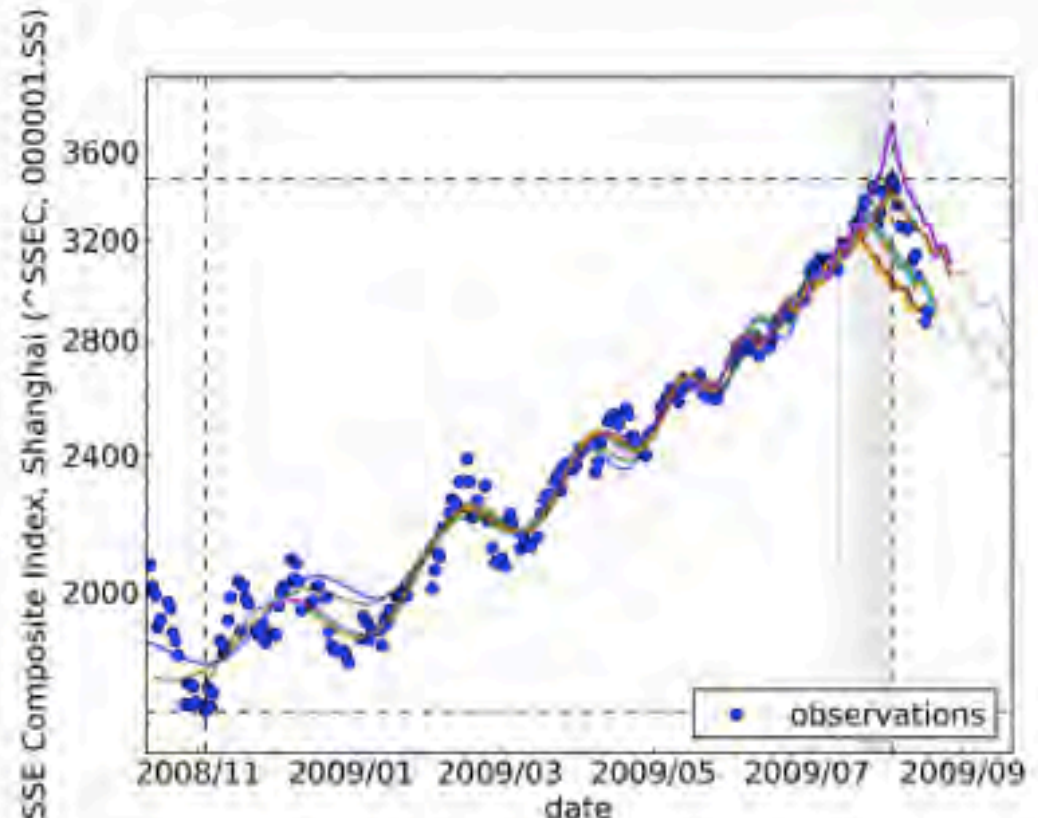
- ***Hypothesis H1: financial (and other) bubbles can be diagnosed in real-time before they end.***
- ***Hypothesis H2: The termination of financial (and other) bubbles can be bracketed using probabilistic forecasts, with a reliability better than chance (which remains to be quantified).***



# FCO@ETH: Towards operational science of financial instabilities

- Main mission:
  - Identify bubbles
- Theory:
  - Positive feedback
- Deliverables
  - Weekly global bubble scan
  - Research, papers
  - Public forecasts
  - Digital timestamps

Didier Sornette, Maxim Fedorovsky, Stefan Riemann, Hilary Woodard, Ryan Woodard, Wanfeng Yan, Wei-Xing Zhou



## Financial Crisis Observatory

### Financial Crisis Observatory

Description

Highlights

Is there an oil bubble?

Pertinent articles

Websites and Blogs

Market Anxiety Measures

RSS Feed

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.

### Financial Bubble Experiment

1 Nov, 2009

We introduce a new experiment involving the forecasts of the end of bubbles in financial time series using techniques developed over the past 15 years. The majority of forecasts that we have made in the past have been published after we found them to be successful. That is, we have predicted certain bubbles to end and then have written about the post-mortem analysis. In this new experiment, we propose a new method of delivering our forecasts where the results are revealed only after the predicted event has passed but where the original date when we produced these same results can be publicly, digitally authenticated. More information can be found in the first delivery of the [Financial Bubble Experiment](#).

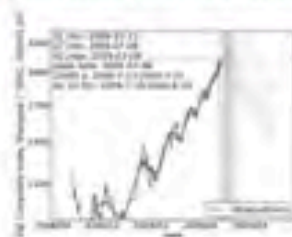
### Highlighted Papers

D. Sornette, [Dragon-Kings, Black Swans and the Prediction of Crises](#), in press in the *International Journal of Terraspace Science and Engineering* (2009), (<http://arXiv.org/abs/0907.4290>)

Featured on the FT blog "[Dragon-king of the outlier events](#)"

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>), to appear in the Proceedings of APFA7 (Applications of Physics in Financial Analysis). This conference series, organized by Misako Takayasu and Tsutomu Watanabe, focuses on the analysis of large-scale Economic data, (<http://www.thic-apfa7.com/en/htm/index.html>)

### Past analysis and forecasts



#### CHINESE EQUITY (10 July 2009)

Amid the current financial crisis, there has been one equity index beating all others: the Shanghai Composite. Our analysis of this main Chinese equity index shows clear signatures of a bubble build up and we go on to predict its most likely crash date: **July 17-27, 2009** (20%/80% quantile confidence interval). See full analysis and results in [this paper](#).



#### 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



### Reports

[Internal reports](#)

### FCO RSS Feed





Weekly scan of (soon-to-be) all major global stock exchanges and indexes.

# FCO Report - US - P bubbles - 21 October

## Academic Portfolio Tracking

- Allow non-integer number of shares
- Use daily adjusted closing prices
- No transaction fees

[FCO] [[FCO Reports](#)]

SP500	SP1000
<a href="#">Weekly reports</a>	<a href="#">Weekly reports</a>
Historical appearances sorted by:	Historical appearances sorted by:
<ul style="list-style-type: none"> <li>• <a href="#">Stock</a></li> <li>• <a href="#">Sector</a></li> <li>• <a href="#">Crashes/Rallies</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Stock</a></li> <li>• <a href="#">Sector</a></li> <li>• <a href="#">Crashes/Rallies</a></li> </ul>
Portfolio transactions:	Portfolio transactions:

Ticker info			Last t1 (1 July 2009)				Qualified fits					Indicators				News	ER	
Ticker	Sector	num. qual. fits	<ret>	<ret> over risk	fraction rets > 0	max. dd index obs. fit	<ret>	<ret> over risk	fraction rets > 0	max. dd index obs. fit	max. dd t1	Bull fit obs	Vol	Crash	Bull Vol Crash	20 Q Crash 80 Q	Bloomberg Google Yahoo	Recommends
<a href="#">AAN</a>	Consumer Discretionary	4	-0.129	-3.076	0.000		-0.042	-0.526	<a href="#">0.136</a>		2008-04-01	0.188 0.656	0.086	80	DVC -VC	2009-12-12 2010-01-14 2010-04-20	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain
<a href="#">ASEI</a>	Industrials	7	-0.043	-1.309	0.000		-0.010	-0.100	<a href="#">0.481</a>		2008-04-01	0.448 0.580	0.106	59	-VC -VC	2009-11-13 2009-12-18 2010-03-17	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain
<a href="#">B</a>	Industrials	3	0.072	1.522	1.000		0.007	0.043	<a href="#">0.929</a>		2009-01-01	0.315 0.357	0.189	21	DHC DHC	2009-10-28 2009-11-10 2009-12-04	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain And Watch Crash Risk
<a href="#">BRKL</a>	Financials	3	-0.064	-1.157	0.000		-0.002	-0.021	<a href="#">0.545</a>		2008-04-01	0.487 0.854	0.080	57	-C U-C	2009-11-10 2009-12-16 2010-03-02	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain
<a href="#">BWLK</a>	Consumer Discretionary	10	0.278	1.807	1.000		0.003	0.012	<a href="#">0.382</a>		2007-01-01	0.450 0.154	0.228	196	H DH	2009-11-21 2010-03-17 2010-06-18	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain
<a href="#">BVC</a>	Financials	1	0.000	0.000	1.000		0.000	0.000	<a href="#">0.545</a>		2008-10-01	0.609	0.110	57	-HC	2009-10-29 2009-12-11	<a href="#">B</a> <a href="#">G</a> <a href="#">Y</a>	Abstain

# METHODOLOGY OF THE FINANCIAL BUBBLE EXPERIMENT

- We choose a series of dates with a fixed periodicity on which we will reveal our forecasts (1 May 2010 + 6 months periodicity)
- Continuous research of +30'000 global financial time series.
- Confident forecast => summarize it in a simple .pdf document
- We do not make this document public.
- We make its digital fingerprint public (MD5 hash algorithm and SHA-2 hash) => three strings of letters and numbers that are unique to this file.
- First version of our “meta” document (description of our theory and methods, the MD5 and SHA-2 hashes of our first forecast and the date (1 May 2010) on which we will make the first original .pdf document public)
- Upload to <http://arxiv.org>. It makes public the MD5 and SHA-2 hashes of our first forecasts + independent timestamp ‘v1’ (version 1) (trusted third party)
- Next confident forecast => new secret .pdf file and public SHA-2 hash in ‘v2’ on <http://arxiv.org>.
- We continue this protocol until 1 May 2010 at which time we upload our final version of the master document and publish all .pdf forecast files + our summary and analysis of the forecasts.

**The Financial Bubble Experiment:  
advanced diagnostics and forecasts of bubble terminations**

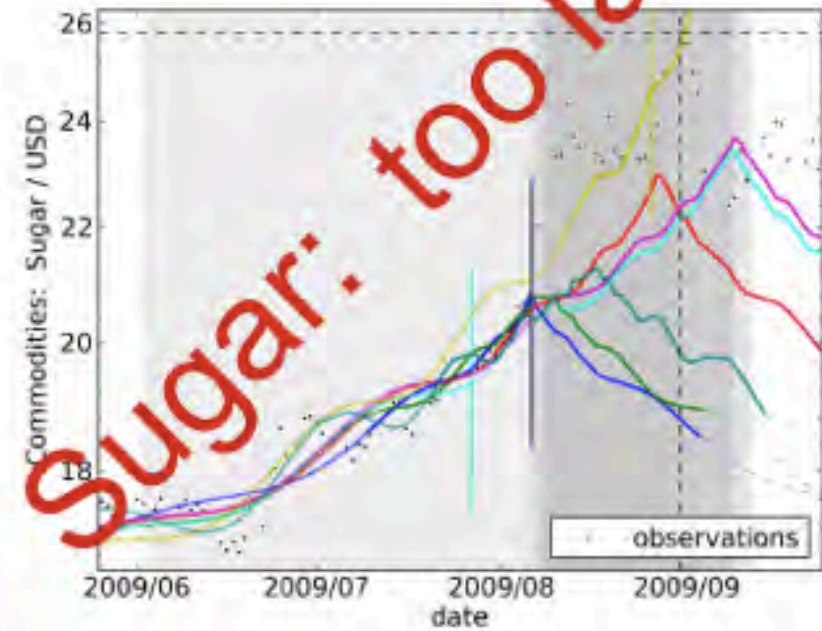
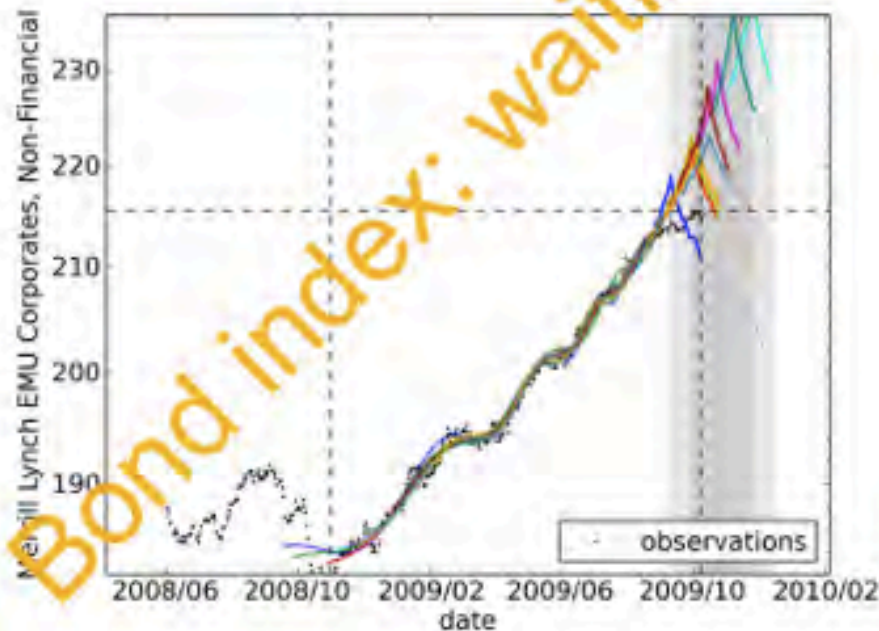
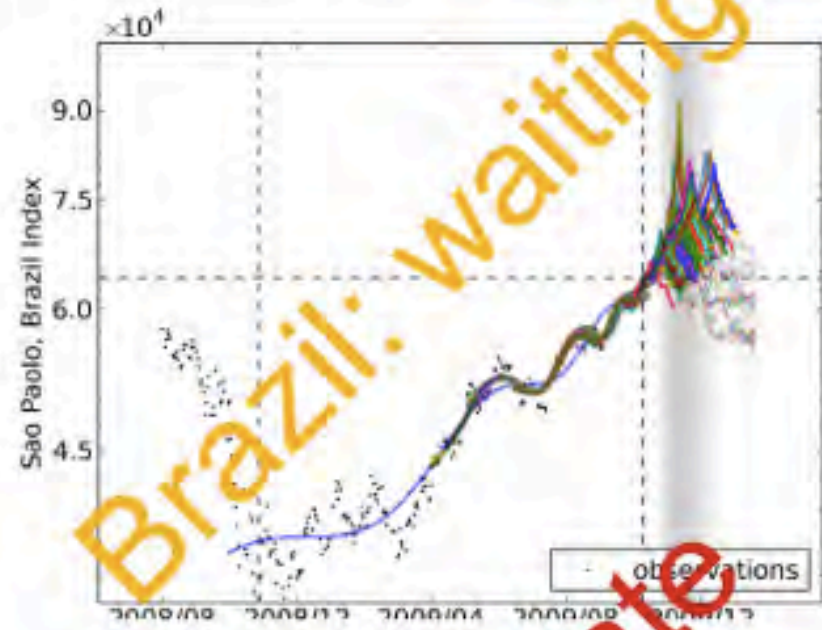
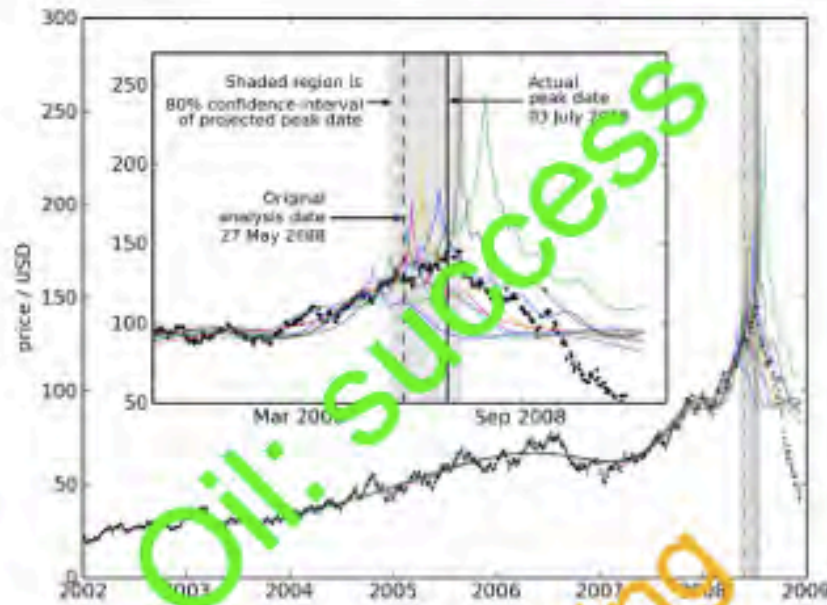
The Financial Crisis Observatory\*  
*Department of Management, Technology and Economics,  
ETH Zurich, Kreuzplatz 5, CH-8032 Zurich, Switzerland*  
(Dated: November 2, 2009)

Publication date	MD5SUM SHA256SUM SHA512SUM
2009-11-02	6d9479eb2849115a12c219cfa902990e d7ad5c9531166917ba97f871fb61bd1f6290b4b4ce54e3ba0c26b42e2661dc06 808bbfaddbca3db8d0f55d74cabedf5201ecd70340f86e27dfac589ce682144f52f6fc4b3ff1ac75231038d86dae58bd320e7fb17ef321b4bc61a19e88071039
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TABLE I: Checksums of Financial Bubble Experiment forecast documents.



# Oil, Brazil, bonds, sugar



Thursday, November 05, 2009

## Forecasting financial crashes: the ultimate experiment begins

If a new technique for predicting crashes really works, a bold new experiment will measure how well.



**Technology**  
PUBLISHED BY MIT  
**Review**

Is it really possible to predict the end of financial bubbles? Didier Sornette at the Swiss Federal Institute of Technology in Zurich thinks so and has set up the Financial Crisis Observatory at ETH to study the idea.

We've looked at his extraordinary predictions before. Earlier this year, [he identified a bubble in the Shanghai Composite Index](#) and much to this blog's surprise, forecast its end with remarkable accuracy.



# Final remarks

1-All proposals 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 as a system variable versus the illusion of control by monetary policy, risk management, and all that

3-Need to make endogenous policy makers and regulators (“creationist” view of government role, illusion of control and law of unintended consequences of regulations)

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