



RISK MANAGEMENT

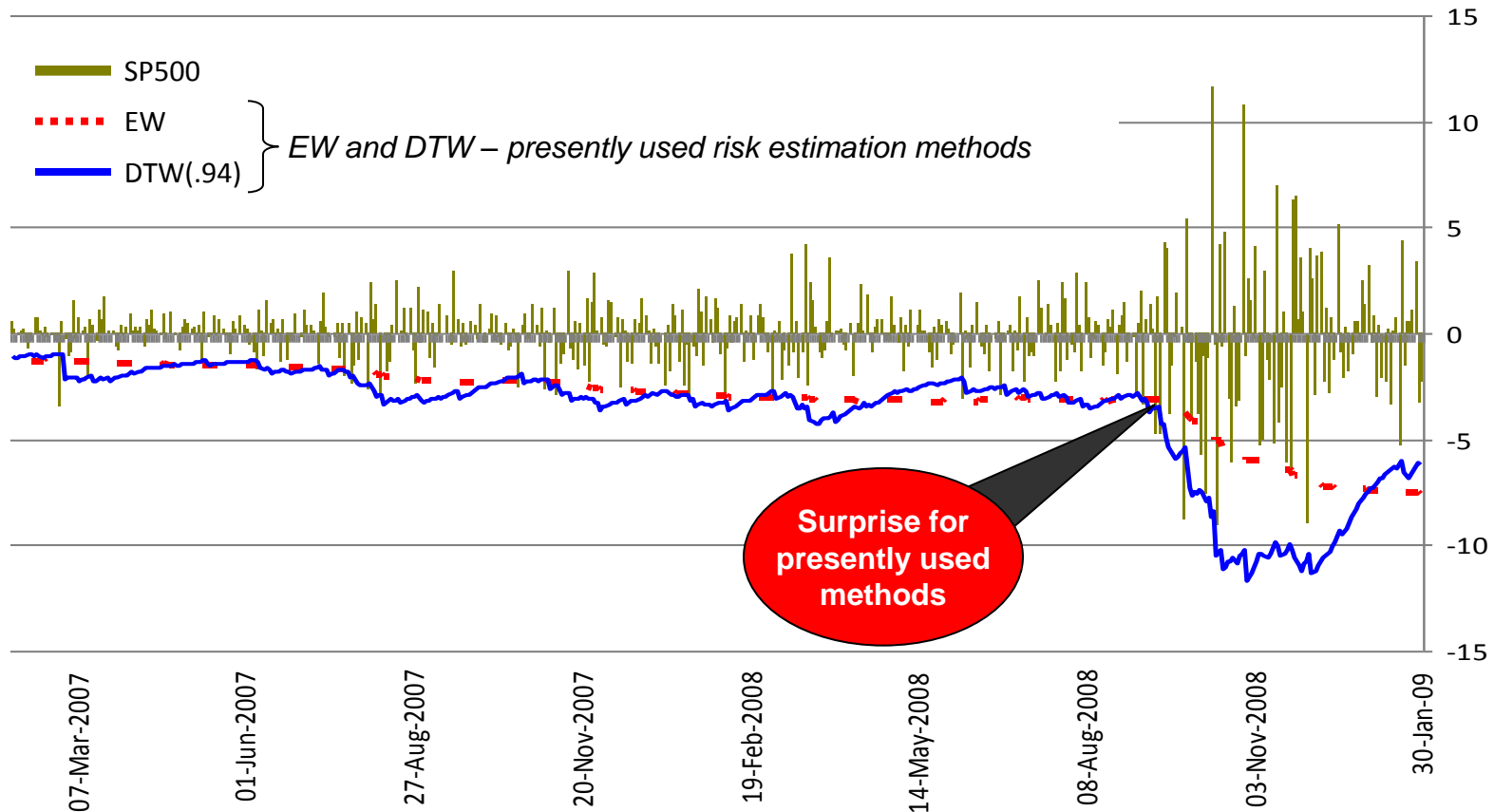


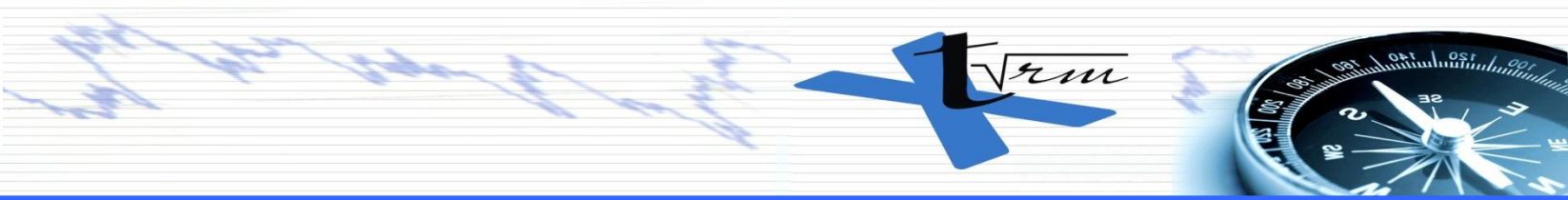
When Swans Are Grey: The New Paradigm of Risk Management



Problem setting: Extreme events surprise presently accepted risk estimation methods

Run up to the 2008 Crash Under the Presently Accepted Methods





- **Definitions**

- **Current state in risk modeling**

- **New paradigm**

- **Application / empirical testing**



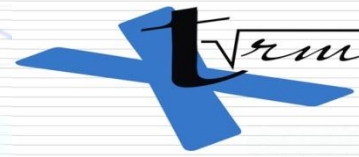
What is Risk – there is no uniform definition

Example definitions

- Frank Knight: Measurable (risk) and Unmeasurable (uncertainty)
- Glyn Holton: Risk involves uncertainty and exposure
- Harry Markowitz/MPT: “...then the investor does (or should) consider expected return a desirable thing and variance of the return an undesirable thing.”
- Hazard: a source of danger; a possibility of incurring loss or misfortune
(wordnetweb.princeton.edu/perl/webwn)

Definition we use

- Probability of a major loss
- Intuitive
- Easy to communicate
- Similar to a widely used metric (Value-at-Risk)



Defining Probability

The Many Faces of Probability

- L. J. Savage: “It is unanimously agreed that statistics depends somehow on probability. But, as to what probability is and how it is connected with statistics, there has seldom been such complete disagreement and breakdown of communication since the Tower of Babel.”
- Frequentist/Evidential
- Objective/Subjective
- Bruno de Finetti: “Probability, too, if regarded as something endowed with some kind of objective existence, is ... an illusory attempt to materialize our true probabilistic beliefs”

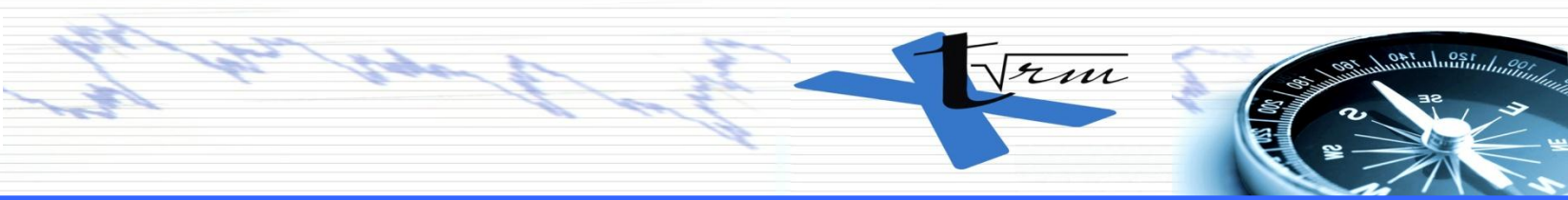
John Maynard Keynes’ definition

- “The terms certain and probable describe the various degrees of rational belief about a proposition which **different amounts of knowledge** authorise us to entertain”
- Same proposition can be assigned different probability by different observers, so, in this sense, it can be called subjective
- “But in the sense important to logic, probability is not subjective. It is not, that is to say, subject to human caprice. A proposition is not probable because we think so”



What is a function of a Paradigm?

- Tells a researcher what the world is like
- Provides foundations/allows to focus on specifics
- Postulates which entities do/do not inhabit the researcher's world
- Provides a theory of **how entities interact** (more on this later)
- Provides “exemplars”
- E. defines acceptable questions to ask
- E. defines acceptable solutions to a problem
- E. defines acceptable methods for obtaining solutions



- **Definitions**

- **Current state in risk modeling**

- **New paradigm**

- **Application / empirical testing**



Old Paradigm Foundations

- 1 Based on classical/neo-classical economics
- 2 Markets slowly tend to equilibrium
- 3 Gradual adjustment – Valrasian “Tatonnement” or “Groping” toward equilibrium i.e. no jumping
- 4 Immutable laws of supply & demand (demand is inversely related with the price; more on that later)
- 5 Inhabited by rationally calculating participants with knowledge of future probability distributions
- 6 Investors actions do not move the market; this has much stronger implications than simply the absence of market impact of large trades
- 7 Market opinion matters; market implied metrics can be used for forecasting via extrapolation



Post 2008 Crisis Realizations – Basel Committee

- “Most risk management models, including stress tests, use historical statistical relationships to assess risk. They assume that risk is driven by a **known and constant statistical process**... Given a long period of stability, backward-looking historical information indicated benign conditions so that these models did not pick up the possibility of severe shocks or the **build up of vulnerabilities** within the system. “
- “Historical statistical relationships, such as correlations, **proved to be unreliable** once actual events started to unfold. [...] Extreme reactions (by definition) occur rarely and may carry little weight in models that rely on historical data.”
- Extrapolation from recent market behavior **stops working at the worst possible time**
- 2008 Crash was not necessary for this realization, this has been proven at least four times in the past quarter century



Post 2008 Crisis Realizations – Alan Greenspan

- “The most credible explanation of **why risk management based on state-of-the-art statistical models can perform so poorly** is that the underlying data used to estimate a model’s structure are **drawn generally from both periods of euphoria and periods of fear, that is, from regimes with importantly different dynamics.**”
- The real problem is that there is no way to distinguish when data from “extreme” periods are more relevant than from “normal” and vice versa



The Flawed Paradigm: Incorporation of Historical Return Data

Fundamentals of current paradigm

- MPT/Equilibrium models
- Equal Weighted (EW)
Estimators forecast risk as an average of the past returns over some pre-specified window

Major flaws

- I If a crisis erupts **after a period of low volatility (underpricing of risk), the risk system will always show low risk – GIGO problem**
- II EW estimators adjust very slowly and still show low risk after it is obvious to even the casual observer that we are in crisis



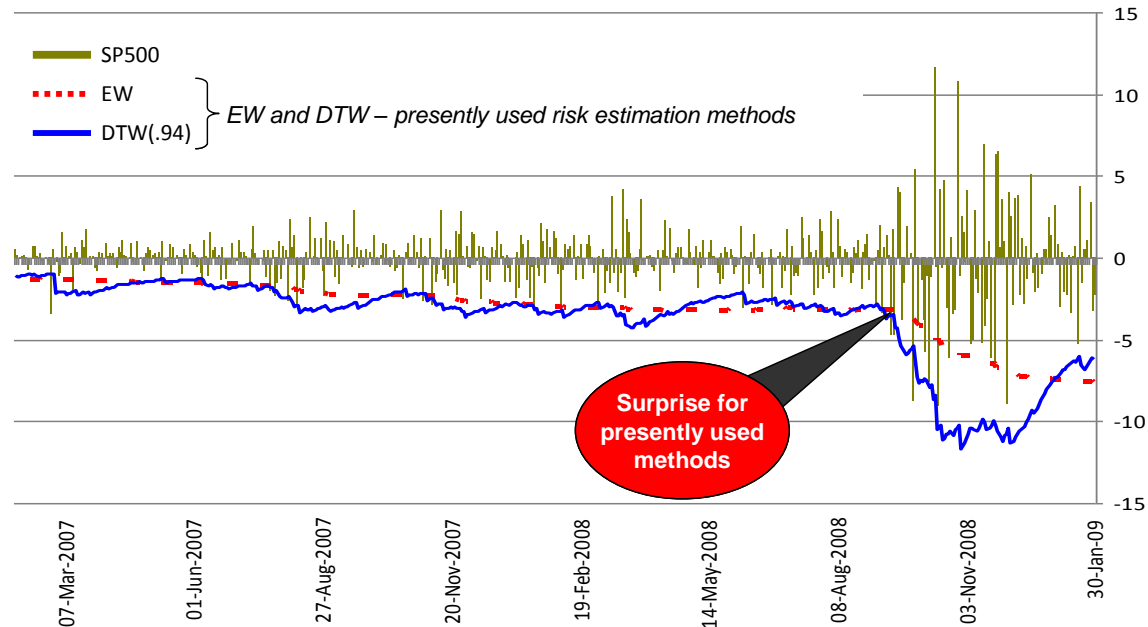
Attempts to fix the flawed paradigm: Attempt 1

Attempt # 1: Decay Time Weighted (DTW) Method

- By assigning **higher value to recent information**, the model is made to adjust quickly
- DTW is **most used today**. But:
 - It **only** fixes the second and a **far less important flaw**
 - After a period of low volatility it will **always show low risk** (GIGO problem)
 - Sometimes DTW will **reduce the risk forecast before the crash** even quicker than the EW method

Paradigm not changed: crisis is a “surprise”

Run up to the 2008 Crash Under the Presently Accepted Methods



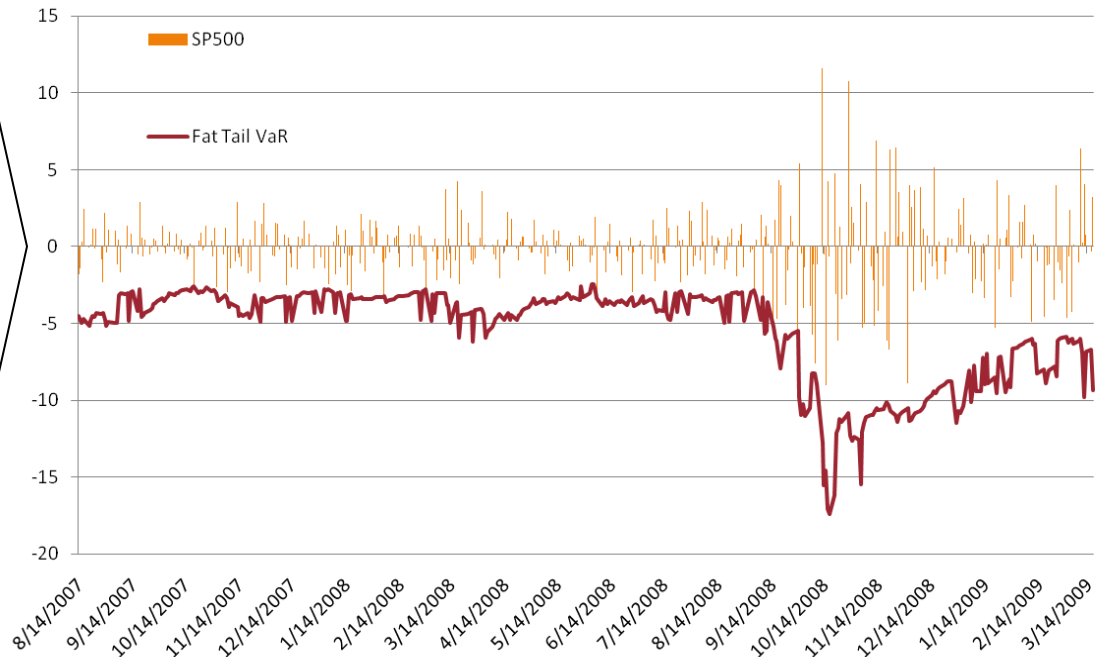


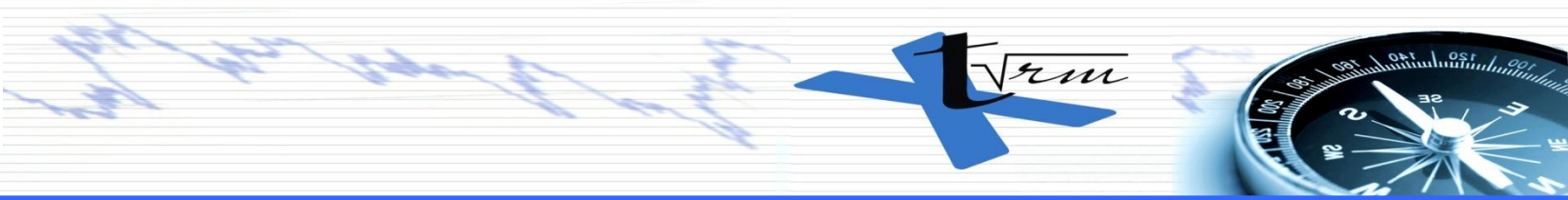
Attempts to fix the flawed paradigm: Attempt 2

Attempt # 2: Fat Tails (Power Law Distributions)

- **Essence:** Risk of extreme events does not decline as swiftly as it does under the bell curve
- Advocated by Mandelbrot (1963) and Taleb (2000) among others
- **More realistic** assumptions
- Student T distribution is one example of a distribution fitting historical data rather well, see Lin & Shen (2006) and Novosyolov & Satchkov (2009)

Paradigm not changed: crisis still a “surprise”





- **Definitions**
- **Current state in risk modeling**
- **New paradigm**
- **Application / empirical testing**



Foundations of the New Paradigm I: Bubble Models

- De Long et al (1990) show a model of market bubbles in which rational traders follow positive-feedback strategies (**rationality is irrelevant under the new paradigm**)
- **Participants buying with rising prices and selling with falling prices** produce self-sustaining trends which ultimately end in a crash
- **Demand moving with price** (as opposed to inversely to it) upsets traditional model supply-demand relationships
- Soros (1987) adds a price-fundamentals feedback loop and calls it “reflexivity”
- Danielsson and Shin (2003): “One of the implications of a highly leveraged market going into reversal is that a moderate fall in asset value is highly unlikely. **Either the asset does not fall at all, or it falls by a large amount.**”



Foundations of the New Paradigm II: Risk Taking Cycle

- Hyman Minsky and Joseph Schumpeter
- Financial Instability Hypothesis, see Minsky (1992)
- “The first theorem of the financial instability hypothesis is that the **economy has financing regimes under which it is stable, and financing regimes in which it is unstable**. The second theorem of the financial instability hypothesis is that **over periods of prolonged prosperity, the economy transits from financial relations that make for a stable system to financial relations that make for an unstable system.**”
- Participants are not independent from each other or from the market
- Deviations exhibit patterns and have repeated over many cycles in various times and markets , see Reinhart & Rogoff (2009)
- **Risk taking (risk pricing)** actions of participants, therefore, are really the **subject of systematic study** under the new paradigm



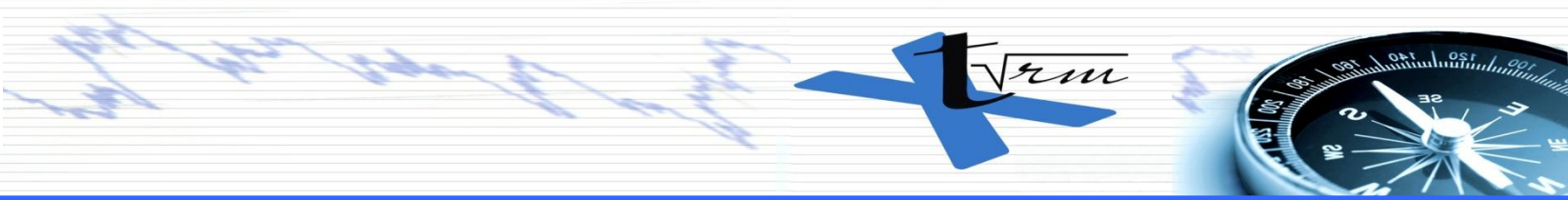
Building a Risk Model in a New Paradigm

- The key to building a good risk model is understanding of the risk-taking behavior and proper incorporation of historical data
- As the mispricing of risk persists, a financial economy becomes increasingly vulnerable to shocks
- Instability Estimator of Risk (IER), see Satchkov (2010), is calculated by assigning progressively higher weight to the observations from the extreme portion of the sample when two conditions are present:
 1. **Risk is persistently mispriced** for a period of time
 2. **The trend of worsening risk mispricing stops** (twilight stage of the bubble, see Soros(1987)) and **shows significant signs of reversal potential**
 - Note that risk mispricing by itself is not a useful indicator, since mispricing may persist for very long periods of time (e.g. 2003-2007)

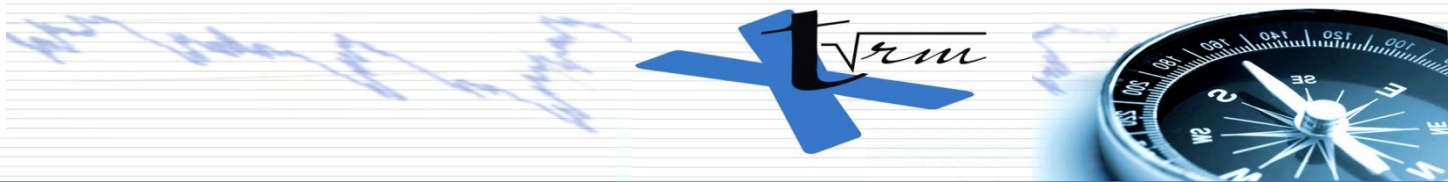


Some Examples of Risk Pricing Metrics

- 1 year average junk credit spreads (JCS)
- 180 day change in JCS
- Volatility trend of JCS
- 1 year average Shiller PE
- Financials credit spreads
- Short-term capital inflows (FX/Sov debt)
- Gross external debt of the economy to exports (FX/Sov debt)
- Exchange rate volatility trend (FX/Sov debt)
- Real effective exchange rate trend (FX/Sov debt)



- **Definitions**
- **Current state in risk modeling**
- **New paradigm**
- **Application / empirical testing**



Empirical Testing of Our Concept

- Compare three currently accepted methods with RiXtrema Risk estimates
- Graphs of 99% VaR estimates from three methods (EW;DTW;XTRM)
- Look at the past quarter century with particular attention to
 - LTCM Meltdown
 - Dot-Com Bubble
 - 2008 Crash
- Statistical tests (binomial testing and likelihood ratio hypothesis testing)

'Early Warning' and Portfolio Construction



Types of signals

Glimpse on radar

- RiXtrema (XTRM) VaR doubles and stays at least as high between 1 day and 2 months
AND
- Actual volatility remains low to moderate

Signal persists

- After doubling and staying at least as high for 2 months, XTRM VaR stays high for 1 day to 4 more months
AND
- Actual volatility remains low to moderate

Crash signal

- After doubling and staying at least as high for 6 months, XTRM VaR continues to stay high
AND
- Actual volatility remains low to moderate

Flash on radar

- XTRM VaR doubles
AND
- Drastic spike in volatility occurs

Actions for risk organization

Talk

- Topic for a risk meeting
- Start monitoring
- Evaluate types of protection and cost

Design contingency plan

- Design action plan & set specific triggers
- Possible execution of first triggers to scale down exposure (depends on conviction of strategists)

The big short?

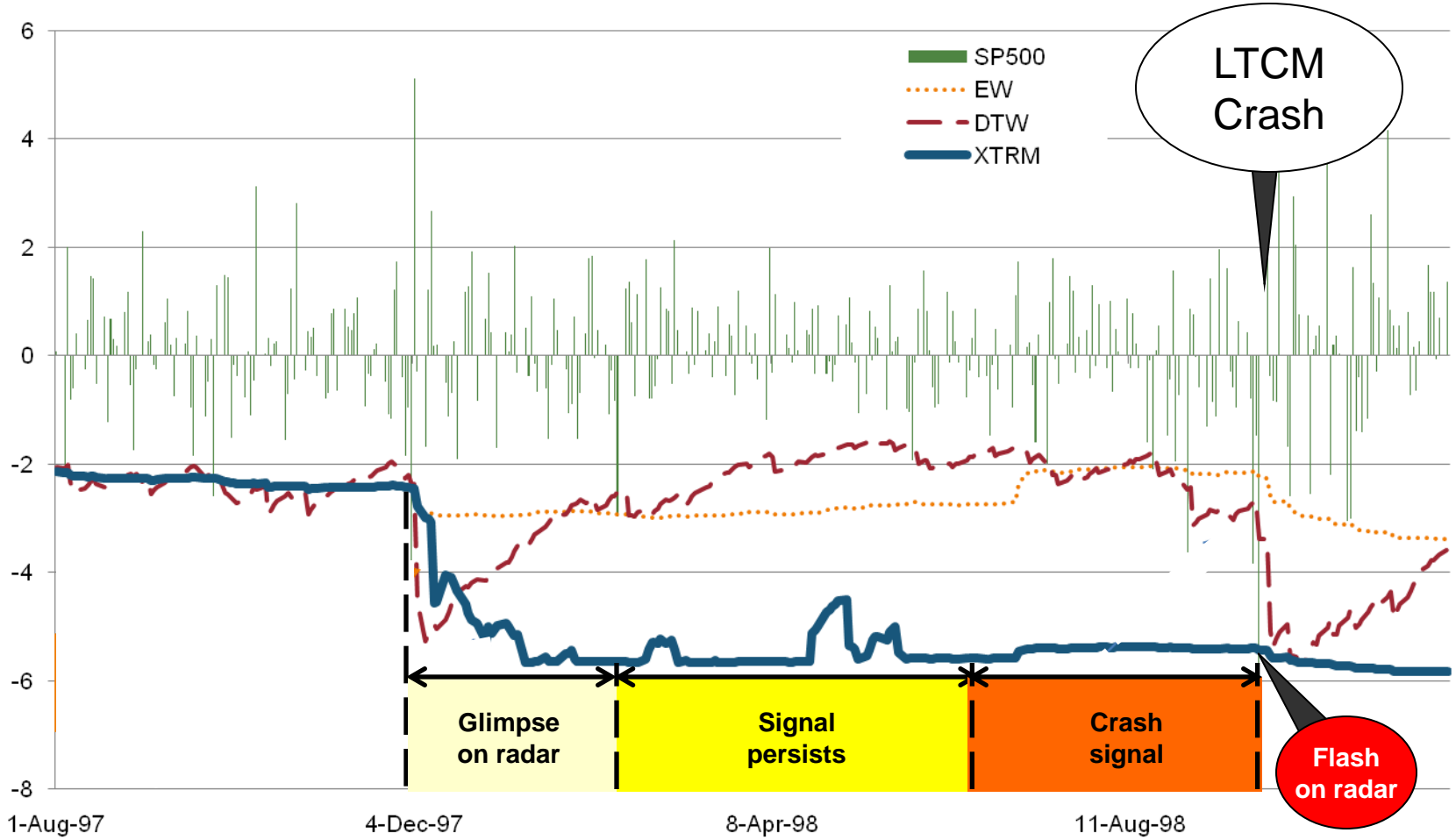
- Limit exposure
- Buy protection while it's cheap

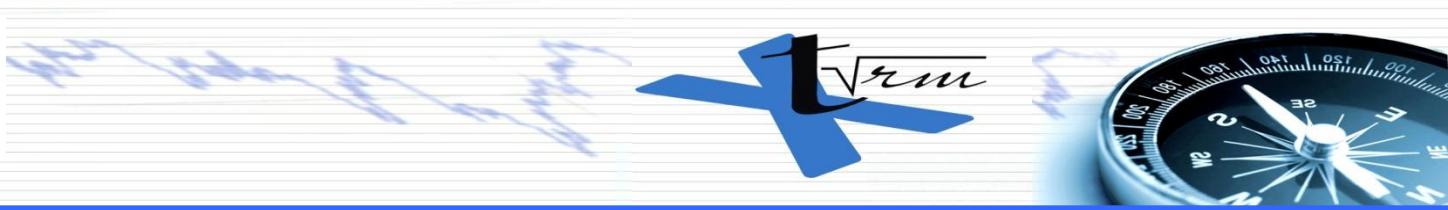
Run for cover

- Get out while you can

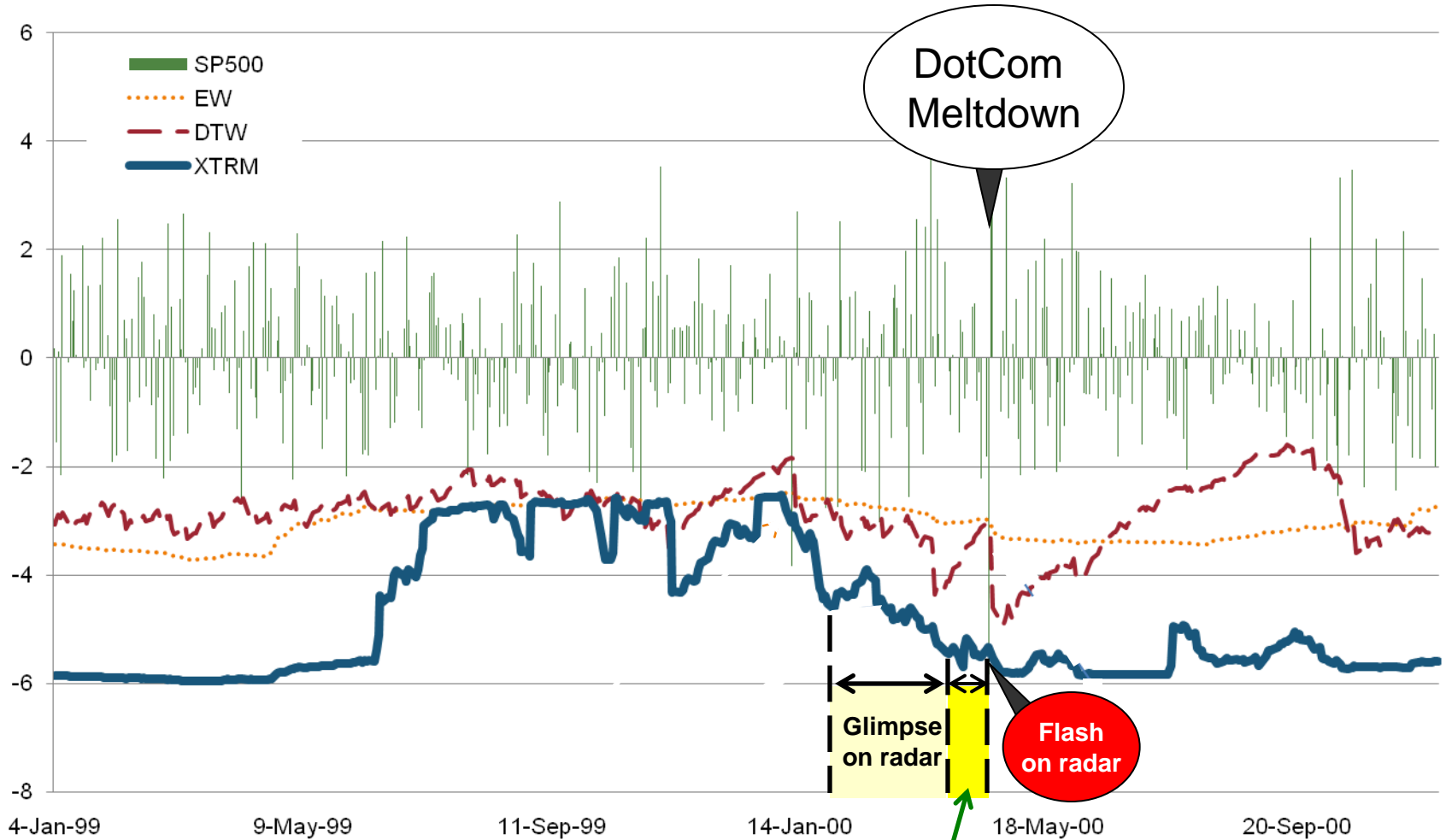


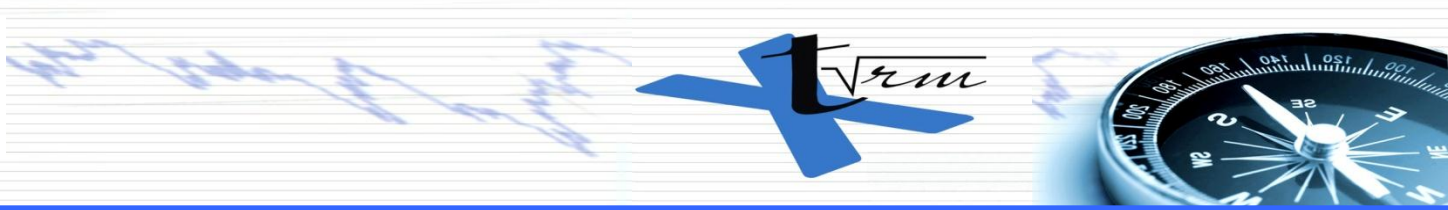
LTCM Crash



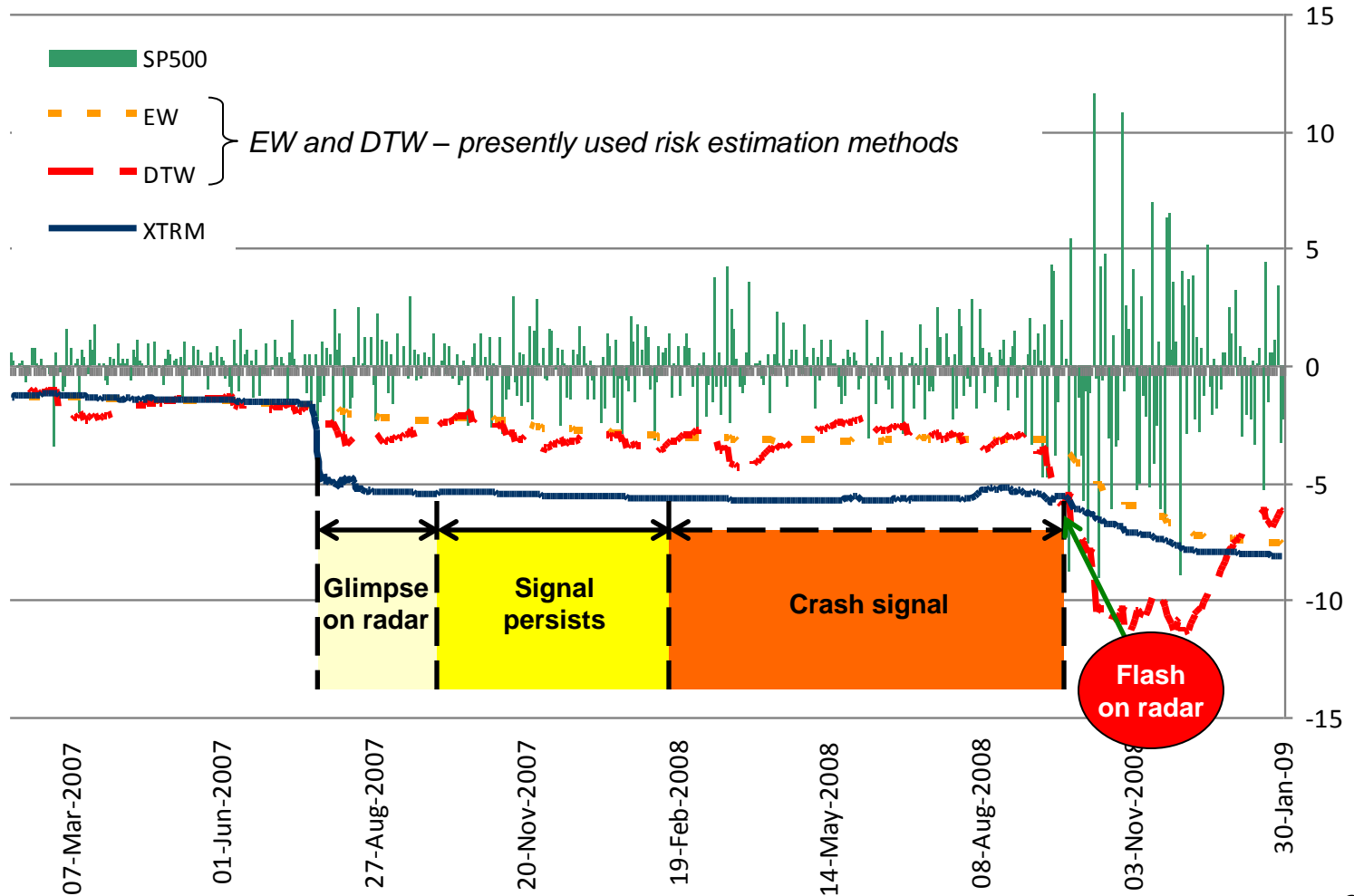


Run Up to the DotCom Meltdown





Run Up to 2008 Crash



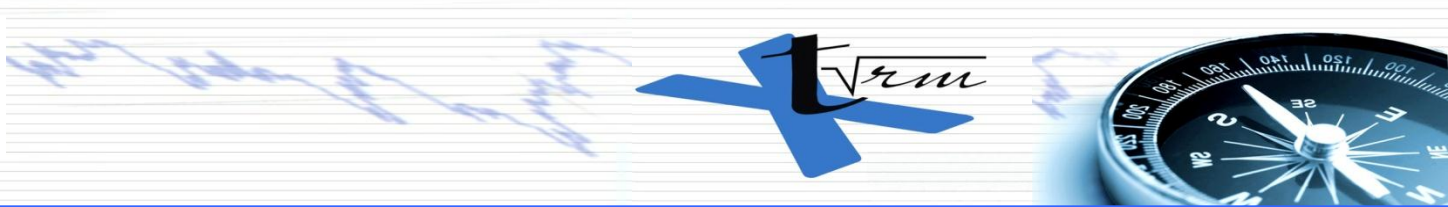


Binomial Test of 99% VaR Models (ideal model should produce ~1% violation for all intervals)

Period	Violation Rate (%)					EW	DTW	XTRM
	1%	2%	3%	4%	5%			
12/31/2005 to 5/21/2010	●		▲▲			2.99%	2.9%	1.54%
12/31/2001 to 5/21/2010	●	▲▲				1.9%	2.1%	.99%
12/31/1997 to 5/21/2010	●	▲▲				1.75%	1.9%	.83%
12/31/1993 to 5/21/2010	●	▲▲				1.97%	2.0%	1.13%
4/26/1989 to 5/21/2010	●	▲▲				1.82%	1.93%	1.03%
12/31/2006 to 12/31/2008	●			▲	▲	4.75%	3.56%	1.58%

Ideal is ~1%

▲ EW ▲ DTW ● XTRM



Statistical Testing

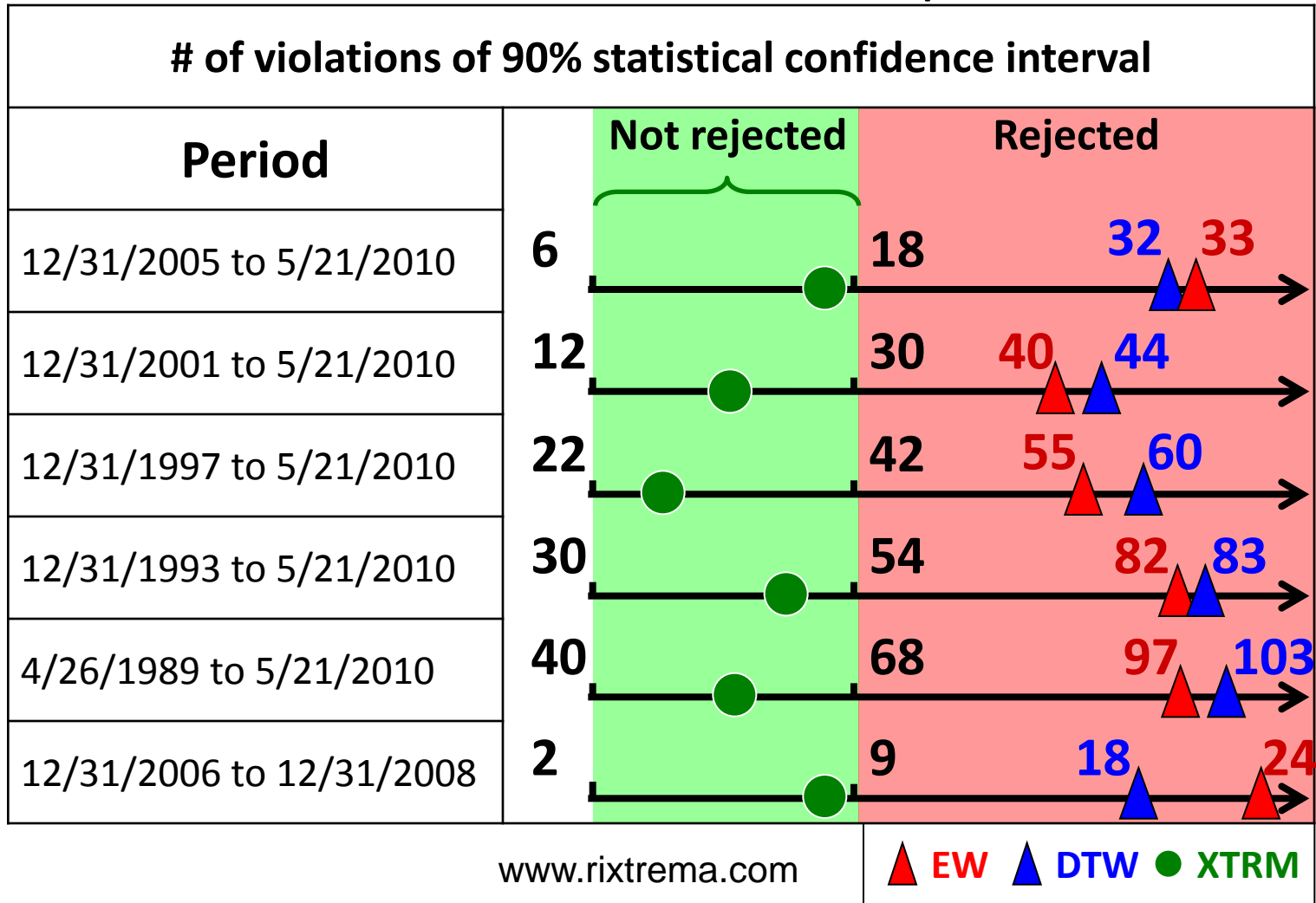
- Statistical tests of VaR are based on the work of Kupiec (1995)

$$LR = -2 * LN \left(\frac{(1 - q)^{n-v} * q^v}{(1 - r)^{n-v} * r^v} \right)$$

- n - number of observations in the sample
- v - number of violations i.e. number of times that the 99% VaR was breached
- q - VaR confidence interval (desired violation rate)
- r - empirical violation rate (v/n)
- Null Hypothesis : $r = q$



Statistical Significance: presently used methods violate 90% confidence interval in all periods





Summary

- Current risk management paradigm can only provide risk estimates that work in “normal” conditions
- Past attempts at improving risk modeling have either addressed secondary problems through algebraic gymnastics or produced excessively conservative risk estimates
- We propose a different conception of the financial economy, as a system that generates measurable endogenous risk through risk taking actions of its participants
- The results of empirical testing of the model show that it can serve as a model of “early warning” without unduly compromising profitability in the up cycle



New Paradigm of Risk Management

Contact

- To ask any questions regarding the webcast, to request a copy of the presentation, a whitepaper or other publications of RiXtrema please email:

mail@rixtrema.com



References

1. *Basel Committee on Banking Supervision, 2009, "Principles for sound stress testing practices and supervision consultative paper"*.
2. *Greenspan, A., "We will never have a perfect model of risk", Financial Times, March 18, 2008.*
3. *Mandelbrot, B., 1963, "The variation of certain speculative prices", Journal of Business 36 (October): pp. 394-419.*
4. *Lin, C. and Shan-Shan, C., 2006, "Can the student t-distribution provide accurate Value-at-Risk?", Journal of Risk Finance, Vol. 7, Issue 3, 292-300.*
5. *Novosyolov, A. and Satchkov, D., 2009, "Tail Risk and VaR: Reconciling Theory with Reality in FactSet's Portfolio Analysis", FactSet Whitepaper.*
6. *Minsky, H., May 1992, "The Financial Instability Hypothesis", working paper #74.*
7. *De Long, B. and Shleifer, A. and Summers, L. and Waldmann, R., 1990, "Positive Feedback Investment Strategies and Destabilizing Rational Speculation", The Journal of Finance, Vol. XLV No.2, June 1990.*
8. *Soros, G., The Alchemy of Finance: Reading the Mind of the Market. New York: Simon & Schuster, 1987.*
9. *Danielsson, J., and Hyun S, 2003, "Endogenous Risk" in Modern Risk Management: A History, Risk Books, 2003.*
10. *Satchkov, D., 2010, "Are Some Swans Grey: VaR as an Early Warning Signal?", Journal of Risk Management in Financial Institutions, Forthcoming August 2010.*
11. *Kupiec, P., 1995, "Techniques for Verifying the Accuracy of Risk Measurement Models", Journal of Derivatives, Vol. 3, No. 2, Winter 1995*



References

12. Keynes, John Maynard, 1921, "A Treatise on Probability". London: MacMillan
13. Savage, L.J., 1954, "The foundations of statistics". New York: John Wiley & Sons, Inc.
14. Bruno de Finetti, 1937, "La Prévision: ses lois logiques, ses sources subjectives," Annales de l'Institut Henri Poincaré,
"Foresight: its Logical Laws, Its Subjective Sources," (translation of the [1937 article](#) in French) in H. E. Kyburg and H. E. Smokler (eds), *Studies in Subjective Probability*, New York: Wiley, 1964.
15. Knight, F.H., 1921, "Risk, Uncertainty and Profit". Reprint by the University of Chicago Press.
16. Kuhn, T.S., 1962, *The Structure of Scientific Revolutions*. The University of Chicago Press.
17. Reinhart, C. and Rogoff K., 2009, "This Time it is Different", Princeton University Press; New Jersey.