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AntiFragility: Tough times don’t last - tough people do!

Presented by Claus Madsen:
CEO FinE Analytics, Partner InRisk,
Associate Professor DTU - FE,
Chairman of the Risk Management Network,
Regional Director Denmark PRMIA
E-mail: cam@fineanalytics.com,
cmads@man.dtu.dk

Fragile, Robust and Anti-Fragile?

- Fragile: The cumulative effect of small shocks is smaller than the single effect of an equivalent single large shock
  - That is: Fragility is related to how a system suffers from the variability of its environment beyond a certain preset threshold (when threshold is K, it is called K-fragility)

- Robust: The resilient resists shocks and stays the same

- Antifragile: Refers to when the system benefits from variability. The antifragile loves randomness and uncertainty

Tail-Events......I

- A coffee cup on a table suffers more from large shocks than from the cumulative effect of some shocks. Conditional on being unbroken, it has to suffer more from "tail" events than regular shocks around the center of the distribution, the "at the money" category
    - This is the case of elements of nature that have survived: conditional on being in existence, in this case the class of events around the mean should matter considerably less than tail events

Tail-Events……II

- Systems which has exposure to tail events suffers from uncertainty; typically, when systems – a building, a bridge, a nuclear plant, or a bank balance sheet– are made robust to a certain level of variability and stress but may fail or collapse if this level is exceeded
  - In this case these systems are particularly fragile to uncertainty about the distribution of the stressor, hence to model error, as this uncertainty increases the probability of dipping below the robustness level, bringing a higher probability of collapse

Tail-Events......III

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Opposite fragile we have that the natural selection of an evolutionary process is particularly antifragile, indeed, a more volatile environment increases the survival rate of robust species and eliminates those whose superiority over other species is highly dependent on environmental parameters

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- When it comes to random events "robust" is certainly not good enough.

    - We need a mechanism by which a system regenerates itself continuously by using, rather than suffering from, random events, unpredictable shocks, stressors, and volatility.

Intrinsic and Inherited Fragility

- The earlier definition of fragility relies on the nonlinearity of exposure as nonlinearity in a source of stress is necessarily associated with fragility

- Clearly, a coffee cup, or a bridge don't have subjective utility functions, etc. Yet they are concave in their reaction to harm: simply, taking z as a stress level and Π(z) as the harm function, it suffices to see that, with

  - $n > 1$, $\Pi(nz) < n\,\Pi(z)$ for all $0 < nz < Z^*$

- where Z^* is the level (not necessarily specified) at which the item is broken. Such inequality leads to Π(z) having a negative second derivative at the initial value z

- **Hint:** Fragility that comes from the effect of the underlying is called inherited fragility

Detection Heuristic

- The main idea is that a wrong ruler will not measure the height of a child; but it can certainly tell us if he is growing
- Since risks in the tails map to nonlinearities (concavity of exposure), second order effects reveal fragility, particularly in the tails where they map to large tail exposures, as revealed through perturbation analysis.
- More generally every nonlinear function will produce some kind of positive or negative exposures to volatility for some parts of the distribution

Fragility and Model Error - I

- The definition of fragility extends to model error, as some models produce negative sensitivity to uncertainty, in addition to effects and biases under variability.
- So, beyond physical fragility, the same approach measures model fragility, based on the difference between a point estimate and stochastic value (i.e., full distribution). Increasing the variability (say, variance) of the estimated value (but not the mean), may lead to one-sided effect on the model

Fragility and Model Error - II

- For instance, the misuse of thin-tailed distributions (say Gaussian) appears immediately through perturbation of the standard deviation:
  - No longer used as point estimate, but as a distribution with its own variance.
- For instance, it can be shown how fat-tailed (e.g. power-law tailed) probability distributions can be expressed by simple nested perturbation and mixing of Gaussian ones:
  - Such a representation pinpoints the fragility of a wrong probability model and its consequences in terms of underestimation of risks, stress tests and similar matters.
- **Reference:** Taleb and Douady, " Mathematical Definition, Mapping, and Detection of (Anti)Fragility", August 2012

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AntiFragility and Regulation

- A complex system does not require complicated systems and regulations and intricate policies to function
- The simpler, the better. Complications (and interventions) lead to multiplicative chains of unanticipated effects
    - Less is more and usually more effective.
- PRINCIPLE: Complex systems are not understandable
- PRACTICE: Don’t try – Avoid interfering with what you don’t understand

- Littterature: Taleb, “Antifragile – Things that Gain from Disorder”, Penguin Books 2012

Appendix A: Markowitz - I

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- The statement: *Portfolio Theory entices people to diversify, hence it is better than nothing*
- Wrong! It pushes them to optimize, hence overallocate
- It does not drive people to take less risk based on diversification, but causes them to take more open positions owing to perception of offsetting statistical properties – making them vulnerable to model error, and especially vulnerable to the underestimation of tail events
- Markowitz is a Fragilista!

Appendix A: Markowitz - II

- Alternatively use Kelly's Criterion

- Kelly's Method developed around the same time as Markowitz, requires no joint probability distribution or utility function

- In this case one needs the ratio of expected profit to worst-case return – dynamically adjusted to avoid ruin

- Antifragile theory supports this selection rule!
- Used by (apparently) Warren Buffet and others…..