

Antifragility Revisited

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How do things behave when they're shaken?

Most of them tend to dislocate—they're fragile; some tend to resist—they're robust; only a few of them gain from the agitation. These are called 'antifragile'. Living organisms, for instance, are known to not only withstand small shocks, but to benefit from their own variability. Sportsmen live longer, and open-minded people gain efficiency over time. The notion of antifragility was first developed in 2012 by Professor Nassim Nicholas Taleb, in his book *Antifragile: Things that Gain From Disorder*.

Today, Gavekal introduces antifragility as a portfolio-optimization tool, to help asset managers build a profitable portfolio which also resists market shocks. TrackRisk, the Gavekal portfolio risk software, can now calculate asset fragility and combine assets to target optimized fragility or antifragility levels.

Let's introduce the conceptual framework.

Antifragility Revisited in Finance

The "gain", or expected return of an asset, for any given level of probability, is the average compounding of two returns: a favorable one on the right side of the distribution, and an unfavorable one, on the left side of the distribution, as illustrated in figure 1.

The "disorder" of an asset is the variance of its returns.

Spotting expected returns as a function of the variance at all probability levels therefore provides an objective measure of fragility. In case of a linear relationship, the fragility is the slope of the function, as shown in figure 2.

Fig 1. Distribution of asset returns

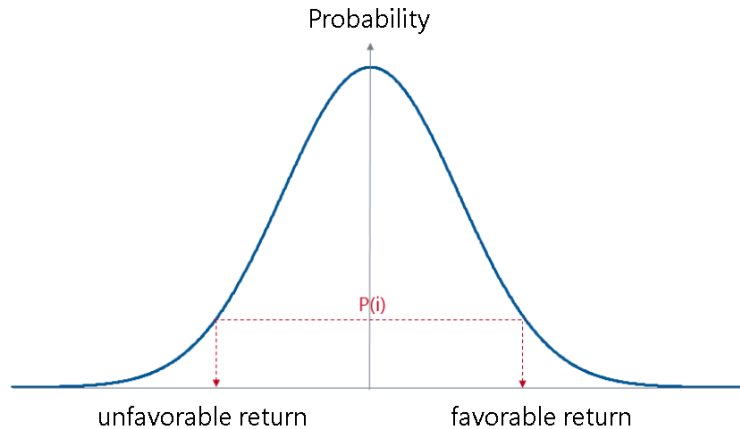
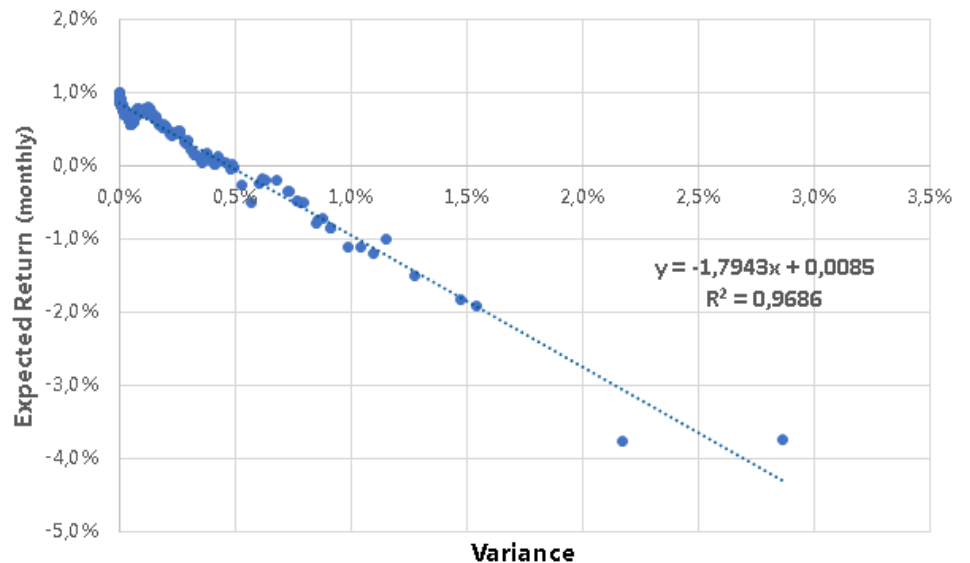


Fig 2. MSCI World fragility from 1970 to 2017



When the MSCI world is calm, its expected return converges towards 1% per month. When it's turbulent, higher positive and negative returns materialize over time. The total expected return, however, decreases linearly with the variance. It comes that the MSCI world is a fragile asset, losing value from its own variability, and that its fragility can be measured precisely, i.e. -1.79 in the last 48 years.

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Fragility is an intrinsic asset characteristic, like mass for an object

Let's measure the S&P fragility during the same period at different time-scales. The expected return vs. risk dependency doesn't depend on the measurement method, say once a day, a week, a month etc., as shown in the following table.

Table 1. S&P fragility measure from 1970 to 2017

Time-scale	Fragility	Confidence (R ²)
annually	-1,4	94%
quarterly	-1,4	97%
monthly	-1,5	95%
weekly	-1,3	87%
daily	-1,6	79%

"Heavy" markets are more fragile than "lighter" ones

Fragility is not a measure of volatility, but a measure of dependency to disorder. 60 million years ago, which were the most fragile animals: massive dinosaurs or tiny lemures? The dominant, well-adapted dinosaurs were fragile when facing environmental changes, and are now extinct.

Most equity indices are fragile, but not to the same extent. Developed markets are better adapted, and therefore more fragile than emerging ones.

Table 2. Equity Markets' Fragilities

Country	Market	Fragility	Confidence (R ²)	From
World	MSCI	-1,8	97%	31/12/1969
USA	S&P500	-1,5	95%	31/12/1969
Japan	NIKKEI	-1,3	91%	31/12/1969
Germany	DAX	-1,1	97%	31/12/1969
Hong Kong	HSI	-0,3	57%	31/12/1969
Russia	RTS	-0,5	93%	29/09/1995

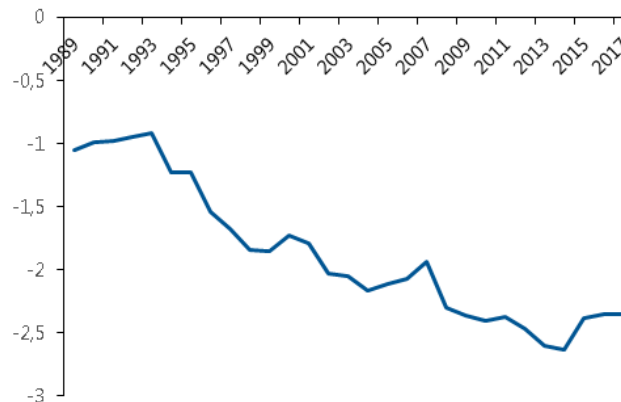
The S&P is getting more fragile over time

The dinosaur analogy provides an insight. In any ecological environment, living organisms can adopt different survival strategies. They can improve their efficiency in absorbing free energy, assuming their environment doesn't change. If successful, they tend to become fat, dominant and fragile. Industrial companies do the same, when they increase fixed costs, reduce their marginal cost of production, and when they gain market shares.

Another strategy is to bet on adaptability, hoping that the environment will change. Lemurines, for instance, were light, agile and antifragile, nocturnal mammals. Things have changed for the best, and some of their descendants—humans—have now adopted the dinosaur's strategy.

The S&P500 pursues this strategy as well, and is becoming heavier and more fragile over time.

Fig 3. S&P Fragility Over 20Y Rolling Periods

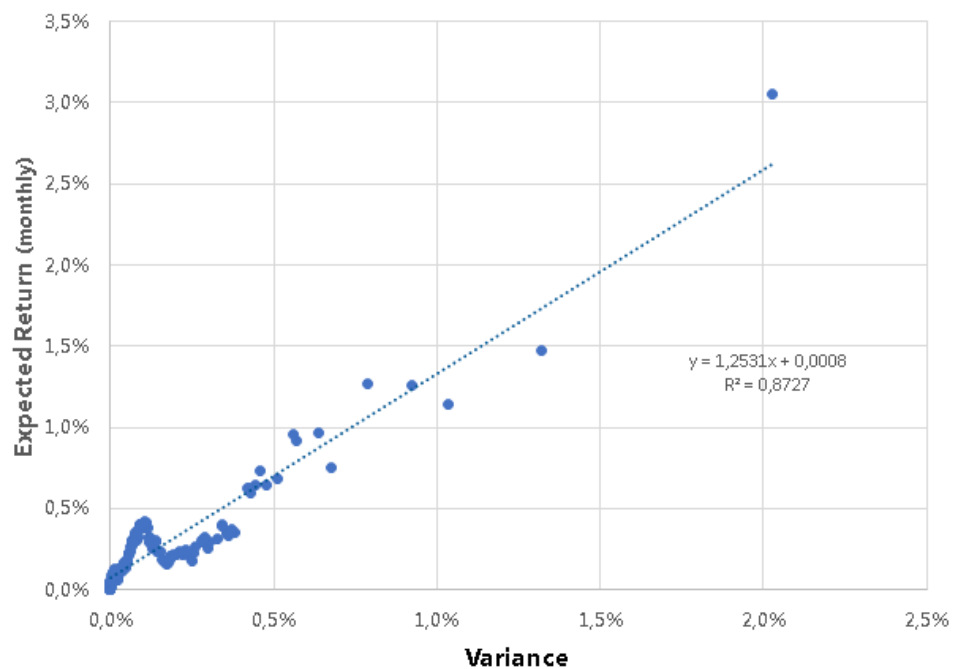


Antifragile Assets

The number of financial assets gaining from disorder is limited. They're the beneficiaries of fights-to-quality in times of equity stress. Here are a few examples.

Table 3. Antifragile Assets

Asset	Fragility	Confidence (R ²)	From
JPY USD	1,3	87%	29/01/1971
10Y UST	0,9	63%	31/12/1969
CHF USD	0,2	15%	29/01/1971
GOLD	0,3	18%	29/01/1971

Fig 4. Antifragile JPY – 1970 to 2017


Example of Portfolio Optimization Under A Fragility Target

The following portfolio equiweights seven fragile and antifragile assets: MSCI World, MSCI EM, Gold, CSFB Hedge Fund Index, 10Y UST, 1M US Tbill, 1M JPY bills. The portfolio exhibits a consolidated fragility of -4.6 since 31/01/1970.

If the optimizer is requested to target full robustness, i.e. zero fragility, with the same volatility, the solution proposed is a concentration of the portfolio on three assets only: 25% Gold, 20% Hedge funds, and 55% 10Y UST.

Fragility optimization, in this case, has eliminated equity investments, even though equities returned more than gold or bonds over the period.

The outcome is surprising:

Table 4. Optimization under fragility

	Return p.a.	Volatility p.a.	Drawdown	Fragility
Initial Portfolio	5,5%	6,5%	-18,9%	-4,6
Optimized Portfolio	6,2%	6,5%	-11,6%	0,0

Conclusion

Fragility is a new concept for portfolio managers to improve long-term portfolio construction. It is based on scientific evidences:

- fragility is an intrinsic characteristic of an asset,
- a measure of its vulnerability to its own variability,
- time-scale independent,
- with slow evolution over time,
- measured with high statistical significance.

The implementation is today available within the Gavekal TrackRisk application.