

# A More Quantitative Fundamental Law 2010 Global Investment Conference

**Peter Millington**  
Director of Quantitative Research  
Pyramis Global Advisors, a Fidelity Investments Company  
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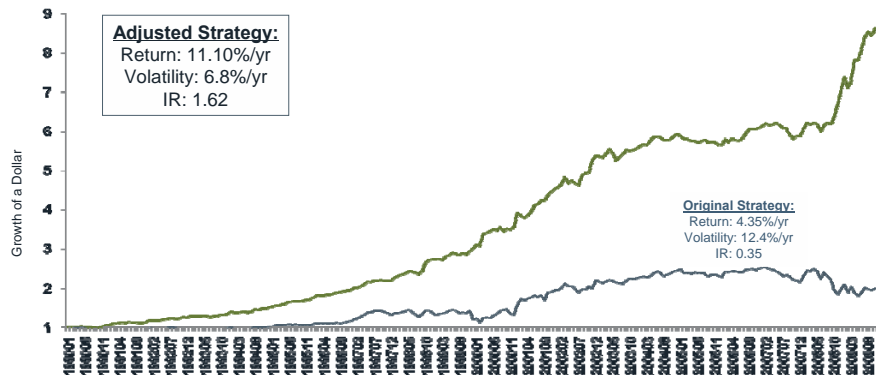


## Agenda

- Revisit the **Fundamental Law of Active Management (FLAM)**
- Introduce an entropy-inspired diversification measure that offers significant improvements over the naïve formulation of the FLAM
- Investigate the general risk structure of the equity market using Principal Component techniques
- Demonstrate shortcomings of FLAM as applied to real alpha strategies
- Use this new framework to demonstrate the potential for significant performance benefits for alpha-based strategies

## Example of Performance Improvement Using Inferences from Modified Fundamental Law of Active Management

1990 - 2009



Results reflect theoretical monthly returns of market-neutral, 2:1 levered equity portfolio, rebalanced monthly with no friction (no transaction costs or market impact, and no liquidity constraints). The long (short) sleeve of the strategy is populated with the most (least) attractive half of the universe using weights proportional each stock's respective normalized alpha signal at each month end.

Source: Pyramis Global Advisors

## Fundamental Law of Active Management

$$IR = IC \times \sqrt{n}$$

Where

IR = Information Ratio = Active Return / Tracking Error

IC = Information Coefficient: A Measure of Manager Skill (correlation between alpha signals & forward returns)

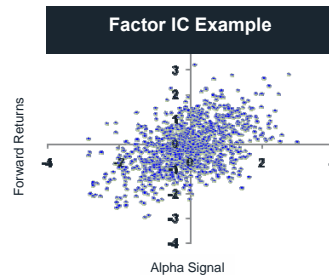
n = BR = Decision Breadth = Number of Independent Portfolio Decisions (bets)

Key Assumptions

Asset returns are uncorrelated, stationary and normally distributed

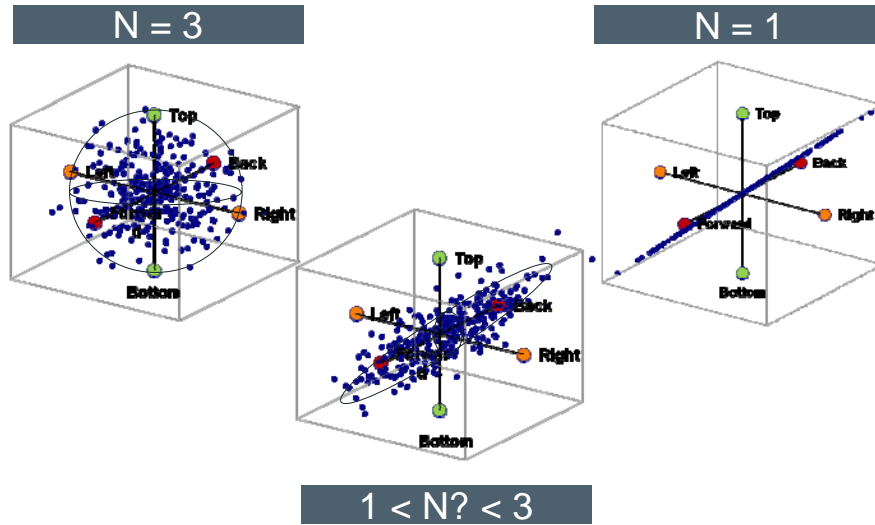
No weight / budget / turnover constraints

Constant IC through time and across universe

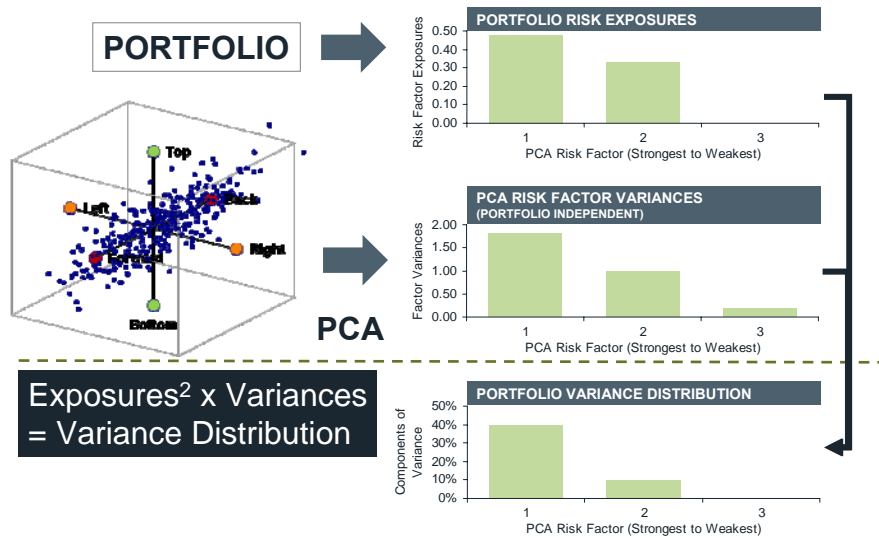


Source: Pyramis Global Advisors  
Reference: Active Portfolio Management, Grinold & Kahn, 2000

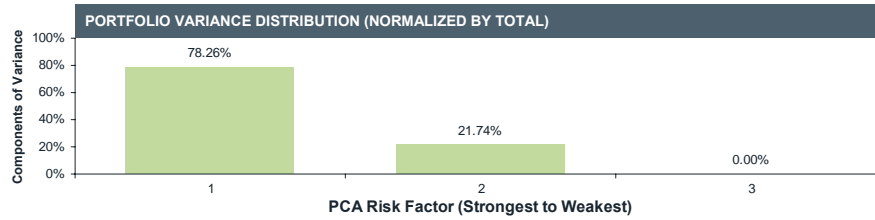
# Principal Components Analysis and Effective Dimensionality



# Portfolio Risk Decomposition Using Principal Components



## Principal Components Analysis and Effective Dimensionality



\*Assume variance distribution are probability masses. Apply exponential information entropy (or Shannon entropy) to probabilities

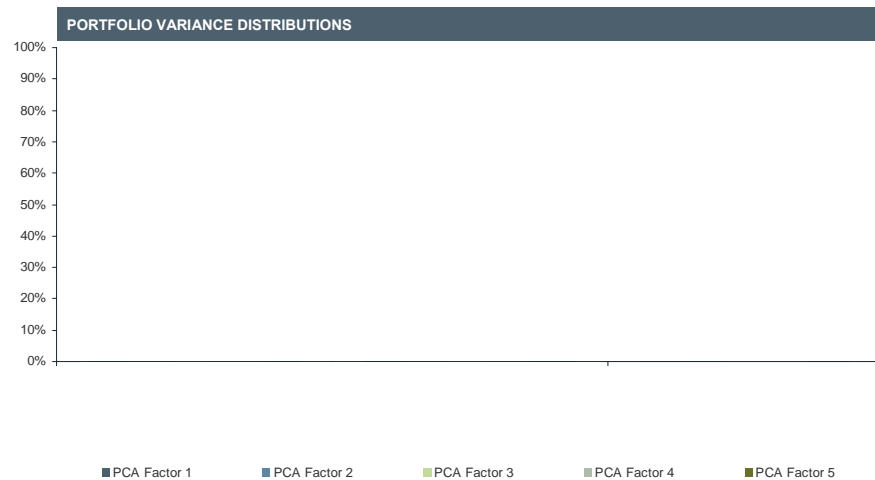
$$\tilde{n} = e^{-1 * \sum_1^N p_i * \ln(p_i)}$$

$$\tilde{n} = 1.68$$

\* Meucci, Attilio, Managing Diversification (March 12, 2009). Bloomberg Portfolio Research Paper No. 2010-02-FRONTIERS. Available at SSRN: <http://ssrn.com/abstract=1358533>

## Principal Components Analysis and Effective Dimensionality

### MORE EXAMPLES



## Modified Fundamental Law of Active Management

$$IR = IC \times \sqrt{\tilde{n}}$$

Where

IR = Information Ratio = Active Return / Tracking Error

IC = Information Coefficient: A Measure of Manager Skill (correlation between alpha signals & forward returns)

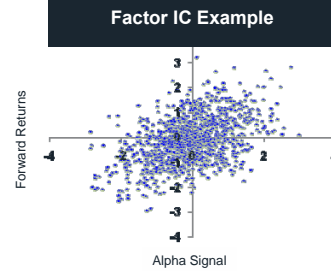
$\tilde{n}$  = BR = Decision Breadth = Number of Effective Independent Portfolio Decisions (bets) = Strategy dimensionality

### Key Assumptions

Asset returns are uncorrelated, stationary and normally distributed

No weight / budget / turnover constraints

Constant IC through time and across universe



- The strategy dimensionality ( $\tilde{n}$ ) captures the effective diversification within the strategy
- Diversification minimizes the net effect of all unwanted risk influences and elevates the relative effect of the desired alpha influences
- Methods that increase product diversification ( $\tilde{n}$ ) without compromising skill (IC) will enhance the IR of an alpha strategy

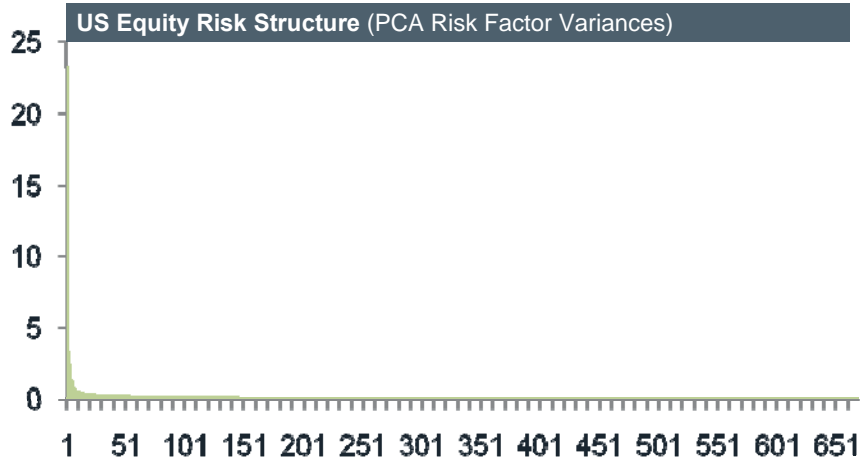
Source: Pyramis Global Advisors  
Reference: Active Portfolio Management, Grinold & Kahn, 2000

## Empirical Market Experiments

- Daily Total Returns: 1990 – 2009 (5,000+ dates)
- All US Stocks w/Cap > \$50M for entire 20 year history  $\Rightarrow$  668 Names
- Create a single PCA risk decomposition for entire history of this universe (in-sample)
- We acknowledge some inherent “survivorship bias” in this universe, however we believe the insights and general conclusions of this analysis remain valid

Source: Pyramis Global Advisors

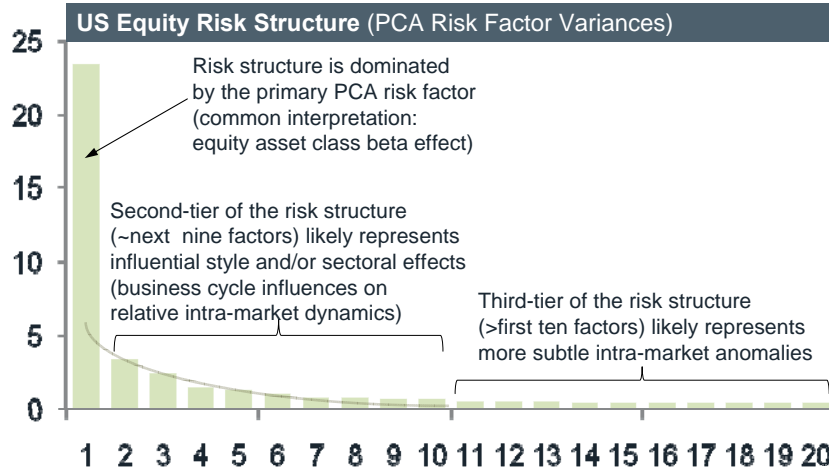
## Empirical US Equity PCA Risk Structure



Source: Pyramis Global Advisors

### CLOSE UP (FIRST 20 FACTORS)

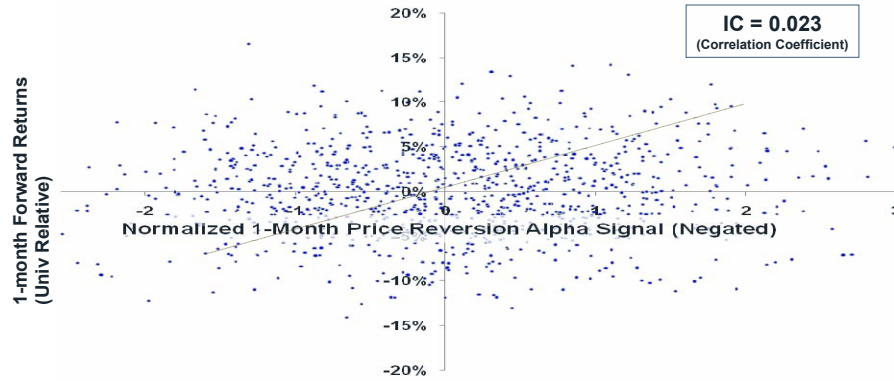
## Empirical US Equity PCA Risk Structure: First 20 Factors



Source: Pyramis Global Advisors

## Real-World Alpha Factor Example: 1-Month Price Reversion

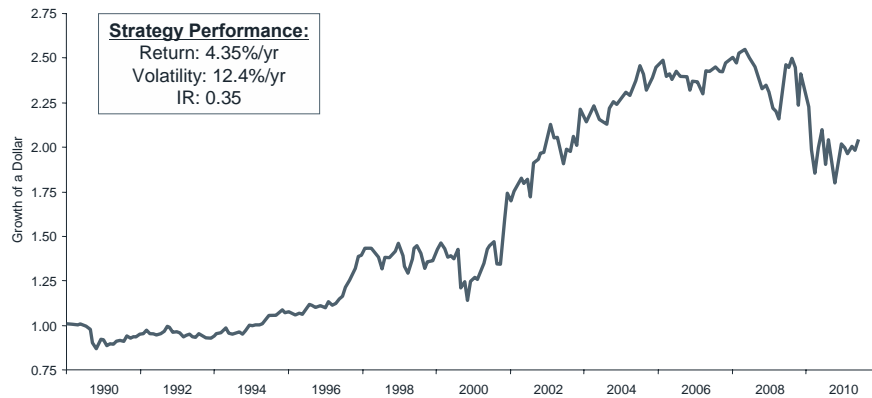
### IC OF 1-MONTH US STOCK PRICE REVERSION



Short-term price reversal is a well-known market inefficiency, (albeit a high-turnover effect that is difficult to realize in practice)

Source: Pyramis Global Advisors

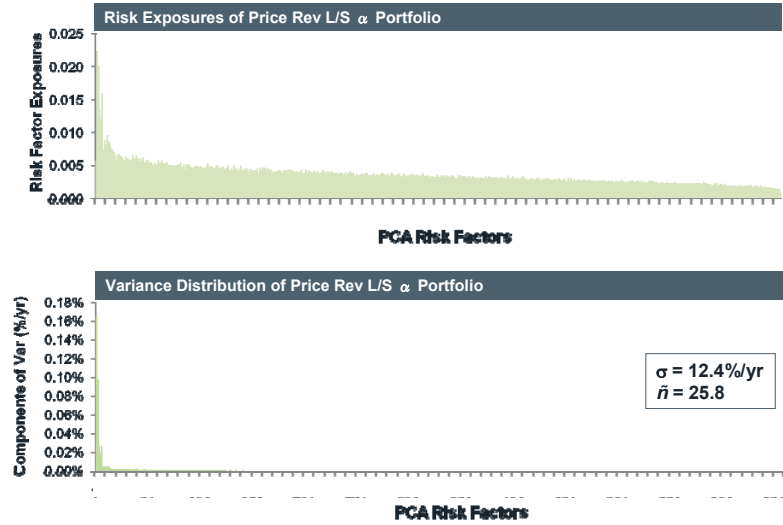
## L/S Portfolio Performance of 1-Month Price Reversion Strategy 1990 - 2009



Results reflect theoretical monthly returns of market-neutral, 2:1 levered equity portfolio, rebalanced monthly with no friction (no transaction costs or market impact) and no liquidity constraints. The long (short) sleeve of the strategy is populated with the most (least) attractive half of the universe using weights proportional each stock's respective normalized alpha signal at each month end.

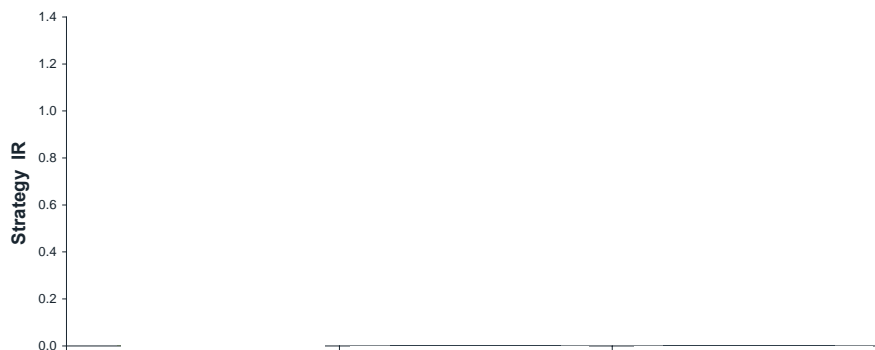
Source: Pyramis Global Advisors

## PCA Risk Decomposition of Reversion L/S Alpha Portfolio



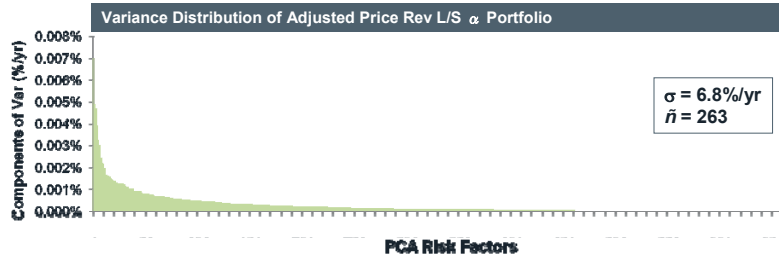
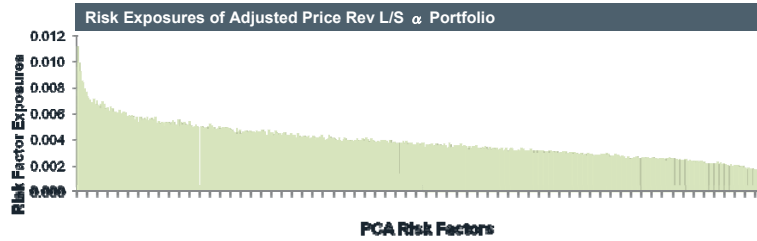
## 1-Month Price Reversion Strategy & The Fundamental Law of Active Management (FLAM)

ACTUAL & THEORETICAL IRS MEAN REVERSION STRATEGY (1990-2009)



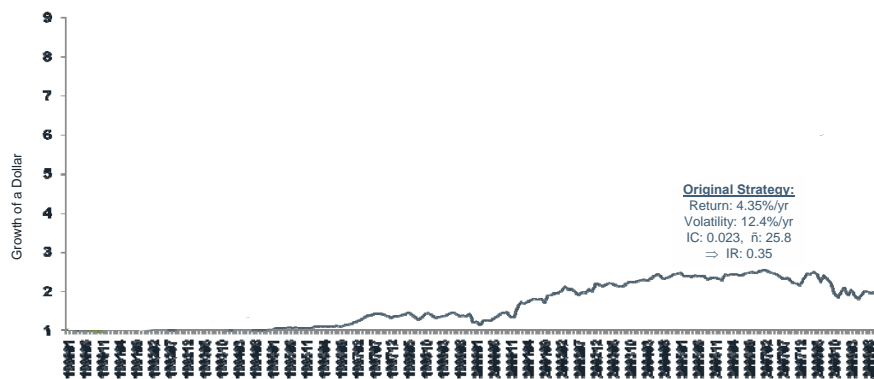
Source: Pyramis Global Advisors

## Risk Decomposition of Adjusted Reversion L/S Alpha Portfolio



## L/S Portfolio Performance of Adjusted Price Reversion Strategy

1990 - 2009

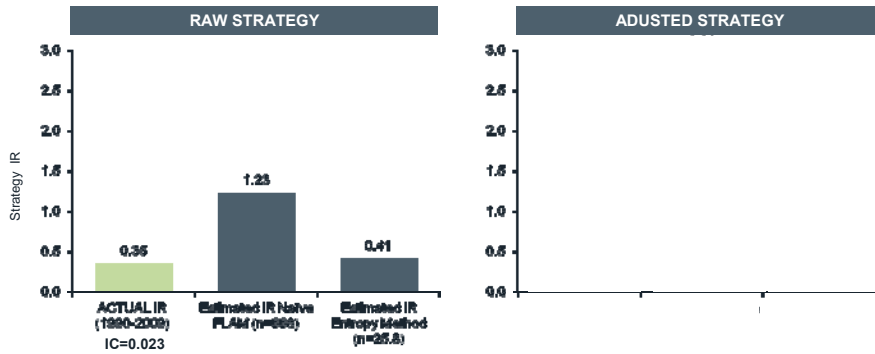


Results reflect theoretical monthly returns of market-neutral, 2:1 levered equity portfolio, rebalanced monthly with no friction (no transaction costs or market impact, and no liquidity constraints). The long (short) sleeve of the strategy is populated with the most (least) attractive half of the universe using weights proportional each stock's respective normalized alpha signal at each month end.

Source: Pyramis Global Advisors

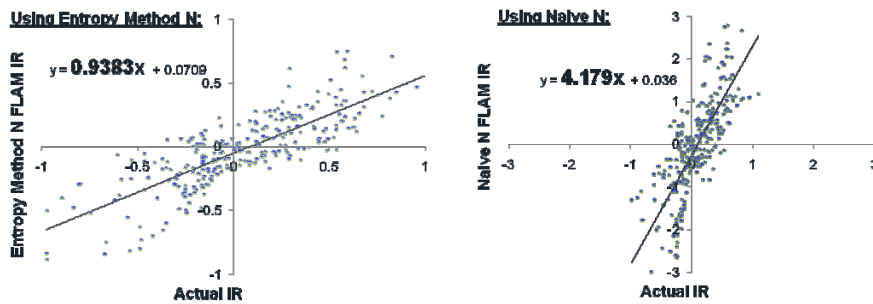
# Adjusted 1-Month Price Reversion Strategy & The Fundamental Law of Active Management (FLAM)

ACTUAL & THEORETICAL IRS MEAN REVERSION STRATEGY (1990-2009)

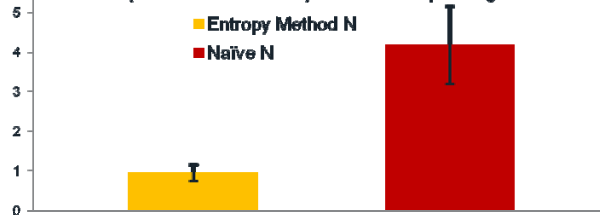


Source: Pyramis Global Advisors

# FLAM and Actual IR of Various Alpha Signals



(FLAM IR / Actual IR) of Various Alpha Signals



## Conclusions

- Generally, it is easier to generate high IR performance using more assets (higher diversification, more alpha sources)
- The original Fundamental Law of Active Management (FLAM) provides a framework to decompose IR into skill level & diversification
- Strategy diversification benefits are overstated using the naïve formulation of the FLAM. As a result, FLAM dramatically overestimates the expected IR of investment strategies
- We have developed an improved framework that better estimates IR using an entropy-inspired dimension measure (these results are consistent across many real-world alpha factors)
- This **Modified Fundamental Law of Active Management** guides to alpha signal adjustment techniques that can significantly improve IR by enhancing the effective dimensionality of the associated alpha strategies

Source: Pyramis Global Advisors

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