HOW TO MEASURE PORTFOLIO DIVERSIFICATION

Talking about Eggs and Baskets when It comes to Diversification? Here is the science behind Diversification. You can use the process of Diversification Calculation to reduce investor naivety and meet or evaluate fiduciary standards.

See in the example how even though we started with 500 assets as we refine the measurement of diversification to account for asset concentration & commonality (aka correlations) 500 becomes misleading.

The example is the S&P 500. A market cap weighted index of the largest 500 U.S listed stocks.
But is it really diversified?

Applying a process such as Principal Component Analysis to a weighted correlation matrix or asset time series produces several dimensions which prove to measure diversification effectively.

SIMPLE DESCRIPTION ASSET COUNT

EXAMPLE
500

NAIVIETY
High

FIDUCIARY RISK EXPOSURE
↑ Significant

SCIENTIFIC — Ambient Dimension — DESCRIPTION

TASK
Simple Count of the Number of Assets in the Portfolio.

DESCRIPTION
The quantity of assets can be a highly misleading method to measure portfolio diversification.

DISCUSSION
500 assets in the S&P 500 Index, naively assumed to be a diversified index.

SIMPLE DESCRIPTION EQUALLY WEIGHTED EQUIVALENT (EWE)

EXAMPLE
194

NAIVIETY
Medium

FIDUCIARY RISK EXPOSURE
↗ Material

SCIENTIFIC — Spanning Dimension — DESCRIPTION

DESCRIPTION
This is a measure of concentration. Equally weighted portfolios have the maximum possible EWE for the number of portfolio assets. Decreases in the EWE increase portfolio concentration. The concentration of the weighting scheme is without regard to commonality of the holdings.

TASK
Normalize asset count for weighting scheme to produce equally weighted equivalent asset count.

DISCUSSION
The top 50 companies comprise 1/2 the weight of the S&P 500 Index. On average the portfolio behaves like it has 194 equally weighted assets.

SIMPLE DESCRIPTION INDEPENDENCE EQUIVALENT

EXAMPLE
21.53

NAIVIETY
None

FIDUCIARY RISK EXPOSURE
↓ Low

SCIENTIFIC — Intrinsic Dimension — DESCRIPTION

DESCRIPTION
Reduce the spanning dimensionality by the Gini-Coefficient - which serves as a measure of the % of commonality - reveals the Intrinsic Dimension of the portfolio. The Quantity deduced is the equivalent number of completely independent assets.

TASK
Normalize again to refine for commonality among the performance of the assets over time. Quantify the number of independent diversification resources (dimensions).

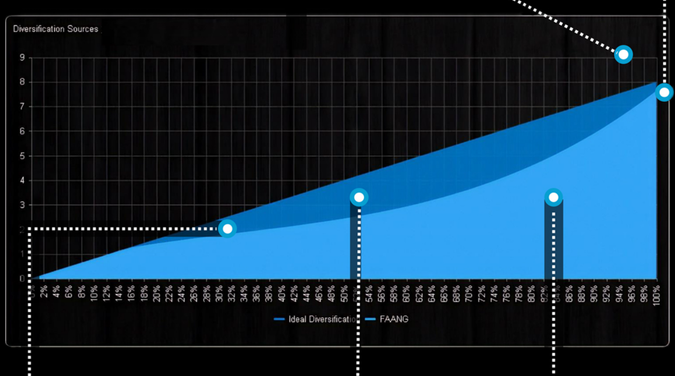
DISCUSSION
The Gini Co-efficient of the S&P 500 is only 11%. This means that compared to a portfolio of 500 equally weighted and uncorrelated assets, this stock index has only 11% diversification. Multiplying the spanning dimension 194 by the Gini Co-efficient (11%) gives 21. It could be said that despite having 500 assets in the portfolio this portfolio has the equivalent of 21 equally weighted and uncorrelated assets.

Understanding How Dimensions Measure Diversification

This chart shows how diversification is distributed in any portfolio. A more even distribution is more diversified.

The Asset Count is the top end of the diagonal and is also called the ambient dimension. In the S&P 500 example, this is 500.

The peak value shows how many dimensions it takes to span the portfolio with 100% of the information included. More dimensions = more diversification. If the top value of the curve is less than the top of the diagonal, then there is redundancy in the portfolio. Redundancy is often greater in larger index strategies. In the S&P 500 example, this drops all the way to 194 indicating large amounts of redundancy. The peak of the curve is the spanning dimension and approximates the Equally Weighted Equivalent.



The graph would fill the diagonal exactly if all the assets were uncorrelated and equally weighted. As systematic commonality and weighting concentrations impact the strategy, the graph will dip down, lowering diversification

The extent which the graphs fills the diagonal is called the Gini Co-efficient. The Gini Co-efficient is a measure of how evenly things are distributed. For the S&P 500 example, the graph only covers 11% of the triangle. The Gini Co-Efficient answers the question, "What Percent diversification does this portfolio have given the count of investments.

The chart integrates idiosyncratic (asset specific) diversification (AKA holding count) with the systemic commonality of the positions (the Gini Co-Efficient). Multiplying the two yields the Intrinsic Dimension.

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