Gravity Investments

The Global Leader in True Diversification

True Diversification: Diversification Weighted Portfolios versus the S&P 500 Benchmark

Date: 1/20/09

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Abstract:

Traditional weighting methodologies help investors build well diversified portfolios and investment vehicles such as mutual funds and ETFs. Considered one of the most diversified of these indexes is the S&P 500. It could also be argued that an equally weighted portfolio comprised of the same 500 components would be more diversified. We introduce True Diversification, and produce a series of comparisons tests to ascertain whether the performance of the diversification weighted indexes have better performance as compared to the equal and capitalization weighted indexes.

The following allocation methods were tested:

- Equal Weighting: In the Equally Weighted index, all assets were assigned an identical percentage weighting. The sum of all individual weightings represents 100% of the index. Given

the index having comprised of ten sectors each sector has a 10% weight. The equally weighted index is provided as a check against inherent biases with traditional Indexing.

- Capitalization Weighting: Capitalization weighted is included as it constitutes the plurality of indexed capital and mindshare. While trillions of dollars are indexed in such methodology, such popularity seems to be the result of herding rather than any true deliberation. Equally weighted indexes are provided against a check on inherent biases within any index framework.

- Diversification Weighting: Diversification weighting is a recently patented methodology. Diversification weighting is a product of Diversification Optimization. Allocation weights are determined by the extent to which an asset adds uniqueness to the portfolio. Asset allocation weights correspond to the diversification impact of any asset and each asset may be combined with a utility function such as risk adjusted returns. Diversification is considered as an autonomous variable, not merely a subcomponent of risk.

Terms:

Diversification Optimization is a patented methodology created by James Damschroder[(1)]. Diversification weighting is a product of Diversification Optimization which creates a geometric blueprint of a portfolio by mapping correlations to vector cosines and projecting the matrix into three dimensions. After imposing a convex hull and selecting the efficient assets comprising the convex hull, the resulting footprint shows portfolio diversification as 3D symmetry and allocation weights are spread against assets on the convex hull using simple pro rata volume contributions so that allocation weights are determined by the extent to which an asset adds uniqueness or volume in the portfolio. The resulting footprint shows the True Diversification of a portfolio as 3D symmetry.

Gravity Investments also has championed True Diversification measurement, an integral evaluation metric of a portfolio, however, as this test is concerned with returns, details on the measurement scoring can be learned in our other papers. True Diversification is used by Gravity Investments to refer to the measurement, analysis, of portfolios as well as the visualization and allocations produced by Diversification Optimization.

The Study:

While the diversification optimization has a primary target of maximizing diversification this research is primarily concerned with the returns of the portfolios. In this capacity the result of the test can provide some evidence as to the impact of diversification on returns. The more positive the result the more True Diversification improves portfolio returns.

The tests were conducted using the Standard & Poor's 500 index and the sector components of that index. Data for the indexes was taken from the Standard Industry classifications. The data provider was Equis International, a subsidiary of Reuters. All tests and calculations were made using the G-Sphere Diversification Platform by Gravity Investments.

The underlying data for the tests are the ten Global Industry Classification Standard (GICS). These sectors are:

- Utilities
- Basic Materials
- Consumer Discretionary
- Energy
- Financials
- Consumer Staples
- Industrials
- Healthcare
- Information Technology
- Telecommunication Services

The data coverage for all tests began on September 11, 1989, the inception date for the index data available through Reuters. Data frequency was daily. All return calculations are based on geometrically compounded annualized returns using a 252 trading day year. Index data is free of any commissions, transaction costs and expenses, although such expenses are not likely to be material in any implementation of this research as liquid and inexpensive tools exist for all investment options studied.

For each test iteration we took a performance calculation. The performance calculation was taken on an out of sample basis. This test produced a one year, two year, three year, five year and ten year returns. Each return ended December 31, 2008. Therefore for the diversification weighted tests the allocations weights were attained using data from inception up to the start of the measurement period. As such the allocations results are indicative of allocations results that mimic real investment performance and decisions. To illustrate the one year performance tests were created from data from inception of the index to 12/31/2007, this data was then used to determine the allocation weights, and then those weights were applied to the forward period, in this case calendar year 2008.

The timing and selection of this test includes the heavy losses of 2008. In good times weighting schemas are less necessary. In tough times allocation schemas should work to protect capital. Because of the asymmetry of positive and negative returns, incremental performance in bear markets is particularly significant. Should the result of this test show positive returns over the index counterparts then it would be evidence that True Diversification improves returns. We theorize that diversification improves returns by improved risk reduction, herein defining risk as loss of capital. If diversification affects risk so well, would it be possible that diversification optimization would control risk better than risk minimization techniques such as mean – variance analysis?

True Diversification was tested using a method called out of sample testing. Therefore the optimization result is determined then applied forward from that creation date. Accordingly, the performances of the returns, while still built with historical data, represent true actionable performance differences. The out of sample performance testing is not necessary for the market capitalization weighting and the

equal weighting as the equal weighting is constant and the market capitalization weighted performance is included in the actual index performance.

In each of these tests the common input to the optimization is the assets correlation matrix. Diversification Optimization uses True Diversification in concert with any sort of utility function. The utility function is a way of comparing the attractiveness of one asset to another. Because Diversification Optimization utilizes True Diversification along with a utility function, the Diversification Optimization tests were run using a variety of utility functions to diminish the impact of a utility selection bias in the performance results. All returns and ratios using these returns were simple annual historical returns at the time of the index constitution. Real world results can be improved based on an investor's ability to accurately forecast returns. By testing a sufficient variety of utility functions the average results will better reflect the impact of True Diversification. The eight various utility functions tested were:

1. Sharpe ratios
2. Sortino ratios
3. Calmar ratios
4. Returns only
5. Standard Deviation Only
6. Semi-variance only
7. Maximum drawdown only
8. Unit functions (only diversification)

Results:

Surprisingly, there was little impact determined by the selection of the utility function. In a total of five periods crossed with these eight variations of Diversification Optimization we generated 40 head to head tests. Diversification weighting outperformed the index results in forty out of forty performance tests. This remarkably consistent result can be extended into comparisons to an equally weighted S&P index wherein D.O had positive performance gains in 39 of 40 comparison tests. **In the combined test, diversification weighed indexes outperformed the alternatives in 79 of 80 head to head tests.**

In the average of all the tests True Diversification outperformed the market capitalization weighting schema by an average of 462 basis points of annual performance. The outperformance versus the equally weighted index was 192 basis points. **In aggregate True Diversification outperformed the alternatives by 327 basis points.**

For these 40 tests True Diversification greatest performance gain was 797 basis points and the lowest was a deficit of 37 basis points in the single losing test against the other weighting schemas.

The consistency of the performance gains for diversification weighting is further verified by the median return improvement of 312 basis points.

Comparing the historical projected performance to the actual S&P 500 Index, the diversification optimization method yielded the following amounts of incremental performance.

Test Period (Trailing from 12/31/2008)	Performance Gain D.O. Spread vs. Market Cap
1 Year	7.71%
2 Year	7.83%
3 Year	5.83%
5 Year	4.56%
10 Year	3.00%

No rebalancing was made to the diversification weighted portfolios. Rebalancing would have no effect to an equally weighted portfolio. In a capitalization weighted portfolio there is a rebalancing effect as a positive price advance increases the allocation weight. The affect of this implicit rebalancing is construed to aid the relative performance of the capitalization weighting during trending markets and conversely hurt its performance during periods of mean reversion. Rebalancing has been shown to increase performance by about 49 basis points[(2)]. Should the diversification weighted index have been rebalanced, as was the capitalization weighted index it would likely have benefited from a similar degree of incremental performance. Rebalancing would likely serve to level the degree outperformance between the shorter and longer time windows.

Looking more granularly at the performance differences the consistency of the results is striking.

The performance differences are as follows:

Diversification Weighting - Market Cap Weighting Spreads

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
1 Year	4.73%	4.28%	3.07%	3.87%	3.55%	6.13%	2.00%	4.05%
2 Year	7.67%	6.56%	5.15%	6.11%	5.48%	6.41%	7.97%	4.89%
3 Year	5.64%	3.70%	5.11%	5.79%	4.67%	4.10%	6.64%	6.08%
5 Year	4.30%	4.13%	3.82%	4.85%	4.93%	4.92%	6.01%	4.07%
10 Year	2.25%	2.85%	1.56%	3.17%	3.27%	3.53%	3.78%	3.56%
Average	4.92%	4.30%	3.74%	4.76%	4.38%	5.02%	5.28%	4.53%

Diversification Weighting - Equal Weighting Spreads

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
1 Year	3.02%	2.57%	1.36%	2.16%	1.84%	4.42%	0.29%	2.34%
2 Year	4.29%	3.18%	1.77%	2.73%	2.10%	3.03%	4.59%	1.51%
3 Year	2.16%	0.22%	1.63%	2.31%	1.19%	0.62%	3.16%	2.60%
5 Year	1.31%	1.14%	0.83%	1.86%	1.94%	1.93%	3.02%	1.08%
10 Year	0.32%	0.92%	-0.37%	1.24%	1.34%	1.60%	1.85%	1.63%
Average	2.22%	1.61%	1.04%	2.06%	1.68%	2.32%	2.58%	1.83%

Conclusion:

True Diversification regularly outperformed other weighting schemas. Such consistency dissipates biases in the observations creating a strong statement as to the superiority of diversification weighted portfolios and indexes. These results held up consistently over multiple time periods, utility functions and against two common allocation schemas: equal weighted and capitalization weighted. To summarize, diversification weighed indexes outperformed the alternatives in 79 of 80 head to head tests. In aggregate True Diversification outperformed the alternatives by 327 basis points.

While the primary objective of diversification optimization is maximizing diversification to reduce losses in a portfolio, our research has shown that using True Diversification to optimally diversify an index consistently outperforms the underlying index in both its capitalization weighted and equally weighted forms.

References:

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