Alternative Index Strategies Compared: Fact and Fiction

IndexUniverse Webinar

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Discussion Road Map

Status Quo of Indexing Community

Popular Alternative Indexing Methodologies

Simulated Performance

Conclusion

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The Status Quo

Status quo within the Indexing Community

- Markets are (generally) efficient
  - Counter-argument: A number of anomalies, such as short horizon momentum and long horizon reversal, are persistently profitable
  - Jegadeesh and Titman (1993), DeBondt and Thaler (1985)
- Cap-weighted indexes viewed as “optimal” passive investment strategies
  - Counter-argument: This is a gross misinterpretation of CAPM
  - Roll (1977)
- Cap-weighted indexes capture the relevant risk exposure of the underlying market
  - Counter-argument: Factor exposures related to value and size are not captured by the standard index
  - Fama and French (1993)

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Recent Research Supports Alternative Indexing

Recent research challenges the status quo

- Fernholz (1999) measures market concentration by "diversity," and shows that its mean-reverting nature provides opportunities for outperforming a cap-weighted index
- Treynor (2005) argues that a market-valuation-indifferent index merits considerations because overpriced stocks are counterbalanced by underpriced stocks
- Arnott, Hsu, & Moore (2005) show that non-price-based equity indexes significantly outperform their cap-weighted benchmarks
- Clarke, de Silva, &Thorley (2006) show that minimizing *ex ante* portfolio volatility yields lower risk *and* higher return than cap-weighted benchmark
- Choueifaty & Coignard (2006) show that a cap-weighted index is not diversified, higher efficiency can be achieved by maximizing ratio of average volatility to portfolio volatility
- DeMiguel, Garlappi, & Uppal (2009) show naïve 1/n weighting is more efficient in out-of-sample tests than extensions of sample-based mean-variance optimal portfolio
- Amenc, Glotz, Martellini, & Retkowsky (2011) show the risk/return efficiency of cap-weighted indices can be significantly improved by a mean-variance optimization with robust parameter estimations and practical turnover and overconcentration controls

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A Survey of Alternative Equity Index Strategies

Paper compares well-known alternative beta strategies

- Reviews methodologies
- Simulates performance in an integrated framework (standardized dataset, investment universes, historical time period, rebalancing frequency, etc.)
- Examines sources of excess performances relative to cap-weighting
- Forthcoming in *Financial Analysts Journal* (September/October 2011)
- Co-authored with Tzee-man Chow, Vitali Kalesnik, and Bryce Little

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A Survey of Alternative Equity Index Strategies

Disclosures

- We based our backtests on published methodologies; we did not attempt to replicate actual investment products
- Authors are associated with Research Affiliates, the inventor of the Research Affiliates Fundamental Index® methodology

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Classifying Strategies

Heuristic:

- Equal weighting
- Equal weight + cap weight blending
- Risk-clustering equal weighting
- Fundamental Index strategy

Optimized:

- Minimum variance
- Mean-variance optimization strategies

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Heuristic Strategies

Equal Weighting

A cap-weighted index is used as the sample set of constituents

The *i*th constituent's weight is:

$$x_{equal,i} = \frac{1}{N}, \quad i = 1, \ldots, N$$

- Possess no information at all on expected returns and covariances

Note that the equal weighting methodology is highly dependent on the universe definition

- How many stocks do you equally weight?
- While S&P 500 and Russell 1000 may have nearly identical performance over time, EW SP500 and EW R1K are completely different

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Equal Weight + Cap Weight Blending

Stock market diversity, an artificial variable constructed by Robert Fernholz, is defined as:

$$D_p(x_{mkt}) = \left(\sum_{i=1}^{n} (x_{mkt,i})^p \right)^{1/p}, \quad p \in (0,1)$$

where *x*'s are the cap-weighted portfolio weights

Diversity portfolio weights are then defined as:

$$x_{diversity,i} = \frac{(x_{mkt,i})^p}{\left(D_p(x_{mkt})\right)^P}, \quad i = 1, \ldots, N, \qquad p \in (0,1)$$

The diversity portfolio is an interpolation between the cap weight and the equal weight portfolio

- When $p = 0$, the portfolio is equally weighted
- When $p = 1$, the portfolio is cap-weighted
- P is set at a specific value to control for the portfolio TE and turnover

Source: Fernholz, R., R. Garvy, and J. Hannon. (1998). "Diversity-Weighted Indexing." *Journal of Portfolio Management, vol.* 24, no. 2 (Winter):74-82.

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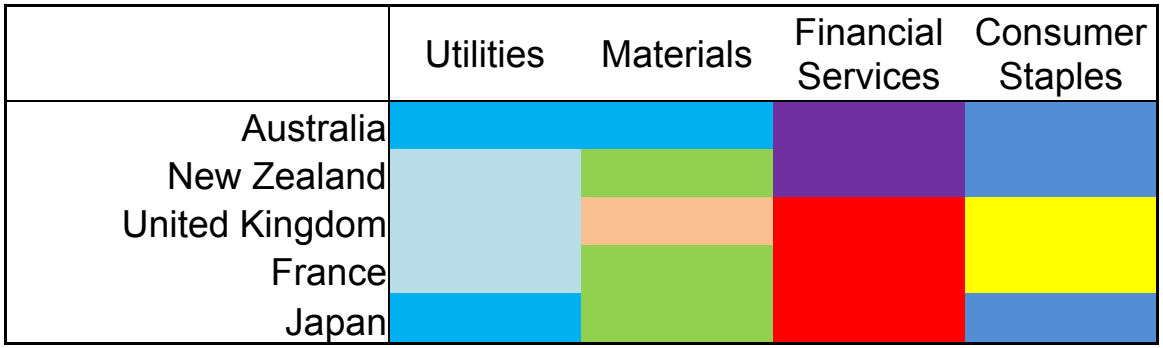
Risk-Cluster Equal Weighting

Global equity premium is "driven" by sectors and geography

Define "risk-units" as country/sector pairings

Apply cluster analysis to group correlated risk-units together:



Equal weight the "risk-units" in each risk cluster; then equal weight the clusters

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Fundamental Index Strategy

Use accounting metrics to proxy economic scale

- Accounting variables other than market capitalization that are representative of the size of company

Weight companies by accounting size variables

- De-link the relationship between portfolio weights and prices
- Ensures high capacity, liquidity, low turnover
- Ensures that the portfolio is representative of the underlying economy

Weights can be formed on a composite of a few metrics, as in Arnott, Hsu, and Moore (2005)

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Optimized Strategies

Mean–Variance Optimization (MVO)

Use MVO to construct "more efficient" passive investments

Requires two ingredients

- Expected return forecasts for each stock in the universe
- Variance–covariance matrix

Difficult to apply in practice

- Empirical research shows errors in forecasts disrupt performance
- Optimizers extremely sensitive to errors in estimates
- Portfolio constraints inhibit mean–variance optimality

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Minimum Variance

Portfolio weights are generated by:

$$\min x'\hat{\Sigma}x \quad subject\ to \quad \begin{cases} e'x = 1 \\ x_i \geq 0 \qquad \forall i \\ x_i \leq 5\% \end{cases}$$

A hidden assumption is that the minimum variance portfolio is only "mean–variance" optimal if all stocks have the same expected returns

Tends to allocate to stocks with low recent volatility and low correlations with others

- Prefer small stocks which tend to have stale prices (low liquidity) and high bid–ask bounces

Rebalancing annually/monthly produces the equivalent return/risk results

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MVO: *E*[*R*] = Volatility

Explicitly attempts to identify the tangency portfolio (under a set of assumptions)

Key assumption: excess returns are proportional to volatility:

$$E[R] = \lambda\sigma$$

Theoretically controversial: are investors compensated for idiosyncratic risk?

- CAPM says only the systematic portion of the volatility earns a risk premium

The tangency portfolio (maximal Sharpe Ratio portfolio) is:

$$max\ \frac{x'E[R]}{\sqrt{x'\Sigma x}} \Rightarrow \max \frac{x'\sigma}{\sqrt{x'\hat{\Sigma}x}}\ subject\ to \begin{cases} e'x = 1 \\ x_i \geq 0 \\ x_i \leq 10\% \end{cases} \quad \forall i$$

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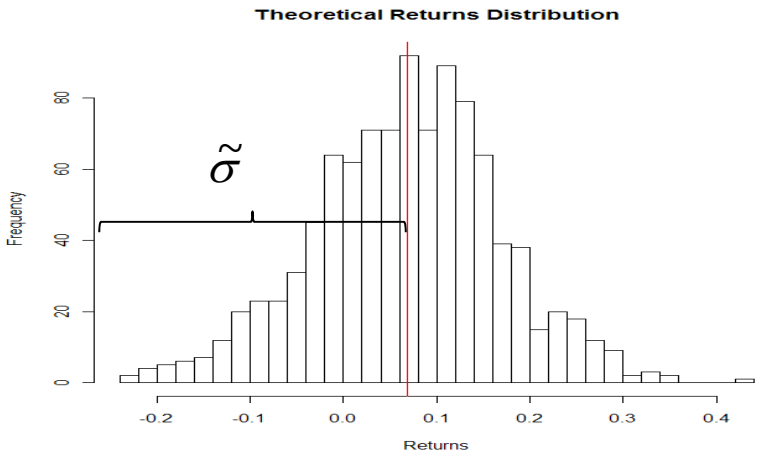
MVO: *E*[*R*] = Downside Semi-Volatility

Key assumption: excess returns are proportional to downside semi-deviation:

$$E[R] = \lambda \tilde{\sigma}$$

Semi-deviation of returns is a more robust measure of investment risk:



The tangency portfolio (maximal Sharpe Ratio portfolio) is:

$$max \frac{x'E[R]}{\sqrt{x'\Sigma x}} \Rightarrow \max \frac{x'\tilde{\sigma}}{\sqrt{x'\hat{\Sigma} x}} \; subject\ to \begin{cases} e'x = 1 \\ x_i \geq 0.05\% \\ x_i \leq 0.20\% \end{cases} \forall i$$

Source: Amenc, Noël, Felix Goltz, Lionel Martellini, and Patrice Retkowsky. (2010). "Efficient Indexation: An Alternative to Cap-Weighted Indices," *EDHEC-Risk Institution Publication*, January.

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Simulated Performance Analysis

Research Results: Risk and Return
United States, 1964–2009

Strategy	Total Return	Volatility	Sharpe Ratio	Relative Return	Tracking Error	IR	One-Way Turnover
S&P 500	9.46%	15.13%	0.26				6.69%[1]
Equal Weighting[2]	11.78%	17.47%	0.36	2.31%	6.37%	0.36	22.64%
Risk-Cluster EW[3]	10.91%	14.84%	0.36	1.45%	4.98%	0.29	25.43%
Diversity[4]	10.27%	15.77%	0.30	0.81%	2.63%	0.31	8.91%
Fundamental Index[5]	11.60%	15.38%	0.39	2.14%	4.50%	0.47	13.60%
Minimum Variance[6]	11.40%	11.87%	0.49	1.94%	8.08%	0.24	48.45%
MVO ($E[R]$ = Vol)[7]	11.99%	14.11%	0.45	2.52%	7.06%	0.36	56.02%
MVO ($E[R]$ = Semi-Vol)[8]	12.46%	16.54%	0.42	3.00%	6.29%	0.48	34.19%

See slide 30 for disclosures regarding individual strategies.
Source: Research Affiliates, LLC.

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Research Results: Risk Decomposition
United States, 1964–2009

Strategy	Annual Alpha	Market (Mkt–Rf)	Small Cap (SMB)	Value (HML)	Momentum (MOM)	R^2
Equal Weighting[2]	**0.15%**	**1.043**	**0.482**	**0.144**	**-0.012**	**0.96**
p-value	*(0.786)*	*(0.000)*	*(0.000)*	*(0.069)*	*(0.242)*	
Risk-Cluster EW[3]	**-0.13%**	**0.954**	**0.116**	**0.185**	**0.040**	**0.91**
p-value	*(0.846)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.002)*	
Diversity[4]	**0.07%**	**1.012**	**0.173**	**0.029**	**0.002**	**0.99**
p-value	*(0.798)*	*(0.000)*	*(0.000)*	*(0.001)*	*(0.654)*	
Fundamental Index[5]	**0.50%**	**1.010**	**0.128**	**0.338**	**-0.076**	**0.97**
p-value	*(0.193)*	*(0.000)*	*(0.086)*	*(0.000)*	*(0.000)*	
Minimum Variance[6]	**0.30%**	**0.708**	**0.198**	**0.344**	**0.011**	**0.81**
p-value	*(0.713)*	*(0.000)*	*(0.978)*	*(0.000)*	*(0.467)*	
MVO (*E*[*R*] = Vol)[7]	**-0.02%**	**0.844**	**0.342**	**0.264**	**0.061**	**0.87**
p-value	*(0.977)*	*(0.000)*	*(0.057)*	*(0.906)*	*(0.000)*	
MVO (*E*[*R*] = Semi-Vol)[8]	**0.19%**	**1.002**	**0.465**	**0.250**	**0.004**	**0.95**
p-value	*(0.732)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.681)*	

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Research Results: Risk and Return Developed Markets, 1987–2009

Strategy	Total Return	Volatility	Sharpe Ratio	Relative Return	Tracking Error	IR	One-Way Turnover
MSCI World	7.58%	15.65%	0.22				8.36%[1]
Equal Weighting[2]	8.64%	15.94%	0.28	1.05%	3.02%	0.35	21.78%
Risk-Cluster EW[3]	10.78%	16.57%	0.40	3.20%	6.18%	0.52	32.33%
Diversity[4]	7.75%	15.80%	0.22	0.16%	1.60%	0.10	10.39%
Fundamental Index[5]	11.13%	15.30%	0.45	3.54%	4.77%	0.74	14.93%
Minimum Variance[6]	8.59%	11.19%	0.39	1.01%	8.66%	0.12	51.95%
MVO ($E[R]$ = Vol)[7]	7.77%	13.16%	0.27	0.18%	7.41%	0.02	59.72%
MVO ($E[R]$ = Semi-Vol)[8]	8.94%	14.90%	0.32	1.35%	3.58%	0.38	36.40%

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Research Results: Risk Decomposition Developed Markets, 1987–2009

Strategy	Annual Alpha	Market (Mkt–Rf)	Small Cap (SMB)	Value (HML)	Momentum (MOM)	R^2
Equal Weighting[2]	**0.77%**	**1.015**	**0.259**	**0.025**	**-0.008**	**0.98**
p-value	*(0.131)*	*(0.000)*	*(0.000)*	*(0.069)*	*(0.312)*	
Risk-Cluster EW[3]	**0.68%**	**1.071**	**0.338**	**0.232**	**0.045**	**0.90**
p-value	*(0.547)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.008)*	
Diversity[4]	**0.38%**	**1.001**	**0.087**	**-0.058**	**0.011**	**0.99**
p-value	*(0.173)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.013)*	
Fundamental Index[5]	**2.18%**	**0.970**	**0.040**	**0.332**	**-0.090**	**0.97**
p-value	*(0.000)*	*(0.000)*	*(0.086)*	*(0.000)*	*(0.000)*	
Minimum Variance[6]	**1.25%**	**0.628**	**0.001**	**0.138**	**-0.013**	**0.73**
p-value	*(0.329)*	*(0.000)*	*(0.978)*	*(0.000)*	*(0.487)*	
MVO (*E*[*R*] = Vol)[7]	**0.49%**	**0.760**	**0.097**	**0.004**	**0.029**	**0.78**
p-value	*(0.716)*	*(0.000)*	*(0.057)*	*(0.906)*	*(0.157)*	
MVO (*E*[*R*] = Semi-Vol)[8]	**0.97%**	**0.947**	**0.176**	**0.056**	**-0.003**	**0.96**
p-value	*(0.154)*	*(0.000)*	*(0.000)*	*(0.002)*	*(0.773)*	

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Volatility-Based Strategies

Developed Markets: 1987–2009

Strategy	Total Return	Vol	Sharpe Ratio	Relative Return	Tracking Error	IR
MSCI World	7.58%	15.65%	0.22			
Volatility[9]	8.16%	17.18%	0.22	0.57%	3.89%	0.15
Volatility^{-1}[10]	9.59%	14.60%	0.35	2.01%	3.79%	0.53
Average Covariance[11]	7.82%	18.02%	0.19	0.23%	4.79%	0.05
Average Covariance^{-1}[12]	10.14%	14.82%	0.38	2.56%	8.17%	0.31

United States: 1964–2009

Strategy	Total Return	Vol	Sharpe Ratio	Relative Return	Tracking Error	IR
S&P 500	9.46%	15.13%	0.26			
Volatility[9]	12.07%	19.18%	0.32	2.61%	8.36%	0.31
Volatility^{-1}[10]	12.42%	15.73%	0.41	2.95%	6.03%	0.49
Average Covariance[11]	12.00%	19.70%	0.31	2.54%	8.68%	0.29
Average Covariance^{-1}[12]	12.77%	14.79%	0.46	3.31%	6.72%	0.49

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Risk Decomposition

Risk Attribution: Developed Markets, 1987–2009

Strategy	Annual Alpha	Market (Mkt–Rf)	Small Cap (SMB)	Value (HML)	Momentum (MOM)	R^2
Volatility[9]	**0.88%**	**1.067**	**0.300**	**-0.014**	**-0.040**	**0.97**
p-value	*(0.156)*	*(0.000)*	*(0.000)*	*(0.381)*	*(0.000)*	
Volatility^{-1}[10]	**1.31%**	**0.933**	**0.107**	**0.142**	**-0.024**	**0.96**
p-value	*(0.052)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.018)*	
Average Covariance[11]	**0.70%**	**1.105**	**0.324**	**0.014**	**-0.073**	**0.96**
p-value	*(0.348)*	*(0.000)*	*(0.000)*	*(0.466)*	*(0.000)*	
Average Covariance^{-1}[12]	**2.10%**	**0.845**	**0.098**	**0.117**	**0.003**	**0.74**
p-value	*(0.201)*	*(0.000)*	*(0.114)*	*(0.007)*	*(0.906)*	

Risk Attribution: United States, 1964–2009

Strategy	Annual Alpha	Market (Mkt–Rf)	Small Cap (SMB)	Value (HML)	Momentum (MOM)	R^2
Volatility[9]	**0.18%**	**1.089**	**0.652**	**0.125**	**-0.026**	**0.96**
p-value	*(0.767)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.025)*	
Volatility^{-1}[10]	**0.25%**	**0.974**	**0.372**	**0.318**	**-0.012**	**0.94**
p-value	*(0.677)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.265)*	
Average Covariance[11]	**0.26%**	**1.118**	**0.656**	**0.128**	**-0.049**	**0.95**
p-value	*(0.689)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	
Average Covariance^{-1}[12]	**0.08%**	**0.914**	**0.342**	**0.368**	**0.042**	**0.90**
p-value	*(0.905)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.001)*	

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Research Results: Robustness of Strategies

Rebalancing frequency

- Performance does not depend significantly on rebalancing frequency
- However, quarterly rebalancing increases turnover nearly two-fold relative to annual rebalancing

Number of companies

- Switching from the top 1,000 stocks to the top 500 reduces the Sharpe ratio for every strategy
- For EW strategies, this reduces small-cap exposure
- For optimized strategies, this reduces the universe

Key design parameter of each methodology

- Risk and return characteristic change, but excess return over cap-weighting is robust
- No significant alpha when evaluated in multifactor framework

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Research Results: Value and Size Bias

When simulated under standardized framework, alternative betas aren't all that different

Empirically, all strategies outperform because of value and/or size exposure

- Strategies that rebalance toward non-price weights naturally incur a value load
- EW-related strategies (such as diversity weighting and risk clusters EW) usually have a size load
- MVO tends to favor stocks with low covariance, resulting in larger weights in lower-beta stocks

Implementation cost is an important selection criterion

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Research Results: Turnover Characteristics

Strategy	Developed Markets 1987–2009 Average Annual Turnover	United States 1964–2009 Average Annual Turnover
Market Capitalization[1]	8.36%	6.69%
Equal Weighting[2]	21.78%	22.64%
Risk-Cluster EW[3]	32.33%	25.43%
Diversity[4]	10.39%	8.91%
Fundamental Index[5]	14.93%	13.60%
Minimum Variance[6]	51.95%	48.45%
MVO ($E[R]$ = Vol)[7]	59.72%	56.02%
MVO ($E[R]$ = Semi-Vol)[8]	36.40%	34.19%

See slide 30 for disclosures regarding individual strategies.
Source: Research Affiliates, LLC.

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Research Results: Capacity/Average Size (Beginning of 2010)

Strategy	Weighted Average Market Cap (USD Billions)		Weighted Average Bid–Ask Spreads		Weighted Average Adjusted Daily Volume (USD Millions)	
	Global	U.S.	Global	U.S.	Global	U.S.
Market Capitalization[1]	66.34	80.80	0.11%	0.03%	464.9	735.4
Equal Weighting[2]	23.90	11.48	0.16%	0.06%	175.0	132.5
Risk-Cluster EW[3]	37.47	37.14	0.17%	0.04%	189.1	312.0
Diversity[4]	52.37	50.53	0.12%	0.04%	368.2	477.9
Fundamental Index[5]	59.14	66.26	0.14%	0.05%	397.8	617.5
Minimum Variance[6]	23.97	19.63	0.35%	0.05%	128.4	136.4
MVO ($E[R]$ = Vol)[7]	20.08	14.77	0.45%	0.06%	122.5	124.1
MVO ($E[R]$ = Semi-Vol)[8]	26.90	12.06	0.15%	0.06%	193.5	140.1

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Conclusion

If you believe markets are not efficient

- Alternative indexing offers attractive alternatives to traditional cap-weighting
- All popular alternative equity indexes are isomorphic to each other; they all improve performance through exposure to value and small-cap companies
- If you believe in the value and small-cap premia, then these new index products are efficient passive investment vehicles
- Implementation cost considerations such as liquidity, capacity, and turnover should be the key selection criteria

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Notes: Strategy Simulation Descriptions

[1] Estimation is based on a simulated cap-weighted index, 1,000 names for global, 500 for US, rebalanced annually.

[2] Equal weighting strategy is constructed by equal weighting the securities of the simulated cap-weighted index.

[3] Risk Cluster EW is constructing by separating stocks weighted by market capitalization into sector/country buckets. Highly correlated buckets are combined to form 20 risk-clusters for global, 7 for US, which are then equal weighted.

[4] The Diversity strategy is constructed by taking cap-weighted index weights for each security and raising each weight to a power of between zero and one. Each security's new value is then divided by the sum of all the security's new values to determine its new weight. Using a value of zero would result in an equal-weighted index, while using a value of one would result in a cap-weighted index. The Diversity[1] strategy uses an exponential factor of 0.76.

[5] Fundamental Index strategy is based on a simulated index weighted using four fundamental factors of company size: revenue, dividends, cash flow, and book value.

[6] Minimum Variance strategy is based on targeting a portfolio of securities that when taken together, result in the lowest possible risk level for the rate of expected return.

[7] Maximum Diversification strategy is based on constructing a portfolio with the highest possible diversification ratio, defined as the weighted average volatilities divided by the total portfolio volatility.

[8] Risk-Efficient -1 strategy weights securities in a manner that targets the highest possible Sharpe Ratio. The strategy uses Lambda parameter of 2.

[9] The Volatility strategy is constructed by taking the holdings of a simulated market capitalization index, calculating the standard deviation of each holding for the past 60 months, and weighting the index based on the calculated 60 month standard deviation.

[10] The Volatility^{-1} strategy is constructed by weighting a portfolio using the inverse of the standard deviation calculated using the Volatility strategy.

[11] The Average Covariance strategy is constructed by weighting each security in a simulated market cap-weighted index by its average covariance with all other securities within the index.

[12] The Average Covariance^{-1} strategy is constructed by weighting a portfolio using the inverse of the average covariance calculated using the Average Covariance strategy.

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