

Newfound / ReSolve Robust Equity Momentum Index Methodology

“I wish to point out that the estimate to which least objection can be raised is the middlemost estimate, the number of votes that it is too high being exactly balanced by the number of votes that it is too low. Every other estimate is condemned by a majority of voters as being either too high or too low, the middlemost alone escaping this condemnation.”

Francis Galton, “One Vote, One Value”, Nature, February 28, 1907

“A plausible argument as to why he has market timing predictive power, if he does, is as follows: Suppose his several dozen indicators are a mixture of indicators that either have weak predictive power or are totally random. When Granville aggregates many such indicators, the noise and errors will tend to diversify away while the signal remains.”

Jerome Basel, George Shows and Edward Thorpe, “Can Joe Granville Time the Market”, The Journal of Portfolio Management, Spring 1982

INDEX OVERVIEW

The Newfound / ReSolve Robust Equity Momentum Index uses a quantitative, rules-based methodology to provide exposure to broad U.S., international, and emerging equity indices to the extent that equity indices are exhibiting positive momentum relative to U.S. Treasury indices. That portion of the portfolio which is not invested in equity indices is invested in indices linked to U.S. Treasury securities. Exposures to underlying indices are expressed through U.S. listed Exchange Traded Funds (“ETFs”).

When the direct source of an investment edge is hidden from view, the best we can hope is to capture a portion of the signal with any single specification. Ensembles view an endogenous investment edge from many perspectives. Just as two eyes provide perspective to our visual senses, and Array Radio Telescopes provide an unparalleled view of the universe by combining signals from many small dishes, ensembles provide greater resolution of investment signals to produce a more stable investment experience.

The Index employs an ensemble approach where a large number of simple strategies “vote” on whether an index has positive or negative momentum, and the weight of each index in the portfolio at each rebalance is in proportion to the percentage of positive votes.

Index Universe

At each rebalance the portfolio is constructed from ETFs representing indexed exposure to the following major asset classes: global equities, U.S. equities, international developed equities, emerging equities, U.S. short-term Treasury notes, and U.S. intermediate Treasury bonds.

The following non-exhaustive list provides examples of ETFs that may be used to gain exposure to each asset class. Target ETFs used for momentum calculations are highlighted in bold.

- Global equities: **ACWI**, VT
- US equities: **IVV**, SPY, VOO, VTI, IWB
- International equities: **IEFA**, EFA, VXUS, ACWX
- Emerging equities: **IEEM**, EEM, VWO
- U.S. short-term Treasury notes: **SHY**, BIL
- U.S. intermediate-term Treasury bonds: **IEF**, VGIT

Momentum Methods

All momentum scores are calculated on returns computed from adjusted prices (P_A) that account for distributions and stock splits. To create adjusted prices, historical prices are adjusted by a factor that is calculated when the ETF begins trading ex-dividend. The amount of the dividend is subtracted from the prior day's price; that result is then divided by the prior day's price. Historical prices are subsequently multiplied by this factor.

For example, an ETF closes at \$80.00 on Monday. On Tuesday, it begins trading ex-dividend based on a \$4.00 distribution. If the ETF opens unchanged, it will be trading at \$76.00.

To calculate the adjustment factor, the \$4.00 distribution is subtracted from Monday's closing price ($\$80.00 - \$4.00 = \$76.00$). Then, we divide 76.00 by 80.00 to determine the distribution adjustment in percentage terms. The result is 0.95.

Lastly, we multiply all historical prices prior to the dividend by the factor of 0.95. This adjusts historical prices proportionately so that they appropriately reflect the total return of the ETF if the distribution had been reinvested back into units of the ETF.

The Index employs four methods for calculating momentum scores from adjusted prices over all lookback horizons ranging from 21 days (approximately 1 month) through 378 days (approximately 18 months).

1. Time-series momentum ("TSM"): Cumulative total returns including reinvested distributions of target ETFs over the past N periods.

$$TSM = \frac{P_{A,t} - P_{A,t-N}}{P_{A,t-N}}$$

2. Price-minus-moving-average (“PMA”): The amount in percent by which the current adjusted price exceeds the average of adjusted prices MA_{P_A} over the preceding N periods.

$$MA_{P_A} = \frac{\sum_{t-N}^t P_A}{N}$$

and

$$PMA = \frac{P_A - MA_{P_A}}{MA_{P_A}}$$

3. Dual moving-average (“DMA”): The amount in percent by which the average of adjusted prices over the preceding N/4 periods (the short moving average) exceeds the average of adjusted prices over the preceding N periods (the long moving average).

$$MA_{P_A,short} = \frac{\sum_{t-N/4}^t P_A}{N}$$

$$MA_{P_A,long} = \frac{\sum_{t-N}^t P_A}{N}$$

and

$$DMA = \frac{MA_{P_A,short} - MA_{P_A,long}}{MA_{P_A,long}}$$

where N is the lookback period in days.

4. Residual momentum (“RM”): Residual adjusted returns are estimated by regressing the adjusted returns for each of U.S. equities, international equities, and emerging equities on the adjusted returns of the global equity index using the following model, specified over the preceding 500 days:

$$r_{M_A,t} = \alpha_M + \beta \cdot r_{G_A,i} + \epsilon_{M,t}$$

where $r_{M_A,t}$ are the adjusted total returns of a respective equity index (i.e. US, international or emerging equities) and $r_{G_A,i}$ are the adjusted total returns of the global equity index.

Residual momentum is calculated as the sum of log residual returns over the the preceding N periods.

$$RM = \sum_{t-N}^t \log(\alpha_M + \epsilon_M)$$

Sampling Frequency

Momentum is calculated at sampling frequencies ranging from every day through every 21 days. Consider an example where momentum is calculated using adjusted prices that are observed weekly (i.e. every 5 days) instead of daily. To approximate a 200-day lookback on weekly prices, momentum would be calculated over the past $(200 / 5 = 40)$ weekly adjusted price observations.

As a result, for each of the four momentum methods the Index requires computation at 21 sampling frequencies over 357 lookback horizons for a total of 29,988 momentum calculations.

Portfolio Formation

Given all momentum estimates, the Index portfolio is formed by averaging the weights produced from two distinct formation approaches. The Index is rebalanced weekly.

1. Dual Momentum: TSM, PMA and DMA momentum scores are compared to the momentum score of U.S. short-term Treasury notes. If the momentum score for global equities exceeds that of U.S. short-term Treasury notes, the index will hold either U.S. equities or international equities conditioned on whichever has the top momentum score. Alternatively, the index will hold either U.S. short-term Treasury notes or U.S. intermediate Treasury bonds conditioned on whichever has the top momentum score.
2. Residual Dual Momentum: The momentum score for global equities is compared against the TSM momentum score of U.S. intermediate Treasury notes. If the momentum score for global equities exceeds that of U.S. intermediate Treasury notes, the index will hold either U.S. equities, international equities, or emerging equities conditioned on whichever has the top RM momentum score. Alternatively, the index will hold U.S. intermediate Treasury bonds.

Staggered Implementation

Academic and empirical evidence suggests that the optimal decay factor – i.e. the time horizon over which trend and momentum signals maximize their forecast accuracy – falls between one week to a little over one month. Rebalancing to the most recent

signals too frequently, then, can put too much emphasis on their ability to forecast short-term returns. Conversely, rebalancing too infrequently can create significant rebalance timing luck, where the portfolio does not adapt to intra-rebalance signal changes and becomes highly sensitive to when it rebalances.

To account for this, the index incorporates a partially staggered rebalance process.

1. The Dual Momentum formation implements a four-week staggered rebalance. This approach is equivalent to investing equal amounts into four sub-indices, each of which is rebalanced every four weeks at a different week-end. In this manner, signal changes are, in effect, partially implemented each week; e.g. a tactical signal change of 100% IVV to 100% IEF would be implemented in 25% changes over a four-week period, assuming signals remain constant.
2. The Residual Dual Momentum formation is implemented weekly.

Portfolio Combination

The weights produced from the two portfolio formation approaches are subsequently weighted 75% to Dual Momentum and 25% to Residual Dual Momentum. Emerging equities are only considered for inclusion in the Residual Dual Momentum formation process, which places a *de facto* maximum weighting of 25% in emerging equities.