Wilshire

FT Wilshire Minimum Variance Index Series

April 2023

1 Introduction

The FT Wilshire Minimum Variance Index Seriesis designed to achieve reduced index volatility relative to the corresponding underlying FT Wilshire market capitalization index. This is achieved via a minimum variance optimization approach which involves an estimated stock covariance matrix and a given set of constraints. The details of the construction are set out below.

2 Index Construction

The index construction process consists of finding portfolio weights that minimize an objective function subject to a set of pragmatic constraints.

2.1 Objective function

The objective function is the absolute index level variance given by the expression:

$$\sigma^2 = \sum_{i,j=1}^{N} W_i \, C_{ij} \, W_j \tag{1}$$

where σ is the index level absolute volatility of a portfolio comprising of N stocks, W_i is the weight of the i^{th} stock and C is the estimated stock covariance matrix.

Estimation of the stock covariance matrix begins with the calculation of an empirical stock covariance matrix based on two years of stock level daily total returns up to the review cut-off date. A minimum of 252 daily standalone and concurrent return observations is required for a stock to be included in the optimization and the final portfolio.

This empirical stock correlation matrix is then refined using a Principal Component Analysis (PCA). The method relies on Random Matrix Theory where small eigenvalues in the PCA are deemed to represent statistical noise and are removed.

2.2 Constraints

The constraints are chosen to allow for meaningful level of volatility reduction while ensuring the minimum variance portfolio is sufficiently investable.

- **Long Only**. Index constituent weights are all positive.
- **Fully Invested**. The sum of index constituent weights equals to one.
- **Maximum Stock Weight**. Individual index constituent weight is capped at the lower of 20 times its underlying weight or 1.5%.
- **Minimum Stock Weight**. The minimum weight of an index constituent will be 5 bps.
- **Country Weight Boundaries**. The country weights W_I^C are constrained to be within the following range:

$$\text{Max}\left[0.8 * M_I^C - 0.05, 0\right] \leq W_I^C \leq \text{Min}[1.2 * M_I^C + 0.05, 1] \tag{2}$$

  where M_I^C is the free-float market capitalization weight of the I^{th} country.

- **Industry Weight Boundaries**. The industry weights W_J^I are constrained to be within the following range:

$$\text{Max}\left[0.8 * M_J^I - 0.05, 0\right] \leq W_J^I \leq \text{Min}[1.2 * M_J^I + 0.05, 1] \tag{3}$$

  where M_J^I is the free-float market capitalization weight of the J^{th} industry set out in the document "Global Assets Taxonomy System".

- **Diversification**. The effective number of stocks as measured by the inverse of the Herfindahl index will be at least 1.5 times that of the underlying index:

$$\frac{1}{\sum W_i^2} \geq 1.5 * \frac{1}{\sum M_j^2}$$

where W_i is the optimized weight of the i^{th} stock, M_j is the free-float market capitalization weight of the j^{th} stock.

- **Factor Exposure**. Active factor exposures (including size, low volatility, value, quality and momentum) are constrained to lay between +/-0.5. The volatility factor is defined as the standard deviation of stock daily total returns in the two-year period up to the review cut-off date. Please refer to the Wilshire Factor Index Series methodology document for the definitions of the other factors and factor exposure.
- **Turnover**. At each subsequent review after initial construction, the two-way index turnover is limited to be a maximum of 20%.

2.3 Determining the optimized index portfolio

Initial optimized weights are found minimizing the objective function subject to all constraints except for the minimum stock weight. Final minimum variance weights are obtained by restricting the eligible universe to stocks whose initial optimized weights are greater than or equal to the minimum stock weight and then re-optimizing using all constraints.

Should the solution be infeasible, constraints will be relaxed in the following manner. Firstly, the turnover constraint is relaxed in steps of 5 percentage points, up to a maximum of 40%. Subsequently, the maximum stock weight is relaxed in steps of 5 bps, up to a maximum of 2%. Should no solution exist at the end of this process the index weights will consist of the pre-review index weights, renormalized to account for exclusion of stocks that are not members of the underlying index on the effective date.

3 Available Minimum Variance Indexes

Table 1 sets out the various indexes, stock universes and optimization currencies that comprise the FT Wilshire Minimum Variance Indexes:

Table 1: FT Wilshire Minimum Variance Index Series

Index Name	FT Wilshire Universe	Optimization Currency	Base Currency
FT Wilshire US Large Minimum Variance Index	US Large Cap Index	USD	USD

4 Ongoing Review

4.1 Index Review

The FT Wilshire Minimum Variance Index Series will be reviewed semi-annually in March and September. The data cutoff date is Wednesday before the first Friday of the review month. Constituent and free-float changes are updated after the close of trading on the third Friday of the review month.

4.1 Intra-review Additions

Additions to the underlying FT Wilshire index will be eligible for inclusion at the next index review of the FT Wilshire Minimum Variance Index Series in March or September.

4.2 Intra-review Deletions

A constituent will be removed from a FT Wilshire Minimum Variance Index if it is removed from the corresponding underlying FT Wilshire Index. The deletion will be concurrent with that from the underlying index and its weight will be distributed pro-rata amongst the remaining constituents in the FT Wilshire Minimum Variance Index.

5 Corporate Events

5.1 Corporate Action Treatment

The weight of a constituent of a FT Wilshire Minimum Variance Index will remain the unchanged should it undergo a stock split, stock consolidation, rights issue, bonus issue, a change in the number of shares in issue or a change in free float (with the exception of tender offers).

5.2 Suspension of Dealing

Suspension of Dealing rules can be found in the "Wilshire Indexes Equity Index Calculation and Corporate Events Guide".

5.3 Takeovers, Mergers and Spinoffs

The treatment of takeovers, mergers and spinoffs can be found in the "Wilshire Indexes Equity Index Calculation and Corporate Events Guide".

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