INDEX METHODOLOGY

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MSCI Quantitative Factor Indexes Methodology

Contents

1. Introduction

The MSCI Quantitative Factor Indexes (herein, the "Indexes")[1] are designed to provide systematic high exposure to the specified style factors[2] relative to the 'Parent Index'[3]. The Indexes are constructed using an optimization-based approach that seeks to achieve high exposure to the target factor, subject to explicit constraints on ex-ante active risk and other unintended risk exposures relative to the Parent Index.

The construction process is designed to:

- Emphasize exposure to the target factor while limiting unintended exposures to other systematic risk characteristics such as styles, sectors and countries
- Apply an optimization-based portfolio construction framework incorporating defined risk controls
- Incorporate implementation considerations pertaining to the investability, including turnover, capacity and liquidity

The Indexes are intended to provide a transparent and systematic representation of quantitative factor strategies within a rules-based index methodology framework, and may be used for research, benchmarking, or investment implementation purposes.

[1] The Indexes are governed by a set of methodology and policy documents ("Methodology Set"), including the present index methodology document. Please refer to Appendix IV for more details.

[2] Please refer to Appendix I for the detailed calculation of the target factor scores.

[3] The Parent Index is defined in Section 2.1. Please refer to Section 2.1 for more details.

2. Index Construction Methodology

Constructing the Indexes involves the following steps:

- Defining the Parent Index
- Defining the Alpha Score
- Defining the Eligible Universe
- Defining the Optimization Setup
- Determining the Optimized Index

The steps mentioned above are defined in detail in the subsequent sections.

2.1 Defining the Parent Index

Construction of the Indexes begins with identifying the Parent Index which is a free-float adjusted market capitalization weighted MSCI Index as per the MSCI Global Investable Markets Index (GIMI) methodology[4]. The optimization is performed from a base currency[5] perspective and does not allow short selling of securities.

2.2 Defining the Alpha Score

Alpha score for each security is computed as winsorized (±3) z-scores[6] of the target factor exposures.

Alpha Score:

$$\propto_i = F_{j,i}$$

Where $F_{j,i}$ represents the factor score of security i for the target factor j.

The factor scores for the target factors are defined in Appendix I.

2.3 Defining the Eligible Universe

The Eligible Universe is constructed by excluding securities without an Alpha score (as defined in Section 2.2) for the relevant target factor from all the constituents of the Parent Index.

2.4 Defining the Optimization Setup

The optimization objective is to maximize the Alpha score (representative of the exposures to the target factor) less a penalty for active risk relative to the Parent Index[7] at the time of rebalancing.

[4] For details about the methodology, please refer to: https://www.msci.com/index/methodology/latest/GIMI.

[5] Any currency within the relevant Barra Equity Model can be used as an optimization currency. The default currency is the US Dollar.

[6] For the Value, Quality, Dividend Yield and Growth factors, the alpha score is computed as winsorized (±3) sector-relative z-score of the corresponding target factor exposures.

[7] For details about the risk aversion parameters, please refer to Section 2.5.

2.5 Optimization Constraints

At each quarterly Index Review, the following optimization constraints are employed, which aim to meet the objectives of the Index while ensuring replicability and investability:

- The maximum weight of the Index constituent will be restricted to the lower of (the weight of the security in the Parent Index + 2%) or 10 times the weight of the security in the Parent Index. The minimum weight of an Index constituent will be restricted to the higher of the (weight of the security in the Parent Index - 2%) or 0.
- Active exposure of the Index to the positive target Barra style factors[8] (factors included in the calculation of Alpha score) will be constrained to be greater than 0.1 standard deviation relative to the Parent Index and the negative target Barra style factors[9] (factors included in the calculation of Alpha score) will be constrained to be less than -0.1 standard deviations relative to the Parent Index.
- Active exposure of the Index to non-target[10] Barra style factors will be restricted to be between +/-0.1 standard deviations relative to the Parent Index.
- The Common Factor Risk Aversion and Specific Risk Aversion parameters[11] in the optimization are set to 0.0015 and 0.015, respectively.
- The ex-ante tracking error and ex-ante active specific risk of the MSCI Quantitative Low Volatility Index and MSCI Quantitative Momentum Index, relative to the Parent Index will be capped at 4% and 2%, respectively.
- The ex-ante tracking error and ex-ante active specific risk of the MSCI Quantitative Value Index, MSCI Quantitative Quality Index, MSCI Quantitative Growth Index, MSCI Quantitative Dividend Yield Index, MSCI Quantitative Low Size Index and MSCI Quantitative Low Residual Volatility Index, relative to the Parent Index will be capped at 3% and 1.5%, respectively.
- The GICS®[12] sector weights of the Index will not deviate more than +/-5% from the GICS® sector weights of the Parent Index.

[8] Positive target Barra style factors include Value and Earnings Yield (for Value as the target factor); Investment Quality, Earnings Quality and Profitability (for Quality); Momentum (for Momentum); Dividend Yield (for Dividend Yield); Mid Capitalization (for Low Size); Growth (for Growth).

[9] Negative target Barra style factors include Earnings Variability and Leverage (for Quality as the target factor); Size (for Low Size); Beta and Residual Volatility (for Low Volatility); Residual Volatility (for Low Residual Volatility).

[10] Active exposure of the Index to the Dividend Yield style factor will not be constrained in the MSCI Quantitative Value Index, as it is correlated with the Value target style factors. Similarly, the active exposure to the Value and Earnings Yield style factors will not be constrained in the MSCI Quantitative Dividend Yield Index, as they are correlated with the Dividend Yield target style factor. Additionally, Active exposure of the Index to the Seasonality, Short Term Reversal, Stock Crowding and Machine Learning factors will not be constrained in the MSCI Quantitative Momentum Index. Active exposure of the Index to the Beta style factor will be constrained to be no greater than 0.0 standard deviations relative to the Parent Index in the MSCI Quantitative Low Residual Volatility Index.

[11] Common Factor Risk Aversion and Specific Risk Aversion are risk aversion parameters in the Barra Open Optimizer utility function. Common Factor Risk Aversion determines the relative weight of common factor risk compared to the alpha, and Specific Risk Aversion determines the relative weight of asset-specific risk compared to the alpha, in the optimization objective.

[12] GICS is the Global Industry Classification Standard jointly developed by MSCI and S&P Dow Jones Indices.

- For countries with weight greater than 2.5% in the Parent Index, the weight in the Index will not deviate more than +/-5% from the country weight in the Parent Index.
- For countries with weight less than or equal to 2.5% in the Parent Index, the weight in the Index will be capped at 3 times their weight in the Parent Index.
- The above country weight constraints will also apply on China A Stock Connect listings as a group separately in addition to the usual country weight constraint on China, relative to Parent Index[13].
- The one-way turnover of the Index is constrained to a maximum of 10% at the time of rebalancing[14].

2.6 Determining the Optimized Index

The Indexes are constructed using the Barra Open Optimizer in combination with the relevant Barra Equity Model[15]. The optimization uses the Eligible Universe as the universe of eligible securities and the specified optimization objective (that is to maximize the Alpha score less a penalty for active risk relative to the Parent Index[11]) and optimization constraints to determine the Index. Infeasible optimizations are handled as explained in Appendix II.

[13] If the weight of China A Stock Connect listings is greater than 2.5% in the Parent Index, the weight of China A Stock Connect listings in the Index will not deviate more than +/-5% from the weight of China A Stock Connect listings in the Parent Index or If the weight of China A Stock Connect listings is less than or equal to 2.5% in the Parent Index, the weight of China A Stock Connect listings in the Index will be capped at 3 times the weight of China A Stock Connect listings in the Parent Index.

[14] The one-way turnover constraint for the MSCI Quantitative Momentum Index is constrained to a maximum of 25% at the time of rebalancing.

[15] Please refer to Appendix III for the detailed information on model usage.

3. Maintaining the Index

3.1 Index Reviews

The Indexes are reviewed on a quarterly basis, usually as of the close of the last business day of February, May, August and November, coinciding with the February, May, August and November Index Reviews of the MSCI Global Investable Market Indexes. Barra Equity Model data as of the day before the rebalancing day is used. This approach aims to capture timely updates to the risk characteristics of the companies and coincide with the review frequency of the relevant Parent Index.

The pro forma Indexes are in general announced nine business days before the effective date.

3.2 Ongoing Event Related Changes

The general treatment of corporate events in the Indexes aims to minimize turnover outside of Index Reviews. The methodology aims to appropriately represent an investor's participation in an event based on relevant deal terms and pre-event weighting of the index constituents that are involved. Further, changes in index market capitalization that occur as a result of corporate event implementation will be offset by a corresponding change in the Variable Weighting Factor (VWF) of the constituent.

The following section briefly describes the treatment of common corporate events within the Indexes.

No new securities will be added (except where noted below) to the Indexes between Index Reviews. Parent Index deletions will be reflected simultaneously in the Index.

EVENT TYPE	EVENT DETAILS
New additions to the Parent Index	A new security added to the Parent Index (such as IPO and other early inclusion) will not be added to the Index.
Spin-Offs	All securities created as a result of the spin-off of an existing Index constituent will be added to the Indexat the time of event implementation. Reevaluation for continued inclusion in the Index will occur at the subsequent Index Review.
Merger/Acquisition	For Mergers and Acquisitions, the acquirer's post event weight will account for the proportionate amount of shares involved in deal consideration, while cash proceeds will be invested across the Indexes.

	If an existing Index constituent is acquired by a non-Index constituent, the existing constituent will be deleted from the Indexes and the acquiring non-constituent will not be added to the Indexes.
Changes in Security Characteristics	A security will continue to be an Index constituent if there are changes in characteristics (country, sector, size segment, etc.). Reevaluation for continued inclusion in the Index will occur at the subsequent Index Review.

Further detail and illustration regarding specific treatment of corporate events relevant to this Index can be found in the MSCI Corporate Events Methodology book under the sections detailing the treatment of events in Capped Weighted and Non-Market Capitalization Weighted indexes.

The MSCI Corporate Events methodology book is available at: https://www.msci.com/index-methodology.

Appendix I: Target Factor Definition Summary

The style factors targeted in the Indexes are the eight style factor groups: Momentum, Value, Quality, Low Volatility, Low Residual Volatility, Low Size, Dividend Yield and Growth.

The following are the definitions of factor groups currently used in the Indexes.

Momentum:

The Momentum score for each security is calculated by combining the security-level exposures to three factors, Momentum, Industry Momentum and Analyst Sentiment, from the relevant Equity Factor Trading Model[16]. A score is derived from the combined score by standardizing (z-score) the combined score and winsorizing at +/-3.

$$\text{Momentum score}_i = (0.5)*\text{Momentum}_i + (0.25)*\text{IndustryMomentum}_i + (0.25)*\text{AnalystSentiment}_i$$

Value:

The Value score for each security is calculated by combining the security-level exposures to two factors, Value and Earnings Yield, from the relevant Equity Factor Model[16]. A sector-relative score is derived from the combined score by standardizing (z-score) the combined score within each sector and winsorizing at +/- 3.

$$\text{Value score}_i = (0.3333) * \text{Value}_i + (0.6667) * \text{EarningsYield}_i$$

Quality:

The Quality score for each security is calculated by combining the security-level exposures to five factors - Profitability, Investment Quality, Earnings Quality, Leverage and Earnings Variability, from the relevant Equity Factor Model[16]. A sector-relative score is derived from the combined score by standardizing (z-score) the combined score within each sector and winsorizing at +/- 3.

$$\text{Quality score}_i = (0.25) * \text{Profitability}_i + (0.25) * \text{Investment Quality}_i + (0.25) * \text{Earnings Quality}_i + (-1) * (0.125) * \text{Earnings Variability}_i + (-1) * (0.125) * \text{Leverage}_i$$

Low Volatility:

The Low Volatility score for each security is calculated by combining the security-level exposures to two factors, Beta and Residual Volatility, from the relevant Equity Factor Model[16]. A score is derived from the combined score by standardizing (z-score) the combined score and winsorizing at +/- 3.

$$\text{Low Volatility score}_i = -(1)*(0.6)\text{Beta}_i + -(1)*(0.4)\text{Residual Volatility}_i$$

[16] Please refer to Appendix III for the detailed information on relevant Equity Factor Models and Equity Factor Trading Models.

Low Residual Volatility:

The Low Residual Volatility score for each security is the winsorized (at +/- 3) z-score of the Low Residual Volatility factor exposure taken from the relevant Equity Factor Model[16].

$$\text{Low Residual Volatility score}_i = -(1) * \text{Residual Volatility}_i$$

Low Size:

The Low Size score for each security is calculated by combining the security-level exposures to two factors, Size and Mid Capitalization, from the relevant Equity Factor Model[16]. A score is derived from the combined score by standardizing (z-score) the combined score and winsorizing at +/- 3.

$$\text{Low Size score}_i = -(1) * (0.9)\text{Size}_i + (0.1)\text{Mid Capitalization}_i$$

Dividend Yield:

The Dividend Yield score for each security is the winsorized (at +/- 3) sector-relative z-score of the Dividend Yield factor exposure taken from the relevant Equity Factor Model[16].

Growth:

The Growth score for each security is the winsorized (at +/- 3) sector-relative z-score of the Growth factor exposure taken from the relevant Equity Factor Model[16].

Appendix II: Handling Infeasible Optimizations

During the quarterly Index Review, in the event that there is no optimal solution that satisfies all the optimization constraints defined in Section 2.5, the following constraints are relaxed, until an optimal solution is found:

- Relax the maximum weight multiple in steps of 2x up to a maximum of 5 iterations (up to a maximum of 20 times the weight of the security in the Parent Index based upon the following formula:

$$wm_{i+1} = 2 + wm_i \quad for\ i = 0 - 4$$

Where wm_i= Maximum Active weight multiple

- Relax the turnover constraint in steps of 2%, up to a maximum of 20%[17]
- Relax the tracking error constraint in steps of 0.4%, up to a maximum of 5%[18]
- Relax the active specific risk constraint in steps of 0.2%, up to a maximum of 2.5%[19]

The maximum active weight multiple, turnover constraint, tracking error constraint and active specific risk constraint are alternately relaxed until a feasible solution is achieved. For example, constraints relaxation is executed in the sequence as illustrated below:

Order of Relaxation	Maximum Asset Weight Multiple	Turnover Limit	Tracking Error Limit	Active specific risk limit
1	**12** times the weight of the security in the Parent Index	10%	3%	1.5%
2	**12** times the weight of the security in the Parent Index	**12%**	3%	1.5%
3	**12** times the weight of the security in the Parent Index	**12%**	**3.4%**	1.5%
4	**12** times the weight of the security in the Parent Index	**12%**	**3.4%**	**1.7%**

In the event that no optimal solution is found after all the above constraints have been relaxed over all the iterations, the Indexes will not be rebalanced for that quarterly Index Review.

[17] For the MSCI Quantitative Momentum Index, turnover constraint will be relaxed from 25% to 35% in steps of 2%.

[18] For the MSCI Quantitative Momentum Index and MSCI Quantitative Low Volatility Index, tracking error constraint will be relaxed from 4% to 6% in steps of 0.4%.

[19] For the MSCI Quantitative Momentum Index and MSCI Quantitative Low Volatility Index, active specific risk constraint will be relaxed from 2% to 3% in steps of 0.2%.

Appendix III: New Release of Barra® Equity Model or Barra® Optimizer

The methodology uses the relevant MSCI Equity Factor Model for the optimization, as determined by the region of the Parent Index. For all target factors other than Momentum, the relevant Equity Factor Model is used, and for the Momentum factor, the relevant Equity Factor Trading Model is used. For example, ACWI-based factor indexes use the MSCI Global Equity Factor Model (EFMGEMLT) and the MSCI Global Equity Factor Trading Model (EFMGEMTR). The table below provides the mapping of Parent Indexes to their corresponding Barra Equity Models. A new release of the relevant Barra Equity Model or Barra Optimizer may replace the former version within a suitable timeframe.

Sr No	Parent Index	Equity Factor Model	Equity Trading Factor Model
1.	ACWI	MSCI Global Equity Factor Model (EFMGEMLT)	MSCI Global Equity Factor Trading Model (EFMGEMTR)
2.	ACWI ex USA	MSCI Global Equity Factor Model (EFMGEMLT)	MSCI Global Equity Factor Trading Model (EFMGEMTR)
3.	World	MSCI Global Equity Factor Model (EFMGEMLT)	MSCI Global Equity Factor Trading Model (EFMGEMTR)
4.	World ex USA	MSCI Global Equity Factor Model (EFMGEMLT)	MSCI Global Equity Factor Trading Model (EFMGEMTR)
5.	EAFE	MSCI Global Equity Factor Model (EFMGEMLT)	MSCI Global Equity Factor Trading Model (EFMGEMTR)

Appendix IV: Methodology Set

The Indexes are governed by a set of methodology and policy documents ("Methodology Set"), including the present index methodology document as mentioned below:

- Description of methodology set – https://www.msci.com/index/methodology/latest/ReadMe
- MSCI Corporate Events Methodology – https://www.msci.com/index/methodology/latest/CE
- MSCI Fundamental Data Methodology – https://www.msci.com/index/methodology/latest/FundData
- MSCI Index Calculation Methodology – https://www.msci.com/index/methodology/latest/IndexCalc
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- MSCI Global Investable Market Indexes Methodology – https://www.msci.com/index/methodology/latest/GIMI

The Methodology Set for the Indexes can also be accessed from MSCI's webpage https://www.msci.com/index-methodology in the section 'Search Methodology by Index Name or Index Code'.

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