MSCI Core Multiple-Factor Indexes Methodology

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Contents

1. Introduction

The MSCI Core Multiple-Factor Indexes (herein, the "Indexes")[1] are designed to represent the performance of a strategy that seeks higher active exposure to three style factors - Value, Momentum and Quality[2] subject to a cap on ex-ante tracking error.

The Indexes use an optimization process that aim to maximize the combined exposure to the target factors while controlling for active risk, active specific risk, and net ex-ante beta relative to the 'Parent Index'[3].

[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 V for more details.

[2] Please refer to section 2.2, appendix I and appendix II for the detailed calculation of the Value, Momentum and Quality factor scores.

[3] The Parent Index is defined in section 2.1. Please refer it 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

The Alpha score is determined by calculating the winsorized (at +/-3) z-score for a weighted combination of the target factor scores. Below are the detailed calculations for the Alpha score.

Calculation of the Alpha Score:

$$\propto_i = 0.3334 * F_{1,i} + 0.3333 * F_{2,i} + 0.3333 * F_{3,i}$$

$F_{j,i}$ = Factor score of each security, i for each of the target factors, j.

The factor scores for the target factors are defined as follows:

- Momentum ($F_{1,i}$) – The Momentum factor score is winsorized (at +/-3) z-score of the average of the Barra Momentum factor score and the Analyst Sentiment score. If Analyst Sentiment score is missing, then the Momentum factor score is the Barra Momentum factor score and vice-versa. The Barra Momentum factor score definition is given in Appendix I and the Analyst Sentiment score definition is given in Appendix II.
- Value ($F_{2,i}$) – The winsorized (at +/-3) sector-relative z-score calculated using the security-level exposures to earnings-based, asset-based and whole-firm based valuation metrics from the relevant Barra Equity Model. The factor definition is given in Appendix I.
- Quality ($F_{3,i}$) – The winsorized (at +/-3) sector-relative z-score calculated using the security-level exposures to all quality factors from the relevant Barra Equity Model. The factor definition is given in Appendix I.

[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.

If any of the factor score ($F_{j,i}$) is missing for a security (i), a value of zero is assigned for that factor score ($F_{j,i}$). A minimum of one factor score is required to calculate the Alpha score.

2.3 Defining the Eligible Universe

The Eligible Universe is constructed by excluding securities without an Alpha score (as defined in section 2.2) 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 set of target factors) less a penalty for active risk relative to the Parent Index at the time of rebalancing.

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:

- If the Parent Index is an MSCI Standard Index or an MSCI Investable Market Index (IMI), then the maximum weight of an index constituents that belong to the Large Cap size segment 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. The maximum weight of an index constituents that belong to the Mid Cap or Small Cap size segments will be restricted to the lower of (the weight of the security in the Parent Index + 1%) or 5 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 - 1%) or 0.
- If the Parent Index is an MSCI Mid Cap Index or an MSCI Small Cap Index, then the maximum weight of an index constituent will be restricted to the lower of (the weight of the security in the Parent Index + 1%) or 5 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 - 1%) or 0.
- Active exposure of the Index to the target Barra style factors, namely, Book-to-Price, Earnings Yield, Earnings Quality, Investment Quality, Profitability and Momentum will be constrained to be greater than 0.1 and less than 0.6 standard deviations relative to the Parent Index and the target Barra style factors, namely, Earnings Variability and Leverage will be constrained to be greater than -0.6 and less than -0.1 standard deviations relative to the Parent Index.
- Exposure of the Index to non-target Barra style factors, namely, Beta, Residual Volatility, Growth, Liquidity, Size and Mid-Cap will be restricted to +/-0.1 standard deviations relative to the Parent Index.
- The Common Factor Risk Aversion and Specific Risk Aversion parameters in the optimization is set to 0.0075 and 0.075, respectively.
- The ex-ante tracking error of the Index, relative to the Parent Index will be capped at 2%.

- The ex-ante active specific risk of the Index, relative to the Parent Index will be capped at 1%.
- The ex-ante beta of the Index will be constrained between 0.98 to 1.02 with respect to the Parent Index.
- The GICS®[6] sector weights of the Index will not deviate more than +/-5% from the GICS® sector weights of the Parent Index.
- 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[7].
- The one-way turnover of the Index is constrained to a maximum of 7.5% at the time of rebalancing.

2.6 Determining the Optimized Index

The Indexes are constructed using the Barra Open Optimizer in combination with the relevant Barra Equity Model[8]. The optimization uses the Eligible Universe as the universe of eligible securities and the specified optimization objective and constraints to determine the Index. Infeasible optimizations are handled as explained in Appendix III.

[6] GICS is the Global Industry Classification Standard jointly developed by MSCI and S&P Global Market Intelligence.

[7] 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.

[8] Please refer to Appendix IV 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, Analyst Sentiment descriptors and Number of Analysts Coverage 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 Index 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 Index at 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 Index. If an existing Index constituent is acquired by a non-Index constituent, the existing constituent will be deleted from the Index and the acquiring non-constituent will not be added to the Index.

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: GEMLTL Target Factor Definition Summary

The GEMLTL style factors targeted in the Index are the three style factor groups and their combinations: Momentum, Value and Quality. Following are the definitions of factor groups currently used in the Index.

Momentum:

The Barra Momentum factor score for each security is the winsorized (at +/- 3) z-score of the Momentum factor taken from the relevant Barra Equity Model (currently GEMLTL).

Value:

The Value score for each security is currently based on earnings-based, asset-based and whole firm-based valuation metrics - currently captured by the following two factors, Book-to-Price and Earnings Yield, from the relevant Barra Equity Model (currently GEMLTL). A sector-relative score is derived from the combined score by standardizing (z-score) the latter within each sector and winsorizing at +/- 3.

$$\text{Value}_i = (0.33) * \text{BtoP}_i + (0.67) * \text{EarningsYield}_i$$

Quality:

The Quality score for each security is currently based on all quality factors, Profitability, Investment Quality, Earnings Quality, Leverage and Earnings Variability, from the relevant Barra Equity Model (currently GEMLTL). A sector-relative score is derived from the combined score by standardizing (z-score) the latter within each sector and winsorizing at +/- 3.

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

Appendix II: Analyst Sentiment Score Definition

The Analyst Sentiment descriptor targeted in the Index are the five descriptor groups. Namely, Cash-flow per share (CPS), Sales (SALES), Earnings per share (EPS), Analyst Recommendation (REC) and Price Target (PRICE TGT). These descriptor groups are described using individual descriptors defined below:

- The **revision ratio** quantifies the number of analysts that are revising upward relative to downward.
- The **change in analyst-predicted estimate** captures the percentage change of the analyst estimate over the past four quarters.
- The **change in analyst-predicted estimate-to-market ratio** captures changes to the ratio of analyst predicted estimate of the indicator to the market-based indicator (price for EPS and CPS; and market capitalization for SALES).

The descriptor groups are constructed as follows:

Descriptor Groups	Descriptors
CPS	Cash Flow Revisions Ratio (CPS_RR_SLOW) Change in Analyst-Predicted Cash Flow per Share (CPSF_C) Change in Analyst-Predicted CPS-to-Price (CPSTOPF_C)
EPS	Ratings Revision Ratio (RR) Change in Analyst-Predicted Earnings per Share (EPSF_C) Change in Analyst-Predicted Earnings-to-Price (ETOPF_C)
PRICE TGT	Price Target Revisions Ratio (PTG_RR_SLOW) Change in Analyst-Predicted Price Target (PTGF_C)
REC	Analyst Recommendation Revisions Ratio (REC_RR_SLOW) Change in Analyst Recommendation (RECF_C)
SALES	Sales Revisions Ratio (SALTOP_RR_SLOW) Change in Analyst-Predicted Sales (SALF_C) Change in Analyst-Predicted Sales-to-MCAP (SALTOPF_C)

Definition of the Analyst Sentiment Descriptor Score:

The Analyst Sentiment descriptors are sourced from MSCI FactorLab[9] and are defined as follows:

1. Revisions Ratio:

   Ratings Revision Ratio (RR): Computed as the weighted sum of the ratio of the number of earnings per share up-revisions minus the number of earnings per share down revisions to the total number of earnings per share forecast:

$$EPS_{RR(t)} = \sum_{l=0,1,2} w_{t,-l} \frac{N^{up}_{t-l*21} - N^{down}_{t-l*21}}{N^{total}_{t-l*21}}$$

   Where, $w_{0,1,2} = \{3, 2, 1\}$

   If the analysis date falls in the middle of a data month, then the above formula will be adjusted to include the pro-rated revision ratio for the latest partial data month.

   Similarly, Cash Flow Revisions Ratio (CPS_RR_SLOW), Sales Revisions Ratio (SALTOP_RR_SLOW), Price Target Revisions Ratio (PTG_RR_SLOW) and Analyst Recommendation Revisions Ratio (REC_RR_SLOW) are calculated by replacing earnings per share revisions and total number of earnings per share forecast in the above formula of RR by the respective revisions and total number of forecast for cash flow per share, sales, price target and number of recommendations.

2. Change in Analyst-Predicted Estimates:

   Change in Analyst-Predicted Earnings per Share (EPSF_C): Computed as the weighted sum of quarterly relative changes of analyst predicted earnings per share:

$$EPSF_{C(t)} = \sum_{l=0,1,2,3} w_l \frac{EPSF_{t-l\times 63} - EPSF_{t-(l+1)\times 63}}{(|EPSF_{t-l\times 63}| + |EPSF_{t-(l+1)\times 63}|)/2}$$

   Where, $w_{0,1,2,3} = \{9, 7, 5, 3\}$

   Similarly, Change in Analyst-Predicted Cash Flow per Share (CPSF_C), Change in Analyst-Predicted Sales (SALF_C), Change in Analyst-Predicted Price Target (PTGF_C) and Change in Analyst Recommendation (RECF_C) use analyst predicted cash flow per share, analyst predicted sales, analyst predicted price target and analyst recommendations, respectively instead of analyst predicted earnings per share in the above formula of EPSF_C.

[9] For more details on MSCI FactorLab, please refer to: https://www.msci.com/our-solutions/analytics/factor-lab.

3. Change in Analyst-Predicted Estimate-to-Market Ratio:

   Change in Analyst-Predicted Earnings-to-Price (ETOPF_C): Computed as the weighted sum of quarterly relative changes of analyst predicted earnings per share to price ratio:

$$ETOPF_{C(t)} = \sum_{l=0,1,2,3} w_l \frac{ETOPF_{t-l\times 63} - ETOPF_{t-(l+1)\times 63}}{(|ETOPF_{t-l\times 63}| + |ETOPF_{t-(l+1)\times 63}|)/2}$$

   Where, $w_{0,1,2,3} = \{9, 7, 5, 3\}$

   Similarly, Change in Analyst-Predicted CPS-to-Price (CPSTOPF_C) and Change in Analyst-Predicted Sales-to-MCAP (SALTOPF_C) use analyst predicted cash flow per share to price ratio and analyst predicted sales to market capitalization ratio, respectively instead of analyst predicted earnings per share to price ratio in the above formula of ETOPF_C.

Calculation of the Analyst Sentiment Descriptor Group Score:

The individual Analyst Sentiment descriptor group score is determined by calculating the winsorized (at +/-3) z-score of the average Analyst Sentiment descriptor scores within the respective group, as outlined in the table above. For example, Analyst Sentiment CPS descriptor group score is calculated as the winsorized (at +/-3) z-score of the average of the Cash Flow Revisions Ratio (CPS_RR_SLOW), Change in Analyst-Predicted Cash Flow per Share (CPSF_C) and Change in Analyst-Predicted CPS-to-Price (CPSTOPF_C).

If one or more of the Analyst Sentiment descriptor scores within the Analyst Sentiment descriptor group are unavailable for a security, the Analyst Sentiment descriptor group score will be calculated as the average of the available Analyst Sentiment descriptor scores. A minimum of one Analyst Sentiment descriptor score is required to calculate the Analyst Sentiment descriptor group score.

Calculation of the Analyst Sentiment Score:

The Analyst Sentiment score for each security is determined by calculating the winsorized (at +/-3) z-score of the average of the five Analyst Sentiment descriptor group scores defined above, namely Cash flow per share (CPS), Earnings per share (EPS), Sales (SALES), Analyst Recommendation (REC) and Price Target (PRICE TGT).

$$\propto_i = Average\ of\ (\mathrm{CPS}_i, \mathrm{EPS}_i, \mathrm{SALES}_i, \mathrm{REC}_i, \mathrm{PRICE\ TGT}_i)$$

Where, $\propto_i$= Analyst sentiment average score for each security i.

For each security, the number of analysts covering its descriptor groups (EPS, CPS, SALES, REC, and PRICE TGT) is examined. Only descriptor groups covered by more than one analyst are considered when calculating the Analyst Sentiment score for that security.

If one or more of the Analyst Sentiment descriptor group scores are unavailable for a security, the Analyst Sentiment score will be calculated as the average of the available Analyst Sentiment descriptor group scores. A minimum of one Analyst Sentiment descriptor group score is required to calculate the Analyst Sentiment score.

Appendix III: 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 for Large Cap size segment up to a maximum of 5 iterations (up to a maximum of 20 times the weight of the security in the Parent Index for Large Cap size segment) and relax the maximum weight multiple in steps of 1x for Mid Cap and Small Cap size segment up to maximum of 5 iterations (up to a maximum of 10 times the weight of the security in the Parent Index for Mid Cap and Small Cap size segment) based upon the following formula:

  $wm_{i+1} = 2 + wm_i \quad for\ i = 0 - 4$ (Large Cap size segment)

  $wm_{i+1} = 1 + wm_i \quad for\ i = 0 - 4$ (Mid Cap and Small Cap size segment)

  Where wm_i= Maximum Active weight multiple

- Relax the turnover constraint in steps of 1.5%, up to a maximum of 15%
- Relax the tracking error constraint in steps of 0.2%, up to a maximum of 3%
- Relax the active specific risk constraint in steps of 0.1%, up to a maximum of 1.5%

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	**12/6** (Large Cap/Mid Cap and Small Cap) times the weight of the security in the Parent Index	7.5%	2%	1%
2	**12/6** (Large Cap/Mid Cap and Small Cap) times the weight of the security in the Parent Index	**9%**	2%	1%
3	**12/6** (Large Cap/Mid Cap and Small Cap) times the weight of the security in the Parent Index	**9%**	**2.2%**	1%
4	**12/6** (Large Cap/Mid Cap and Small Cap) times the weight of the security in the Parent Index	**9%**	**2.2%**	**1.1%**

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

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

The methodology presently uses MSCI Barra Global Equity Model for Long-Term Investors ("GEMLTL") for the optimization. A new release of the relevant Barra Equity Model or Barra Optimizer may replace the former version within a suitable timeframe.

Appendix V: 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
- MSCI Index Glossary of Terms – https://www.msci.com/index/methodology/latest/IndexGlossary
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- MSCI Global Industry Classification Standard (GICS) Methodology – https://www.msci.com/index/methodology/latest/GICS
- 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'.

Contact us

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AMERICAS

United States	+ 1 888 588 4567 *
Canada	+ 1 416 687 6270
Brazil	+ 55 11 4040 7830
Mexico	+ 52 81 1253 4020

EUROPE, MIDDLE EAST & AFRICA

South Africa	+ 27 21 673 0103
Germany	+ 49 69 133 859 00
Switzerland	+ 41 22 817 9777
United Kingdom	+ 44 20 7618 2222
Italy	+ 39 02 5849 0415
France	+ 33 17 6769 810

ASIA PACIFIC

China	+ 86 21 61326611
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India	+ 91 22 6784 9160
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Taiwan	008 0112 7513 *
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