

MSCI EXTENDED RISK CONTROL INDEX METHODOLOGY

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1 Introduction

The MSCI Extended Risk Control Indexes aim to replicate the performance of an investment strategy that attempts to control the level of volatility by adjusting the weights of an MSCI Equity index Component, a Treasury Component and a Cash Component.

2 Index Construction

2.1 INDEX COMPONENTS

The MSCI Extended Risk Control Indexes (the “Indexes”) use three components in the overall index construction: an MSCI Equity Index Component (“Equity Index Component”), a Treasury Component (“Treasury Component”) and a Cash-Return Index Component (“Cash Component”)¹.

A list of the MSCI Extended Risk Control Indexes based on five MSCI Equity Indexes are shown in Appendix 4 along with their respective methodology parameter choices.

2.2 INDEX COMPONENTS: WEIGHT CALCULATION

The weights of the Components of the Indexes are calculated daily based on the following steps:

- Step 1

The preliminary weight of the Equity Index Component (*E*) on day *t* is calculated as the ratio of the predefined target risk level and the Equity Index Component Volatility² on day *t* subject to a maximum leverage of 1:

$$PrelimW_{E,t} = \text{Minimum} \left(1, \frac{\text{Targeted Risk Level}}{\sigma_{E,t}} \right)$$

The preliminary weight of the Treasury Component (*T*) on day *t* is equal to 1 minus the preliminary weight of the Equity Index Component on day *t*:

$$PrelimW_{T,t} = 1 - PrelimW_{E,t}$$

- Step 2

The weights of the Equity Index Component, the Treasury Component and the Cash Component are calculated in accordance with the following formulae:

$$W_{E,t} = \text{Min} \left(\text{Max Lev}, \frac{\text{Targeted Risk Level}}{\text{Port Vol}_{ET,t}} \right) \times PrelimW_{E,t}$$

$$W_{T,t} = \text{Min} \left(\text{Max Lev}, \frac{\text{Targeted Risk Level}}{\text{Port Vol}_{ET,t}} \right) \times PrelimW_{T,t}$$

$$W_{Cash,t} = 1 - (W_{E,t} + W_{T,t})$$

¹ Please refer to Appendix 3 for more information on Cash Component.

² Please refer to Appendix 1 for calculation details.

where:

$W_{E,t}$ is the Equity Index Component weight on day t

$W_{T,t}$ is the Treasury Component weight on day t

$W_{Cash,t}$ is the Cash Component weight on day t

$MaxLev$ is the predefined maximum leverage

$PortVol_{ET,t}$ is the volatility³ on day t for the of the portfolio consisting of the Equity Index Component and the Treasury Component with the respective preliminary weights calculated in Step 1.

The list of all parameters is shown in Appendix 2.

³ Please refer to Appendix 1 for calculation details.

3 Turnover Buffers, Maximum Absolute Change and Exchange Holidays

The Indexes apply turnover buffers and caps on the change in weight of each component to reduce turnover associated with changes in Index Component weights. These Indexes are rebalanced on days when the percentage change in daily Index Components weight exceeds such a predefined buffer. Additionally, the changes in the weight of each Component are subject to a specified maximum level.

The Indexes are not calculated on the specified Index Calculation Holiday⁴.

The Indexes Component Volatility is not calculated on the specified Index Component Volatility Holiday.

⁴ Please refer to Appendix 2 for details.

4 Index Calculations

The Indexes calculation uses the:

- Total Return of the Equity Index Component
- Total Return of the Treasury Component
- Return of the Cash Component

The Index calculation formulae are given below:

$$IL_t = IL_{t-1} \times (1 + IR_t)$$

where:

IL_t is the Index levels on day t

IR_t is the index return on day t, calculated in accordance with the following formula:

$$IR_t = W_{E_t} \times \text{Equity Index Component Return}_t + W_{T_t} \times \text{Treasury Component Return}_t + (1 - (W_{E_t} + W_{T_t})) \times \text{Cash Component Return}_t - RC \times \frac{ACT(t-1,t)}{\text{Day Count}} - TC_t$$

where:

$$\text{Equity Index Component Return}_t = \frac{\text{Equity Index Component Level}_t}{\text{Equity Index Component Level}_{t-1}} - 1$$

$$\text{Treasury Component Return}_t = \frac{\text{Treasury Component Level}_t}{\text{Treasury Component Level}_{t-1}} - 1$$

$$\text{Cash Component Return}_t = \text{Rate}_{t-1} \times \frac{ACT(t-1,t)}{N}$$

$ACT(t-1,t)$ - number of actual calendar days between day t-1 and t

N - day count convention used by the short-term rate

RC - is the Return Cost that may be set to a fixed level to represent items such as replication costs, borrow costs, collateral costs etc.

Day Count - day count that can either be 360 or 365

TC_t - is used to represent return frictions that may arise at the Index rebalance and determined in accordance with the following formula:

$$TC_t = C_T \times \text{ABS}(W_{T_t} - W_{T_{t-1}}) + C_E \times \text{ABS}(W_{E_t} - W_{E_{t-1}})$$

where:

C_T, C_E may be set to a fixed level, where E and T are related to Equity Index Component and Treasury Component respectively

$W_{T_t}, W_{T_{t-1}}, W_{E_t}, W_{E_{t-1}}$ Treasury Component weight and Equity Index component weight as of day t and day $t-1$ respectively

5 Treatment of Corporate Events

The MSCI Extended Risk Control Indexes are derived from the existing underlying MSCI Indexes. As a result, corporate events are reflected in the MSCI Extended Risk Control Indexes as they occur and as they are captured in the underlying MSCI Equity Indexes.

Appendix 1: Volatility calculation for the MSCI Extended Risk Control Indexes

The volatility for the of the portfolio on day t consisting of Equity Index Component and Treasury Component with the respective preliminary weights calculated in Section 2.2:

$$Port Vol_t^2 = PrelimW_{E,t}^2 \times \sigma_{E,t}^2 + PrelimW_{T,t}^2 \times \sigma_{T,t}^2 + 2 * PrelimW_{E,t} \times \sigma_{E,t} \times PrelimW_{T,t} \times \sigma_{T,t} \times Correl_t$$

where:

$PrelimW_{E,t}$, $PrelimW_{T,t}$ are the Component Preliminary weights on day t for the Equity Index Component and the Treasury Component respectively,

$\sigma_{E,t}$ is the annualized Volatility of the Equity Index Component

$\sigma_{T,t}$ is the annualized Volatility of the Treasury Component

$$Correl_t = Max(\rho_{LT,t}, \rho_{ST,t})$$

$$\rho_{LT,t} = \frac{COV_{ET,LT,t}}{\sigma_{E,LT,t} \times \sigma_{T,LT,t}}$$

$$\rho_{ST,t} = \frac{COV_{ET,ST,t}}{\sigma_{E,ST,t} \times \sigma_{T,ST,t}}$$

where:

$\rho_{LT,t}$ and $\rho_{ST,t}$ are short-term and long-term correlations on day t between the Index Components

$\sigma_{E,ST,t}$ and $\sigma_{T,LT,t}$ are short-term and long-term annualized volatilities for day t for each Index Component

$COV_{ET,LT,t}$ and $COV_{ET,ST,t}$ are long-term and short-term covariances between the Equity Index Component and the Treasury Component defined by

$$Cov_{ET,LT,t} = \lambda_{LT} \times Cov_{ET,LT,t-1} + (1 - \lambda_{LT}) \times r_{E,t-1} \times r_{T,t-1}$$

$$Cov_{ET,ST,t} = \lambda_{ST} \times Cov_{ET,ST,t-1} + (1 - \lambda_{ST}) \times r_{E,t} \times r_{T,t}$$

λ_{ST} and λ_{LT} are the chosen short term and long term decay factors respectively
 $r_{E,t-i}$ is the logarithmic daily return of the Equity Index Component on day “t-i”
 $r_{T,t-i}$ is the logarithmic daily return of the Treasury Component on day “t-i”
i is the number of “days lag” in the return calculation used for computing covariance (i.e., the lag between the return date and the covariance calculation date)

where the covariance on day t is dependent on the initial estimate of covariance which is computed using the formula below

$$Cov_{ST,t_{ini}+1} = (1 - \lambda_{ST}) \times \sum_{j=1}^{t_{ini}} \lambda_{ST}^{t_{ini}-j} \times r_{E,j} \times r_{T,j}$$

$$Cov_{LT,t_{ini}+1} = (1 - \lambda_{LT}) \times \sum_{j=1}^{t_{ini}} \lambda_{LT}^{t_{ini}-j} \times r_{E,j} \times r_{T,j}$$

where:

t_{ini} is the number of days for calculating initial volatility estimate.

The volatility of an Index Component σ_t on date t is the maximum of the long-term and short-term volatilities of an Index Component on date t determined using the exponentially weighted volatility calculation methodology as follows:

Index Component Volatility $\sigma_t = \text{Max}(\sigma_{ST,t}, \sigma_{LT,t})$

$$\sigma_{ST,t} = \sqrt{\lambda_{ST} \times (\sigma_{ST,t-1})^2 + (1 - \lambda_{ST}) \times (r_{t-i})^2}$$

$$\sigma_{LT,t} = \sqrt{\lambda_{LT} \times (\sigma_{LT,t-1})^2 + (1 - \lambda_{LT}) \times (r_{t-i})^2}$$

where:

$\sigma_{ST,t}$ and $\sigma_{LT,t}$ are the short-term and long-term annualized realized volatilities respectively for day t

$\sigma_{ST,t-1}$ and $\sigma_{LT,t-1}$ are short-term and long-term annualized realized volatilities respectively for day t-1

λ_{ST} and λ_{LT} are the short-term and long-term decay factors respectively

i is the number of “days lag” in the return calculation used for computing volatility (i.e., the lag between the return date and the volatility calculation date)

r_{t-i} is the logarithmic daily return of the index component on “t-i” day

The volatility on day t is dependent on the initial estimate of volatility is computed using the formula below:

$$\sigma_{ST,t_{ini}+1} = \sqrt{\left((1 - \lambda_{ST}) \times \sum_{j=1}^{t_{ini}} \lambda_{ST}^{t_{ini}-j} \times r_j^2 \right)}$$

$$\sigma_{LT,t_{ini}+1} = \sqrt{\left((1 - \lambda_{LT}) \times \sum_{j=1}^{t_{ini}} \lambda_{LT}^{t_{ini}-j} \times r_j^2 \right)}$$

where:

t_{ini} is the number of days for calculating initial volatility estimate.

Appendix 2: Extended Risk Control Index Methodology Parameters

Main methodology parameters for Extended MSCI Risk Control Indexes:

	MSCI Extended Risk Control Index Parameters	Available settings
1	Equity Index Component (its Return Type, Currency)	any MSCI index
2	Treasury Component	Treasury based Index
3	Cash Component	Short-term rates applicable for the MSCI Extended Risk Control Indexes
4	Targeted Risk Level	as specified
5	Short term decay factor (λ_{ST})	94%
6	Long term decay factor (λ_{LT})	97%
7	Correlation lookback horizon	as specified
8	Number of days for calculating initial volatility estimate (T_{ini})	as specified
9	Number of days lagged for the return when computing volatility and covariance (i)	as specified
10	Leverage Cap	as specified
11	Return Period for Volatility Estimation	as specified
12	Turnover buffer	as specified
13	Maximum Absolute Change in Weight	as specified
14	Index holiday, Component Volatility Calculation Holiday	as specified
15	Return Cost, Day Count	as specified
16	C_T, C_E	as specified

Appendix 3: Short-term rates

The MSCI Extended Risk Control Indexes Methodology uses the below short-term rates for determining the returns of Cash Component:

Currency	USD	GBP	EURO	CHF	JPY
Short-term Rate	Overnight SOFR	Overnight SONIA	3-month EURIBOR	Overnight SARON	3-month TIBOR

The MSCI Extended Risk Control Indexes Methodology may use other rates as applicable for determining the returns of Cash Component.

Appendix 4: Parameter Settings

Parameters for the MSCI World 10% Extended Risk Control Index:

MSCI World 10% Extended Risk Control Index Parameters		
1	MSCI Equity Index Component (its Return Type, Currency)	MSCI World Index (GTR, USD)
2	Treasury Component	10-Year US Treasury Futures Index (TR) ⁵
3	Cash Component	Fed Funds Rate
4	Targeted Risk Level	10%
5	Short term decay factor (λ_{ST})	94%
6	Long term decay factor (λ_{LT})	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate (T_{ini})	120
11	Number of days lagged for the return when computing volatility and covariance (i)	2
12	Leverage Cap	1.5
13	Return Period for Volatility Estimation	5 days
14	Turnover buffer	Not applied
15	Maximum Absolute change of weight	Not applied
16	Index holiday, Component Volatility Calculation Holiday	Not applied
17	Return Cost	Not applied
18	C_T, C_E	Not applied

Parameters for the MSCI World ESG Leaders 10% Extended Risk Control Index:

MSCI World ESG Leaders 10% Extended Risk Control Index Parameters		
1	MSCI Equity Index Component (its Return Type, Currency)	MSCI World ESG Leaders Index (GTR, USD)
2	Treasury Component	10-Year US Treasury Futures Index (TR)
3	Cash Component	Fed Funds Rate

⁵ [iEdge US Treasury Futures Index - Index Methodology DCI A4 4 Jun 2020 1.pdf \(sgx.com\)](#)

4	Targeted Risk Level	10%
5	Short term decay factor (λ_{ST})	94%
6	Long term decay factor (λ_{LT})	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate (T_{ini})	120
11	Number of days lagged return for computing volatility and covariance (i)	2
12	Leverage Cap	1.5
13	Return Period for Volatility Estimation	5 days
14	Turnover buffer	Not applied
15	Maximum Absolute change of weight	Not applied
16	Index holiday, Component Volatility Calculation Holiday	Not applied
17	Return Cost	Not applied
18	C_T, C_E	Not applied

Parameters for the MSCI Emerging Markets 5% Extended Risk Control Index

MSCI Emerging Markets 5% Extended Risk Control Index Parameters		
1	MSCI Equity Index Component (its Return Type, Currency)	MSCI Emerging Markets Index (GTR, USD)
2	Treasury Component	10-Year US Treasury Futures Index (TR)
3	Cash Component	Fed Funds Rate
4	Targeted Risk Level	5%
5	Short term decay factor (λ_{ST})	94%
6	Long term decay factor (λ_{LT})	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate (T_{ini})	120
11	Number of days lagged return for computing volatility and covariance (i)	2
12	Leverage Cap	1.5
13	Return Period for Volatility Estimation	5 days
14	Turnover buffer	Not applied
15	Maximum Absolute change of weight	Not applied
16	Index holiday, Component Volatility Calculation Holiday	Not applied

17	Return Cost	Not applied
18	C_T, C_E	Not applied

Parameters for the MSCI EAFE 5% Extended Risk Control Index

MSCI EAFE 5% Extended Risk Control Index Parameters		
1	MSCI Equity Index Component (its Return Type, Currency)	MSCI EAFE Index (GTR, USD)
2	Treasury Component	10-Year US Treasury Futures Index (TR)
3	Cash Component	Fed Funds Rate
4	Targeted Risk Level	5%
5	Short term decay factor (λ_{ST})	94%
6	Long term decay factor (λ_{LT})	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate (T_{ini})	120
11	Number of days lagged return for computing volatility and covariance (i)	2
12	Leverage Cap	1.5
13	Return Period for Volatility Estimation	5 days
14	Turnover buffer	Not applied
15	Maximum Absolute change of weight	Not applied
16	Index holiday, Component Volatility Calculation Holiday	Not applied
17	Return Cost	Not applied
18	C_T, C_E	Not applied

Parameters for the MSCI USA ESG Leaders 5% Extended Risk Control Index

MSCI USA ESG Leaders 5% Extended Risk Control Index Parameters		
1	MSCI Equity Index Component (its Return Type, Currency)	MSCI Emerging Markets Index (GTR, USD)
2	10-Year US Treasury Futures Index Component	10-Year US Treasury Futures Index (TR)
3	Cash Component	Fed Funds Rate
4	Targeted Risk Level	5%
5	Short term decay factor (λ_{ST})	94%

6	Long term decay factor (λ_{LT})	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate (T_{ini})	120
11	Number of days lagged return for computing volatility and covariance (i)	2
12	Leverage Cap	1.5
13	Return Period for Volatility Estimation	1 day
14	Turnover buffer	Not applied
15	Maximum Absolute change of weight	Not applied
16	Index holiday, Component Volatility Calculation Holiday	Not applied
17	Return Cost	Not applied
18	C_T, C_F	Not applied

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