MSCI MAXIMUM EXPOSURE RISK CONTROL INDEX METHODOLOGY

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1 Introduction

The MSCI Maximum Exposure Risk Control Indexes aim to replicate the performance of an investment strategy that targets a specified level of overall risk by adjusting the weights within the strategy of an MSCI Equity index-related Component, a Treasury Component and a Cash Component.

2 Index Construction

2.1 INDEX COMPONENTS

The MSCI Maximum Exposure Risk Control Indexes use three blended components in the overall index construction: an MSCI Equity Index Component, a "Treasury"-related Index Component ("Treasury Component") and a Cash-Return Index Component ("Cash Component").

A list of the current MSCI Maximum Exposure Risk Control Indexes based on five MSCI Equity Indexes are shown in Appendix 2 alongside their respective methodology parameter choices.

2.2 INDEX COMPONENTS: WEIGHT CALCULATION

The weights of the Components of the MSCI Maximum Exposure Risk Control Indexes are calculated daily with the objective to maximize the overall risk-weighted index exposure:

$Max\ (\sum w_i * \sigma_i)$

where:

w_i is an Index Component weight

σ_i is the corresponding Index Component volatility[1]

Subject to the following constraints on a daily basis:

- Calculated volatility[2] of the MSCI Maximum Exposure Risk Control Index is equal to the Specified Risk Level[3]
- Minimum weight of the MSCI Equity index Component is 0%.
- Minimum weight of the Treasury Component is 0%.

[1] See Appendix 1 for details.

[2] Please refer to Appendix 1 for calculation details.

[3] Please refer to Appendixes 2 for details.

- The maximum weight of the sum of MSCI Equity Index Component and Treasury Component is equal to a specified Maximum Leverage[4]
- The Cash Component weight is equal to (1 minus the sum of the MSCI Equity Index Component and Treasury Component weights).

[4] Please refer to Appendixes 2 for details.

3 Index Calculations

The MSCI Maximum Exposure Risk Control Indexes calculation uses the:

- Total Return of the MSCI 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 as:

$$IR_t = w_{E_t} \times MSCI\ Equity\ Index\ Component\ return_t + w_{T_t} \times Treasury\ Component\ Return_t + (1 - (w_{E_t} + w_{T_t})) \times Cash\ Component\ Return_t$$

where:

$$MSCI\ Equity\ Index\ Component\ Return_t = \frac{MSCI\ Equity\ Index\ Component\ Level_t}{MSCI\ Equity\ Index\ Component\ Level_{t-1}} - 1$$

$$Treasury\ Component\ Return_t = \frac{Treasury\ Component\ Level_t}{Treasury\ Component\ Level_{t-1}} - 1$$

$$Cash\ Component\ Return_t = Fed\ funds_{t-1} \times \frac{ACT(t, t-1)}{360}$$

where:

$ACT(t\text{-}1,t)$ = number of actual calendar days between business day t-1 and t

4 Maintenance of the Index

4.1 TREATMENT OF CORPORATE EVENTS

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

Appendix 1: Volatility calculation for the MSCI Maximum Exposure Risk Control Indexes

The volatility for the MSCI Maximum Exposure Risk Control Indexes is calculated using the formula below:

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

where:

$w_{E,t}$, $w_{T,t}$ are the Component weights for the MSCI Equity Index Component and the Treasury Component respectively,

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

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

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

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

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

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 MSCI Equity Index Component and the Treasury Component defined by

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

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

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 MSCI 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:

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

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

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

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:

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

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

where:

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

Appendix 2: Parameter Settings

Parameters for the MSCI World 10% Maximum Exposure Risk Control Index:

	MSCI World 10% Maximum Exposure Risk Control Index Parameters	
1	MSCI Parent Index (its Return Type, Currency)	MSCI World Index (GTR, USD)
2	Treasury Component	10-Year US Treasury Futures Index (TR)
3	Cash Component	Fed Funds Rate
4	Specified Risk Level	10%
5	Short term decay factor (λST)	94%
6	Long term decay factor ($\lambda \mathrm{LT}$)	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate ($Tini$)	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

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

	MSCI World ESG Leaders 10% Maximum Exposure Risk Control Index Parameters	
1	MSCI Parent Index (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
4	Specified Risk Level	10%
5	Short term decay factor (λST)	94%
6	Long term decay factor ($\lambda \mathrm{LT}$)	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate ($Tini$)	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

Parameters for the MSCI Emerging Markets 5% Maximum Exposure Risk Control Index

	MSCI Emerging Markets 5% Maximum Exposure Risk Control Index Parameters	
1	MSCI Parent Index (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	Specified Risk Level	5%
5	Short term decay factor (λST)	94%
6	Long term decay factor (λLT)	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate ($Tini$)	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

Parameters for the MSCI EAFE 5% Maximum Exposure Risk Control Index

	MSCI EAFE 5% Maximum Exposure Risk Control Index Parameters	
1	MSCI Parent Index (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	Specified Risk Level	5%
5	Short term decay factor (λST)	94%
6	Long term decay factor (λLT)	97%

9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate ($Tini$)	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

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

	MSCI USA ESG Leaders 5% Maximum Exposure Risk Control Index Parameters	
1	MSCI Parent Index (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	Specified Risk Level	5%
5	Short term decay factor (λST)	94%
6	Long term decay factor (λLT)	97%
9	Correlation lookback horizon	120 days
10	Number of days for calculating initial volatility estimate ($Tini$)	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

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