STOXX Minimum Variance Indices

June 2020

QONTIGO AXIOMA | DAX | STOXX

Content

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Minimum Variance

Overview

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STOXX is now part of Qontigo…

A new financial intelligence driver, modernizing investment management

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Index

STOXX & DAX
World-class indices that are licensed to more than 500 companies, including the world's largest financial product issuers, capital owners and asset managers.

Analytics

AXIOMA
Best of breed portfolio construction and risk analytics tools.

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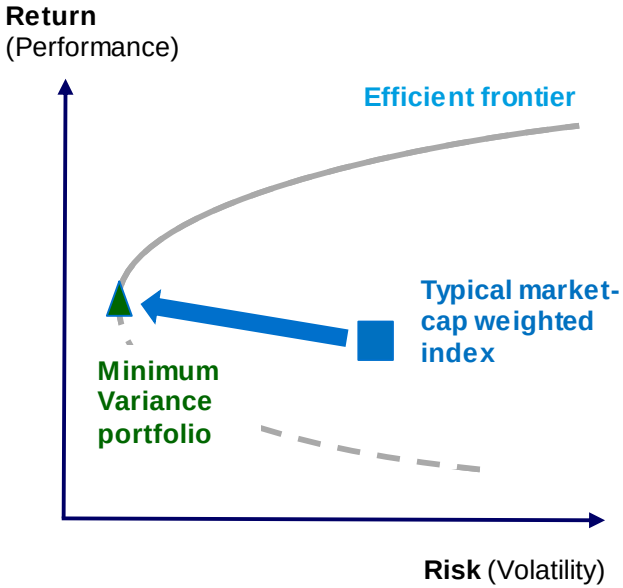
Minimum Variance Portfolio

Based on Markowitz's Nobel Prize winning Modern Portfolio Theory

Why Minimum Variance

- The Minimum Variance portfolio (MVP) is an efficient portfolio with minimal risk
- The MVP is the only portfolio on the efficient frontier that does not require a return estimation:
  - Unlike returns, risks can be forecasted relatively accurately and reduced without harming returns as non-remunerated market risks are diversified away
- Historically, MVP strategies were less impacted by market downturns
- MVPs use less risk budget available to investors, giving access to higher long term returns on a constant risk basis

Risk-return optimization



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Advantages of Minimum Variance Investing

Distinctively improved risk-return profile

- Low risk, enables higher allocation to equity with same risk budgeting
  - In low interest rate environment especially, ability to reduce fixed income allocation
- Low drawdowns, low beta: can be combined with high beta for overall portfolio enhanced risk/return
- Historically, higher long term performance with temporary underperformance in strong years only
  - Win by losing less!
  - Active-like returns with stable upward trending returns, avoiding large drawdowns
- Outperformance and strong Sharpe ratio driven by behavioral reasons
  - Behavioral biases: investor psychology, asymmetric (lottery) payout preferences, representativeness, over-confidence
  - Structural constraints: inability to employ leverage, benchmark relative risk constraints
  - These promote the outperformance and low risk of Min Var portfolios

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STOXX Approach – A Robust Factor-based Risk Model Reducing Computational Complexity and Generating Superior Results

Two primary approaches used in the industry

Historical Covariance Approach

- Mathematically cumbersome and inefficient
- Spurious correlations
- Universe often cut just to enable computation

Factor Model Approach

- More robust, using more information
- No spurious correlations
- Enable full universe utilization

STOXX adopts AXIOMA's state-of-the-art factor model for its minimum variance indices

- Fundamental / technical factors that specify systematic risk drivers in regions and single countries. Models designed to forecast volatility "out of sample"

STOXX Minimum Variance Indices uses best of breed portfolio optimization algorithm

- Creates more efficient portfolios than competitors with more stable optimization results and constraining the results against relevant factors, leading to more investable indices

STOXX is the only provider of true Minimum Variance Indices using a Factor Model Approach

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STOXX Minimum Variance Indices

Methodology

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STOXX's Innovative Minimum Variance Concept

Extends its global smart-beta offering

1 Superior methodology

- Using Axioma's superior fundamental risk model to robustly and accurately forecast and minimize risk
- Overpriced securities are not over-weighted
- Weighting done by optimization, requires fewer components
- Reduced risk and draw downs, higher returns
- Superior methodology, superior output compared
- to low risk weighting

2 Flexible dual offering

- STOXX Minimum Variance Indices come in two versions: Constrained and Unconstrained
- The Constrained Version: Similar exposures to market-cap index with much lower risk
- The Unconstrained Version: first of its kind globally,
  - with complete freedom to fulfill its Minimum Variance mandate

STOXX Minimum Variance

3 Highly liquid and low transaction costs

- Selection universe is a broad index
  - Only extremely liquid stocks considered
  - Model less constrained as a result
- Turnover and transaction costs are considered in optimization directly for a holistic optimization

4 Adapted to portfolio constraints

- Well-diversified and UCITs compliant
- Tradable and trackable
- Constrained version has very low active positions on countries/sectors/risk factors

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STOXX's Minimum Variance Indices Come in Two Versions

Catering to different investor objectives

Unconstrained version

- Full optimization to minimize risk
- With only very basic constraints, there is the freedom to provide increased optimality in resulting portfolio
- Resulting portfolio might have a bias towards certain properties (specific factor, geography etc.) as the aim is purely to Minimize Variance
- The freedom is expected to provide lower risk

- Caters to an investment in a Minimum Variance portfolio while not concerned about the underlying benchmark

Constrained version

- Optimization is constrained to limit bias of Minimum Variance index into a specific industry/country/factor when compared to the underlying index
- Most factors/attributes are constrained except for variance, resulting in a very similar index but with reduced risk
- Offers an advantage for investors seeking to track a benchmark

- Caters to the need of a superior risk return profile over the benchmark, or a risk minimized benchmark

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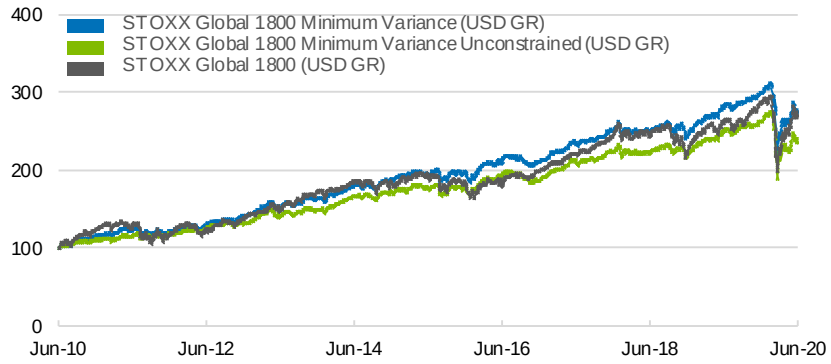
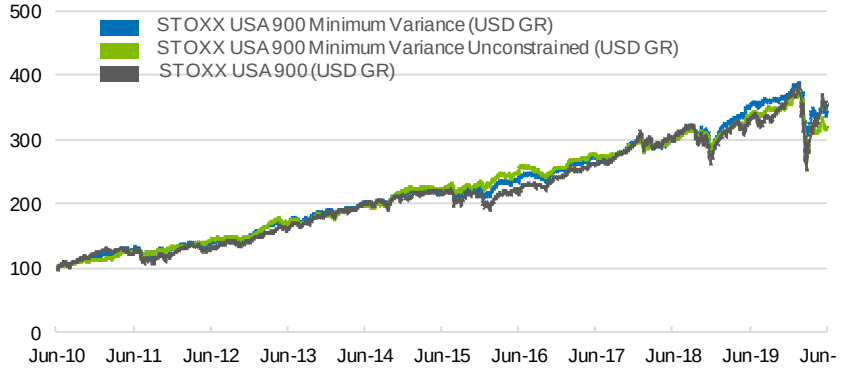
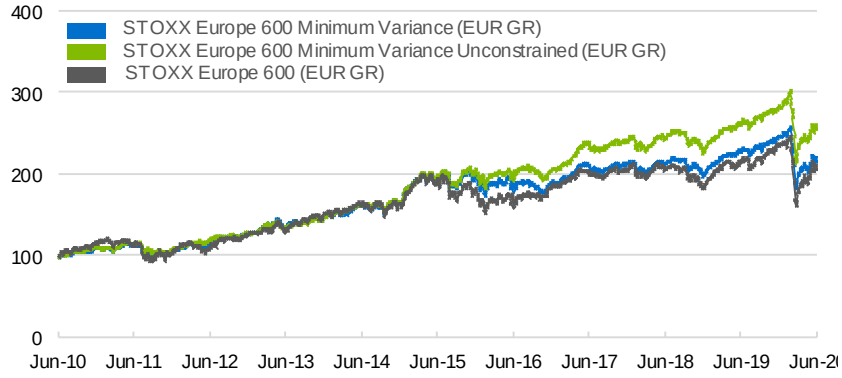
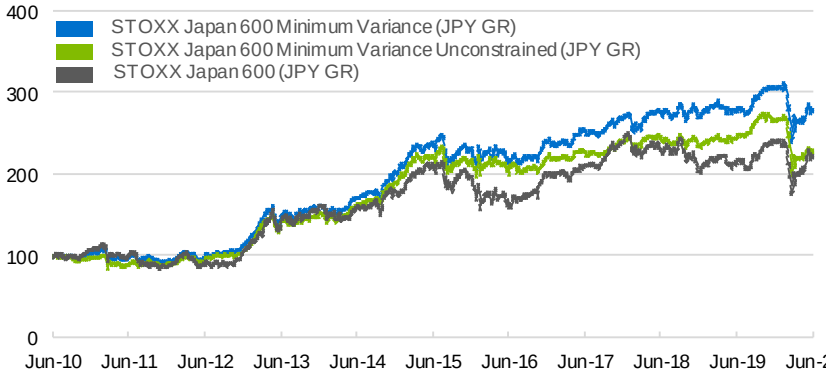
STOXX Minimum Variance Methodology Works Empirically in All Geographies









1) Source: STOXX data from Jun. 30, 2010 to Jun. 30, 2020

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Risk and Return Characteristics

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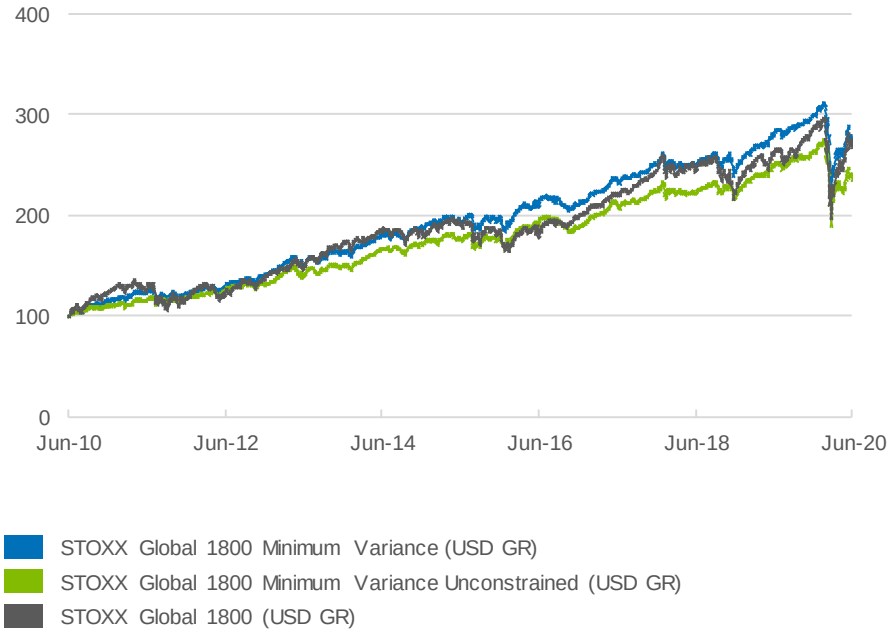
STOXX Global Minimum Variance Indices

Risk and return characteristics

	STOXX Global 1800 Min. Var.	STOXX Global 1800 Min. Var. Unconstrained	STOXX Global 1800
Perf. overall (annualized)	10.80%	9.12%	10.67%
Perf. (1Y)	-1.85%	-5.07%	3.79%
Perf. (3Y) (annualized)	5.59%	4.08%	7.42%
Perf. (5Y) (annualized)	7.49%	6.17%	7.58%
Vol. overall (annualized)	11.46%	10.64%	15.05%
Volatility (1Y) (annualized)	23.48%	22.41%	27.76%
Volatility (3Y) (annualized)	14.88%	14.19%	18.26%
Volatility (5Y) (annualized)	12.87%	12.36%	16.10%
Sharpe ratio (Overall)	0.89	0.81	0.71
Sharpe ratio (5Y)	0.53	0.45	0.46
Tracking Error (Overall)	7.50%	9.39%	
Tracking error (5Y)	6.66%	8.21%	
Dividend Yield (Overall)	5.34%	4.84%	4.92%
Maximum drawdown	31.79%	31.67%	33.77%
Constituents	190	225	1801

Return[1)]



1) Source: STOXX data from Jun. 30, 2010 to Jun. 30, 2020

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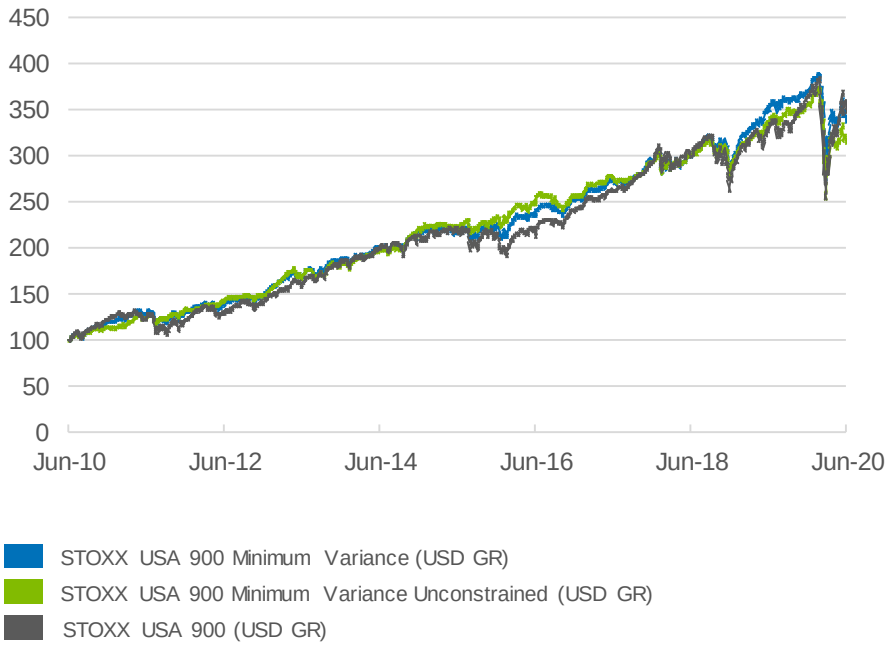
STOXX USA Minimum Variance Indices

Risk and return characteristics

	STOXX USA 900 Min. Var.	STOXX USA 900 Min. Var. Unconstrained	STOXX USA 900
Perf. overall (annualized)	13.32%	12.50%	13.76%
Perf. (1Y)	-2.03%	-4.85%	8.09%
Perf. (3Y) (annualized)	8.30%	5.34%	11.04%
Perf. (5Y) (annualized)	10.04%	7.89%	10.69%
Vol. overall (annualized)	14.13%	12.98%	17.59%
Volatility (1Y) (annualized)	28.27%	28.99%	33.91%
Volatility (3Y) (annualized)	18.51%	18.48%	22.72%
Volatility (5Y) (annualized)	15.74%	15.60%	19.55%
Sharpe ratio (Overall)	0.91	0.92	0.78
Sharpe ratio (5Y)	0.61	0.49	0.56
Tracking Error (Overall)	6.44%	8.91%	
Tracking error (5Y)	7.62%	9.08%	
Dividend Yield (Overall)	5.99%	6.24%	5.14%
Maximum drawdown	29.97%	32.66%	34.55%
Constituents	90	95	900

Return[1)]



1) Source: STOXX data from Jun. 30, 2010 to Jun. 30, 2020

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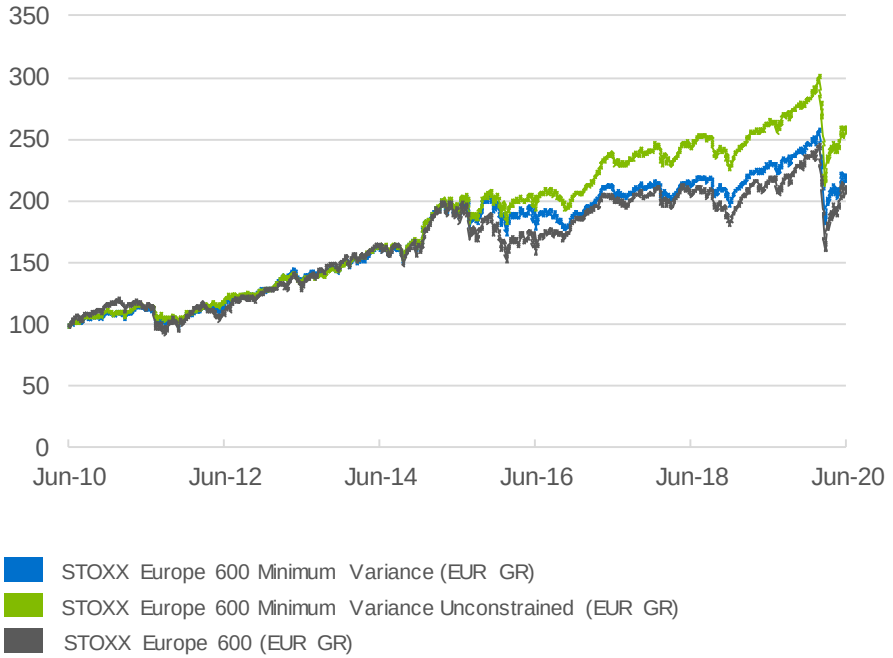
STOXX Europe Minimum Variance Indices

Risk and return characteristics

	STOXX Europe 600 Min. Var.	STOXX Europe 600 Min. Var. Unconstrained	STOXX Europe 600
Perf. overall (annualized)	8.16%	10.03%	7.68%
Perf. (1Y)	-4.82%	-1.79%	-3.87%
Perf. (3Y) (annualized)	1.80%	3.57%	1.51%
Perf. (5Y) (annualized)	2.86%	6.07%	2.20%
Vol. overall (annualized)	13.39%	12.28%	17.27%
Volatility (1Y) (annualized)	21.81%	21.13%	26.80%
Volatility (3Y) (annualized)	14.75%	14.41%	18.06%
Volatility (5Y) (annualized)	15.21%	14.41%	18.38%
Sharpe ratio (Overall)	0.66	0.84	0.52
Sharpe ratio (5Y)	0.29	0.51	0.23
Tracking Error (Overall)	6.61%	8.35%	
Tracking error (5Y)	6.04%	7.34%	
Dividend Yield (Overall)	4.66%	5.40%	4.85%
Maximum drawdown	29.87%	29.87%	35.34%
Constituents	160	133	600

Return[1)]



1) Source: STOXX data from Jun. 30, 2010 to Jun. 30, 2020

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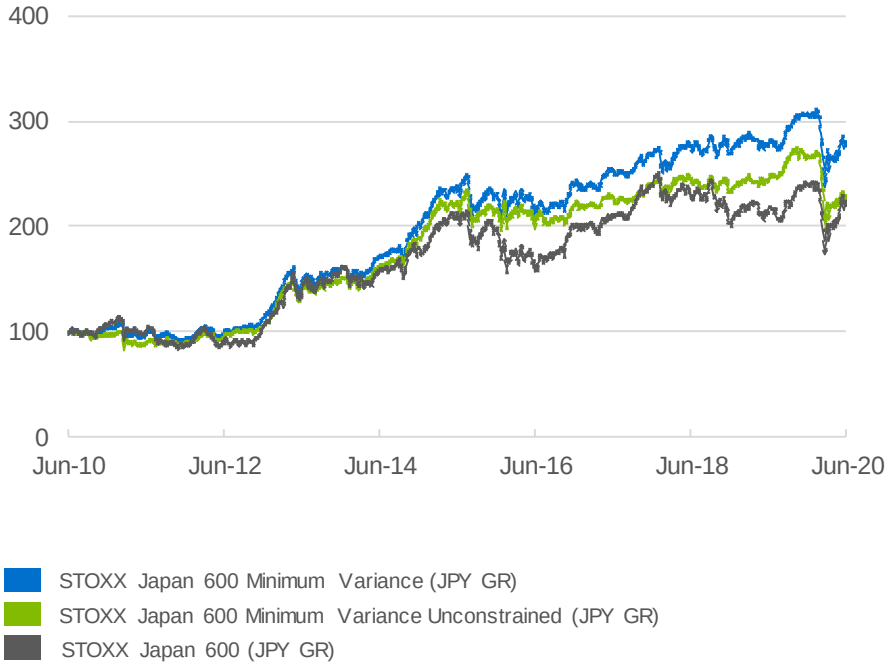
STOXX Japan Minimum Variance Indices

Risk and return characteristics

	STOXX Japan 600 Min. Var.	STOXX Japan 600 Min. Var. Unconstrained	STOXX Japan 600
Perf. overall (annualized)	10.88%	8.65%	8.31%
Perf. (1Y)	0.19%	-6.92%	2.75%
Perf. (3Y) (annualized)	3.39%	0.28%	1.52%
Perf. (5Y) (annualized)	3.47%	0.62%	1.15%
Vol. overall (annualized)	15.50%	14.13%	19.45%
Volatility (1Y) (annualized)	17.27%	18.39%	21.07%
Volatility (3Y) (annualized)	13.25%	13.07%	16.67%
Volatility (5Y) (annualized)	15.55%	14.64%	19.43%
Sharpe ratio (Overall)	0.74	0.66	0.51
Sharpe ratio (5Y)	0.30	0.12	0.16
Tracking Error (Overall)	8.41%	11.30%	
Tracking error (5Y)	8.23%	11.22%	
Dividend Yield (Overall)	4.42%	3.92%	3.13%
Maximum drawdown	24.25%	28.70%	31.18%
Constituents	121	104	600

Return[1)]



1) Source: STOXX data from Jun. 30, 2010 to Jun. 30, 2020

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Appendix

STOXX Minimum Variance Indices Come in Two Versions…

	Unconstrained version	Constrained version
Capping	▪ UCITS compliant: individual components capped at 8%; all individual components with weights ≥4.5% jointly capped at 35%[1)]	
Effective portfolio size	▪ At least 30% of underlying broad index: $H_{MinVar} \geq H_{Base} * 30\%$ with w = component weight; H = effective number of assets, and $H = \frac{1}{\sum w^2}$	
Rebalancing and max. turnover	▪ Monthly rebalancing ▪ 5% one way turnover constraint[2)]	▪ Quarterly rebalancing ▪ 7.5% one way turnover constraint[2)]
Country and industry exposure	▪ Not applied to unconstrained version	▪ Constrained Minimum Variance Index's exposure by country and industry must remain within ±5% of exposure of base index by country and industry
Factor exposure	▪ Not applied to unconstrained version	▪ Constrained Minimum Variance Index must remain within a 0.25 standard deviation of the base index's exposure to each factor

1) Note that these "4.5/8/35" rule is slightly stricter than required by UCITS constraints which imply "5/10/40" rule
2) One-way turnover defines the portion of a portfolio that is sold in order to buy other components

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…that Cater to Different Investor Needs (I)

Version 1: STOXX Minimum Variance Unconstrained Index

Index Characteristics

Caters to investors trying to capture the full benefit of a minimum variance strategy

- Most optimal risk-adjusted return
- Full optimization to minimize risk
- With only very basic constraints, there is the freedom to provide increased optimality in the resulting portfolio
- May have relative biases towards certain factors, geographies etc.
- Expected to provide lowest risk

Index Constraints

- **Diversification**
  - index constituent capping at 8%
  - sum of index constituent with weight over 4.5% are capped at 35%
- **Turnover**
  - monthly rebalancing
  - one-way turnover constrained to a maximum of 5%

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…that Cater to Different Investor Needs (II)

Version 2: STOXX Minimum Variance Constrained Index

Index Characteristics

Caters to investors with high benchmark sensitivity and tracking error constraints

- Optimization is constrained to limit biases of Minimum Variance index relative to the benchmark
- Most factors/attributes are constrained except for variance, resulting in a very similar index but with reduced risk
- Improves portfolio risk-return efficiency while tracking benchmark

Index Constraints

- **Diversification**
  - index constituent capping at 8%
  - sum of index constituent with weight over 4.5% are capped at 35%
- **Turnover**
  - quarterly rebalancing
  - one-way turnover constrained to a maximum of 7.5%
- **Benchmark Constraints**
  - ICB sector and country weights constrained to +/-5% of the underlying benchmark index
  - index is constrained within +/-0,25 standard deviations of the underlying benchmark index's factor exposure (excl. volatility, size)

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Historical Covariance Method Versus the Factor Model Approach

Variance/covariance matrix is superior

Historical covariance

- Correlation model determines the correlation between the components by using historical data

Covariance matrix	Component A	Component B	Component C
Component A	1		
Component B		1	
Component C etc.			1

- Minimizing of variance using the covariance matrix is subject to certain constraints:
  - Component capping
  - Industry capping
  - Diversification in terms of effective assets

Variance/covariance Matrix

- For each component, the exposure to each factor is determined, and factor covariances are calculated

Covariance matrix component A	Factor 1	Factor 2	Factor 3
Factor 1	1		
Factor 2		1	
Factor 3 etc			1

For the constrained version:

- Apply further constraints:
  - Component capping
  - Diversification in terms of effective assets
  - Rebalancing and max turnover
  - Country and industry exposure
  - Factor exposure

For the unconstrained version:

- Apply further constraints:
  - Component capping
  - Diversification in terms of effective assets
  - Rebalancing and max turnover

The Axioma Optimization Process

Technical methodology

Optimization

- Uses a Second Order Cone Optimization (SOCP)
- With Branch and Bound
  - SOCP to model any quadratic term (in objective or constraint)
  - Branch and Bound to solve combinatorial constraints

- Additional proprietary methods used to improve quality of solution and speed of optimization
  - Specialized heuristics
  - Fine tuned Branch and Bound algorithm
  - Proprietary reformulation techniques for combinatorial constrains

Factor constraints

- Except for the unconstrained versions, all STOXX Minimum Variance indices will be constrained to have factor exposure similar to its underlying index, with respect to the factors:
  - Value
  - Growth
  - Medium Term Momentum
  - Short Term Momentum
  - Leverage
  - Liquidity
  - Exchange rate Sensitivity

- Size is not used as the underlying index is a broad index and a size pre selection has already been made

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