Minimum Variance: A Leg Up on Geopolitical Risk?

Olivier d'Assier, Executive Director of Analytics Applied Research (APAC)
Christoph Schon, Executive Director of Analytics Applied Research
Marco Della Seta, Head of Index Applied Research

Minimum Variance: A Leg Up on Geopolitical Risk?

Introduction

There is no denying that politicians—some more than others—have superseded regulators and central bankers as drivers of market volatility. Unfortunately for investors, this new breed of politicians is even more unpredictable than the regulators and bankers. In fact, monetary and fiscal policy have now themselves become dependent on the outcome of geopolitics. One cannot forecast the direction of interest rates without taking a view on how—or when—the US-China trade war or Brexit might end. Given the binary nature of these issues, many investors are left with a low level of confidence in their return forecasts (i.e., these have become too salty for their taste). In such conditions, they typically turn to minimum-variance strategies to protect their downside.

Here we take a look at how minimum variance performed vis-à-vis its core market counterpart during nine recent geopolitical risk events. The nature of these events is that they tend to push correlations towards 1.0. This may pose a problem for minimum-variance portfolios, as they are constructed by leveraging the covariance matrix in order to build portfolios with strong systematic hedges, simultaneously going long on negatively correlated factors or (in active space) long and short positively correlated ones. In these types of crises, is their ability to significantly reduce portfolio risk vis-à-vis a core benchmark hampered? If not, what kind of outperformance can we expect in down-markets, and what are the performance costs of this insurance in up-markets?

Stress Tests

To help us answer these questions, we used the Axioma Risk platform to construct nine historical stress tests from recent geopolitical risk events. The table in Figure 1 summarizes these, as well as the performance of relevant financial time series during each sub-period. The selection of events can be seen as having had a wide range of market responses—some more negative/positive than others, and some resulting in negative/positive correlations between equities and bonds.

Figure 1: Historical Scenario Summary Information

SCENARIO NAME	START-DATE	END-DATE	10Y USTB	RUSSELL 1000	10Y BUND	EURO STOXX 50	10Y GILT	FTSE 100
Brexit Vote	23-Jun-2016	27-Jun-2016	-0.28%	-5.48%	-0.21%	-9.12%	-0.45%	-5.62%
French Election	12-Apr-2017	18-Apr-2017	-0.12%	-0.09%	-0.04%	-1.75%	-0.03%	-2.69%
Inflation Fears	26-Jan-2018	08-Feb-2018	0.19%	-10.05%	0.12%	-7.06%	0.14%	-6.45%
Fed Overshoots	03-Oct-2018	24-Dec-2018	-0.40%	-19.84%	-0.21%	-10.47%	-0.29%	-10.29%
Trade War Escalates	03-May-2019	03-Jun-2019	-0.45%	-6.87%	-0.22%	-3.12%	-0.35%	-2.12%
US Curve Inversion	31-Jul-2019	05-Aug-2019	-0.29%	-4.67%	-0.08%	-4.29%	-0.11%	-4.77%
Brexit Breakthrough	01-Dec-2017	26-Jan-2018	0.29%	8.49%	0.28%	3.95%	0.22%	5.15%
Trade Deal Hopes	24-Dec-2018	05-Apr-2019	-0.25%	23.49%	-0.26%	16.96%	-0.13%	12.98%
Rate Cut Hopes	31-May-2018	26-Jul-2019	-0.06%	10.02%	-0.19%	5.73%	-0.19%	5.76%

Source: Axioma Risk, STOXX Indices, FTSE Indices

A bit of context about each of these scenarios.

- *Brexit Vote* refers to the five days following the surprise referendum result.
- *French Election* refers to the market anxiety ahead of the French presidential election of 2017, when opinion polls indicated a sudden surge in votes for left-wing candidate Jean-Luc Mélenchon. This raised fears of a potential second-round showdown between the latter and far-right leader Marine Le Pen, which would have seen Emmanuel Macron eliminated.
- *Inflation Fears* refers to the volatility spike that occurred in January 2018 after a stronger-than expected US Jobs Report sparked fears of rising inflation and the associated monetary policy tightening as a response from the Fed.
- *Fed Overshoots* refers to market participants' fears in October of 2018 that the Fed was raising rates too fast, too high and might cause the economy to slow down, given global headwinds.
- *Trade War Escalates* refers to the breakdown of trade negotiations and the ensuing new round of tit-for-tat tariffs in May 2019 between the US and China, after it was thought a deal was imminent.
- *US Curve Inversion* refers to the dates when the 10-year USTB yield fell below that of the 2-year USTB—a sign market participants interpreted as a precursor to recession.
- *Brexit Breakthrough* refers to the days following British PM Mays reaching an agreement for an orderly departure of Britain from the EU (but preceding Parliament's rejection of that deal.
- *Trade Deal Hopes* refers to the three-month period starting in December 2018, during which the US and China were in negotiations and threatened tariffs had been postponed or reduced.
- *Rate Cut Hopes* refers to the period of market consensus that the Fed had become more dovish and would reverse some of its 2018 rate hikes due to global economic headwinds caused by the escalating trade war.

Benchmark Portfolios

We selected three variants each from the STOXX family of indices, for the US, the Eurozone, and global-developed markets. The three variants represent the core-parent index and two minimum-variance indices. The STOXX® Minimum Variance family is a group of indices designed to achieve the lowest return volatility in a given investable universe (the parent index). Every index in the family is constructed via an optimization process using the Axioma optimizer, risk models, and an estimated covariance matrix. The optimization objective is to minimize volatility, without any expected return considerations, for given a set of pre-specified constraints.

Figure 2: Minimum Variance and Parent (benchmark) Indices

	Global	**US**	**Europe**
Constrained MinVar	STOXX® Global 1800 Minimum variance	STOXX® USA 900 Minimum Variance	EURO STOXX® Minimum variance
Unconstrained MinVar	STOXX® Global 1800 Minimum Variance Unconstrained	STOXX® USA 900 Minimum Variance Unconstrained	EURO STOXX® Minimum Variance Unconstrained
Parent (Benchmark)	STOXX® Global 1800	STOXX® USA 900	EURO STOXX®

Source: STOXX Indices

STOXX® offers two versions of minimum-variance indices: an unconstrained version, where the optimizer is (almost) free to achieve the maximum possible risk reduction; and a constrained version, where a number of index-construction rules are imposed to avoid extreme positionings arising from the risk minimization objective. More specifically, the constrained version limits the maximum country and industry active exposures to 5%, relative to the benchmark, and sets the maximum active factor exposure (with the exclusion of the size, beta, and volatility factors) to +/-0.25 standard deviations. The two versions also differ in their rebalancing frequencies and maximum levels of turnover allowed. The constrained version is rebalanced quarterly with a turnover limit of 7.5%, while the unconstrained version is rebalanced monthly with a maximum turnover of 5%.

The outperformance of minimum variance over their parent indices over the last decade or so is well documented. Charts 1-6 in Appendix A show the yearly performance for the three variants (Charts 1-3), as well as their maximum drawdowns (Charts 4-6) during that period.

Some observations on this historical performance:

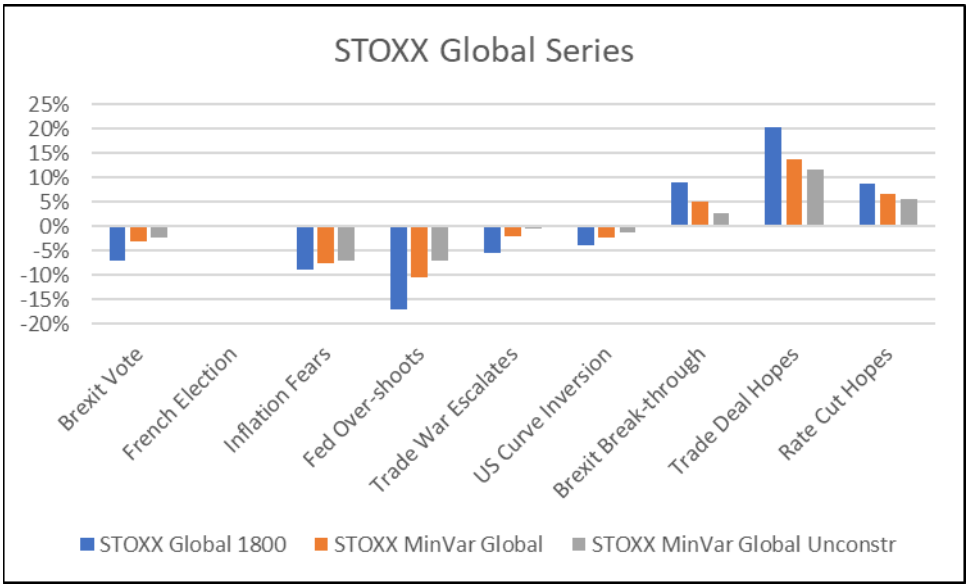
- Over the considered time horizon, the minimum-variance indices had a very attractive risk-return profile (see Chart 7 in Appendix A).
- Volatility reduction was around 25% and 40% for the constrained and unconstrained versions, respectively.
- Minimum-variance indices consistently outperformed during market downturns and often outperformed in years of positive market returns.
- Minimum-variance indices not only limited the depth of the drawdowns, but also substantially shortened their length.

Results Summary

Our goal in this study was not to 'validate' minimum variance's well-documented track record, especially during down-markets, but to investigate its ability to still deliver its risk-reducing properties once its main tool (the covariance matrix) is hampered by rising correlations during a geopolitical shock. To measure this, we replayed our nine historical stress scenarios on each of the nine STOXX indices using their constituents as of August 19, 2019[1].

Figure 3 below shows the expected loss/gain in percent of present value for the STOXX Global Index series. In each of the six scenarios leading to a negative return for the parent index, the minimum variance counterparts were able to minimize this loss—in some cases (i.e., *Fed Overshoots*) by quite a lot. The unconstrained variant—the most reliant on the covariance matrix for risk-minimization—retained its ability to minimize risk more than its less covariance-reliant counterpart. For the three scenarios with positive outcomes for the parent index, the two minimum-variance portfolios delivered a lower gain. It should be noted, though, that the average loss-reductions in the first six scenarios by the two minimum-variance portfolios (constrained and unconstrained) were 43% and 62%, respectively. In comparison, the gains achieved by the minimum-variance portfolios in the three scenarios with a positive outcome averaged 67% and 51% of those delivered by the parent index.

Figure 3: Historical Stress Test Results for STOXX Global Series

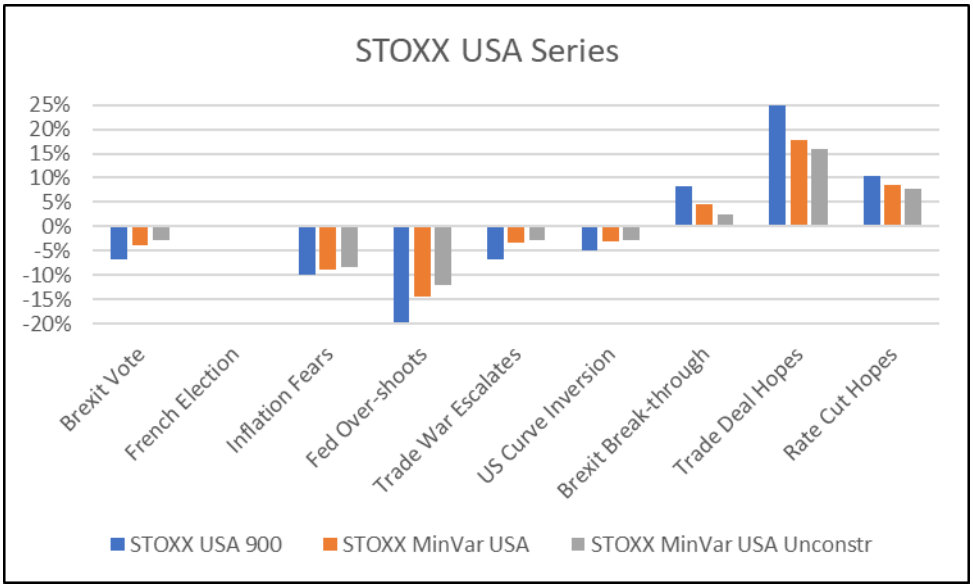


Source: Axioma Risk and STOXX Indices

Figure 4 below shows the results for the STOXX USA index series. We see the same pattern as with the Global Series, with minimum variance suffering lower losses in the negative scenarios and lower gains in the positive ones. Vis-à-vis the parent index, losses on average were reduced by 43% and 52%, while gains were lower by 31% and 44% for the constrained and unconstrained variants, respectively.

[1] I.e., we're asking how today's index would have performed during each of these scenarios.

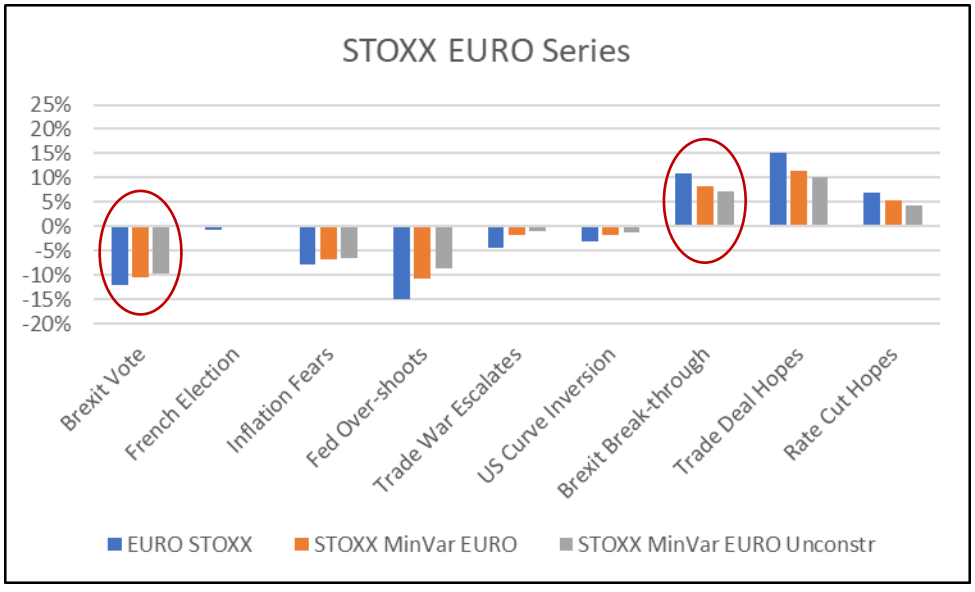
Figure 4: Historical Stress Test Results for STOXX USA Series



Source: Axioma Risk and STOXX Indices

The pattern was repeated for the EURO series (see Figure 5 below), with minimum variance producing both lower losses and lower gains. Losses were on average 38% and 52% lower for the constrained and unconstrained variants, respectively, while gains were 24% and 34% smaller. We note that the two Brexit-related scenarios had a much bigger impact on this series than on those of other regions.

Figure 5: Historical Stress Test Results for STOXX EURO Series



Source: Axioma Risk and STOXX Indices

The table below summarizes the results across all nine scenarios and indices. We note the absence of an (absolute) impact of the *French Election* scenario across all indices and the strong sensitivity to both the *Fed Overshoots* and *Trade Deal Hopes* scenarios. The direction of US interest rates and the resolution of the US-China trade war seem to be top-of-mind for investors across all regions, trumping even local concerns (*Brexit* and *French Elections*) in Europe. Interestingly, the losses from the *Fed Overshoots* scenario were much bigger than the projected gains from the *Rate Cut Hopes* one. Perhaps this is a sign that investors believe the damage already done to the global economy cannot be reversed with monetary policy alone. Given their importance, we will decompose the results from those two scenarios in the next section.

Index Name/Stress Scenario	Brexit Vote	French Election	Inflation Fears	Fed Over-shoots	Trade War Escalates	US Curve Inversion	Brexit Break-through	Trade Deal Hopes	Rate Cut Hopes
STOXX Global 1800	-7.0%	-0.2%	-9.0%	-17.0%	-5.5%	-4.0%	8.9%	20.5%	8.8%
STOXX MinVar Global	-3.0%	0.2%	-7.6%	-10.6%	-2.1%	-2.2%	5.0%	13.8%	6.7%
STOXX MinVar Global Unconstr	-2.2%	0.0%	-7.0%	-7.0%	-0.5%	-1.2%	2.8%	11.5%	5.7%
STOXX USA 900	-6.7%	-0.1%	-9.8%	-19.5%	-6.8%	-4.8%	8.3%	24.8%	10.5%
STOXX MinVar USA	-3.9%	0.3%	-8.7%	-14.3%	-3.3%	-3.1%	4.6%	17.7%	8.5%
STOXX MinVar USA Unconstr	-2.9%	0.3%	-8.4%	-12.0%	-2.8%	-2.8%	2.4%	15.8%	7.8%
EURO STOXX	-12.1%	-0.7%	-7.7%	-14.8%	-4.4%	-3.0%	10.9%	15.3%	6.9%
STOXX MinVar EURO	-10.4%	-0.2%	-6.9%	-10.7%	-1.8%	-1.8%	8.2%	11.3%	5.3%
STOXX MinVar EURO Unconstr	-9.6%	0.0%	-6.5%	-8.7%	-0.9%	-1.2%	7.2%	10.1%	4.4%

STOXX Global- Details

The table in Figure 6 below shows the contribution to losses/gains for both scenarios on each of the three indices for the STOXX Global Series. The *Fed Overshoots* scenario replays an event that led investors to become bearish on the US (and global) economy. It is therefore not surprising to see that the parent index's large allocations to cyclical sectors, such as consumer discretionary, information technology, and industrials, hurt it a lot in this scenario. Conversely, this allocation helped the parent portfolio perform better in the more bullish *Trade Deal Hopes* scenario. Note that these two scenarios have a range of outcomes of 37.5% between them, which is quite volatile when one considers that they overlap by one month[2]. Conversely, the unconstrained minimum-variance portfolio's outcomes ranged from -7% to 11.5%, or less than half the range of the parent index. Financials retained their influence on portfolio outcomes, while information technology traded places with consumer staples and utilities as key contributors to expected loss/gain in the minimum-variance portfolios.

[2] *Fed Overshoots* = Oct-Dec 2018, *Trade Deal Hopes* = Dec 2018 – April 2019

Figure 6: Sector Allocation/Contribution for STOXX Global Series

GICS SECTORS	STOXX Global 1800			STOXX MinVar Global			STOXX MinVar Global Unconstr		
	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes
	100	-17.0	20.5	100	-10.6	13.8	100	-7.0	11.5
Communication Services	8.0	-1.2	1.5	8.8	-0.6	0.9	11.4	-0.7	1.0
Consumer Discretionary	10.7	-1.9	2.2	8.7	-1.0	1.0	7.2	-0.8	0.8
Consumer Staples	8.6	-1.0	1.0	23.7	-2.5	2.5	12.9	-1.3	1.2
Energy	4.5	-1.3	1.0	0.4	-0.1	0.1	0.1	0.0	0.0
Financials	14.7	-2.4	2.7	15.4	-2.1	2.5	17.7	-2.2	2.8
Health Care	12.8	-2.3	2.5	7.2	-1.3	1.1	3.2	-0.5	0.4
Industrials	11.9	-2.2	2.4	9.3	-1.4	1.6	4.1	-0.3	0.5
Information Technology	17.2	-3.5	5.3	6.2	-1.2	1.6	0.1	0.0	0.0
Materials	4.4	-0.8	0.8	0.4	0.0	0.0	0.5	-0.1	0.1
Real Estate	3.6	-0.3	0.6	11.1	-0.5	1.6	6.7	0.0	0.7
Utilities	3.6	-0.1	0.4	8.7	0.2	0.9	36.0	-1.0	4.1

Figure 7: Style-Factor Exposure for STOXX Global Series

Style Factors	STOXX Global 1800	STOXX MinVar Global	STOXX MinVar Global Unconstr
Dividend Yield	0.02	0.29	0.45
Earnings Yield	0.00	-0.10	0.00
Exchange Rate Sensitivity	0.00	0.11	0.11
Growth	-0.03	-0.28	-0.22
Leverage	0.02	0.17	0.21
Liquidity	0.19	0.27	0.19
Market Sensitivity	0.08	-0.62	-0.85
Medium-Term Momentum	0.02	0.15	0.17
Profitability	0.04	0.00	-0.12
Size	0.20	-0.07	-0.08
Value	-0.05	-0.11	0.04
Volatility	-0.17	-0.39	-0.43

These sector allocations, in turn, helped create the style-factor exposures seen in Figure 7 above. Not surprisingly, both minimum-variance portfolios have strongly negative exposures to the Volatility and Market Sensitivity (beta) factors. They also overweight Dividend Yield and underweight Growth, which are negatively correlated style factors (-0.26).

Figure 8 below shows the sector allocations and contributions to loss/gain for the STOXX USA series for our two selected scenarios. Here again, we see that cyclical sectors have all been reduced in the minimum-variance portfolios, with the exception of industrials in the constrained portfolio, but even with this increased allocation, industrials contributed less to the loss in the *Fed Overshoots* scenario. Here, too, we give up the upside potential of the IT sector in favor of not holding its volatility risk. Recall that the minimum-variance objective is solely focused on risk minimization and contains no alphas on sectors or otherwise. Simply put, if a sector is more risky than others, then it doesn't want anything to do with it.

Figure 8: Sector Allocation/Contribution for STOXX USA Series

GICS SECTORS	STOXX USA 900			STOXX MinVar USA			STOXX MinVar USA Unconstr		
	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes
	100.0	-19.5	24.8	100	-14.3	17.7	100	-12.0	15.8
Communication Services	8.8	-1.6	2.0	2.3	-0.4	0.4	3.0	-0.4	0.5
Consumer Discretionary	10.5	-2.2	2.8	9.5	-1.4	1.7	13.2	-2.1	2.4
Consumer Staples	7.3	-1.0	1.1	21.9	-2.7	3.0	13.8	-1.7	1.9
Energy	4.2	-1.3	1.1	3.9	-1.1	0.9	4.2	-1.2	1.0
Financials	12.7	-2.5	2.9	13.4	-2.2	2.5	25.4	-3.5	4.4
Health Care	14.0	-2.8	3.2	8.4	-1.5	1.5	3.2	-0.6	0.6
Industrials	9.8	-2.2	2.5	11.0	-2.1	2.1	2.8	-0.4	0.5
Information Technology	22.8	-4.8	7.4	7.8	-1.3	2.0	0.2	0.0	0.1
Materials	2.5	-0.6	0.6	0.6	-0.1	0.1	3.5	-0.7	0.7
Real Estate	4.0	-0.4	0.9	10.9	-1.0	2.2	0.7	-0.1	0.1
Utilities	3.5	-0.2	0.5	10.3	-0.4	1.3	30.0	-1.2	3.8

Figure 9: Style-Factor Exposure for STOXX USA Series

Style Factors	STOXX USA 900	STOXX MinVar USA	STOXX MinVar USA Unconstr
Dividend Yield	0.01	0.29	0.84
Earnings Yield	0.02	-0.03	0.02
Exchange Rate Sensitivity	0.03	0.23	0.22
Growth	-0.01	-0.29	-0.25
Leverage	0.02	0.27	0.53
Liquidity	0.44	0.54	0.83
Market Sensitivity	0.21	-0.54	-0.83
Medium-Term Momentum	0.04	0.22	0.15
Profitability	0.06	0.03	-0.10
Size	0.26	0.06	-0.02
Value	-0.05	-0.08	0.19
Volatility	-0.17	-0.32	-0.31

The style-factor exposures reflect the lower allocation to the IT sector with negative bets on Growth, Volatility, and Market Sensitivity, as well as the positive bets on Dividend Yield. Size has been a particularly volatile factor in the last couple of years and, as such, it is not surprising to see the exposure to that factor being neutralized in the minimum-variance portfolios. Interestingly, the unconstrained variant increased its exposure to Leverage, while decreasing its exposure to Profitability; exposures that we would normally attribute to an aggressive growth strategy. These style exposures must represent a hedge with some of the sector allocations via the covariance matrix.

Figure 10 below shows the same sector allocation and contribution to expected loss/gain for the STOXX EURO series, and Figure 11 shows their style-factor exposures. A very similar pattern emerges with allocations to IT being removed from the minimum-variance portfolios, Consumer Discretionary and materials reduced, while Utilities, Consumer Staples, and Real Estate are added to. We note that the allocation to Financials is reduced in this series when it was increased in the Global and USA series. Real Estate is also greatly increased in the unconstrained variant. Also note that in the Parent index, contributions to expected losses/gains are spread across more sectors, with 96% of the losses from eight sectors and 83% of the gains from seven of those eight.

In contrast, contributions to scenario results in the minimum-variance portfolios are much more concentrated, with the unconstrained variant having 68% and 67% of its losses and gains contributed by just four sectors.

Figure 10: Sector Allocation/Contribution for STOXX EURO Series

GICS SECTORS	EURO STOXX			STOXX MinVar EURO			STOXX MinVar EURO Unconstr		
	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes	% Weight	Fed Over-shoots	Trade Deal Hopes
	100.0	-14.8	15.3	100	-10.7	11.3	129.9725	-9.9	13.8
Communication Services	5.2	-0.5	0.5	12.9	-1.2	1.3	15.7	-1.1	1.3
Consumer Discretionary	12.3	-2.1	2.0	5.7	-0.8	0.8	3.6	-0.5	0.5
Consumer Staples	10.4	-1.1	1.1	27.4	-2.8	2.3	32.1	-3.2	2.8
Energy	5.3	-1.4	0.9	1.8	-0.5	0.3	0.9	-0.2	0.2
Financials	16.2	-2.3	2.4	9.9	-1.3	1.4	10.2	-1.3	1.4
Health Care	7.8	-1.3	1.1	3.1	-0.5	0.3	4.0	-0.5	0.5
Industrials	15.3	-2.8	2.5	10.1	-1.3	1.3	4.1	-0.4	0.5
Information Technology	9.4	-1.6	2.4	0.9	-0.2	0.2	3.0	-0.5	0.5
Materials	8.9	-1.6	1.3	7.7	-1.3	1.3	7.3	-0.5	0.9
Real Estate	2.5	-0.2	0.3	9.4	-0.7	1.1	19.1	-0.4	1.6
Utilities	6.6	-0.1	0.6	11.0	-0.1	1.0	30.0	-1.2	3.8

Similar to other regional series, the style-factor exposures shown in Figure 11 for the STOXX EURO series have a strongly negative exposure to Volatility and Market Sensitivity as expected, but contrary to the other two regional series, it is making a strong bet against Liquidity, Exchange Rate Sensitivity, and Earnings Yield. In fact, the only two mildly positive style exposures left are to Leverage and Medium-Term Momentum. What this indicates is that, unlike in the other two regional variants, the optimizer must have mainly used the covariances between industry and style factors in order to construct hedges and reduce portfolio predicted risk, as it perhaps did not find any more attractive covariances within the style-factor block itself.

Figure 11: Style-Factor Exposure for STOXX EURO Series

Style Factors	EURO STOXX	STOXX MinVar EURO	STOXX MinVar EURO Unconstr
Dividend Yield	-0.05	-0.08	-0.02
Earnings Yield	-0.01	-0.14	-0.25
Exchange Rate Sensitivity	-0.11	-0.20	-0.22
Growth	0.03	-0.02	-0.17
Leverage	-0.02	0.08	0.11
Liquidity	-0.21	-0.20	-0.27
Market Sensitivity	0.08	-0.43	-0.52
Medium-Term Momentum	-0.03	0.05	0.09
Profitability	-0.15	-0.08	-0.12
Size	0.06	-0.11	-0.11
Value	0.06	-0.09	-0.18
Volatility	-0.15	-0.28	-0.30

Conclusion

Geopolitics—and, in particular, US politics—are clearly the most influential leverage on investors' minds in recent years. The US yield curve dynamics, which seemed to be driven more by what happened in the trade negotiations with China than by what the Fed did, are proof of that. Also, the fact that European stock markets skyrocketed alongside the US in the first half of the year, despite all leading indicators forecasting a recession, underpins the one-sided influence of the US economy and monetary policy on other parts of the world. This was confirmed by the (lack of) impact of the *French Election* and Brexit scenarios on the US portfolios versus the outsized impact of the trade war and Fed-related scenarios on the European and Global ones.

At first glance, minimum-variance portfolios exhibit large concentrations in both sector and style exposures, giving them the appearance of being riskier than their well-diversified parent index. This perception is often based on incomplete information. Recall that the primary goal of a minimum-variance portfolio is to minimize risk in the absence of any alphas or scenarios, and the only tool at the optimizer's disposal is the factor covariance matrix—plus, in the case of the constrained variant, some business rules. Therefore, the concentrated sector and style exposures it exhibits are actually not reckless but quantitatively explainable when looked at through the lens of the covariance matrix. An added bonus, as we have seen in the previous section, comes from the differences in its performance across stress scenarios, which are smaller than those for the more diversified—but not necessarily mean-variant efficient—parent index. For investors seeking refuge in an increasingly uncertain geopolitical world, a narrower confidence interval around a scenario-weighted mean should come as a welcome relief.

Appendix A – STOXX Minimum Variance Indices – Characteristics & Performance

Table 1: Number of index constituents

	Number of constituents		
	Average	**Max**	**Min**
STOXX® Global 1800	1800	1800	1800
STOXX® Global 1800 MinVar	286	320	220
STOXX® Global 1800 MinVar Unconstr	287	353	246
STOXX® USA 900	900	900	900
STOXX® USA 900 MinVar	144	166	120
STOXX® USA 900 MinVar Unconstr	123	194	123
EURO STOXX®	298	307	287
EURO STOXX® MinVar	112	129	73
EURO STOXX® MinVar Unconstr	107	122	75

Source: STOXX Indices

Chart 1: Yearly performance of the global indices (2004/01/02 – 2019/09/12)

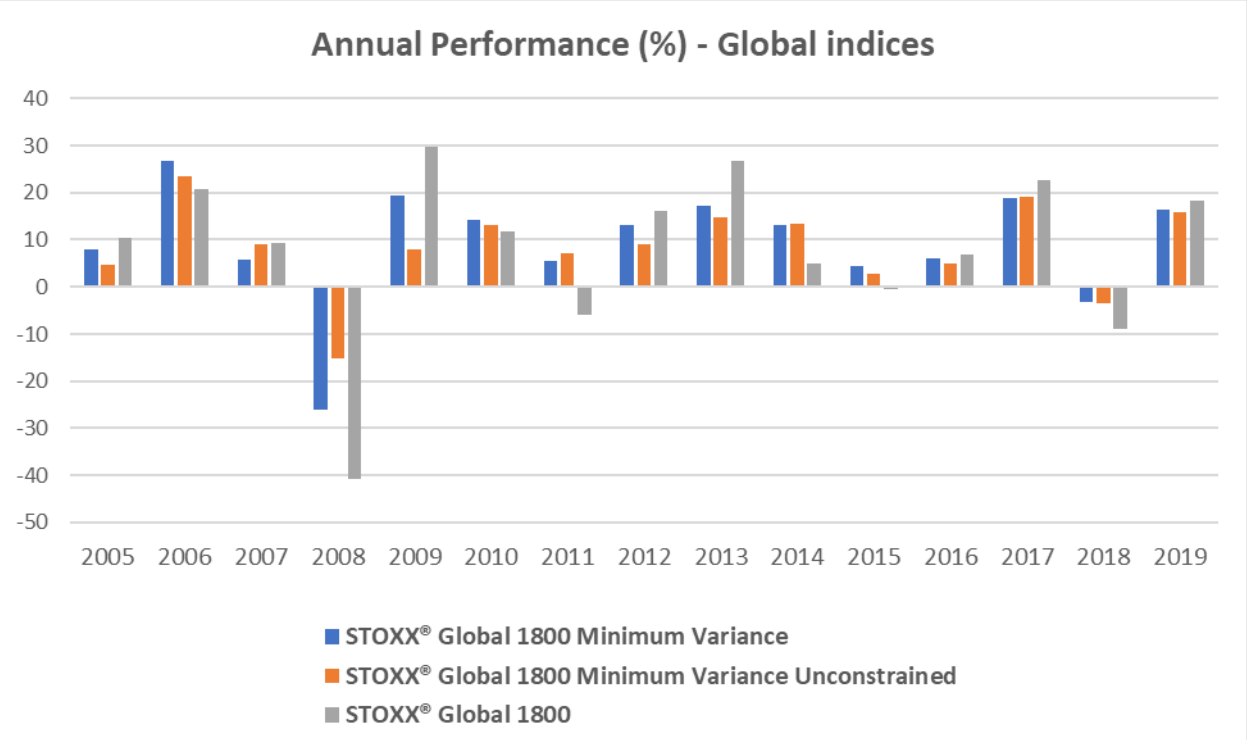


Chart 2: Yearly performance of the US indices (2002/07/01 – 2019/09/12)

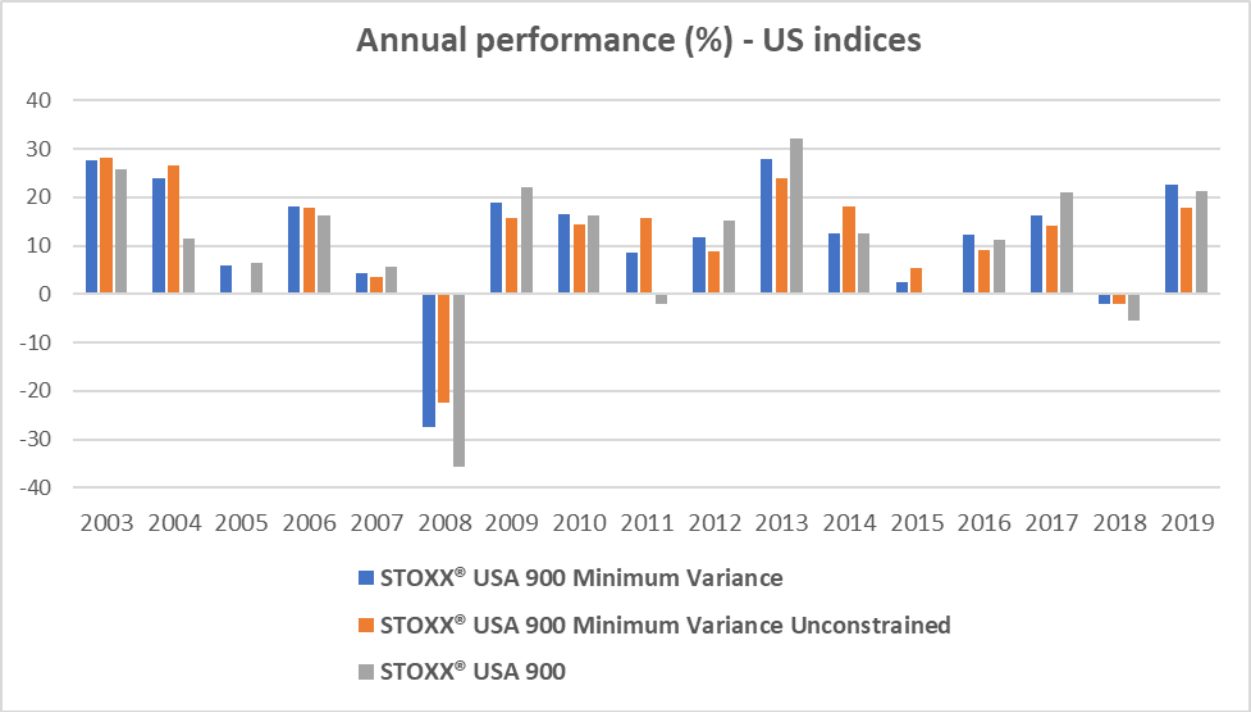
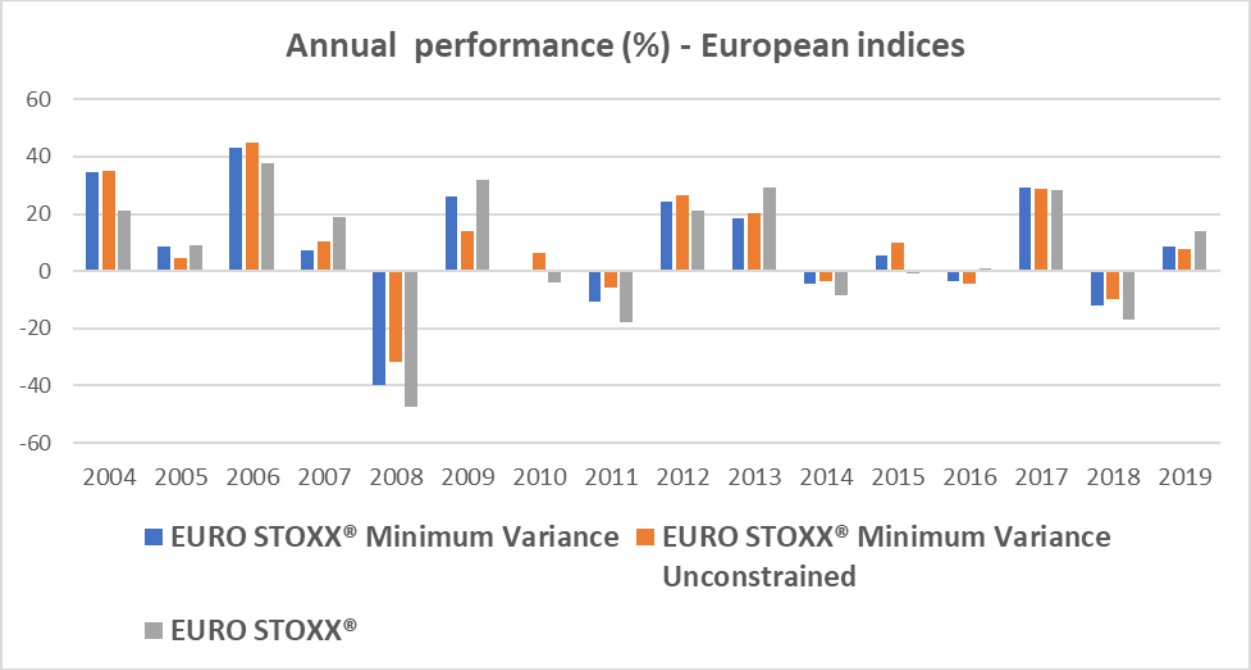


Chart 3: Yearly performance of the European indices (2002/07/01 – 2019/09/12)



Source: STOXX Indices

Chart 4: Drawdowns length and depth for the global indices

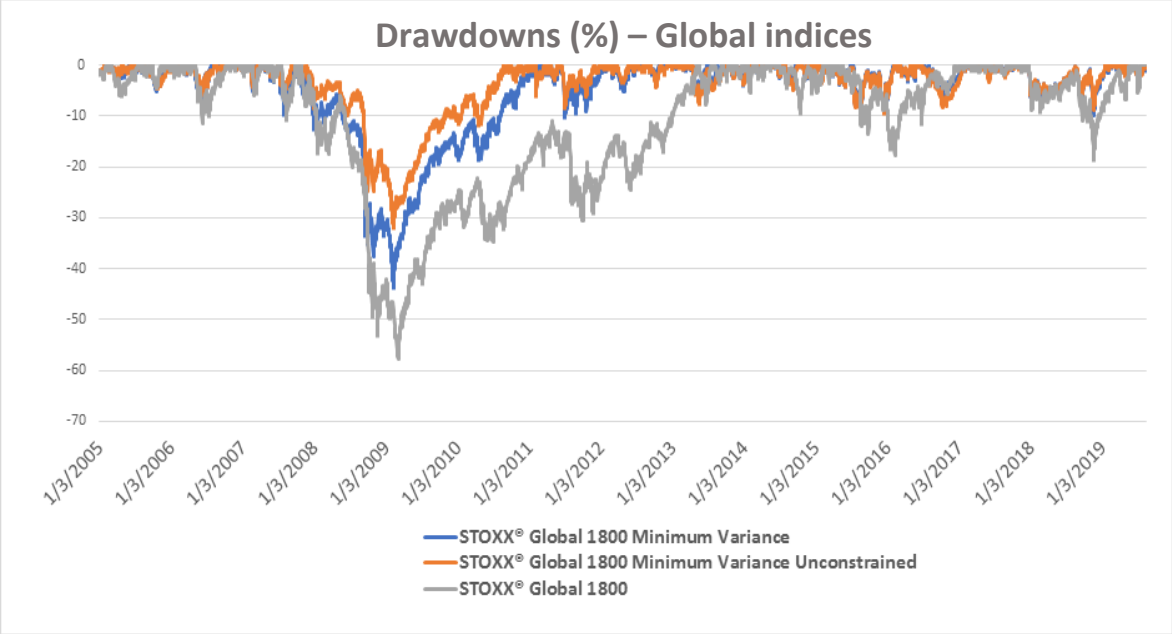


Chart 5: Drawdowns length and depth for the US indices

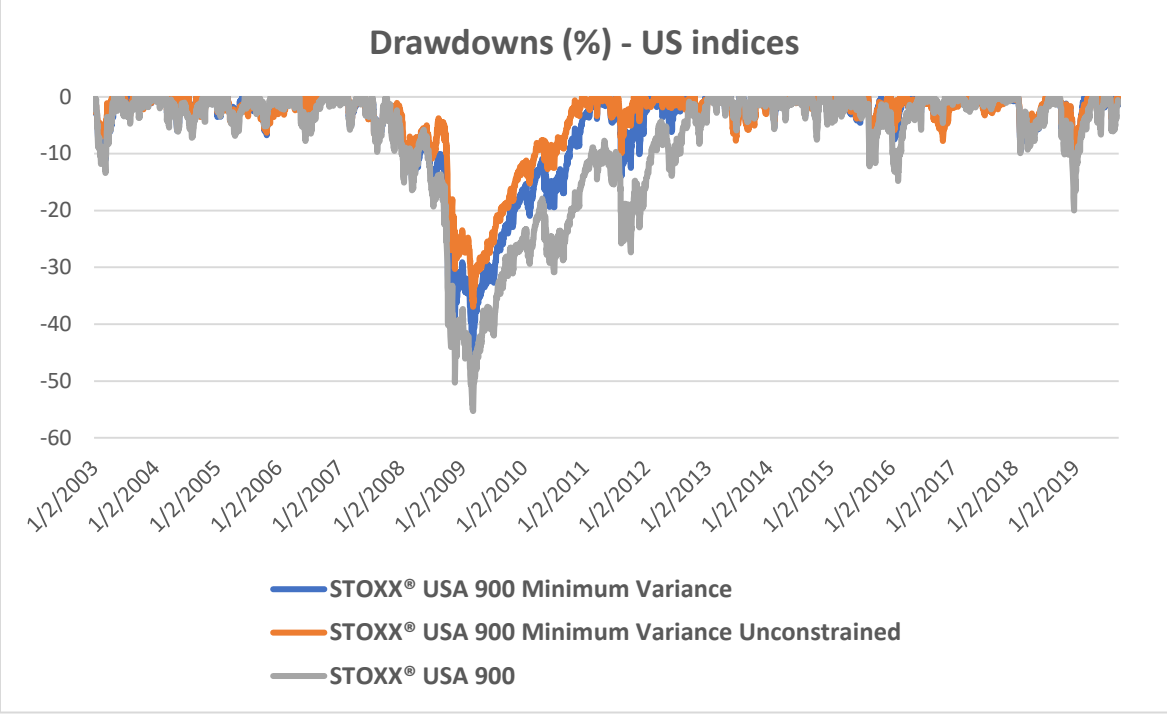


Chart 6: Drawdowns length and depth for the European indices

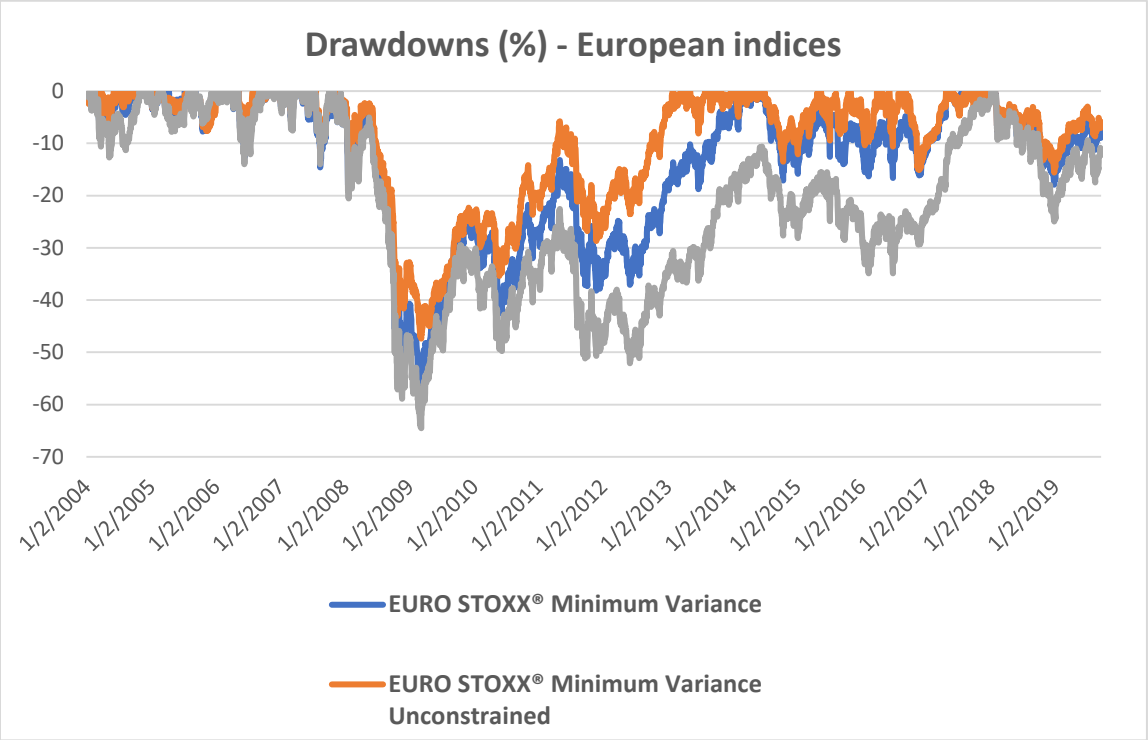


Chart 7: Risk & Return Scatter Plot for full period