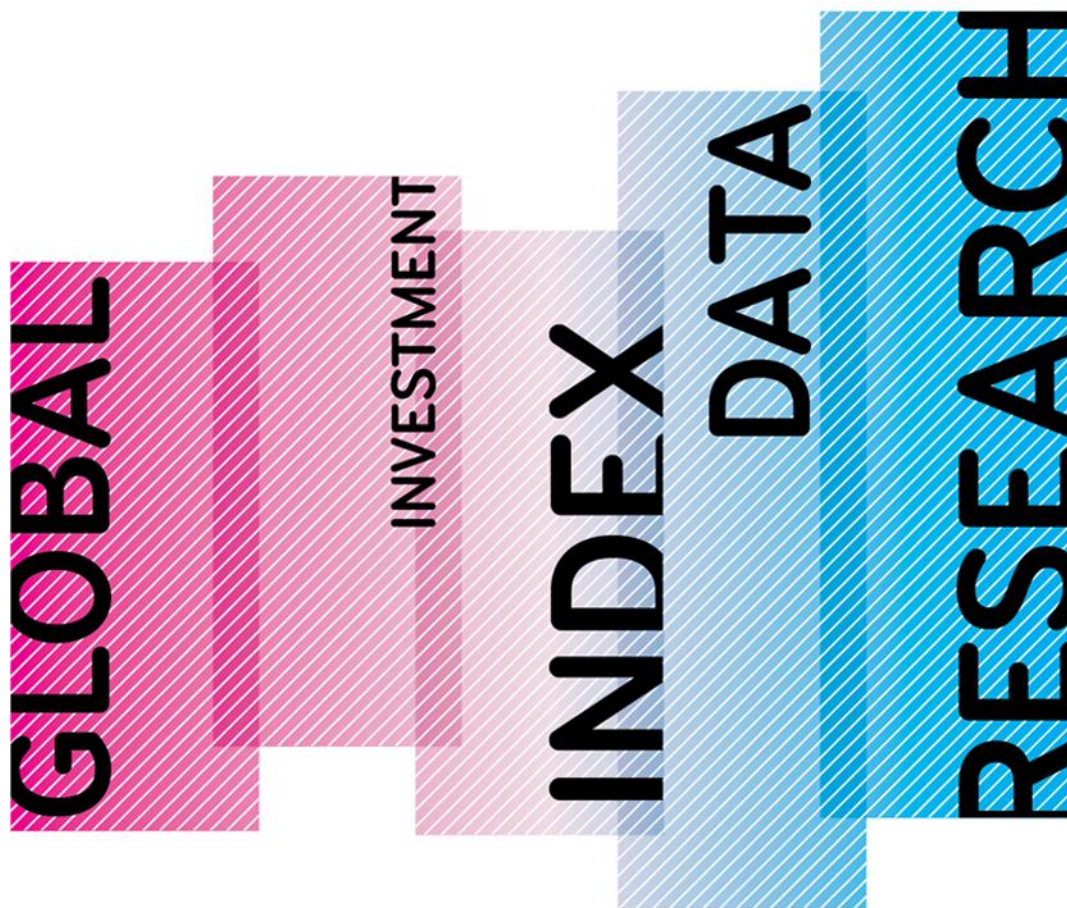


May 2017

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND- LIKE VOLATILITY

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# TABLE OF CONTENTS

<b>Abstract</b>	<b>3</b>
<b>1 Introduction</b>	<b>4</b>
<b>2 The Index Concept</b>	<b>4</b>
<b>3 iSTOXX Europe Single Factor Market Neutral Indices</b>	<b>7</b>
<b>4 iSTOXX Europe Multi-Factor Market Neutral Index</b>	<b>11</b>
<b>5 A potential portfolio diversifier – an example</b>	<b>14</b>
<b>6 Conclusion</b>	<b>18</b>
<b>References</b>	<b>19</b>
<b>Appendix A</b>	<b>20</b>
<b>Appendix B</b>	<b>22</b>

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# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## Abstract

The **iSTOXX Europe Market Neutral Single and Multi-Factor Indices** developed by STOXX in collaboration with Alpha Centauri<sup>1</sup> offers investors a unique and very innovative way to target and capture premia of six well-documented sources of systematic risk: value, carry, momentum, size, low risk as well as quality.

Based upon the long only **iSTOXX Europe Factor indices**, which provide investors with a broad market exposure plus a factor tilt, the market neutral indices are constructed by beta hedging the factor index with one of Europe's most liquid benchmark index, the STOXX Europe 600. Due to its innovative construction, these market neutral indices distill the respective equity factor premia, mostly undisturbed by systematic sources of risk, into an investable index, hereby neutralizing market directionality and volatility. Hence, investors can capture pure returns associated with targeted factors without the need to "drag along" a broad market exposure.

Comparably low volatility levels around five percent make market neutral factor indices an interesting investment vehicle also for risk-averse investors, who traditionally might only consider fixed income products. Further, very low correlations between market neutral factor returns and the market itself enables investors to build better diversified portfolios with superior risk-return characteristics. The increased diversification can decrease sensitivities to common market risk factors (such as interest rate risk for bond portfolios).

The empirical results show that all iSTOXX Europe Market Neutral Single Factor Indices provide significant excess returns relative to their benchmark over our sample period of twelve years. With correlations to the benchmark index STOXX Europe 600 ranging from a minimum of -0.62 (low risk factor) to a maximum of 0.06 (value factor), factor returns are found to also serve as a great source of diversification when used in addition to an existing investment in a broad European benchmark index such as the STOXX Europe 600. Low correlations *among* factor returns further add to the diversification potential when investing in more than just one factor index.

However, risk premia are found to vary over time. This observation as well as the low correlation among factor returns provide the grounds for the construction of the iSTOXX Europe Market Neutral Multi-Factor index. Its innovative methodology leads to higher returns compared to a heuristic, e.g. equally weighted aggregation of single factor indices.

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<sup>1</sup> Alpha Centauri is an independent multi-asset management boutique founded in 2005 and based in Hamburg, Germany. It is an investment manager specialized in innovative liquid alternative products, with factor investing at the core of its business. [www.alpha-centauri.com](http://www.alpha-centauri.com).

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## 1 Introduction

The traditional Capital Asset Pricing Model (CAPM) which goes back to the 1960s suggests only one risk factor, the market factor, to be systematically priced.<sup>2</sup> Over the following decades, however, empirical research observed the existence of additional factors in the attempt to explain equity returns. The first extension of the CAPM was brought forward by Fama and French (1992) who suggested an extension of the one-factor CAPM by two additional factors, size and value. They found that small-cap companies as well as companies that are relatively undervalued compared to their book value outperformed their respective counterparts. Carhart (1997) extended the "Three Factor Model" by a fourth factor, momentum. Next to these four factors, today's models typically include a variety of additional factors such as carry or quality.

What all of these factors have in common is that they contribute to the explanation of equity returns. In other words, investors may harvest additional return, in terms of a premium, when exposing themselves to such risk factors.

The iSTOXX Europe Single Factor index family developed by STOXX in collaboration with Alpha Centauri offers investors a very unique and innovative way to target and capture these risk premia while simultaneously minimizing distortions, which may arise from other systematic sources of risk. In addition, the iSTOXX Europe Multi-Factor index aims at simultaneously capturing premia from various well-known risk factors rather than from just one single source of risk.

This paper starts off with an introduction into the construction of the long only iSTOXX Europe Single and Multi-Factor indices before discussing the achievement of market neutrality. In the next sections, the development of market neutral risk premia over time is analyzed from a single-factor as well as from a multi-factor perspective.

The empirical results show that all iSTOXX Europe Market Neutral Single Factor Indices provide significant excess returns relative to their benchmark over a sample period of twelve years. With correlations to the benchmark index STOXX Europe 600 ranging from a minimum of -0.62 (low risk factor) to a maximum of 0.06 (value factor), factor returns are found to also serve as a great source of diversification when used in addition to an existing investment in a broad European benchmark index such as the STOXX Europe 600. Low correlations *among* factor returns further add to the diversification potential when investing in more than just one factor index.

However, risk premia are found to vary significantly over time. This observation as well as the low correlation among factor returns provide the grounds for the construction of the iSTOXX Europe Multi-Factor Market Neutral index. Its innovative methodology leads to lower risk and higher returns compared to a heuristic, e.g. equally weighted aggregation of single factor indices.

## 2 The Index Concept

iSTOXX Europe Factor Indices aim at capturing targeted risk premia while simultaneously minimizing the exposure to other systematic sources of risk. Available factors are value, carry, momentum, size, low risk as

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<sup>2</sup> The CAPM goes back to William F. Sharpe, John Lintner and Jan Mossin who developed the model, independent from one another, in the 1960s. See, e.g., Sharpe (1964), Lintner (1965) and Mossin (1965).

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

well as quality.<sup>3</sup> The underlying universe for the construction of all factor indices is the STOXX Europe Total Market Index. This index covers approx. 95% of the investable market capitalization of developed Europe.

In the selection process, the exposure of each company in the universe to each factor is assessed by a variety of fundamental measures.<sup>4</sup> In order to compose a single, company-factor-specific score, each measure is transformed into a normalized score, subject to industry specific level deviations, before being aggregated. Hereby, each variable is assigned the same importance, i.e. the same weight.

The selection of stocks, as well as the determination of corresponding weights, happen simultaneously based on an optimization approach.<sup>5</sup> The optimization hereby aims at maximizing the exposure to the respective targeted factor while subjecting itself to a series of constraints that are chosen in order to achieve the best tradeoff between tradability and factor replication. The constraints are as follows:

- maximum tracking error of three percent relative to STOXX Europe 600,
- maximum systematic risk contribution of ten percent to tracking error,
- targeted beta of one relative to STOXX Europe 600 with allowed maximum deviation of +/- 0.025,
- maximum deviation of component weights from those of the STOXX Europe 600 of +/- 1.5 percentage points,<sup>6</sup>
- targeted number of components between 50 and 120,
- components are capped in such a way that the sum of stocks with a weights of more than 4.5% cannot exceed 35% which each single stock is capped at a maximum weight of 8%
- industry weights cannot deviate from those of the STOXX Europe 600 by more than +/- 1.5%,
- one-way turnover per month is set to a maximum of 25%,
- liquidity constraint on constituent level: 100 mn times weight needs to be at most 15% of the average 20-day value traded.

The factor exploitation takes place within the allowed tracking error of three percent relative to the benchmark index. As this remainder, however, is influenced by a variety of systematic factors, the influence of these remaining factors is restricted to a maximum of ten percent, i.e. 0.3% (= 10% \*3%) within the optimization process.

Unconstrained optimizations have two tendencies: on the one hand, they may derive very concentrated results. On the other hand, they may end up with a large number of components that have very small weights and thus, an insignificant contribution to the characteristics of the overall portfolio. In order to control for both effects, the optimization aims at a number of components that ranges between a minimum of 50 and a maximum of 120.<sup>7</sup> The specified maximum of 120 also aims at keeping the number of components at a reasonable level in order to facilitate trading. Further, the maximum weight on component level is set to 10% in order to prevent single components from dominating the index.

Lastly, the optimization process takes into account the industry allocation of the STOXX Europe 600 Index. Industry weights of the iSTOXX Europe Factor Indices cannot deviate by more than 1.5 percentage points from those of the benchmark. This step is necessary in order to increase the purity of the targeted premium

<sup>3</sup> The iSTOXX Europe Multi-Factor Index aims at maximizing the overall exposure to the targeted risk factors.

<sup>4</sup> For an overview and explanation of the measures underlying the factor construction, please refer to Appendix A.

<sup>5</sup> The optimization is conducted using the APT Risk Model. FIS' investment risk solution (APT) provides award-winning investment technology for multi-asset class risk management, analytics and risk reporting, serving buy-side institutions globally. [www.fisglobal.com](http://www.fisglobal.com).

<sup>6</sup> For companies that are not part of the STOXX Europe 600, the reference weight is set to 0%.

<sup>7</sup> Please note that the actual number of components may be above or below the defined thresholds. However, the optimization procedure assigns a penalty for deviations. Thus, there needs to be a "good" reason for a breach of this criterion.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

when shorting the market via the STOXX Europe 600. Without industry constraints, sector deviations between the long and short positions, which remain in spite of the industry-specific normalization of factor scores and the targeted beta of 1 relative to the benchmark, may still lead to active sector bets or, in more general terms, to exposure to unwanted risk factors.

## 2.1 Market Neutral Factors

In order to allow for the extraction of the pure factor premium net of the market, the optimization tries to achieve a beta of one relative to a highly tradable broad market index. In our case, one of Europe's most liquid indices in terms of derived products, the STOXX Europe 600, is used. Thus, a long investment in one of the iSTOXX Europe Factor indices while maintaining a short position in STOXX Europe 600 futures allows to easily hedge the market and extract the targeted risk premium.

The size of the short position in STOXX Europe 600 futures is calculated in such a manner that the resulting portfolio is market neutral, that is, has a Beta of 0. The market neutral index values are calculated as follows:

$$IV_t = IV_{reb} \times \left[ \frac{FI_t}{FI_{reb}} - \beta \times \left( \frac{RF_t}{RF_{reb}} - 1 \right) \right]$$

where:

IV: Market Neutral Index value

FI: Single/Multi Factor Equity index

RF: Rolling Future index (the iSTOXX Europe Market Net Return Total Return indices use the STOXX Europe 600 Futures Roll Excess Return as RF while the iSTOXX Europe Market Neutral Net Return Excess Return indices use the STOXX Europe 600 Futures Roll Total Return as RF)

$\beta$ : Beta of FI to the STOXX Europe 600 (180 weekly returns)

Reb: Rebalancing day (index close as of Friday)

Figure 1 graphically demonstrates the move from long only to market neutral factor indices. The left hand side of Figure 1 details the returns of both the STOXX Europe 600 and the long only iSTOXX Europe Momentum Factor performance since 2010. The right hand side of Figure 1 exhibits the performance of the market neutral value factor, that is the beta hedged version of the iSTOXX Europe Momentum Factor.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

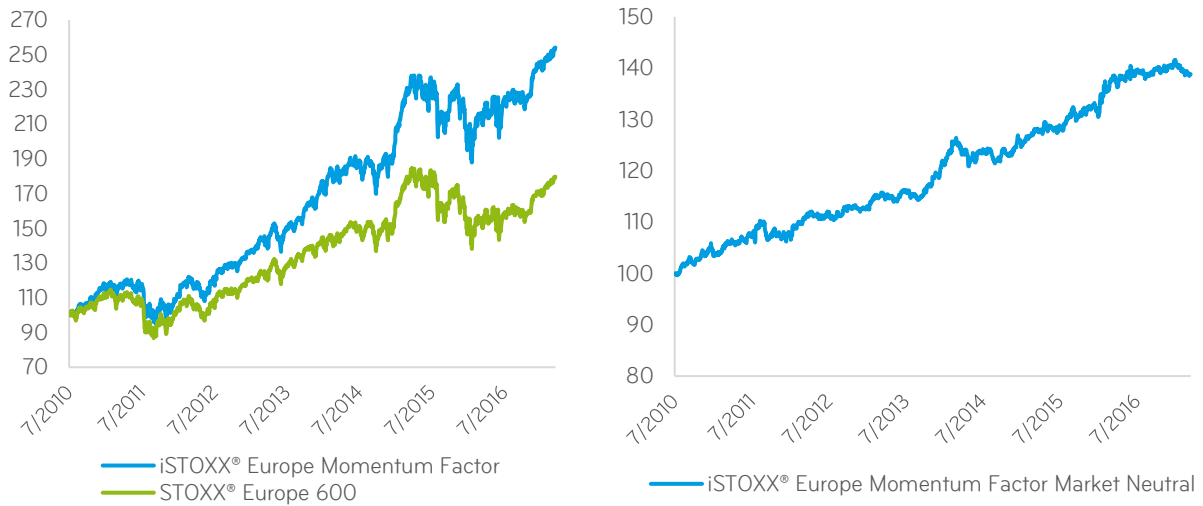


Figure 1: Indexed excess returns of iSTOXX Europe Momentum Factor Index over STOXX Europe 600 Index measured in EUR GR. Time period: Jul. 2010 - Apr. 2017

## 3 iSTOXX Europe Single Factor Market Neutral Indices

### 3.1 Factor Returns

In order to analyze the behavior of factor returns over time, we base the following study upon the six market neutral single factor indices as well as the market neutral multi-factor index.

Figure 2 displays the historical development of all six single factor premia over a time period ranging from Jul. 2010 to Apr. 2017. It is directly observable that the six risk factor have been a significant source of return over the time period observed. Thus, investors would have been compensated for being exposed to those sources of risk.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

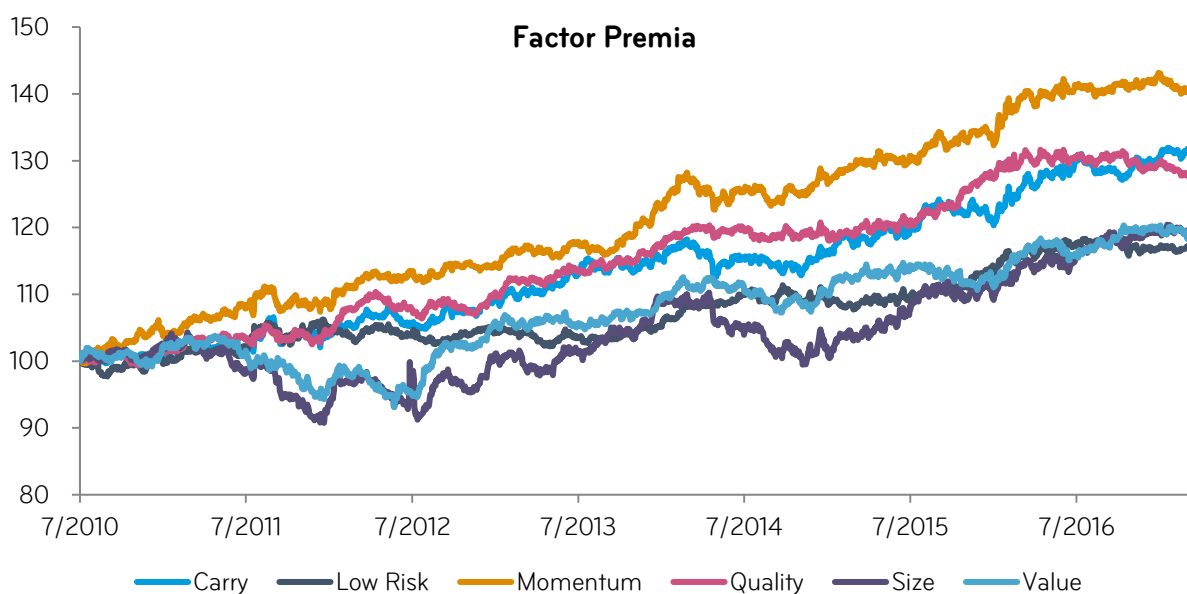


Figure 2: Indexed total returns of iSTOXX Europe Factor Indices over STOXX Europe 600 Index measured in EUR GR. Time period: Jul. 2010 - Apr. 2017

The momentum factor hereby yielded the highest overall premium with an annualized return of 5.17% while the low risk factor showed the lowest return with 2.43% on an annualized basis (see column 2 of Table 1).

	<b>Performance (p.a.)</b>	<b>Annualized volatility</b>	<b>Correl. to STX Europe 600</b>
Carry	4.29%	4.30%	-0.14
Low Risk	2.43%	3.46%	-0.62
Momentum	5.17%	3.99%	-0.04
Quality	3.80%	3.35%	-0.17
Size	2.64%	6.31%	-0.09
Value	2.62%	4.46%	0.06
Multi-Factor	6.47%	4.25%	-0.28

Table 1: Annualized performance figures, standard deviations and correlations of factor returns to benchmark (STOXX Europe 600). All figures are based on EUR GR. Volatility and correlation figures are based on weekly returns. Time period: Jul. 2010 - Apr. 2017.

But apart from overall positive returns, the graphical representation of Figure 3 also indicates that factor returns vary over time. In times of market distress, as observable during the European debt crisis, returns stemming from more cyclical factors such as value and size, are found to have been negative.



# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## 3.2 Factor Correlations

Investors who consider a factor investment will typically have an existing exposure to a standard, i.e. market cap weighted broad market index. In our case, this may be the STOXX Europe 600. It is therefore of significant importance to understand how factor indices interact with a corresponding broad market investment.

To investigate these interactions, we look at correlations between market neutral factor premia and the STOXX Europe 600 Index (see Figure 3).

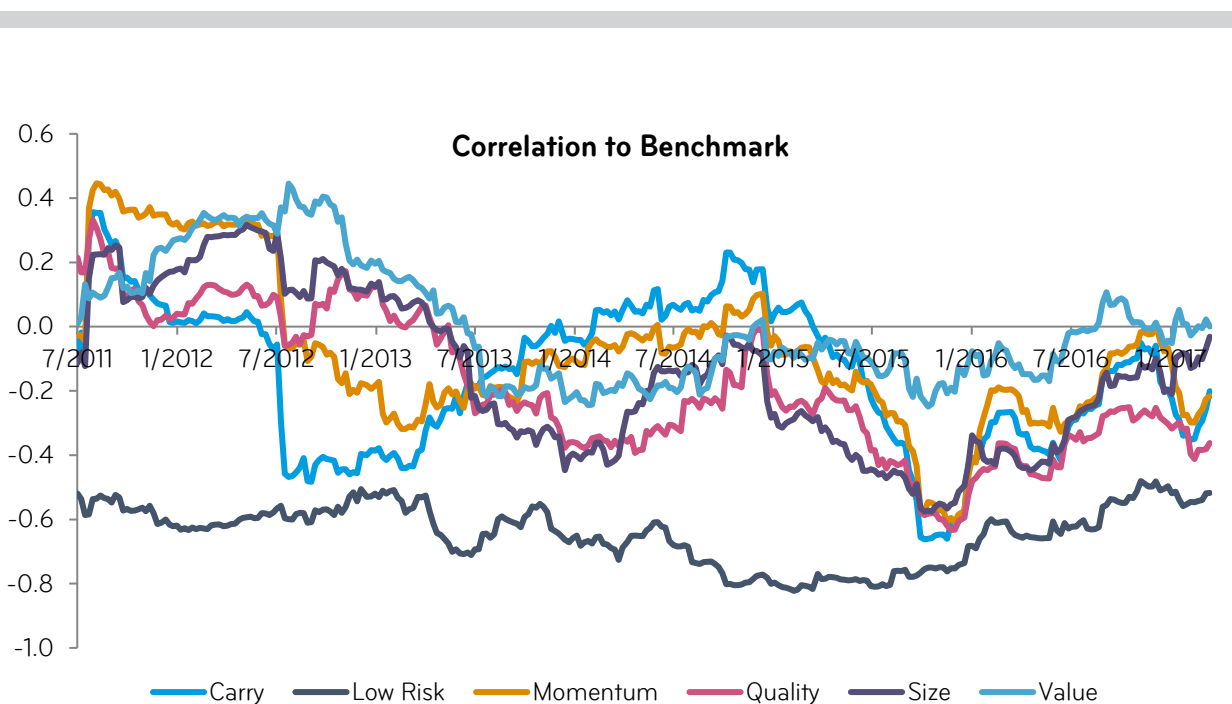


Figure 3: Correlations between factor returns and the STOXX Europe 600 (EUR GR). Time period: Jul. 2010 – Mar. 2017. Correlations are based on weekly returns measured over a 52-week time period.

One-year time averages range of weekly correlations range from a minimum of -0.64 (Low-Risk factor) to a maximum of 0.06 (Value factor).<sup>8</sup> Thus, with correlations to the broad market being this low, factor returns indeed serve as a good instrument for diversification. However, when following correlations over time, it can be observed that this diversification potential fluctuates.

The low correlations between market neutral factor returns and the broad market have a direct impact also on risk characteristics of long only indices. One may intuitively assume that the addition of a factor as a source of risk may increase the overall volatility of a portfolio. However, this may not always be the case. This conclusion is supported when looking at volatilities of the long-only iSTOXX Europe Factor Indices, rather than at the excess returns constructed by long-short positions (see column 2 of Table 2). With the exception of the iSTOXX Europe Value index, which had the highest correlation to the broad market (0.04)

<sup>8</sup> See also column 4 of Table 1 for correlations measured over the entire time period observed.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

an annualized volatility of 17.0%, all other factor indices actually display lower levels of risk than the STOXX Europe 600 (see Table 2).

	Performance (p.a.)	Annualized Volatility	Max. Drawdown
iSTOXX Europe Carry	13.9%	16.2%	-22.7%
iSTOXX Europe Low Risk	11.9%	14.4%	-20.1%
iSTOXX Europe Momentum	14.8%	16.2%	-21.7%
iSTOXX Europe Quality	13.3%	16.2%	-22.6%
iSTOXX Europe Size	12.1%	15.8%	-29.0%
iSTOXX Europe Value	11.8%	17.0%	-27.3%
iSTOXX Europe Multi-Factor	16.3%	15.2%	-21.1%
STOXX Europe 600	9.1%	16.9%	-25.2%

Table 2: Annualized performance figures and standard deviations of long only iSTOXX Europe Factor Indices and STOXX Europe 600. Volatilities are based on weekly returns. Returns are measured in EUR GR. Time period: Jul. 2010 – Apr. 2017.

So far, we have looked at correlations *between factor returns* and *returns of the broad market*. When adding one or more factor indices to an existing portfolio, however, it is important to understand the interactions, i.e. correlations, *among factors*. Table 3 provides correlations among factor returns measured over a time period ranging from Jul. 2010 to Mar. 2017.

	Carry	Low Risk	Momentum	Quality	Size	Value
Carry	-	0.39	0.67	0.52	0.51	0.24
Low Risk	0.39	-	0.38	0.35	0.23	0.01
Momentum	0.67	0.38	-	0.53	0.44	0.19
Quality	0.52	0.35	0.53	-	0.49	0.37
Size	0.51	0.23	0.44	0.49	-	0.54
Value	0.24	0.01	0.19	0.37	0.54	-
<i>Average</i>	0.47	0.27	0.44	0.45	0.44	0.27

Table 3: Correlations among factor returns measured based on weekly EUR gross returns. Time period: Jul. 2010 - Mar. 2017.

Correlations range from a minimum of 0.01 (Value and Low Risk) to a maximum of 0.67 (Carry and Momentum).<sup>9</sup> To put these figures into context: with an average correlation of 0.62 among developed market equity indices and an average correlation among developed markets' industries with about 0.72, style factors are found to be significantly less similar among each other<sup>10</sup>.

As stated, factor returns as well as correlations between factor returns and the STOXX Europe 600 Index fluctuate over time. This leads us to assume that correlations *among* factor returns may be subject to the

<sup>9</sup> Correlations between factor returns may be higher compared to returns of indices that are constructed according to Fama-French. This is due to the fact that the Fama-French approach is mainly free from benchmark and tradability constraints and allows long-short positions *within* factor indices.

<sup>10</sup> Correlations among countries and industries are based on developed countries (classified according to the STOXX country classification system) and industries (classified based on the ICB industry classification) and measured over the time period: Sept. 2010 to March 2017.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

same behavior. Figure 4 graphically displays average correlations *among all six factor premia*.<sup>11</sup> To view the behavior of correlations in a market context, the performance of the STOXX Europe 600 is also displayed.

## 4 iSTOXX Europe Multi-Factor Market Neutral Index

Given the variation of factor returns over time and in light of low correlations among those returns, it makes intuitive sense to consider an investment across more than just one factor for matters of diversification. But how to best combine single factor exposures in a multi-factor index?

The iSTOXX Europe Multi-Factor Index aims to maximize the aggregated exposure to all of the six factors - value, carry, momentum, size, low risk as well as quality. As we will see, this approach yields significantly better results than a mere heuristic, i.e. equal weighted combination of single factor indices.

Figure 4 provides median percentiles of company factor exposures from the perspective of each of the six single factor indices as well as from the perspective of the multi-factor index.<sup>12</sup>

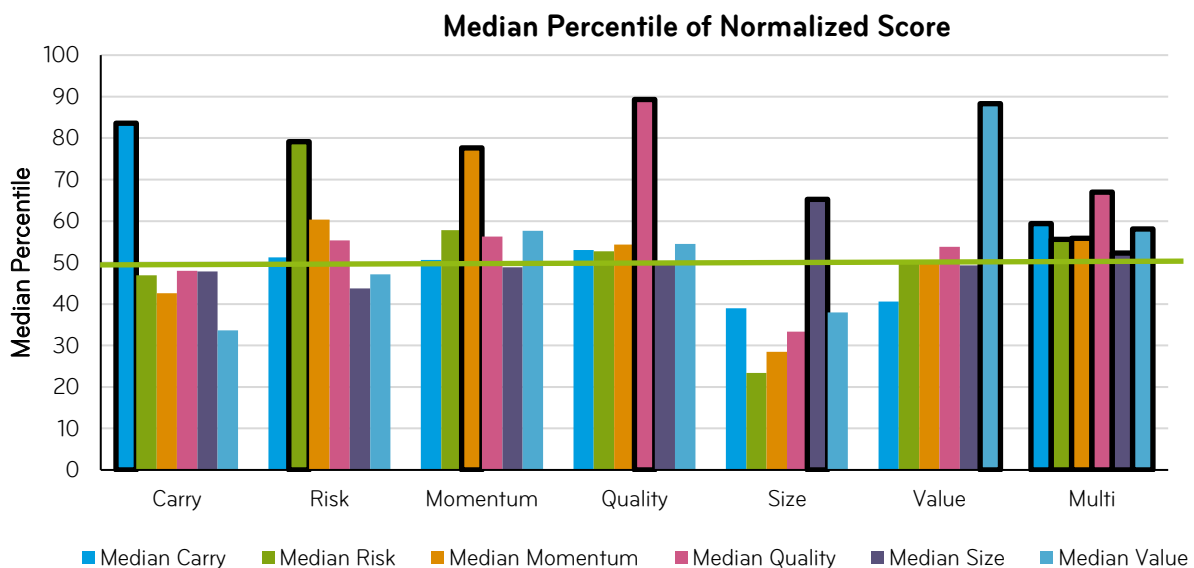


Figure 4: Median percentiles of companies selected into a respective factor index with regard to every one of the six specified factors.

As expected, companies selected into the single factor indices score highest on the factor in focus. The median percentiles to non-targeted factors are mostly below 50%.

<sup>11</sup> Average correlations are calculated as average of averages. In a first step, the average over all correlations between factor return x and all other factor returns is determined (which is repeated for each factor). In a second step, the average over all previously calculated average correlations is determined.

<sup>12</sup> Percentiles are calculated relative to the universe index STOXX Europe Total Market Index. Cut-Off Date: Feb. 29, 2016.

## ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

With the exception of the size factor, median percentiles of companies selected into the iSTOXX Europe Multi-Factor Index, however, are found to be above 50%. Thus, the majority of companies selected into the multi-factor index belong to the top 50% with regard to more than just one factor. Hence, the iSTOXX Europe Multi-Factor Index tends to include companies that score relatively well across the majority of the factors rather than selecting those companies that score well in just one dimension but do badly in all the others. Here lies a significant difference compared to a mere combination of single factor indices.

To further illustrate the differences between the two approaches, Figure 6 provides a simplified graphical representation of two possible extremes of combining factors for the case of a hypothetical two-factor scenario with factors E and F.

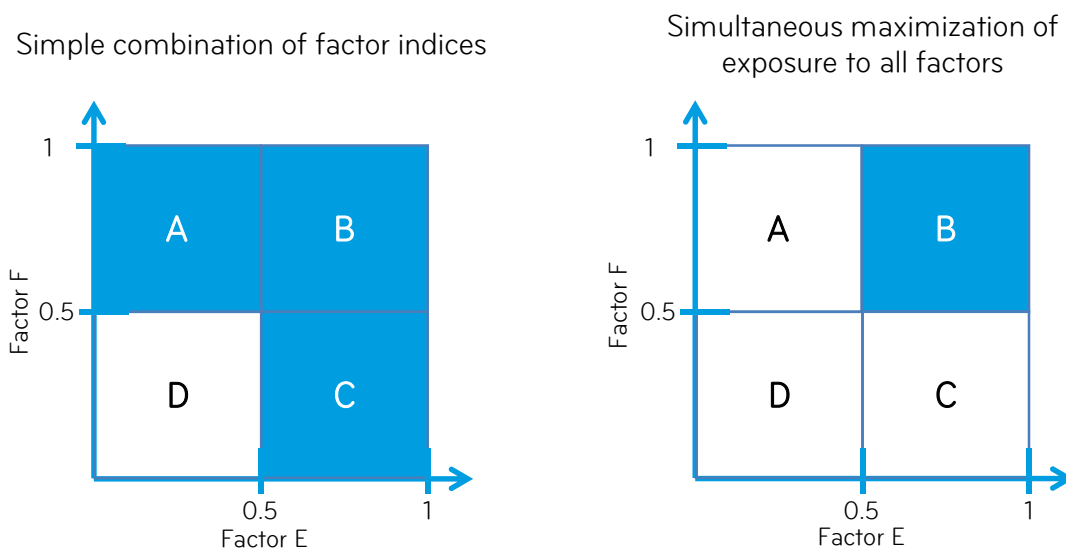


Figure 5: Simplified graphical representation of hypothetical two factors investment with factors E and F. The “index of indices” approach is displayed on the right hand side while a simultaneous maximization to both factors is displayed on the left hand side.

The “index of indices” approach, displayed on the left hand side of Figure 5, would lead to the inclusion of companies from quadrants A, B and C. Assuming that both factors E and F are independent from one another, companies that score high with regard to factor E (e.g. belong to the top 50%) could either have a very high (quadrant B) or very low (quadrant C) exposure to factor F. The same holds true from the perspective of factor F relative to factor E. Consequently, a combination of single factor indices would be a mix of companies with very different exposures to both factors.

The other extreme would be to include only those companies that score above the median with regard to both factors, E and F (quadrant B). As we have seen in Figure 4, the iSTOXX Europe Multi-Factor index

## ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

tends to rather include those companies that score relatively well in both dimensions which would correspond with quadrant B (see right hand side of Figure 5).<sup>13</sup>

But how does this difference translate into performance? Figure 6 provides performance figures for both approaches, the “index of indices” concept as well as the methodology chosen for the iSTOXX Europe Multi-Factor Index.

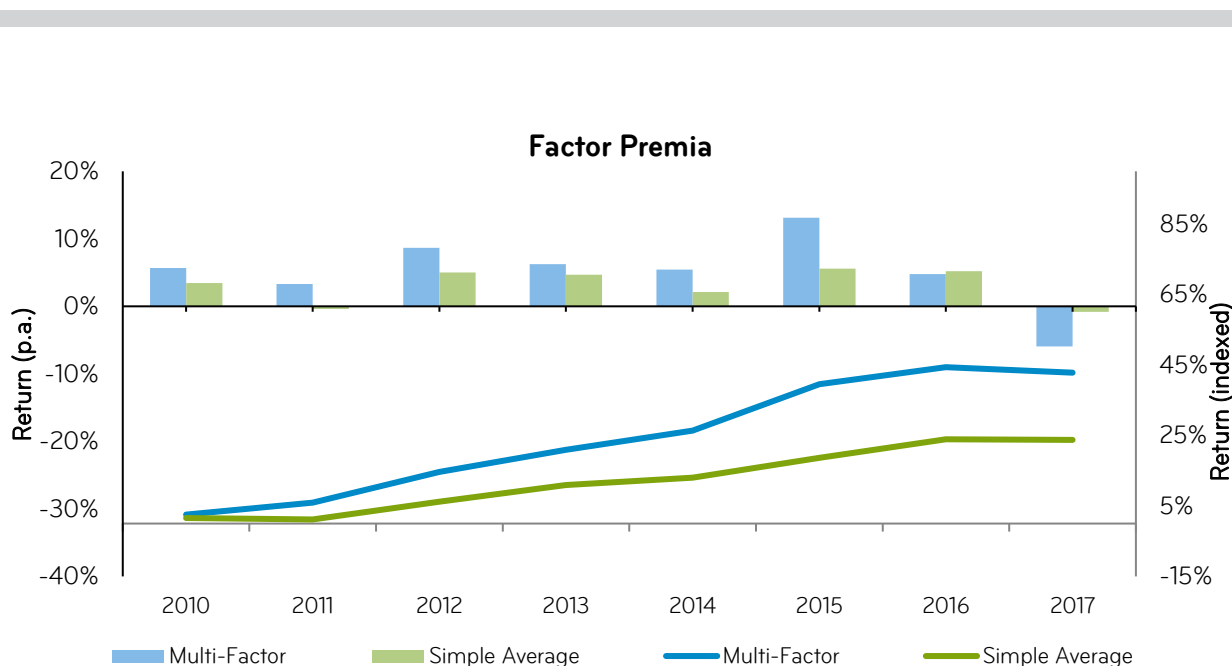


Figure 6: Annual and indexed returns of iSTOXX Europe Multi-Factor index as well as of equal-weighted combination of iSTOXX Europe Single Factor returns over STOXX Europe 600 measured in EUR GR. Time period: Jul. 2010 to Mar. 2017.

With an overall performance of 42.8% measured from Jul. 2010 to Apr. 2017, the iSTOXX Multi-Factor Index outperforms its equal-weighted benchmark, which generated a performance of “only” 23.7% over the 7 years observed, by a factor of 1.8 or 19 percentage points. More importantly, the superior performance does not only emerge in the long run. In fact, the iSTOXX Europe Multi-Factor Index outperformed its benchmark in all but one of the seven years observed. Thus, focusing on “hidden champions”, i.e. those companies that score relatively well across more than one factor, rather than focusing on companies that score very well with regard to just one factor but poorly in the remaining factors, leads to better performance results.

As we have seen above, factor returns are found to have low correlation not only with the market but also amongst each other. Hence, an investment that combines a broad market investment with an investment across factors should provide significantly lower risk than an investment into the broad market alone. A comparison of volatility and maximum drawdown figures for those two alternatives supports this assumption (see columns 3 and 4 of Table 2). The iSTOXX Europe Multi-Factor index shows a total risk

<sup>13</sup> Please note that the selection process of the iSTOXX Europe Multi-Factor index does not explicitly require companies to fall into quadrant B. However, the empirical results indicate that the majority of companies selected into the index tend to score above the median in the majority of the targeted factors.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

that is about 1.7 percentage points below that of a stand-alone investment into the STOXX Europe 600. Even more notably, the maximum drawdown of the iSTOXX Europe Multi-Factor index, measured over the entire period observed, is four percentage points below that of the STOXX Europe 600.

## 5 A potential portfolio diversifier – an example

In this section, we make use of the iSTOXX Europe Multi-Factor Index in a concrete portfolio construction example. The iSTOXX® Europe Multi-Factor Market Neutral exhibits very low correlations with traditional asset classes. This makes it an ideal portfolio diversifier. Table 4 highlights the correlations between major (European) asset classes and the iSTOXX® Europe Multi-Factor Market Neutral index, which has an average correlation of -0.1 against the four indices listed in Table 4. This property, coupled with its low volatility enables even highly risk-averse investors, who traditionally would only invest in fixed income products, to gain access to equity factor premia and as a result construct better diversified portfolios.

	iSTOXX Europe Multi-Factor Market Neutral	EURO STOXX 50 Corporate Bond	STOXX 600 TR	Bloomberg Eurozone Sovereign Bond Index	Bloomberg Commodity Index Euro Total Return
iSTOXX Europe Multi-Factor Market Neutral	1.00	0.03	-0.38	-0.03	-0.10
EURO STOXX 50 Corporate Bond	0.03	1.00	0.06	0.64	0.11
STOXX 600 TR	-0.38	0.06	1.00	0.13	0.39
Bloomberg Eurozone Sovereign Bond Index	-0.03	0.64	0.13	1.00	-0.04
Bloomberg Commodity Index Euro Total Return	-0.10	0.11	0.39	-0.04	1.00

Table 4: Correlations of a selection of Euro based indices. Correlations are based on weekly returns. Returns are measured in EUR GR. Time period: Jan. 2011 – Apr. 2017.

By adding the iSTOXX® Europe Multi-Factor Market Neutral index to his portfolio, a fixed income investor may increase diversification, resulting in higher returns at no increase in volatility. For instance, a bond portfolio's performance may primarily be driven by two factors, interest rates and credit spreads, however, by allocating a certain proportion into the market neutral multi-factor index, the performance can be improved without increasing risk. In Table 4 below we calculate a hypothetical portfolio that is invested by 70% in the EURO STOXX 50 Corporate Bond TR and by 30% in the iSTOXX Europe Multi-Factor Market Neutral, based on monthly rebalancings. This combination portfolio strictly dominates an exclusive investment in the EURO STOXX 50 Corporate Bond index on a risk-return basis, with annualised returns from 5.3% compared to 4.7% whilst the historical annual volatility is equivalent for both at 2.3%.

	Performance (p.a.)	Annualized Volatility	Return/Risk Ratio	Maximum Drawdown
EURO STOXX 50 Corporate Bond TR	4.7%	2.3%	2.0	-3.3%
iSTOXX Europe Multi-Factor Market Neutral	6.6%	4.6%	1.4	-4.5%
70%-30% Combination	5.3%	2.3%	2.3	-2.7%

Table 5: performance statistics of EURO STOXX 50 Corporate Bond TR, iSTOXX Europe Multi-Factor Market Neutral and a linear combination thereof. Returns are measured in EUR GR. Time period: Jan. 2011 – Apr. 2017.

## ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

Figure 7 outlines the historical performance of the 70-30 portfolio. The benefit of such an allocation can be observed around mid-2015 when the performance of the EURO STOXX 50 Corporate Bond TR begins to flatten as a consequence of low to negative interest rates. The combined portfolio significantly outperforms the stand alone bond investment over this period.

But even in an environment with ultra-low interest environment poised to come to an end and economic growth and inflation gradually increasing, an allocation to market neutral style factors should be value adding. In such an environment, bond investors face severe performance headwinds. Diversifying their portfolios with market neutral factor indices will allow investment managers to better insulate their portfolios against these risks, whilst maintaining a similar risk profile.

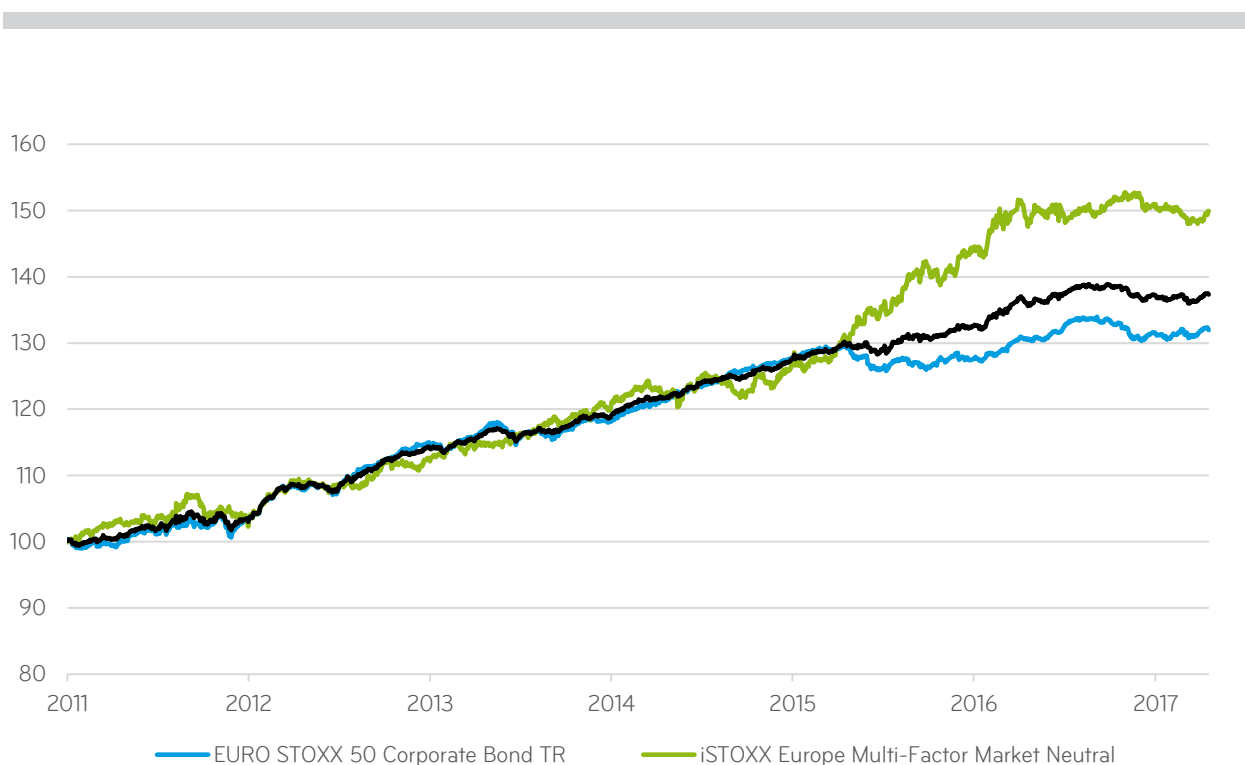


Figure7: Annual and indexed returns of EURO STOXX 50 Corporate Bond TR index, iSTOXX Europe Multi-Factor Market Neutral as well as a 70-30-weighted combination of EURO STOXX 50 Corporate Bond TR index returns iSTOXX Europe Multi-Factor Market Neutral measured in EUR GR. Time period: Jan. 2011 to Apr. 2017.

To further illustrate the diversification benefits, Figure 8 plots both the returns and return/risk ratios for 11 different combinations of the market neutral multi factor and the bond index from (0% invested in the multi-factor to 100%). It is noteworthy that the return/risk ratio is maximized in the 10% - 30% (multi-factor allocation) range.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

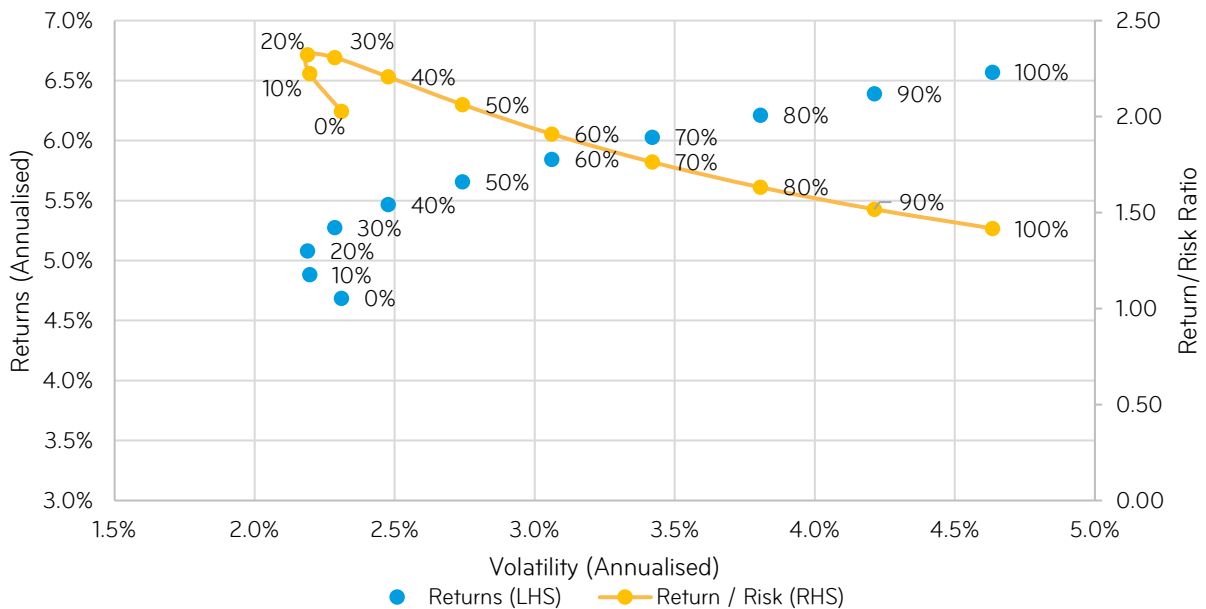


Figure 8: Based on weighted combinations of EURO STOXX 50 Corporate Bond TR index returns iSTOXX Europe Multi-Factor Market Neutral measured in EUR GR. Time period: Jan. 2011 to Apr. 2017.

Another benefit of diversification is the reduction of sensitivities to common market risk, such as interest rate risk. We investigate the impact of including the factor index on the sensitivity to interest rates and credit spreads by performing regression analyses. The results of the regressions detailed in equations (1) and (2) for weekly changes in credit spreads (Bloomberg Euro Aggregate Corporate OAS Index) and changes in 3M Euro LIBOR are outlined in Table 6. We find that the iSTOXX® Europe Multi-Factor Market Neutral has no statistically significant sensitivity to either credit spreads or 3M LIBOR and hence adding it to the portfolio reduces the sensitivity to changes in credit spreads and 3M LIBOR by 49% and 22% respectively.

$$\frac{\Delta IV_t}{IV_t} = \alpha_{CS} + \beta_{CS} \Delta CS_t + \varepsilon_t \quad (1)$$

$$\frac{\Delta IV_t}{IV_t} = \alpha_{IR} + \beta_{IR} \Delta IR_t + \varepsilon_t \quad (2)$$

Where:

- IV: Index value (or portfolio value for 70/30 combined)
- CS: Credit Spread (Bloomberg Euro Aggregate Corporate OAS Index)
- IR: 3M Euro LIBOR
- $\beta$ : Sensitivity to changes in explanatory variable



## ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

Allocation Corp Bonds	Allocation MN Multi Factor	Beta ( $\Delta CS$ )	Beta ( $\Delta IR$ )
100%	0%	-0.92***	-6.12***
0%	100%	0.59	-1.60
70%	30%	-0.47**	-4.76***

Table 6: Regression Results of combinations of EURO STOXX 50 Corporate Bond TR and iSTOXX Europe Multi-Factor Market Neutral against changes in Bloomberg Euro Aggregate Corporate OAS Index and 3M Euro LIBOR. Returns are measured in EUR GR. Time period: Jan. 2011 – Apr. 2017. (\* significant at 10% level, \*\* significant at 5% level, \*\*\* significant at 1% level)

This further illustrates the diversification powers of the iSTOXX Europe Multi-Factor Market Neutral and highlights its potential to aid investors to insulate against risk posed by rising interest rates or widening credit spreads for example.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## 6 Conclusion

The empirical results show that iSTOXX Europe Market Neutral Factor Indices provide significant excess returns relative to their benchmark over a sample period of twelve years. With correlations to the benchmark index STOXX Europe 600 ranging from a minimum of -0.62 (low risk factor) to a maximum of 0.06 (value factor), factor returns are found to also serve as a great source of diversification when used in addition to an existing investment in a broad European benchmark index such as the STOXX Europe 600. Low correlations *among* factor returns further add to the diversification potential when investing in more than just one factor index.

However, risk premia are found to vary significantly over time. This observation as well as the low correlation among factor returns provide the grounds for the construction of the iSTOXX Europe Multi-Factor index. Its innovative methodology leads to lower risk and higher returns compared to a heuristic, e.g. equally weighted aggregation of single factor indices.

Finally, iSTOXX Europe Market Neutral Factor indices are shown to be uncorrelated with traditional asset classes, and as a result can act as portfolio diversifier. This enables investors to include these indices in their portfolio in order to build better diversified portfolios with superior risk-return characteristics without adversely affecting the risk characteristics of their portfolios. Furthermore, the increased diversification can decrease sensitivities to common market risk factors (such as interest rate risk for bond portfolios).

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# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

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# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## Appendix A

### Metrics underlying the factor construction

#### A.1 Carry

The carry factor is a composite of four measures:

$$A.1.1 \text{ Price to dividend} = \frac{\text{Price}}{\text{dividend per share over the last 12 months}},$$

$$A.1.2 \text{ Internal growth} = \text{Return on equity} \times \text{Payout ratio} = \frac{\text{Earnings}}{\text{Book value}} \times \left(1 - \frac{\text{Dividend per share}}{\text{Earnings per share over the last 12m}}\right),$$

$$A.1.3 \text{ Earnings dispersion} = \text{Standard deviation of earnings; timeweighted forward 12 month},$$

$$A.1.4 \text{ Shares out reduction} = \frac{\text{Historical common shares decrease over last 24 months}}{\text{Common shares out}}.$$

#### A.2 Risk

The risk factor is a composite of three measures:

$$A.2.1 \text{ 3M volatility} = \text{Standard deviation of returns over 3 months},$$

$$A.2.2 \text{ 12M volatility} = \text{Standard deviation of returns over 12 months},$$

$$A.2.3 \text{ 12M semi volatility} = \text{Semi deviation of returns over 12 months}.$$

#### A.3 Momentum

The momentum factor is a composite of two measures:

$$A.3.1 \text{ 1M reversal} = -T \text{ Value of return index over 1 month},$$

$$A.3.2 \text{ 12M momentum} = T \text{ Value of return index over 12 months}.$$

#### A.4 Quality

The quality factor is a composite of five measures:

$$A.4.1 \text{ Operating income to common equity} = \frac{\text{Operating income}}{\text{Common equity}}, \text{ which becomes } \frac{\text{Operating income}}{\text{Total assets}} \text{ if } \text{Common equity} \leq 0,$$

$$A.4.2 \text{ Cash to current liabilities} = -1 \times \frac{\text{Cash and equivalent}}{\text{Current liabilities}},$$

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

$$\text{A.4.3 Net external financing } 12M = -1 \times \frac{12M \Delta \text{ sh out} \times 12M \text{ average price} + 12M \Delta \text{ long debt} + 12M \Delta \text{ short debt} + 12M \Delta \text{ pref stocks}}{12M \text{ Average total assets}},$$

with,

$$12M \Delta \text{ sh out} = \text{Shares outstanding}_{t_0} - \text{Shares outstanding}_{t_0-12\text{month}},$$

$$12M \Delta \text{ long debt} = \text{Long debt}_{t_0} - \text{Long debt}_{t_0-12\text{month}},$$

$$12M \Delta \text{ short debt} = \text{Short debt}_{t_0} - \text{Short debt}_{t_0-12\text{month}},$$

$$12M \Delta \text{ pref stocks} = \text{Preferred stocks}_{t_0} - \text{Preferred stocks}_{t_0-12\text{month}},$$

$$12M \text{ average price} = \text{Average price in local currency with monthly observations},$$

$$12M \text{ Average total assets} = \text{Average total assets in local currency with quarterly observations},$$

$$\text{A.4.4 Coverage} = \text{Composite} \left( \frac{\text{EBIT}}{\text{Interest payments}}; \frac{\text{EBIT}}{\text{Total debt}}; \frac{\text{CFO}}{\text{Interest payments}}; \frac{\text{CFO}}{\text{Total debt}} \right).$$

$$\text{A.4.5 Accruals quality} = \frac{12M \Delta \text{ Net Operating Assets}}{\text{Total Assets}},$$

with,

$$12M \Delta \text{ net operating assets} = \text{Net operating assets}_{t_0} - \text{Net operating assets}_{t_0-12\text{month}},$$

with,

$$\text{Net operating assets} = \text{Total assets} - \text{Cash} - \text{Total liabilities} + \text{Short debt} + \text{Long debt}.$$

## A.5 Size

The size factor is a composite of two measures:

$$\text{A.5.1 Inverse MCAP} = -1 * \text{Market capitalization},$$

$$\text{A.5.2 Inverse EV} = -1 * (\text{Market capitalization at end of fiscal year} + \text{Preferred stocks} + \text{Minority interest} + \text{Total debt} - \text{Cash}).$$

## A.6 Value

The value factor is a composite of two measures:

$$\text{A.6.1 Forward } 12M \text{ earnings yield; replaced with } \frac{\text{Cash flows from operations}}{\text{Total assets}} \text{ if negative},$$

$$\text{A.6.2 Cash flow yield; replaced with } \frac{\text{Cash flows from operations}}{\text{Total assets}} \text{ if negative}.$$

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

## Appendix B

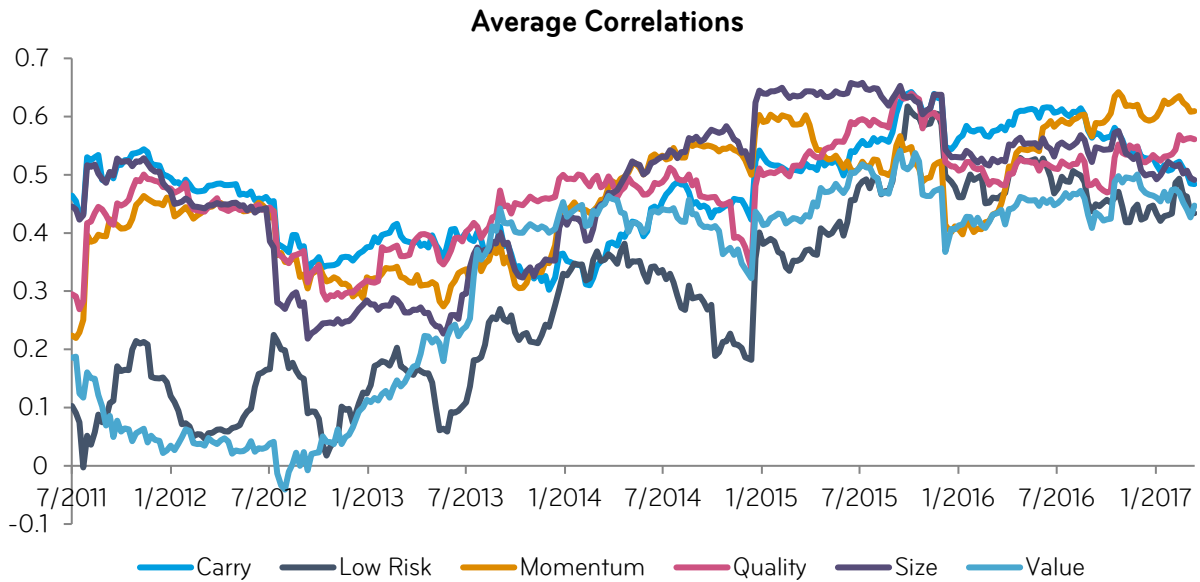


Figure A.1: Average correlations among factor returns from the perspective of each factor to all other five factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

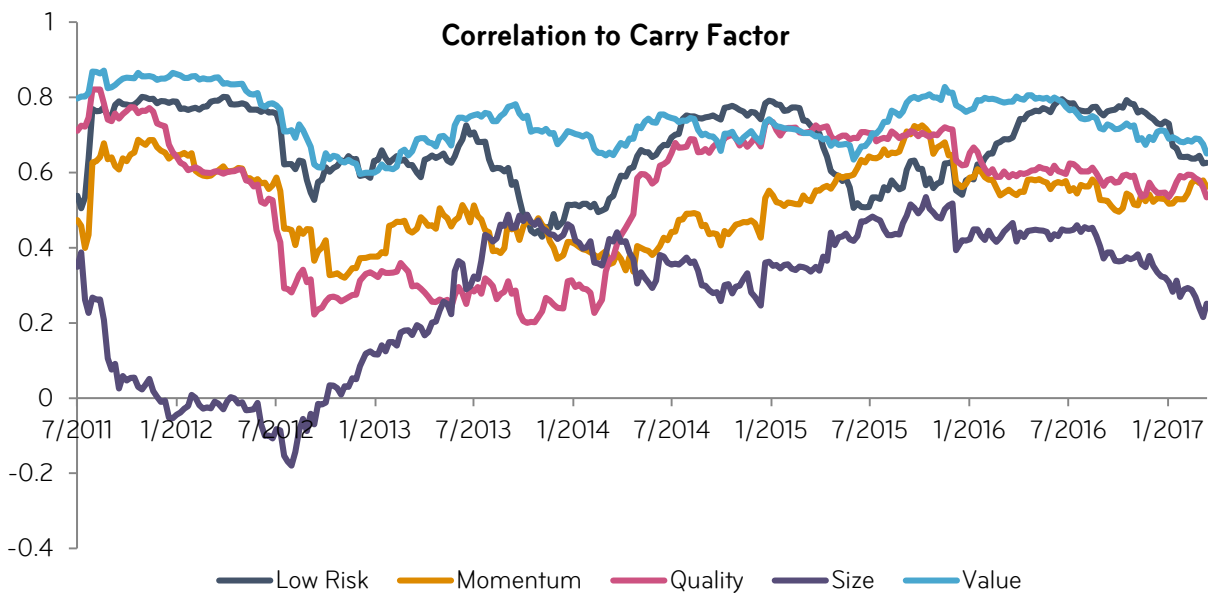


Figure A.2: Correlations of carry factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

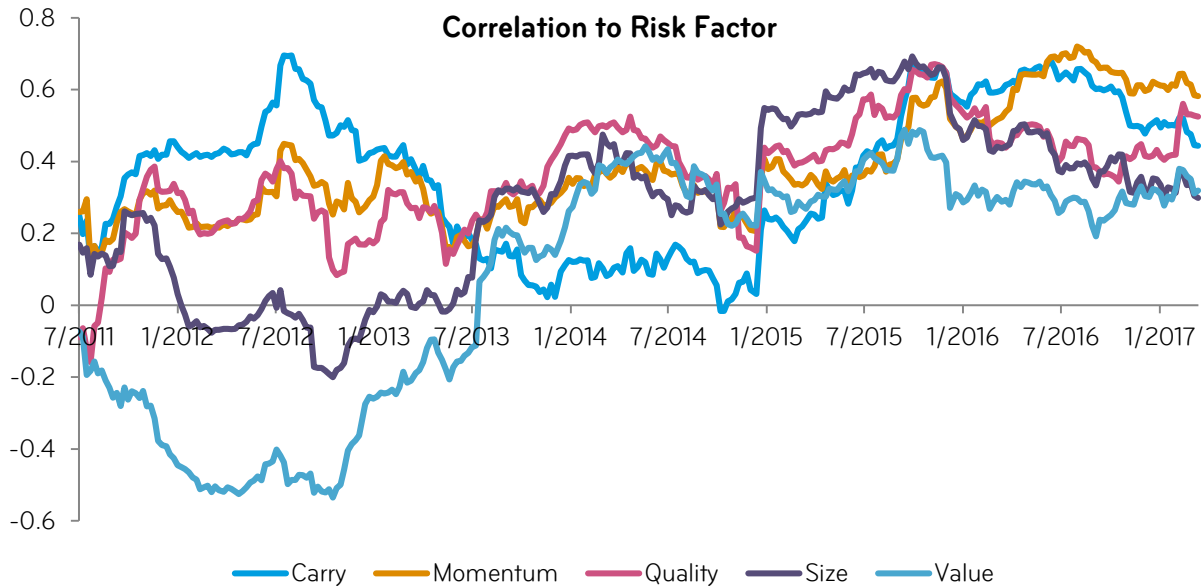


Figure A.3: Correlations of risk factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

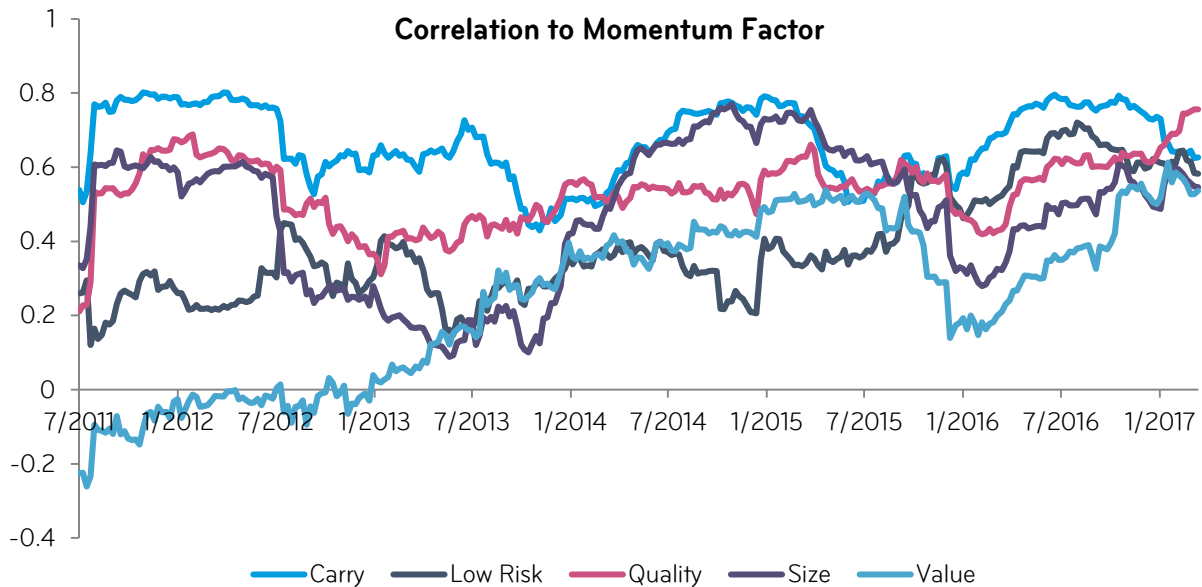


Figure A.4: Correlations of momentum factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

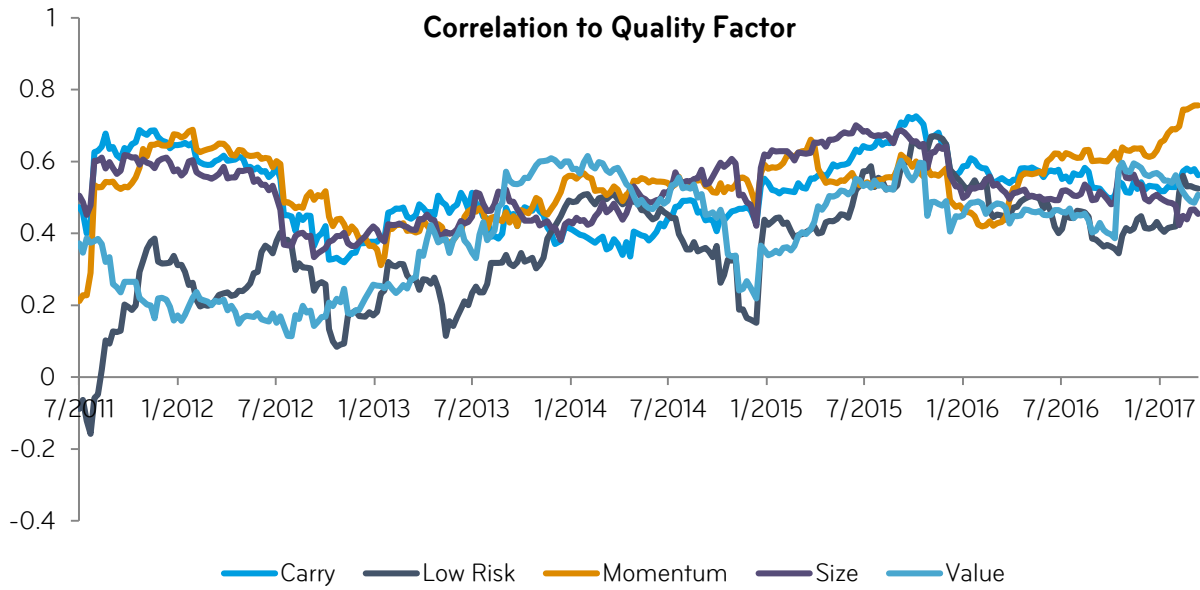


Figure A.5: Correlations of quality factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

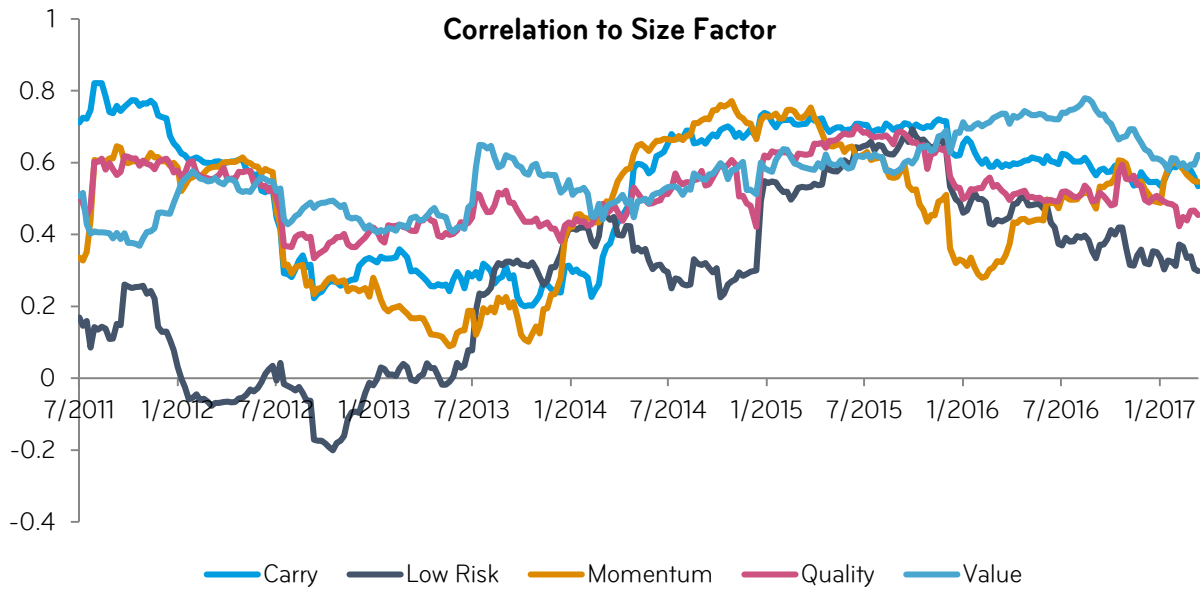


Figure A.6: Correlations of size factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.



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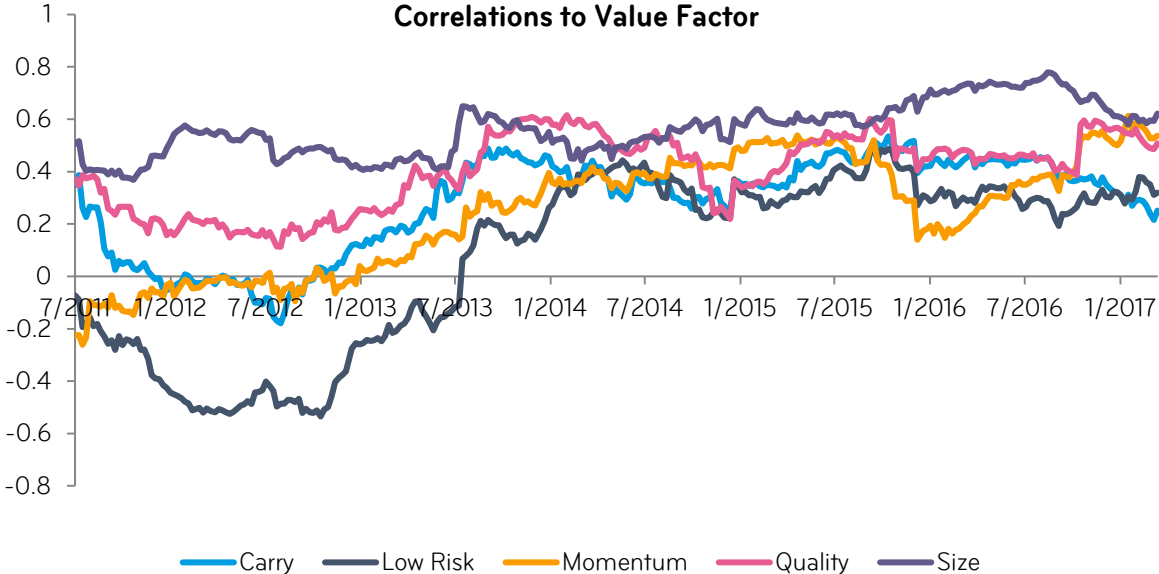


Figure A.7: Correlations of value factor to all other factors. Correlations are based on weekly EUR gross returns measured over a 52-week time-period. Time period: Jul. 2010 - Mar. 2017.

# ISTOXX EUROPE FACTOR INDICES – HARVESTING EQUITY RETURNS WITH BOND-LIKE VOLATILITY

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