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# VOLATILITY AS AN ASSET CLASS



**STOXX**

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# VOLATILITY AS AN ASSET CLASS

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## INTRODUCTION

Volatility has become a key word of the recent financial crisis with realised volatilities of asset prices soaring and volatilities implied by option prices as measured by volatilities indices such as the EURO STOXX 50 Volatility Index (VSTOXX), VDAX or VSML reaching unprecedented levels, reflecting the increasing cost of buying downside protection in the form of options during the market turmoil.

It is interesting to note that volatility is more than a mere measure for the level of uncertainty prevailing in financial markets. In fact, in recent years volatility has become a new asset class for investors looking to diversify their portfolio strategy. Due its complexity, volatility offers a wide range of investment opportunities and has developed from a niche investment strategy for institutional investors to an asset class accessible for retail investors in the form of certificates and structured products. For institutional investors, volatility is tradable in the form of listed and OTC derivatives, in particular on the S&P500, EURO STOXX 50, FTSE 100, DAX, SMI and the Nikkei.

Before discussing various investment strategies for investing in volatility, it is important to understand its basic characteristic features:

1. Volatility does not produce any direct returns such as dividends or interest;
2. It shows a property known as mean reversion in the long run, i.e. volatility cannot grow to arbitrary high or low levels but tends towards a medium level in the long run;
3. Volatility does not show long term upwards trends like equities, but typically shows periods of high volatility occurring within a short period of time (i.e. volatility "jumps") and then shows a downward trend to return to the long run medium level. Mathematically speaking this is due to the heteroscedasticity property of equity returns, i.e. equity returns are stochastic with the variance of the underlying probability distribution varying itself in time.
4. Volatility is typically high when equity markets are falling and vice versa, i.e. there is a negative correlation between volatility and the underlying equity market.
5. On average, implied volatilities tend to be higher than realised volatilities. Economically speaking, this is because investors buying protection in the form of options for their portfolios have to pay a risk premium to the protection seller.

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Figure 1 illustrates property 2, 3 and 5 whereas property 4 is demonstrated in figure 2.

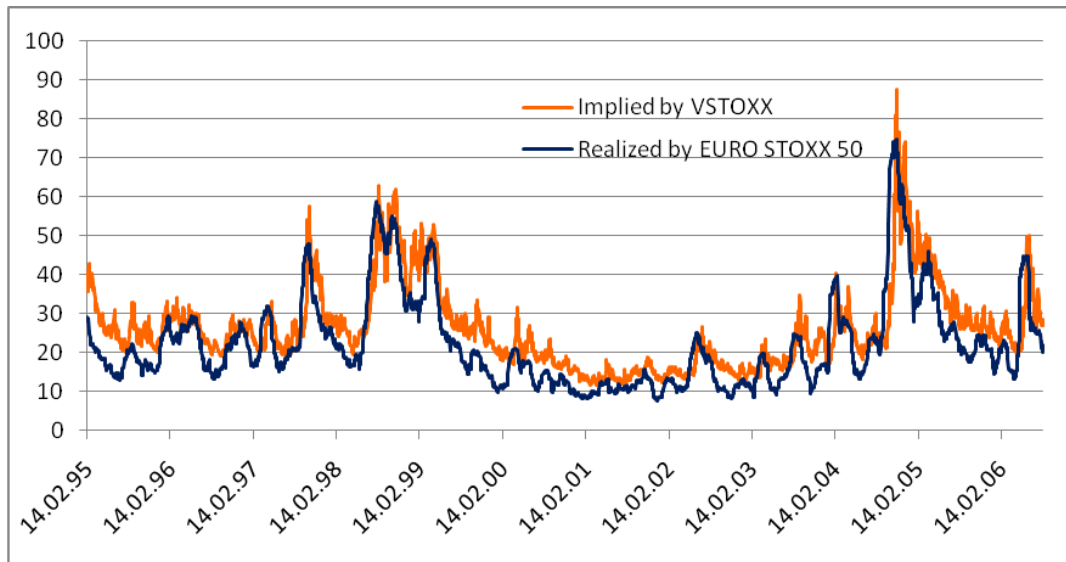


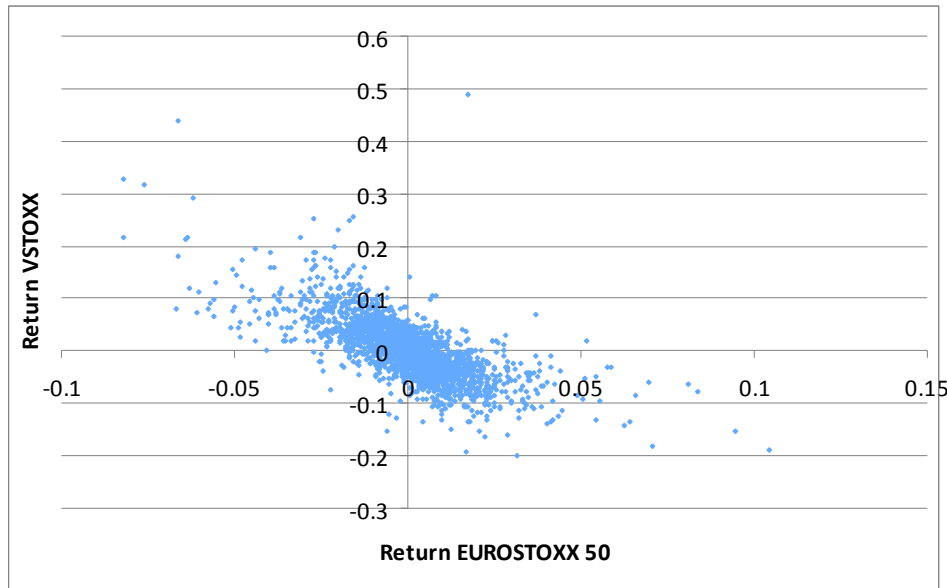
Figure 1: The (lagged) implied volatility as measured by the VSTOXX versus the realised volatility of the EURO STOXX 50 Index. Two aspects are worth mentioning: Firstly, volatility tends to jump occasionally to high levels and then shows a mean reversion over a period of time. Secondly, on average implied volatility exceeds realised volatility.

The apparent negative correlation between volatility and the equity markets can be explained by the fact that during market turbulences many investors are buying protection for their portfolios, pushing options prices and hence implied volatilities upwards. This also explains why volatility indices are often cited as a benchmark to assess the level of uncertainty prevailing in the respective financial market.

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Figure 2: Daily returns of the VSTOXX versus the returns of the EURO STOXX 50 Index, showing a correlation of -0.72.



An alternative fundamental explanation for the negative correlation between equity markets and volatility is based on the so-called leverage effect: A decline in the value of a company's equity results in an increase of the company's balance sheet leverage, making its equity more risky and hence increasing the volatility of its share price.

## DIRECT INVESTMENT STRATEGIES

There are various ways to invest in volatility. For example, investors who want to speculate directly on a certain trend in volatility in the short or medium term can do so through listed volatility futures (for institutional investors) or by investing in retail long or short volatility tracker certificates (for retail investors) on the respective volatility indices which have become a standard product in the derivatives industry. This implies that the investor has a clear directional view regarding the future trajectory of volatility on a well-defined time horizon.

For instance, figure 3 shows the performance of a rolling investment strategy in 1months VSTOXX futures in comparison to the performance of the EURO STOXX 50 Index. The negative correlation of this investment strategy to the equity markets is apparent.

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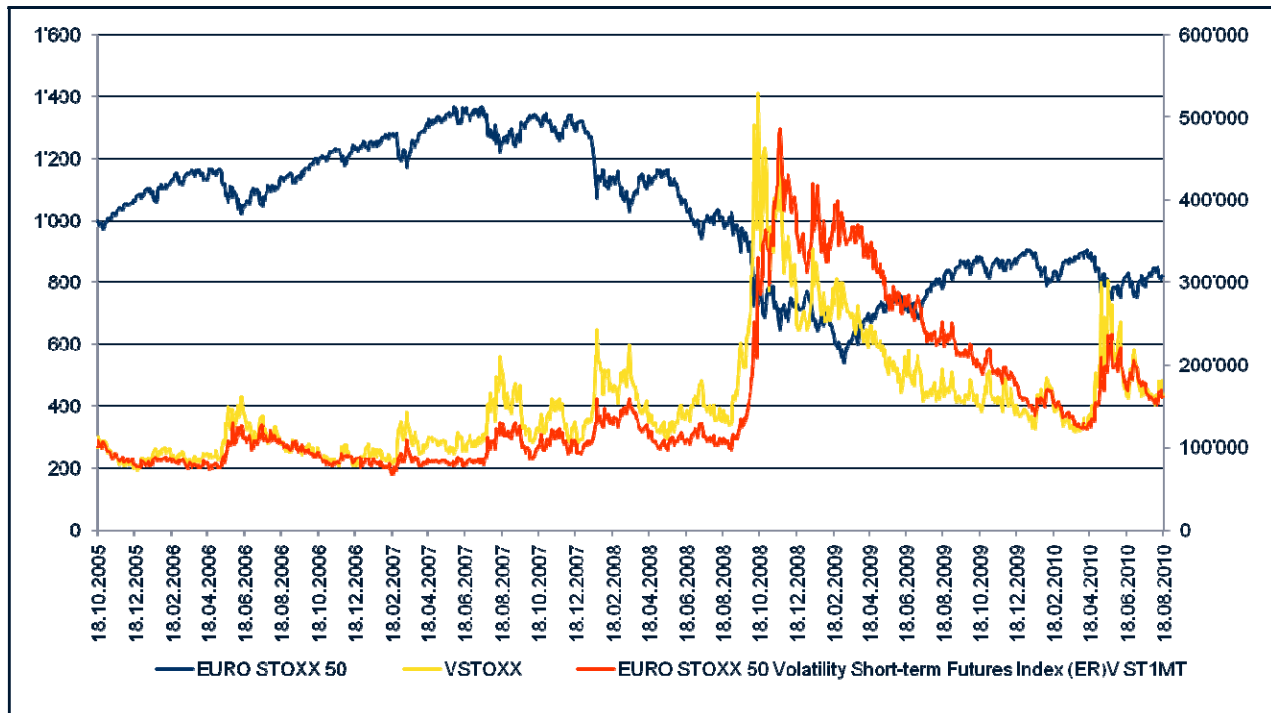


Figure 3: Performance of a rolling VSTOXX futures strategy in comparison to the VSTOXX index and the EURO STOXX 50 Index. Apparently, volatility is typically rising when equity markets are falling and vice versa. Further, the differences between the rolling futures strategy and the underlying VSTOXX index are due to rolling effects of the futures contracts.

Even for markets where volatility indices and related listed futures or tracker certificates do not exist, investors can indirectly speculate on a directional view on volatility through options – investors expecting rising volatility levels will go long options, whereas investors expecting a fall in volatility will be short options. The most commonly used strategy for speculating on a rise of volatility is a straddle (i.e. a long call and a long put on the same underlying, typically with the same strike), where the investor profits from rising volatility since he is vega long, reflecting the increased probability of the underlying moving upwards or downwards, as indicated in figure 4.

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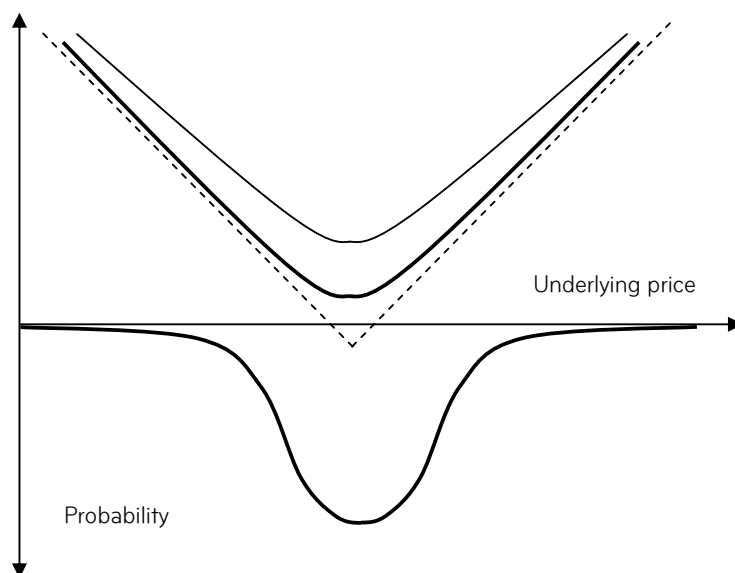


Figure 4: Pay-off of a straddle in the upper half (=long put and long call with the same strike on the same underlying asset) where the dashed line indicates the intrinsic value. The related probability distribution of the underlying asset is illustrated in the lower half. When volatility rises as indicated by the arrows, the investor profits, because the time value of both options increases (shifting the entire pay-off upwards) reflecting the fact that the probability of large profitable up or down movements increases.

The disadvantage of these option based strategies compared with volatility futures or tracker certificates is the fact that their performance does not only depend on volatility, but also on the price of the underlying asset.

Regarding a directional view on volatility, there is a clear asymmetry between up and down movements in volatility. Upwards movements in volatility are typically intense but very short and not foreseeable and hence a strategy to track a trend of rising volatility is hardly possible. On the other hand, since jumps in volatility are typically followed by a period of falling volatility bringing volatility back to the long term mean level, going short volatility after sudden jumps in volatility can be a promising strategy.

In any case, taking a constant directional view cannot be deemed a profitable strategy in the very long run due to the lack of direct returns and the mean reversion property of volatility.

Nevertheless, as we show in the following the above-mentioned properties 1-5 can be used to generate returns and to reduce the volatility of an investment portfolio, in particular when used in combination with equity positions, exploiting the negative correlation between the two asset classes.

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## VOLATILITY ARBITRAGE STRATEGIES

A straightforward strategy to generate returns using volatility is based on property 5, i.e. the fact that option writers can typically earn a risk premium. In other words, any strategy where the investors is short implied volatility and long realised volatility should yield a positive (additional) return in the long run.

Investment strategies to achieve this goal are:

- » Buy-write strategy (also referred to as covered call): The investor is long equity and short a call on the same underlying. By rolling the strategy after each option expiry the investor continuously pockets a call premium as long as implied volatilities are higher than realised volatilities. In the past years, the buy-write strategy produced extra returns compared with a simple equity long strategy and implies a lower volatility, as indicated in Table 1 below and is even available in the form of index-linked investment products for retail investors for various underlying indices. However, the performance of such a strategy is influenced by both market volatility and the performance of the underlying asset and hence is not a plain investment strategy for volatility.
- » Delta neutral: The delta neutral strategy basically aims to separate the return generated by volatility from the influence of the underlying asset by investing in a delta-neutral portfolio of an option and the underlying asset. For taking advantage of the fact that implied volatility tends to be higher than realised volatility, the investors has to hold a short option position, which he then delta-hedges with the underlying share. However, when the underlying moves one has to re-hedge the portfolio continuously, implying transaction costs and a residual performance impact of the underlying on the investment strategy.
- » Volatility arbitrage: This strategy perfectly segregates the performance of volatility from the underlying asset. The investor engages into a variance swap, receiving implied variance (i.e. squared volatility) and paying realised variance on a rolling basis. The advantage of using variance swaps (instead of volatility based swaps) is that they can be replicated more easily by a portfolio of vanilla options at any time. The return generated is purely the difference between implied and realised variance, i.e. it is not "diluted" by movements in the underlying as it is the case for the buy-write strategy. The performance is indicated in Figure 5.

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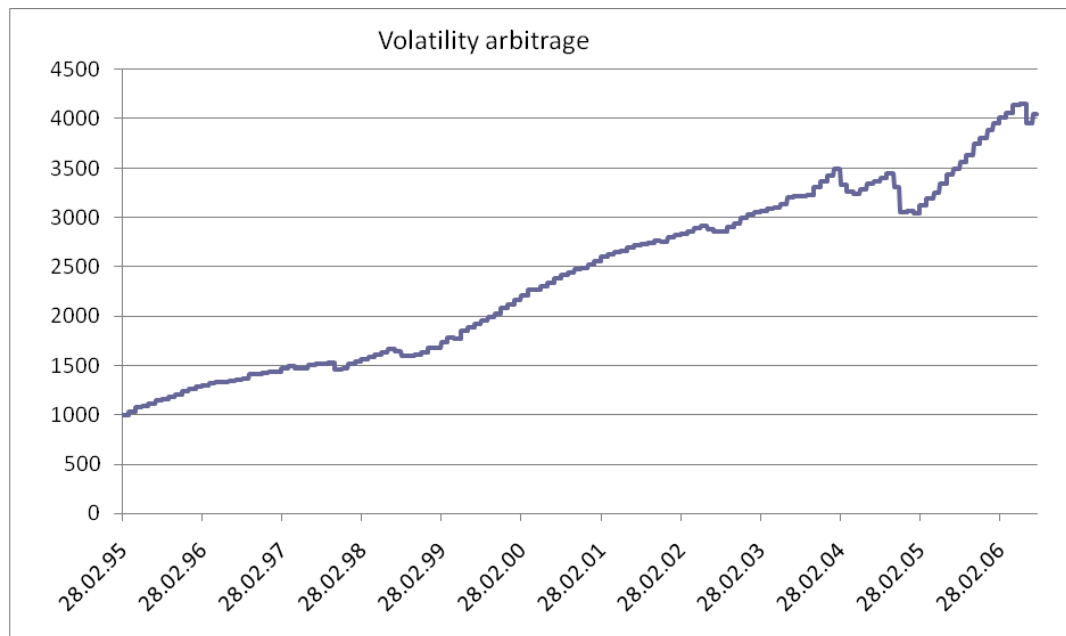


Figure 5: Return generated by a monthly rolling investment in variance swaps, receiving one month lagged implied variance ( $VSTOXX^2$ ) and paying realised variance on the EURO STOXX 50 Index. The index performance is mostly positive except for short phases where realised volatilities suddenly jump upwards and exceed implied volatilities until protection sellers adjust the cost of selling protection, which occurred for instance in the market turbulence of 2002/2003 and 2007/2008.

Apparently, the performance of the volatility arbitrage strategy is closely linked to the difference between implied and realised volatility as indicated in Figure 1, i.e. the index performance is mostly positive except for phases where realised volatility jumps upwards, typically due to market turbulences, and hence exceeds implied volatility.

However, these periods tend to be relatively short since protection sellers typically react quickly by increasing the cost of selling protection, bringing implied volatility back above realised volatility and hence ensuring positive returns for the volatility arbitrage strategy.

The volatility arbitrage strategy is well-known in the derivative market and is even available for retail investors in the form of volatility arbitrage certificates.

The reason for implied volatilities to exceed realised volatilities and hence for the continuously good performance of volatility arbitrage is the fact that options are largely used as hedging instruments to insure portfolios against adverse movements of financial markets. Consequently, as in the insurance business,



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protection providers (i.e. options writers) expect a risk premium on top of their expected payouts to compensate for the risks they are assuming, which drives the performance of the volatility arbitrage strategy.

## MULTI-ASSET STRATEGIES

The third strategic concept is to use volatility within a multi-asset portfolio context to make use of the negative correlation between equity and volatility and low correlation to fixed-income markets.

As a straightforward example, we assume a portfolio that invests 85% in the EURO STOXX 50 Index and 15% in VSTOXX in the form of 1month futures (or listed certificates). The basic idea is to profit diversify the risk of the portfolio across the business cycle. In particular, in bear markets where equities are sluggish we can expect to improve the performance of the portfolio due to rising volatility levels often seen in bear markets.

Figure 6 shows the corresponding simulation, which demonstrates that adding a negatively correlation investment in volatility improves the risk-return profile of the investment portfolio by reducing the investments volatility across the business cycle and enhancing returns.

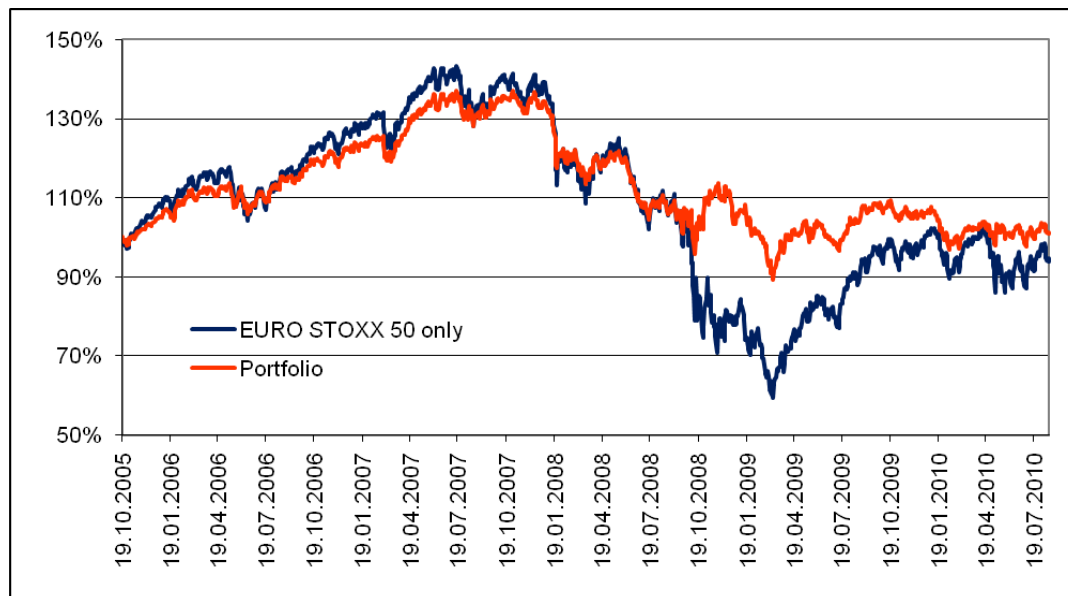


Figure 6: Portfolio strategy of an investment of 85% into the EURO STOXX 50 equity portfolio and 15% into VSTOXX futures contracts (grey) versus a 100% EURO STOXX 50 portfolio (blue). Due to the negative correlation between equity markets and volatility, the diversified portfolio shows a much lower volatility across the business cycle and a higher average performance than the simple equity only strategy.

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## CONCLUSION

The three main concepts of investing into volatility that we discussed are

1. To take a directional view on volatility in the short to medium term;
2. Volatility arbitrage to profit from the risk premium between implied and realised volatilities and
3. A portfolio mix of volatility and other asset classes, in particular equity to take advantage of negative correlations between volatility and traditional investment markets to smoothen the investor's performance across the business cycle.

Volatility arbitrage strategies clearly provide a good performance throughout the business cycle with relatively low performance volatility compared to standard equity portfolios, in particular when the strategy is completely decoupled from the underlying asset by investing in variance swaps. The downside risk is typically limited to relatively short periods when realised volatilities suddenly jump upwards until protection sellers adjust the cost of protection.

As with any arbitrage strategy, spreads between implied and realised volatility might tighten with an increasing number of arbitrageurs appearing on the market. However, the key determinant of the future performance of a volatility arbitrage strategy is the size of the market for protection buyers in relation to the size of the arbitrageur market.

The multi asset investment concept is the direct addition of volatility into an investment portfolio, making use of the negative correlation to equity markets and low correlation to other asset classes such as fixed-income. Due to the high volatility of volatility itself, volatility is mainly suited as an addition to an existing asset portfolio. In particular the mean reversion property makes a long-short volatility strategy a valuable portfolio addition.

Another important concept related to volatility are risk controlled or risk budget investment schemes, which determine the portfolio mix of a risky asset and a riskless asset based on a volatility measure and which are especially interesting for institutional investors operating under strict risk management rules, e.g. pension funds.

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**LITERATURE**

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Understanding VIX, Robert E. Whaley, <http://ssrn.com/abstract=1296743>.

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STOXX Index Guide, [www.stoxx.com/download/indices/rulebooks/djstoxx\\_indexguide.pdf](http://www.stoxx.com/download/indices/rulebooks/djstoxx_indexguide.pdf).

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