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Managing Market Price Risks

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Abstract

Being exposed to financial market price risk is an omnipresent aspect of investing. This includes the risk of capital losses when investing in the stock or bond market or the risk of currency fluctuations when investing abroad. In this article, we compare symmetric and asymmetric hedging approaches. We argue that asymmetric hedging is the better choice for most investors. We discuss active hedging based on trend-following models and suggest a passive option-based strategy to benchmark them. Here we find that trend-following models often are superior to the option-based strategy. Finally, we identify three market characteristics, which may have a significant impact on the outperformance of trend-following models over passive option-based hedging strategies: the relationship between the historical and implied volatility, the occurrence of large price movements and the presence of high short-term noise in the market.

Keywords: Market price risk management; Overlay management; Currency hedging; Asymmetric hedging strategies; Quantitative finance

Introduction

Being exposed to financial market price risk is an omnipresent aspect of investing. This includes the risk of capital losses when investing in the stock or bond market or the risk of currency fluctuations when investing abroad. Yet, making the trade-off between the expected returns from such activities against the associated risks remains a difficult decision. The extreme points of the risk-taking spectrum are (i) seeking the maximum expected return without controlling the risk and (ii) avoiding any risk at all and thus also giving up any potential return. However, most investors would prefer a more balanced solution, which may take the form of a symmetric risk profile or an asymmetric risk profile as shown in the Figure 1.

A symmetric risk profile mitigates both unfavorable and favorable outcomes of the risk factors by a similar amount and can be obtained passively by entering into a forward or a future contract. In contrast, an asymmetric risk profile mitigates only the particularly unfavorable outcomes to a substantial extent, but reduces all other outcomes by a rather small amount. An asymmetric profile can be implemented passively by buying a put option. Alternatively, an option-like profile can also be generated by an active hedging strategy based on trend-following models, which gradually hedges the risk factor if it develops towards an unfavorable outcome and otherwise gradually unwinds the hedge.

We find that though symmetric strategies commonly outperform asymmetric strategies in sideways markets, asymmetric strategies lead to superior performance in bull and bear markets. Further, active trading strategies create an asymmetric risk profile similar to an option-based protection, but also offer the prospect of outperforming it.

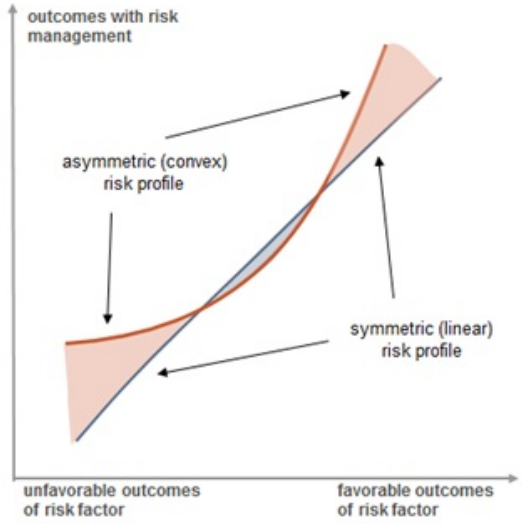

Figure 1: Risk return profile.

In this article, we begin by comparing the general properties of symmetric and asymmetric hedging approaches in the introduction part. We discuss active hedging based on trend following models and suggest a passive option-based strategy to benchmark trend following strategies in the symmetric and asymmetric hedging strategies part. Further in this section we analyze and compare different hedging approaches on historical currency market data. Finally, in Alternative constructions of the asymmetric option strategy part, we reflect on the unique properties of trend-following models and how they may contribute to outperforming passive option-based hedging strategies.

Symmetric and Asymmetric Hedging Strategies

Managing market price risk does not seem very hard in hindsight: In a bear market any investor will appreciate a full hedge. In a bull market any hedging activity will incur costs, which the investor may regret. When looking ahead, on the other hand, the question about the optimal hedging becomes more challenging.

Firstly, the investor must choose between a symmetric and asymmetric hedging approach. In the symmetric case, being fully hedged or not hedging at all are typical choices, but have the drawback of being costly if the market moves the other way. A symmetric hedge of 50%, which is often called the minimum regret ratio, serves as a compromise between these extreme alternatives. The typical passive asymmetric strategy is the protective put. Frequently, an at-the-money (ATM) put strategy is chosen as the investor wants to have an unbiased protection at the prevailing market level. We will give some further thoughts about the structuring of a protective put strategy at the end of this section. If the investor chooses an asymmetric strategy, he has the further option to do it actively, as we discuss in the next section. Here we focus on comparing the pay-off profiles of the two basic passive hedging approaches (symmetric 50% hedge and ATM put).

Schematic pay-off profiles for symmetric hedges and the put option are depicted in Figure 2. The relationship between the pay-off of the symmetric strategies and the underlying are linear, while the option yields the typical "hockey-stick" profile. This means that the asymmetric strategy will only contribute a positive pay-off after the underlying has fallen "far enough", while the benefit of the symmetric strategy is immediate. When the price of the underlying rises, the opportunity cost of the symmetric hedge increases, while that of the option is bounded by the premium.

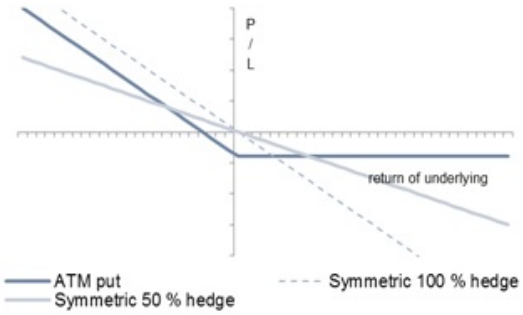

Figure 2: Comparison of schematic pay-off profiles of symmetric and asymmetric hedging approaches. The pay-off of the protective put strategy rises linearly with falling asset prices and loses the (constant) premium otherwise. The pay-off profiles of the symmetric strategies are linear for falling and rising asset prices.

When we subtract the pay-off of the ATM put from that of the symmetric 50% hedge, we get a schematic of the corresponding outperformance of the option over the symmetric hedge shown in the Figure 3. We see that it increases linearly with the absolute value of the price change in the underlying. For small changes the option underperforms the symmetric hedge. The exact range where this happens is determined by the option premium.

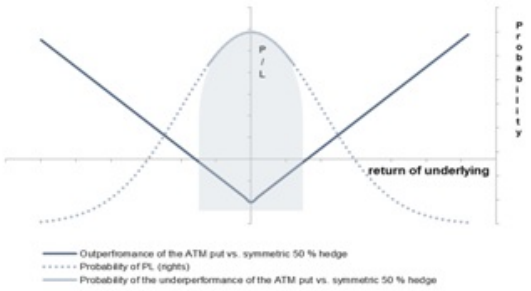

Figure 3: P/L and probability of the outperformance of ATM put vs. symmetric 50 % hedge.

Making standard assumptions about the return distribution of the underlying (normally distributed returns indicated by Gaussian curve in Figure 3), we may conclude that the expected return is independent of the chosen hedging strategy. Indeed, considering the high probability of only small price changes (blue area in Figure 3), we see that the under performance of the asymmetric strategy is quite likely, but small in size relative to the possible outperformance for large price movements as shown in the Figure 3. It is helpful to compare the corresponding return distributions resulting from the two hedging strategies shown in the Figure 4. The asymmetric strategy leads to a skewed return distribution where the negative tail risk is eliminated. The distribution resulting from the symmetric strategy on the other hand retains the shape of the underlying distribution, which includes the negative tail.

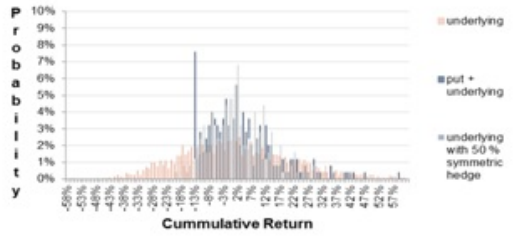

Figure 4: Comparison of return distributions of hedged portfolios, where the hedge is implemented with an ATM put and symmetric 50% hedge. The plot is based on simulated returns having a normal distribution centered around zero.

Based on prior analysis of the pay-off profiles one may conclude that the symmetric hedge performs best inside ways markets, which experience only small price movements. Similarly, one would expect that asymmetric strategies benefit from trending markets with large moves in the underlying. In conclusion we believe the asymmetric approach to hedging to be superior in practice. Although the symmetric approach may produce lower hedging costs in sideways market, it also exposes the investor to the risk of unlimited costs in general. Large losses inferred by large market moves are particularly

painful for the investor. This is where asymmetric strategies provide a better protection. This characteristic together with the ability to also let the investor participate in the upside makes asymmetric hedging the preferable hedging approach in our eyes.

Alternative constructions of the asymmetric option strategy

Due to the imposed costs of an asymmetric hedging approach, investors try to improve protective put strategies by choosing different strike levels other than ATM. Setting the strike in-the-money (ITM) is often not reasonable for hedging purposes, because one would have to pay the intrinsic value in addition to the option time value. So the viable alternative is setting the strike out-of-the-money (OTM), which results in a lower option premium. The higher probability of the option expiring worthless is the reason for the option premium being cheaper. Although OTM options are cheaper than ATM options, they also provide a lower level of protection.

In this sense buying an OTM put makes particularly sense if the investor has a more positive view on the market. The reduced hedge efficiency is accompanied by a higher rate of participation in any upward move. Figures 5 and 6 illustrate the effect that shifting the strike has on the pay-off profile of the put option and the outperformance range of the OTM put over a symmetric 50% hedge.

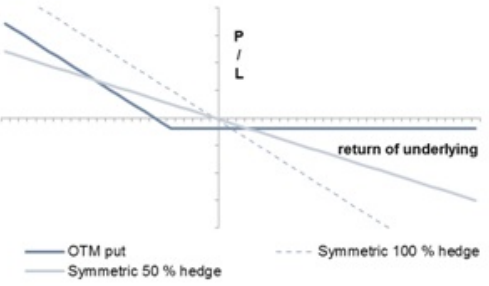

Figure 5: Comparison of schematic pay-off profiles of symmetric and asymmetric hedging approaches. The asymmetric approach is based on an OTM put.

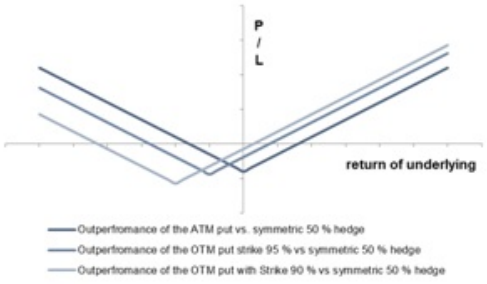

Figure 6: Outperformance of the option vs. symmetric 50% hedge. The asymmetric approaches are based on OTM puts with different strike levels.

In a rising market the OTM option will perform better than the ATM option, but this will be reversed in falling markets. We may conclude that setting the strike differently changes the resulting hedge profile with advantage in rising markets, it does not lead to a better performing hedge in general. Also the ATM put option is the preferred unbiased hedging strategy for an investor who does not want to express his market view in the hedging strategy.

Implementing and valuing asymmetric hedging strategies

While the asymmetric hedging profile may be implemented passively by a rolling ATM put, we believe that an asymmetric hedge can be implemented more effectively with an active strategy based on trend-following models. This offers the prospect of outperforming the option strategy while keeping the characteristics of an asymmetric strategy.

Implementation via trend-following models

The models used in the Trend Following Overlay have a representative trend-following character and are used for market price hedging. Their decisions are based solely on market price data. When a significant market move occurs, a trend-following model will take a position in the direction of the trend and keep this position until it identifies the beginning of a trend in the opposite direction. In sideway markets these strategies will lack performance due to unprofitable trading signals.

The active hedging strategies are made up of several trend-following models acting in concert. The binary signals of individual models are thus translated into a more gradual increase and decrease of the hedge ratio, which is comparable to the waxing and waning of the delta of the option. Further, from Figure 7 we see that this hedging strategy yields an asymmetric risk profile.

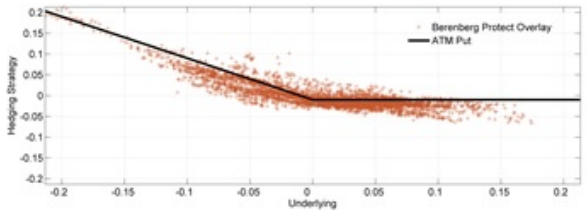

Figure 7: Real money data for a EURUSD currency overlay. Each dot represents the return over a time period of 3 months. The total time period is 01.01.1999 to 30.06.2014.

Evaluation of asymmetric strategies

The comparison of symmetric and asymmetric strategies suggests that any active asymmetric strategy should be evaluated against a benchmark that shares its particular characteristic. Unfortunately a passive strategy of rolling a single put option is problematic as a benchmark, because its performance depends significantly on the timing of the rolls. This is due to the fact that on the day of the roll the delta of the option is reset – independent of any price movements. Also, the new strike depends only on the price of the underlying on that same day as shown in the Figure 8 – the red arrows indicate the dates of the rolls).

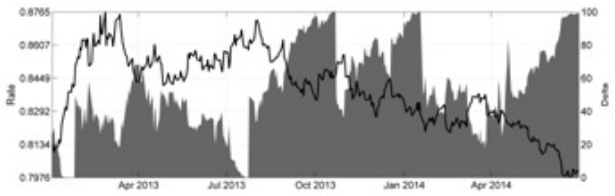

Figure 8: Option's delta for a single rolling option, where the strike is set at-the-money. The red arrows highlight the synthetic delta resetting to 50 % at roll-over. (EURGBP EUR Long 01.01.2013–30.06.2014).

To avoid the shortcomings of a single rolling option we construct a composite benchmark. To avoid the dependencies on the starting date, we assemble a basket of 90 options starting with a one-day delay. All options are weighed equally. Each option has a maturity of three months and is rolled-over at maturity. The strikes are chosen at-the-money for the abovementioned reasons. This procedure leads to a benchmark independent of the starting date and featuring a continuous evolution of the averaged delta. Though the practical implementation of the benchmark is much more complex due to the large number of options, we gain a higher degree of stability. We therefore believe that this is a solid benchmark for evaluating active asymmetric strategies and will use it in the following sections.

Illustrating the characteristics of different hedging strategies on market data

In the following, we will analyse the performance of an active trading strategies using the models from the Trend Following Overlay by comparing it to a symmetric 50% hedge and the asymmetric option-based benchmark.

In order to analyse the performance with respect to different market regimes we divide the time period 01.01.2013-30.06.2014 into three representative subparts:

- Bull market: 01.01.2013 - 01.03.2013
- Sideways market: 01.03.2013 - 01.05.2014
- Bear market: 01.05.2014 - 30.06.2014.

In Figure 9 the outperformance of the trend-following strategy (denoted by "Strategy") against the option benchmark and the symmetric hedge are shown, as well as the outperformance of the option against the symmetric hedge. Also, the corresponding hedge ratios are displayed. We note the high consistency of the deltas of the active and passive asymmetric strategies.

The bull market time period is depicted in Figure 10. Here the asymmetric benchmark clearly outperforms the symmetric hedge, and the active Trend Following Overlay strategy outperforms both passive strategies. This is in line with our expectations. We see that the outperformance of the trend-following strategy against the asymmetric benchmark is due to its ability to attain a zero hedge ratio.

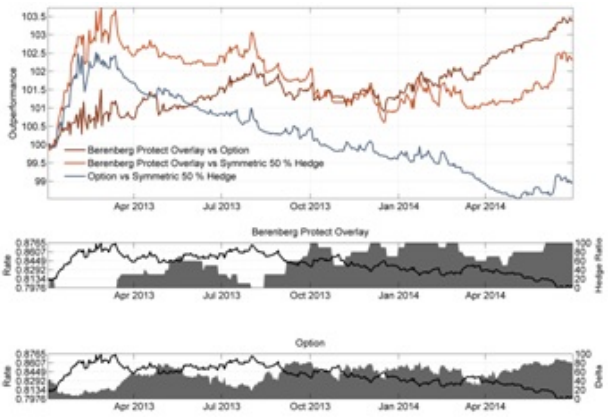

Figure 9: EURGBP EUR Long 01.01.2013 – 30.06.2014, relative performance of the asymmetric and symmetric strategies (top) and hedge ratios corresponding to the asymmetric strategies (bottom).

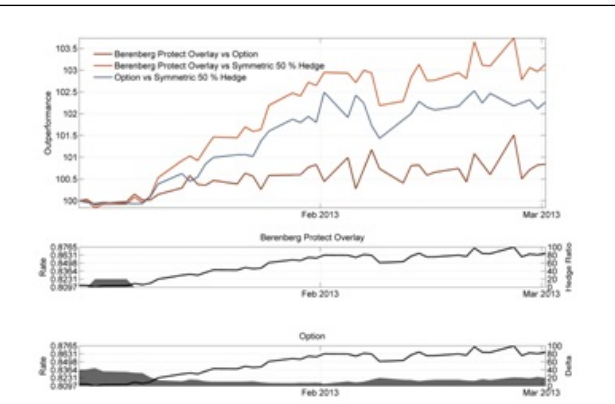

Figure 10: Example for a bull market. (EURGBP EUR Long 01.01.2013–01.03.2013).

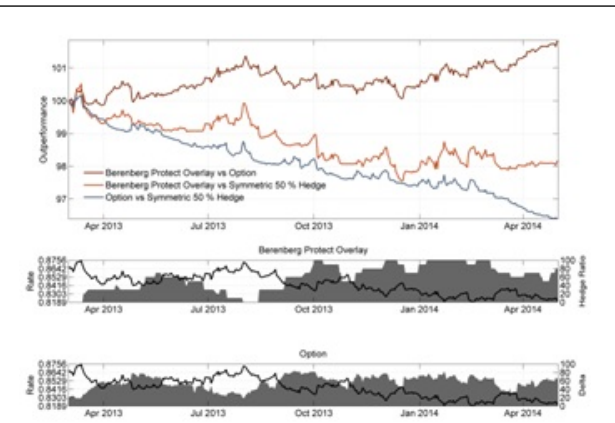

Figure 11: Example for a sideways market. (EURGBP EUR Long 01.03.2013 – 01.05.2014).

In the sideways market shown in Figure 11 both asymmetric strategies clearly underperform the symmetric hedge. However,

compared to the option strategy, the trend-following strategy produces about half the hedging costs.

In the case of a bear market shown in the Figure 12, the option strategy outperforms again the symmetric hedge, while the Trend Following Overlay strategy outperforms both strategies. This time it is the ability to attain a hedge ratio of 100 % that gives the trend-following models the advantage over the option benchmark.

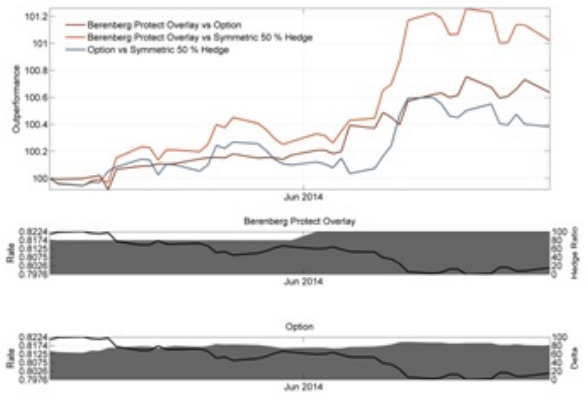

Figure 12: Example for a bear market. (EURGBP EUR Long 01.05.2013 – 30.06.2014).

Differences between active and passive asymmetric hedging

We have seen that a trend-following system can be expected to outperform an option-based asymmetric strategy in many cases. But it may sometimes also fail to do so. Here we are interested in specifically comparing their performance against the option based benchmark. We already know that this benchmark performs well in directional markets and struggles in range markets, and that the same is true for trend-following systems. But the two approaches also differ in important aspects:

- The price of the option depends, among other things, on the implied expectation of future volatility, while trend-following systems act on the realized price movement.

- The periodical reset of the strike on rolling the option leads to a relatively narrow distribution of the hedge-ratios for the option-basket. A trend-following system on the other hand is able to attain more extreme hedge-ratios of 100% or 0% over a period of time.

- The delta of an option moves continuously with the underlying. So an option-based strategy will immediately adjust its hedge-ratio with every market move. A trend-following system takes a position based on the historical market context. This may enable the model to detect a trend early on, or lead to a time lag, where the model hesitates to make a position until "the trend has been established".

These observations suggest some hypotheses about when a trend-following system may outperform the option-based asymmetric benchmark:

- In periods where the realized volatility of the market is lower than the one implied by option prices, we should expect the trend-following system to beat the option strategy. Similarly, in cases where the implied volatility underestimates the amplitude of the realized price movements the strategy will be harder to beat.

- Trend-following systems should be better at benefiting from strongly directional markets than the option strategy due to their ability to maintain extreme hedge-ratios.

- Trend-following systems will struggle in markets characterized by high short-term noise, because it makes it difficult to correctly identify mid- and long-term trends.

The second hypothesis was illustrated in the previous section shown in the Figures 10 and 12. We therefore here restrict ourselves to the items (1) and (3).

Implied vs realized volatility

Implied volatility contains expectation on future volatility as well as premiums for the option seller. Often the expectation on future volatility fails to realize in the market. In these cases, we expect trend-following strategies to have an advantage over the asymmetric option strategy due to the relatively high option premiums. Our experience shows that this is indeed the case as is illustrated in Figure 13 for EURUSD data. The lower implied than realized volatility as from December 2008 to July 2011 and from December 2011 until July 2012 in Figure 13 improves the relative performance of the trend-following system. On the other hand, in the longer period of lower premiums as from March 2006 to January 2009, from May to December 2011 and from March 2013 to June 2014 shown with the circles in Figure 13 the outperformance is less pronounced.

Figure 13: Outperformance of the active trend-following hedge on EURUSD over the put protection depending on the difference between the implied and realized volatility.

Market character on different time-scales

When we talk about directional or sideways markets it is always with respect to a certain time-scale. A time-series which exhibits a mean-reverting behavior, i.e. oscillates around a certain mean over the span of a year, may still show significant moves of a shorter duration, which one might identify as a (short-term) trend. Conversely, a trending time-series may be interspersed with periods of a mean-reverting character. A typical trend-following model is attuned to identify trends on a specific time-scale, and may consequently struggle to benefit from trends on longer or shorter time-scales. In other words, a trend may not "last long enough" for the model to catch on to it in time. Also, a long-term trend may be hidden by high volatility in the short-term.

We illustrate this effect by studying the performance of one of our models. This model feeds on intraday data and is attuned to identify

trends on a relatively short time-scale. Intuition suggests that for this model to profit from a trend, it would need to persist over a number of days before changing direction (depending on the size of the price movement of course). Conversely, a volatile mean-reverting behavior on a short time-scale (intraday) will provoke the model into triggering erratic and loss making signals.

We aim to identify periods where a time-series has favorable or adverse characteristics with respect to our model. To this end we analyse the volatility characteristics of that time-series. More precisely, we contrast volatility on a daily time scale (which should be good for the model) with intraday-volatility (which should be problematic). The former is measured by the conventional close-to-close volatility , the latter by an extreme-value-based volatility estimator P:

$$\sigma^2 = \frac{1}{n}\sum_i \left(\ln\frac{S_{i+1}}{S_i}\right)^2, \quad P = \sqrt{\frac{1}{4In(2)n}\sum_i \left(In\frac{S_i^h}{S_i^l}\right)^2}$$

Where is the look-back window in days [1]. Following Taleb [2], we consider the ratio (Parkinson ratio):

$$I = {}^{P}\!/_{\sigma}$$

We use a look-back period of 60 days for both estimators. A Parkinson ratio greater than one (I>1) corresponds to high intraday-noise relative to close-to-close volatility. Figure 14 illustrates the information that the Parkinson ratio confers by showing two exemplary time-series having a low and a high Parkinson ratio respectively [3].

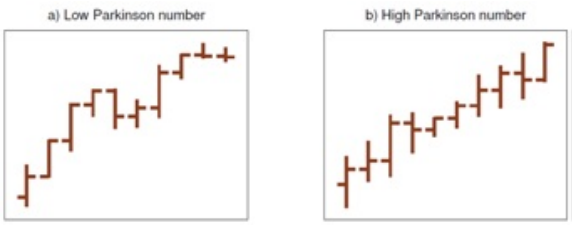

Figure 14: Illustration of the information conferred by the Parkinson ratio. The figure contrasts two time series exhibiting a Parkinson ratio smaller (a) and greater than one (b) respectively. Notice the relatively tall intraday-bars in (b) compared to the close-to-close changes.

We test our indicator by analysing EURUSD market data and examining the real-money performance of our model from January 2006 until May 2014. We do not start before 2006 because option price data become unreliable. In Figure 15 we compare the cash flow of the hedge delivered by the model (executing short-signals only) with that of the option-based benchmark. Periods of high intraday-noise (I>4) are shaded. The curve labeled "outperformance" is the difference between the two corresponding equity curves. So an increase in this curve indicates that the hedge delivered by the model yields a higher return (or lower costs) than the one delivered by the put-option-basket.

We observe that in periods with a low Parkinson number (for example the year 2010), the trend-following model tends to outperform the asymmetric benchmark. On the contrary, in the periods with a high Parkinson number (notably the years 2012 and 2013) the model tends to fall behind the benchmark [4].

In summary we see that though sometimes certain market determinants may set trend-followers at a disadvantage, they still offer a robust hedging solution with reliably asymmetric profile. Further, in many cases their unique properties offer the prospect of outperforming an option-based passive strategy.

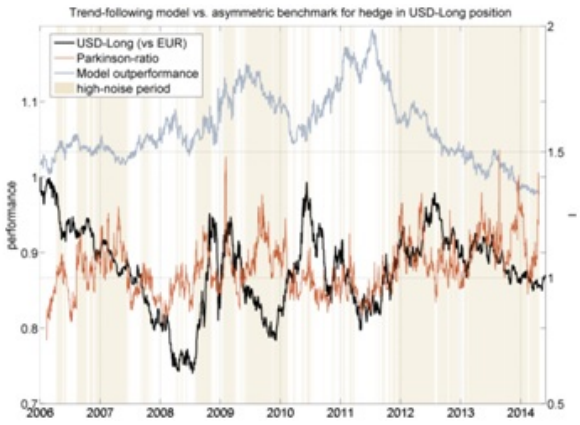

Figure 15: Outperformance of the hedge delivered by a trend-following model over the asymmetric benchmark comprised of a put-option basket. "Model outperformance" marks the difference of the respective equity curves. Periods where the Parkinson ratio is greater than one correspond to the shaded "high-noise periods". The shown Parkinson-ratio is the median out of three different fixing times (London, New York and Tokyo).

Conclusion

We believe that asymmetric hedging approaches are preferable in practice, because they are able to mitigate the most problematic risks for the investor. Symmetric hedges are appealing due to their simplicity, but in rising and falling markets asymmetric strategies offer better participation and protection respectively. As such, asymmetric hedging strategies are particularly well suited for tail-risk hedging. As for the currency market analysed above, the active asymmetric overlay strategy results in an appealing hedging characteristic for the equity, fixed income and liquid commodities market as well [5].

We have argued that trend-following strategies do not only yield a similar performance characteristic to that of a put option, but could be superior to it in two respects. One, they have a distinct focus on the risk coming from large market movements. Two, they reduce the major shortcoming of an option based strategy – the cost.

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