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A COMPARISON OF DIFFERENT FAMILIES OF PUT-WRITE OPTION STRATEGIES

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Abstract: *In [5] the authors study and analyze the performance properties of certain put-write option strategies on the S&P500 index, and they find that these strategies show a systematic outperformance. This outperformance is a consequence of the observation that, in the past, the implied volatility often overestimated the actual volatility of the S&P500 index. The strategies studied in [5] are based on trading put spreads only. In the discussion following the publication of [5], the question frequently arose, if whether working with naked put short position instead of put spreads can even further increase the performance of these strategies. In this paper we study this question and can answer it in an essentially negative way.*

Keywords: *put options, trading strategies, Black-Scholes formula, outperformance, implicite volatility, historic volatility, sharpe ratio.*

Introduction and Aim of the Paper

In [5] we have stated several assertions of different authors about the fact that put options on various underlyings with strikes in a certain out-of-the-money region seem to be systematically overpriced. We do not repeat these assertions here, we just give some references: See for example [1], [2], [3], [4], [7], [8] or [10]. Motivated by these assertions we define in [5] a class of special put-write option strategies, test these strategies under realistic conditions with historic option prices for the time period 1990 until 2010, and find that most of these strategies indeed showed a significant outperformance in the past. (Other investigations in this direction earlier were carried out for example in [6] or in [9].) Of course there are several different setup possibilities for put-write strategies which are of interest in this context. In [5], for the reasons stated below, our strategies consist not only of shortening of put options, but also contain long positions in certain put options. The following four priorities determine our concrete choice of the principal setup:

- No margin calls for the duration of the strategy (i.e., in any case, the possible losses must be limited by the actual investment sum);
- Trading short-term options, i.e., options terminating on the next third Friday of a month;
- Optimal utilization of the invested capital;
- Seeking to avoid total losses by limiting losses with the help of strict exit strategies.

These priorities result in the following rules for our strategies in [5]:

- Each short position in a put option is combined with a long position in a put option with the same maturity and with a strike $\overline{K}_2$ lower than the strike $\overline{K}_1$ of the short position. This construction guarantees that the maximum loss for one contract of such a long/short combination is limited by $100 \cdot (\overline{K_1} - \overline{K_2})$. Note that the contract size of S&P500 options is 100.
- Let I be a given total investment sum in US dollars. On the third Friday of each month, we invest in $A = \left\lfloor \frac{I}{100(\overline{K}_1 - \overline{K}_2)} \right\rfloor$ contracts of short/long combinations of put options on the S&P500 with maturity on the third Friday of the next month. This choice of the number of contracts ensures that no margin call could be triggered.
- Gains will be reinvested in the next trading period (i.e., the next trading month).
- During the whole period, the available investment (in dollars, parked on a margin account) yield additional interest. We assume the following interest rate

$$\max[0,\min[7,3\ monthLibor - 0.5]].$$

- Each strategy is equipped with a mechanism (an "exit strategy") which seeks to limit losses. We test two fundamentally different types of such mechanisms:
  1. Close all positions as soon as the S&P500 falls below a specified level (below $\overline{K}_1$, or below a certain percentage of $\overline{K}_1$) ;
  2. Close all positions as soon as the aggregated losses of these positions rise above a certain level (percentage of the investment sum I).

After closing positions, we wait until the next third Friday and then we proceed with opening new positions on the next third Friday.

It is certainly necessary to give some further arguments for choosing to combine short positions with long positions instead of trading naked short positions only. In several of the papers cited above it was pointed out that out-of-the-money put options are the more overvalued the more out-of-the-money they are. At first glance, it may thus seem odd that a strategy that sells closer to the money puts and buys further out-of-the-money puts should be profitable. The main reason for such a strategy is that in many countries the regulations for fund management demand that, even in the worst case, the losses cannot exceed the invested sum. This demand is satisfied if each short position is combined with a long position in the way described above, whereas it is not satisfied if we use naked positions only.

Furthermore, in most cases, the combination of short with long positions, due to the usual margin regulations for options, allows us to trade substantially more short positions than naked positions only would allow. As already mentioned above, it protects in any case from margin calls and eventual necessary premature closing of contracts because of margin requirements (for more details on the negative impact of margin calls to the profitability of put short strategies see [9]).

Let us illustrate the situation with a concrete example: Assume a basis investment sum of \$100,000, for example, on July 23, 2007. The closing value of the S&P500 was at 1541 points. In one of the strategies considered in [5], we trade - according to the framework defined above - 20 contracts put short August 2007 with strike 1450 and 20 contracts put long August 2007 with strike 1400. The prices were

\$4.9 for the short positions and \$2.3 for the long positions. Hence, we obtain a premium of 20×260=\$5,200 (not taking transaction costs into account in this example). Without long positions (and assuming a realistic margin requirement of 15% of the strike per short position) it would have been possible to trade only 4 contracts of naked short positions, at a price of \$4.9. This would have resulted in a premium of only 4×490=\$1,960. Assume now that the short position was overpriced by 10% and the long position even by 15%. That means that the fair prices of the positions were \$4.45 for the short position and \$2.00 for the long position. In this fair market, we would have obtained a premium of 20×245=\$4,900 for our 20 short/long combinations. Thus, although the long position is more overpriced than the short position, the premium of \$5,200 for the combinations is higher than the fair price.

On the other hand, of course, if positions must be closed, we would have to close more combinations than naked positions. It is, however, cheaper to close a combination than to close a naked position. This fact, together with the regularly substantially higher premiums obtained for combinations, seems to make combination strategies at least as profitable as the corresponding short-only strategies.

To investigate if this is indeed the case is the topic of this paper. We will, however, not give a full comparison of the short-only analogs of *all* the strategies analyzed in [5], but we take the most interesting (in different aspects) strategies of [5] and compare them with their naked position analogs. By analyzing these strategies we give an answer to the first open problem given in the collection of open problems in the final chapter of [5].

We will show that - at least for these types of strategies - the naked position strategies still show a significant outperformance under realistic assumptions, but they do not perform as well as the put spread based versions.

The "realistic assumptions" are based on (i) the depth of experience of the second author, who has been following such strategies in his asset management company since 2002 and (ii) historical option prices for the period January 1990 to May 2011. We use data from *MarketDataExpress* for European options on the S&P500 index traded at the Chicago Board Options Exchange. This dataset includes daily high, low, open, last, and last bid/ask prices for the period from January 1990 to May 2011.

In Section 2 we will give the setup of our tested strategies in more detail and in Section 3 we will give the results for the tested strategies, their comparison with the put spread based versions and a discussion of the results.

The setup for testing the strategies

In [5] we have tested a whole universe of strategies. The strategies considered in this paper have the same structure as the strategies in [5], with the only difference being that we use naked put option positions only, wherever in [5] we use put spreads. This influences the number of positions that can be traded. For the case of put spreads the number of traded contracts is given - depending on the investment and on the strikes K_1 and K_2 - by the second rule in Section 1. For example, if we have an investment of \$100,000 and the difference between K_1 and K_2 is 50 points, then we can trade 20 put spread contracts in this case. If we do not use long positions but short positions only, then we have to meet margin requirements of the exchange. As can be seen below, in almost all cases, we will be invested in short positions with a strike lower than the current value of the S&P500. Only in some situations we will have a value of the S&P500 which is at most 5% less than the strike of the short positions in the strategy.

In all cases of our strategy, therefore, the following rule for our margin management will meet the regulations of the CBOE: “For each traded short position in a put option we reserve 15% of the strike of this option as margin.”

So in the above example assume that the strike K_1 is 1000. Then for each option contract we have to reserve \$ 15,000 as margin, i.e., we can trade 6 contracts of naked positions based on an investment of \$ 100,000.

For the sake of completeness we also repeat here the details of the setup. Given the basic framework explained above, the variable parameters of the short-only strategies are:

- Strike $\overline{K}_1$ of the short option;
- The exit strategy.

The “realistic assumptions” are:

- Since our historical data provides the daily high, low, open, last, and the last bid/ask prices for each option on the S&P500 and for each trading day, we assume opening of contracts on each third Friday at the end of the trading day, based on the last price of the S&P500 and on the last bid/ask offer.

We assume opening prices

$$\frac{2}{3} \cdot \text{Bid} + \frac{1}{3} \cdot \text{Ask} \qquad \text{for the short position}$$

and

$$\frac{1}{3} \cdot \text{Bid} + \frac{2}{3} \cdot \text{Ask} \qquad \text{for the long position}$$

- Depending on the exit strategy chosen, it may be necessary to close positions during a trading day. To obtain the corresponding price for the particular option (in general we do not have historical tick prices for our options), we first use the Black-Scholes equation to calculate the implied bid/ask volatilities for this option from the last bid/ask offer of the options and the last price of the S&P500 on this trading day. Then we use these volatilities and again the Black-Scholes equation to compute the bid/ask prices for the particular option for other S&P500 values on this trading day.
- The transaction costs are adopted from the actual transaction costs of a particular international online broker, namely \$1.50 per option contract.
- Whenever a (mathematical) rule for the choice of a strike for a short position suggests a certain real number K_1, the actual available option with the largest strike $\overline{K}_1$ less or equal to K_1 is chosen. If such an option is not available at all, there is no trade in this trading month (the interest payment for the basic investment is simply accumulated).

As already pointed out above, the variable parameters in our strategies are:

- Strike $\overline{K}_1$ of the short position ($\overline{K}_1 \leq S_0$ = the current price of the S&P500);
- The exit strategy.

We make several general remarks on the different parameter choices.

Choosing the strike $\boldsymbol{\overline{K}_1}$ *for the short position*

In [5] we consider five basic philosophies (note that, hereafter, we always give upper bounds K_1 for $\overline{K}_1$). For the present paper it is sufficient to define three of them:

- K_1=fixed percentage$\cdot S_0$ (S_0 is the current price of the S&P500). For example, K_1=0.9$\cdot S_0$. This is the most "naive" type of strategy. The parameters we choose for K_1 are:

$$K_1 = (1 - 0.02n_1) \cdot S_0,$$

$$n_1 \in \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

- K_1= a percentage chosen depending on (some) historical volatility of the S&P500 $\cdot S_0$.

For example, K_1=(1−0.3$\cdot hv$)$\cdot S_0$, where hv is the annualized historical volatility estimated from the daily S&P500 returns (based on open prices) of the last 20 trading days. That means, the "risk-distance" depends on the volatility realized during the last trading period. The parameters we choose for K_1 are:

$$K_1 = (1 - 0.1n_2 \cdot hv) \cdot S_0,$$

$$n_2 \in \{1, 2, 3, 4, 5, 6, 7\}$$

- K_1= a percentage chosen depending on the implied volatility of the S&P500 represented by the actual VIX-value $\cdot S_0$. For example, K_1=(1−0.3$\cdot VIX$)$\cdot S_0$. This means that, the "risk-distance" depends on the volatility anticipated by the market for the coming trading period. In this case the parameters we choose for K_1 are:

$$K_1 = (1 - 0.1n_3 \cdot VIX) \cdot S_0$$

$$n_3 \in \{1, 2, 3, 4, 5, 6, 7\}$$

In this paper we test only these three classes of strategies in full detail. It seems to be not interesting to study the last two philosophies of [5] because one of them (*the minimum premium strategy*) yields very similar results as the VIX dependent strategy and the last one performs significantly worse among all the tested strategies.

Choice of exit strategy

In order to limit losses and avoid total losses, the trading strategies must be equipped with exit strategies. Each of our tested exit strategies consists of the directive to close all positions under specific conditions. We test two different exit strategies:

- Type I: We close all positions as soon as the S&P500 reaches K_1 (or a specified percentage of K_1, e.g., $0.99 \cdot K_1$).
- Type II: We combine the type I exit directive with a defined boundary for the losses. For instance, during the trading month, the value of the whole portfolio is determined continuously. When this value falls below a certain percentage of the initial investment I for the actual trading month, all positions are closed. The directive is then, for example: Close all positions as soon as 'current portfolio value $\leq 0.8 \cdot I$'.

Type II exit strategies are thus always a combination of two closing directives, which means we must close all positions as soon as one of the two conditions is fulfilled.

For the exit strategies we choose the following parameters:

Any of the following 3 Type I exit-conditions:

- close all positions as soon as S&P500 reaches $K_1 - 2\%$;
- close all positions as soon as S&P500 reaches $K_1 - 1\%$;
- close all positions as soon as S&P500 reaches K_1;

combined with any of the 6 Type II exit-conditions:

- no condition on the losses;
- close all positions as soon as the losses exceed 5% of I in the current trading month;
- close all positions as soon as the losses exceed 10% of I in the current trading month;
- close all positions as soon as the losses exceed 15% of I in the current trading month;
- close all positions as soon as the losses exceed 20% of I in the current trading month;
- close all positions as soon as the losses exceed 25% of I in the current trading month.

3 Concrete testing results and their discussion

In [5] we created a Mathematica program for testing the put-write strategies for a total of 4,512 different parameter choices for the whole time period January/February 1990 until September/October 2010 (249 trading months) and for each of the following sub-periods:

- Jan. 1990 until Dec. 1999
- Jan. 2000 until Dec. 2010
- Jan. 1994 until Dec. 1996 (low volatility period)
- Jan. 2003 until Dec. 2006 (low volatility period)

- Jan. 2000 until Dec. 2002 (high volatility period)
- Jan. 2007 until Dec. 2010 (high volatility period, financial crisis).

In this paper we are first interested in the strategies tested in [5] with the "best performance properties" over the whole period January/February 1990 until September/October 2010 and over the period January/February 2000 until September/October 2010, and we will compare the properties of these best strategies with the properties of their analogs when using short positions only. In this paper the time period is longer (until May 2011) to use as much data as possible, but the results for the return per annum and for the Sharpe ratio can be compared with the results in [5].

The "best" strategies of [5] are given by the Tables 1, 2 and 3. Table 1 gives the best performing strategies over the whole period 1990 until 2010, Table 2 gives the best performing strategies over the period 2000 until 2010, and Table 3 shows the two best "easy manageable" strategies over the whole period.

What do we mean by "easy manageable"? The best strategies in terms of return p.a. were strategies for which the choice of K_1 is based on a fixed distance from the S&P500 at trading day (0% or 2% distance) or on VIX (10% VIX distance) or on historical volatility hv (10% distance), i.e., for choices of K_1 near at-the-money. Choosing K_1 near at-the-money seems to give the best results. However, these parameter choices are in some sense risky in practice. The value of such portfolios can vary extremely quickly, and necessary exit-reactions may in reality take effect too late. The probability of many successive losses is high and may lead to total loss for such choices of parameters. So in [5] we have defined classes of strategies which do not show this somewhat erratic behavior and we will call them "easy manageable".
In Table 2 we use E_2 to denote a family of exit-strategies as follows:

$$E_2 \coloneqq \text{exit at } 0.99 \cdot K_1, \text{ or } 0.98 \cdot K_1, \text{ each combined with a 5\% loss boundary.}$$

In all tables, for our purposes (use of naked positions only) the choices of the parameter K_2 (the strike of the long position in the put spread) is of no relevance.

In the following we now give the corresponding performance results for the above strategies when we use short positions only.

As we can see in Table 4 and 5, all strategies, also when carried out with short positions only, show a significant outperformance. However, in each case the performance results are, by far, not as good as in the corresponding put spread versions (both concerning return per annum as Sharpe ratio). Indeed, the strategies with best performance results for the put spread case, do not give the best results in the short-only cases. This is illustrated by Table 6 where we give the 10 best short-only results over the whole period 1990 - 2011 from our investigated universe of strategies. Again in the case of short-only strategies as in the case of spread strategies, we obtain the best results in terms of return p.a. for K_1 near at-the-money. Since these strategies have the same disadvantages described for the put spread, we list the best "easy manageable" short-only strategies in Table 7.

All these numerical results support our conjecture stated at the end of Section 1. In this paper we can give only the pure performance values of the strategies. In detailed studies, we have also investigated the behavior of the strategies in each single trading month. The detailed chronology of the single strategies tested above, with all trading parameters for each single trading month can be found under http://www.finanz.jku/short-only/results.

To explain the reasons for the better performance of the spread strategies in comparison with the short-only strategies let us consider one example in detail: In Table 5 we see that the strategy with parameters:

$K_1 = (1 - 0.1 \cdot VIX) \cdot S_0,$

$K_2 = 0.97 \cdot K_1,$

Exit at 15% loss or at $0.98 \cdot K_1$

shows a return p.a. of 59.95% over 10 years in the spread case, whereas it has only 5.36% p.a. in the short-only case. In Table 8 we give more information on the characteristics of the two variants of this strategy (put spread and short-only). We choose to give details about this strategy because it shows the largest difference between the returns p.a. for the two variants, but the characteristics that we observe hold for all strategies as well.

It is interesting that the two variants behave quite similar in loss months. There are only few months in which one variant has a loss and the other variant does not. The average value of losses in the short-only case is even smaller than in the spread case. However: The returns in positive months are, on average, significantly higher for the spread strategy (SP) than for the short-only strategy (SO). (The highest monthly return in SO is higher than in SP, only because of an exceptional event in the trading month November/December 2008. Note that the second largest value for a monthly return in short-only strategies is 17.48%.) On average we trade 6.5 times more short positions relative to an available margin in SP than in SO. Although we have to pay premiums for opening the long positions in SP, the premiums obtained for opening the spreads in SP are on average 2.35 times the premiums for opening the short positions in SO. At a first glance it seems that this fact has, as a consequence, significantly more loss months in SP (or significantly higher losses in the case that positions are closed because the level K_1−2% is hit). But, as can be seen in Table 8 this is not the case. The main reason why the number of losses (the height of losses) is not significantly higher for SP than for SO is, that in the moment when positions are closed in the strategies the index has decreased before, so that the open put option positions are much more at the money than in the moment of the opening, so that the proportion

price of short positions : price of long positions

now is much smaller than in the moment of the opening. This results in the fact that the costs of closing the many spreads are insignificantly higher than the costs of closing the fewer short positions only. So one has to close positions in strategy SP at an only slightly higher level of the S&P500 index than this is necessary in the strategy SO.

Concerning possible worst case scenarios, i.e., for example scenarios in which it is not possible to close positions and therefore not possible to carry out exit strategies at all, a total loss in SP happens earlier. So, if for example we consider the concrete example from the end on Section 1 once more: Here, without any closings, a total loss of the actually invested amount would appear as soon as the S&P500 falls below 1400 and it stays here until the 3rd Friday of August. In SO a total loss occurs only when the S&P500 falls below approximately 1284 points (not taking into account possible additional margin calls) and it stays there until the third Friday of August. On the other hand in SP also in the worst case scenario the losses cannot exceed the invested capital, whereas in SO this indeed can happen.

Of course, a comprehensive study of the analogs of *all* strategies considered in [5] would give an even more complete picture. However, the results given above do not motivate such further investigations, since they clearly point out that working with put spreads give better performance results in the most interesting cases.

So, for us, the first open problem stated in [5] is answered. Nevertheless, there still remain several interesting open problems, which we state here again, thereby concluding this paper:

1. Immediate trade after closing:
   In our tests, after the closing of positions as a consequence of an exit scenario, we proceed with a new trade on the next third Friday. Instead it would seem reasonable to use the usually high implicit volatility on a closing day to gain large premiums from an immediate new opening, either for the same trading month or the next trading month. Since, in such a case, we have a different maturity for this variant, we should also discuss adapted risk-distances.
   It would be of considerable interest to analyze the advantages of this approach.

2. Preemptive closing of short positions:
   In some cases (in the versions when we are working with put spreads), when it is necessary to close positions, it should be advantageous to just close the short positions first and the long positions later. The philosophy behind this variant is that a fast-falling market does not usually stop at the very moment when the first (short) positions are closed. We can therefore close the long positions with higher profit at a later time and an even lower value of the S&P500. Although this variant implies further risks, it seems more promising in the long run.

3. Longer maturity options:
   Of course, it is not necessary to carry out our strategies with options of one month maturity only. A rather interesting variant seems to be the following: Invest 50% with a pre-determined strategy in 2-month options. After one month, invest the remaining 50% of the investment - obeying the same strategy - in 2-month options, and so on. This way it would be possible to react with the second trade to developments of the market during the first month.

Obviously, a lot of further aspects should be tested, for example, simultaneous trading of several short-strikes, or a dynamic strategy change for the choice of risk-distances depending on changing market conditions, several aspects of money management, or the use of futures in risk scenarios instead of only closing positions.

Tables

Rank	Choice of short strike	Choice of long strike	Exit Strategy	Return p.a.	Sharpe ratio
1	$K_1=S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.98 \cdot K_1$	84.62%	1.59
2	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 15% loss or at $0.98 \cdot K_1$	79.6%	1.54
3	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 20% loss or at $0.98 \cdot K_1$	76.65%	1.34
4	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 15% loss or at $0.98 \cdot K_1$	76.01%	1.35
5	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.95 \cdot K_1$	at 10% loss or at $0.98 \cdot K_1$	73.2%	1.84
6	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 10% loss or at $0.98 \cdot K_1$	72.36%	1.58
7	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.95 \cdot K_1$	at 10% loss or at $0.98 \cdot K_1$	72.33%	1.67
8	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.95 \cdot K_1$	at 15% loss or at $0.98 \cdot K_1$	71.98%	1.6
9	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 20% loss or at $0.98 \cdot K_1$	71.74%	1.14
10	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 10% loss or at $0.98 \cdot K_1$	70.77%	1.41

Table 1: Best spread strategies in terms of return p.a. over the period 1990−2010

Rank	Choice of short strike	Choice of long strike	Exit Strategy	Return p.a.	Sharpe ratio
1	$K_1=S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.98 \cdot K_1$	75.94%	1.38
2	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.98 \cdot K_1$	64.77%	1.52
3	$K_1=0.98 \cdot S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.98 \cdot K_1$	63.43%	1.56
4	$K_1=0.98 \cdot S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.99 \cdot K_1$	62.3%	1.53
5	$K_1=S_0$	$K_2=0.95 \cdot K_1$	at 5% loss or at $0.98 \cdot K_1$	61.9%	1.29
6	$K_1=(1-0.1 \cdot hv) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 5% loss or at $0.99 \cdot K_1$	61.52%	1.46
7	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.95 \cdot K_1$	at 10% loss or at $0.98 \cdot K_1$	60.34%	1.38
8	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.97 \cdot K_1$	at 15% loss or at $0.98 \cdot K_1$	59.95%	1.06
9	$K_1=(1-0.1 \cdot VIX) \cdot S_0$	$K_2=0.97 \cdot K_1$	E_2	58.81%	1.45

Rank	Choice of short strike	Choice of long strike	Exit Strategy	Return p.a.	Sharpe ratio
10	K_1=(1−0.1·hv)·S_0	K_2=0.95·K_1	at 5% loss or at 0.98·K_1%	57.34%	1.53

Table 2: Best spread strategies in terms of return p.a. over the period 2000−2010

Rank	K_1	Choice of long strike	Exit Strategy	Return p.a.	Sharpe ratio
1	(1−0.2·hv)·S_0	K_2=0.95·K_1	at 10% loss or at 0.98·K_1%	56.63%	1.65
2	(1−0.2·VIX)·S_0	K_2=0.95·K_1	at 10% loss or at 0.98·K_1%	54.85%	1.96

Table 3: Best "easy manageable" spread strategies over the period 1990 - 2010

Rank	Choice of short strike	Choice of long strike	Exit Strategy	Return p.a. put spread	Sharpe ratio put spread	Return p.a. short only	Sharpe ratio short only
1	K_1=S_0	K_2=0.97·K_1	at 5% loss or at 0.98·K_1	84.62%	1.59	18.34%	0.57
2	K_1=(1−0.1·VIX)·S_0	K_2=0.97·K_1	at 15% loss or at 0.98·K_1	79.6%	1.54	26.29%	0.77
3	K_1=(1−0.1·VIX)·S_0	K_2=0.97·K_1	at 20% loss or at 0.98·K_1	76.65%	1.34	17.37%	0.53
4	K_1=(1−0.1·hv)·S_0	K_2=0.97·K_1	at 15% loss or at 0.98·K_1	76.01%	1.35	22.48%	0.65
5	K_1=(1−0.1·VIX)·S_0	K_2=0.95·K_1	at 10% loss or at 0.98·K_1	73.2%	1.84	28.31%	0.88
6	K_1=(1−0.1·VIX)·S_0	K_2=0.97·K_1	at 10% loss or at 0.98·K_1	72.36%	1.58	28.31%	0.88
7	K_1=(1−0.1·hv)·S_0	K_2=0.95·K_1	at 10% loss or at 0.98·K_1	72.33%	1.67	25.36%	0.77
8	K_1=(1−0.1·VIX)·S_0	K_2=0.95·K_1	at 15% loss or at 0.98·K_1	71.98%	1.6	26.29%	0.77
9	K_1=(1−0.1·hv)·S_0	K_2=0.97·K_1	at 20% loss or at 0.98·K_1	71.74%	1.14	8.90%	0.33
10	K_1=(1−0.1·hv)·S_0	K_2=0.97·K_1	at 10% loss or at 0.98·K_1	70.77%	1.41	25.36%	0.77

Table 4: Comparison between return p.a. and Sharpe ratio for spread and short-only strategies over the period 1990−2010

Rank	Choice of short strike	Choice of long strike	Exit Strategy	Return p.a. put spread	Sharpe ratio put spread	Return p.a. short only	Sharpe ratio short only
1	$K_1=S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.98\cdot K_1$	75.94%	1.38	22.87%	0.63
2	$K_1=(1-0.1\cdot hv)\cdot S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.98\cdot K_1$	64.77%	1.52	18.1%	0.60
3	$K_1=0.98\cdot S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.98\cdot K_1$	63.43%	1.56	19.29%	0.62
4	$K_1=0.98\cdot S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.99\cdot K_1$	62.3%	1.53	17.9%	0.58
5	$K_1=S_0$	$K_2=0.95\cdot K_1$	at 5% loss or at $0.98\cdot K_1$	61.9%	1.29	22.87%	0.63
6	$K_1=(1-0.1\cdot hv)\cdot S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.99\cdot K_1$	61.52%	1.46	16.22%	0.55
7	$K_1=(1-0.1\cdot VIX)\cdot S_0$	$K_2=0.95\cdot K_1$	at 10% loss or at $0.98\cdot K_1$	60.34%	1.38	15.59%	0.49
8	$K_1=(1-0.1\cdot VIX)\cdot S_0$	$K_2=0.97\cdot K_1$	at 15% loss or at $0.98\cdot K_1$	59.95%	1.06	5.36%	0.24
9	$K_1=(1-0.1\cdot VIX)\cdot S_0$	$K_2=0.97\cdot K_1$	at 5% loss or at $0.99\cdot K_1$	58.81%	1.45	22.76%	0.76
10	$K_1=(1-0.1\cdot hv)\cdot S_0$	$K_2=0.95\cdot K_1$	at 5% loss or at $0.98\cdot K_1$%	57,34%	1.53	18.1%	0.60

Table 5: Comparison between return p.a. and Sharpe ratio for put spread and short-only strategies over the period 2000−2010

Rank	Choice of short strike	Exit Strategy	Return p.a.	Sharpe ratio
1	$K_1=S_0$	at $0.94\cdot K_1$	43.02%	0.92
2	$K_1=S_0$	at $0.93\cdot K_1$	38.99%	0.86
3	$K_1=S_0$	at $0.95\cdot K_1$	38.11%	0.85

4	$K_1=(1-0.1\cdot VIX)\cdot S_0$	at $0.98\cdot K_1$	38.11%	1.11
5	$K_1=(1-0.2\cdot hv)\cdot S_0$	at $0.98\cdot K_1$	36.70%	1.2
6	$K_1=S_0$	at $0.96\cdot K_1$	36.28%	0.85
7	$K_1=(1-0.1\cdot hv)\cdot S_0$	at $0.98\cdot K_1$	36.01%	1.02
8	$K_1=S_0$	at $0.97\cdot K_1$	35.39%	0.88
9	$K_1=(1-0.3\cdot hv)\cdot S_0$	at $0.99\cdot K_1$	34.52%	1.45
10	$K_1=(1-0.2\cdot VIX)\cdot S_0$	at $0.99\cdot K_1$	34.27%	1.30

Table 6: Best short-only strategies in terms of return p.a. over the period 1990−2011

Rank	K_1	Exit Strategy	Return p.a.	Sharpe ratio
1	$(1-0.2\cdot hv)\cdot S_0$	at $0.98\cdot K_1\%$	36.70%	1.2
2	$(1-0.2\cdot VIX)\cdot S_0$	at $0.98\cdot K_1\%$	33.60%	1.18

Table 7: Best "easy manageable" short-only strategies over the period 1990 - 2010

Type of Strategy	short long spread	short-only
Performance from $ 100,000 to	$ 8,651,623	$ 168,639
Return p.a.	59.97%	5.36%
Sharpe ratio	1.06	0.24
Positive months	74	81
Negative months	46	39
Highest monthly return	25.98%	30.01% (17.48%)
Average return in positive months	18.96%	8.06%
Average monthly loss	−14.71%	−12.35%
Common negative months	37	37

Table 8: Comparison of the strategy with $K_1=(1-0.1\cdot VIX)\cdot S_0$ and exit strategy at $K_1-2\%$ or at 15% loss for the short long spread case (with long strike $=0.97\cdot K_1$) and the short-only case over the time period 2000−2010

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