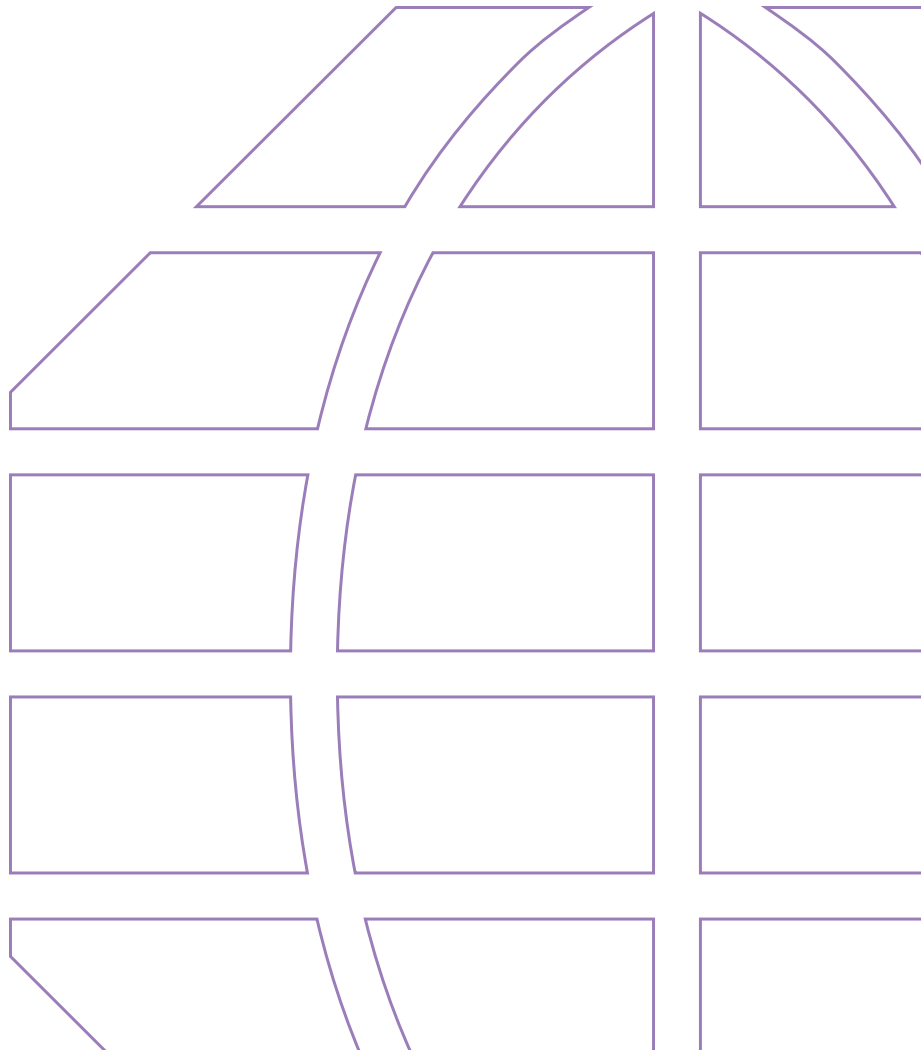


RESEARCH AND PRODUCT DEVELOPMENT

Box Spreads of Equity Index Options on Futures as a Financing Tool

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This article discusses the potential for using Options Box Strategies as a collateralized lending and borrowing alternative – and some advantages they may offer over a term repo arrangement.

With a myriad of expirations and strike listings from which to choose, market participants can often utilize index option products to engineer very interesting financial solutions. In this short article, we highlight the possibility of using Index Option Box Spreads to simulate collateralized lending and borrowing.

Option Box Spreads

An option box spread consists of four individual option positions, or “legs.” Using the CME Group European-style End-of-Month (EOM) options on S&P 500 futures as an example, we can consider the following combination, with all options expiring at the end of September 2008:

Long	Short
Call Struck at 500	Put Struck at 500
Put Struck at 2,500	Call Struck at 2,500

Notice that, as of this writing (early August 2008), the two long options positions are “deep in the money,” whereas the two short positions are deep out of the money. More interestingly, regardless of the price of the underlying futures at the expiration of these options, this combination will always generate a payout of 2,000 index points,¹ or \$500,000. As such, the box spread behaves like a discount instrument, with the premium priced at the net present value of the 2,000-point payoff. Effectively, the trade is equivalent to lending out \$500,000 for the period corresponding to the remaining life of the options contracts.

Box Spread as Collateralized Lending

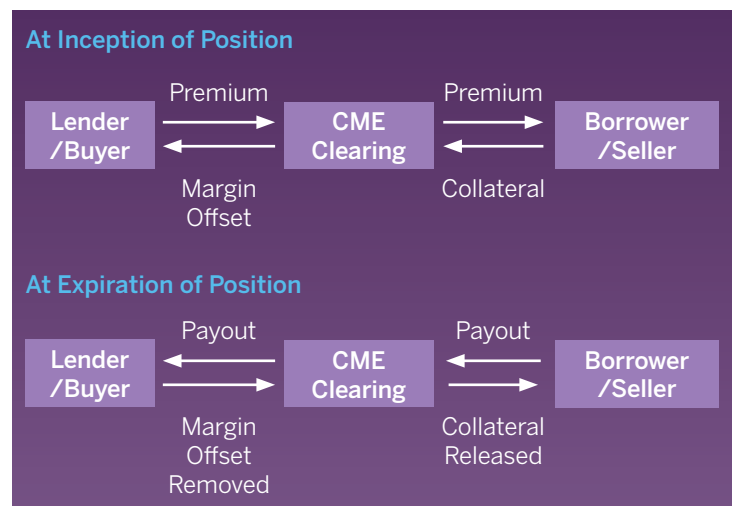
A close inspection of the credit relationship suggests that this trade is roughly equivalent to a term “repo” transaction in the money market, in which a third party is acting as the custodian of the collateral.

The buyer of the options combo pays the premium in cash, and will receive the fixed payout at the expiration. Effectively, the buyer lends the money for the balance of the option’s life. The seller of the options combo takes in cash premium, and will repay the fixed payout at the expiration. Effectively, the seller borrows the money. The differential between the repayment and the upfront options premium is the interest payment.

CME Clearing (the exchange’s clearing house) performs a very important function in this trade. From the perspective of the buyer or lender, it guarantees the performance of the borrower. CME Clearing demanding and holding a suitable amount of collateral from the seller or borrower makes this guarantee possible.

Since the repayment is a fixed amount and is not subject to market risk, the collateral requirement for the borrower will amount to the value of the loan.² The borrower can post liquid securities at CME Clearing, subject to the “haircut schedule”³ in effect. As such, the borrower will slightly over-collateralize the loan. This is very similar to a repo transaction, in which the borrower transfers securities to the lender at a slightly over-collateralized level to ensure performance.

In our options box trade, however, the collateral will reside at CME Clearing instead of being passed to the lender. It is as if the lender has a claim on the clearing house. This claim can be used for margin offset purposes for the lenders’ other options and futures positions at CME Clearing. Schematically, the credit relationship resembles the following:



Structural Advantages over Term Repo

Box spreads enjoy several advantages over the traditional term repo:

- **Net margin requirement**

From the borrower's perspective, the performance bond requirement is a single number that encompasses the requirements for all positions held at CME Clearing. A margin surplus in the rest of the portfolio can be applied to the collateralized borrowing using box spreads. Conversely, the lender will enjoy the margin offset afforded by the long box spreads position to fulfill performance bond requirements for the rest of his/her positions in futures and options.

- **Substitution of collateral**

The borrower may desire to substitute collateral underlying a repo transaction. If it were an unintermediated repo, the lender would have to be involved in the substitution – wiring out the old collateral and receiving the new collateral, and so on. In the case of these box spreads, the lender is literally facing CME Clearing, leaving the duty of interfacing with the borrower to the clearing house. Therefore, when the borrower decides to substitute collateral, the lender will not be involved.

- **Clean close-out trades**

Novation of these option boxes to CME Clearing allows for clean close-out trades. If either the lender or borrower wishes to close out the collateralized lending or borrowing early, they only need to sell or buy back the options boxes in the market. The novation process will net the existing positions with the closing trade.⁴ Again, the original counterparty would not be involved.

Borrowers and lenders may enjoy net margin benefits as well as counterparty efficiency working with CME Clearing in this arrangement.

Box Spread Pricing

As we have concluded that the index option box spreads are no more complicated than discount instruments, pricing the net premium of the spreads is straightforward.

Assuming that we would like to express the implicit interest rate using the ACT/360-day count convention, the following equation must be satisfied:

$$P \times \left(1 + r \cdot \frac{\#days}{36000} \right) = \text{StrikeDiff}$$

where P denotes the options premium, expressed in index points, r denotes the implicit interest rate, StrikeDiff denotes the difference between the two strike prices in the box spread, and #days denotes the remaining life of the options.

On any given day, and for any particular box spread combination, only P and r are unknown in the equation above. Thus, the equation provides a mapping from P to r, and vice versa. For example, with the two strikes 2,000 index points apart, and with 90 days left to expiration, a premium of 1990.25 would imply a rate of 1.96 percent per annum.

As with any discount instrument, an increase in price is equivalent to a drop in the interest rate. In listed options trading, the prices need to conform to the minimum price variation convention. For example, S&P 500 options trade in increments of 0.05 index points.⁵ This minimum price variation will also dictate the minimum price fluctuation in the equivalent rate quotes.

An approximate relationship⁶ between the minimum variation in premium and the corresponding rate difference is as follows:

$$\text{Change in Rate} \approx - \frac{\text{Change in Premium}}{\text{StrikeDiff}} \times \frac{36000}{\#days}$$

Given a strike differential of 2,000 index points, and the options expiring in 90 days, each 0.05 increase in the premium is equivalent to a 0.01 percent, or 1 basis point, decrease in rates (per annum). We can make two observations on this equation:

- A large difference between the two strike prices will have two effects: (i) making the notional value per box larger, and (ii) forcing the minimum allowable variation in rates smaller, i.e., the boxes can be quoted in tighter increments in rate term;
- As the expiration of the options draw closer, the minimum variation in terms of the implicit rate will become bigger, since the minimum variation in premium remains at 0.05.

As such, boxes are typically attempted with a large strike differential.

Note on Cash Flow Dates

Since box spreads are nothing more than regular option trades, the cash flow timing conforms to regular trade processing schedule as well.

Following the daily settlement of the trades, CME Clearing will issue the net cash variation pay and collect totals to the clearing firm, including the cash options premium. The cash variation shall be paid or received by the firm on the next business day on behalf of its customer.

Likewise, at the expiration of the options, CME Clearing will perform the necessary options exercise and assignment, followed by the mark-to-market settlement of the resulting futures positions. The net cash variation will then be relayed to the clearing firms, and will be paid on the following business day.

Assuming that the clearing firms make available the cash paid and deduct the cash used on the same day they make and receive payment on behalf of the customers, the cash movement would behave as if they were on a T+1 basis, both on the inception as well as on the maturity. This cash flow timing departs from the usual practice in the repo market, in which the cash flow occurs on the T+0 basis. Market participants may want to take the cash flow convention into consideration when pricing the trade.

Available Terms

It is worth noting that this trade should only be attempted with European-style options, i.e., options that cannot be exercised prior to the expiration. If attempted with American-style options, the full face value of the loan can be called back by exercising the options early (or, for that matter, immediately after the trade).

Within the family of options available at CME Group on the S&P 500 Index product, the End-of-Month (EOM) series of options are European-style options and are regularly listed with expirations out to six calendar months.

Beyond the regularly listed EOM options, European-style Flex options on S&P 500 Index futures, or any other regular-sized index futures, are also available. Since Flex options can be specified to expire on any given day, tailor-made financing solutions can be engineered.

For more information about CME Group Equity products visit www.cmegroup.com/equities.

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- 1 With the two European-style options struck at 500, the owner of the options combination will acquire a futures position at the price of 500 at the expiration. Likewise, with the two options struck at 2,500, the owner of the combination will dispose of a futures positions at the price of 2,500. The two opposing futures positions will net 2,000 index points, regardless of the price of the underlying futures at that point.
- 2 Strictly speaking, the precise level of collateral requirement will change slightly given normal changes in the options mark-to-market prices. Since the combination is nothing more than a fixed rate loan, the mark-to-market value of the options combination will not fluctuate significantly in relation to the principal.
- 3 Please visit the CME Group Web site to obtain information about acceptable securities as collateral, as well as the applicable "haircuts" corresponding to the collateral.
- 4 Of course, the close-out trade will be done at the current market rates. To the extent the box spreads behave like any other discount instruments, principal losses are possible.
- 5 Strictly speaking, the premium of an S&P Option ticks in 0.05 only if the premium is below five index points. However, there are two deep out-of-the-money options in each of the box spread, making the net premium eligible for 0.05 increments.
- 6 A more exact relationship can be shown to be: $\partial r \approx -(1+r \cdot \text{frac})^2 \frac{\partial P}{\text{StrikeDiff}} \times \frac{1}{\text{frac}}$

where frac denotes the day count fraction. At a low interest rate environment, and for a short maturity, the leading term on the right is approximately 1.