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The Optimal Total Costs for Writing a Straddle

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Abstract

The straddle is one of the most popular combinations of option strategies suitable in highly volatile markets. Minimization of transaction costs is one of the three objectives for volatility trade design. The purpose of this article is to investigate the optimal total costs for writing a straddle using Taiwan stock index options (TXO) data. Assuming that TXOs are priced based on the Black-Scholes model, the optimal strike price that minimizes the total costs of writing a straddle, regardless of maturities, theoretically occurs at the point where options are about at-the-money. Empirical results are consistent with theory, implying that the pricing of TXOs is consistent with the Black-Scholes model.

Key words: writing a straddle; total costs; optimal strike price; Black-Scholes model

JEL classification: C15; G10

1. Introduction

A straddle, appropriate when an investor does not know in which direction the move will be, involves purchasing a call and a put with the same strike price and expiration date. Straddles are among the most popular strategies in the world's large derivative markets. For example, Chaput and Ederington (2003) find that spreads and combinations collectively account for over 55% of large trades (i.e., trades of 100 contracts or more) in the Eurodollar options market and almost 75% of the trading volume due to large trades. In terms of total volume, straddles, ratio spreads, vertical spreads, and strangles are the four most heavily traded combinations (in that order), which represent about two-thirds of all combination trades. Notably, the contract volume attributable to straddles and ratio spreads exceeds that accounted for naked puts and calls. Moreover, Chaput and Ederington (2005) find that straddles are the most popular volatility trade.

The issue of whether the buy-side or sell-side of these option strategies is more

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appealing is controversial. Cordier and Gross (2005) note that the reason that sell-side strategies of options are not welcome by many investors is that the profits are limited but the risk is unlimited. However, Coval and Shumway (2001) find that zero-beta,[1] at-the-money straddle positions produce average losses of approximately three percent per week. Santa-Clara and Saretto (2004), using data on S&P 500 index options from January 1985 to December 2002, investigate the risk and return of a wide variety of trading strategies, including naked and covered positions, straddles, strangles, and calendar spreads, with different maturities and levels of moneyness. Overall, they find that strategies involving short positions in options generally compensate the investors with very high Sharpe ratios, which are statistically significant even after taking into account the non-normal distribution of returns.

Although these option strategies are very useful to option traders and the sell-side of these option strategies are likely to be profitable, the investigation of the existence of the optimal strike prices that minimize the total trading costs of writing these option strategies is ignored in the literature. Yet, the investigation of this topic is useful to the practice and may provide some insight into the option pricing. Chaput and Ederington (2005) have indicated that volatility traders seek designs with three objectives: (1) to minimize its deltas, (2) to minimize transaction costs, and (3) to maximize the combination's gamma and vega. Only straddles satisfy all three conditions. However, the transaction costs issue is not further discussed in their paper. Moreover, if there exist optimal strike prices that minimize the total costs of writing these option strategies, then investors will be better off from this knowledge. Among these strategies, writing a straddle is easier to make profit if the underlying asset (or portfolio) is less volatile. More importantly, by comparing the empirical optimal strike prices with the theoretical ones that minimize the total costs of writing these option strategies, we are able to infer the consistency (or inconsistency) between the empirical and the theoretical pricing of options (since the total costs of writing these option strategies are related to the option prices). Since straddles are the most popular volatility trades and the transaction costs issue has received scant attention in the literature, the purposes of this article are to theoretically investigate the optimal strike prices that minimize the total costs for writing a straddle, and to empirically test whether the actual optimal strike prices using the Taiwanese options data are consistent with the theoretical options pricing.

The remainder of this article is organized as follows. In Section 2, we theoretically investigate the optimal strike prices that minimize the total costs for writing a straddle. In Section 3, we describe the data and the empirical methodology. In Section 4, we present the results. Section 5 concludes.

2. Optimal Total Costs for Writing a Straddle: Theoretical Investigation

To find the optimal strike price that minimizes the total costs of writing a straddle, we need to analyze the components of the total costs for writing a straddle. Since the total trading costs of writing a straddle may vary from market to market, we use the practice of the Taiwan option market to derive the theoretical optimal strike price that minimizes the total costs for writing a straddle. Basically, the total costs (TC) for writing a straddle in the Taiwan option market consist of transaction costs ($Cost_T$) and the opportunity cost for the margin requirement ($Cost_{OM}$):

$$TC = Cost_T + Cost_{OM} . \tag{1}$$

Transaction costs include commission fees that the writer pays for a broker and taxes that are imposed by the government when (i) the writer sells the option contracts (i.e., transaction tax) and (ii) the delivery of in-the-money options at maturity (i.e., delivery tax). The opportunity cost for the margin requirement is the interest incurred on the initial margin in the period that the option contracts are alive. These two components of the total costs of writing a straddle will be examined in detail in the following subsections. To simplify the theoretical analysis, we assume that the options are priced based on the Black-Scholes (1973) model. We note that all options in Taiwan are European.

2.1 Transaction Costs at the Expiry Involved for Selling a Straddle ($Cost_T$)

Transaction costs involved in selling a straddle include commission fees charged by brokers and taxes imposed by the government. First, commission fees charged may vary from investor to investor and from broker to broker in practice. Large traders are offered a preferable discount of commission fees. Usually, a brokerage firm charges a fixed amount of money per option contract (say, NTD 50) regardless of option premium. Next, the taxes imposed by the government include transaction tax and delivery tax. The transaction tax, which is dependent on the strike price of options, is imposed on the option sellers at the time the options are sold. The delivery tax is imposed if options are exercised at the expiry. The transaction tax is 1/1000 of the proceeds of options for both buyers and sellers (i.e., *Transaction tax* = *Option premium* × 50 × 0.001, where the *Option premium* is quoted by "points"), and the delivery tax is 0.1/1000 of the final settlement price times the multiplier (i.e., 50) at delivery for both buyers and sellers (i.e., *Delivery tax* = *Settlement Index Value at delivery* × 50 × 0.0001, where the *Settlement Index* is quoted by "points"). Therefore, the total transaction costs at the expiry are the sum of commission fees and the two taxes and can be examined on a case-by-case basis.

First, suppose that (i) $S_T > X$. In this case, the call option is expired in-the-money, but the put option is out-of-the-money. The call option will be exercised, but the put option is worthless. Thus, we have:

$$Cost_T = \alpha \cdot e^{r(T-t)} + \tau_1 \cdot m \cdot (c_M + p_M) \cdot e^{r(T-t)} + \tau_2 \cdot m \cdot S_T , \tag{2}$$

where c_M and p_M are the market prices of call and put options, respectively, α is the commission fee for selling one call and one put, τ_1 is the transaction tax rate, τ_2 is the delivery tax rate, *m* is the multiplier (i.e., NTD 50), and S_T is the final settlement price of the underlying index. We note that since the three parts of the total transaction costs are charged at different time points, for consistency, we use the terminal value of the total transaction costs at the options' expiry in equation (2).

Next, suppose that (ii) $S_T = X$. In this case, both the call and put options are expired worthless. Therefore, the terminal value of the total transaction costs at the options' expiry is:

$$Cost_T = \alpha \cdot e^{r(T-t)} + \tau_1 \cdot m \cdot (c_M + p_M) \cdot e^{r(T-t)}, \tag{3}$$

Last, suppose that (iii) $S_T < X$. In this case, the put option is expired in-the-money, but the call option is out-of-the-money. The put option will be exercised, but the call option is worthless. Therefore, the terminal value of the total transaction costs at the options' expiry is:

$$Cost_T = \alpha \cdot e^{r(T-t)} + \tau_1 \cdot m \cdot (c_M + p_M) \cdot e^{r(T-t)} + \tau_2 \cdot m \cdot S_T . \tag{4}$$

2.2 Opportunity Cost for the Margin Requirement for Selling a Straddle ($Cost_{OM}$)

According to the regulation of the Taiwan Futures Exchange (TAIFEX), the margin requirement for writing a straddle position ($M_{Straddle}$) using Taiwan stock index options (TXO) is the maximum of margin requirement for call and margin requirement for put, plus the option market value of call or put (depending on which margin requirement is less, see http://www.taifex.com.tw/eng/eng_home.htm). Mathematically,

$$M_{Straddle} = \begin{cases} M_C + m \cdot p_M & \text{if } Max[M_C, M_P] = M_C \\ M_P + m \cdot c_M & \text{if } Max[M_C, M_P] = M_P, \end{cases} \tag{5}$$

where

M_C = Margin requirement for a call
= 100% of the call market value + *Max* {*A* – out-of-the-money amount, *B*}
= $m \cdot c_M + Max\{A - m \cdot Max[X - S, 0], B\}$

M_P = Margin requirement for a put
= 100% of the put market value + *Max* {*A* – out-of-the-money amount, *B*}
= $m \cdot p_M + Max\{A - m \cdot Max[S - X, 0], B\}$

A = a fixed amount as announced by the TAIFEX or a percentage of margin required by the TAIEX futures contracts (NTD 29,000 on March 19, 2008)

B = a fixed amount as announced by the TAIFEX for the minimum margin level (NTD 18,000 on March 19, 2008)

m = multiplier (i.e., NTD 50)

The margin requirement for a short straddle position can be further simplified based on the moneyness of options on a case-by-case basis as follows.

First, suppose that (i) $S \geq X + [(A - B)/m]$. This implies that

$A - m \cdot (S - X) \le B$. In this case, the call is in-the-money and the put is out-of-the-money. Thus:

$$M_C = m \cdot c_M + A$$
$$M_P = m \cdot p_M + B \, .$$

From the put-call parity, we have $c_M > p_M$. Since $A > B$, $M_C > M_P$, the margin requirement for a short straddle is:

$$M_{Straddle} = M_C + m \cdot p_M = m \cdot (c_M + p_M) + A \, . \tag{6-1}$$

Next, suppose that (ii) $X < S < X + [(A - B)/m]$. This implies that $A - m \cdot (S - X) > B$. In this case, the call is in-the-money and the put is out-of-the-money. Thus:

$$M_C = m \cdot c_M + A$$
$$M_P = m \cdot p_M + A - m \cdot (S - X) \, .$$

From the put-call parity, we have $c_M > p_M$, implying that $M_C > M_P$. The margin requirement for a short straddle is:

$$M_{Straddle} = M_C + m \cdot p_M = m \cdot (c_M + p_M) + A \, . \tag{6-2}$$

Third, suppose that (iii) $S = X$. In this case, both the call and the put are at-the-money. Thus:

$$M_C = m \cdot c_M + A$$
$$M_P = m \cdot p_M + A \, .$$

From the put-call parity, we have $c_M > p_M$, implying that $M_C > M_P$. Therefore, the margin requirement for a short straddle is:

$$M_{Straddle} = M_C + m \cdot p_M = m \cdot (c_M + p_M) + A \, . \tag{6-3}$$

Fourth, suppose that (iv) $Xe^{-r(T-t)} < S < X$. In this case, the call is out-of-the-money and the put is in-the-money. Thus:

$$M_C = m \cdot c_M + A - m \cdot (X - S)$$
$$M_P = m \cdot p_M + A$$
$$M_C - M_P = m \cdot (c_M - p_M) - m \cdot (X - S) \, .$$

To determine the sign of $(M_C - M_P)$, note that as $S = X$, $c_M > p_M$ and $M_C > M_P$; on the other extreme, as $S = Xe^{-r(T-t)}$, $c_M = p_M$ and $M_C < M_P$. Therefore, there must exist a point κ in the interval $(Xe^{-r(T-t)}, X)$ such that $M_C - M_P > 0$ for $S \in (\kappa, X)$, $M_C - M_P = 0$ for $S = \kappa$, and $M_C - M_P < 0$ for

$S \in (Xe^{-r(T-t)}, \kappa)$. For $S \in (\kappa, X)$, $M_C - M_P > 0$, therefore, the margin requirement for a short straddle position is:

$$M_{Straddle} = M_C + m \cdot p_M = m \cdot [c_M + p_M - (X - S)] + A. \quad (6\text{-}4)$$

For $S = \kappa$, $M_C - M_P = 0$. As $c_M > p_M$, $M_P + m \cdot c_M > M_C + m \cdot p_M$, the margin requirement for a short straddle position is:

$$M_{Straddle} = M_P + m \cdot c_M = m \cdot (c_M + p_M) + A. \quad (6\text{-}5)$$

For $S \in (Xe^{-r(T-t)}, \kappa)$, $M_C - M_P < 0$. The margin requirement for a short straddle position is:

$$M_{Straddle} = M_P + m \cdot c_M = m \cdot (c_M + p_M) + A. \quad (6\text{-}6)$$

Fifth, suppose that (v) $X - [(A - B)/m] < S \le Xe^{-r(T-t)}$. This implies that $A - m \cdot (X - S) > B$. In this case, the call is out-of-the-money and the put is in-the-money. Thus:

$$M_C = m \cdot c_M + A - m \cdot (X - S)$$
$$M_P = m \cdot p_M + A.$$

From the put-call parity, we have $p_M > c_M$, implying that $M_P > M_C$. Therefore, the margin requirement for a short straddle is:

$$M_{Straddle} = M_P + m \cdot c_M = m \cdot (c_M + p_M) + A. \quad (6\text{-}7)$$

Sixth, suppose that (vi) $S \le X - [(A - B)/m]$. This implies that $A - m \cdot (X - S) \le B$. In this case, the call is out-of-the-money and the put is in-the-money. Thus:

$$M_C = m \cdot c_M + B$$
$$M_P = m \cdot p_M + A.$$

From the put-call parity, we have $p_M > c_M$. As $A > B$, $M_P > M_C$, the margin requirement for a short straddle is:

$$M_{Straddle} = M_P + m \cdot c_M = m \cdot (c_M + p_M) + A. \quad (6\text{-}8)$$

For convenience of reference, we summarize all the cases of the margin requirement for selling a straddle in Table 1.

An opportunity cost is incurred because the seller of options must put a specific amount of dollars for the margin requirement when she/he sells option contracts. Therefore, the opportunity cost is the interest rate times the margin requirement for selling a straddle.

Table 1. The Margin Requirement for a Short Straddle under Different Stock Price Levels

Moneyness	Margin Requirement
$S \geq X + \frac{A-B}{m}$	$M_C + m \cdot p_M = m \cdot (c_M + p_M) + A$
$X < S < X + \frac{A-B}{m}$	$M_C + m \cdot p_M = m \cdot (c_M + p_M) + A$
$S = X$	$M_C + m \cdot p_M = m \cdot (c_M + p_M) + A$
$Xe^{-r(T-t)} < \kappa < S < X$	$M_C + m \cdot p_M = m \cdot [c_M + p_M - (X - S)] + A$
$Xe^{-r(T-t)} < \kappa = S < X$	$M_P + m \cdot c_M = m \cdot (c_M + p_M) + A$
$Xe^{-r(T-t)} < S < \kappa < X$	$M_P + m \cdot c_M = m \cdot (c_M + p_M) + A$
$X - \frac{A-B}{m} < S \leq Xe^{-r(T-t)}$	$M_P + m \cdot c_M = m \cdot (c_M + p_M) + A$
$S \leq X - \frac{A-B}{m}$	$M_P + m \cdot c_M = m \cdot (c_M + p_M) + A$

According to Table 1, for $S \notin (\kappa, X)$, the margin requirement for selling a straddle is:

$$M_{Straddle} = m \cdot c_M + m \cdot p_M + A \,. \tag{7}$$

Therefore, its opportunity cost ($Cost_{OM}$) is:

$$Cost_{OM} = (m \cdot c_M + m \cdot p_M + A) \cdot \left(e^{r(T-t)} - 1\right). \tag{8}$$

For $S \in (\kappa, X)$, the margin requirement for selling a straddle is:

$$M_{Straddle} = M_C + m \cdot p_M = m \cdot [c_M + p_M - (X - S)] + A \,. \tag{9}$$

Therefore, its opportunity cost is:

$$Cost_{OM} = (m \cdot c_M + m \cdot p_M + A - m \cdot (X - S)) \cdot \left(e^{r(T-t)} - 1\right). \tag{10}$$

2.3 The Optimal Total Costs for Writing a Straddle

The total costs for writing a straddle is:

$$TC = Cost_T + Cost_{OM} \,. \tag{11}$$

The optimal total costs for writing a straddle is the strike price that minimizes the expected total costs for writing the straddle. To derive the optimal strike price, we can differentiate (11) with respect to the strike price (*X*) and set it to zero. That is:

$$\frac{\partial(TC)}{\partial X} = \frac{\partial(Cost_T)}{\partial X} + \frac{\partial(Cost_{OM})}{\partial X} = 0 \,. \tag{12}$$

According to (2)–(4) which express the transaction costs ($Cost_T$) for writing a straddle under three cases, we have (see Smith, 1976, p. 24, for the derivative $\partial c/\partial X$):

$$\frac{\partial(Cost_T)}{\partial X} = \tau_1 \cdot m \cdot e^{r(T-t)} \cdot \left\{-e^{-r(T-t)} N(d_2) + e^{-r(T-t)}\left[1 - N(d_2)\right]\right\}. \tag{13}$$

However, the opportunity cost depends on the stock price level. Thus, the optimal strike price for minimizing total costs can be evaluated on a case-by-case basis.

First, suppose that (i) $S \notin (\kappa, X)$. According to (8), which expresses opportunity cost for the margin requirement for $S \notin (\kappa, X)$, we have:

$$\frac{\partial(Cost_{OM})}{\partial X} = m \cdot (e^{r(T-t)} - 1) \cdot \left\{-e^{-r(T-t)} N(d_2) + e^{-r(T-t)}\left[1 - N(d_2)\right]\right\}. \tag{14}$$

Therefore:

$$\begin{aligned}
\frac{\partial(TC)}{\partial X} &= \left[\tau_1 \cdot m \cdot e^{r(T-t)} + m \cdot \left(e^{r(T-t)} - 1\right)\right] \cdot \left\{-e^{-r(T-t)} N(d_2) + e^{-r(T-t)}\left[1 - N(d_2)\right]\right\} \\
&= \left[\tau_1 \cdot m \cdot e^{r(T-t)} + m \cdot \left(e^{r(T-t)} - 1\right)\right] \cdot e^{-r(T-t)} \cdot \left[1 - 2N(d_2)\right] = 0 \\
&\Rightarrow N(d_2) = \frac{1}{2} \\
&\Rightarrow \frac{\ln(\frac{S}{X}) + (r - \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}} = 0 \\
&\Rightarrow X^* = Se^{(r - \frac{1}{2}\sigma^2)(T-t)}.
\end{aligned} \tag{15}$$

Furthermore, the second-order condition for this optimality at X^* is greater than zero (the proof is easy and available upon request), implying that X^* is the minimum point.

Next, suppose that (ii) $S \in (\kappa, X)$. According to (10), which expresses the opportunity cost for the margin requirement for $S \in (\kappa, X)$, we have:

$$\begin{aligned}
\frac{\partial(Cost_{OM})}{\partial X} &= m \cdot (e^{r(T-t)} - 1) \cdot \left\{-e^{-r(T-t)} N(d_2) + e^{-r(T-t)}\left[1 - N(d_2)\right]\right\} \\
&\quad - m \cdot (e^{r(T-t)} - 1).
\end{aligned} \tag{16}$$

Therefore:

$$\begin{aligned}
\frac{\partial(TC)}{\partial X} &= \left[\tau_1 \cdot m \cdot e^{r(T-t)} + m \cdot \left(e^{r(T-t)} - 1\right)\right] \cdot \left\{-e^{-r(T-t)} N(d_2) + e^{-r(T-t)}\left[1 - N(d_2)\right]\right\} \\
&\quad - m \cdot (e^{r(T-t)} - 1) \\
&= \left[\tau_1 \cdot m \cdot e^{r(T-t)} + m \cdot \left(e^{r(T-t)} - 1\right)\right] \cdot e^{-r(T-t)} \cdot \left[1 - 2N(d_2)\right] - m \cdot (e^{r(T-t)} - 1) = 0
\end{aligned}$$

$$\Rightarrow \quad N(d_2) = \frac{1}{2}\left[1 - \frac{e^{r(T-t)} - 1}{\tau_1 - e^{-r(T-t)} + 1}\right]$$

Note that $N(d_2) = 0.4740$ if we let $r = 0.02$, $\tau_1 = 0.001$, and $T - t = 1$ year. Therefore:

$$\Rightarrow \quad d_2 = \frac{\ln(\frac{S}{X}) + (r - \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}} \approx -0.0652$$

$$\Rightarrow \quad X^* = Se^{\left[\left(r-\frac{1}{2}\sigma^2\right)(T-t)+0.0652\sigma\sqrt{T-t}\right]}. \qquad (17)$$

However, this solution implies that $X^* > S$. Thus, the optimal solution does not exist in the interval (κ, X).

Therefore, from (i) and (ii), we conclude that the strike price that minimizes the total costs of writing a straddle is $X^* = Se^{[r-(1/2)\sigma^2](T-t)}$. Note that this optimal strike price is about at-the-money for both call and put.

3. Empirical Tests

3.1 The Data

We use Taiwan stock index options (TXO) to investigate empirical optimal strike prices for writing a straddle for three reasons. (1) The number of strike prices of TXOs is the largest in the Taiwan options market. (2) The near-month contracts of the TXO are the most active, so that their pricing may be more efficient than other stock index options and sector index options (i.e., financial sector index options and electronic sector index options). (3) The time value decay of an option accelerates as it approaches expiry, especially in the last 30 days before the expiry (see Tannous and Lee-Sing, 2008, p. 193). Therefore, near-month contracts are more attractive than other month contracts for option writers (sellers).

The daily prices of TXO calls and puts (at 13:30 pm) with the same strike prices and maturity dates are retrieved from TAIFEX, and the daily TAIEX stock index price data are collected from the *Taiwan Economics Journal* for the empirical tests. The 1-month interest rates are retrieved from the Taiwan Bank since the Treasury bills market in Taiwan is inactive and the Taiwan Bank is the most reliable government-owned bank. Since the options data and the spot index data are collected at the same time, no synchronization problem exists. The sample period covers December 20, 2000, through December 19, 2008. The annual volatility of the TAIEX stock index can be calculated from the daily close prices for each year (i.e., $\textit{annual volatility} = \sqrt{250} \times \textit{daily volatility}$, where 250 is the number of trading days per year).

3.2 Empirical Methodology

The procedures of finding the optimal strike prices that minimize the total costs of a short straddle are detailed as follows.

1. To simplify calculations of summary statistics (e.g., mean and variance), we redefine the order of strike prices of options at each trading day as follows: $X_{-m}, \ldots, X_{-j}, \ldots, X_{-2}, X_{-1}, X_0, X_1, X_2, \ldots, X_i, \ldots, X_n$, where X_0 is the strike price of at-the-money options (i.e., $S = X$; if no strike price is equal to the stock price, then the strike price which is closest to closed stock price is defined as X_0), X_i is the i th strike price that is greater than S, and $X_0 < X_1 < \cdots < X_i \cdots < X_n$, and X_{-j} is the j th strike price that is less than S, and $X_{-m} < \cdots < X_{-j} < \cdots < X_{-1} < X_0$.
2. At 13:30 pm of each day (e.g., Nov. 20, 2007), write near-month straddles (with maturity on Dec. 19, 2007) for all strike prices if both transactions data for calls and puts exist. Thus, the problem of synchronicity can be reduced. Then, hold the contracts until the maturity date.
3. On the maturity date (e.g., December 19, 2007), calculate the total costs ($TC = Cost_T + Cost_{OM}$) with the j th strike price, X_j.
4. Calculate the sample period's mean cost from all contract months' averages in the whole sample period. The same procedures for calculating total costs are repeated for the three sub-periods.
5. From step 4, we can find the optimal strike price that minimizes the total costs.

4. Results and Analyses

The simulation results of the total average costs for writing a straddle are presented in Table 2 (with transactions costs in parentheses) and plotted in Figure 1. From Table 2 and Figure 1, it is clear that the optimal strike prices that minimize the total costs (or the transactions costs or the opportunity costs) for writing straddles occur at the same point where options are about at-the-money regardless of holding periods. These results are consistent with the theoretical prediction. The implication of this finding is that the pricing of the TXOs is consistent with the Black-Scholes model since our derivation of the optimal strike price is based on the assumption that the TXOs are priced according to the Black-Scholes model.

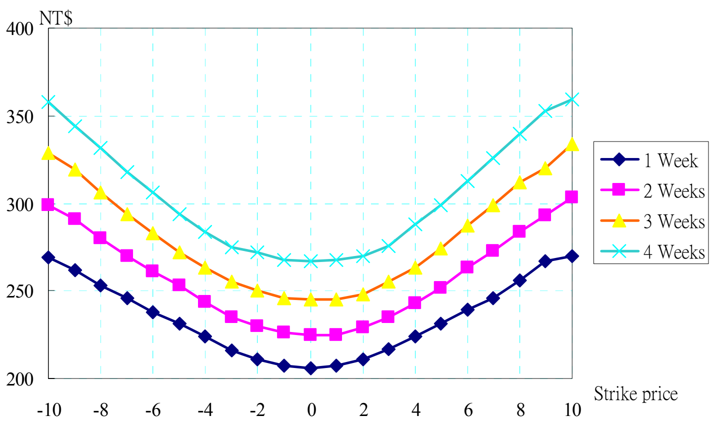
Table 2. Total Average Costs for Writing Straddles

Strike Price	Holding 1 Week		Holding 2 Weeks		Holding 3 Weeks		Holding 4 Weeks	
X_{-10}	269	(188)	299	(188)	329	(188)	358	(188)
X_{-9}	262	(183)	291	(183)	319	(183)	344	(183)
X_{-8}	253	(178)	280	(178)	306	(178)	332	(178)
X_{-7}	246	(173)	270	(173)	294	(173)	318	(173)
X_{-6}	238	(168)	261	(168)	283	(168)	306	(169)
X_{-5}	231	(163)	253	(163)	272	(164)	294	(165)
X_{-4}	224	(158)	244	(159)	263	(160)	284	(161)

Strike Price	Holding 1 Week		Holding 2 Weeks		Holding 3 Weeks		Holding 4 Weeks	
X_{-3}	216	(153)	235	(155)	255	(157)	275	(158)
X_{-2}	211	(149)	230	(152)	250	(154)	272	(156)
X_{-1}	207	(147)	226	(150)	246	(153)	268	(155)
X_0	206	(146)	225	(149)	245	(152)	267	(155)
X_1	207	(147)	225	(150)	245	(153)	268	(155)
X_2	211	(150)	229	(152)	248	(155)	270	(157)
X_3	217	(153)	235	(155)	255	(157)	276	(159)
X_4	224	(158)	243	(159)	263	(161)	288	(162)
X_5	231	(163)	252	(163)	274	(165)	299	(166)
X_6	239	(168)	263	(168)	287	(169)	313	(170)
X_7	246	(173)	273	(173)	299	(173)	326	(174)
X_8	256	(178)	284	(178)	312	(178)	340	(179)
X_9	267	(183)	293	(183)	320	(183)	353	(184)
X_{10}	270	(188)	303	(188)	334	(188)	359	(188)

Note: All figures are in NTD. Figures in parentheses are transactions costs. Thus, the *Opportunity cost* = *Total cost − Transaction cost*.

Figure 1. Total Average Costs for Writing Straddles



Notes: The horizontal axis represents strike price, and the vertical axis represents total average costs in NTD. Curves for 1–4 weeks represent the time length of holding the straddle to expiration.

5. Conclusions

In this article we theoretically investigate the optimal strike price that minimizes the total costs of writing a straddle and empirically test the optimality of total costs of writing a straddle using the TXO options data to see whether the actual optimality is consist with the theoretical one. From the theoretical point of view, if the TXO options are priced according to the Black-Scholes model, then the strike price that minimizes the total costs for writing a straddle will appear at a point around at-the-money. The empirical results are consistent with this prediction. Surprisingly, this optimal strike price that minimizes the total costs for writing a straddle is also consistent with market practice that straddle traders virtually always choose strikes which result in fairly low deltas and high absolute gammas and vegas (see Chaput and Ederington, 2005, p. 261). Thus, this article has bridged a gap relating to transaction costs, which is one of the three objectives of volatility trade design.

This article contributes to both theory and practice. First, from the viewpoint of practice, it provides additional knowledge to the option players. The result of the optimal strike price for writing a straddle is applicable to other markets, such as US and European markets, since the major difference in the total costs in other markets is the taxes, but the ratio of taxes to all total costs is very small. Other minor differences are the sizes of commission fees and the margin requirements, but the essence of these two costs is the same for all markets. Second, this article also develops the pricing behavior of TXOs. Since the derivation of the theoretical optimal strike price that minimizes the total costs of writing a straddle is based on the assumption that TXO options are priced according to the Black-Scholes model, we conclude that the pricing of TXO options is consistent with that model.

Note

1. The zero-beta, or zero-delta, straddle positions can be formed by combining puts and calls with the same strike price and maturity in proportion to their betas. According to the Black-Scholes/CAPM model, zero-beta straddles should have expected returns equal to the risk-free rate (see Coval and Shumway, 2001, p. 995).

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