Chapter 7

Advanced Option Strategies

Chapter 7: Advanced Option Strategies

Read every book by traders to study where they lost money. You will learn nothing relevant from their profits (the markets adjust). You will learn from their losses.

Nassim Taleb

Derivatives Strategy, April, 1997, p. 25

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Chance/Brooks, An Introduction to Derivatives and Risk Management, 10th Edition. © 2016 Cengage. All Rights Reserved. May not be scanned, copied or duplicated, or posted to a publicly accessible website, in whole or in part.

Important Concepts in Chapter 7

- Profit equations and graphs for option spread strategies, including money spreads, collars, calendar spreads and ratio spreads
- Profit equations and graphs for option combination strategies including straddles and box spreads

Option Spreads: Basic Concepts (1 of 3)

- Definitions
  - spread
    - vertical, strike, money spread
    - horizontal, time, calendar spread
  - spread notation
    - June 120/125
    - June/July 120
  - long or short
    - long, buying, debit spread
    - short, selling, credit spread

Option Spreads: Basic Concepts (2 of 3)

- Why Investors Use Option Spreads
  - Risk reduction
  - To lower the cost of a long position
  - Types of spreads
    - bull spread
    - bear spread
    - time spread is based on volatility

Option Spreads: Basic Concepts (3 of 3)

- Notation
  - For money spreads
    - $X_1 < X_2 < X_3$
    - C_1, C_2, C_3
    - N_1, N_2, N_3
  - For time spreads
    - $T_1 < T_2$
    - C_1, C_2
    - N_1, N_2
  - See Table 7.1 on 24th slide for DCRB option data

Money Spreads (1 of 9)

- Bull Spreads
  - Buy call with strike X_1, sell call with strike X_2. Let $N_1 = 1$, $N_2 = -1$
  - Profit equation: $\Pi = \text{Max}(0, S_T - X_1) - C_1 - \text{Max}(0, S_T - X_2) + C_2$
    - $\Pi = -C_1 + C_2$ if $S_T \leq X_1 < X_2$
    - $\Pi = S_T - X_1 - C_1 + C_2$ if $X_1 < S_T \leq X_2$
    - $\Pi = X_2 - X_1 - C_1 + C_2$ if $X_1 < X_2 < S_T$
    - See Figure 7.1 on 25th slide for DCRB June 125/130, $C_1 = \$13.50$, $C_2 = \$11.35$.
  - Maximum profit = $X_2 - X_1 - C_1 + C_2$, Minimum = $-C_1 + C_2$
  - Breakeven: $S_T^* = X_1 + C_1 - C_2$

Money Spreads (2 of 9)

- Bull Spreads (continued)
  - For different holding periods, compute profit for range of stock prices at T_1, T_2, and T using Black-Scholes-Merton model. See Figure 7.2 on 26th slide.
  - Note how time value decay affects profit for given holding period.
  - Early exercise not a problem.

Money Spreads (3 of 9)

- Bear Spreads
  - Buy put with strike X_2, sell put with strike X_1. Let $N_1 = -1$, $N_2 = 1$
  - Profit equation: $\Pi = -\text{Max}(0, X_1 - S_T) + P_1 + \text{Max}(0, X_2 - S_T) - P_2$
    - $\Pi = X_2 - X_1 + P_1 - P_2$ if $S_T \leq X_1 < X_2$
    - $\Pi = P_1 + X_2 - S_T - P_2$ if $X_1 < S_T < X_2$
    - $\Pi = P_1 - P_2$ if $X_1 < X_2 \leq S_T$
    - See Figure 7.3 on 27th slide for DCRB June 130/125, $P_1 = \$11.50$, $P_2 = \$14.25$.
    - Maximum profit = $X_2 - X_1 + P_1 - P_2$. Minimum = $P_1 - P_2$.
    - Breakeven: $S_T^* = X_2 + P_1 - P_2$.

Money Spreads (4 of 9)

- Bear Spreads (continued)
  - For different holding periods, compute profit for range of stock prices at T_1, T_2, and T using Black-Scholes-Merton model. See Figure 7.4 on 28th slide.
  - Note how time value decay affects profit for given holding period.
  - Note early exercise problem.
- A Note About Put Money Spreads
  - Can construct call bear and put bull spreads.

Money Spreads (5 of 9)

- Collars
  - Buy stock, buy put with strike X_1, sell call with strike X_2. $N_S = 1$, $N_P = 1$, $N_C = -1$.
  - Profit equation: $\Pi = S_T - S_0 + \text{Max}(0, X_1 - S_T) - P_1 - \text{Max}(0, S_T - X_2) + C_2$
    - $\Pi = X_1 - S_0 - P_1 + C_2$ if $S_T \leq X_1 < X_2$
    - $\Pi = S_T - S_0 - P_1 + C_2$ if $X_1 < S_T < X_2$
    - $\Pi = X_2 - S_0 - P_1 + C_2$ if $X_1 < X_2 \leq S_T$
  - A common type of collar is what is often referred to as a zero-cost collar. The call strike is set such that the call premium offsets the put premium so that there is no initial outlay for the options.

Money Spreads (6 of 9)

- Collars (continued)
  - See Figure 7.5 on 29th slide for DCRB July 120/136.165, $P_1 = \$13.65$, $C_2 = \$13.65$. That is, a call strike of 136.165 generates the same premium as a put with strike of 120. This result can be obtained only by using an option pricing model and plugging in exercise prices until you find the one that makes the call premium the same as the put premium.
  - This will nearly always require the use of OTC options.
  - Maximum profit = $X_2 - S_0$. Minimum = $X_1 - S_0$.
  - Breakeven: $S_T^* = S_0$.

Money Spreads (7 of 9)

- Collars (continued)
  - The collar is a lot like a bull spread (compare Figure 7.5 on 29th slide to Figure 7.1 on 25th slide).
    - The collar payoff exceeds the bull spread payoff by the difference between X_1 and the interest on X_1.
    - Thus, the collar is equivalent to a bull spread plus a risk-free bond paying X_1 at expiration.
  - For different holding periods, compute profit for range of stock prices at T_1, T_2, and T using Black-Scholes-Merton model. See Figure 7.6 on 30th slide.

Money Spreads (8 of 9)

- Butterfly Spreads
  - Buy call with strike X_1, buy call with strike X_3, sell two calls with strike X_2. Let $N_1 = 1$, $N_2 = -2$, $N_3 = 1$.
  - Profit equation: $\Pi = \text{Max}(0, S_T - X_1) - C_1 - 2\text{Max}(0, S_T - X_2) + 2C_2 + \text{Max}(0, S_T - X_3) - C_3$
    - $\Pi = -C_1 + 2C_2 - C_3$ if $S_T \leq X_1 < X_2 < X_3$
    - $\Pi = S_T - X_1 - C_1 + 2C_2 - C_3$ if $X_1 < S_T \leq X_2 < X_3$
    - $\Pi = -S_T + 2X_2 - X_1 - C_1 + 2C_2 - C_3$ if $X_1 < X_2 < S_T \leq X_3$
    - $\Pi = -X_1 + 2X_2 - X_3 - C_1 + 2C_2 - C_3$ if $X_1 < X_2 < X_3 < S_T$
    - See Figure 7.7 on 31st slide for DCRB July 120/125/130, $C_1 = \$16.00$, $C_2 = \$13.50$, $C_3 = \$11.35$.

Money Spreads (9 of 9)

- Butterfly Spreads (continued)
  - Maximum profit = $X_2 - X_1 - C_1 + 2C_2 - C_3$, minimum = $-C_1 + 2C_2 - C_3$
  - Breakeven: $S_T^* = X_1 + C_1 - 2C_2 + C_3$ and $S_T^* = 2X_2 - X_1 - C_1 + 2C_2 - C_3$
  - For different holding periods, compute profit for range of stock prices at T_1, T_2, and T using Black-Scholes-Merton model. See Figure 7.8 on 32nd slide.
  - Note how time value decay affects profit for given holding period.
  - Note early exercise problem.

Calendar Spreads

- Buy call with longer time to expiration, sell call with shorter time to expiration.
- Note how this strategy cannot be held to expiration because there are two different expirations.
- Profitability depends on volatility and time value decay.
- Use Black-Scholes-Merton model to value options at end of holding period if prior to expiration.
- See Figure 7.9 on 33rd slide.
- Note time value decay. See Table 7.2 on 34th slide and Figure 7.10 on 35th slide.
- Early exercise can be problem.
- Can be constructed with puts as well.

Ratio Spreads

- Long one option, short another based on deltas of two options. Designed to be delta-neutral. Can use any two options on same stock.
- Portfolio value
  - $V = N_1C_1 + N_2C_2$
  - Set to zero and solve for $N_1/N_2 = -\Delta_2/\Delta_1$, which is ratio of their deltas

    (recall that $\Delta = N(d_1)$ from Black-Scholes-Merton model).
- Buy June 120s, sell June 125s. Delta of 120 is 0.630; delta of 125 is 0.569. Ratio is $-(0.569/0.630) = -0.903$. For example, buy 903 June 120s, sell 1,000 June 125s
- Note why this works and that delta will change.
- Why do this? Hedging mispriced option

Straddles (1 of 2)

- Straddle: long an equal number of puts and calls
- Profit equation: $\Pi = \text{Max}(0, S_T - X) - C + \text{Max}(0, X - S_T) - P$ (assuming $N_c = 1$, $N_p = 1$)
  - $\Pi = S_T - X - C - P$ if $S_T \geq X$
  - $\Pi = X - S_T - C - P$ if $S_T < X$
- Either call or put will be exercised (unless $S_T = X$).
- See Figure 7.11 on 36th slide for DCRB June 125, C = \$13.50, P = \$11.50.
- Breakeven: $S_T^* = X - C - P$ and $S_T^* = X + C + P$
- Maximum profit: ∞, minimum = $-C - P$
- See Figure 7.12 on 37th slide for different holding periods. Note time value decay.

Straddles (2 of 2)

- Applications of Straddles
  - Based on perception of volatility greater than priced by market
- A Short Straddle
  - Unlimited loss potential
  - Based on perception of volatility less than priced by market

Box Spreads (1 of 3)

- Definition: bull call money spread plus bear put money spread. Risk-free payoff if options are European
- Construction:
  - Buy call with strike X_1, sell call with strike X_2
  - Buy put with strike X_2, sell put with strike X_1
- Profit equation: $\Pi = \text{Max}(0, S_T - X_1) - C_1 - \text{Max}(0, S_T - X_2) + C_2 + \text{Max}(0, X_2 - S_T) - P_2 - \text{Max}(0, X_1 - S_T) + P_1$
  - $\Pi = X_2 - X_1 - C_1 + C_2 - P_2 + P_1$ if $S_T \leq X_1 < X_2$
  - $\Pi = X_2 - X_1 - C_1 + C_2 - P_2 + P_1$ if $X_1 < S_T \leq X_2$
  - $\Pi = X_2 - X_1 - C_1 + C_2 - P_2 + P_1$ if $X_1 < X_2 < S_T$

Box Spreads (2 of 3)

- Evaluate by determining net present value (NPV)
  - $NPV = (X_2 - X_1)(1 + r)^{-T} - C_1 + C_2 - P_2 + P_1$
  - This determines whether present value of risk-free payoff exceeds initial value of transaction.
  - If NPV > 0, do it. If NPV < 0, do the reverse.
- See Figure 7.13 on 38th slide.
- Box spread is also difference between two put-call parities.

Box Spreads (3 of 3)

- Evaluate June 125/130 box spread
  - Buy 125 call at $13.50, sell 130 call at $11.35
  - Buy 130 put at $14.25, sell 125 put at $11.50
  - Initial outlay = $4.90, $490 for 100 each
  - $NPV = 100[(130 - 125)(1.0456)^{-0.0959} - 4.90] = 7.85$
  - NPV > 0 so do it
- Early exercise a problem only on short box spread
- Transaction costs high

Summary

TABLE 7.1: DCRB OPTION DATA, MAY 14

EXERCISE PRICE	CALLS ON MAY	CALLS ON JUNE	CALLS ON JULY	PUTS MAY	PUTS JUNE	PUTS JULY
120	8.75	15.40	20.90	2.75	9.25	13.65
125	5.75	13.50	18.60	4.60	11.50	16.60
130	3.60	11.35	16.40	7.35	14.25	19.65

Current stock price: 125.94

Expirations: May 21, June 18, July 16

Risk-free rates (continuously compounded): 0.0447 (May); 0.0446 (June); 0.0453 (July)

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FIGURE 7.1: Call Bull Spread

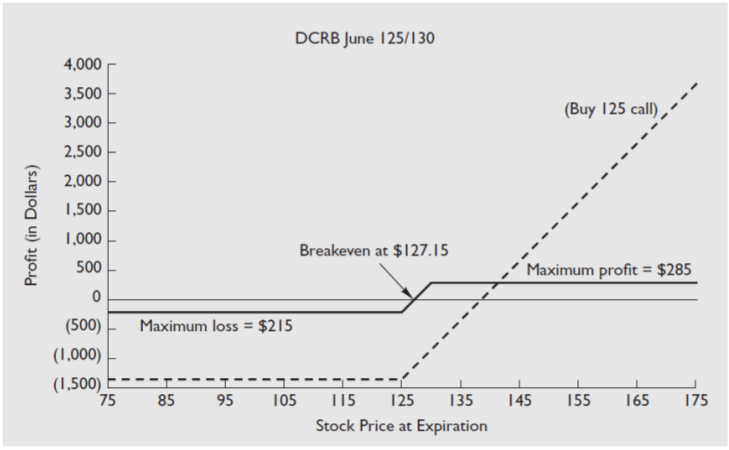

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FIGURE 7.2: Call Bull Spread: Different Holding Periods

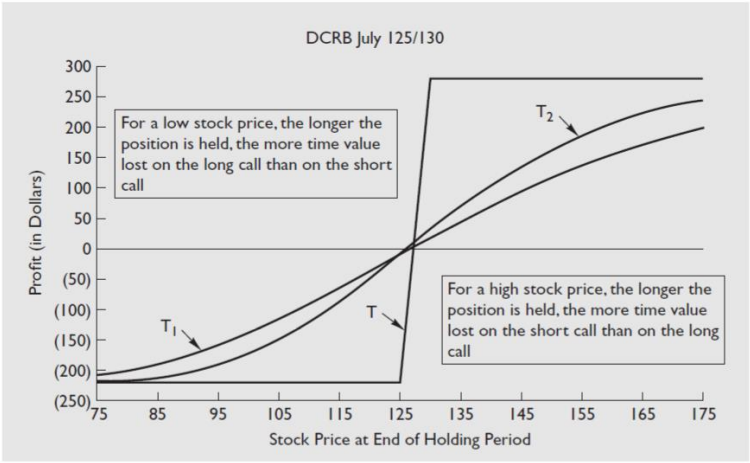

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FIGURE 7.3: Put Bear Spread

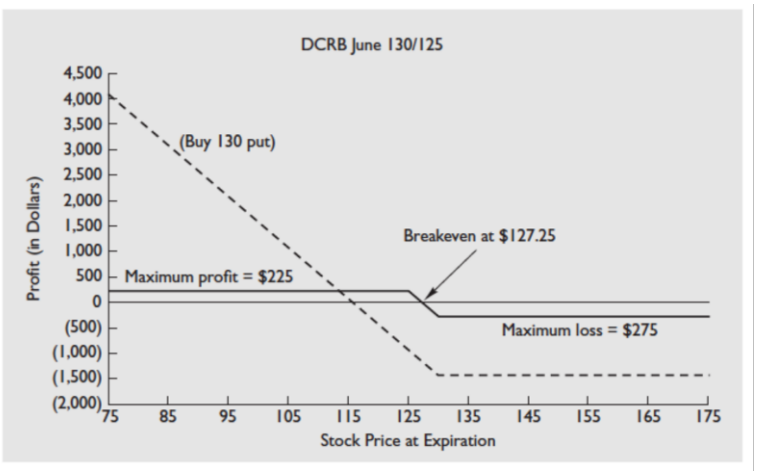

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FIGURE 7.4: Put Bear Spread: Different Holding Periods

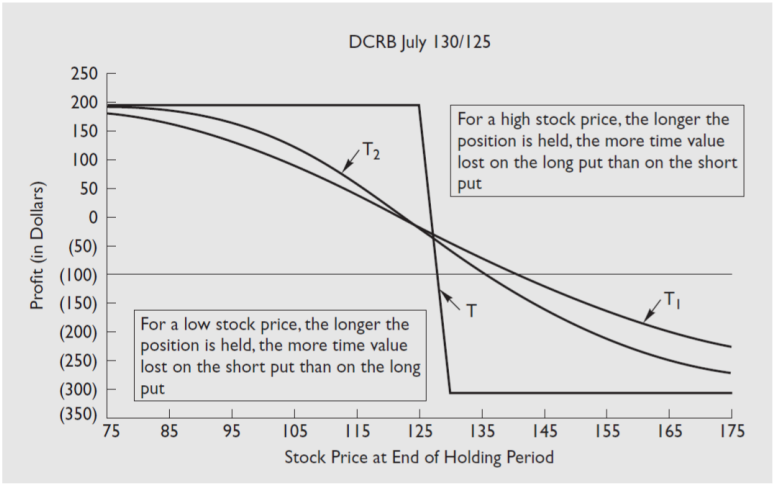

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FIGURE 7.5: Collar

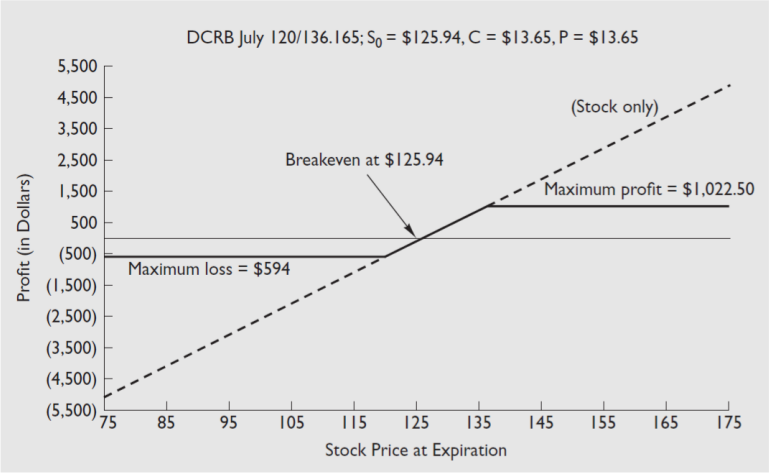

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FIGURE 7.6: Collar: Different Holding Periods

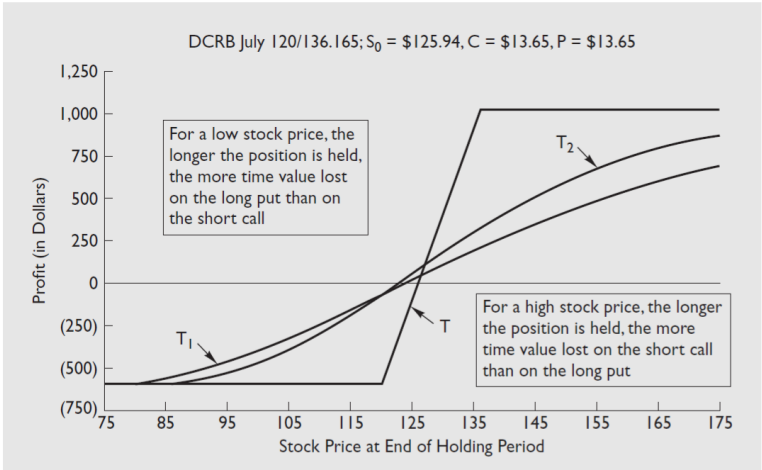

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FIGURE 7.7: Call Butterfly Spread

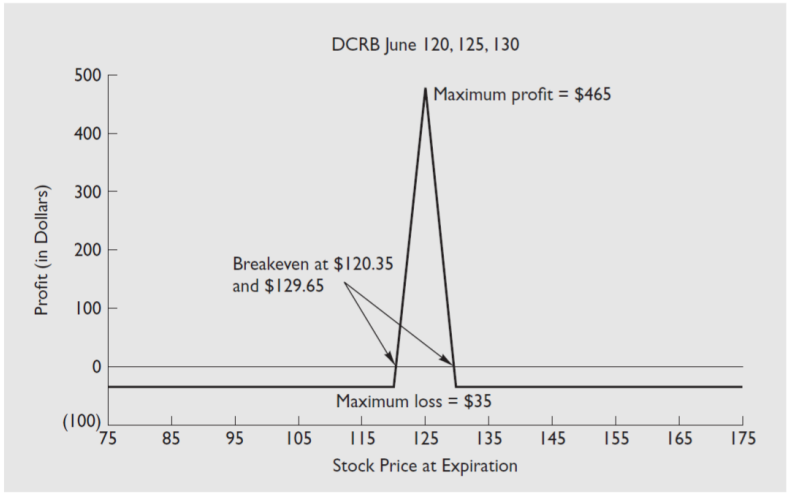

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FIGURE 7.8: Call Butterfly Spread: Different Holding Periods

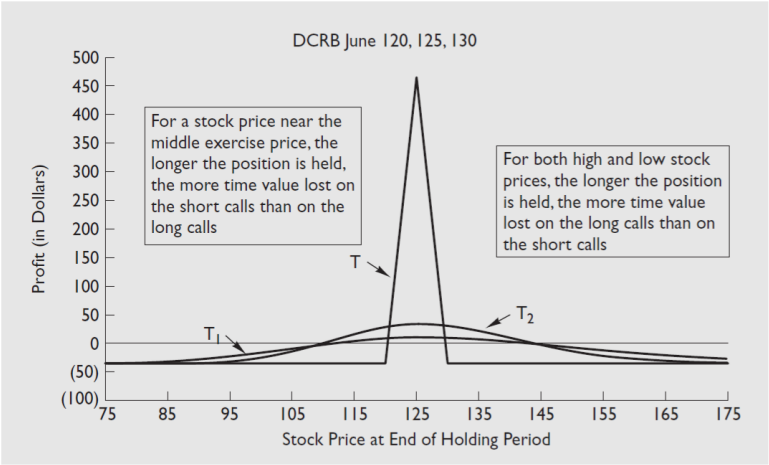

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FIGURE 7.9: Call Calendar Spread

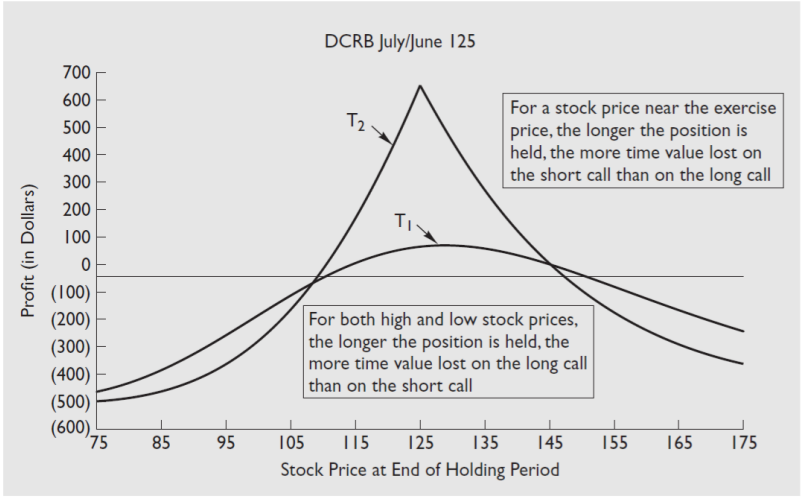

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TABLE 7.2: TIME VALUE DECAY, JUNE AND JULY 125 AND CALENDAR SPREAD

DATE	JUNE 125: TIME	JUNE 125: TIME VALUE	JUNE 125: THETA	JULY 125: TIME	JULY 125: TIME VALUE	JULY 125: THETA	SPREAD TIME VALUE	SPREAD THETA
May 14	0.0959	12.61	−68.91	0.1726	17.14	−51.54	4.53	17.37
May 21	0.0767	11.22	−76.92	0.1534	16.12	−54.65	4.91	22.27
May 28	0.0575	9.64	−88.63	0.1342	15.04	−58.39	5.40	30.24
June 4	0.0384	7.77	−108.19	0.1151	13.88	−63.02	6.11	45.17
June 11	0.0192	5.35	−152.11	0.0959	12.62	−68.95	7.27	83.16
June 18	0.0000	0.00	0.00	0.0767	11.22	−76.96	11.22	−76.96

$\sigma = 0.83$, $S_0 = 125.94$, r_c(June) = 0.0446, r_c(July) = 0.0453

The spread time value and theta equal the time value and theta on the long July call minus the time value and theta on the short June call. The time value of each option is obtained as the Black–Scholes–Merton value, which is the intrinsic value plus the time value minus the intrinsic value of 0.94.

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FIGURE 7.10: Time Value Decay

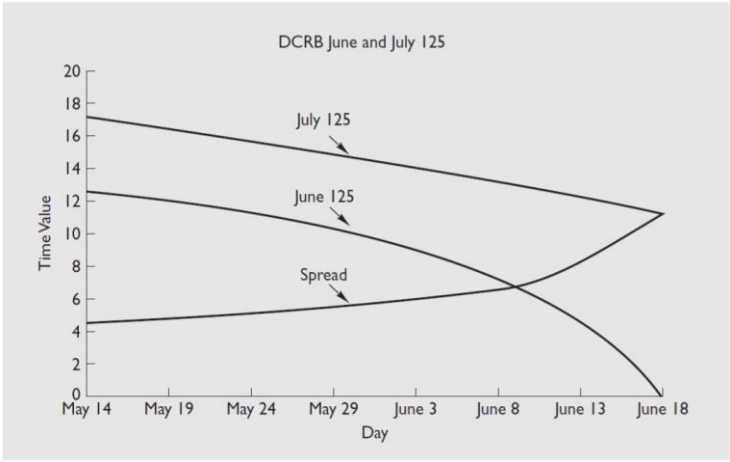

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FIGURE 7.11: Straddle

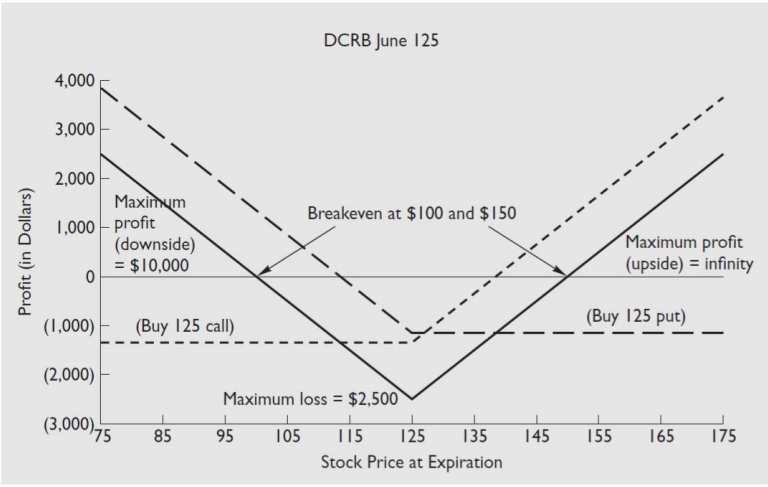

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FIGURE 7.12: Straddle: Different Holding Periods

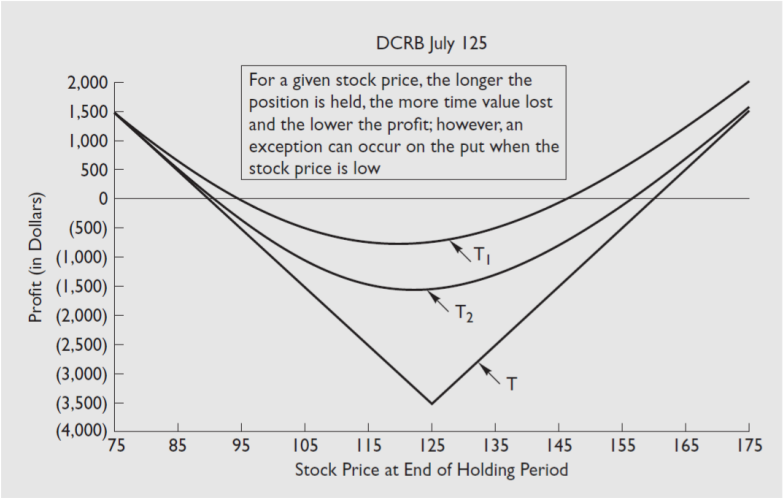

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FIGURE 7.13: The Box Spread

$-(C_1 - C_2 + P_2 - P_1)$ $(X_2 - X_1)$

Today — Expiration

(Find the present value of the future payoff)

$$NPV = (X_2 - X_1)(1 + r)^{-T} - (C_1 - C_2 + P_2 - P_1)$$

If NPV > 0, execute the box spread.
If NPV < 0, execute a reverse box spread.

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