Volatility Smiles

Chapter 15

Put-Call Parity Arguments

- Put-call parity $p + S_0 e^{-qT} = c + X e^{-rT}$ holds regardless of the assumptions made about the stock price distribution
- It follows that

$p_{mkt} - p_{bs} = c_{mkt} - c_{bs}$

Implied Volatilities

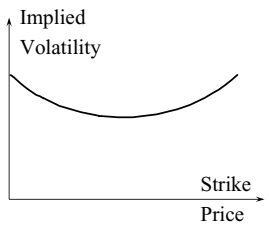
- The implied volatility calculated from a European call option should be the same as that calculated from a European put option when both have the same strike price and maturity
- The same is approximately true of American options

Volatility Smile

- A volatility smile shows the variation of the implied volatility with the strike price
- The volatility smile should be the same whether calculated from call options or put options

The Volatility Smile for Foreign Currency Options

(Figure 15.1, page 332)

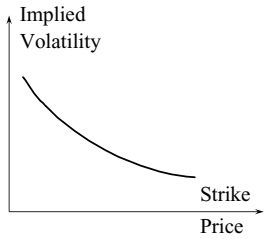


Implied Distribution for Foreign Currency Options

- The implied distribution is as shown in Figure 15.2, page 332
- Both tails are heavier than the lognormal distribution
- It is also "more peaked than the lognormal distribution

The Volatility Smile for Equity Options

(Figure 15.3, page 334)



Implied Distribution for Equity Options

The implied distribution is as shown in Figure 15.4, page 335
The right tail is less heavy and the left tail is heavier than the lognormal distribution

Other Volatility Smiles?

What is the volatility smile if

- True distribution has a less heavy left tail and heavier right tail
- True distribution has both a less heavy left tail and a less heavy right tail

Possible Causes of Volatility Smile

- Asset price exhibiting jumps rather than continuous change
- Volatility for asset price being stochastic

(One reason for a stochastic volatility in the case of equities is the relationship between volatility and leverage)

Volatility Term Structure

- In addition to calculating a volatility smile, traders also calculate a volatility term structure
- This shows the variation of implied volatility with the time to maturity of the option

Volatility Term Structure

The volatility term structure tends to be downward sloping when volatility is high and upward sloping when it is low

Example of a Volatility Surface

(Table 15.2, page 336)

	Strike Price				
	0.90	0.95	1.00	1.05	1.10
1 mnth	14.2	13.0	12.0	13.1	14.5
3 mnth	14.0	13.0	12.0	13.1	14.2
6 mnth	14.1	13.3	12.5	13.4	14.3
1 year	14.7	14.0	13.5	14.0	14.8
2 year	15.0	14.4	14.0	14.5	15.1
5 year	14.8	14.6	14.4	14.7	15.0