PUT OPTIONS AND
THE AUSTRALIAN OPTIONS MARKET

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The versatility of the Australian Options Market has been significantly increased by the recent addition of put options. This Market now offers the same scope to investors as its major international counterparts in the USA and Europe. This development should lead to greater interest and activity in this small but important sector of our securities market.

Specifically this article examines the exchange-traded put option which was recently introduced on the Australian Options Market. The likely levels of market activity, the increased scope for strategies using put options, and the pricing of put options are considered.

INTRODUCTION

A market for exchange-traded options, the Australian Options Market (AOM), was established in 1976. At present options are listed on eleven stocks. Unlike the conventional options market which has been in existence since 1960 only call options have been available up until September 1982.

Following developments on overseas option exchanges, notably the Chicago Board Options Exchange (CBOE), the London Options Market (LOM) and the European Options Exchange (EOE) in Amsterdam, the AOM introduced put options on September 9, 1982. Put options are now available on all eleven stocks listed on the AOM.

Whilst only call options have been available on the AOM in the first six years of its operation since 1976, put options have been available on the conventional option market since 1960. However, since the introduction of exchange-traded options in Australia the conventional options market has shrunk dramatically in size and few options of any type are traded in this market.

With put options available on the AOM it is now possible to create a “straddle” by purchasing both a put and call option contract in a given stock with identical exercise price and expiration date on an exchange traded market in which both puts and calls are available.

SYNTHETIC PUT OPTIONS

The lack of exchange-traded put options has severely restricted the range of options strategies possible in the exchange-traded market. These are discussed later in this paper. To overcome this problem in the USA certain firms there have created a “synthetic put options” in stocks in which call options, but not put options, are listed on an options exchange.

To create a synthetic put option, a firm can sell stock short in BHP (for example), buy listed BHP call options, and then sell to a customer an unlisted synthetically created put option. Thus a put option can be created through transactions in the related stock and in call options in that stock.

This can be explained using the option vector notation suggested by Kruizenga [15] which is helpful in illustrating how stocks and options can be combined together. His method of representing the six basic alternative positions that a participant can take in the market is as follows:

- Purchasing a call: \[ \begin{bmatrix} +1 \\ 0 \end{bmatrix} \]
- Purchasing a put: \[ \begin{bmatrix} 0 \\ +1 \end{bmatrix} \]
- Writing a call: \[ \begin{bmatrix} -1 \\ 0 \end{bmatrix} \]
- Writing a put: \[ \begin{bmatrix} 0 \\ -1 \end{bmatrix} \]
- Long position: \[ \begin{bmatrix} +1 \\ -1 \end{bmatrix} \]
- Short position: \[ \begin{bmatrix} -1 \\ +1 \end{bmatrix} \]

Each position is represented by a two element column vector. The upper number indicates if the trader benefits from an upward movement in the stock price. The lower number indicates if the trader benefits from a downward movement in the stock price.

By combining the stock and the option in a number of ways a new net position is created. In the case of the creation of a synthetic put we can write:

\[
\begin{bmatrix} +1 \\ 0 \end{bmatrix} \text{ buy call} + \begin{bmatrix} -1 \\ +1 \end{bmatrix} \text{ short in stock} = \begin{bmatrix} 0 \\ +1 \end{bmatrix} \text{ buy put}
\]
This vector notation can be used to create a whole range of positions resulting from combinations of stock and option alternatives.3

US broker-dealers finding themselves in a position of being short in a stock and having a corresponding call position as a result of their trading activities, may solicit orders for synthetic puts. The sale of a synthetic put can eliminate the market risk of the firm’s position and earn commission for that firm.4 Restrictions on short selling and the relatively smaller market in Australia appear to have prevented this practice in Australia. However, if the Campbell Committee’s suggestion that the possible reintroduction of short selling should be examined, results in short selling becoming legal in Australia, creating of synthetic puts would become possible.

POSSIBLE LEVELS OF PUT OPTION ACTIVITY

Following the introduction of put options in September 1982 what will be the likely level of increased activity on the AOM once the market has become familiar with this new form of traded option? This answer to this question is not clear. It will of course depend on the levels of activity in the underlying equity market and other factors, such as the sophistication of option traders and their inclination to become involved in more complex option trading strategies.

Two measures may, however, help us in considering this issue. Firstly, the level of put option activity in the conventional option market that has existed in Australia since 1960, and secondly, levels of put option activity on overseas option exchanges.

Levels of activity for put, call, double and straddle options for the conventional options market in Australia have been described elsewhere [18]. In individual years there was a considerable variation in put option activity compared with overall option activity. Put options as a percentage of all options ranged from 2.3 per cent in 1980 to 28.6 per cent in 1960. However, in both these extreme years only a handful of option contracts were traded. Over the entire period 1960-1981 put options represented 6.1 per cent of all conventional options traded.

With respect to overseas option exchanges, put options have been available on the CBOE since June 1977, four years after the start of trading in call options on that exchange. From 1977/78 to 1979/80, the first three years of put option trading, contract volume averaged 13.6 per cent and dollar volume averaged 12.4 per cent over this period. Put options were available in 43 of the 120 stocks listed on the CBOE at the end of this period.

It is worthwhile pointing out the massive promotional and educational effort made by the CBOE in launching listed put options. In the first year of put option trading some 11,000 registered representatives in 55 cities were contacted as part of the educational program conducted by the CBOE [7, p.11]. The size of our options market in Australia would clearly not permit such a massive (and expensive) educational program to promote put options.

Put options were listed on the EOE for the first time in March 1979. In the first year of put option activity on the EOE, put options were available on four of the most heavily traded thirty-two stocks and represented 17.8 per cent of total contract volume. In 1980 puts represented 26.9 per cent and in 1981, 24.4 per cent of total contract volume. Put options have only been available on the LOM since May 1981.

To what extent then does this help us in determining the possible future levels of put option activity on the AOM? For a start is clear that call options have been far more popular than put options, regardless of whether the stock market is going through a ‘bull’ or a ‘bear’ phase. This applies to both conventional and exchange-traded options markets.

In September 1982, the first month of trading put options on the AOM, 1,883 contracts were traded with a value of $182,000 representing 4.7 per cent of total option control volume. In October 1982 this had grown to 2,028 contracts with a value of $176,000 representing 6.7 per cent of option contract volume.

With the market for put options in such early days and with only two months trading history it is difficult to accurately predict future levels of put option activity on the AOM. The overseas experience does, however, suggest upper limits (in terms of percentages) as to the likely level of put option trading in Australia.

On balance, we consider the listing of put options will possibly add around ten to fifteen per cent to existing option volume after a year’s operation. This will represent a modest but useful increase in option volume on the AOM.

USERS OF PUT OPTIONS

Whilst the probable increase in volume as a result of introducing puts may not be high, considerable advantages in terms of additional investment strategies will result from their introduction. The most simple strategies relate to the writing (selling) and buying of put options. The profit and loss potentials of option purchase for a hypothetical BHP put option is shown in Figure 1 for an uncovered seller.

The put option writer is obliged to buy stock at any time during the life of the option, at the price fixed at
the time the option was created, when the buyer of the put option delivers the underlying shares on which the option is written. For example, assume a BHP put option is written at an exercise price of $8.00 with a June 1983 expiry and a premium of $1.00. If BHP sells below $8.00, the writer of the put may be called upon to buy BHP at $8.00 per share. If this happens, the writer will lose the benefit of part of the premium if the price falls between $8.00 and $7.01, or all of the premium if it falls to $7.00. If it falls below $7.00 he will incur further losses over and above the loss of his premium.

The put option buyer will recover portions of premium as the price falls below $8.00 until it reaches $7.00 at which point he will have covered the full costs of his premium. As prices fall below $7.00 he will make increasing profits. This is shown in Figure 1.

**FIGURE 1**

**POTENTIAL PROFITS AND LOSSES FOR A BUYER AND WRITER (SELLER) OF A PUT OPTION IN BHP**

![Diagram of potential profits and losses for a buyer and writer of a put option in BHP](image)

* Commission charges are not included — see footnote or current issue of Australian Stock Exchange Journal for details of commission charges.

Rather than exercising this exchange-traded put, it will be possible to liquidate it at any time in the secondary market on the AOM and recover all or part of the premium value. Depending upon the prevailing premium, either losses or profits will be made. The majority of options buyers tend to use the secondary market rather than exercising their options.

In the above example the put option writer is uncovered — he has no position in the stock over which the option is written. If the writer is uncovered and there is a rapid decrease in the price of the stock there is a limit to how much he can lose as the stock price cannot fall below zero. This is in contrast with the uncovered writer of a call option whose loss potential is only limited by the level to which the stock price can rise. Stated another way, because of the asymmetric distribution of stock prices, uncovered call option writing is intrinsically a safer strategy than uncovered put option writing.

Buyers of put options can use them in several ways depending on their individual needs. The most obvious one is the buyer may believe the underlying stock price is about to decrease.

Another important but less common use is to provide protection against a possible decline in the price of the stock held. Here an investor may wish to protect a previous share price gain and buys a put option to provide, in effect, insurance against a fall in the price of the stock.

Put options can also be used as a ‘hedge’ where a put option and the stock are purchased simultaneously. This enables an investor to effectively sell his stock if the price falls, thus limiting his potential loss. In this way the put acts as a ‘hedge’. If the price rises, he gains in that he holds the stock. The put is worthless and he writes off the option premium. This provides a means of reducing the downside risk whilst only marginally affecting the upside profit potential.

Writers (or sellers) of put options are optimistic that share prices will not fall below the exercise price. Should the price fall the writer may be called upon to purchase the stock at a significantly higher price (the exercise price) than the current stock price. The writer can, of course, cancel out his position in the option at any time by purchasing a corresponding put option, identical to the series he sold, in a closing transaction. Investors may write puts as a means of generating income or to acquire stock.

In addition to simply writing or buying put options, other strategies are also possible which involve writing or buying put options in combination with other positions in the stock or in an option. These include the simultaneous writing (or buying) of both a put and a call option in the same stock (a ‘straddle’ option). The number of alternative strategies using options in different combinations is almost unlimited.

It is beyond the scope of this article to discuss put option strategies in any greater detail. This topic has been described in a booklet “An Introduction to Put Options” [23] prepared by the Australian Options Market and in a recent issue of the Australian Stock Exchange Journal [14]. Gastineau [12] provides a more exhaustive treatment of options strategies. Bookstaber and Clarke [5] discuss how they can be used to generate a wide variety of portfolio return distributions.
PROBLEMS IN THE PRICING OF PUT OPTIONS

Since the seminal work by Black and Scholes (B & S) [3,4] a great deal of attention has been focused on the area of pricing of options. The B & S formula provided a solution for European options — that is — options which are exerciseable only on the expiration date of the option date and not before. The type of options traded on the AOM (and on the CBOE and other US option exchanges) are termed American options. These American options may be exercised at any time prior to the expiration date.

Valuation of an American call option presents no problem because it can be shown that the value of an American call option is the same as a European call option [4, p.646]. This, however, is not the case with put options, for Merton [16] has shown the value of a European option 

(1) an American put option. This, however, is not the case with put options, for Merton [16] has shown the value of a European option. Thus the value of a European option is less than the value of an American put option.

We can illustrate this as follows: if the price of a stock falls almost to nothing, early in the life of an American put option, and there is almost no probability of it increasing, we can exercise it early and invest the proceeds. We can gain interest on the proceeds up to the expiry date. This would not have been possible with a European option. Thus the value of a European option is less than an American option. Furthermore, relaxation of the assumption that the stock pays no dividends, further complicates the pricing problem.

At the time of publication of their paper (1973) B & S pointed out that no-one had developed a formula for valuing put options [4, p.647] and it was not until 1977 that a published attempt at constructing a formula for valuing an American put option was made by Parkinson. In his paper Parkinson uses a limiting process, sets reducing boundary conditions, and maintains this procedure until a complete solution is obtained for the value of put options [17, p.27]. It is a discreet form model for put options based on the assumptions made by Black and Scholes [4, p.640].

The approach taken by Parkinson involves the construction of tables of the ratio between the value of the put and the exercise price for a range of values for interest rates, time to expiry, and variance of the rate of return of the stock (standard parameters in the B & S formula).

However, as Gastineau points out, whilst mathematically inclined readers may find Parkinson’s work fascinating, they may despair of being able to use it directly to develop an option valuation procedure which also incorporates dividend adjustments [12, p.264]. There is in fact no closed form solution for the valuation of put options on dividend paying stock.

PRACTICAL ESTIMATION OF PUT OPTION VALUES

A recent article in this journal [20] has dealt with the practical estimation of option value for options traded on the AOM (i.e. call options). With the introduction of put options on the AOM it is necessary to develop the discussion of option pricing further. Here we will discuss estimation of value for American and European put options and make some comments on the differences in value between these two types of put options.

Let us first consider the more difficult type of option — the American put. If we are concerned with attempting to develop the most accurate estimates of put option value it is possible to adapt the Parkinson method of table construction using a computer and change his method to include dividends. Black, in a privately circulated paper [2], outlines the approach he has adopted. He starts with a table similar to that developed by Parkinson (which does not allow for dividends) and then constructs a group of tables to allow for different possible dividend rates. His tables assume that stocks pay dividends continuously, which of course they don’t. Dividends are generally paid yearly or half yearly. To compensate for this, Black has developed a method of splitting the dividend on a stock up into two parts — (1) an initial dividend which he subtracts from the stock price, and (2) continuous dividend which he uses to decide which table of option values to choose from. Black explains how he divides the dividend up in this way:

“We find the initial dividend by adding up the amounts by which each dividend exceeds interest on the exercise price between that dividend and the one before it. For the first dividend, it’s the amount by which the dividend exceeds interest on the exercise price in the time till the first dividend. One reason this works is that if the dividends are greater than interest on the exercise price, they will largely eliminate the possibility of early exercise. Any added dividends can be moved to the present without changing the early exercise pattern significantly.” [2, p.91].

If we want as accurate as possible estimates for American put options paying dividends, we must use a numerical integration method such as that suggested by Parkinson and make appropriate adjustments for dividends. As no closed form solution exists we cannot simply plug values into an equation such as the B & S formula for put options and receive a result.

Many investors will, however, require a simpler method. If we are prepared to forego some accuracy we can utilise the B & S formula for a European put option paying no dividends. This differs slightly in form from the B & S formula given for a call option.
The value of a European put option as given by B & S [4] is:
\[ w = -xN(-d_1) + Ce^{-rt}N(-d_2) \]
where:
- \( w \) = the price of put option for a single share of stock
- \( x \) = current price of the stock
- \( C \) = the striking price of the option
- \( r \) = the short term rate of interest
- \( t^* \) = duration of the option
- \( d_1 = \frac{\ln(x/C) + (r + \frac{1}{2}\sigma^2)t^*}{\sigma\sqrt{t^*}} \)
- \( d_2 = d_1 - \sigma\sqrt{t^*} \)
- \( N(d) \) = the value of the cumulative normal density function
- \( \sigma^2 \) = the variance of the rate of return on the stock

We can either program a computer to solve this equation, use a commercial program, or resort to a graphical solution.

The Hewlett-Packard program $GBSVAL referred to in [20, p.8] also provides for printing out put option values. Alternatively one can use a nomogram developed by Dimson.

The use of nomograms for valuing call options was discussed in an earlier issue of this journal [20, p.8-9] however, for put options, a further nomogram is necessary. Dimson [9, 10] has also developed a nomogram for put options. This is shown in Figure 2.

To value a put option we can use the same approach as for call options. The steps to calculate the value of the put option in Figure 2, are for an eight month option with a standard deviation of 60 per cent, a share price of $2.60, an exercise price of $2.00 and an interest rate of 10 per cent.

The steps are:
1. **Maturity:** Draw a vertical line through 8 months which intersects the curves representing annual standard deviation 60 per cent (upper left quadrant) and the interest rate of 10 per cent (lower left quadrant).
2. **Interest Rate:** Draw a horizontal line from the intersection with the 10 per cent curve through to the right-hand side of the nomogram. This line will intersect with the curve representing share price as a percentage of exercise price, in this sample 130 per cent (2.60/2.00 x 100).
3. **Share Price as a Percentage of Exercise Price:** Draw a vertical line from the point of intersection with the 130 per cent curve up into the upper right quadrant.
4. **Standard Deviation:** Reverting to step one draw a horizontal line from the point of intersection with the 60 per cent curve (upper left quadrant) across into the upper right quadrant. In the upper right quadrant there are now two lines which intersect at a value between the 10 and 5 per cent curves.

![FIGURE 2 VALUING A PUT OPTION](image-url)

Source: Dimson [9]
5. Interpolate the Results: The point of intersection in the upper right quadrant is 6.2 per cent. Therefore the value of the put option is 6.2 per cent of the share price, that is 16.12 cents ($2.60 x 6.2/100).

Dimson suggests a method for allowing for the effect of dividends by adjusting the share price before valuation by the present value of the dividends payable, discounted at the interest rate used in the nomogram [9, p.7].

The nomogram can also be used in reverse to estimate the implied stock volatility given the price of the put option. To do this step 4 (above) is reversed. Using the case above, if the market has priced the option at 16.12 cents and we wish to estimate the implied stock volatility, we estimate the put option value as a percentage of the share price 6.2 per cent ($16.12 x 100/$2.60). Because a European option is worth less than an American option, if the actual standard deviation is greater than the implied standard deviation, then the put option is undervalued regardless of whether it is of the European or American type.

CONCLUDING COMMENTS

Under current circumstances little growth is expected in the stagnant conventional options market where turnover is extremely low. Should short selling become more widely permitted as a result of NCSC study of this issue a small market might conceivably develop for 'synthetic' put options but it is not expected to be of much significance if it does develop.

Listed put options were introduced for the first time on the AOM in September 1982. The levels of market activity in the first two months activity since puts commenced has been encouraging and can be expected to grow in the months ahead. The experience of puts in our conventional options market since its introduction in 1960 and on listed options exchanges in Chicago and Amsterdam suggests that regardless of whether the stock market is moving through a 'bull' or a 'bear' phase, the level of put option activity will be very much less than that for call options. Listed put option transaction volumes of between ten and fifteen per cent of total option volume might be expected once investors become more aware of puts.

The main contribution of put options will be in the additional strategies that they bring to the investor. Whilst it is still possible to buy put options on the conventional market, (if a writer can be found), the facility to close out an option position prior to the expiration of that option does not exist. Now put options are listed on the AOM it will be possible to close out put option positions by selling them on the exchange in the same way as call options are traded on the AOM. The availability of both listed puts and calls will enable investors to combine puts, calls and stock positions in an almost limitless number of combinations. The simple vector notation explained earlier can be used to show the net effect of any combination of these combined positions. In fact the availability of puts and calls and being able to use them in combination, together with the ability to liquidate positions in the secondary market for options will probably have some effect on increased demand for options which may add a small but hopefully useful amount of liquidity to the options market.

The pricing of put options still remains an area to be researched further. The numerical integration technique of Parkinson [17] and later approaches including the finite difference approach suggested by Brennan and Schwartz [6] and the binomial process recently described by Cox, Ross and Rubinstein [8] which can be used for numerical approximation, have all made a contribution to the area but further work is necessary.

As Geske and Shastri [13] have pointed out, the above researchers’ results using these valuation approaches are inconclusive: Brennan and Schwartz concluding that their technique overvalues the American put and Parkinson that his method undervalues the American put. Additionally their empirical research is limited in that it deals with small samples and it used data from the conventional not the listed options market. Later work by Farkas and Hoskin [11] use Parkinson’s method to examine the listed put market in the USA and found a median absolute per cent error of 10.1. They concluded from their tests that the model works better for in-the-money puts [13, p.55]. They also correctly point out that at the time their research was completed the put option market was not a mature one and might be inefficient. They consider that the results might reflect pricing mechanisms applicable to an imperfect market and a more mature and perfect market would better reflect an adequate test of Parkinson’s model.

In the current early stages of development of the put option market in Australia the market is not a mature one and could well be inefficient. Hence the values obtained from using models to established ‘fair’ put option prices could reflect errors in the model or inefficiencies in the market. If we are prepared to forgo some accuracy, the B & S formula for a European put option may be used with appropriate adjustments for dividends. This formula underestimates the value of an American put but Dimson [9, p.4] asserts for most put options this underestimation tends to be small.

In the absence of analysis of prices of put options traded on the AOM using different approaches, and a comparison of them, the investor should adopt caution in using these models. He will look forward to empirical research in the area of pricing of puts in Australia.