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Basic Concepts of Stock Option Pricing Models Traded in the Capital Market

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Abstract

An option, in the world of capital markets, is a right based on an agreement to buy or sell a commodity, financial securities, or a foreign currency at an agreed price at any time within a three-month contract period. Factors that determine the value of an option include the current price of the stock, intrinsic value, expiration time or time value, volatility, interest rate, and cash dividends paid. Some options pricing models use this parameter to determine the fair market value of an option. This paper aims to learn the basic concepts of option pricing. The method used in studying the pricing of options is a literature review, which is an activity to collect scientific data, especially in the form of theories, methods, or research that has been carried out previously, either in the form of books, manuscripts, journals, and others that already exist in the library. Based on the results of the study, concepts, scientific findings, and method innovations that have been achieved previously are obtained, which are very relevant and useful for understanding the determination of stock option prices.

Keywords: Options, fair prices, influencing factors, capital market, agreements.

1. Introduction

A stock option is an agreement between two parties whereby an investor can buy or sell a stock at a specific price before or at a specified date (Ravenscroft & Williams, 2009). According to Stoll (1969) opinion that the process of buying shares by investors is also called 'call', while the sales process is called 'put'. Options can be a better option when you want to limit the risk to a certain amount. Options are derivative contracts that are based on a variety of different underlying assets, including stocks (Figlewski, 1987). Options contracts help you try to profit from price increases or losses, but when you buy an option, you enter a contract instead of buying a stock (Luo & Wang, 2023). Options can allow you to earn profits like stocks while investing less money, so options can be a way to limit your risk within certain limits (Singh & Ahmad, 2013). Options can be a useful strategy when you are an advanced investor.

You can start options trading by opening an account, choosing to buy or sell a put or call, and choosing the strike price and timeframe accordingly. In general, call buyers and put sellers profit when the value of the underlying stock rises. Put buyers and call sellers profit when the value falls (Janková, 2018). The options strategy consists of buying a single put in the hope of profiting from the decline in the underlying stock/index (Stoll, 1969). However, by writing another put with the same expiration, at a lower strike price, you create a way to offset some of the costs. This superior strategy requires net cash outflows or net debits at the beginning. The stock options investment strategy, including the Call Ratio Backspread consists of two parts: selling one or more calls at-the-money or out-of-the-money and buying two or three calls that are longer in-the-money than the calls sold (Odhiambo, 2023). This strategy is also considered the best option selling strategy.

In this paper, a study was carried out on the basic concept model of option pricing. The option price, known as a premium, consists of the sum of intrinsic value and time value (Su & Zhang, 2009). Intrinsic value is the price difference between the current stock price and the strike price. The time value of an option or the extrinsic value of an

option is the amount of premium above its intrinsic value. This price is determined by the strength of demand and supply in the market. The factors that affect market prices can be very diverse, including investor sentiment, economic news, political conditions, and more (Alfajriyah et al., 2024). Market prices can be very volatile and volatile in a short period of time. There are several ways to determine the price of an option, including the Black-Scholes Method and the Binomial Method.

2. Literature Review

The literature review method is a summary of the subject area that supports the identification of a particular research question. Literature reviews need to utilize and evaluate a variety of different types of sources including academic and professional journal articles, books, and web-based resources. The object studied in determining the option price includes the intrinsic value of the option and any additional amount to the intrinsic value. The premium on intrinsic value is called the time value or time premium. The intrinsic value of an option is the economic value if the option is exercised promptly (Su & Zhang, 2009).

3. Materials and Methods

3.1. Materials

The object studied in this study is the capital market value of an option. This research uses scientific data in the form of theories, methods, or research that has been carried out previously, either in the form of books, manuscripts, journals, and others. The benchmarks used in determining the value of an option include intrinsic value, expiration time or time value, volatility, interest rate, and cash dividends paid.

3.2. Methods

The steps taken in determining the option value in a capital market are as follows:

(a) Problem Formulation: Identifying problems in the pricing of stock options in the capital market, as well as how Black-Scholes and binomial models can be used.
(b) Literature studies: utilize and evaluate different types of sources including academic and professional journal articles, books, and web-based resources.
(c) Define the model: Select the model to be tested, such as the Black-Scholes and binomial models.
(d) Collect data: Data on call and put options, underlying stock prices, volatility, risk-free interest rates, and maturity times.
(e) Application of the model: The process of calculating the option price in the form of the underlying stock price, volatility, risk-free interest rate, maturity time, and stock price using a predetermined model.
(f) Data analysis: Analyzing whether the model is delivering accurate results or not, as well as comparing it to market prices.
(g) Conclusion: summarize the results of the analysis conducted.

4. Results and Discussion

Options indicate the right to choose to do something so that the financier or financial manager can do it or not. According to (Ravenscroft & Williams, 2009) stated that in the capital market or other exchanges that allow options trading, options are valuable pieces of paper that allow financiers to buy or sell a stock at a certain price at a certain time (or before). Options can be used for hedging as well as speculation.

4.1. Call, Put, and Stock

According to Stoll (1969) there are two types of options, namely call and put. Besides that, there are also European types and American types. The European type indicates that it can only be exercised on a specific date. As for the American type, it can be carried out on a certain date or earlier. A call option indicates the right to buy a stock at a certain price, called *the exercise price,* on a specific date (for the European type) or earlier (for the American type). The maturity date is referred to as *the exercise date*.

Suppose someone offers the following call options. One year from now we can sell A shares for IDR 10,000,-. Figure 1. Indicates the call value at the time the call option expires (Broadie & Detemple, 2004). If at the time the call option drops tempo, the price of A's shares is below IDR 10,000,- then the call value is equal to zero rupiah.

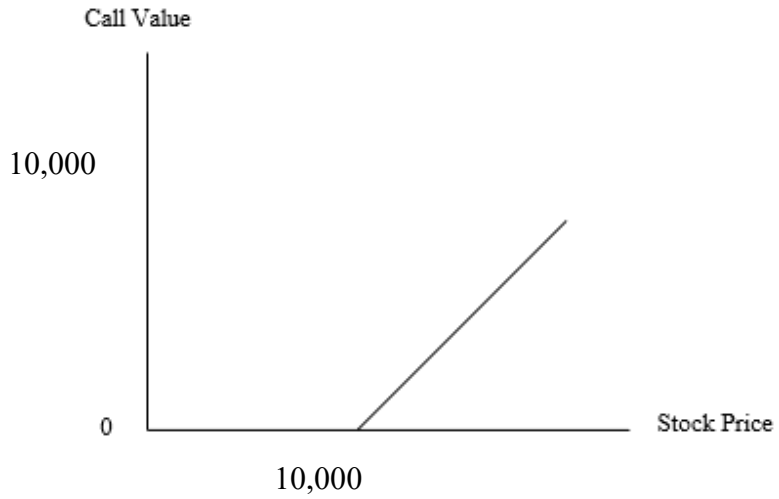

Figure 1: Assess the call option with exercise proce IDR 10,000

According to Stoll (1969) If the share price is above IDR 10,000,-, then we will make a profit when exercising this option. In this case, the call value will be equal to the market price minus the exercise price. While a put option indicates the right to sell a stock at a certain price at a certain time (or before). This is in line with the opinion of Broadie & Detemple (2004) suppose someone offers a put option as follows. By buying the put option you can sell stock A to that person for IDR 10,000,- one year in the future. The put option will have value if the price of stock A at maturity is below IDR 10,000,-. When the price of A shares is for example IDR 8,000,-, the investor will come to the issuer of the put option and ask him to buy the A shares owned for IDR 10,000,-. Because on the stock exchange the price of stock A is IDR 8,000,-, then shortly before the put option is exercised, the value of the put option is IDR 2,000,-. Conversely, when the stock price is above the exercise price, the value of the put option will be equal to zero.

The highest value of a put option is when the share price is zero rupiah (Stoll, 1969). At that time the value of the put will be IDR 10,000, - the same as the exercise price. Thus obtained:

$$\text{put option value} = \text{exercise price} - \text{stock price} \quad (1)$$

at the time of the share price of IDR 2,000,-, then:

$$\text{put option value} = \text{IDR } 10{,}000 - \text{IDR } 2{,}000 = \text{IDR } 8{,}000 \quad (2)$$

4.2. Investment in options

Suppose a call option is issued on A. Exercise price is IDR 10,000,-, and the option can be exercised for another year. The current share price of A, for example IDR 9,000,-. The option is offered at a price (referred to as premium) of IDR 500,- and we are interested in buying a total of 18 options. If one year later the price of A's shares becomes IDR 11,000,- per share, how much profit will be obtained?

Value of options at maturity $18 \times$ IDR 1,000 = IDR 18,000
The price (premium) of the option we paid at the beginning of the year = IDR 9,000 -
Investment profit (loss) = IDR 9,000

If the profit is expressed as a percentage of the initial investment, then the level of investment profit is:

$$\left(\frac{9{,}000}{9{,}000}\right) \times 100\% = \quad 100\%$$

When comparing the profit of the investment with the investment in A shares, the results will be as follows,

Sale price one year later : IDR 11,000
Current purchase price : IDR 9,000
Investment profit (loss) : IDR 2,000

Expressed in percentages:

$$\left(\frac{2{,}000}{9{,}000}\right) \times 100\% = 22.2\%$$

It appears that investing (in the same amount) in options provides a greater level of profit. However, it is not necessarily that options are better than stocks. For that, pay attention to what happens if one year in the future the share price reaches only IDR 10,000,-.

Value of options at maturity 18 x IDR 0,- = IDR 18,000
The price (premium) of the option we paid at the beginning of the year = IDR 9,000 -
Investment profit (loss) = IDR 9,000

If the loss is expressed as a percentage of the initial investment, then the level of investment profit is,

$$\left(\frac{-9{,}000}{9{,}000}\right) \times 100\% = -100\%$$

When comparing the investment loss with the investment in A shares, the result will be as follows,

Sale price one year later : IDR 10,000
Current purchase price : IDR 9,000
Investment advantages : IDR 1,000

Expressed in percentages,

$$\left(\frac{1{,}000}{9{,}000}\right) \times 100\% = 11.1\%$$

In other words, if you want to buy an option, the loss will reach 100% when the stock price only reaches IDR 10,000,- but there is still a profit when choosing to buy the stock (Broadie & Detemple, 2004). The example shows that the possibility of earning huge profits from investing in options is higher than investing in stocks. However, the probability of loss is also much higher. Therefore, it is said that investing in options carries more risk than investing in stocks. In addition, since options can only be created if there is a stock to which the option is linked, options are also referred to as financial derivatives (securities derived from other securities).

4.3. Call, Put and Stock Combinations

Investors can also diversify by buying calls, puts, and stocks simultaneously. Let us use the same example of stock A with an exercise price for both call and put of IDR 10,000,-. Suppose that put options and stock A will be purchased. Therefore, to find out what happens to wealth (embedded in puts and stocks) at various stock prices, we can compile a table as listed in Table 1.

Table 1: Value of puts and shares at various share prices (exercise price IDR 10,000)

Stock Price	Put Value	Stock Value	Put and Stock Values
0	IDR 10,000	0	IDR 10,000
IDR 4,000	IDR 6,000	IDR 4,000	IDR 10,000
IDR 10,000	0	IDR 10,000	IDR 10,000
IDR 12,000	0	IDR 12,000	IDR 10,000
IDR 20,000	0	IDR 20,000	IDR 10,000

If the table is drawn, then a picture is obtained as shown in Figure 2. The image shows that whatever happens to the stock price, the amount of wealth will be at least IDR 10,000 (Su & Zhang, 2009). This wealth is obtained when the stock price is below the exercise price. When the stock price is above the exercise price, the value of the wealth will be equal to the price of the stock.

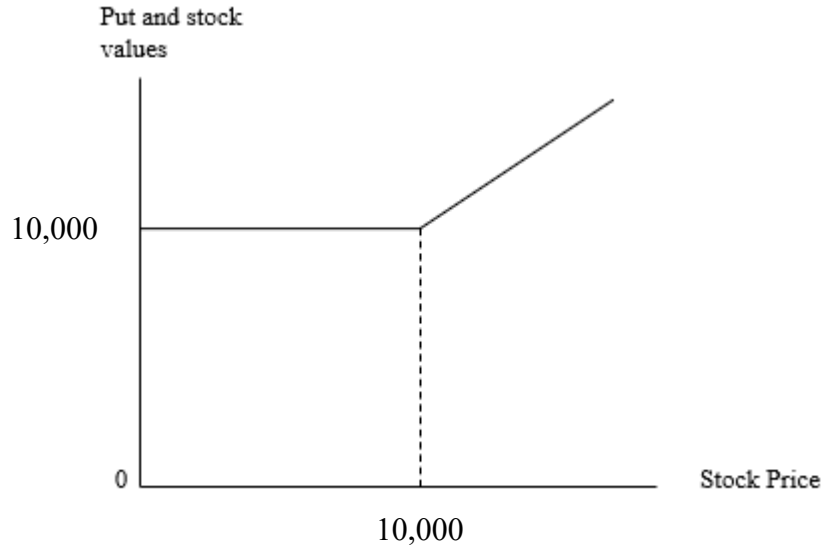

Figure 2: Value of put and stock options at various stock prices

By comparing Figure 2 with Figure 1, it is obtained that the pattern of the two images is the same. However, there is a difference in Figure 2 showing that the figure of IDR 10,000 is greater than Figure 1, at each share price. At the time of the share price of IDR 4,000, Figure 1 shows a value of zero dollar rupiah, while Figure 2 shows a value of IDR 10,000. At the time of the share price of IDR 20,000, Figure 1 shows a value of IDR 10,000 while Figure 2

shows a value of IDR 20,000. Thus this means that if: (1) the purchase of the call option is coupled with (2) setting aside a sufficient amount of money to pay the exercise price at maturity, the same value will be obtained by buying the put option plus buying the stock, Since the two investment packages produce the same value (payoffs), then both must have the same value. Thus,

$$\text{Call Value} + \text{present value of exercise price} = \text{put value} + \text{stock price} \quad (3)$$

This relationship is valid because of the payoff from,

[Buy Call, invest in a safe asset to get a value equal to the exercise price at maturity]

will result in a payoff equal to,

[buy put and buy stock].

This equation is a basic equation in combining calls, puts, and stocks. The above equation can also be modified to:

$$\text{call value} - \text{put value} = \text{stock price} - \text{present value of exercise price} \quad (4)$$

Which means that,

[buy call, sell put] identik with,

[buy stocks, borrow the present value of the exercise price]

Financiers can also combine call and put options together. Suppose call and put options are issued on shares A. Both options have an exercise price of IDR 10,000 (this situation is referred to as a straddle), and each is sold at a price (premium) of IDR 500 per option. If one call option and one put option are purchased, the profit (loss) at maturity will be shown in Table 2 (depending on the stock price at the time of expiration).

Table 2: Gains and losses at various stock prices for investors who buy call and put options with the same exercise price.

Stock Price	Put Value	Call Value	Invensment Value	Profit (loss)
IDR 7,500	IDR 2,500	0	IDR 1,000	IDR 1,500
IDR 8,000	IDR 2,000	0	IDR 1,000	IDR 1,000
IDR 8,500	IDR 1,500	0	IDR 1,000	IDR 500
IDR 9,000	IDR 1,000	0	IDR 1,000	0
IDR 9,500	IDR 500	0	IDR 1,000	IDR (500)
IDR 10,000	0	0	IDR 1,000	IDR (1,000)
IDR 10,500	0	IDR 500	IDR 1,000	IDR (500)
IDR 11,000	0	IDR 1,000	IDR 1,000	0
IDR 11,500	0	IDR 1,500	IDR 1.000	IDR 500
IDR 12,000	0	IDR 2,000	IDR 1.000	IDR 1,000

The table shows that as long as the share price falls below IDR 9,000 or rises above IDR 11,000, the financier will make a profit. If the share price is between IDR 9,000 and IDR 11,000, it will suffer a loss.

4.4. Factors Affecting Option Value

So far we have discussed the option price at maturity. Next we will discuss the value of the call option before maturity. If a call option on Bank BNI shares is offered, and the current share price of Bank BNI is IDR 500, while the exercise price is IDR 600 which can be exercised one year in the future, the price (also known as premium) of the call option will be determined when it is offered at this time. In stock pricing, the model that can be used to value stocks is the cash flow present value model. In option valuation, this model cannot be used because the option value is based on the value of the underlying assets, which can change at any time.

There are several factors that affect the value of options. For ease of understanding, we can look at the valuation of a call option. Knowing the basic relationship between call and put options, it is possible to determine the value (or premium) of a call option and also to estimate the value of a put option. Stoll (1969) explained that these factors are:

(a) The price of the stock or underlying asset
(b) Exercise Price
(c) Interest Rate
(d) Term to maturity
(e) Volatility of stock prices or asset prices

If factors a, c, d and e increase, the value of the call option will increase, while if factor b increases, the value of the call option will decrease.

5. Conclusion

Based on the results of the study, there are several models that can be used in determining stock option prices. The discounted cash flow model used to determine stock prices cannot be applied to the valuation of options because there is a risk that the option changes every time the stock price changes. When purchasing a call, a position in the stock is taken but less money is required than buying the stock outright. As a result an option will always be riskier than the stock in question. The option will have a higher beta and standard deviation than the stock.

How far the option risk is greater will depend on the stock price relative to the exercise price. An option that is "in the money" (the stock price is greater than the exercise price) is safer than an option that is "out of the money" (the stock price is less than the exercise price). So an increase in stock prices will increase the price of options and reduce the risk of options. On the other hand, when the stock price falls, the option price will fall and increase the risk of the option. Therefore, the level of profit desired by the financier will change when the stock price changes.

There are two models for estimating option prices, namely the Binomial Option Pricing Model (BOPM) and the Black and Scholes model. The trick used is to make an option equivalent by combining investment in common stocks and borrowing. The net cost of purchasing the equivalent of the option must be equal to the value of the option.

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