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Determination of Stock Option Prices Using the Black Scholes Method on Stocks Listed on the Jakarta Islamic Index for The Period 2021-2022

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Abstract: The capital market is one of the investment instruments favored by the Indonesian people. Reporting from KSEI, the number of investor growth from 2019 to 2022 continues to increase. Recorded in 2019 the number of capital market investors in Indonesia reached 2,484,354 and at the end of the listing on November 3, 2022 the number of capital market investors in Indonesia reached 10,000,628. The purpose to be achieved in this study is to find out and explain the calculation of the value of call options with weekly company stock data in order to find out which stocks are suitable for hedging and decisions that can be made based on the data that has been calculated. The type of research used is descriptive research with a quantitative approach. The sample taken amounted to 12 companies obtained based on determining the criteria in the form of increasing shares seen from the company's trend line during 2021-2022. The calculation method used is Black-Scholes by utilizing Microsoft Excel. The results showed that by using the Black Scholes method in determining option contracts, some stocks in certain semesters are not recommended to use call option contracts because the option price is zero (0), such as INCO shares in semester 2, PTBA shares in semester 4, TLKM shares in semester 3, and UNTR shares in semester 2. The results of the comparison of the Black Scholes stock option contract with the JCI call option contract show that ADRO, AKRA and PTBA shares can provide the highest profit for investors when using the Black Scholes method because they have a lower call option contract value than the market value. ADRO, AKRA and PTBA stocks have a positive purchase option contract difference value of 3 semesters so that they can provide the highest profit for investors.

Keywords: Black Scholes model, buy option, risk

1. Introduction

The Stock Exchange is a legal entity that has the task as a means of carrying out and regulating the course of Securities trading activities in the Capital Market. In terms of microeconomics for members of the stock exchange (issuers), the Stock Exchange serves to obtain capital that can be used to expand the business. While in terms of macroeconomics, the Stock Exchange has an important role to drive the country's economy. Securities trading activities have an influence on the development of the country's economy. If the Securities trading in the capital market carried out on the Stock Exchange shows positive results, then the picture can result in the achievement of positive performance in the economy of a country, as well as the opposite. The Stock Exchange is a conventional market that brings together sellers and buyers.

The Jakarta Islamic Index (JII) is one of the stock indices in Indonesia that calculates the average share price index for stocks that meet sharia criteria. The establishment of the JII cannot be separated from the cooperation between the

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Indonesian Capital Market (PT Jakarta Stock Exchange) and PT Danareksa Invesment Management (PT DIM). The JII has been developed since July 3, 2000. The Jakarta Composite Index (JCI) is an index that measures the price performance of all stocks listed on the Indonesia Stock Exchange. In global markets the JCI is known as the Indonesia Composite Index (ICI) or IDX Composite. The JCI is calculated using a weighted average based on the number of shares on the exchange or Market Value Weighted Average Index.

Shares are one of the investment instruments favored by the Indonesian people. The number of investors that continues to increase from year to year is one proof that capital market instruments are increasingly developing and favored by the Indonesian people. Recorded for the last 4 years, the number of investors who joined the capital market increased with the turn of the year.

Table 1 - Number of investors in Indonesia

Year	Investor(s)
2019	2.484.354
2020	3.880.753
2021	7.489.337
2022	10.000.628

Source: Kustoidan Sentral Efek Indonesia (KSEI)

Although investment in the capital market has increased from year to year, there are several risks that need to be considered when investing in the Capital Market. Risk can be interpreted as actual returns that differ from expected returns. There is an assumption that investors basically dislike things that contain elements of uncertainty. However, it still depends on each investor regarding risk preferences. In accordance with the rules of investing, where high risk will produce high returns and vice versa.

Risk in investing is unavoidable, but it can be minimized. There are three possibilities for risk in investment. They are investment size, cashflow replenishment, and cashflow deviation. The size of investment refers to a large investment is better than a small investment, especially from the element of failure. If a project with a large investment fails, its failure can cause the company to go bankrupt, while a small investment has a small risk, meaning that it does not interfere too much with the company's overall operations. Reinvestment of cash flow refers to the consideration of an investor in making decisions in making investments within a certain period of time by considering the level of risk that the company/investor will face. Deviation from cashflow refers to how the company benefits from future revenues. The cashflow for each investment project is not the same, some variations are large and some variations are small. If the variation in revenue is large, the risk is also large, so if the variation is small, the risk faced is also small.

Option contracts are one method of minimizing the level of risk in investing in stocks. Option contracts are included in one of the Derivative Instruments which determine a pricing contract between investors and issuers that have been determined. The derivative instrument used in this study is a stock option contract using the Black Scholes method. The Black-Scholes method is one of the methods for determining option prices. The assumption used in this model is that there is a dividend distribution. Dividends are paid in a constant market. Stock prices that change randomly over time are assumed to be stochastic processes. The Black Scholes model was first developed in 1973 by Fischer Black and Myron Scholes. The Black Scholes model can only be used for European-type options. This model can only be used at maturity. The Black Scholes model is based on the assumption that the options used are European type options and there are no taxes and transaction costs until the time of maturity of the option.

2. Literature Review

One of the decisions in managing finances is to invest. Bodie, Kane, and Marcus (2019) state that Investment is a series of activity processes for analyze various risk factors and estimate the expected return provide the best benefits in the future which leads to a decision investment involving commitment and tolerable sacrifice in the present.

This research focuses on stock investment by minimizing the risks contained in these investment instruments. Mamduh M. Hanafi (2018) state that shares are proof of ownership of a company. Shareholders earn income from dividends and capital gains (the difference between the selling price and the buying price). Unlike bonds, stocks do not pay a fixed income. And dividends do not have to be paid if the company does not have cash. Even if the company has cash, but the company needs the cash for expansion, the company also does not have to pay dividends.

The important point in investing is to expect a return on the shares that have been invested in. Dewi and Wijaya (2018) state that return is the profit obtained by companies, individuals, and institutions from the results of their investment policies. Another opinion is also expressed by Zulfikar (2016) state that return is the reward for the investor's courage to bear the risk, as well as the commitment of time and funds that have been spent by the investor.

In minimizing risk, derivative instruments can be an alternative choice for investors so that the risk received can be minimized according to their needs. Brigham & Houston (2018) state that in dealing with the risk of fluctuations in foreign currency exchange rates, the company can carry out several policies. First the company can purchase spot foreign currency when economic conditions are stable to later to be used to fulfil obligations or purchase the needs of companies that use foreign currencies, both companies can apply hedging. natural value, where all the costs borne by the company in foreign currency exchange rates can be covered by sales made by the company in foreign currencies as well, and the third company can hedge by entering into currency forward contracts, currency futures contracts, currency options money, as well as currency swaps.

3. Research Methodology

This research uses descriptive research with a quantitative approach. This type of descriptive research was chosen because this research will explain the determination of the purchase price of shares listed on the Jakarta Islamic index using the Black-Scholes method.

The type of research data used is quantitative data because the data is related to the problem under study in the form of the Jakarta Islamic Index (JII) stock price, the stock price of securities included in the JII and the risk-free rate of return (BI rate) during the period from January 2021 to December 2022. The data used in the study comes from secondary data sources, so researchers do not need to go to institutions to collect data. It is because, all the data needed has been published openly and the researchers can obtained the data from the official website www.idx.co.id, www.yahoofinance.com, and www.bi.go.id.

The sample withdrawal in this study was carried out using purposive sampling method with several research criteria. Of the 30 population of companies listed on the Jakarta Islamic Index, only 12 companies were selected as research samples. the following are the company samples in this study:

Table 2 - Reasearch sample

No	Company Code	Company Name	IPO Date	Sector
1	ADRO	Adaro Energy Indonesia Tbk.	16 July 2008	Mining
2	AKRA	AkR Corporindo Tbk.	3 October 1994	Logistic and Mining
3	EXCL	Aneka Tambang Tbk.	27 November 1997	Mining
4	ICBP	Indofood CBP Sukses Makmur Tbk.	07 October 2010	Goods and Consumer Industry
5	INCO	Vale Indonesia Tbk.	16 May 1990	Mining
6	INDF	Indofood Sukses Makmur Tbk.	14 July 1994	Goods and Consumer Industry
7	KLBF	Kalbe Farma Tbk.	30 July 1991	Goods and Consumer Industry
8	MIKA	Mitra Keluarga Karyasehat Tbk.	24 March 2015	Health
9	PGAS	Perusahaan Gas Negara Tbk.	15 December 2003	Oil and Gas
10	PTBA	Bukit Asam Tbk.	23 December 2002	Mining
11	TLKM	Telkom Indonesia (Persero) Tbk.	14 November 1995	Infrastructure, Utilities & Transportation
12	UNTR	United Tractors Tbk.	13 October 1972	Trade, Services & Investment

Source: Indonesia Stock Exchange (IDX), Indonesia (2022)

4. Data Analysis and Result

Stocks that will be determined by the stock option price are based on criteria that have been determined in sampling. The criteria in question are to take stocks with trend scatter lines that tend to increase in the 2021-2022 period and have a positive regression coefficient using the Excel application.

This research has several stages in determining the price of stock options using the Black Scholes method. include downloading stock prices from the IDN Financials website www.yahoofinancials.com , calculating weekly stock returns, calculating stock volatility, and determining the contract value of stock options using the Black Scholes method. After determining the Black Scholes stock option value, the market value of the call option is also determined using JCI data per company for the 2021-2022 period so that it can be compared and it can be determined which stocks

can provide the highest profit for investors and which stocks do not need to use the Black Scholes call option contract because it is not effective and will only provide losses for investors.

Stock returns are the first step in determining the black scholes call option price to find out how much return each stock can provide.

Table 3 - Stock return

No	Stock Code	Semester			
		1	2	3	4
1	ADRO	-0.09531	0.47296	0.31383	0.33962
2	AKRA	-0.04474	0.31121	0.20613	0.22314
3	EXCL	-0.01808	0.20550	-0.18990	-0.21154
4	ICBP	-0.17920	0.04355	0.08292	0.07220
5	INCO	-0.13794	0.01307	0.10746	0.42663
6	INDF	-0.12419	-0.01533	0.07411	-0.00722
7	KLBF	-0.09065	0.14286	0.05716	0.19416
8	MIKA	-0.00725	-0.19182	0.14781	0.13492
9	PGAS	-0.39256	0.34604	0.21511	0.10288
10	PTBA	-0.31534	0.24285	0.43022	-0.00536
11	TLKM	-0.02131	0.28197	0.01224	-0.06156
12	UNTR	-0.21214	0.04983	0.29790	-0.01498

Source: Data processed by the author (2022)

Based on the table above, it shows that stock returns are negative and positive depending on the value of the stock price. A stable stock price will tend to produce a positive return value, and conversely a stock price that tends to fluctuate will produce a negative return. The return will be used in the next stage to calculating the value of stock price volatility.

Table 4 - Stock table

No	Stock Code	Semester			
		1	2	3	4
1	ADRO	0,09346	0,46341	0,30694	0,33302
2	AKRA	0,04387	0,30492	0,20160	0,21881
3	EXCL	0,01773	0,20135	0,18572	0,20743
4	ICBP	0,17572	0,04267	0,08110	0,07079
5	INCO	0,13526	0,01281	0,10510	0,41835
6	INDF	0,12178	0,01502	0,07248	0,00708
7	KLBF	0,08889	0,13998	0,05590	0,19039
8	MIKA	0,00711	0,18795	0,14456	0,13230
9	PGAS	0,38494	0,33905	0,21038	0,10088
10	PTBA	0,30922	0,23795	0,42076	0,00526
11	TLKM	0,02090	0,27627	0,01197	0,06036
12	UNTR	0,20802	0,04883	0,29136	0,01469

Source: Data processed by the author (2022)

Based on the table above, there are stocks with a purchase option price value of zero (0), namely INCO, TLKM, PTBA and UNTR. In the 1st semester, there were no stock purchase options worth zero (0). In the 2nd semester, there are two stocks that are worth zero (0), including INCO, and UNTR. In the 3rd semester, there are two stocks that are worth zero (0), including TLKM and INCO shares. INCO shares in the 3rd semester are worth 0.03 where the value when rounded is close to the value of zero (0). Therefore, the author clarifies INCO shares in the 3rd semester as one of the stocks worth zero (0). In the 4th semester, there were two stocks with a value of zero (0), including PTBA and UNTR shares. The existence of a zero (0) value of call option contracts is due to significant fluctuations in stock prices in related companies which cause stock returns and stock volatility to decrease compared to the previous semester. Therefore, stocks with Black Scholes call option contracts worth zero (0) cannot use call option contracts.

Table 5 - Comparison of Black Scholes Option contracts with market options

Stock	Call Option Value											
	SMT 1			SMT 2			SMT 3			SMT4		
	B.S.	Market	Dev	B.S.	Pasar	Dev	B.S.	Pasar	Dev	B.S.	Pasar	Dev
ADRO	196,06	178,27	-17,79	82,24	101,06	18,82	34,32	110,08	75,76	51,2	203,37	152,17
AKRA	6,21	40,69	34,48	13,19	7,02	-6,17	20,39	29,81	9,42	4,81	51,07	46,26
EXCL	518,75	458,75	-60	79,48	32,57	-46,91	409,24	378,99	-30,25	258,06	259,88	1,82
ICBP	1117,29	933,43	-183,86	78,62	80,77	2,15	648,29	651,85	3,56	319,34	217,61	-101,73
INCO	250,87	1597,12	1346,25	0	126,26	126,26	0,03	291,04	291,01	133,58	1129,64	996,06
INDF	577,31	447,71	-129,6	263,37	134,25	-129,12	244,77	92,98	-151,79	474,95	449,95	-25
KLBF	46,35	25,07	-21,28	43,14	13,85	-29,29	30,74	11,02	-19,72	41,77	48,42	6,65
MIKA	92,59	11,72	-80,87	414,4	351,08	-63,32	48,37	58,99	10,62	102,36	7,33	-95,03
PGAS	292,05	331,08	39,03	37,5	21,7	-15,8	46,86	67,46	20,6	9,92	9,89	-0,03
PTBA	433,71	455,61	21,9	43,75	59,04	15,29	106,62	182,22	75,6	0	284,81	284,81
TLKM	46,07	146,69	100,62	90,01	84,83	-5,18	0	0,13	0,13	19,39	44	24,61
UNTR	4254,33	4733,49	479,16	0	96,85	96,85	486,44	817,36	330,92	0	2142,87	2142,87

Source: Data processed by the author (2022)

Based on the results of the comparison of the Black Scholes call option value with the market call option value above, it is explained as follows. If the Black Scholes call option contract value is higher than the market call option

value, then the call option contract difference will be negative and the stock is not recommended to be purchased using the Black Scholes option contract. Otherwise, if the Black Scholes call option value is lower than the market call option value, then the stock is worth buying because it can benefit investors.

Stocks that can provide profits for investors are stocks with Black Scholes call option contract values that are lower than the market call option contract values. Therefore, stocks that can provide the highest profit to be purchased using Black Scholes call option contracts include ADRO, PTBA and AKRA stocks because they have 3 semesters with a Black Scholes call option contract value that is lower than the market call option contract value so that it can provide more profit for investors. PTBA shares in the 4th semester cannot use the Black Scholes call option contract because the Black Scholes option contract value is zero (0). While stocks that are not recommended for purchase are INDF shares because in the 4th semester of the calculation the value of the Black Scholes call option contract is higher than the value of the market call option contract so that if using the Black Scholes method will only provide losses for investors.

5. Conclusion

Based on the application of the Black Scholes method to 12 sample companies, the value of the stock option price is obtained which can be used as a way for investors to minimize the risk of buying shares. In its application, it is necessary to do several calculation steps in order to get the value of the call option using the Black Scholes method. Such as first determining stock returns, calculating stock volatility, then being able to calculate the purchase option price. However, in the results of the option contract calculation, there are several semesters in several companies with the purchase price of their stock options worth zero (0). This is due to the occurrence of significant stock fluctuations in a particular semester, affecting the value of volatility and stock returns that occur in that semester to be low. Therefore, the semester with a stock option price value of zero (0) explains that there is no need for hedging using a call option contract. In addition, it is recommended for investors to take companies with increasing share prices in order to obtain returns from the increase in share prices and can buy these shares below market prices and determine companies with relatively stable share prices.

There is a price difference between the stock option price using the Black Scholes method and the market price based on the JCI value which is the benchmark for whether the stock is worth buying using an option contract or not. Based on the results presented in table 4.5, it can be concluded that if the market value is higher than the Black Scholes option contract value, then the stock is worth buying because it can provide benefits for investors and the difference value will be positive. Meanwhile, if the market value is lower than the contract value of the Black Scholes option, then the stock is not recommended to be purchased because it will provide a loss for investors and the difference value will be negative. The higher the value of the difference between the contract value of the Black Scholes option and the market value, the more profit it will give to investors. Therefore, stocks that can provide the highest profit for investors include ADRO, PTBA and AKRA stocks because they have 3 semesters with a Black Scholes call option contract value that is lower than the market call option contract value. While stocks that are not recommended for purchase are INDF shares because in 4 semesters the calculation of the Black Scholes call option contract value is higher than the market call option contract value so that if using the Black Scholes method will only provide losses for investors.

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