GATR Journal of Finance and Banking Review

Journal homepage: http://gatrenterprise.com/GATRJournals/JFBR/vol7_2023_issue4.html

J. Fin. Bank. Review 7(4) 16–27 (2023)

Comparison of Black-Scholes and GARCH Option Models on The Jakarta Islamic Index with Collar Strategy

Riko Hendrawan[1*], Zainal Arifin[2]

[12]Telkom University, Gegerkalong, 40152, Bandung, Indonesia

ABSTRACT

Objective –The revival of the Islamic economy in Indonesia was marked by the establishment of the Jakarta Islamic Index (JII) on July 3, 2000. From 2000 to 2020, two economic crises hit Indonesia in 2008 and 2020. These crises also had an impact on the high price fluctuations of JII. Assets can be protected from significant losses by hedging. One of the hedging strategies was option contracts with a collar strategy.

Methodology – The data analysed in this research were the JII closing price data from 2000 to 2020 using the Black Scholes model and the GARCH model with the Collar strategy.

Findings – Option with the Collar strategy provided more benefits in crises than without Option. In crisis conditions, the Option with the GARCH method and the collar strategy provided a higher average profit of 3.07% on the one-month Option and 7.01% on the three-month Option than without using the Option with the collar strategy. In non-crisis conditions, the Option using the GARCH method, and the collar strategy provided a 0.16% higher average profit at one-month maturity than without the Option. Meanwhile, the average profit decreased by 1.45% at the three-month maturity. The collar strategy resulted in less volatility. Without a collar strategy, JII volatility was 103%. The collar strategy produced maximum volatility of 12.71%, 15.18%, and 17.14%. The findings also revealed that the GARCH model was better than the Black Scholes based on the AMSE value obtained in crisis conditions with a maturity of one month and three months and in non-crisis conditions with a maturity of one month. Meanwhile, the Black Scholes model showed better results in non-crisis conditions with a maturity of three months.

Novelty – Based on the research result, the Option with a collar strategy is effective for hedging in crisis conditions. This research assesses the collar strategy with several different maturity values to get the most effective value.

Type of Paper: Empirical

JEL Classification: G11, G13.

Keywords: Black Scholes; Collar Strategy; GARCH; Jakarta Islamic Index; Option Contracts.

Reference to this paper should be made as follows: Hendrawan, R; Arifin, Z. (2023). Comparison of Black-Scholes and GARCH Option Models on The Jakarta Islamic Index with Collar Strategy, *J. Fin. Bank. Review*, 7(4), 16 – 27. https://doi.org/10.35609/jfbr.2023.7.4(2)

1. Introduction

Indonesia is a country with the largest number of Muslims in the world. The total Muslim population in Indonesia has reached 229 million people, which is 12.7% of the total Muslim population in the world. The rise of the Islamic economy in Indonesia is an interesting phenomenon, which was marked by the establishment of Bank Muamalat on November 1, 1991, as the first Islamic bank in Indonesia, the issuance of the first Sharia mutual fund in 1997, and the launch of the Jakarta Islamic Index (JII) as the first Sharia stock index in Indonesia on July 3, 2000.

[*] Paper Info: Revised: January 26, 2023
Accepted: March 31, 2023

[*] Corresponding author: Riko Hendrawan
E-mail: riko_hendrawan@yahoo.com
Affiliation: Telkom University, Gegerkalong, 40152, Bandung, Indonesia

ISSN 2636-9176, e-ISSN 0128-3103 © 2023 **Global Academy of Training & Research (GATR) Enterprise. All rights reserved.**

In the past twenty years (2000-2020), the return volatility of the Jakarta Islamic Index (JII) was relatively high. As presented in Figure 1, the lowest value occurred on October 6, 2008, with a return value of -14.25%, and the highest return value occurred on March 9, 2020, with a return value of 12.81%.

Two crises hit the Indonesian economy in the period between 2000-2020. The first was the 2008 subprime mortgage crisis that started with bad housing loans in the USA, which caused stock prices to drop and affected global stock indexes, including Indonesia. The second was the COVID-19 pandemic in 2020, which caused the Indonesian economy to decline. As presented in Table 1, The 2008 crisis caused JII to be corrected by 66.65%. The highest closing value of JII in 2008 was 517.8, which occurred on February 28, 2021. While the lowest closing value of JII occurred on October 28, 2021, with a value of 172.7. The volatility range of JII's return in 2008 was quite far, between -14.25% and 7.95%. Meanwhile, JII's return volatility range in 2020 is between -7.84% to 12.81%, the value of JII's return volatility was very high when a crisis occurs.

Hendrawan et al. (2020) stated that the emergence of volatility could lead to the emergence of risk and uncertainty, causing the interest of market participants to invest in becoming unstable. This is corroborated by (El-Hassan et al., 2018), who stated that an unexpectedly sharp increase in the index could result in substantial investment losses. For example, after the global financial crisis of 2008-2009, the yield deviation on the S&P/ASX 200 index from September 4, 2009, to October 1, 2009, was 6% (70% per annum).

According to (Isynuwardhana & Surur, 2018), one way to manage risk is to hedge the assets owned. There are several types of options strategies to be chosen in conducting speculation or hedging efforts. (Isynuwardhana & Surur, 2018) also suggested that the long straddles strategy provides large profits when market prices rise or fall drastically. According to (Lee & Kim, 2015), one options strategy to be used for hedging is the collar strategy.

In the last 20 years, the Jakarta Islamic Index (JII) has had an upward trend because the stocks included in the constituents of the Jakarta Islamic Index were 30 Sharia stocks with the highest market capitalization value and the most liquid in the IDX secondary market. One of the conditions for entry into sharia shares is that the issuer should have a maximum total debt of 45% of total assets, meaning that the shares included in the JII constituents are stocks with good performance. However, JII was also affected during the crisis. Figure 3 shows that there was a significant decline in JII in crisis conditions, such as in 2008 due to the subprime mortgage crisis and in 2020 due to COVID-19.

From this phenomenon, it can be concluded that JII also needs hedging to minimize risks during a crisis. According to (Basson et al., 2018), the zero-cost collar (ZCC) and long butterfly (LB) strategies provide the best returns on indexes with moderate volatility and good performance.

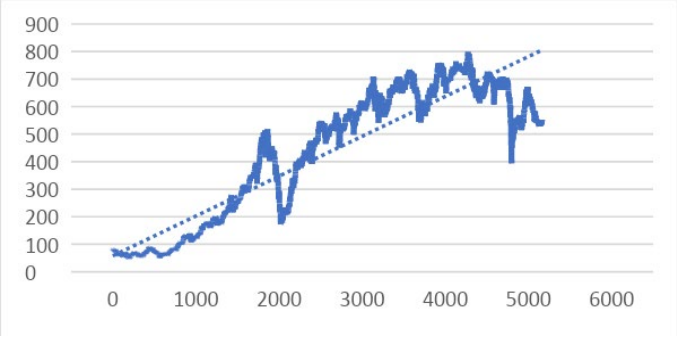


Figure 1. Graph of JII Closing Price for 2000-2020

Based on the above phenomenon and previous research, this research aimed at further analysing the application of Black-Scholes option using historical variance and GARCH variance modelling, then evaluate the results of implementing contracts Option with the Collar strategy to hedging in the Jakarta Islamic Index

(JII), which model is better? This study also analyses what is the impact of the collar strategy in hedging on the Jakarta Islamic index, and what type of collar strategy is the best?

2. Literature Review

The literatures that used as a source of reference and comparison in this study are as follows:

(Riko Hendrawan, Laksana, et al., 2020) examined the JCI volatility in 2009-2018 using the long strangle strategy and tested its accuracy with AMSE on two historical volatility models with the Black Scholes model and the GARCH volatility model based on the ARIMA lag model. This research showed that the GARCH model was more accurate than the Black Scholes for one and two-month call option, with results of 0.26% and 0.92%, respectively. Meanwhile, for one and two-month put option the Black Scholes model was more accurate with values of 0.18% and 0.26%. For a period of three months, Black Scholes was more accurate both put and call with a value of 2% and 0.31%.

(El-Hassan et al., 2018) examined the performance of holding the S&P / ASX 200 index with an active, passive, zero-cost collar, and protective put strategy in the period January 2008-March 2016. The data were taken from option market data and Black Scholes calculations. The success of the option strategy depends on the market conditions. In this research, a zero-cost collar strategy with a call and put strike price of 2% of the index price and a six-month contract period was the most profitable.

(Israelov & Klein, 2016) investigated the return comparison between the S&P 500 Index (SPX) and the CBOE S&P 500 Collar Index (CLL) with various strategies from March 25, 1996 to December 31, 2014. The research found that the S&P 500 Index without a collar strategy provided a larger return, namely 5.2% while the CBOE S&P 500 yielded a return of 2.3%. The volatility of the S&P 500 Index was greater than using the collar strategy. The volatility of the S&P 500 was 16.5%, the CBOE Collar Index was 11.4%, the S&P 500 Index (36%) was 5.9%, the CBOE PPUT Index (101%) was 13.2%, the CBOE BXM Index (49%) was 5.6%, and the Hedged BXM Index (45%) was 4.1%.

(Bhat & Arekar, 2016) examined the implementation of the Black Scholes model and GARCH on the closing price of USD call option against INR on the National Stock Exchange (NSE) from 1 May to 31 October 2013. The period from 1 May – October 2013 was chosen due to high volatility in that period. The research found that the MSE value of the Black Scholes model was smaller than the GARCH in the short, medium, and long term.

(Lee & Kim, 2015) studied the effect of the collar strategy on construction projects in South Korea. Most construction projects in South Korea were financed from bank loans. If during the project there had been changes due to design errors and findings causing the project time to be longer or more expensive, the costs would have increased. The results of this research found that of the 237 projects, there were 109 (46%), which costs were increased beyond the strike call price, 126 (53%) projects, which costs were less than the strike put price, and there were 2 (1%) projects, which prices were between the call and put strike price.

(Bi et al., 2014) examined the implementation of the black Scholes model using GARCH (1,1) in determining option prices at ten company stock prices in India. In this study, it was found that from the results of SPSS calculations using the T-Test, it was found that the price of a call option with a maturity time of 30, 60 and 90 days was greater than 0.05, indicating that there was no significant difference between the actual price and the predicted price. At the put option price with a maturity time of 60 and 90 days the value is also greater than 0.05. At the price of a put option with a maturity time of 30 days, the value is less than 0.05. This indicates that there is a significant difference between the actual price and the expected price.

Furthermore, (Szado E., 2012) examined risk management using a collar strategy on various types of assets including equities, currencies, commodities, fixed income, and real estate. The results of this research indicated that the collar strategy using the purchase of a put option with a maturity of six months and the sale

of a call option with a maturity of one month in a row provide increased risk-adjusted performance and a significant reduction in risk.

(R Hendrawan, 2010) compare the Black Scholes option model and the GARCH option model for Astra, BCA, Indofood, and Telkom stock option on the Indonesia Stock Exchange. The research found that the GARCH model was more accurate than the Black Scholes model in valuing stock option prices with maturity period one, two and tree-month, the average correction relative to the average percentage of the square root of the error being 28.10%, 23.30%, and 20%, respectively.

According (El-Hassan et al., 2018), zero cost-collar strategy with a call and put strike price of 2% of the index price and a six-month contract period was the most profitable in the S&P / ASX 200 index. This is opposite to (Israelov & Klein, 2016) that found that the S&P 500 Index without a collar strategy provided a larger return, but the collar strategy provides lower volatility than without a collar strategy. (Lee & Kim, 2015) and (Szado E., 2012) found nearly the same results, that the collar strategy delivers increased risk-adjusted performance and a significant reduction in risk.

(R Hendrawan, 2010) found that the GARCH Model is more accurate than the Black-Scholes Model on 4 stocks on the Indonesian index (IDX), this contradicts (Bhat & Arekar, 2016) research which states that the Black-Scholes model gives smaller errors than the GARCH model on the National Stock Exchange (NSE). (Bi et al., 2014) found that the GARCH model for options with maturity of two and three months is not significant compared to the actual price, while at maturity of one month the difference is significant.

Reviewing the literature leads back to the question: which Black-Scholes or GARCH (1,1) models are best for determining options prices on the Jakarta Islamic index (JII)? Is the collar strategy effective in hedging the Jakarta Islamic index?

3. Research Methodology

3.1 Option Teory

Hedging as risk management in the financial world can be conducted by using a derivative strategy. Derivatives can be defined as financial instruments, which value depends on (or is derived from) the value of another more basic variable. The variable underlying the derivative is the price of the asset being traded. Stock options, for example, are derivatives, which value depends on the stock price. Several types of derivative products are Future, Forward, Swap and Option (Hull, 2009). Futures, Forwards and Swaps are obligatory, meaning that transactions should be executed when the contract expires, while Option are obligatory for those who sell but Option for those who buy. The option buyer has the choice to exercise, or not, at maturity by giving a premium to the option seller.

3.2 Black Scholes Option Model

The Black Scholes model invented in 1973 by Fischer Black and Myron Scholes is the basis for setting the fair price of a call and put Option. The Black Scholes model uses 6 variables in determining an option price, including volatility, type of Option, stock price, time, strike price, and risk-free interest rate (Hull, 2009).

According to (R Hendrawan, 2010) the Black Scholes model calculates the expected rate of return using the basis of the risk-free asset variable that replaces the expected return variable. There is a lot of speculation going on in the stock market that making proper option pricing eliminates arbitrage opportunities. The Black Scholes formula provides a theoretical estimate of the price of European-type Option and shows that Option have a unique price regardless of security risk and expected return. The main objective of this model is to

hedge the value of the Option by buying and selling the underlying asset in the most appropriate way, namely eliminating the risk.

The Black Scholes model invented in 1973 by Fischer Black and Myron Scholes is the basis for setting the fair price of a call and put Option. The Black Scholes model uses 6 variables in determining an option price, including volatility, type of Option, stock price, time, strike price, and risk-free interest rate (Hull, 2009).

The Black Scholes equation in determining the Call value is as follows:

$C = S_0 N(d_1) - Ke^{-rT} N(d_2)$……(1)

The equation to determine the Put value is as follows:

$P = Ke^{-rT} N(-d_2) - S_0 N(-d_1)$……(2)

where:

$d_1 = \frac{\ln(S_0/K)+(r+\sigma^2/2)\,T}{\sigma\sqrt{T}}$……(3)

$d_2 = \frac{\ln(S_0/K)+(r+\sigma^2/2)\,T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$.....(4)

With:

C = Value of call options.
P = Value of put options.
S0 = Spot price of a stock
X = Execution price
T = Expiration date / Option contract due date
r = Risk free interest rate / SBI
σ = Variance of stock price/volatility
N. = Cumulative standard of normal distribution

3.3 GARCH Option Model

The GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model is a development of the ARCH (Autoregressive Conditional Heteroscedasticity) model. This model was developed to avoid orders that are too high in the ARCH model as developed by (Bollerslev, 1986), which is parsimony or simpler model so that the variance is always positive. The ARCH/GARCH model was used to model risk over time. The GARCH model provides a more flexible framework for capturing the dynamic structure of conditional variances

(Bollerslev, 1986) proposed GARCH (1,1) model in volatility modelling with n2 calculated from long variance average level and, VL from n-1 and un-1. According to (Hull, 2009) GARCH (1,1) equation is as follow:

n2=γVL+αun-12+βn-12…….….(5)

If it represents VL, represents un-12, and represents n-12, then the whole constant follows the following equation:

γ+α + = 1…….……....……..(6)

In GARCH (1,1) it was shown that n2 was based on the most recent observations of u2 and the most recent estimates of the degree of variance. The more general GARCH(p,q) model calculates n2 of observations p on u2 and the latest estimation q of the variance level. If ω= γVL, then the GARCH (1.1) model can be formulated as :

2=ω+αun-12+βn-12 …….……..(7)

3.4 Collar Strategy

(Sinclair, 2010), stated that the collar strategy is a combination of buying the underlying stock/index, covered call option and protective put option. This Option limits returns to both positive and negative and is useful for overcoming high price volatility to obtain more stable prices. The collar option strategy is carried out by buying a put option and selling a call option simultaneously on the shares held. The payoff diagram of the Collar option is presented in Figure 2. Put Option provides benefits if the stock price in the capital market is lower than the strike price put Option (Kp) because the stock price is protected from a significant decline. Meanwhile, stock profits are limited to the strike price of the call option (Kc) because the call option will be executed if the market price is higher than Kc. Although it provides limited benefits, the collar strategy is a way to hedge with minimum costs or even no costs if the selling price of the call option is the same as the buy price of the put Option.

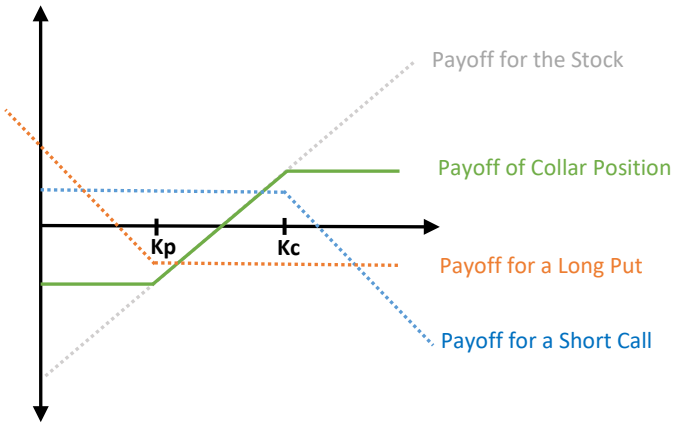


Figure 2. Payoff Diagram of a Collar Strategy

This research compared several types of collar strategies in one and three-month option contracts using the historical variance Black Scholes and GARCH (1,1) methods at JII. The type of collar strategy used was the collar strategy with Xp = 95%*So and Xc = 105%*So, Xp = 95%*So, Xc = 107.5%*So, Xp = 95%*So, and Xc = 110%*So. This research used time-series data with a sample of JII closing prices. If the time of maturity fell on a holiday, then the Option would be exercised on the next working day (Riko Hendrawan, 2017).

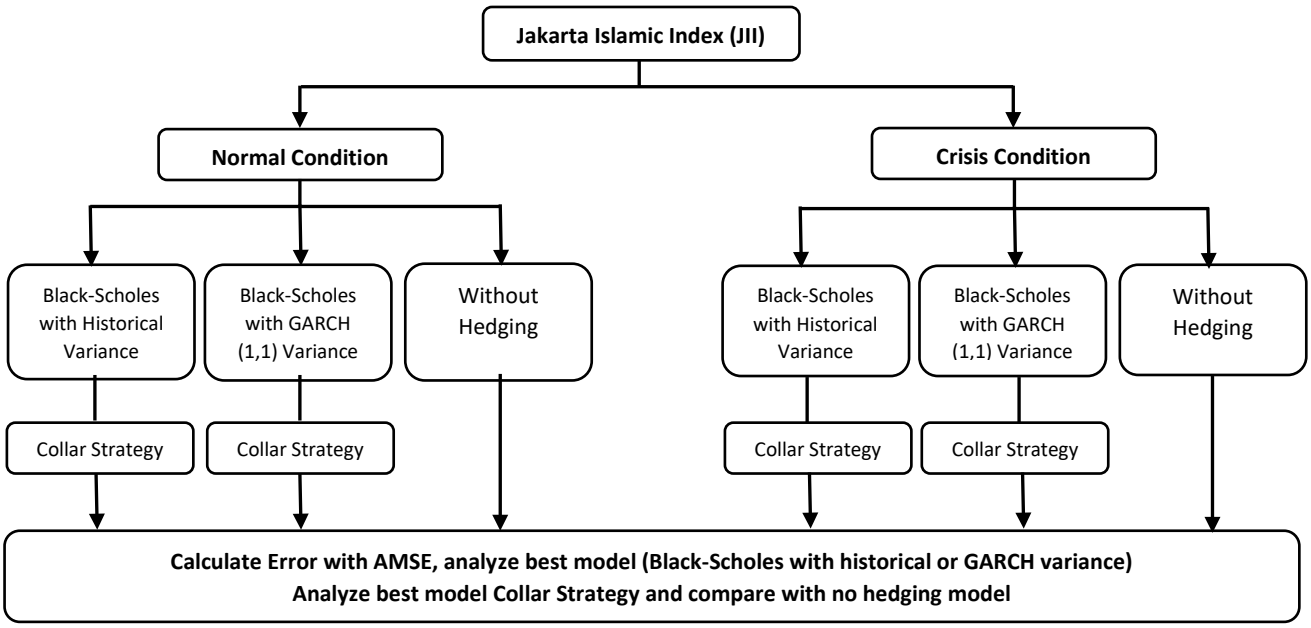
The average mean square error (AMSE) model was used to determine the error rate. The smaller the AMSE value was, the smaller the error rate was. The AMSE equation is as follows:

AMSE = $\frac{1}{N}\sum_{t=1}^{N}(\quad)2$ (8)

With,

Apt = Value of Actual Option Premium
SPt = Value of Premium Option calculation results
N = Number of Experiments performed.

The framework of this research is as follows:



4. Results

4.1 Comparison of Option Profit Opportunities with Collar Strategy using Historical Variance and GARCH

The analysis was conducted by calculating the probability of the option strike price (X) below the put strike price (Xp), between Xp and the initial price (So), between the initial price and the call strike price (Xc) and above Xc. Calculations were conducted using Option with maturities of one month and three months.

When X is less than Xp, the long put will be executed so that the loss of the collar strategy user is only So-Xp-option premium. In this condition, hedging applies. If X is between Xp and So, the loss for the collar strategy user is So-X. If X is between So and Xc, the profit for the collar strategy user is X-So and if X is more significant than Xc, the short call will be executed so that the profit for the collar strategy user is only Xc-So-option premium.

Tables 2 and 3 show that the profit opportunities of the Black-Scholes Model with Historical Variance and GARCH Variance had the same magnitude in both crisis and non-crisis conditions and with one or three-month Option. The value of X < Xp was greater during crisis conditions than during non-crisis conditions. During the crisis, the value of X<Xp was 39.33% in the one-month Option and 44.35% in the three months option. This indicated that the collar strategy was very effective in hedging in times of crisis. On the other hand, in non-crisis conditions, the value of X > Xc was much higher, where in the one-month Option the chance was 25.44% and in the three months option the chance was 49.49% meaning that investors lost the opportunity to get bigger profits. The collar strategy with Xp = 95%*So, Xc = 110%* So provided a greater profit opportunity with the greatest opportunity for the value of X between So and Xc, which was 49.85% in the one-month Option and 34.62% in the three-month Option.

4.2 Comparison of the advantages/disadvantages of Option with Collar Strategy using Historical Variance, GARCH, and without Option

The calculation was conducted by calculating the amount of profit or loss obtained from using the collar strategy or not on the one month and three months option.

As presented in Table 4, it was effective in limiting the range of JII price volatility. The lowest range was obtained using GARCH Variance and a maturity of one month with a range of only 10.4%. The collar strategy of type Xp = 95%*So, Xc = 110%* So provided the highest average profit of 1.6%. In crisis conditions, the Option with the collar strategy provided a better average profit than without using the Option. In non-crisis conditions, Option with a collar strategy provided a better average return at maturity of one month compared to those without Option. Meanwhile, at maturity of three months, the average profit for Option with a collar strategy was smaller than that without Option. In this study it was found that the collar strategy was very effective in limiting JII volatility so that return uncertainty could be limited. The collar strategy is very profitable when used in crisis conditions. In non-crisis conditions, the collar strategy provides better returns on short-term investments.

4.3 Comparison of AMSE Option with Collar Strategy using Historical Variance and GARCH

The calculation was conducted by calculating the magnitude of the BEP price error of the collar option compared to the price at maturity. The price of the BEP option with the Collar strategy was the same as So – long put premium + short call premium.

Table 5 shows that the GARCH model produced a smaller AMSE than the Historical volatility model in crisis conditions with one month and three-month option maturity and in non-crisis conditions at one month maturity. Meanwhile, the Black Scholes model with historical variance produces a smaller AMSE value only in non-crisis conditions with an option maturity of three months. Thus, in this study the Black-Scholes method provides better accuracy than the GARCH method.

5. Discussion

This research theoretically proved that Option with the Collar strategy was more profitable in crisis conditions than those without Option. In a crisis condition, the Option using the GARCH method and the collar strategy type Xp = 95%*So, Xc = 110%* So provided an average profit of 3.07% higher on the one-month Option 7.01% on the three months option than with no option using the collar strategy. In non-crisis conditions, the Option using the GARCH method and the collar strategy type Xp = 95%*So, Xc = 110%*So obtained an average profit of 0.16% higher than without using an option at one month maturity. Meanwhile, at maturity of three months, it provided a lower average profit of 1.45%.

The results of this research indicated that the collar strategy provided good hedging in crisis conditions and better returns than without using the collar strategy. This is in line with the research of (Szado E., 2012) which found that the collar strategy by using the purchase of a put option with a maturity of six months and the sale of a call option with a maturity of one month in a row provided an increase in risk-adjusted performance and a significant reduction in risk.

The collar strategy provided less volatility than those without the collar strategy. Without the collar strategy, JII volatility reached 103%, the collar strategy with type Xp = 95%*So, Xc = 105%* So produced a maximum volatility of 12.71%, type Xp = 95%*So, Xc = 107.5%* So produced volatility of up to 15.18% and the type Xp = 95%*So, Xc = 110%*So produced 17.14% volatility. This is similar to the research of (Israelov & Klein, 2016) who found that the Volatility of the S&P 500 Index was more significant than using

the collar strategy. S&P 500 Volatility 16.5%, CBOE Collar Index 11.4%, S&P 500 Index (36%) 5.9%, CBOE PPUT Index (101%) 13.2%, CBOE BXM Index (49%) 5.6%, Hedged BXM Index (45%) by 4.1%.

The results also showed that the GARCH model was better than the Black Scholes based on the AMSE value obtained in crisis conditions with a maturity of one month and three months and in non-crisis conditions with a maturity of one month. At the same time, the Black Scholes model gave better results in non-crisis conditions with a maturity of three months. This result was not entirely similar to the research conducted by (Isynuwardhana & Surur, 2018) which found that the long straddle strategy was the best strategy. Meanwhile, research conducted by (Riko Hendrawan & Sasmito, 2021) on the LQ45 index in 2009 - 2018 and (Riko Hendrawan, Akbar, et al., 2020) found that the Black Scholes model had better gold price index option contracts than the GARCH model for one month, two-month, and three months terms.

6. Conclusion

From this research, it can be concluded that the use of option contracts with a collar strategy on the Jakarta Islamic Index (JII) in a crisis condition provided maximum benefits. In crisis conditions, the option contract with the Collar strategy provided benefits both in option contracts with a one-month and three-month maturity. During the crisis, the value of X<Xp was 39.33% in the one-month Option and 44.35% in the three months option. This indicated that the collar strategy was very effective in hedging in times of crisis. Meanwhile, in non-crisis conditions, option contracts with a collar strategy provided a higher average profit for option contracts with a maturity of one month with an average profit of 1.53. In contrast,ile those with a maturity of three months had lower profits. Strategy Collar with Xp = 95%*So, Xc = 110%* So is more profitable than Xp = 95%*So, Xc = 105%* So and Xp = 95%*So, Xc = 107.5%* So.

The collar strategy produced less volatility than without using a collar strategy. This strategy was suitable for investors who want a relatively stable asset value. The maximum volatility range of JII with collar strategy is17.14, while the maximum volatility range without collar strategy is 103.82.

The GARCH model produced a smaller AMSE value in crisis conditions with one month and three-month option contracts. In non-crisis conditions, GARCH was better in a one-month option contract, while in a three-month AMSE Black Scholes option contract, the historical variance was more minor than GARCH. Thus, in this study the Black-Scholes method provides better accuracy than the GARCH method.

References

Basson, L. J., van den Berg, L., & van Vuuren, G. (2018). Performance of two zero-cost derivative strategies under different market conditions. *Cogent Economics & Finance*, *6*(1), 1492893.

Bhat, A., & Arekar, K. (2016). Empirical performance of Black-Scholes and GARCH option pricing models during turbulent times: The Indian evidence. *International Journal of Economics and Finance*, *8*(3), 123–136.

Bi, Z., Yousuf, A., & Dash, M. (2014). A study on options pricing using GARCH and Black-Scholes-Merton model. *Asian Journal of Finance & Accounting*, *6*(1), 423–439.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, *31*(3), 307–327.

El-Hassan, N., Hall, A., & Tulunay, I. (2018). *Methods and performances of collar strategies*.

Hendrawan, R. (2010). Comparison of the Black-Scholes Option Model and the GARCH Option Model on the Indonesian Stock Exchange. *Jurnal.Unmer.Ac.Id*, *14(1)*.

Hendrawan, Riko. (2017). Forward, forward Option, and no hedging which one is the best for managing currency risk. *Jurnal Keuangan Dan Perbankan*, *21*(3), 356–365.

Hendrawan, Riko, Akbar, F., & Yuniarti, S. (2020). Hedging strategy in emerging market: Application long straddle option in gold price index. *Jurnal Keuangan Dan Perbankan*, *24*(4), 463–473.

Hendrawan, Riko, Laksana, G. T., & Aminah, W. (2020). Can The IDX Be Hegded?: Comparison of Black Scholes Option Model And Garch Option Model Using Long Strangle Strategy. *Jurnal Manajemen Indonesia*, *20*(3), 252–259.

Hendrawan, Riko, & Sasmito, A. (2021). Testing Of The Black Scholes And Garch Models In Lq45 Using Long Straddle Strategy In 2009-2018. *Jurnal Bisnis Dan Manajemen*, *22*(1), 30–39.

Hull, J. (2009). *Options, futures and other derivatives/John C. Hull.* Upper Saddle River, NJ: Prentice Hall,.

Israelov, R., & Klein, M. (2016). Risk and return of equity index collar strategies. *The Journal of Alternative Investments*, *19*(1), 41–54.

Isynuwardhana, D., & Surur, G. N. I. (2018). Return Analysis on Contract Option Using Long Straddle Strategy and Short Straddle Strategy with Black Scholes. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *8*(4), 16–20.

Lee, S., & Kim, K. (2015). Collar option model for managing the cost overrun caused by change orders. *Sustainability*, *7*(8), 10649–10663.

Sinclair, E. (2010). *Option trading: Pricing and volatility strategies and techniques*. John Wiley & Sons.

Szado E., & S. T. (2012). *Risk Mitigating Collar Strategy Option-Based Risk Management*.

Appendix

Table 1.

The Smallest and Largest Return of Jakarta Islamic Index (JII)

Smallest Daily *Return JII* Values		Largest Daily *Return JII* Values		Range
Date	Percentage (%)	Date	Percentage (%)	Percentage (%)
9-Mar-20	-7.84%	26-Mar-20	12.81%	20.65%
5-Aug-19	-3.00%	18-Feb-19	2.44%	5.44%
5-Sep-18	-4.65%	29-Jun-18	3.45%	8.10%
30-Nov-17	-2.31%	19-May-17	3.11%	5.42%
11-Nov-16	-5.23%	15-Sep-16	3.38%	8.61%
24-Aug-15	-4.83%	27-Aug-15	5.80%	10.63%
10-Apr-14	-3.51%	13-Jan-14	3.34%	6.84%
19-Aug-13	-6.39%	26-Jun-13	5.74%	12.13%
4-Jun-12	-4.20%	6-Jun-12	3.45%	7.64%
22-Sep-11	-9.43%	27-Sep-11	5.10%	14.53%
19-May-10	-4.21%	26-May-10	9.15%	13.36%
18-Jun-09	-4.60%	5-Jan-09	8.18%	12.78%
6-Oct-08	-14.25%	15-Dec-08	7.95%	22.21%
12-Nov-07	-6.73%	20-Aug-07	7.88%	14.61%
22-May-06	-6.69%	30-Jun-06	7.24%	13.92%
29-Aug-05	-5.50%	30-Aug-05	4.99%	10.48%
17-May-04	-9.55%	19-May-04	6.82%	16.37%
12-Jun-03	-4.39%	7-Apr-03	5.70%	10.09%
14-Oct-02	-13.85%	6-Mar-02	7.11%	20.96%
19-Mar-01	-5.09%	15-Feb-01	8.22%	13.31%
18-Sep-00	-8.76%	19-Sep-00	5.98%	14.74%
Average	**-6.43%**	***Average***	**6.09%**	**12.52%**
Max	-14.25%	***Max***	2.44%	16.69%
Min	-2.31%	***Min***	12.81%	15.12%

Source: (2020). Finance.Yahoo.com

Table 2.

Comparison of Profit Opportunities for the Black Scholes Model with Historical Variance (HV) and GARCH Variance (GV) on Option with one month maturity and Collar strategy

Condition	Data Amount	HV Black Scholes using Collar Strategy (%)				GV Black Scholes using Collar Strategy (%)			
		X < Xp	Xp < X < So	So < X < Xc	X > Xc	X < Xp	Xp < X < So	So < X < Xc	X > Xc
Crisis	Xp = 95%*So, Xc = 105%* So	39.33	24.27	13.18	23.22	39.33	24.27	13.18	23.22
	Xp = 95%*So, Xc = 107.5%* So	39.33	16.95	13.18	30.54	39.33	16.95	13.18	30.54
	Xp = 95%*So, Xc = 110%* So	39.33	9.62	13.18	37.87	39.33	9.62	13.18	37.87
Non Crisis	Xp = 95%*So, Xc = 105%* So	13.41	24.30	36.87	25.44	13.41	24.30	36.87	25.44
	Xp = 95%*So, Xc = 107.5%* So	13.41	25.08	47.47	14.06	13.41	25.08	47.47	14.06
	Xp = 95%*So, Xc = 110%* So	13.41	25.86	53.76	6.99	13.41	25.86	53.76	6.99
Total	Xp = 95%*So, Xc = 105%* So	15.91	24.30	34.58	25.23	15.91	24.30	34.58	25.23
	Xp = 95%*So, Xc = 107.5%* So	15.91	24.30	44.16	15.65	15.91	24.30	44.16	15.65
	Xp = 95%*So, Xc = 110%* So	15.91	24.30	49.85	9.96	15.91	24.30	49.85	9.96

Table 3.

Comparison of Profit Opportunities for the Black Scholes Model with Historical Variance (HV) and GARCH Variance (GV) on Option with a three-months maturity and Collar strategy

Condition	Number of Data	HV Black Scholes with Collar Strategy (%)				GV Black Scholes with Collar Strategy(%)			
		X < Xp	Xp < X < So	So < X < Xc	X > Xc	X < Xp	Xp < X < So	So < X < Xc	X > Xc
Crisis	Xp = 95%*So, Xc = 105%* So	44.35	31.38	15.27	9.00	44.35	31.38	15.27	9.00
	Xp = 95%*So, Xc = 107.5%* So	44.35	26.99	15.27	13.39	44.35	26.99	15.27	13.39
	Xp = 95%*So, Xc = 110%* So	44.35	20.50	15.27	19.87	44.35	20.50	15.27	19.87
Non-Crisis	Xp = 95%*So, Xc = 105%* So	18.85	14.59	17.07	49.49	18.85	14.59	17.07	49.49
	Xp = 95%*So, Xc = 107.5%* So	18.85	15.06	27.56	38.53	18.85	15.06	27.56	38.53
	Xp = 95%*So, Xc = 110%* So	18.85	15.76	36.70	28.69	18.85	15.76	36.70	28.69
Total	Xp = 95%*So, Xc = 105%* So	21.33	16.22	16.89	45.56	21.33	16.22	16.89	45.56
	Xp = 95%*So, Xc = 107.5%* So	21.33	16.22	26.37	36.08	21.33	16.22	26.37	36.08
	Xp = 95%*So, Xc = 110%* So	21.33	16.22	34.62	27.83	21.33	16.22	34.62	27.83

Table 4.
Comparison of Advantages of the Black Scholes Model with Historical Variance (HV) and GARCH Variance (GV) using Option and without Option

Condition	*Maturity*	Types of *Collar Strategy*	*HV Black Scholes* with *Collar Strategy (%)*				*GV Black Scholes* with *Collar Strategy (%)*				Without Strategi *Collar (%)*			
			Min	Max	Mean	Range	Min	Max	Mean	Range	Min	Max	Mean	Range
Crisis	1 month	Xp = 95%*So, Xc = 105%* So	-4.96	6.09	-0.26	11.05	-5.00	5.40	-0.48	10.40	-40.80	26.45	-2.86	67.25
		Xp = 95%*So, Xc = 107.5%* So	-5.28	7.68	-0.11	12.96	-5.10	7.50	-0.09	12.60				
		Xp = 95%*So, Xc = 110%* So	-5.84	9.98	0.03	15.81	-5.38	10.00	0.21	15.38				
	3 months	Xp = 95%*So, Xc = 105%* So	-4.82	7.56	0.35	12.38	-4.82	6.69	0.01	11.51	-53.79	36.63	-6.60	90.42
		Xp = 95%*So, Xc = 107.5%* So	-4.95	9.11	0.41	14.06	-4.97	8.33	0.18	13.30				
		Xp = 95%*So, Xc = 110%* So	-5.43	10.71	0.49	16.15	-5.35	10.12	0.41	15.47				
Non Crisis	1 month	Xp = 95%*So, Xc = 105%* So	-4.96	6.09	-0.26	11.05	-5.00	5.40	-0.48	10.40	-24.56	28.98	1.44	53.54
		Xp = 95%*So, Xc = 107.5%* So	-5.21	7.95	1.30	13.17	-5.10	7.58	1.30	12.68				
		Xp = 95%*So, Xc = 110%* So	-5.79	10.00	1.53	15.79	-5.28	10.00	1.60	15.28				
	3 months	Xp = 95%*So, Xc = 105%* So	-4.98	8.71	2.55	13.69	-4.98	7.73	2.29	12.71	-44.04	59.78	4.76	103.82
		Xp = 95%*So, Xc = 107.5%* So	-4.98	10.20	2.97	15.18	-4.98	9.26	2.80	14.24				
		Xp = 95%*So, Xc = 110%* So	-5.36	11.79	3.39	17.14	-5.28	10.99	3.31	16.28				

Table 5.

Comparison of AMSE Black Scholes Model with Historical Variance (HV) and GARCH Variance (GV)

Condition	Maturity	*Collar Strategy type*	AMSE HV Black Scholes	AMSE GARCH Black Scholes	Research result
Crisis	1 month	Xp = 95%*So, Xc =105%* So	1.84%	1.82%	GARCH (1,1) Model is better than HV. Model
		Xp = 95%*So, Xc = 107.5%* So	1.82%	1.82%	
		Xp = 95%*So, Xc = 110%* So	1.82%	1.82%	
	3 months	Xp = 95%*So, Xc =105%* So	8.57%	8.41%	GARCH (1,1) Model is better than HV. Model
		Xp = 95%*So, Xc = 107.5%* So	8.26%	8.16%	
		Xp = 95%*So, Xc = 110%* So	8.03%	7.99%	
Non Crisis	1 month	Xp = 95%*So, Xc =105%* So	0.72%	0.75%	GARCH (1,1) Model is better than HV. Model
		Xp = 95%*So, Xc = 107.5%* So	0.77%	0.76%	
		Xp = 95%*So, Xc = 110%* So	0.80%	0.77%	
	3 months	Xp = 95%*So, Xc =105%* So	1.59%	1.63%	HV Model is better than GARCH(1,1) Model
		Xp = 95%*So, Xc = 107.5%* So	1.68%	1.71%	
		Xp = 95%*So, Xc = 110%* So	1.76%	1.78%	