VOLATILITY TRADING STRATEGIES: EVIDENCE FROM SET50 INDEX OPTIONS

BY

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AN INDEPENDENT STUDY SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
PROGRAM IN FINANCE (INTERNATIONAL PROGRAM)
FACULTY OF COMMERCE AND ACCOUNTANCY
THAMMASAT UNIVERSITY
ACADEMIC YEAR 2022

THAMMASAT UNIVERSITY
FACULTY OF COMMERCE AND ACCOUNTANCY

INDEPENDENT STUDY

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ENTITLED

VOLATILITY TRADING STRATEGIES:
EVIDENCE FROM SET50 INDEX OPTIONS

was approved as partial fulfillment of the requirements for
the degree of Master of Science (Finance)

on June 2, 2023

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Independent study title	VOLATILITY TRADING STRATEGIES: EVIDENCE FROM SET50 INDEX OPTIONS
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Degree	Master of Science (Finance)
Major field/Faculty/University	Master of Science Program in Finance (International Program) Faculty of Commerce and Accountancy Thammasat University
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Academic year	2022

ABSTRACT

This study aims to determine the best model between standard deviation volatility and GARCH volatility for SET50 index options volatility trading strategies using delta-hedging for all moneyness. The study finds that delta-hedging with standard deviation volatility trading returns and GARCH volatility trading returns cannot outperform risk-free for both call and put options. After taking the transaction cost, the standard deviation volatility trading return is larger than the GARCH volatility trading return in all the moneyness periods. However, the difference in return between these two strategies is insignificant. Volatility trading strategies have a better chance of generating a positive return in in-the-money periods for call options and out-of-the-money periods for put options, excluding close to zero delta. However, the probability of gaining a positive return for both the return from GARCH and the standard deviation is comparable to gambling. The Delta Neutral strategy is not 100% risk management and is ineffective for hedging due to fluctuating delta values.

Keywords: Volatility trading strategy, Delta hedging, SET50 index option

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere gratitude to my advisor, Assistant Professor Anutchanat Jaroenjitrkam, Ph.D., for their invaluable guidance and support throughout my independent study process. Her expertise and patience have played a crucial role in the success of this independence study. I would also like to thank Associate Professor Woraphon Wattanatorn, Ph.D., the chairman of this independent study committee, who provides valuable feedback and suggestions to improve the effectiveness and completeness of my study.

Second, I am grateful to all MIF lecturers for passing down knowledge and experiences that served as the foundation for my independent study. I am also thankful to all MIF staff for their good support and suggestions.

Third, I would like to thank my friends, my coworkers, my MIF classmate, and my family for their support during this process. Without their encouragement and motivation, this study would not be possible.

Lastly, the responsibility for the content and any remaining errors, omissions, and inaccuracies is my own. However, no funding source was involved in the design or conduct of the research or preparation of the manuscript, and the analyses and opinions expressed are those of the authors alone.

Ratirat Sungthong

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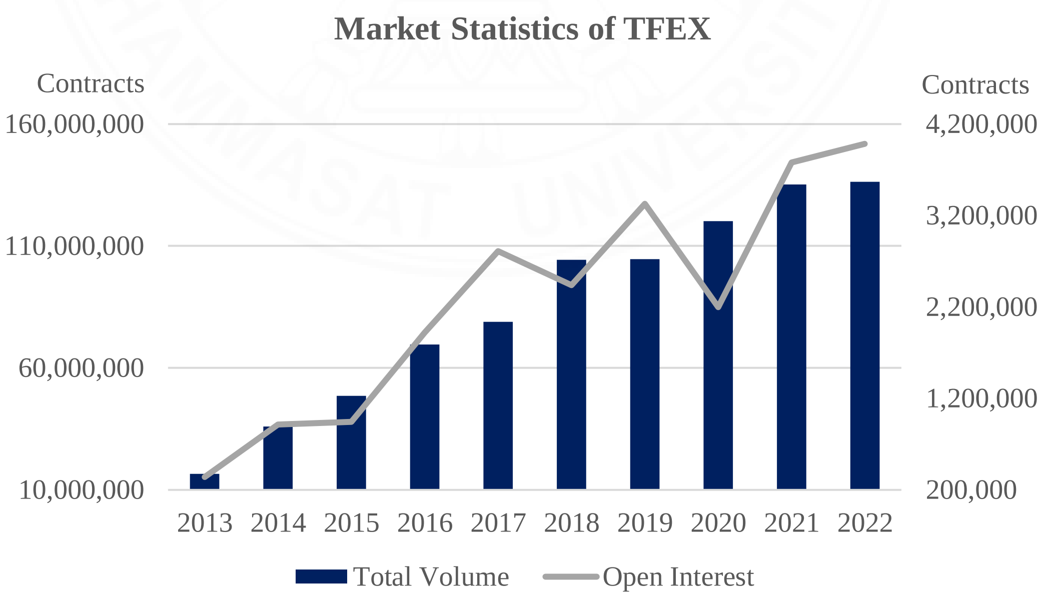
CHAPTER 1
INTRODUCTION

Nowadays, Derivatives are financial instruments that significantly impact financial economic by providing speculative opportunities, hedging risks, determining the price of underlying assets, increasing market efficiency, and accessing unavailable assets or markets. In Thailand, the Thailand Futures Exchange (TFEX) has seen its total trading volume increase from 16,994,126 contracts in 2013 to 136,316,012 contracts in 2022, with a compound annual growth rate (CAGR) of 26.30%. Furthermore, TFEX's open interest was 3,983,852 contracts at the end of December 2022, up from 340,778 contracts at the end of December 2013. The compound annual growth rate (CAGR) is 31.42%. These indicate that there is a growing trend in trading derivatives in Thailand, as well as an increase in the number of investors who hold derivatives to generate profits and manage risks.

Figure 1.1

Market Statistics of TFEX



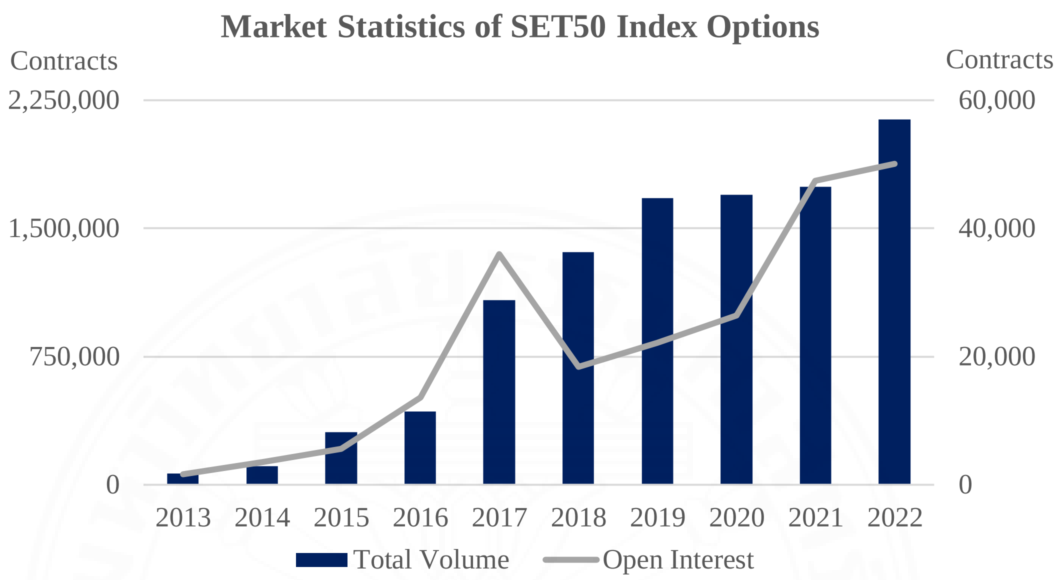
Source: TFEX

The advantage of investing in derivatives is that it requires less investment, as investors can place a margin on only a portion of the contract value, allowing them to trade without investing the full amount. Options offer more strategies, allowing investors to design strategies to suit market conditions and increase opportunities. To create more rewards by opening a long position in an uptrend market or a short position in a downtrend market condition. Due to the advantages of options, we decide to study the SET50 index options, which also have a growing trend in trading. It has 2,139,216 contracts of trading volume in 2022, up from 65,409 contracts in 2013. The compound annual growth rate (CAGR) is 47.33%. However, options are high-risk assets. If the investor does not close the position manually before the derivatives expire, the system will close the position itself, so investors should study the details of each derivative before investing. Due to the impact of losses from derivatives, the accuracy of trading strategies is more important to generate profit. The most popular and widely used method of pricing options is the Black-Scholes model because it is a simple and straightforward computational model that is capable of assessing options prices quickly. However, there are many factors affecting the price of option derivatives, such as the underlying asset price, the exercise price, the volatility of the underlying asset return, the age of the options, etc. Accuracy in estimating the volatility of the return of the options' underlying asset is the most challenging factor to estimate, as it is an unobservable and significant factor for pricing options.

In this study, we will examine the best estimated volatility model for the SET50 index return between Standard deviation and GARCH to create the highest return for SET50 index options in all moneynesses, including In the Money (ITM), Out of the Money (OTM), and At the Money (ATM) trading. We will divide the study process into two steps: Firstly, we estimate the SET50 Index Return volatility using the standard deviation and GARCH. Then, we will use these two different volatility models in delta hedging, with the delta calculations based on the Black-Sholes option pricing model.

Figure 1.2

Market Statistics of SET50 Index Options



Source: TFEX

CHAPTER 2
REVIEW OF LITERATURE

As a result of its simplicity and ease of use in pricing options, the Black-Scholes (1973) model is extensively used by investors. The model is based on the assumption that an underlying asset's price movement follows a geometric Brownian motion and that the rate of return follows a normal distribution. Volatility is a critical and difficult-to-assess component in option price estimation. Volatility is defined as the conditional standard deviation of asset return and is utilized in asset pricing, risk management, and portfolio management. When volatility rises, correspondingly rises the prices of call and put options.

However, one of the most important drawbacks of the Black-Scholes model is the constant volatility assumption, which disregards the volatility smile phenomenon discovered in the SET50 index by Wattanatorn and Sombultawee (2021) and Patakkinang et al. (2012). Moreover, the options market is a forward-looking market, which means that the volatility in the options pricing is supposed to be the forecasted volatility over the lifetime of the options. Sinclair, E. (2010) If the forecasted volatility is different from the implied volatility, the investor can get a return from the mispriced options.

2.1 Estimating Volatilities

Due to the non-directly observable nature of volatility, it is very challenging to forecast financial asset volatility. The estimated and forecasted volatility models have been developed to capture the stylized facts of financial asset volatility. According to Xiao and Aydemir (2007), stylized facts of volatility in financial time series reveal particular patterns that are critical for proper model specification, estimation, and forecasting. The stylized facts are: 1) Fat tails; 2) Volatility clustering; 3) Leverage effects; 4) Long memory; and 5) Co-movements in volatility. Many volatility models have been developed to capture these stylized features, measure them, and forecast volatility, such as Autoregressive Moving Average (ARMA) models, Autoregressive

Conditional Heteroscedasticity (ARCH) models, and Stochastic Volatility (SV) models, each with its own set of advantages and limitations.

According to Xiao and Aydemir (2007), the advantages of Autoregressive Moving Average (ARMA) models are as follows: 1) There is a complete theory available for linear difference equations; 2) in terms of computation, modeling data with ARMA structure is easy; and 3) the class of models has had acceptable success in data analysis, forecasting, and control. However, the limitations of the ARMA model are: 1) the assumption of constant variance; 2) the ARMA model does not fit data with strong asymmetry; and 3) ARMA models are not appropriate for data exhibiting time irreversibility. The capacity of ARCH models to capture volatility clustering in financial data is an essential attribute. Furthermore, GARCH estimation and testing are straightforward, and the techniques developed for ARMA models, which have found widespread use in modeling changes in means, are applicable to ARCH models. However, GARCH processes have a symmetric distribution, so they cannot capture the asymmetric effect, which the SV model can solve this limitation.

The GARCH model is one of the most popular methods to predict volatility. Mikosch (2004) explains the reasons due to: 1) Its relation to ARMA processes, which are thoroughly studied, generally understood, and appear to be simple. 2) uncomplicated estimation of the parameters 3) Even GARCH (1,1), which does not use long-period data, also fits real-life financial data. Moreover, GARCH can capture the volatility clustering, Fat Tails, and volatility mean reversion of financial volatility. (Kongcharoen, (2021) Engle and Patton (2001) define the good volatility model of financial asset price as being able to capture and reflect these stylized facts, namely, volatility persistence, mean-reverting behavior, the asymmetric impact of negative versus positive return innovations, and the possibility that exogenous or pre-determined variables may have a significant impact on volatility. They found out that the GARCH family can capture these stylized facts for the 12-year daily close price data of the Dow Jones Industrial Index.

There are many studies that have measured the performance of GARCH. For example, Wei, Y., et al. (2010) use nonlinear GARCH-class models to forecast the volatility of crude oil and showed that GARCH-class models, which are capable of capturing long-memory and/or asymmetric volatility, exhibit greater forecasting accuracy than linear models, especially when forecasting volatility over longer time horizons, such as five or twenty days. Guo, D. (2000) uses the Hull and White (1987) model in computing the currency option price for both the GARCH and the ISVR daily volatility. The results show that the GARCH method tends to overpredict calls while undervaluing and overvaluing puts. The ISVR method tends to underpredict low prices.

In Thailand, Manowattanakul and Boonvorachote (2015) investigate optimum methods for assessing the implied volatility of the SET50 index on the TFEX. The results indicate that the six-month historical volatility model outperforms the GARCH (1,1) model when it comes to estimating the call option values. Since the trading liquidity of call options on the TFEX is low, call option prices estimated using constant historical volatility outperform those computed using time-varying volatility. Arunsingkarat et al., (2021) apply these three models, GARCH, EGARCH, and GJR risk-neutral models, to calculate option pricing for the Thai Stock Exchange and compare them to the Black-Scholes model. The results show that for SET50 option contracts with time to maturity durations of 30 and 60 days, majority of the pricing options using the GARCH model are the closest to the actual values..

Therefore, in this study, we will use the standard deviation and GARCH estimation models to forecast the SET50 index volatility and compare it with the implied volatility of SET50 index options to find the best volatility estimation model for a volatility trading strategy.

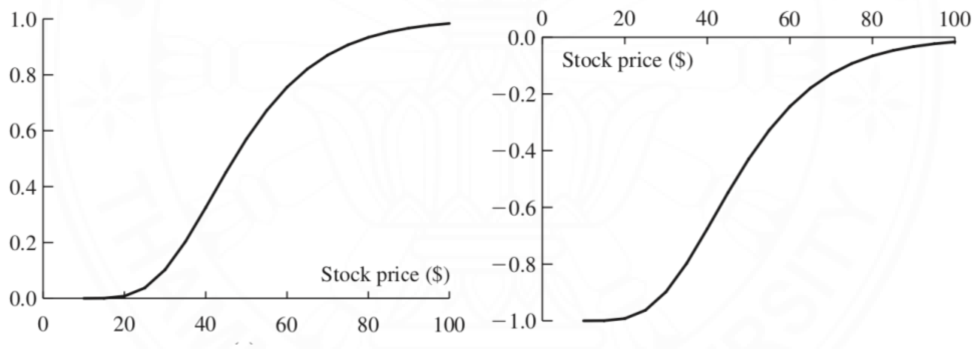
2.2 Volatility Trading Strategies

The discrepancy between the realized volatility and implied volatility enables investors to gain profit from the magnitude of the price movement regardless of the direction of the price movement (Singh, 2017; Silic and Poulsen, 2021). Implied volatilities, according to Goyal and Saretto (2009), should be viewed as a representation of option prices. They believe that big differences in implied volatility from historical volatility indicate option mispricing. Therefore, they do not need an accurate option pricing model. The explanation for this is the mean-reversion of volatility. Implied volatility reflects the notion that future volatility will be closer to its long-run average historical volatility than it is currently.

The delta hedging option is a strategy that involves buying or selling the underlying asset. If the investor believes that the implied volatility is lower than the future realized volatility, they will long call options and short the underlying asset, with the amount depending on the delta of the option, or long put options and long the underlying asset, with the amount depending on the delta of the option. The stock position's delta cancels out the option position's delta. Delta neutral refers to a position having a delta of zero. Because an option's delta does not remain constant, the trader's position remains delta neutral for only a short interval of time. An increase in the stock price leads to an increase in delta (Hull (2003)).

Figure 2.1

A valuation of delta with stock price for a call option and a put option on-dividend-paying stock



Call Option

Put Option

Source: Options futures and other derivatives book by John C. Hull

Many research studies have been conducted on the profitability of misplaced options defined by volatility spread and traded in various strategies such as delta hedging, straddle, strangles, and so on. Goyal and Saretto (2009) find significant positive returns for high volatility spreads and negative returns for low volatility spreads in delta-hedged call portfolios for U.S. equity option market. They focus on high liquidity options contracts. Delta-hedged calls have lower returns than straddles because they benefit from only the mispricing of calls and a part of the portfolio weight in stocks. Historical volatility is determined by the standard deviation of stock returns, and implied volatility is computed by averaging the implied volatilities closest to at the money. The high profitability of Goyal and Saretto's (2009) volatility spread trading corresponds with Do et al.'s (2016) examination of the straddle profitability of Australian Securities Exchange (ASX) equity options and Hong et al.'s (2018) investigation of the performance of 18 volatility trading strategies on the S&P 500 equity index (SPX).

Besides that, the profitability of volatility trading is challenged by testing different forms of options apart from plain vanilla. Poon and Pope (2000) identify the efficiency of the index option market by seeking the profitability of a trade between OEX (S&P 100) and SPX (S&P 500) that share common volatility components. They discover that trading methods based on the OEX-SPX implied volatility spread and applying vega-delta-neutral strategies are profitable even after transaction costs are taken into account. Guo (2000) reveals that, after considering transaction costs, both delta-neutral and straddle trading strategies involving currency options resulted in observed profits that are not significantly different from zero when forecasting the volatility of foreign exchange rates using the implied stochastic volatility regression method or the GARCH method. However, it provides returns with a greater Sharpe ratio and a weaker correlation with several major asset classes.

Therefore, in this study, we will use the volatility spread to identify mispriced options and trade them with delta hedging to find a positive return.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Data

In this study, we use the daily data of SET 50 index options trading from January 2nd, 2020, to December 30th, 2022, or three years. The SET 50 index options trading series will only include the nearest exercise month series, which have the highest liquidity. We chose the SET 50 index options contracts at random with strike prices of 950, 975, 1000, 1025, and 1050. The information about the SET 50 index options, including settlement prices, exercise prices (Strike prices), and the underlying SET50 index, is collected from the SETSMART database. We use one-month Thai Treasury bills as the risk-free rate, gathered from the Thai Bond Market Association.

3.2 Methodology

The objective of this study is to examine whether the volatility trading on SET50 index options can create a positive return in the period between January 2nd, 2020, and December 30th, 2022. The steps are as follows:

Step 1: Calculate the SET50 index return

The price of the SET50 index is assumed to be lognormally distributed because it has a zero boundary, which is consistent with an asset price that cannot be negative. In the calculation of the SET 50 index return, we use log normal returns to represent the continuous return and normal distribution. One of the advantages of using the log normal return is the additivity of multiperiod log returns, from which we can easily construct the total return from the weekly return. The forms are as follows:

$$y_t = \ln S_t - \ln S_{t-1} = \ln \left(\frac{S_t}{S_{t-1}}\right)$$

Where

y_t is the SET50 index return

S_t is the price of SET50 index at time t

Step 2: Forecast the SET50 index volatilities

This section is devoted to predicting the volatility of the SET50 index's continuous return. We assume there are 241 trading days, which is the average trading day in 2020–2022. In forecasting the volatility, we estimate it from the one-year data of the SET50 index ending the day prior to the forecasting period, which equals 241 trading days of data and a rolling window for all the observations.

1) Standard Deviation

$$\sigma = \sqrt{\frac{\sum_{t=1}^{n}(y_t - \mu)^2}{n-1}}$$

Where:

σ is standard deviation

y_t is SET50 index continuous return at time t

μ is constant mean of y_t

n is number of periods

2) GARCH Model

The GARCH model (General autoregressive conditional heteroskedasticity) is an extension of the ARCH model, which allows for the conditional variance to change over time as a function of past errors, a longer memory of past observations, and a more flexible lag structure (Bollerslev, 1986).

$$y_t = \mu_t + \epsilon_t$$

$$\epsilon_t = \sigma_t z_t$$

$$z_t \sim \text{i.i.d } (0,1)$$

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2$$

Where

y_t	is the SET50 index continuous return at time t
μ_t	is mean of the SET50 index continuous return at time t
ϵ_t	is error term at time t
σ_t	is the volatility of a variable for week t
z_t	is independent and identically distributed random variables which mean equal to zero and variance equal to one
ω	is weighted long-run variance = γV_L

If α + β < 1, the model is stationary. The GARCH model parameter can be estimated by the maximum likelihood method. To select the optimal order of GARCH, we will compare the goodness-of-fit statistics, namely Akaike's Information Criterion (AIC) and Schwartz Bayesian Information Criterion (BIC), of the model that has the smallest value of them.

Step 3: Create option trading strategy

This section explores how to make investing decisions based on volatility discrepancies in order to create profit opportunities. The investing decision is made through the comparison between the current implied volatility, which represents the current market expectation of the SET50 index volatility, and the forecasted volatility to find the mispriced options and create option trading strategy.

Table 3.1 Option Trading Strategy

Option Type	Criteria	Meaning	Delta hedging
Call	Forecasted Vol > Implied Vol	Market Undervalue	Long SET50 Options, Short SET50 Futures
	Forecasted Vol < Implied Vol	Market Overvalue	Short SET50 Options Long SET50 Futures
Put	Forecasted Vol > Implied Vol	Market Undervalue	Long SET50 Options Long SET50 Futures
	Forecasted Vol < Implied Vol	Market Overvalue	Short SET50 Options Short SET50 Futures

Step 4: Delta-neutral hedging

Delta is the rate of change in the option price due to the change in the underlying asset price. Delta neutral is perfect hedging that can get rid of price-changing risk and have a delta of zero. After making a decision to trade options, make the portfolio delta neutral by using the stock or future position's delta to cancel out the option position's delta. To calculate the number of stocks that make the portfolio delta neutral, we will use the forecasted volatility in the Black-Scholes model (1973).

The most well-known option pricing model is The Black-Scholes model (1973), The stock price process is assumed to follow the geometric Brownian motion process.

$$\frac{dS_t}{S_t} = r_f dt + \upsilon dZt$$

Where

S_t is underlying asset price at time t

dS_t is change in underlying asset price by the end of dt

r_f is risk-free interest rate

dt is a very small interval of time

ν is variance of the underlying asset price assumed to be constant

Z_t is Brownian motions of underlying asset price

The price of European options on non-dividend paying stock at time t, given a strike price K and expired at time T:

$$\boldsymbol{C} = S_t N(d_1) - Ke^{-r(T-t)} N(d_2)$$
$$P = Ke^{-r(T-t)} N(-d_2) - S_t N(-d_1)$$

Where

$$d_1 = \frac{log(\frac{S}{K}) + (r + \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}}$$
$$d_2 = d_1 - \sigma\sqrt{T-t}$$

C	is Call option price
P	is Put option price
K	is Strike Price
T – t	is the time to maturity
N (•)	is cumulative normal distribution function

For a European call option on a non-dividend-paying stock, delta is given by

$$\Delta = \frac{\partial C}{\partial S} = N(d_1)$$

For a European put option on a non-dividend-paying stock, delta is given by

$$\Delta = \frac{\partial P}{\partial S} = N(d_1) - 1$$

Because the delta of an option does not remain constant, the trader's position is only delta hedged (or delta neutral) for a relatively short period of time. In this study, we will open a contract on Monday and close the contract on Friday.

Step 5: Estimate the return

If our forecasted volatility is correct and the cost of hedging the option is less than the gain, the delta neutral strategy can generate riskless gains by writing options and hedging them. To calculate the return, use the following equation:

$$PL = no * m * [(O_S - O_L) + \Delta_t * (S_S - S_L)] - TC$$

Where

no	is the number of contracts
m	is the contact multiplier
O_S	is the price of the SET50 index options shorted
O_L	is the price of the SET50 index options longed
S_S	is the price of the SET50 index future shorted
S_L	is the price of the SET50 index future longed
Δt	is delta on Monday
TC	is total transaction cost

In this study, we assume 1,000 contracts are traded per week and use the settlement price as the SET50 index options price and the SET50 index futures price. We also add the brokerage fee as the transaction cost equal to THB 31.5 per contract[1] for the SET50 index options and THB 33.5 per contract[2] for the SET50 index future, which already include the trading fee, clearing fee, and regulatory fee. The contact multiplier is equal to THB 200 per index point. After we get the return for each contract, we will compare the estimated return between the standard deviation volatility and GARCH volatility and also compare the estimated return with the risk-free rate to make the decision in terms of the value of the investment.

[1] The average brokerage fee from Asia Plus Securities Co., Ltd., Bualuang Securities PLC, Finansia Syrus Securities PLC, Krungsri Securities PLC, and Maybank Securities (Thailand) PLC

CHAPTER 4
EMPIRICAL RESULTS

4.1 Volatility Forecasted

Table 4.1 presents the descriptive statistics of the SET50 index daily closing price from January 2nd, 2020, to December 30th, 2022. According to the table data, the closing price of the SET50 Index throughout the testing period ranged between 1,159.79 and 680.07, showing that the option contract employed in this study covered the whole moneyness. Table 4.1 additionally shows descriptive statistics for the SET50 Index Call Option, SET50 Index Put Option, and SET50 Index Future, which eliminate the missing value and no trading volume observations from the original 722, 721, and 775 observations, respectively.

Table 4.1 Descriptive Statistics of SET50 Index, Return of SET50, SET50 Index Call Option, SET50 Index Put Option, and SET50 Index Future

	Max	Min	Mean	STD	No. Obs
SET50 Index	1,159.79	680.07	981.05	90.56%	986
SET50 Index Return	8.86%	-12.44%	-0.01%	1.26%	985
SET50 Index Call Option	82.50	0.10	12.41	1502.23%	582
SET50 Index Put Option	317.50	0.20	64.94	5862.50%	582
SET50 Index Future	1,079.90	733.00	940.43	7069.78%	635

For the GARCH volatility, GARCH (1,1) have the smallest Schwartz Bayesian Information Criterion (BIC), compare with a GARCH (1,2), GARCH (1,3), GARCH (2,1), GARCH (2,2), GARCH (2,3), GARCH (3,1), GARCH (3,2) and GARCH (3,3) model. Therefore, we use the GARCH (1,1) to represent GARCH volatility in this study.

4.2 Delta-Hedging Returns

4.2.1 Call Options

Table 4.2 presents the delta-hedging returns of call options from volatility trading strategies, including standard deviation volatility and GARCH volatility in different moneynesses. The return from standard deviation volatility excluding transaction costs is between -67.27% and 21.72%, with an average return of -0.58% and a 51.03% chance of a positive return. On the other hand, the return from standard deviation volatility after transaction costs is substantially lower, ranging from -68.37% to 19.76%, with an average -0.97% return and a 40.21% chance of a positive return. However, the standard deviation volatility trading strategy return before transaction cost can be profitable during in-the-money (ITM), but it is insufficient to beat risk-free, which is equal to 1.17% in this study.

The return from GARCH volatility before transaction costs is between -37.89% and 25.61%, with an average return of -0.15% and a 58.93% chance of a positive return. On the other hand, the GARCH volatility trading return after transaction costs is substantially lower, ranging from -43.64% to 8.04%, with an average -1.30% return and a 42.96% chance of a positive return. However, the GARCH volatility trading return before transaction cost can be profitable during in-the-money (ITM), but it is insufficient to beat risk-free, which is equal to 1.17% in this study.

For the call option, the result found that the return from GARCH volatility trading strategies before transaction cost is higher on average than the return from standard deviation volatility trading strategies before transaction cost, but not for all the moneyness. For the after-transaction cost, standard deviation volatility trading returns are higher than GARCH volatility trading. However, GARCH volatility trading has a higher probability of generating a positive return.

4.2.2 Put Options

Table 4.3 presents the delta-hedging returns of put options from volatility trading strategies, including standard deviation volatility and GARCH volatility in different moneyness. The return from standard deviation volatility, excluding transaction costs, ranges from -7.11% to 6.83%, with a 0.04% average return and a 53.44% chance for a positive return. On the other hand, the return from standard deviation volatility after transaction costs is substantially lower, ranging from -7.22% to 6.43%, with an average -0.06% return and a 45.53% chance of a positive return. For a risk-free rate equal to 1.17%, profits before transaction costs are inadequate to beat risk-free. However, the standard deviation volatility trading strategy can be profitable only in the at-the-money (ATM) and out-of-the-money (OTM) periods for before transaction cost return and in the out-of-the-money (OTM) period for after transaction cost return.

The return from GARCH volatility before transaction costs is between -15.91% and 8.13%, with an average return of -0.01% and a 52.75% chance of a positive return. On the other hand, the GARCH volatility trading return after transaction costs is substantially lower, ranging from -16.46% to 7.66%, with an average -0.11% return and a 43.99% chance of a positive return. However, the GARCH volatility trading strategy can be profitable only in the out-of-the-money (OTM) period before transactions cost return, but the return is inadequate to beat risk-free, which in this study is equivalent to 1.17%.

For the put option, the result found that the return from standard deviation volatility trading strategies is higher on average than the return from GARCH volatility trading strategies for both before and after transaction costs at all levels of moneyness. In addition, GARCH volatility trading strategies and standard deviation volatility trading strategies have a very close probability of generating a positive return.

4.2.3 Call and Put Options

Table 4.4 presents the delta-hedging returns of call and put options from volatility trading strategies, including standard deviation volatility and GARCH volatility in different moneyness. The return from standard deviation volatility excluding transaction costs is between -67.27% and 21.72%, with an average return of -0.27% and a 52.23% chance of a positive return. On the other hand, the return from standard deviation volatility after transaction costs is substantially lower, ranging from -68.37% to 19.76%, with an average -0.51% return and a 42.87% chance of a positive return. The standard deviation volatility trading strategy can be profitable only at-of-the Money (ATM) periods before transaction cost, but the return is inadequate to beat risk-free, which in this study is equivalent to 1.17%.

The return from GARCH volatility before transaction costs is between -37.89% and 25.61%, with an average return of -0.08% and a 55.84% chance of a positive return. On the other hand, the GARCH volatility of trading after transaction costs is substantially lower, ranging from -43.64% to 8.04%, with an average -0.70% return and a 43.47% chance of a positive return. However, the GARCH volatility trading strategy cannot be profitable for all levels of moneyness.

From the options trading, it shows that the return before transaction costs of the GARCH volatility trading returns is higher than the standard deviation volatility trading returns on average and in the out-of-the-money (OTM) period. But for the after-transaction cost return, the standard deviation volatility trading returns on average are higher than the GARCH volatility trading returns for all levels of moneyness. In addition, GARCH volatility trading strategies and standard deviation volatility trading strategies have a very close probability of generating a positive return. The mean difference testing given in Table 4.5 shows that the difference in return for both strategies is insignificant at a 90% confidence level.

Although the transaction cost in our study is assumed to be fixed per contact of derivative, the gap in return before and after transaction cost is inconsistent for out-of-the-money (OTM) periods, with the lowest delta in absolute terms when compared to other periods. If the delta is near zero and the option price does not change, which the low liquidity market in Thailand is one of the causes for, we cannot receive a capital gain from the options, and our only source of return is from futures contracts, which have a small number of contracts. Despite the fact that this scenario can yield a positive return before transaction costs, the return after taking into account the significant amount of fixed transaction costs for options and future transaction costs might be a substantial negative return. In this study, the lowest delta in absolute terms for put options is 0.01 and very near zero for call options, which explains why the difference between before and after transaction costs for call options is greater than for put options during out-of-the-money (OTM) periods.

Table 4.2 Delta-Hedging Returns of Call Options from Standard Deviation Volatility and GARCH Volatility

The Returns from Standard Deviation Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (S/K < 0.97)	-0.99%	21.72%	-67.27%	8.71%	341.00	52.20%	0.15	149.00
ATM (0.97 < S/K < 1.03)	-0.02%	1.94%	-4.22%	0.75%	186.00	48.39%	0.50	502.00
ITM (S/K > 1.03)	0.04%	0.79%	-0.46%	0.26%	55.00	52.73%	0.86	857.00
All	-0.58%	21.72%	-67.27%	6.69%	582.00	51.03%	0.33	329.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (S/K < 0.97)	-1.57%	19.76%	-68.37%	8.86%	341.00	42.23%	0.15	149.00
ATM (0.97 < S/K < 1.03)	-0.13%	1.79%	-4.34%	0.75%	186.00	38.71%	0.50	502.00
ITM (S/K > 1.03)	-0.03%	0.72%	-0.53%	0.26%	55.00	32.73%	0.86	857.00
All	-0.97%	19.76%	-68.37%	6.83%	582.00	40.21%	0.33	329.00
The Returns from GARCH Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (S/K < 0.97)	-0.23%	25.61%	-37.89%	4.58%	341.00	58.94%	0.11	114.00
ATM (0.97 < S/K < 1.03)	-0.06%	1.68%	-4.32%	0.75%	186.00	60.75%	0.50	496.00
ITM (S/K > 1.03)	0.04%	0.77%	-0.76%	0.27%	55.00	52.73%	0.87	874.00
All	-0.15%	25.61%	-37.89%	3.53%	582.00	58.93%	0.31	308.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (S/K < 0.97)	-2.12%	8.04%	-43.64%	6.81%	341.00	40.76%	0.11	114.00
ATM (0.97 < S/K < 1.03)	-0.16%	1.57%	-4.43%	0.75%	186.00	47.85%	0.50	496.00
ITM (S/K > 1.03)	-0.03%	0.70%	-0.83%	0.27%	55.00	40.00%	0.87	874.00
All	-1.30%	8.04%	-43.64%	5.32%	582.00	42.96%	0.31	308.00

Table 4.3 Delta-Hedging Returns of Put Options from Standard Deviation Volatility and GARCH Volatility

The Returns from Standard Deviation Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (K/S < 0.97)	0.37%	6.83%	-5.79%	1.82%	55.00	58.18%	(0.14)	144.00
ATM (0.97 < K/S < 1.03)	0.05%	2.89%	-7.11%	0.82%	183.00	53.01%	(0.50)	496.00
ITM (K/S > 1.03)	-0.01%	2.26%	-2.34%	0.56%	344.00	52.91%	(0.85)	850.00
All	0.04%	6.83%	-7.11%	0.85%	582.00	53.44%	(0.67)	672.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (K/S < 0.97)	0.01%	6.43%	-6.96%	1.81%	55.00	45.45%	(0.14)	144.00
ATM (0.97 < K/S < 1.03)	-0.05%	2.75%	-7.22%	0.82%	183.00	45.36%	(0.50)	496.00
ITM (K/S > 1.03)	-0.08%	2.17%	-2.40%	0.56%	344.00	45.64%	(0.85)	850.00
All	-0.06%	6.43%	-7.22%	0.84%	582.00	45.53%	(0.67)	672.00
The Returns from GARCH Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (K/S < 0.97)	0.16%	8.13%	-15.91%	2.79%	55.00	63.64%	(0.13)	127.00
ATM (0.97 < K/S < 1.03)	-0.03%	3.03%	-6.41%	0.85%	183.00	54.10%	(0.50)	502.00
ITM (K/S > 1.03)	-0.02%	2.34%	-1.74%	0.49%	344.00	50.29%	(0.88)	885.00
All	-0.01%	8.13%	-15.91%	1.05%	582.00	52.75%	(0.69)	693.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM (K/S < 0.97)	-0.20%	7.66%	-16.46%	2.80%	55.00	52.73%	(0.13)	127.00
ATM (0.97 < K/S < 1.03)	-0.13%	2.87%	-6.52%	0.85%	183.00	44.26%	(0.50)	502.00
ITM (K/S > 1.03)	-0.09%	2.26%	-1.81%	0.49%	344.00	42.44%	(0.88)	885.00
All	-0.11%	7.66%	-16.46%	1.05%	582.00	43.99%	(0.69)	693.00

Table 4.4 Delta-Hedging Returns of Call and Put Options from Standard Deviation Volatility and GARCH Volatility

The Returns from Standard Deviation Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM	-0.80%	21.72%	-67.27%	8.12%	396.00	53.03%	0.12	120.00
ATM	0.01%	2.89%	-7.11%	0.79%	369.00	50.68%	0.00	1.00
ITM	0.00%	2.26%	-2.34%	0.53%	399.00	52.88%	(0.60)	604.00
All	-0.27%	21.72%	-67.27%	4.78%	1,164.00	52.23%	(0.17)	166.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM	-1.36%	19.76%	-68.37%	8.27%	396.00	42.68%	0.12	120.00
ATM	-0.09%	2.75%	-7.22%	0.78%	369.00	42.01%	0.00	1.00
ITM	-0.07%	2.17%	-2.40%	0.53%	399.00	43.86%	(0.60)	604.00
All	-0.51%	19.76%	-68.37%	4.89%	1,164.00	42.87%	(0.17)	166.00
The Returns from GARCH Volatility								
Before transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM	-0.17%	25.61%	-37.89%	4.37%	395.00	59.75%	0.10	98.00
ATM	-0.05%	3.03%	-6.41%	0.80%	369.00	57.45%	(0.01)	6.00
ITM	-0.02%	2.34%	-1.74%	0.47%	399.00	50.63%	(0.63)	626.00
All	-0.08%	25.61%	-37.89%	2.60%	1,164.00	55.84%	(0.18)	183.00
After transaction cost								
	Mean	Max	Min	STD	No. Obs	%Gain	Delta	No. Future
OTM	-1.85%	8.04%	-43.64%	6.44%	396.00	42.42%	0.10	98.00
ATM	-0.15%	2.87%	-6.52%	0.80%	369.00	46.07%	(0.01)	6.00
ITM	-0.08%	2.26%	-1.81%	0.47%	399.00	42.11%	(0.63)	626.00
All	-0.70%	8.04%	-43.64%	3.88%	1,164.00	43.47%	(0.18)	183.00

Table 4.5 Mean Difference Testing Between Delta-Hedging Returns of Call and Put Options from Standard Deviation Volatility and GARCH Volatility

	Call Option		**Put Option**		**Call and Put Option**	
	t-test	**P-Value**	**t-test**	**P-Value**	**t-test**	**P-Value**
Before transaction cost						
OTM	-1.42	0.16	0.63	0.53	-1.34	0.18
ATM	0.51	0.61	1.20	0.23	1.03	0.30
ITM	0.03	0.98	0.36	0.72	0.33	0.74
All	-1.38	0.17	1.07	0.29	-1.19	0.23
After transaction cost						
OTM	0.90	0.37	0.64	0.52	0.95	0.34
ATM	0.54	0.59	1.21	0.23	1.06	0.29
ITM	0.01	0.99	0.33	0.74	0.29	0.77
All	0.93	0.36	1.07	0.28	1.05	0.29

CHAPTER 5
CONCLUSION

In this study, we aim to determine the best model that creates the highest return over risk-free between standard deviation volatility and GARCH volatility that is used for SET50 index options volatility trading strategies by delta-hedging for all moneyness. We use the daily data of SET 50 index options trading from January 2nd, 2020, to December 30th, 2022, or three years. The SET 50 index options trading series will only include the nearest exercise month series, which have the highest liquidity. We chose the SET 50 index options contracts at random with strike prices of 950, 975, 1000, 1025, and 1050. We trade weekly, opening positions on Monday and closing positions on Friday.

We find out that the average before and after transaction costs return from the delta-hedging strategy of options using GARCH volatility trading techniques is negative for both call and put options. For the standard deviation of volatility, the average trading return can generate a positive return for only the before-transaction return in trading the put option. After comparing the returns, we find that the GARCH volatility trading return can be higher than the standard deviation volatility trading returns only in the case of call option trading before transaction costs on average. In other cases, the standard deviation of volatility trading has a higher return than the GARCH volatility trading return. However, in the case of a call option, the GARCH volatility has a greater possibility of gaining a positive return than the standard deviation. For the put option, the probability of getting a positive return for GARCH and the standard deviation are close. On the evidence in this study, the conclusion is that standard deviation volatility trading can give a higher return after transaction cost than GARCH volatility trading on average when moneyness is not taken into account. However, the gap between these two strategies returns is an insignificant difference. In real-life option trading, we suggest trading the volatility trading strategy with delta-hedging in in-the-money (ITM) periods for call options and out-of-the-money (OTM) periods, excluding the case of close to zero delta for put options, since there is a greater likelihood of generating a positive return.

Nevertheless, both GARCH and Standard deviation volatility trading do not provide positive returns for all scenarios, and they have a possibility of gaining positive returns of just 40.21–58.93 times from the 100 times of the investment, which is comparable to gambling. That means the Delta Neutral strategy does not provide 100% risk management and is ineffective for hedging since delta values fluctuate depending on market conditions. As a result, the delta-hedging strategies require very regular rebalancing to gain a profit. Furthermore, because the SET50 index options market is not a complete market and has low liquidity, the results may deviate from the theoretical.

Future research would benefit from developing a model to test the true capabilities of the GARCH model by increasing the testing period, adding options data to all series, and adding related costs such as bid-ask spread, interest, and so on, as well as testing other models that predict volatility more accurately. Furthermore, regular portfolio rebalancing is required for delta hedging strategies.

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