The impacts of Volatility Spread and Timing on writing non-directional options strategies

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The impacts of Volatility Spread and Timing on writing non-directional options strategies

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The study examines the impacts of volatility spread and time-to-maturity on the returns of writing non-directional options strategies on SET50 index options in Thailand Futures Exchange. The study allows to use over-lapping data for the periods of 1-month, 2-month and 3-month maturities to test with the same expiration date to examine the impacts of time-to-maturity. Also, this paper adds the data of in-the-money and out-of-the-money by 25 points and 50 points call and put options to build strangle in various moneyness to find the difference of the impact of volatility spread and time-to-maturity from various moneyness.

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INTRODUCTION

Background and Significance of the problem

The options market in the U.S., named Chicago Board Options Exchange, presented the exchange options market in 1973 with the establishing of the exchange, while Thailand Future Exchange was opened in 2006, beginning by listing SET50 Index futures and started to list SET50 Index options in the market on 2007. Trading futures and options are a zero-sum game, so it is different from general equity trading that is not zero-sum game due to receiving a dividend from the company. Theoretically, there are benefits for options trading, which gain is unlimited and loss is limited for buy-side and limited gain and unlimited loss for sell-side. Also, options can be mixed into various strategies. One of the strategies is straddle that is said as a directional freed strategy, and the returns depend on volatility on the underlying asset. The study explains the asymmetrical return of writing straddle and strangle strategies by investigating the relationship among implied volatility, realized volatility and returns with proving that this strategy is free-directional strategy and timing to enter positions.

Typically, the options market always has zero net position, while the market of normal securities is always long in net position. As the property of a zero-sum game in options trading, the aggregate payoffs are zero as the offset of long and short options positions. The previous studies mostly are about a leg of holding call or put. Merton et al. (1982) indicate that long call options have positive returns on average, while long put options have negative returns on average. It widely known that the call options and put options have positive and negative return, respectively. Lately, Eraker (2008) demonstrates that the returns of both short-selling options, call and put options, is on average positively related to higher implied volatility than realized volatility. Ni (2007) claims that short call options of out-of-the-money, on average have positive return. Jackwerth and Rubinstein (1996) and Eraker (2008) claims that one of the reasons that cause the positive return of writing options is positive volatility spread. This study thus focuses on testing the reason that positive volatility spread been able to make a positive return on writing options which ignore directional relationship by using straddle and strangle strategies to write options.

Since Whitelaw (2000) and Bekaert and Wu (2000) argue that the volatility and the price of underlying asset movement are negatively related which can see during times of crisis, the underlying asset's volatility increases significantly. Bakshi and Kapadia (2003) states that the application of call and put options against loss might happen, and option prices and volatility is a positive correlation. It also supports to the higher return when volatility increases.

Coval and Shunway (2001) and Constantinides et al. (2013) show evidence that one of factors, that prices options, is volatility. The previous studies and Che (2015) show that there are volatility spread, defined as the difference between options' implied volatility and the underlying asset's realized volatility, in the US and the HK securities and options markets and found that there are positive in the volatility spread on average. Implied volatility of options considers as investors' expectations of volatility in the future. Black (1976), French et al. (1987) and Glosten et al. (1993) argue that the correlation between volatility spread and returns of the underlying asset is positive.

Implied volatilities in each options' strike price and time-to-maturity are different as investor expectation of each period and level of exercise. Cont and Fonseca (2002) find from the empirical study that implied volatility of options for in-the-money moneyness decrease when it is near to expiration date, and the strike prices that far from at-the-money make higher implied volatility when decreasing in the time to maturity. Zhu and Avellaneda (1997) indicate higher volatility of option's implied volatility relative to a decrease in time to maturity. Xu and Taylor (1994) argue that 15 days' time-to-maturity options and long-term options' implied volatilities are expectation of volatility for 15 days and long-term view. The expectations of both time frame frequently change and frequently cross over and standard deviation of implied volatility of 15 days options are higher than of long-term options. Thus, the implied volatility's term structure of options for time-to-maturity are arguable. This study focuses on an influence of volatility spread and time-to-maturity on returns of writing straddle and strangle strategies.

In this reseach, I first estimate the impact of underlying return on return of writing straddle and strangle strategies in Thai market to confirm that these strategies

are truly directional free, and add volatility spread to investigate that return on the strategies has relationship with different of implied volatility and realized volatility as Che (2015)'s claim. Moreover, I additionally add time-to-maturity as a factor to clarify the well timing to enter positions which previous studies are still not clear about the implied volatility's term structure of option and mostly test in the US market and FX market.

Objective

1. To prove writing straddle and strangle strategies that are truly free-directional strategies when open the positions in Thailand Futures Exchange
2. To estimate the effect of volatility spread on returns of writing straddle and strangle strategies on options of SET50 index in Thailand Futures Exchange
3. To estimate the effect of time-to-maturity on returns of writing straddle and strangle strategies on options of SET50 index in Thailand Futures Exchange
4. To investigate that there are different of the volatility spread's impacts from various moneyness on returns of writing straddle and strangle strategies on options of SET50 index in Thailand Futures Exchange.

Research hypothesis

Hypothesis 1: Volatility spread are positive relationship with returns of writing straddle and strangle strategies on options of SET50 index in Thailand Future Exchange.

The prices of options are included volatility to be computed (Black, 1976) that indicate higher implied volatility in the option, affecting the return on writing options when underlying direction are adjusted out. Because higher implied volatility means higher premium options for writing side, investors can receive higher premium to offset their risk to be exercise options, and how much implied volatility higher than realized volatility means the market expects the risk higher than current risk, so writing options' investor should receive more returns from the premium of the expected risk.

Hypothesis 2: As longer time to writing options, the probability of gain on return of writing straddle and strangle strategies should be higher on SET50 index options in Thailand Future Exchange.

Implied volatility is more stable for longer time-to-maturity options (Rama Cont and Jose da Fonseca, 2002). This means that long time-to-maturity options have less risk in term of change in implied volatility. Options premium is higher for longer time-to-maturity (Black, 1976), constant of other variables, to offset the risk of writing longer time that the options might be exercised. Writing options investor, thus, should have more win rate on enter position as longer time-to-maturity because writing options investors receive higher options premium as longer writing options to be a buffer for options exercised.

Hypothesis 3: Higher moneyness option on both in-the-money and out-of-the-money can cause greater probability of gain of writing straddle and strangle strategies on SET50 index options in Thailand Future Exchange.

The far of moneyness in options is the probability of options to be exercised. The deep out-of-money options are less probability to be exercise. Thus, if options are more out-of-the-money, the win rate should be higher than less out-of-the-money or at-the-money or in-the-money. As Che (2015), the study claims that from the testing on the Hang Seng Index (HSI) options, in short selling strangle of out-of-the-money, the win rate of 6% moneyness is 81%, while the win rate of at-the-money short straddle strategy is 59%. I believe that the result on SET50 index options in Thailand Future Exchange will be in the similar direction.

LITERATURE REVIEW

Since the options market of Chicago Board Options Exchange is opened in 1973, there are many researchers to study financial derivative instruments.

Che (2015) studies short selling option in the Hang Seng Index futures and options' risk and returns between July 2000 and December 2009 by testing on writing call options, put options and straddle/strangle strategies. The study indicates that volatility spread significantly impacted to returns of writing option. Especially, free-directional writing options, like straddle/strangle strategy, highly related to the

distinctiveness of implied volatility and realized volatility. If implied volatility is higher than realized, the average return and win rate is much higher and higher out-of-the-money are also higher average return and win rate. On at-the-money short straddle strategy, average returns and probability to gain are 1.66% and 59%, respectively, while on 6% moneyness of out-of-the-money short strangle strategy, average return and win rate are 3.07% and 81%.

Cont and Fonseca (2002) study the dynamic properties of the implied volatility of S&P500 index European style options on the Chicago Board of Options Exchange between 2 March 2000 and 2 February 2001 on daily basis. An empirical study of options' implied volatility of at-the-money decreases coextensively with a decrease in time to maturity. In contrast, the implied volatility of deep in-the-money options and deep out-of-the-money options are negative relationship with time-to-maturity.

Zhu and Avellaneda (1997) study 13 currency pairs for the term structure of implied volatility of options from January 1995 to July 1996. The study indicates that when the options' expiration date increase, the confidence internals become narrower. In other words, there is less standard deviation on implied volatility as longer time to maturity for options.

Merton et al. (1978) studies option trading strategies by back testing the data during July 1963 and December 1975. The study find that an increase in exercise price is negatively related to call options' returns and positively related to put options' returns.

Coval and Shumway (2001), Ni (2007) and Constantinides et al. (2013) study by using a non-overlapping option data and find that monthly returns for holding call are negative relationship with strike price and the returns for out-of-the-money options are negative on average. The researchers argue that the overprices in call option are from risk-seeking investors due to option is a leverage financial instrument. Moreover, they find that holding put options are negative return on average as well. However, the estimated parameters are not stable.

Bakshi and Kapadia (2003) research options of the S&P 500 index between January 2988 and December 1995. The study finds the returns from delta-hedged at-the-money and out-of-the-money option portfolios, which rebalances the portfolio on daily basis, are negative. Jackwerth and Rubinstein (1996) also find that long call options are negative returns, which one of the reasons is positive volatility spread. Both indicate the existing of volatility spread and relation between volatility and option returns, which is similar to Eraker (2008) that if volatility spread is positive, the return on short selling options should be positive whether call and put options.

Glosten et al. (1993), Whitelaw (2000) and Bekaert and Wu (2000) discover the correlation between stock return and the volatility are the significant negative by using time-series models.

In conclusion, there are many studies that research about option return and volatility related. Generally, holding put option are negative returns on average, while holding call options are still in arguable. The relationship between underlying price and volatility effects on option returns are significant. However, the term structure of options for time-to-maturity is not conclusion yet. In the study, thus, the research explores the returns from volatility spread with non-directional option strategies and timing to enter positions.

DATA

All data is from the Thailand Futures Exchange obtained from The Stock Exchange of Thailand contains quoted prices for contracts of the SET 50 Index (SET50) options and futures that trade on the Thailand Future Exchange (TFEX). The settlement prices of each trading day are collected to use in this research. The samples are in the period between January 2012 and December 2019 (96 monthly observations and 32 quarterly observation).

The maturities of the SET50 Index future and option are every month. However, this study focuses on contracts that maturities are only on March, June, September and December because there is more liquidity than other month maturities which mostly no one trades on those options. This research uses future prices and

options premium monthly in the series that have nearest maturity date in March, June, September or December series.

To examine about the effect of time-to-maturity, overlapping datasets allow in this research by using options that is set to mature in 1 month, 2 months, and 3 months and futures to enter positions and hold until maturity date.

This research does not focus only on at-the-money, but also on options of in-the-money and out-of-the-money because the study is a test of the volatility spread effect on returns of short selling straddle and strangle and I would like to examine that different moneyness of each options will affect the returns in short straddle and strangle strategies. There are 25 points space for each strike price of options, so this study uses 25 points out-of-the-money/in-the-money options and 50 points out-of-the-money and in-the-money options which the moneyness is equated to the difference between options' strike price and settlement price of futures on the date of each time-to-maturity that the futures has the same maturity date with the options.

For example, on 31th October 2018 the futures that has maturity on 27th December 2018 (S50Z18) settled at 1099.10, I will clarify S50Z18 options series on 31th October 2018 by given call and put options of 1100-strike price as at-the-money options, and call options of 1125-strike price as 25 points out-of-the-money options to pair with put options of 1075-stirke price as 25 points out-of-the-money options, and call options of 1150-strike price as 50 points out-of-the-money options to pair with put options of 1050-strike price as 50 points out-of-the-money options, and call options of 1075-strike price as 25 points in-the-money options to pair with put options of 1125-strike price as 25 points in-the-money options, and call options of 1050-strike price as 50 points in-the-money options to pair with put options of 1150-strike price as 50 points in-the-money options.

METHODOLOGY

Options which are examined in this study are options of moneyness between at-the-money and 50 points out-of-the-money options and in-the-money options. Moneyness is defined that the points of the strike price of the options are far from the underlying asset's spot prices. Since the SET50 options contract are slightly low liquid, the settlement prices are used in calculation of options return, and the SET50 futures contract are also used the settlement price in calculation of futures return to be align with options return.

This research studies the effect of the volatility spread on the return on straddle and strangle strategies. Volatility spread is defined that is the distinctiveness of options' implied volatility and the underlying asset's realized volatility which calculates on a month realized volatility.

1. Realized Volatility

The realized volatility (RV) is computed the same way as the standard deviation of the settlement price returns on daily basis of the SET50 Index futures. This study uses returns of SET50 Index futures and find the implied volatility by the modified Black's (1976) option pricing model, which is more convenient than the Black-Scholes model as we do not have to estimate the dividend rate of SET50 Index. Also, SET50 Index options settle with the futures, and calculates from the futures contracts that have nearest maturity date in March, June, September or December series.

$$RV_t = \sqrt{\frac{N\sum_{i=t-n}^{t} R_i^2}{(n-1)}} \quad (1)$$

Where, *N* is the trading days' number in a year, assumed at 252 days.

n is the trading days' number in a month, assumed at 20 days.

R_i is the settlement return on daily basis of SET50 Index futures on time i.

2. Implied Volatility

Implied volatility (IV) is figured by the modified Black's (1976) option pricing model as all the other factors of the model could observe in the market. The call and put option pricing model can be written as follows:

$$c_t = F_t N(d_{1,t}) - XN(d_{2,t}) \quad (2)$$

$$p_t = XN(-d_{2,t}) - F_t N(-d_{1,t}) \quad (3)$$

Where, $d_{1,t} = \frac{ln\left(\frac{F_t}{X}\right)+\sigma_t^2\tau_t/2}{\sigma_t\sqrt{\tau_t}}; d_{2,t} = \frac{ln\left(\frac{F_t}{X}\right)-\sigma_t^2\tau_t/2}{\sigma_t\sqrt{\tau_t}}$

F_t is the futures settlement price on time t

X is the exercise price

$N(.)$ is the cumulative normal distribution

σ_t is the volatility on time t

τ_t is the time to maturity in fraction of a year on time t.

3. Straddle/Strangle Return

To calculate the return of futures and options, the study uses percentage of returns of the futures prices of the time to maturity. Options returns from futures prices of the time to maturity based allows the study of effect and relative comparison from futures return to return of straddle and strangle strategies. The return of SET50 Index futures ($R_{futures}$), the returns of short SET50 Index call option (R_{call}), the returns of short SET50 Index put option (R_{put}) and the returns of short straddle and strangle strategies ($R_{straddle}$) are computed each future, call options and put options that the study uses in a maturity that are 3 months and 2 months and 1 month of time to maturity.

In a maturity, $R_{futures}$, R_{call} , R_{put} and $R_{straddle}$ have 3 numbers for each one which are calculated from data of 1 month, 2 months and 3 months' time-to-maturity as following equations.

$$R_{futures,T-d} = \frac{F_{Settlement,T}-F_{T-d}}{F_{T-d}} \quad (4)$$

$$R_{call,T-d} = \frac{C_{T-d}(X)-max\ (F_{Settlement,T}-X,0)}{F_{T-d}} \quad (5)$$

$$R_{put,T-d} = \frac{P_{T-d}(X)-max\ (X-F_{Settlement,T},0)}{F_{T-d}} \quad (6)$$

$$R_{straddle,T-d} = R_{put,T-d} + R_{call,T-d} \quad (7)$$

Where, T is maturity dates of futures and options which are March 2012, June 2012, until December 2019.

d is time-to-maturities of futures and options which are 1 month, 2 months, and 3 months.

F_{T-d} is the settlement futures price at the date of T−d

$F_{Settlement,T}$ is the settlement price on the expiration day of T maturity date futures.

$C_{T-d}(X)$ is the settlement call premium with exercise price X on the date of T−d of T maturity date options.

$P_{T-d}(X)$ is the settlement put premium with exercise price X on the date of T−d of T maturity date options.

Figure 1. Timeline of future and option in a maturity

4. Regression Testing

To investigate the effect of volatility spread and market movements on the returns from short straddle strategy, multiple regression analyses are performed. The relationship between the volatility spread and the returns of short straddle strategy is analysed by regressing the model, which is the return of futures and the options strategies against the futures returns, to test if it is directionless and the volatility spread to find the impact on the returns. In this step, at-the-money options, which combined to be straddle strategy, are used to examine with the following regression model.

Note that returns in straddle/strangle is from 1, 2 and 3 months' time-to-maturity options. To help partially normalize, the researcher adds time-to-maturity term (TTM) in the regression model.

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \beta_3 TTM_{T-d} + \varepsilon \quad (8)$$

Where, $R_{straddle,T-d}$is the returns of straddle/strangle from writing the date of T−d of T maturity date options.

$R_{futures,T-d}$is the returns of SET 50 futures from holding the date of T−d of T maturity date futures.

IV_{T-d} is the implied volatility of the straddle/strangle on the date of T-d of T maturity date options.

RV_{T-d} is the realized volatility of the futures on the date of T-d of T maturity date futures.

TTM_{T-d} is time-to-maturity of the option in fraction of a year on the date of T−d of T maturity date options.

5. Regression Testing on Each Time-To-Maturity

Then, to test there are different in the impacts on the returns from various time to maturity options. The observers are separated to 3 groups by time to maturity; 3 months' , 2 months' and 1 month' time to maturity as figure 2, and data of each group is separately examined with the following regression model.

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \varepsilon \quad (9)$$

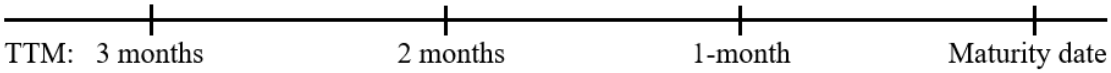
Where, $R_{straddle,T-d}$is the returns of straddle/strangle from writing the date of T−d of T maturity date options.

$R_{futures,T-d}$is the returns of SET 50 futures from holding the date of T−d of T maturity date futures.

IV_{T-d} is the implied volatility of the straddle/strangle on the date of T-d of T maturity date options.

RV_{T-d} is the realized volatility of the futures on the date of T-d of T maturity date futures.

Figure 2. Groups for separation time to maturity



6. Regression Testing on Different Moneyness

To test there are different in the impact of volatility spread and market movements on the returns from various moneyness options. This research separately examines data of in-the-money and out-of-the-money by 25 points and 50 points to run the specification (8) and compare the difference of co-efficient of regressors from each moneyness. To separate the data by moneyness, the data is divided to 4 sets which is short strangle of 25 points in-the-money options, short strangle of 50 points in-the-money options, short strangle of 25 points out-of-the-money options, and short strangle of 50 points out-of-the-money options.

Then, this also examine the difference of impacts of time-to-maturity on the returns from various moneyness options by separating each moneyness, in-the-money and out-of-the-money by 25 points and 50 points, of strangle by time-to-maturity, 1 month, 2 months and 3 months. The data of each group is separately examined with the specification (9) and compare the difference of coefficients of regressors from each moneyness and time-to-maturity.

This step, thus, run regressions of the specification (8) for 4 times, which are 4 groups of moneyness of 25 and 50 points in-the-money and out-of-the-money strangle, and test the specification (9) for 12 times, which are 25 points in-the-money strangle 3 times from 3 groups of time-to-maturity, 50 points in-the-money strangle 3 times from 3 groups of time-to-maturity, 25 points out-of-the-money strangle 3 times from 3 groups of time-to-maturity, and 50 points out-of-the-money strangle 3 times from 3 groups of time-to-maturity.

I believe that pairing equal moneyness of call and put options to build strangle strategy cause directionless positions which this study focuses on effects of volatility spread and time-to-maturity, and does not need directional effect in the result.

7. Back Testing

The study back test the data to find average percentage of returns, maximum percentage of returns, minimum percentage of returns, probability of gain and probability of loss by computing returns of straddle and strangle positions, using equation (7). After getting returns of straddle and strangle positions, I split the returns

by moneyness, at-the-money and in-the-money and out-of-the-money by 25 points and 50 points. There are 5 sets of data to compute average percentage of returns, maximum percentage of returns, minimum percentage of returns, probability of gain and probability of loss.

Then, I divide the returns of each moneyness by time-to-maturity, getting 15 sets of data, and compute average percentage of returns, maximum percentage of returns, minimum percentage of returns, probability of gain and probability of loss to compare the difference of various moneyness and time-to-maturity.

Empirical Results

This chapter display all the statistical hypothesis tests and describe the impacts of volatility spread and timing on writing non-directional options strategies. This paper first examine on at-the-money short straddle strategy, then discuss the result of impact of SET50 index futures returns and volatility spread, and lastly the result of impact of SET50 index futures returns and volatility spread on the returns of in-the-money and out-of-the-money short strangle strategies.

Regression testing on at-the-money short straddle strategy

In our empirical analysis, the statistic result of the impacts of SET50 index futures return, volatility spread and time-to-maturity on the returns of at-the-money short straddle strategy is shown in Table 1. Table 1 shows SET50 index futures returns are negatively related with the returns of at-the-money short straddle strategy at 5% level of significance, and the volatility spread, and the return of at-the-money short straddle are negatively related at 1% level of significantly. However, results confirm that the time-to-maturity and the returns of the strategy have no relation, due to the insignificant estimated parameter of the time-to-maturity.

Table 1: The impacts of SET50 index futures return, volatility spread and time-to-maturity on the return of short straddle strategy

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \beta_3 TTM_{T-d} + \varepsilon$$

*, **, *** indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

VARIABLES	ATM
R_{future}	-0.127**
	(0.055)
IV - RV	-0.252***
	(0.086)
TTM	0.026
	(0.045)
Constant	-0.049
	(0.007)
Observations	96
Adjusted R-squared	0.133

Then, the researcher separated the data set to 3 groups, 1 month of time-to-maturity, 2 months of time-to-maturity and 3 months of time-to-maturity. As Table 2, the regression results show that the return of SET50 index futures and the return of at-the-money short straddle strategy is not related due to the insignificant estimated parameter of the SET50 index futures return in all the data groups. However, the relation between volatility spread and the return of at-the-money short straddle strategy is negative at 5% level of significantly in 3 months' time-to-maturity, while volatility spreads in 1 and 2 months' time-to-maturity are not related with the strategy return as the insignificant estimated parameters.

These results are inconsistent with theoretical expectation. As our hypothesis, volatility spread should be positive relationship with returns of short straddle strategy. However, in this result, volatility spread is significantly negative relationship with returns of short straddle strategy.

To find the reason behind these results, figure 3 is plotted to compare historical of implied volatility of straddle and realized volatility of SET50 index futures. As figure 3, the implied volatility significantly closes to the realized volatility in most of the time, however, sometimes the implied volatility adjusts delay to the realized volatility. This situation is different from the US stock market which Hull and White (1987) show that future realize volatility could predict by the Black-Scholes model which the implied volatility of an at-the-money option is roughly same as the expected realized volatility. Thus, the implied volatility should adjust before realized volatility. This might cause the different of results from the theoretical expectation.

Moreover, the researcher tried to run the regression model by changing the futures returns of SET50 Index to be absolute value of the SET50 futures returns. This yields mostly the same result that the absolute of SET50 futures returns is negative relationship with the straddle returns at 1% level of significantly, and the volatility spread is negative relationship with the straddle returns at 5% level of significantly for 3 months' time-to-maturity options (see Appendix A for the regression results).

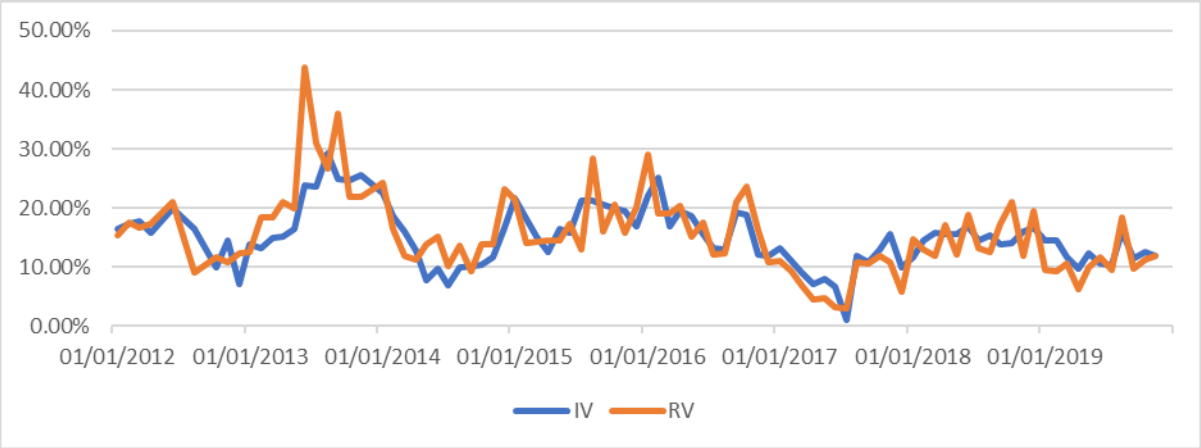
Table 2: The impacts of SET50 index futures return, volatility spread on the return of short straddle strategy by time-to-maturity

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \varepsilon$$

*, **, *** indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

VARIABLES	ATM		
	1 mo	2mo	3 mo
R_{future}	-0.129	-0.091	-0.134
	(0.090)	(0.096)	(0.103)
IV - RV	-0.070	-0.163	-0.373**
	(0.133)	(0.181)	(0.150)
Constant	-0.002	-0.002	0.002
	(0.004)	(0.006)	(0.007)
Observations	32	32	32
Adjusted R-squared	0.007	0.002	0.221

Figure 3. Implied volatility of Straddle and Realized Volatility



Regression testing on in-the-money and out-of-the-money short strangle strategy

In our empirical analysis, the statistic result of the impacts of SET50 index futures return, volatility spread and time-to-maturity on the return of in-the-money and out-of-the-money short strangle strategies is shown in Table 3. Table 3 shows the negative relation between SET50 index futures return and the strategy return at 5% level of significance in 25 points in-the-money and out-of-the-money short strangle strategies, while at 1% level of significance in 50 points in-the-money and out-of-the-money short strangle strategies, and the volatility spread and the return of strangle are negatively related at 1% level of significantly in 25 points in-the-money and out-of-the-money, and 50 points out-of-the-money short strangle strategies, while the volatility spread negatively related to the return of strangle at 10% level of significance in 50 points in-the-money. However, these results confirm that the time-to-maturity is not associated with the return of the strategy in both of in-the-money and out-of-the-money short strangle, since the estimated parameters of the time-to-maturity are insignificantly.

Table 3: The impacts of SET50 index futures return, volatility spread and time-to-maturity on the return of short strangle strategy

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \beta_3 TTM_{T-d} + \varepsilon$$

*, **, *** indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

Variables	25 ITM	50 ITM	25 OTM	50 OTM
R_{future}	-0.110**	-0.117***	-0.101**	-0.088***
	(0.05)	(0.03)	(0.05)	(0.03)
IV - RV	-0.211***	-0.077*	-0.244***	-0.15***
	(0.07)	(0.04)	(0.07)	(0.05)
TTM	0.001	0.006	-0.017	-0.021
	(0.04)	(0.03)	(0.04)	(0.03)
Constant	0.002	0.003	0.005	0.01*
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	96	96	96	96
Adjusted R-squared	0.132	0.122	0.158	0.150

The researcher separated the dataset to 3 groups, 1 month time-to-maturity, 2 months time-to-maturity and 3 months time-to-maturity. As Table 4, the regression results show that the return of SET50 index futures and the return of in-the-money and out-of-the-money short straddle strategies mostly are not related because the estimated parameter of the SET50 index futures return is not significant in most of the data groups, excepting in 50 points in-the-money and out-of-the-money short strangle, the estimated parameters are significantly at 5% and 10% level with negative relationship, respectively.

However, the relationships between volatility spread and the return of in-the-money and out-of-the-money short straddle strategies are negative at 5% level of significantly in 3 months time-to-maturity, while volatility spreads in 1 month time-to-maturity and 2 months time-to-maturity are not related with the strategy return as the insignificant estimated parameters in both of in-the-money and out-of-the-money short strangle.

These results are contrary to theoretical expectation. As our hypothesis, volatility spread should be positive relationship with returns of short straddle strategy. However, in this result, volatility spread is significantly negative relationship with returns of short strangle strategy as the same with short straddle strategy that could explain similarly to previous.

Table 4: The impacts of SET50 index futures return, volatility spread on the return of short strangle strategy by time-to-maturity

$$R_{straddle,T-d} = \beta_0 + \beta_1 R_{futures,T-d} + \beta_2 (IV_{T-d} - RV_{T-d}) + \varepsilon$$

*, **, * indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

Variables	25 pts ITM			50 pts ITM			25 pts OTM			50 pts OTM		
	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo
R future	-0.085	-0.098	-0.116	-0.063	-0.087	-0.152**	-0.064	-0.069	-0.136	-0.045	-0.062	-0.119*
	(0.07)	(0.08)	(0.90)	(0.41)	(0.06)	(0.06)	(0.07)	(0.08)	(0.09)	(0.04)	(0.05)	(0.07)
IV - RV	-0.113	-0.146	-0.279**	0.047	0.056	-0.185**	-0.113	-0.23	-0.288**	-0.004	-0.113	-0.219**
	(0.09)	(0.16)	(0.13)	(0.03)	(0.10)	(0.08)	(0.11)	(0.16)	(0.12)	(0.06)	(0.10)	(0.09)
Constant	0.002	0.000	0.002	0.003	0.004	0.005	0.002	0.001	0.002	0.005**	0.005	0.006
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
Observations	32	32	32	32	32	32	32	32	32	32	32	32
Adjusted R-squared	0.03	0.008	0.194	0.042	0.028	0.269	0.005	0.037	0.234	-0.021	0.031	0.237

Back testing

Table 5 shows the back testing result from writing an at-the-money or in-the-money or out-of-the-money straddle/strangle until maturity. For the short at-the-money straddle strategy, the average return is -0.06% with maximum percentage of returns is 10.41% and minimum percentage of returns is -8.36%. The probability to gain is 47.92%.

For the short 25 points in-the-money and out-of-the-money, both average returns are near each other at 0.12% and 0.15%, respectively with maximum percentage of returns of 7.69% and 7.23%, and minimum percentage of returns of -7.70% and -8.53%, respectively. Both probability to gain are 55.21%.

For the short 50 points in-the-money and out-of-the-money, both average returns are 0.30% and 0.44%, respectively with maximum percentage of returns is 5.25% and 5.69%, and minimum percentage of returns is -6.81% and -8.11%, respectively. Both probability to gain are 72.92% and 71.88%.

The exam could be explained that when the moneyness is farther from at-the-money, the average returns and probability to gain is higher since options is more difficult to be exercised for out-of-the-money options and there are larger buffer of options premium to be exercised than less moneyness options for in-the-money options. On the other hand, maximum percentage of returns reduces as how far of moneyness from at-the-money. These results are consistent with theoretical expectation that higher moneyness from at-the-money cause higher probability to gain.

Table 5: Back testing on short straddle and strangle

	ATM	25 pts ITM	50 pts ITM	25 pts OTM	50 pts OTM
Average	-0.058%	0.120%	0.303%	0.155%	0.437%
Max	10.413%	7.692%	5.247%	7.234%	5.960%
Min	-8.360%	-7.698%	-6.810%	-8.530%	-8.107%
N	96	96	96	96	96
Prob of Gain	47.917%	55.208%	72.917%	55.208%	71.875%

Table 6 shows the back testing result, which separated groups by time-to-maturity, 1 month, 2 months time-to-maturity and 3 months time-to-maturity, from writing an at-the-money or in-the-money or out-of-the-money straddle/strangle until maturity. The average returns range from -0.36% (at-the-money, 1 month time-to-maturity) to 0.46% (50 points out-of-the-money, 3 month time-to-maturity) with the range of maximum percentage of returns from 1.73% (50 points in-the-money, 1 month time-to-maturity) to 10.41% (at-the-money, 3 month time-to-maturity) and the range of minimum percentage of returns from -8.53% (25 points out-of-the-money, 3 month time-to-maturity) to -3.08% (50 points out-of-the-money, 1 month time-to-maturity). The highest probability to gain is 81.25% on 50 points out-of-the-money with 1 month time-to-maturity, while the lowest probability to gain is 43.75% on at-the-money with 1 month time-to-maturity.

The exam could be explained as near the same with Table 5 that when the moneyness is farther from at-the-money, the average returns and probability to gain is higher since options is more difficult to be exercised for out-of-the-money options and there are larger buffer of options premium to be exercised than less moneyness options for in-the-money options. Moreover, the average returns increase as how long of time-to-maturity to write the options.

These results are consistent with theoretical expectation that higher moneyness from at-the-money cause higher probability to gain. However, our expectation that longer time-to-maturity to write straddle/strangle cause higher probability to gain since longer to hold position that means investors facing more inconsistent in the futures movement as Table 3 shown the influence of the futures returns on the returns on short straddle/strangle in 5% and 1% level of significantly, respectively. On the other hand, the average returns are higher when moneyness is farther from at-the-money.

Table 6: Back testing on short straddle and strangle by time-to-maturity

	ATM			25 pts ITM			50 pts ITM		
TTM	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo
Average	-0.359%	-0.100%	0.284%	0.002%	0.078%	0.282%	0.228%	0.303%	0.378%
Max	4.262%	4.563%	10.413%	3.200%	5.301%	7.692%	1.730%	3.472%	5.247%
Min	-5.011%	-5.743%	-8.360%	-3.681%	-5.358%	-7.698%	-3.352%	-4.443%	-6.810%
N	32	32	32	32	32	32	32	32	32
Prob of Gain	43.750%	46.875%	53.125%	53.125%	56.250%	56.250%	81.250%	75.000%	62.500%

	25 pts OTM			50 pts OTM		
TTM	1 mo	2 mo	3 mo	1 mo	2 mo	3 mo
Average	0.056%	0.178%	0.230%	0.417%	0.407%	0.485%
Max	3.109%	5.395%	7.234%	1.762%	3.846%	5.960%
Min	-4.045%	-4.973%	-8.530%	-3.080%	-3.660%	-8.107%
N	32	32	32	32	32	32
Prob of Gain	53.125%	62.500%	50.000%	81.250%	75.000%	59.375%

Conclusion

The study examines the impacts of volatility spread and time-to-maturity on the returns of writing non-directional options strategies on SET50 index options in Thailand Futures Exchange using the data of the futures and options contracts. Prices of SET50 index futures and premiums of SET50 options use the settlement price which is represented for the price of the day. Because of the data shortage in SET50 options data, the study allows to use over-lapping data for the periods of 1-month, 2-month and 3-month maturities to test with the same expiration date and cause the study be able to examine the impacts of time-to-maturity in the same time. Also, the paper adds the data of in-the-money and out-of-the-money by 25 points and 50 points call and put options to build strangle in various moneyness to find the difference of the impact of volatility spread and time-to-maturity from various moneyness.

The main findings are summarized as follows. Firstly, even options strategies that usually call as non-directional strategy such as straddle and strangle, the options strategies on SET50 index options are still affected by the movement of underlying

asset, SET50 index futures in Thailand Futures Exchange. However, the effect is less when investors write at-the-money straddle and less time-to-maturity options. Since, holding higher time-to-maturity options means that investors must face higher movement of the underlying asset.

Secondly, the study finds that the volatility spread and the returns of short straddle/strangle on SET50 index options in Thailand Futures Exchange are negative relationship. Especially, on long time-to-maturity straddle and strangle, such as 3 months time-to-maturity straddle and strangle, the relationship is significant in all examined moneyness, and time-to-maturity of options does not influence the returns of the strategies.

Thirdly, on back testing, Table 5 and 6 find that farther moneyness from at-the-money and longer time-to-maturity of writing straddle and strangle on SET50 index options in Thailand Futures Exchange cause higher average returns on short straddle and strangle. Also, farther moneyness from at-the-money of writing straddle and strangle cause higher probability to gain, while longer time-to-maturity of writing straddle and strangle does help to improve probability to gain due to facing longer inconsistent in movement of the underlying asset.

APPENDICES

APPENDIX A

Table 7: The impacts of absolute value of SET50 futures return, volatility spread and time-to-maturity on the return of short straddle strategy

$R_{straddle,T-d} = \beta_0 + \beta_1|R_{futures,T-d}| + \beta_2(IV_{T-d} - RV_{T-d}) + \beta_3 TTM_{T-d} + \varepsilon$

*, **, *** indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

VARIABLES	ATM
R future	-0.799***
	(0.052)
IV - RV	-0.121**
	(0.047)
TTM	0.117***
	(0.025)
Constant	0.017***
	(0.004)
Observations	96
Adjusted R-squared	0.746

Table 8: The impacts of absolute value of SET50 futures return, volatility spread on the return of short straddle strategy by time-to-maturity

$R_{straddle,T-d} = \beta_0 + \beta_1|R_{futures,T-d}| + \beta_2(IV_{T-d} - RV_{T-d}) + \varepsilon$

*, **, *** indicate the statistically significant coefficient at 10%, 5%, and 1% level, respectively.

VARIABLES	ATM		
	1 mo	2mo	3 mo
R future	-0.826***	-0.771***	-0.796***
	(0.090)	(0.077)	(0.097)
IV - RV	0.066	-0.115	-0.205**
	(0.070)	(0.086)	(0.086)
Constant	0.027***	0.033***	0.046***
	(0.004)	(0.004)	(0.007)
Observations	32	32	32
Adjusted R-squared	0.730	0.769	0.750

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