Research Report From Equity Group：Premium Selling

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Abstract

This article illustrates the premium selling strategy and its performance in Chinese option market. Analyzing the advantages and disadvantages of strategy application. This work will show the performance of traditional option strategy in Chinese market, whether it is effective or not. We choose options whose delta that is most close to our target value. Selling the option and collecting the premium as profit, undertaking extreme fluctuation of option price as risk, which is the main theme of our strategy. Furthermore, this paper will include backtest procedure and all major parts that should be involved in trading strategy such as signal generation, quotative analysis, qualitative analysis, portfolio construction and performance analysis.

Keywords: *premium selling, performance analysis, delta, Chinese option market*

1. Introduction

1.1 Idea of Strategies

Definition: The term “premium selling” refers to selling options.

The basic idea of premium selling is to sell out of the money puts and calls, form a delta-neutral portfolio. Making money by collecting premiums from both sides and undertaking risk from extreme movement of underlying assets[1,2] The research background of this strategy comes from the release of Chinese 300ETF in 2019, which gives the investors more choice in participating in Chinese option market

This paper will backtest the traditional premium selling strategy and perform attribution analysis.

1.2 Highlights (strategy overview and performance estimate)

Economic intuition (alpha source / what money this strategy wants to earn from market?)

Based on the supply and demand of option, there are always natural buyer in the market to hedge their delta risk, which means premium can be earned in the natural sense by performing risk management strictly.[3]. As showed below, Figure 1 shows the PnL performance of short strangle strategy theoretically, which is a trapezoid shape curve. Two sides means that the market face tail risk, extreme situation.

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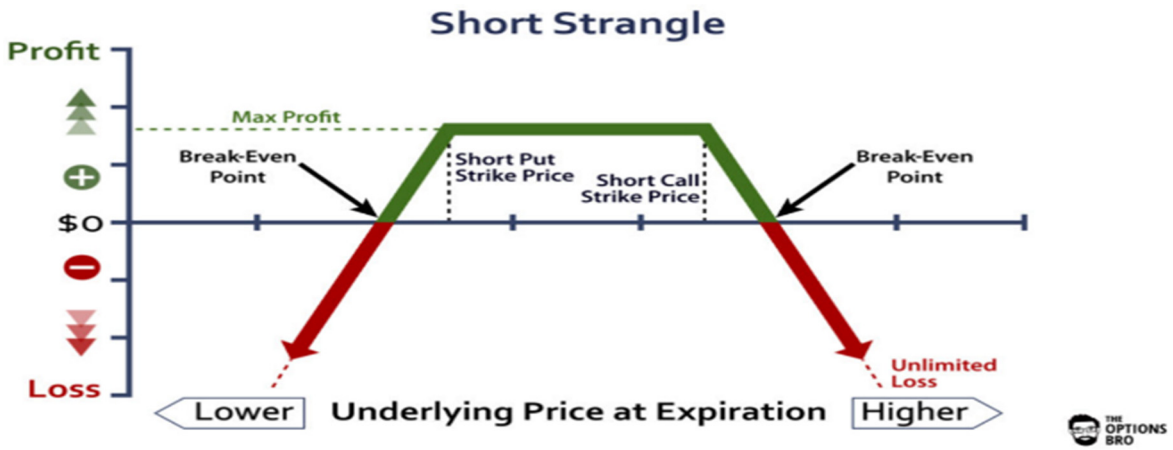

Figure 1 Short Strangle PnL Graph

1.3Signal Generation in sentence

1.3 find out the option with preset target delta (e.g., 0.3 for call), calculate the historical volatility of underlying assets, our predicted return of each option would be current market price of option with target delta minus the theoretical price of option with historical volatility which share the same underlying, same expiration and same strike price with the previous option. [4]

1.4 Portfolio Construction in sentence:

As discussed in class, ($call\ delta = 0.3$, $put\ delta = -0.25$) or call ($delta = 0.4$, $put\ delta = -0.35$), these are the trigger or the threshold of premium selling strategy.

Trading frequency is set to be weekly reallocation of portfolio. Daily delta hedging of our portfolio will be performed. which means number of calls and number of puts times their respective delta should sum up to zero. This concept is deemed as *delta-neutral unit* which means the least combination of calls and puts to set the portfolio delta to be zero. Previous trigger (0.3-0.25) or (0.4 – 0.35) tells which puts or calls should be traded.

This paper will use 80% of gross notional to initiate the trading position. (Since investor are short side of option, who must pay margin) which can be deemed as the cash occupied for trading. Strategy participator equally allocate the cash occupied to option strangle with underlying of 50ETF and underlying of 300ETF. Finally, dividing the cash occupied of each stock index underlying (40% of gross notional) to the total margin of the delta-neutral unit, investor can get the exact number of calls and puts should be traded in short position

1.5 Performance Estimate (guess first):

For premium selling, Since the common sense that "one day of volatility fluctuation" will eliminate your whole year's return. So, first guess the max drawdown rate may be 10% a day. The annual return may be 10%, the volatility of this strategy may be 5%. (Vol should be low of short selling, we earn premium gradually) Considering the risk-free rate to be 3%. The final shape ratio may be 1.2

2. Specification

2.1 Qualitive Analysis:(Economic Intuition)

This "Premium Selling Strategy" is a limited profit, unlimited risk options trading strategy by selling nearby call with a higher strike price and selling nearby put with a lower strike with the same underlying and the same expiration date. Where options trader bet on that underlying asset will experience little volatility in the near term, profit from collecting premiums on both sides and risk from obligation to fulfill an unfavorable transaction when spot price hit the strike. Above concepts was summarized as "short strangle" in industry.

There is so-called 'natural buyer' in the market served as the demand of option, for the sake of hedging delta, which can be regarded as purchasing insurance to protect their in-hand assets. But there are not always supply of option in the market to meet the needs of the buyer. So there forms a surplus for investor to earn the premium, which can be also regarded as saying option are always overpriced.

2.2 Quantitative Analysis:(Statistics to be used)

Return – measure how much can be earned by this strategy on average within a year

Volatility – measure how volatile the strategy performance could be

Max Drawdown – measure how large the loss may be faced when apply this strategy

Sharpe Ratio – measure the excess return with regard to risk

2.3 Data used in strategy back testing

2.3.1-Universe

Nearby Chinese Stock Index Option with underlying of 50ETF and 300ETF will be choose as Strategy Universe. – (both are European style Option)

2.3.2-Datasets

Below "features" of universe assets will be used to build strategy SQL database column

-trading_day (8-digit, type: date e.g., 2019/02/15)

-option_code (type:str e.g., 10021151.SH)

-option_name (type:str e.g., 50ETF_CALL_June_2600)

-option_price (type: float e.g., 2500) including the open high low close 4 prices

-option_multiplier (type:int eg10000 as one lot)

-option_margin (type: float in %form e.g., 10%)

-risk-free rate (type: float in %form e.g., 3%)

-option_delta (type: float)

-option_gamma (type: float)

-option_vega (type: float)

-option_theta (type: float)

-option_IV (type: float)

-option_Strike (type: float)

-option_time_to_maturity (type:int eg15)

-option_Exchange_commission_fee (type: float in %form e.g., 0.1%)

The reason I choose these price data and risk data (Greeks) is that we will use these data to calculate PnL of my strategy and perform a daily market to market risk management.

2.4 Data Source (where to get these data)

1)WIND-API Database

2)SSE Shanghai Stock Exchange official website（ where China Stock Index Option is released

http://www.sse.com.cn/assortment/options/price/）

Not hard to get daily option data

2.5 Data Ranges for backtest

Full data range is past five year start from spring festival till now: 2016/02/01 to 2021/10/08

In The Sample data range is: 2016/02/22 – 2020/02/17

Out of Sample data range is: 2020/02/17 – latest trading from now

Full data range consists of bull market and bear market of stock index, which can be showed in the sample data, (Full Life Cycle of strategy, face both favorable and unfavorable environment) which means the backtest of strategy will experience both high volatility and low volatility environment, fair enough.

For the reason out of sample data to choose is that the work want to see whether it works well this coming year.

2.6 *Strategy Details- Signal Generation*

Black-Sholes-Merton Model

$$\textbf{Call} = \boldsymbol{S0N(d1) - Ke^{-rt}N(d2)}$$
$$\textbf{Put} = \boldsymbol{Ke^{-rt}N(-d2) - S0N(-d1)}$$
$$\boldsymbol{d1} = \frac{\boldsymbol{ln\left(\frac{S0}{K}\right) + \left(rf - q + \frac{\sigma^2}{2}\right)T}}{\boldsymbol{\sqrt{T}}}$$
$$\boldsymbol{d2 = d1 - \sigma\sqrt{T}}$$

where:

$$\boldsymbol{C = Call\ option\ price}$$
$$\boldsymbol{S0 = Current\ stock\ (or\ other\ underlying)\ price}$$
$$\boldsymbol{K = Strike\ price}$$
$$\boldsymbol{r = Risk - free\ interest\ rate}$$
$$\boldsymbol{T = Time\ to\ maturity}$$
$$\boldsymbol{N = A\ normal\ distribution}$$
$$\boldsymbol{\sigma = annualized\ volatility}$$

Formular 1 Black-Scholes-Merton (BSM) pricing model

above known as the Black-Scholes-Merton (BSM) model, is one of the most important concepts in option pricing theory, this article uses Formular 1 for European-style option pricing theoretically.

Historical volatility = annual standard deviation of return of underlying stock index asset

$$= \frac{1}{\mathrm{n}-1}\sum_{k=1}^{n}(Ri - mean(R))^2$$

Formular 2 historical volatility calculation formular

$$Predicted\ Return = Market\ price\ of\ option\ with\ target\ delta\ (\text{e.g., } CALL^{Delta=0.3}) - Theoretical\ price\ of\ option\ with\ historical\ volatility = \boldsymbol{BSM\ (IV|S,K,t,T,r) - BSM\ (HV|S,K,t,T,r)}$$

Formular 3 Predicted Return calculation based on volatility side

Before further research, this paper try to estimate the predicted return(signal) of premium selling strategy, thus defining the historical volatility in formular 2 and

calculate out implied volatility used numerical method, try to find out the theoretical gain of option selling in formular 3

2.7 Portfolio Construction

Delta-neutral Principle (Daily delta hedging criteria for short strangle):

$\Delta(put) * \#(put) + \Delta(call) * \#(call) = 0$
(this gives the amount ratio of single delta-neutral unit)

Total Margin for delta-neutral unit = Amt(call) * Margin of call + Amt(put) * Margin of put

(Equally Weighted)

$Total\ Cash\ Occupied = 80\% * Gross\ Notional$
(Leave 20% for possible margin call)

$Cash\ Occupied\ for\ 50ETF\ strangle = Cash\ Occupied\ for\ 300ETF\ strangle = Total\ Cash\ Occupied/2 = 40\% * Gross\ Notional$

$Number\ of\ 50ETF\ calls\ and\ 50ETF\ puts\ in\ portfolio = Cash\ Occupied\ for\ 50ETF\ strangle / Total\ Margin\ for\ 50ETF\ delta-neutral\ (30-25\ or\ 40-35)\ unit$

$Number\ of\ 300ETF\ calls\ and\ 300ETF\ puts\ in\ portfolio = Cash\ Occupied\ for\ 300ETF\ strangle / Total\ Margin\ for\ 300ETF\ delta-neutral\ (30-25\ or\ 40-35)\ unit$

Trading Frequency: Weekly

Hedge Frequency: Daily

(Please be aware that Chinese 300ETF stock index option first released on Dec 23rd 2019，before that the backtest work cannot equally assigned cash occupied to these two different underlying)

2.8 Trading Execution (transaction cost)

Fill cost: bid ask spread (lowest sell – highest buy) *amount (in lots unit)

Commission cost: total option value (put or call) * commission rate (put or call) approximately 12 for each option to initiate or liquid

Opportunity cost: money occupied (option value * margin rate) *risk-free rate (one year treasure bill int rate eg 2.1% in China)

Latency cost + impact cost: setting to 1/10000 each time when investor readjust the portfolio every time. Since strategy participator cannot initiate trade at the ideal open price case, always face some cost – (hard to measure) [5,6]

3. Implementation (Backtest results)

3.1 in the sample (ITS) data backtest result

ITS means in the sample

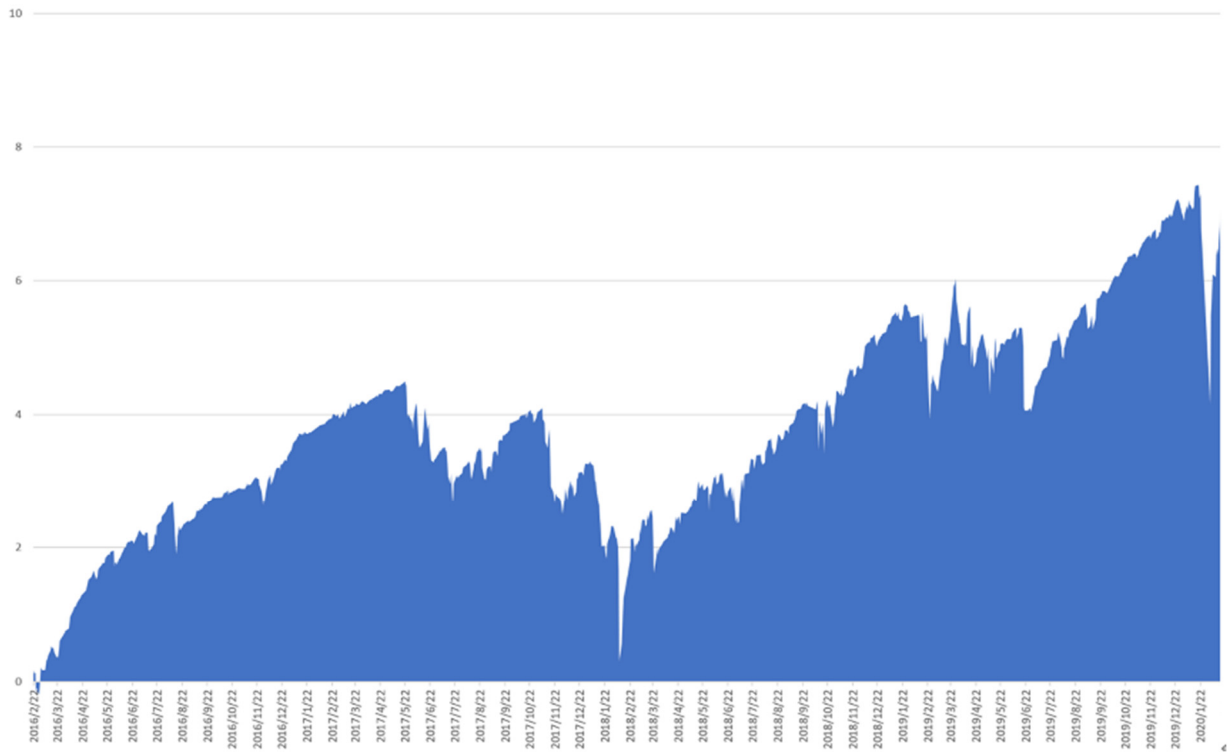

Figure 2 Short Strangle (0.3-0.25) _ITS Cumulative PnL Graph

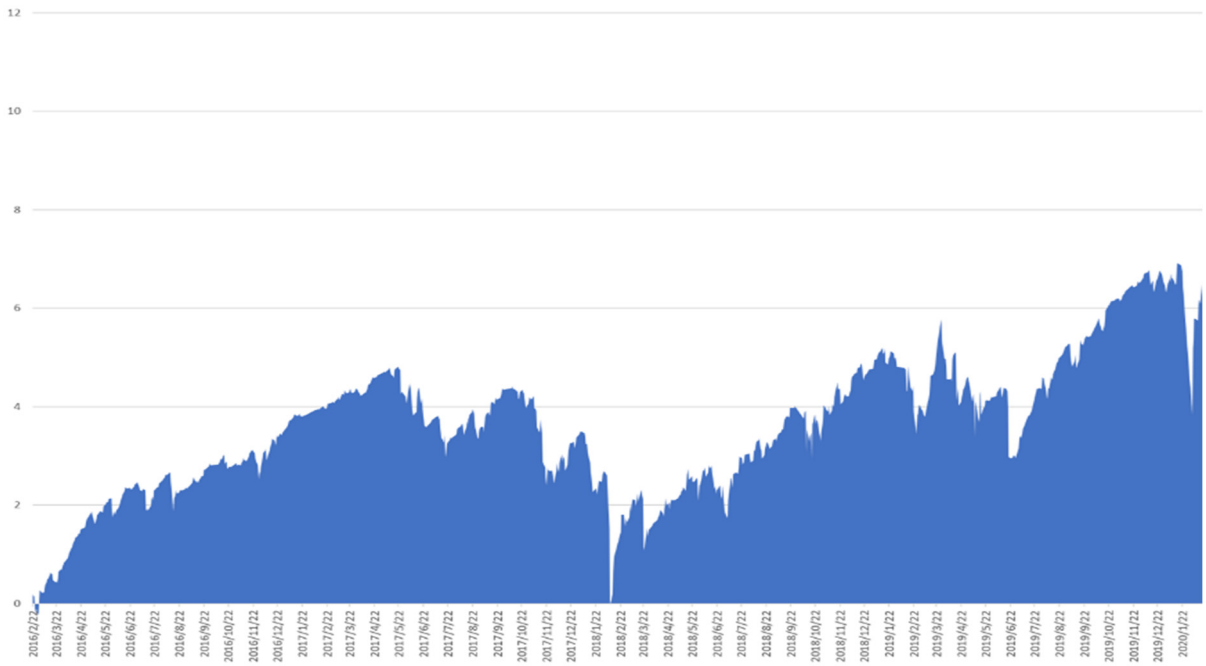

Figure 3 Short Strangle (0.4-0.35) _ITS Cumulative PnL Graph

The investor should focus on the simple cumulative PnL result first to have a basic idea of strategy performance, as showed in Figure 2 and Figure3. The same strategy using different parameter (delta difference) perform almost same in in the sample date range (x-axis from 2016/02/22-2022/01/22) ITS, the y axis of these two graphs is percentage (%). Reader can at least have idea that the summed-up result is positive.

Figure4 Delta (0.3-0.25) ITS cumulative Net Value Line

Figure5 Delta (0.4-0.35) ITS cumulative Net Value Line

Figure6 comparation of two cumulative ITS Net value line

If investors have a brief view of cumulative simple return, next move to net value line, which means that investing 1 dollar at first, as time goes by, how much will be earned at the end of time, Figure 4 5 6 give us the basic idea of strategy return in ITS date range. After full round of backtest, below Table 1 present the backtest result of ITS (in the sample) data, with Sharpe ratio to be around 0.5 and volatility to be 3%, seems to be an acceptable result for quant fund as a sub-strategy.

Table1 Backtest results of Short Strangle Strategy In the sample

ITS Statistics	Strangle (30-25)	Strangle (40-35)
Return	7.89%	7.25%
Volatility	3.22%	3.34%
MaxDrawdown	-4.6%	-4.9%
Sharpe	0.46	0.43

3.2 out of the sample (OOS) data backtest result
OOS means out of the sample

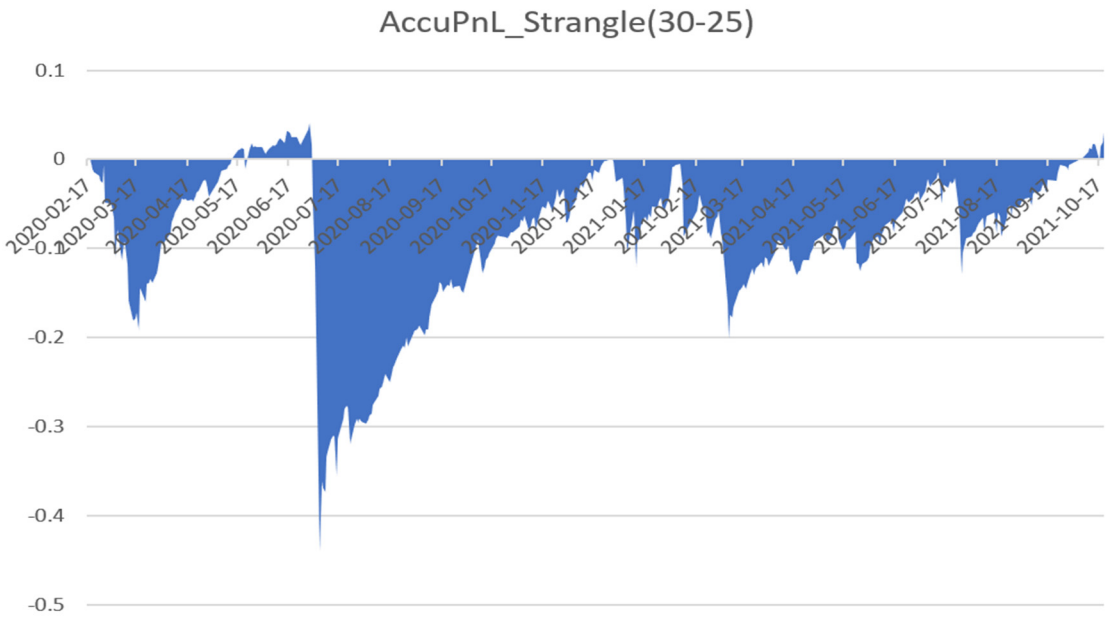

Figure 7 Short Strangle (0.3-0.25) _OOS Cumulative PnL Graph

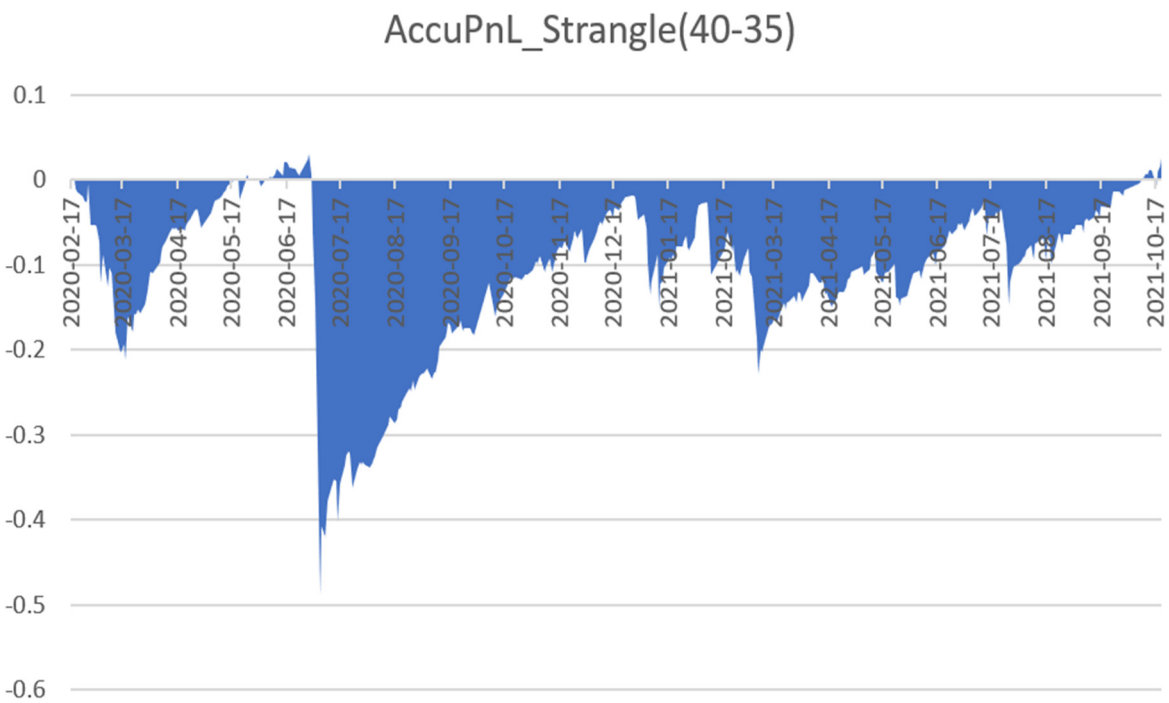

Figure 8 Short Strangle (0.4-0.35) _OOS Cumulative PnL Graph

The result in Figure7 and Figure8 measures the cumulative PnL in OOS date range, not like Figure 2 and Figure 3, summed-up result was close to zero, which means there are strong probability that short strangle strategy met the “black swan”.

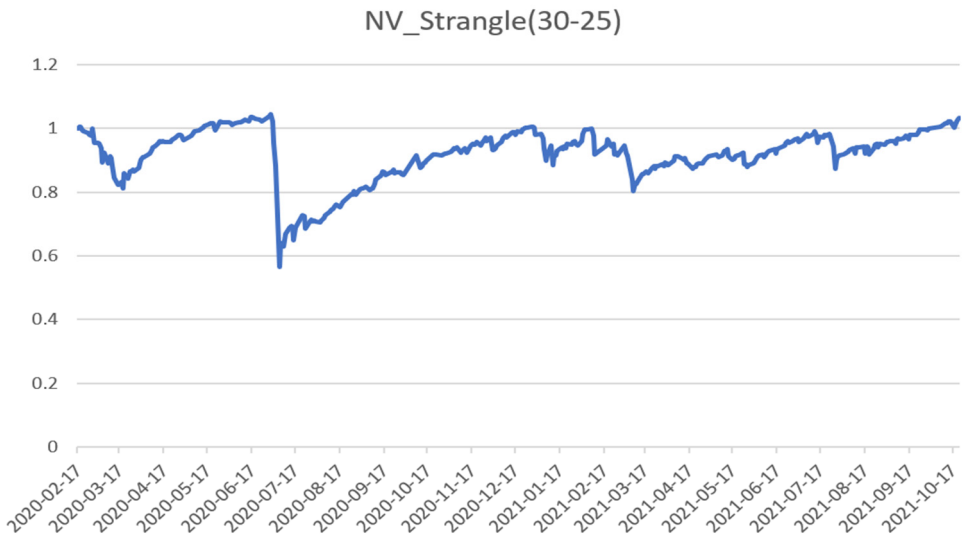

Figure9 Delta (0.3-0.25) OOS Net Value Line

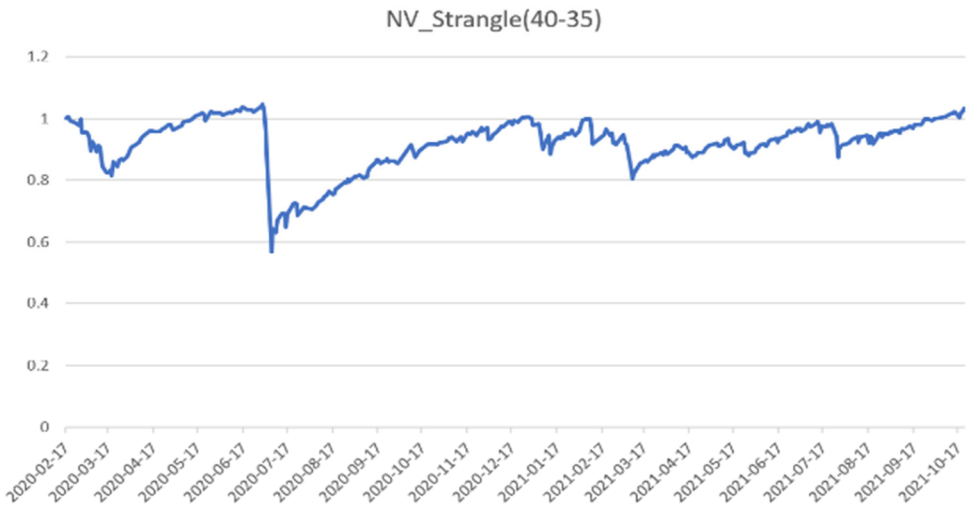

Figure10 Delta (0.4-0.35) OOS Net Value Line

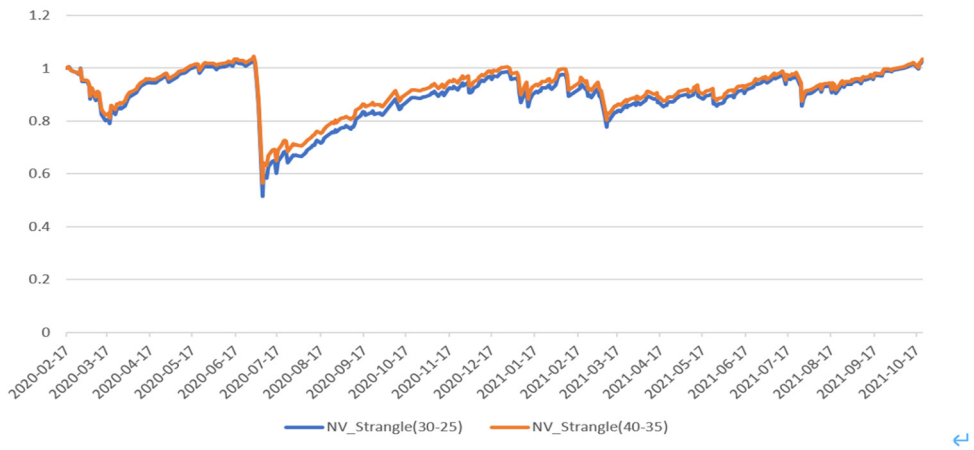

Figure11 comparation of Short Strangle Net Value line

Figure 9,10,11 shows the net value lines of short strangle strategy using different parameter, which seems to make sense since cumulative PnL is close to 0, leading the net value to be nearby 1. After full round of backtest, Table 2 below shows the full result of OTS (out of the sample) data, since it is including the “black swan” situation. The results seem quite horrible, which leads an improvement motivation for investor to use this premium selling strategy, which will be discussed later in this work.

Table2 Backtest results of Short Strangle Strategy Out of the sample

OOS Statistics	Strangle (30-25)	Strangle (40-35)
Return	2.52%	3%
Volatility	16.02%	16.57%
MaxDrawdown	-47.6%	-45.9%
Sharpe (set r =0)	0.16	0.171

4. *Strategy Refinement*

4.1 Strategy Refinement:(Iron Condor) introduced to avoid the disadvantage of short strangle (premium selling)

Definition: An iron condor is an option strategy consisting of two puts (one long and one short) and two calls (one long and one short), and four strike prices, all with the same expiration date. Figure 12 below shows the PnL graph of Iron Condor strategy [7].

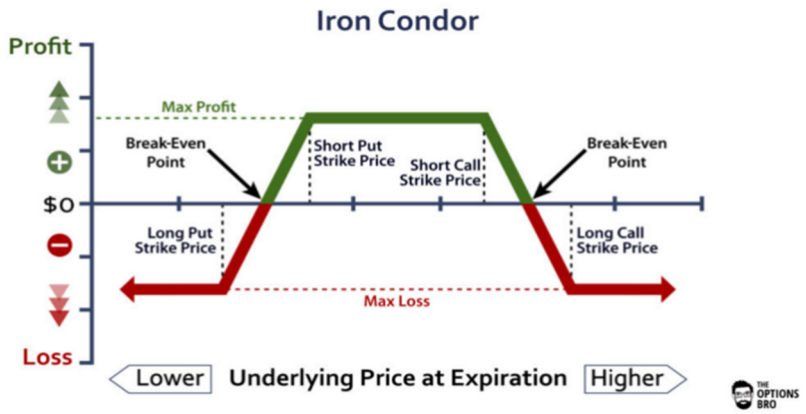

Figure12 PnL performance of Iron Condor strategy

Back test Result: (for short position of IronCondor, the strategy uses same delta as strangle (eg 0.3-0.25) for the long position of IronCondor, here below in Figure 13 ,14, 15pick up the cheapest option to purchase) Return :0.0521 vol:12.3% max drawdown: 21.4% sharpe:0.22[8]

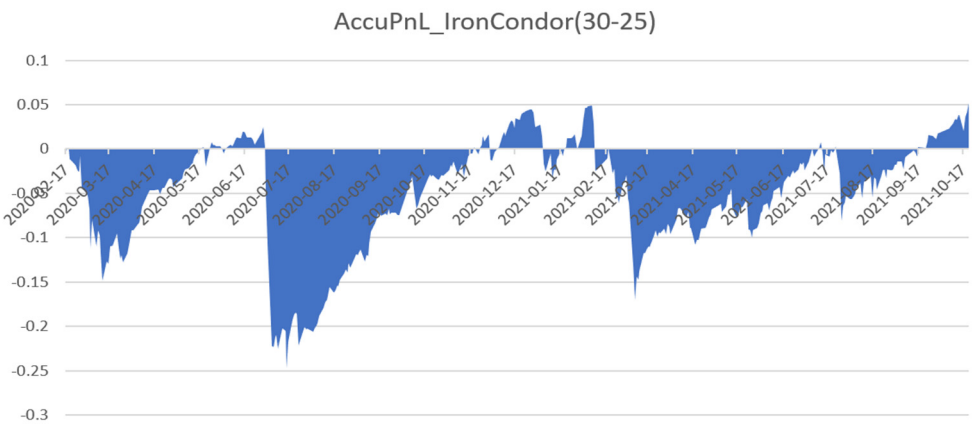

Figure13 IronCondor (0.3-0.25) _Cumulative PnL(simple return%)

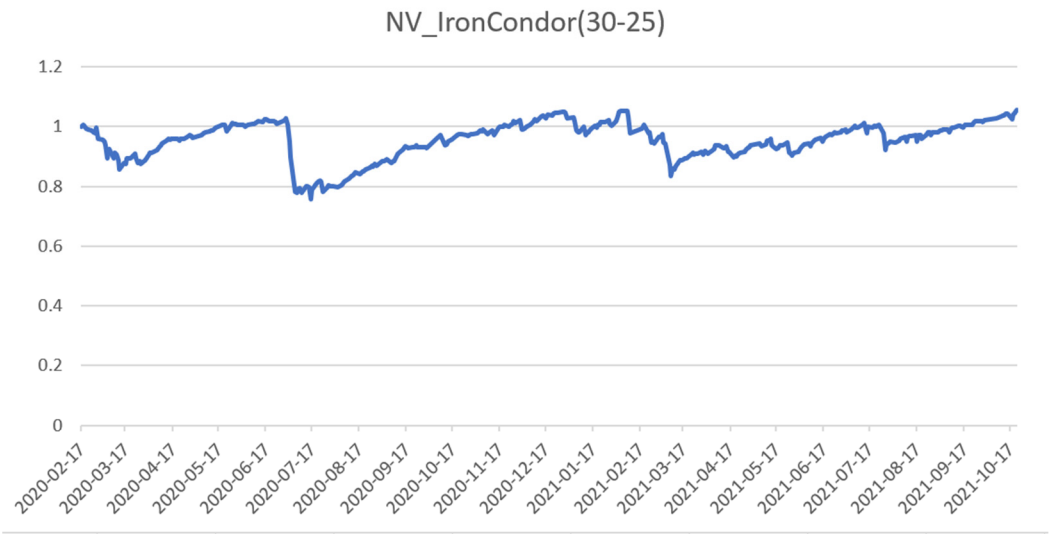

Figure14 Delta (0.3-0.25) Net Value Line

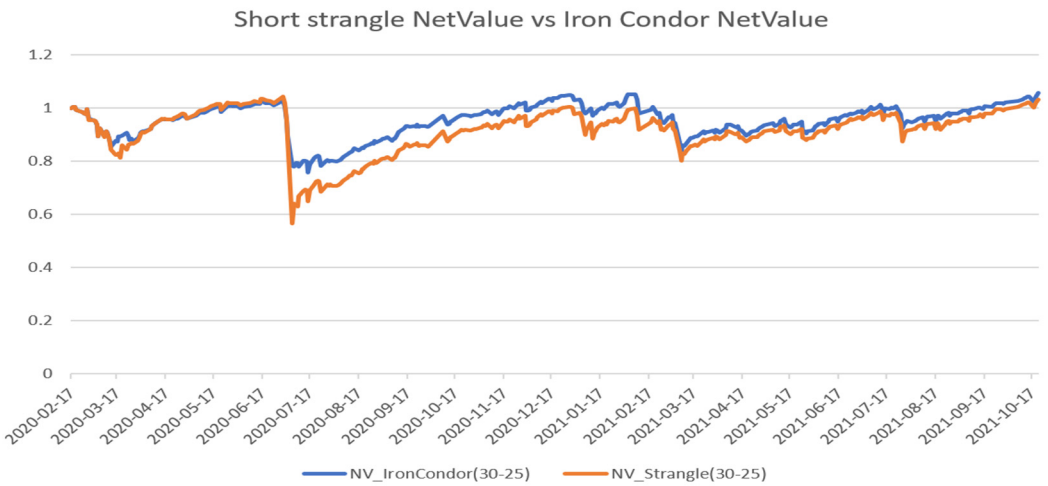

Figure15 the comparation of Net value line btw IronCondor and Short Strange

4.2 Additional Considerations:

4.2.1 Underlying Correlation analysis

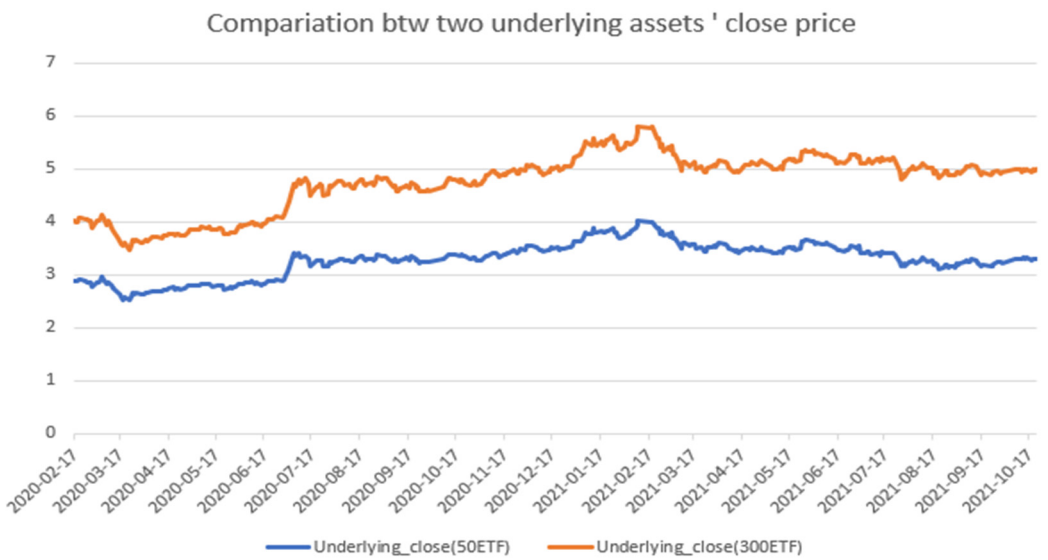

Figure16 the comparation btw two underlying assets ‘close price (50ETF and 300ETF)

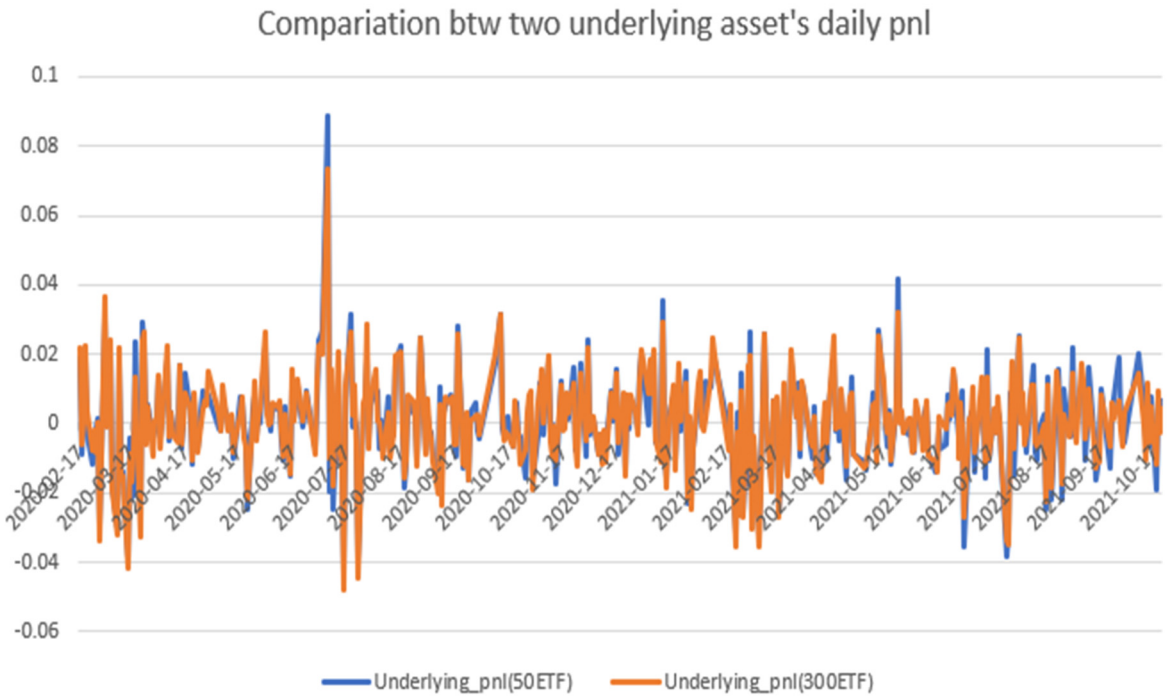

Figure17 the comparation btw two underlying assets 'daily PnL (50ETF and 300ETF)

As can be seen above (Figure 16 and Figure 17), the underlying price movement of 300ETF and 50ETF are quite the same thing. This is mainly because the stock universe in 50ETF was also included in universe of 300ETF, these two things are the "core assets" (large net worth, industry tycoon) of Chinese Economy, the performance attribution of 300ETF mainly come from performance of 50ETF. In out of sample time period, the mutual fund investor and other institutional investor huddle together to seek "safety asset" to survive through "covid 19" crisis. Large amounts of money surged into the "main asset" 50ETF for safety. Which also support our "equal weight" decision, two underlying assets has strong correlation almost close to 1 [9].

4.2.2 PnL Attribution

$$\begin{aligned} &PnL\ Attribution\ formular \\ &= -1 * (Theta * d(t) + Delta * d(s) + Vega * d(V) \\ &\quad + 1/2Gamma * d(s)^2) - commission\ fee \\ &= time\ decay + price\ movement + volatility\ movement \\ &\quad + delta\ movement - commission\ fee \end{aligned}$$

(Delta-neutral and we neglect the influence of Rho, assume risk-free rate keep the same)

Table 3 The major influences of long position option value

Options	Increase in Volatility	Decrease in Volatility	Increase in Time to Expiration	Decrease in Time to Expiration	Increase in the Underlying	Decrease in the Underlying
Calls	+	-	+	-	+	-
Puts	+	-	+	-	-	+

Table 3 just give investors a clear view that how risk measures like Greeks impose influence on final portfolio PnL. For premium selling case, just present the opposite sign in that table. Since premium selling portfolio holding option assets in short position.

Now look at strange (30-25) attribution analysis using Greek system:

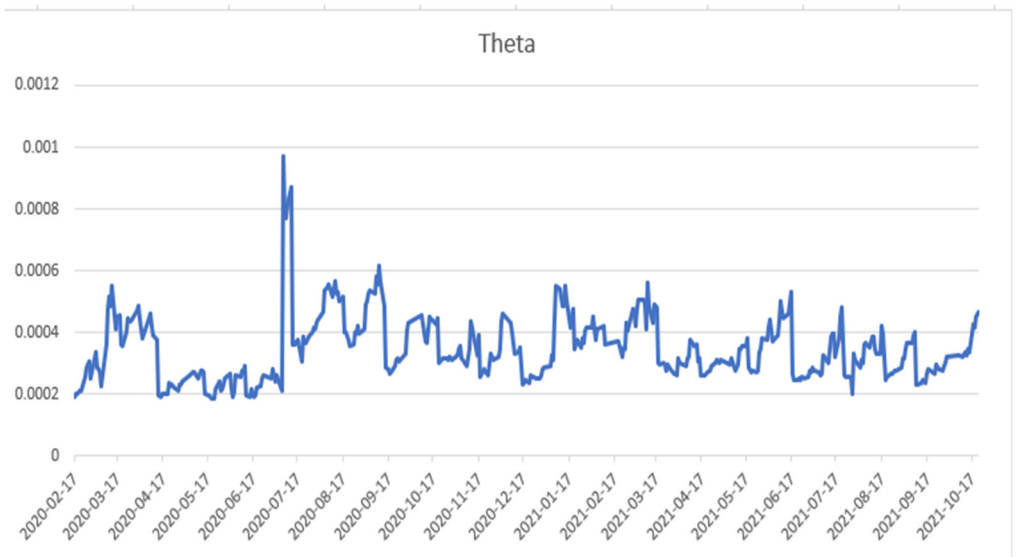

Figure 18 the risk measure (Theta) of short strangle strategy in full data range

As we can see from Figure 18, since premium selling strategy holds short position on options, theta remain positive which means that time is friend of this strategy

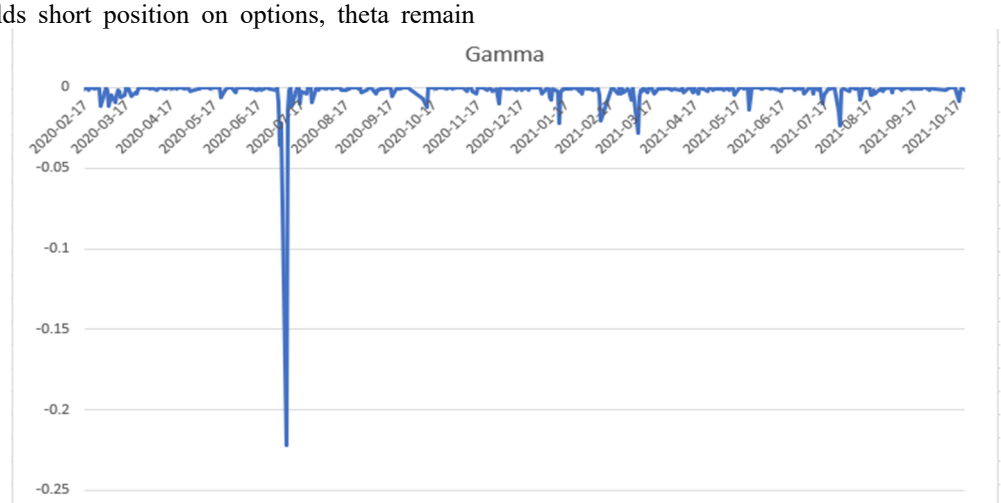

Figure19 the risk measure (Gamma) of short strangle strategy in full data range

As we can see from Figure 19, since premium selling strategy holds short position on options, gamma remain negative

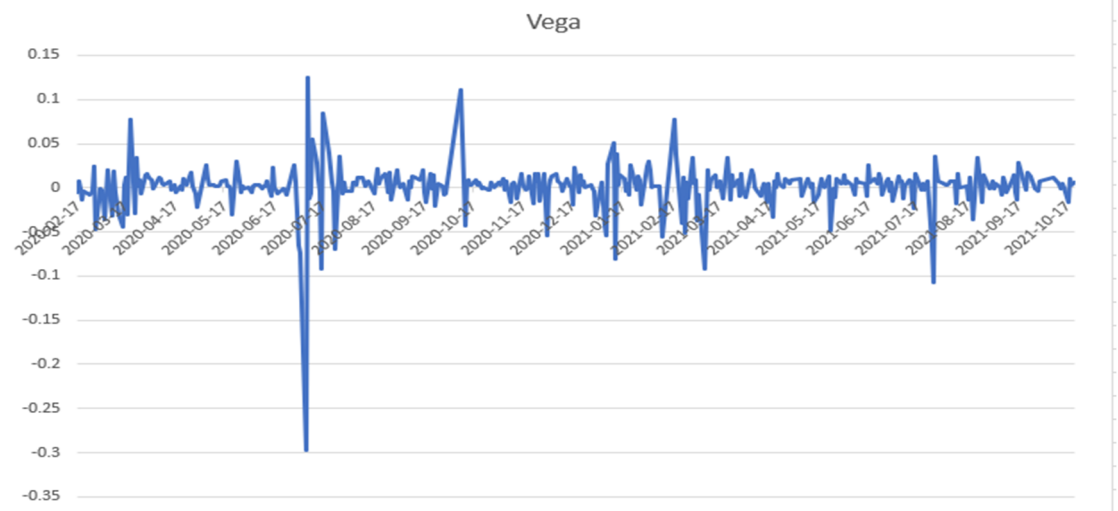

Figure 20 the risk measure (Vega: influence of volatility) of short strangle strategy in full data range

As can be seen above, for short strangle: $portfolio\ gamma < 0\ in\ Figure19$ $portfolio\ theta > 0\ in\ Figure18$, the only thing not sure is Vega in Figure20, which contribute most of the PnL of our strategy, and that's also the reason why somebody call "premium selling" as "volatility selling". We should do further research on "volatility". Such as build our own "implied volatility index" and try to predict future volatility based on historical volatility [10].

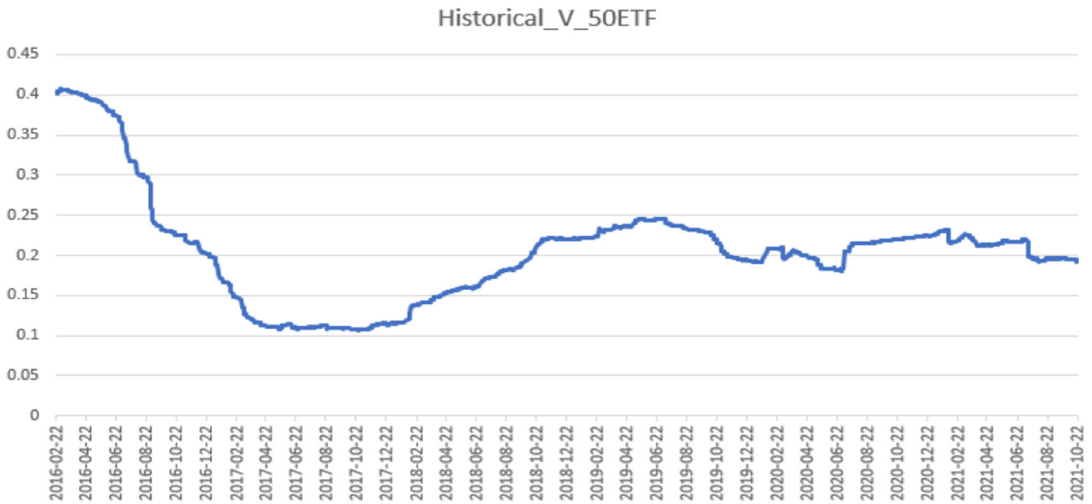

Figure 21 the historical volatility of underlying asset(50ETF)

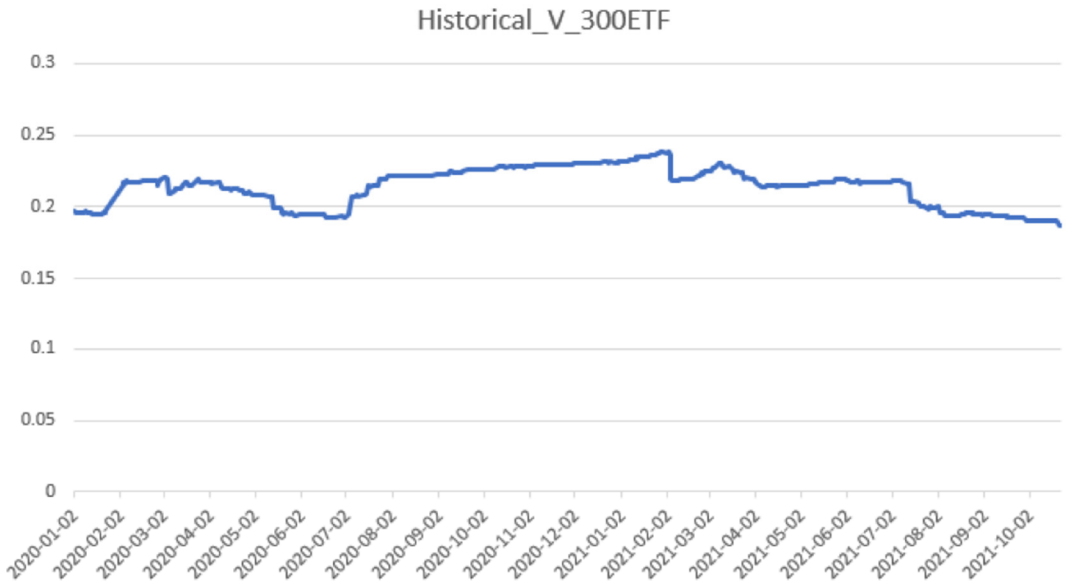

Figure 22 The historical volatility of underlying asset(300ETF)

Recall from the signal generation part, in this work, predicted return is based on historical volatility (HV) and implied volatility (IV), Figure21 and Figure22 shows their fluctuation and correlation

5. Conclusion

The investors should trade this strategy in most case and should perform strict risk management. As can be seen from the out of sample back test results, the strategy met the "black swan". Two things should be considered in Chinese market is the "calendar effect" of option, which means after vocation, the volatility of stock may extremely rise, market timing sometimes is important for this strategy. Second thing is how to avoid "one day's extreme movement of volatility". The first thing can be solved by performing "volatility index research" as the market timing index. Second thing can be solved by using "spreads" (IronCondor Strategy), which may decrease our revenue of premium selling, but give some protection on the short position for investors.

Acknowledgement

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Then, all authors of this thesis made significant and constructive contributions to some parts of the paper. For example, Siyun Li spend a lot of time to finish the code, Chengxuan Liu contribute to the supplement and improvement of the strategy and Weicong Liang search and analyze all the data. So we decide that we are all co-first authors of thesis.

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