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The Simple Long Volatility Trade

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Abstract

Based on the fact that researchers are only just beginning to address the question of what we mean precisely by risk or volatility, and how best to model it, investment opportunity is clearly indicated. This opportunity reflects the potential for generating abnormal returns through identifying and executing trades based on volatility. The evidence to support this in favors of traditional portfolio strategies is that volatility processes are eminently more persistent and forecast able than asset return processes. Following this, there is a view that volatility arbitrage is likely to prove one of the most fruitful investment opportunities in the next decade, providing adequate means can be found to describe and model the underlying process.

Keywords: Volatility trade; Investment opportunity; Traditional portfolio

Introduction

Based on the fact that researchers are only just beginning to address the question of what we mean precisely by risk or volatility, and how best to model it, investment opportunity is clearly indicated. This opportunity reflects the potential for generating abnormal returns through identifying and executing trades based on volatility. The evidence to support this in favors of traditional portfolio strategies is that volatility processes are eminently more persistent and forecast able than asset return processes. Following this, there is a view that volatility arbitrage is likely to prove one of the most fruitful investment opportunities in the next decade, providing adequate means can be found to describe and model the underlying process.

I) Asset class: FTSE-20 index futures, options on the FTSE-20 index

ii) Strategy: Volatility Arbitrage

While standardized exchange traded options only started trading in 1973 when the CBOE (Chicago Board Options Exchange) opened; options were first traded in London from 1690. Pricing was made easier by the Black-Scholes-Merton formula (usually shortened to Black-Scholes), which was invented in 1970 by Fischer Black, Myron Scholes and Robert Merton [1].

Literature Review

Despite their importance to well-functioning derivative markets and their popularity among option traders, volatility trades have received little attention in the financial research literature. While every derivatives textbook discusses such volatility trades as straddle, strangle and butterflies, to my surprise there was no paper devoted to their design or trading. Furthermore, to my knowledge no one has used real time data to construct a volatility trade portfolio in practice, assuming transaction cost and margin requirements. Without a doubt, the most important "imperfection" of real financial markets is the existence of transaction costs. Broadly speaking, transaction costs create bounds around the theoretical price within which the market price may fall without giving rise to a profitable arbitrage or volatility trade, large enough to cover the cost of exploiting it [2]. The main scope of this paper is to fill this gap by examining Volatility Trades on a recently established market, the Athens Derivatives Exchange. In the following chapters we will introduce some of the market's most liquid products and the common practices used by major financial institutions acting as market-makers/traders in the ADEX.

Volatility Trading vs Traditional Investment

In considering traditional investment most of the people think of stock or equity. Whether an investment on a stock or equity will produce profit or not, depends on the direction of the market. If the stock rises then the investor can capitalize on this price and accumulate the profits. On the other hand if the price of the stock falls the investor is accumulating losses. Only by using derivative products the investor could establish a short position and benefit from the falling prices. In both cases the investor has to have a clear view on the direction of the price [3].

Most fund managers will agree that despite the progress made in technical and fundamental analysis, view takers can hope to be on the winner side more times 4 than they lose.

On the other hand volatility trading offers another dimension to investing, which is trading the volatility of the price and not the direction. The volatility trader is not interested in whether the price is going to rise or fall; since he can benefit from both and can almost completely ignore the first dimension. He is primarily interested in whether the market is going to be volatile or not. The very position of the volatility trader is based on exploiting the volatility of the portfolio constructed. In order to do this, the portfolio will have to be fully hedged and this way has no exposure to the market. This is a crucial point to the volatility trade when constructing volatility portfolios. The most attractive feature of trading volatility is that, volatility portfolios often produce gains at times when directional strategies are performing poorly. For this purpose, in the following section we will introduce the concept of volatility and introduce its numerical and statistical significance.

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Volatility

Almost everyone has a concept of volatility when used in connection with finance or investment. For example, volatile markets or stocks involve higher risk since volatility is used as a measure of uncertainty about the returns provided by the stock or the market.

Measuring volatility: The volatility of a price series is a measure of the deviation of price changes around the trend. One use of the volatility measure is to make probability statements about the approximate likely range of the range of the stock price in the future. According to the strict mathematical terminology, volatility represents the standard deviation of the lognormal distribution. If a volatility of a series is x%, then in one year's time:

- 68.30% of all stock prices that are expected to occur under the lognormal distribution within the limits set by the mean +/- one standard deviation (volatility) are covered.
- 95.40% of all stock prices that are expected to occur under the lognormal distribution within the limits set by the mean +/- two standard deviation (volatility) are covered.
- 99.70% of all stock prices that are expected to occur under the lognormal distribution within the limits set by the mean +/- three standard deviation (volatility) are covered.

Different types of volatility

When discussing volatility we have to be aware that there are different types of volatility. To avoid confusion, we should look at the different types and their main characteristics.

Future volatility: This is the type of volatility every market participant would like to know, because it describes the future fluctuation of stock prices. If we knew a way of exactly determining the future volatility, we would be in a position to calculate correctly the theoretical options price applicable in the future already today. This information edge would among other things; enable a trader to sell overpriced options and buy underpriced ones.

However, since market participants cannot foretell the future, they are equally dependent on forecasts when it comes to determining future volatility. Many different models have been developed for this purpose although the pace of theoretical development has slowed somewhat in the last decade.

It should be noted that Economists have become increasingly intrigued of late by the possibilities afforded by the high frequency data. The key point is that precise estimation of volatility does not require long spans of data, but volatility can be measured arbitrarily well from return series that are sampled sufficiently frequently. The tendency towards the use of high frequency data to construct volatility estimates is now becoming standard research practice.

Historical volatility: Historical Volatility on the other hand is the volatility that can be calculated by the price series of the past. The purpose of this paper is to provide a detailed analysis of volatility.

The importance of historical volatility is that this volatility is used for the fair pricing of an option as input in the Black-Schools formula to calculate the fair value of an option as shown in Figure 1.

Implied volatility: Historical as well as future volatility are associated with the price of the underlying and say something about how the prices of the underlying are distributed over time. On the other hand, a different type of volatility, the implied volatility, is derived from the option price itself.

In Figure 2, the calculation method for deducing the implied volatility from an option's price in the market is presented.

Outline of this dissertation

In starting we begin with an introduction to the notion of the simple Long Volatility Trade. This chapter explores the meaning of volatility trading as well as provides numerical examples of the long volatility trade using puts or calls. We then present the sensitivities of the long volatility trade to parameters affecting its returns. Finally, in order to illustrate the profitability of such trades, we construct a long volatility portfolio using at-the-money puts and evaluate its performance when transaction costs and margin requirements are taken into account. In mid we investigate the price profile of the Short Volatility Trade. We begin by illustrating how a short volatility portfolio can be constructed in order to exploit the lack of volatility and illustrate where the profits of this trade come from. We continue by presenting how time decay and volatility affects the profits of this trade and construct a short volatility portfolio for this purpose. The return of this portfolio is then evaluated. By using real-time data from the settlement prices of the Athens Derivative Exchange, the profitability of the long and short

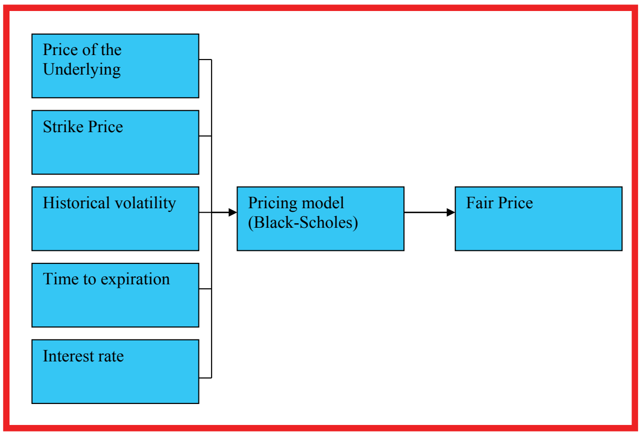

Figure 1: Historical volatility.

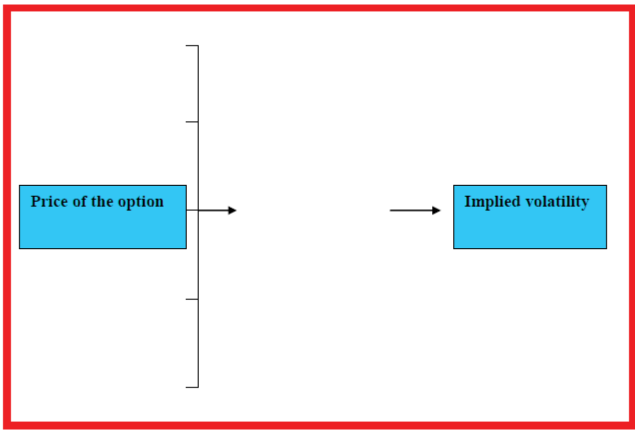

Figure 2: Implied volatility.

volatility trading scenarios are compared. The effect of transaction costs and margin requirements in these returns is also illustrated.

We explore the use of combinations of options of different series in volatility trading. Following this, we illustrate the price profile and sensitivities of the commonly used volatility strategies to parameters such as theta and Vega. We conclude by implementing trading scenarios using at-the-money straddles and strangles and examine their returns. This way the reader can compare the performance of the two trading strategies with the returns produced by the simple long and short volatility trade. We identify the functional requirements in order to build a prototype volatility trading system. We continue by introducing the limitations and constraints of the system under development. We introduce the concept of Visual Modeling and graphically illustrate the business domain of the volatility trading system using a class diagram. We document the decision of using Rapid Application Development in constructing the prototype and employ the Dynamic Systems Development Method to develop that prototype. Finally we illustrate the prototypes conceptual level using the entity relationship diagram.

The simple long volatility trade

Outperforming index portfolios: In this chapter we will examine the profile of one the most straightforward volatility trade in the market [4]. The trade consists of a long position in a call option and shorts the underlying instrument in such a ratio in order to achieve delta neutrality. It is due to the curved profile of options that a volatility trade can profit in a rising as well as a declining market. The ratio of two options to one future is dictated by the delta of the at-the-money call, discussed in later chapters. The profile of this trade is presented Profit/Loss in index points as mentioned earlier the profit of the trade comes from the different rate of increase/decrease of the price of the option responding to changes in the underlying asset. As the index rises the option price outperforms the loss from the short position in the future. In a decreasing market, the short side of the future outperforms the decline in the options price, thus producing profit to the volatility trader. In a nutshell, the option portfolio outperforms the future portfolio both in the rising as well as the declining market.

The simplest and most straightforward way of benefiting from this trade is to completely liquidate. Sell the option portfolio and buy the futures in the index to close the two positions set at start point. However, there may be still profit to be made in this trade providing the market continues to be volatile and the investor wishes to capitalize on the option price curvature. By rehedging his position (ratio of option to futures) the investor can not only lock his profit, but also continue to benefit from volatility, without having to exit his position or set up another volatility portfolio.

It appears from our simplified approach that the above out performance will always be achievable by going long on options and short the underlying. The answer to this is that this is not exactly true, as we will witness later. It is the purpose of this chapter to show that several parameters and risks have to be taken into consideration for a volatility trade to be profitable. At this point it would be useful to define basis risk. According to Hull basis risk is defined as follows:

Basis = Spot price of asset to be hedged – Futures price of contract used

In a situation where we are short futures, a strengthening of the base could result in losses, even when the underlying asset exhibits increased volatility. Basis risk can thus easily affect the effectiveness of the rehedging process. According to the Value basis of the front-month contract, basis risk can be as high as 3 percent illustrating the risk associate with the trade and potential losses-profits resulting from the rehedging activity.

Another interesting parameter affecting the rehedging process should also be noted. According to practitioners acting as market-makers in the ADEX, profit and losses can often result from the difference between the implied volatility the ADEX uses to estimate the settlements price of all options and the volatility exhibited intraday (during the day) on which options have been bought or sold.

The price profile of the call: In order to further illustrate where the profits in a long volatility trade come from, it is necessary to examine the price profile of a call. For this we will have to examine what determines the value of a call and how this value changes over time.

The option sensitivities

An option’s price is sensitive, having a tendency to change in response to certain key variables. These key variables, called “the sensitivities” or “the Greeks”, measure a change in the price of an option or combination of options in response to a change in one of the key variables.

The Greeks (Delta, Gamma, Theta, Vega and Rho) enable, among other things:

- Prediction of a movement in an option’s price, given a change in a variable
- Calculation of the number of options required to hedge a change in a variable

Delta: At this point it would be useful to discuss delta, an important parameter in the pricing and more importantly in our case, the hedging of options. Being the first derivative of option price with respect to the underlying, the delta is represented by the formula: change in the option price Delta: change in the underlying price.

According to Hull’s definition: The delta of a stock option is the ratio of change in the price of the stock option to the change in the price of the underlying stock. It is the number of units of the stock we should hold for each option shorted in order to create a risk less hedge. Keeping this in mind, a risk fewer portfolios is said to be delta neutral, when having a delta equal to zero. The delta of a call option is positive and can vary between 0 and 1, whereas the delta of a put option is negative and can vary between 0 and -1.

Gamma: As described in the previous section, the trade profits from volatility are a result of the options curvature. And the price profile is only curved because of the kink to expiry. For a given index price move, say x%, the more curved the profile the more significant the rehedging profit. Curvature is so important in the option market that it has also been assigned a Greek letter –Gamma. Since the slope of the curve is the delta, the curvature is the rate of change of delta.

Gamma measures the rate of change for a given movement in the underlying price. Gamma compensates for the convexity of the near-day option value curve by measuring the rate at which delta changes for an identical change in the underlying value. It equals the increase in the delta of an underlying asset for every increase in the asset’s price. Having the following formula, gamma is the second derivative of the option price with respect to the underlying:

$$\text{Gamma} = \frac{\text{Change in option price}}{\text{Change in the underlying price}}$$

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Theta: The theta of a portfolio of options is the rate of change of the portfolio's value with respect to the passage of time *ceteris paribus*. In other words, it is the rate of change of the value of a portfolio with respect to a decrease in the time to maturity of the options in a portfolio.

Vega: Vega (ê) (actually a star, not a Greek letter), also known as kappa, measures changes in the option premium per 1% shift in volatility. Vega is always positive and maximum for at-the-money options, decreasing to zero for in the money and out-of the money options. It is the first derivative of option price with respect to volatility.

The sensitivity of options to volatility changes is similar to the sensitivity exhibited to time passage. Near-the-money options are most sensitive and deep out-of the money and deep in-the-money options are less sensitive. The importance of getting volatility right is illustrated. Rising volatility results in additional profits to the long volatility trader [5].

Additivity of sensitivities

Before proceeding to the trading simulations, it would be useful to present a special feature of the price profile of portfolio of options. In deriving the price profile of option portfolios, consisting by many different combinations of different options, weighted for position sizes, we simply have to add them together. This concept of price additively can be extended to even the most complex portfolios, containing large numbers of different series of calls and puts.

Deriving the price profile of a combination of options is very useful and with experience, most volatility players will have a fairly good idea even without the use of software.

Trading scenario

We have identified the trading opportunities in the Athens Derivative Exchange. In order to benefit from the underpriced options, we will perform a long volatility trade for the period from mid-September 2000 to October 2000. Instead of using at-the-money calls in order to construct our long volatility trade, at-the-money puts are preferred since they exhibit lower implied volatility thus are cheaper to buy from the corresponding calls.

Strangles

A strangle involves the simultaneous purchase or sale of an equal number of puts and calls on a given underlying instrument with the same expiration date but different strike prices. Typically the call will have a strike above the current futures price, while the putt's strike will be below the stock price. As with the straddle, the strangle purchase is looking for a large move in the underlying that exceeds either strike level by more than the amount paid for both options.

Sellers of strangles are looking for little or no movement from the underlying. These sellers of short volatility will look for options with higher implied volatilities that provide more premiums. The short positions will be profitable if the stock price stays within the range bounded by the strike prices of the sold options plus the premium collected. Sellers will also benefit if the options implied volatilities decrease, which would make the options cheaper to buy back if the seller wishes to close the position.

Conclusions

Having presented both the long volatility trade and short volatility trade profile and sensitivities of each position, one can see that the worst-case scenario for the short volatility trader is the best-case scenario for the long volatility trader. In a market crash as well as in a market ramp the losses for the short volatility trader can be enormous. The short volatility trade is a strategy, which we can calculate beforehand what the maximum possible profit is but not the extent of the losses. This strategy has a limited profit potential and an unlimited loss potential thus should be used with great caution.

On the other hand in a long volatility trade position a market ramp or crash is the dream of every trader (and nightmare of the short volatility trader). The profit depends on the severity of the price moves. The long volatility strategy provides an unlimited profit potential and this together with the limited loss feature makes it a very attractive strategy.

It is a common ground for both practices that a highly liquid derivatives market is imperative. As the market becomes more liquid larger positions can be built, transaction costs can be decreased and profits increased. Market makers actively involved in the Athens Derivative market are eligible to lower transaction costs and can benefit from smaller movements in volatility or lack of it.

At the end of the day market makers are concerned in being delta neutral and gamma or *Vega* positive having to manage combination of options of different series and classes and numerous positions in futures.

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