Norges Handelshøyskole

FIN11 Trading and Market Microstructure

Term paper

Predefined Information

Start date:	2018-11-28 10:00 AM	**Term:**	2018 12
End date:	2018-12-18 02:00 PM	**Assessment type:**	Norwegian 6-point scale (A-F)
Examination type:	Termpaper (60%)		
SIS Code:	191 FIN11 1 O 2018 12		
Internal assessor:	(Anonymised)		

Participant

Candidate No.: 28

Group

Group name: (Anonymised)
Group number: 9
Other members: 22, 2

Volatalia: Option Trading Strategies for the Italian Yield Curve

Course: FIN11 – Trading and Market Microstructure

Assignment: Term Paper

Candidate #: 2

22

28

Date: 2018-12-16

Word count: 5,963

Abstract

This paper will examine option trading strategies relating to the current market turmoil in the Italian sovereign bond market. More specifically, the paper will – by using market data from Bloomberg's Terminal and Eurex Exchange – look at how nondirectional volatility strategies might perform in the future, as well as how these market-neutral strategies have performed thus far in 2018.

The objective of this analysis is to determine whether or not traders can benefit from the increased volatility in the Italian sovereign bond markets, and more specifically *how*. To answer this question the paper will backtest the different strategies to analyze how they performed during 2018. In this backtest we find that a long straddle strategy generated significant profit when applied on a rolling basis throughout the year, while a short straddle strategy yielded negative payoff on a similar basis.

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1 Introduction

"We care about markets, but between the spread and Italian people I choose the Italian people..."

- Luigi Di Maio, Italian Deputy Prime Minister

This paper will discuss how traders may profit from the Italian government bond market, which is currently experiencing a lot of volatility due to recent political developments. The paper will look at options on Euro-BTP futures contracts, and will examine how much futures prices have to move in order to profit from various option strategies. Quantitative results will be presented for numerous option strategies, and the crucial assumptions underlying each strategy will be discussed in detail.

First, the paper will give an overview of the current Italian market conditions as well as the political developments that underpin it. Next, the paper will present the theoretical framework used later in the analysis, i.e. how options work and which options strategies are available for traders to pursue. The paper will then use this framework to examine various option trading strategies on Italian debt derivatives, with a special focus on market-neutral, nondirectional strategies. Lastly, the paper will backtest these strategies to examine how they performed in 2018, and which ones performed better.

2 Background & Option Theory

2.1 The Italian Economy & Budget Crisis

For the last few decades the Italian economy has barely witnessed any nominal growth.[1] Moreover, one third of the country's population between ages 20 and 34 are unemployed.[2] Italy's public debt has increased steadily since 2007 and reached 131% of nominal GDP in 2017; this constitutes the Eurozone's highest government-debt-to-GDP-ratio, and the third highest globally.[3] Yet, arguably, Italy's biggest long-term challenge may not, in the end, be economic or fiscal, but rather political.

[1] Bloomberg Terminal [2018-11-29].
[2] Bloomberg Terminal [2018-11-29].
[3] Bloomberg Terminal [2018-11-29].

On March 4, 2018, Italian politics experienced a marked shift: The political establishment that had held power since the mid-1990s lost in favor to populistic political parties.[4] To observers' surprise, the left-wing Five Star Movement and the far-right Northern League were elected into government on a Eurosceptic, anti-immigration platform.[5] The ensuing political turmoil resulted in some of the biggest swings in the Italian bond markets since 2014; moreover, Italian stocks – in particular bank stocks which generally carry vast amounts of Italian government bonds – experienced a significant sell-off.[6] Meanwhile, foreign investors withdrew from Italian markets, causing liquidity to shrink.[7]

Currently, Italian government bonds are rated BBB and Baa3 by S&P and Moody's, respectively, which is one downgrade away from junk status.[8] This has a large impact on Italy's borrowing costs as they must compensate with higher interest payments to attract investors. Consequently, Italy is vulnerable to a turn in economic conditions or interest rates cycles, as well as other external shocks such as the European Central Bank's stated out-phasing of quantitative easing in December 2018.

In sum, Italy faces a multitude of problems. In order to handle the combination of chronically low growth and increasing debt, however, Italy are dependent on a functioning government. Recently, the coalition government agreed to raise Italy's budget deficit to 2.4% of GDP and that to the EU's despair – the EU has been pressuring Italy to impose stricter fiscal controls on the backdrop of the country's high public debt levels.[9] Faced with investor uneasiness and increased pressure from the EU, the Italian government decided to lower their target deficit in December.[10] Still, a snap election is scheduled to take place in 2019; indeed, a lot is at risk, even the fate of Italy's EU membership.[11]

The paramount question in this paper is whether market participants are putting a correct price on volatility. If market participants are underestimating the potential volatility in Italian markets, then traders should be long volatility. However, if market participants are overestimating volatility due to media scare and uncertainty, traders ought to be short volatility. The paper will discuss and look at these questions in greater detail later, where a backtest of different strategies will be performed.

[4] "Italy's Populist Coalition: What You Should Know." *BBC*. Jun 01, 2018.
[5] "Italy's Populist Coalition: What You Should Know." *BBC*. Jun 01, 2018.
[6] Allen, Kate. "Italian Bonds' Extreme Volatility Exposes Liquidity Constraints." *Financial Times*. Jun 01, 2018.
[7] Allen, Kate. "Italian Bonds' Extreme Volatility Exposes Liquidity Constraints." *Financial Times*. Jun 01, 2018.
[8] Moody's Investor Service. "Moody's Downgrades Italy's Ratings to Baa3, Stable Outlook." *Moody's*. Oct 19, 2018.
[9] Legorano, Giovanni. "Italy's Government Passes Draft Budget That Would Widen Deficit" *WSJ*. Oct 15, 2018.
[10] Legorano, Giovanni. "Italy Trims Spending Plans in Bid to Avoid EU Discipline" *WSJ*. Dec 12, 2018.
[11] Soros, George. "If the EU Punishes Italy, It Will Reap the Whirlwind." *The Guardian*. Jun 05, 2018.

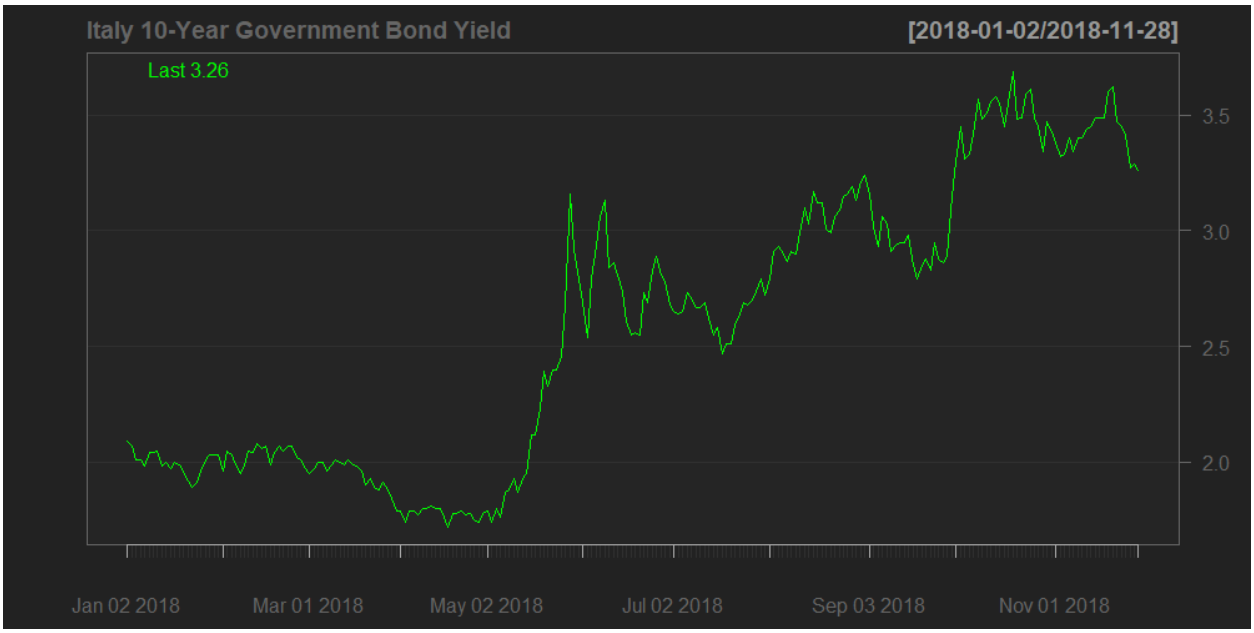


Figure 1: Italy 10-Year Benchmark Yield from 2018-01-02 to 2018-11-28 (Source: The Bloomberg)

2.2 Options: Strategic Trading Strategies

2.2.1 Options & Market Volatility

Given that the paper's purpose is to look at how traders can take advantage of the difficult macro-economic situation in Italy in order to make a profit, the paper will consequently focus on options on Italian bond futures contracts as they provide a very flexible structure in terms of risk management and profit-generation.[12] The strategies to be discussed in later sections of the paper will utilize both a call and a put option individually as well as a combination of them to form a "straddle". In this section the paper will elaborate on the fundamentals of options and their pricing as well as the properties of the different strategies that can be created through basic calls and puts, e.g. a straddle.

2.2.2 Option Basics: Calls & Puts

First, there are multiple types of options, and each option has a distinct risk-reward profile. A call option involves paying a premium for the right, but not the obligation, to buy the underlying asset

[12] Berk and DeMarzo (2016) / Sinclair (2013).

of the option at a particular strike price on, or before, an expiration date. Call option writers receive a premium and have an obligation to sell the underlying asset at the strike price if the buyer decides to exercise their right. In essence, the purchase of a call option is inherently a bullish position with limited downside risk. If the market should advance beyond the strike price, the call is considered "in-the-money" (ITM) and one may exercise the call by purchasing the underlying asset at the pre-specified strike price, even if the market price exceeds the strike price. This implies a profit that is only reduced by the premium paid to purchase the option. Conversely, if the market should decline below the strike price, the option is considered "out-of-the-money" (OTM) and may expire, leaving the buyer with a loss limited to the premium paid. Figure 2 below illustrates a call's dynamics.

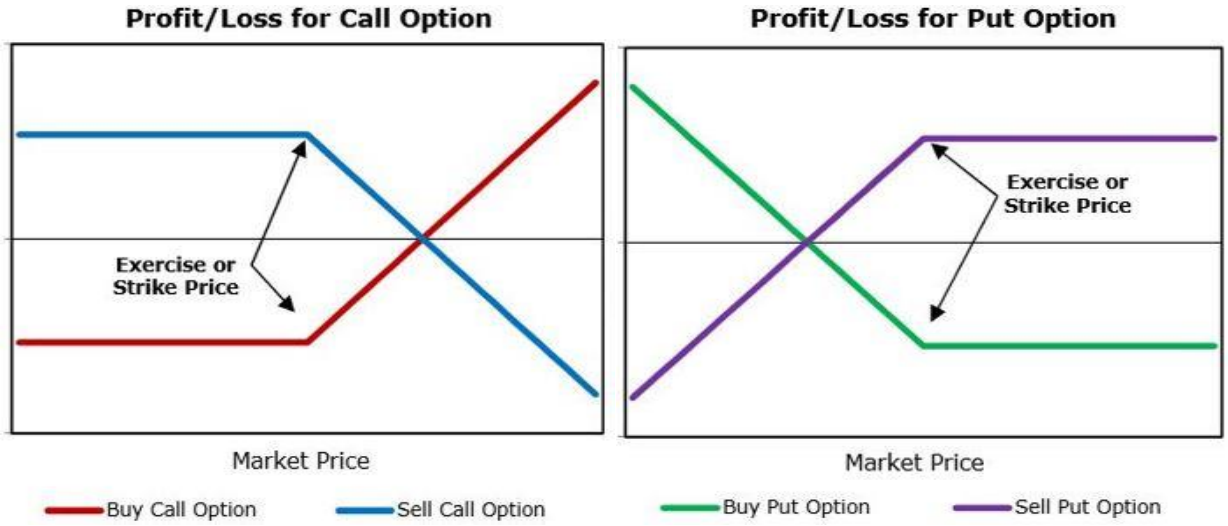


Figure 2: Call and Put Options Dynamics, Profit and Loss (Source: Chicago Mercantile Exchange)

A put option, on the other hand, involves paying a premium for the right, but not the obligation, to sell the underlying asset at a particular strike price on or before an expiration date. The writer of a put option receives a premium for taking on the obligation to buy the underlying asset at the strike price if the put buyer decides to exercise his or her right. The purchase of a put option is essentially the opposite of a call option; it is a bearish position with limited downside risk. Thus, the favorable scenario for the put buyer is if the market declines below the strike price, as the put is then in-the-money. One may then exercise the put option by buying the underlying asset cheaply in the market and then sell it to the put writer at the pre-specified strike price. Conversely, if the market does not move downwards, the put is out-of-the-money. Figure 2 above illustrates a put option's dynamics.

2.2.3 Option Theory: Pricing Tools

Inherently, option pricing is a difficult task and it is considered one of the most complex topics in the area of financial economics. The term "fair value" is often used in this context, as a fair market value for an option is such that both a buyer and writer expect to break even in a statistical sense.[13] As a result, this implies that if a trader consistently buys overpriced options and writes underpriced ones, the trader would expect to incur a loss over the long run. In order to avoid such losses, many mathematicians have tried to create different models to accurately discover the fair, true value, and these models include the Black-Scholes and Cox-Ross-Rubinstein models, among many others.[14] In this paper, however, option pricing will not be studied in depth; data from Bloomberg on option prices will be taken as an accurate representation of fair value. If markets are efficient, this is true.

2.2.4 Volatility & Options Trading

Ultimately, because of the different types of options available, including calls and puts with many strike prices and expiration dates, traders may create an almost infinite variety of strategies to suit their own unique needs. First, one of the most popular strategies that deploy both a call option and a put option is called a straddle strategy; a straddle strategy requires either the purchase or sale of both a call and a put option. To illustrate a long straddle, consider an at-the-money call and an at-the-money put, both with premiums equal to $7.50; in such a scenario the maximum downside risk would be the initial net debit, $15. If the market does not move by expiration then both options are at-the-money and thus worthless, yielding a net loss. On the other hand, if the market moves up or down by a significant amount, the straddle yields a profit. This market-neutral property leads to a possible characterization of the straddle as a non-directional trade in regards to the fact that it will yield a profit regardless of the direction of market movements. Yet, the straddle is dependent upon market volatility, so it only makes sense to pursue such a strategy if a trader expects high volatility.

The short straddle, on the other hand, involves writing both a call option and a put option. Such a strategy allows traders to take advantage of the possibility that the underlying asset will trade between the break-even points. It is essentially the opposite of the long straddle, with the profit being

[13] Black and Scholes (1973).
[14] Cox, Ross and Rubinstein (1979).

the premiums collected from writing the options. The downside, however, is virtually unlimited as prices have no upward bound. If the market stays within a narrow range traders make money; they lose money if the market moves out of this range. As a result, a short straddle only makes sense to pursue if a trader expects calm markets with small price movements or if implied volatility is over-stated by other traders. The dynamics of the long and short straddles are depicted in figure 3 below.

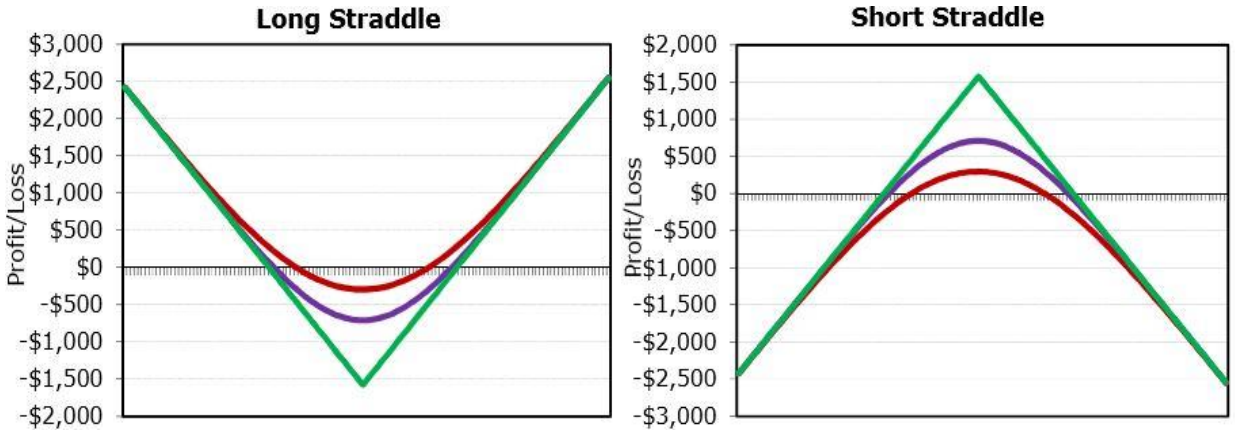


Figure 3: Long/Short Straddle Dynamics, Profit and Loss (Source: Chicago Mercantile Exchange)

2.2.5 Trading – Over-the-Counter

Options may trade at electronic exchanges, but usually they trade over-the-counter or OTC.[15] OTC is a generic term for trades executed off-exchange. OTC-trades are usually organized between two market participants contacting each other directly, or through an interdealer broker who locates a counterparty for the trade. Such a counterparty can often be a market maker who specializes in one particular contract.[16] Once the two parties agree on terms, they make sure the other party will not default by using a CCP (central counterparty) as a clearing house; they may also clear the trade bi-laterally by signing an agreement covering their transactions.[17] Over the past years the OTC-market for options has exploded in popularity; the reason is likely that investors and traders appreciate the ability to tailor the specifications and terms of the option contract to their own unique needs. The options that will be studied in this paper are traded OTC through Eurex Exchange in Germany.

[15] Harris (2002).
[16] Hull (2018).
[17] Hull (2018).

3 Analysis & Trading Strategies

3.1 Euro-BTP Futures & Futures Options

3.1.1 Euro-BTP Futures Contracts

Eurex, an international exchange which offers a suite of European-based derivatives, launched its first futures contract on the long end of the Italian yield curve in 2009. Its long-term Euro-BTP – "BTP" for *Buoni del Tesoro Poliennali* (or Treasury bonds) – futures contracts was introduced in the wake of the Great Recession as a means for investors to protect bond portfolios from negative price movements in Italian sovereign bonds. The underlying instruments for these futures contracts is a long-term debt instrument issued by the Republic of Italy with an original maturity not longer than 16 years and a remaining term of 8.5 to 11 years and a 6.0% coupon. More than 108.8 million contracts have traded since their launch while average daily trading volume was 112,700 in 2017.[18]

3.1.2 Options on Euro-BTP Futures

On October 2, 2017, Eurex launched options on Euro-BTP futures. The Euro-BTP futures options are efficient instruments for hedging, as well as for trading volatility in the longer end of the Italian yield curve. Specifically, one option contract is a right to buy (or sell) a Euro-BTP futures contract; the contract size of the Euro-BTP futures are €100,000. Eurex, however, operates with a minimum option contract block size of 100 lots, so the quoted option prices have to be multiplied by 100,000 to yield the minimum trade sizes. In other words, if the quoted option price is €1.76, the minimum trade size is €176,000. If this is a call option on the Euro-BTP futures contact with a €122.50 strike price, it entitles you to buy 100 futures contracts for a total of €12,250,000. Should the underlying futures contract be worth €125.00 you have made €324,000 (12,500,000 - 12,250,000 - 176,000).[19]

Eurex states on their website that "market makers are obliged to quote continuously calls and puts in four strike prices, each from a window of 17 strikes, around the current underlying price for the first two expiration months."[20] This means that there is always liquidity available in options around

[18] Eurex Exchange's website: http://www.eurexchange.com/ [2018-11-29].
[19] Eurex Exchange's website: http://www.eurexchange.com/ [2018-11-29].
[20] Eurex Exchange's website: http://www.eurexchange.com/ [2018-11-29].

the current underlying futures price. Yet, options that are relatively far in-the-money or out-of-the-money will have no such liquidity guarantee, which means they are more difficult to trade out of.

3.1.3 Recent Price/Volatility Trends

As discussed in the introduction, Italian debt markets have been very volatile following the election of the populist Five Star Movement and Northern League into government on March 4, 2018. The two parties' determination to increase fiscal spending, coupled with an already high national debt burden and soft growth outlook, has catapulted the Italian 10-year government bond yield to levels not seen since 2014. Euro-BTP futures prices, which are obviously highly correlated with the current rolling 10-year government bonds and their yields, have seen a similar trend. In figure 4 below we have graphed the price of the current rolling Euro-BTP futures contract with expiration in December 2018, which was issued in March 2018. The chart shows that the price fell from a level of €135 to €120 after the election; trading has since oscillated between €118 and €128, and the spikes reflect important news events. Volatility seems to have increased markedly after March, and prices seem to be influenced by positive/negative news about the populist government's latest endeavors.

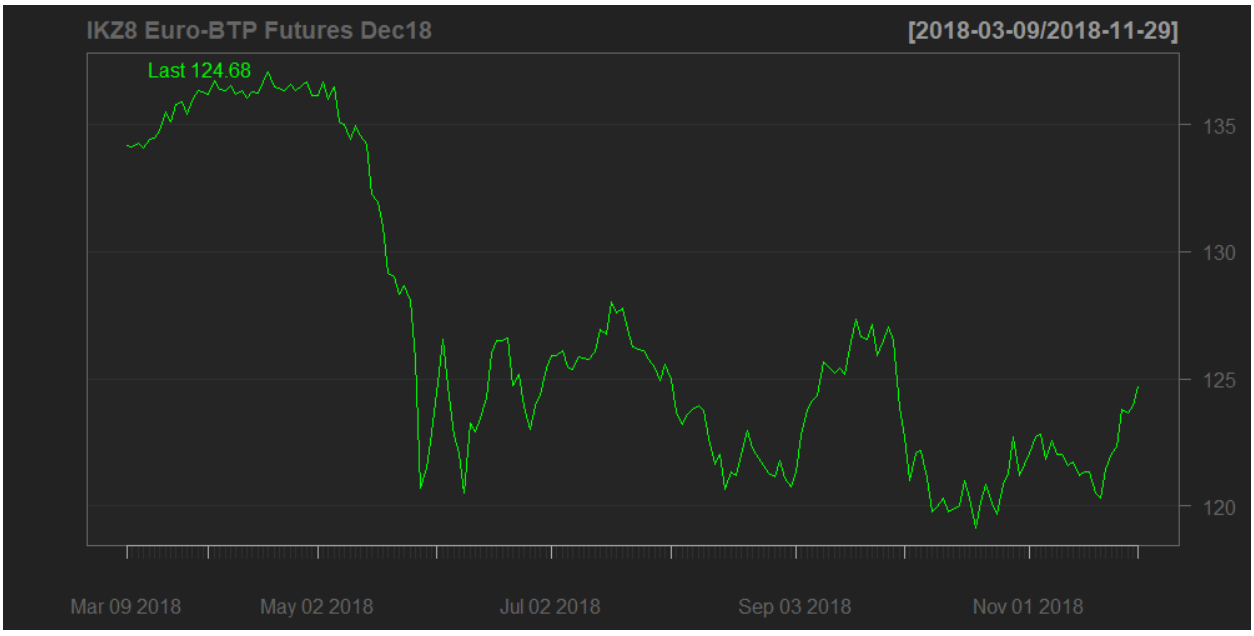


Figure 4: IKZ8 Euro-BTP Futures Dec18 from 2018-03-09 to 2018-11-29 (Source: The Bloomberg)

In figure 5 we have graphed the Euro-BTP futures' one-month implied volatility. Implied volatility is extracted from option prices, and illustrates the degree of volatility that traders expect to see in the near future. It is evident from the chart that traders expect the Euro-BTP futures contract to be relatively volatile in the future compared to past levels. The spike in implied volatility to over 20% in June also shows that the market has potential for big price movements over short time horizons.

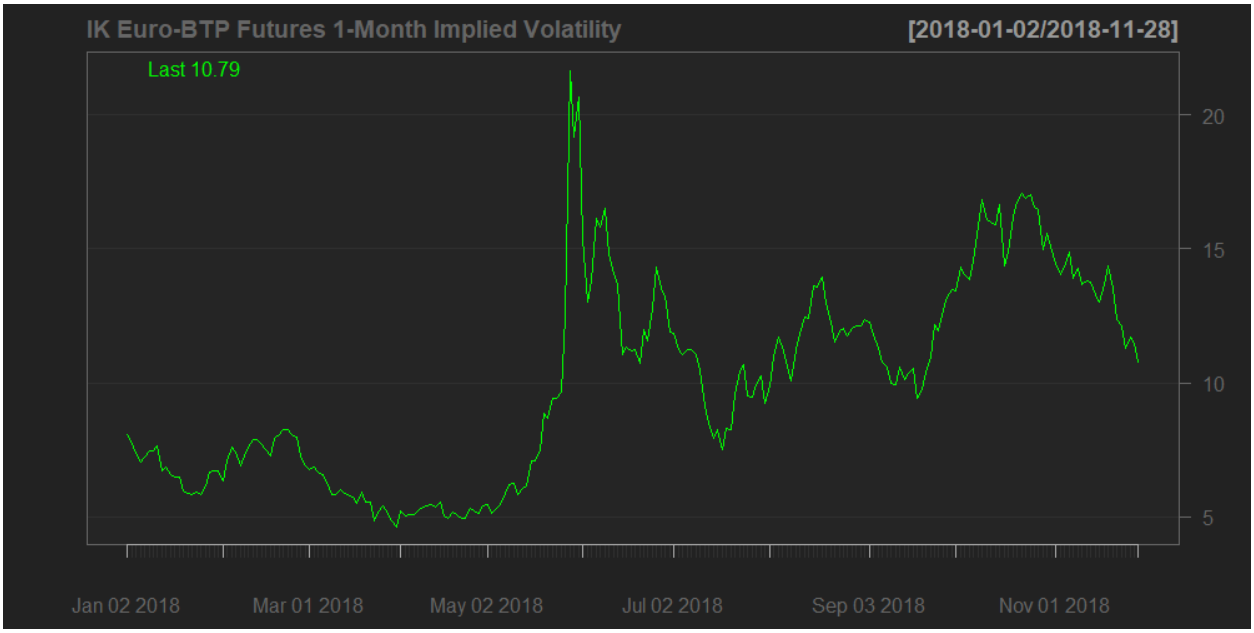


Figure 5: IK Euro-BTP Futures 1-Month Implied Volatility for 2018 YTD (Source: The Bloomberg)

3.2 Neutral & Positional Option Strategies

3.2.1 Euro-BTP – Jan. 2019 Bound

For simulation purposes, it is helpful to choose a bound (albeit wide) which the Euro-BTP futures contract will likely trade within in January 2019. The purpose of this is not to predict future prices, but simply to get a suitable January 2019 price bound that will be used for simulating option pay-offs. In figure 6 we have again plotted the current rolling Euro-BTP futures contract with expiration in December 2018; as seen from the chart, the futures contract has traded between the two red lines since March. In addition, we have added a 20-day simple moving average in orange to depict the general price trend. The blue lines enclose the bound which will be used in simulating payoffs;

a maximum of €135 is chosen because this represents the price level before the turmoil, and much good news are needed to reach this level again in the near future. The minimum of €110 is chosen to account for all the downside risk related to the government's precarious situation. These bounds are not very important parameters, but form a suitable simulation range for all the option strategies.



Figure 6: IKZ8 Euro-BTP Futures Dec18 from 2018-03-09 to 2018-11-29 (Source: The Bloomberg)
The red lines depict max./min. prices; the blue lines enclose the bound. The orange line is 20D SMA.

3.2.2 IKH9 Euro-BTP March 2019

So far the paper has been concerned with the current rolling Euro-BTP futures contract with expiration in December 2018. However, most options are traded on the futures contract with expiration in March 2019, so the paper will use this contract onwards. The March 2019 contract is obviously closely aligned with the December 2018 contract, except for a slightly lower price due to the cost-of-carry. Issued in June 2018, this Euro-BTP futures contract is currently trading at €122.62, which is approximately in the middle of the trading range since its issuance. As with the December 2018 contract, figure 7 below illustrates that the contract has been trading in a range of €118 to €126 for the last five months, and that there are sizable short-term price changes due to spikes of volatility.

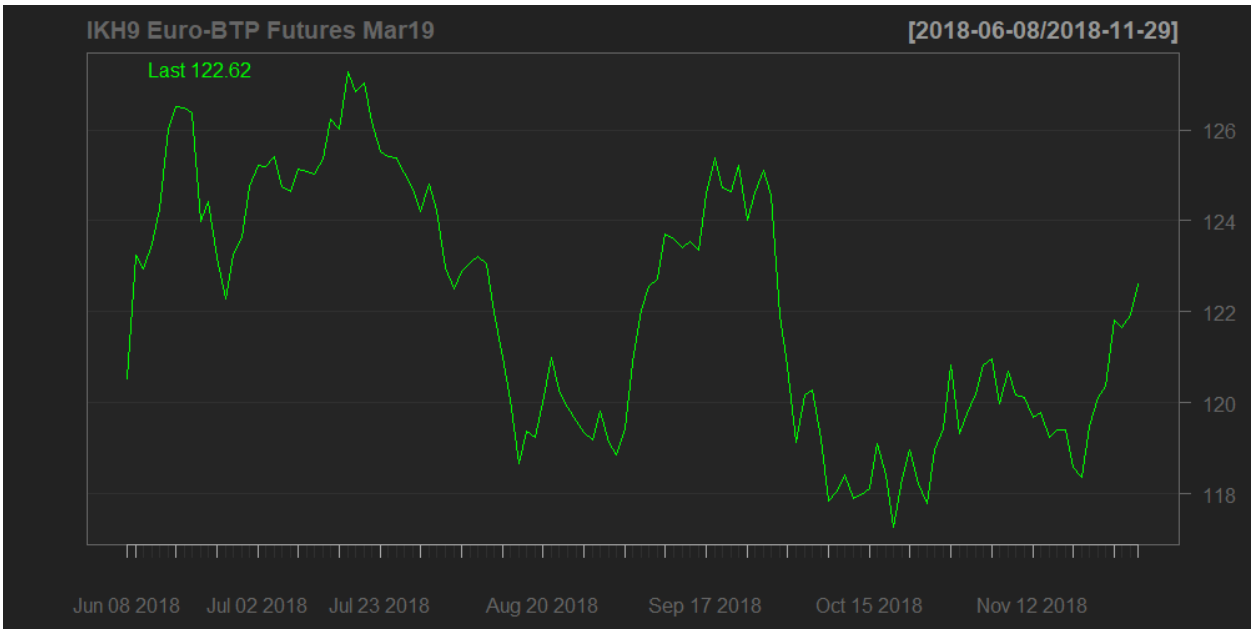


Figure 7: IKH9 Euro-BTP Futures Mar19 from 2018-06-08 to 2018-11-29 (Source: The Bloomberg)

3.2.3 Option Contracts, Premiums

The option strategy simulations in the next subsections are all based on two specific options, i.e. a call option on the IKH9 Euro-BTP futures contract with a strike price of €122.50 and a similar put option. Both options have settlement on January 25, 2019, and are American-style options. These options, which are at-the-money at the time of writing, are the most heavily traded and were hence chosen. Premiums for each option contract – as well as a summary – is illustrated in table 1 below.

Table 1: Call / Put Options on IKH9 Euro-BTP Futures Mar19, Summary (Source: The Bloomberg)

Type	Call option	Put option
Exercise price	€122.50	€122.50
Expiration date	2019-01-25	2019-01-25
On instruments	IKH9 Euro-BTP Futures Mar19	IKH9 Euro-BTP Futures Mar19
Premium	€1.76	€1.85
Implied volatility	9.24%	9.42%

The simulations are based on buying (or selling) 100,000 option contracts as was described in the previous sections. Consequently, "buying one call option" will imply buying 100,000 call options for €176,000, and "buying one put option" will involve buying 100,000 put options for €185,000.

3.2.4 Option Strategy #1: Straddle

An option straddle strategy was described in detail in section two of the paper. Figure 8 illustrates this strategy with options on the IKH9 Euro-BTP futures contract with parameters from table 1. In this option payoff diagram it is evident that futures prices either need to move below €119 or above €126 for the strategy to be profitable. If prices do not move out of this range, however, the strategy may potentially lose €361,000, i.e. the sum of the call and put premiums. If prices do progress out of the range, however, payoffs can be large: up to €800,000 if price falls to €110 or jumps to €135.

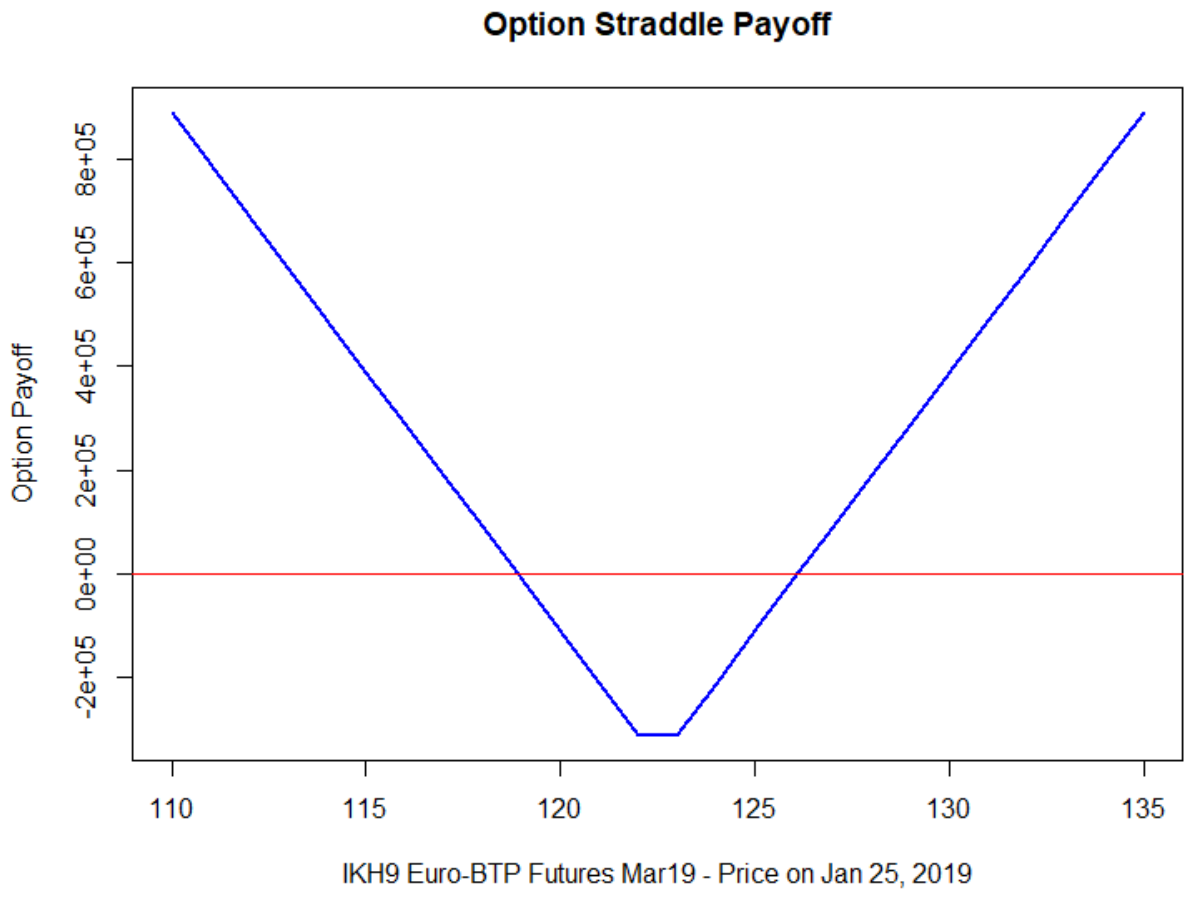


Figure 8: Option Straddle Payoff (Absolute Payoff)

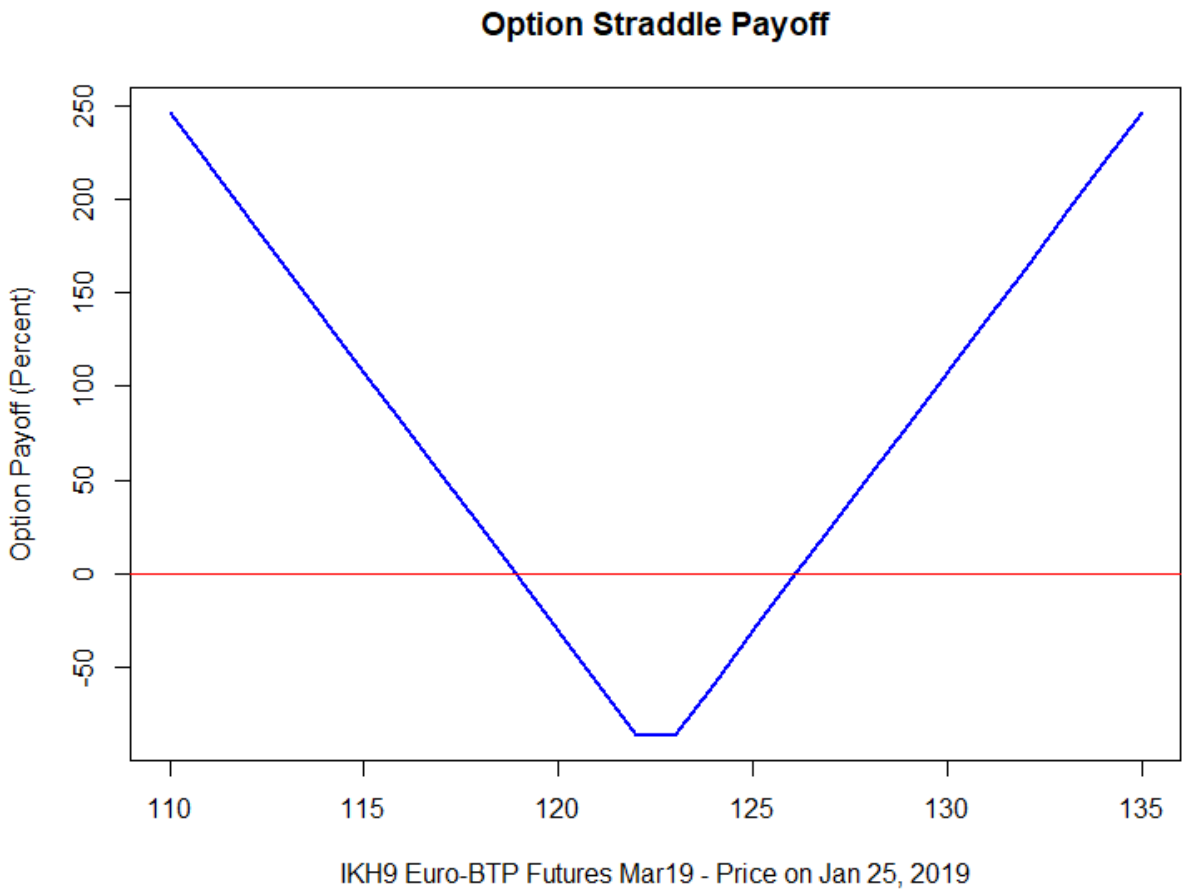


Figure 9: Option Straddle Payoff (Percent Return)

Straddles are market neutral; they do not gamble on the price moving in a certain direction. Hence, a straddle strategy is optimal for traders who think volatility will be high in the future but who do not have any strong assumption regarding future price movements. Given the current Italian market environment, in which material news is equally likely to move futures prices in either direction, such a strategy may well be optimal. While market makers naturally price higher volatility into the option contracts, volatility may be underestimated due to events not yet foreseen. However, there are also reasons to believe that volatility is perhaps overestimated due to recent market turmoil; in this case, the straddle strategy will likely lose money because prices will need to move much more to yield a payoff. Therefore, traders who expect more volatility in the next one to two months than is currently priced in will benefit from a straddle; the opposite goes for those who expect calmness.

While a straddle strategy may look attractive, it is certainly relatively risky; as seen in figure 8 and 9, the strategy may lead to large losses if the futures prices do not move out of the €119-126 bound. Traders therefore need to have quite strong assumptions about high future volatility in Italy's 10-year benchmark yield and, by extension, the IKH9 Euro-BTP futures price for the strategy to offer a satisfying risk-return tradeoff. Spending €361,000 on such a straddle is not for the faint-hearted.

3.2.5 Option Strategy #2: Call/Put

If traders have strong assumptions about the direction of future price movements, it might be more beneficial to adopt a pure call or put strategy. These strategies, however, bet on movements in *one* specific direction and not just on high volatility in general; they are, as a result, not market neutral.

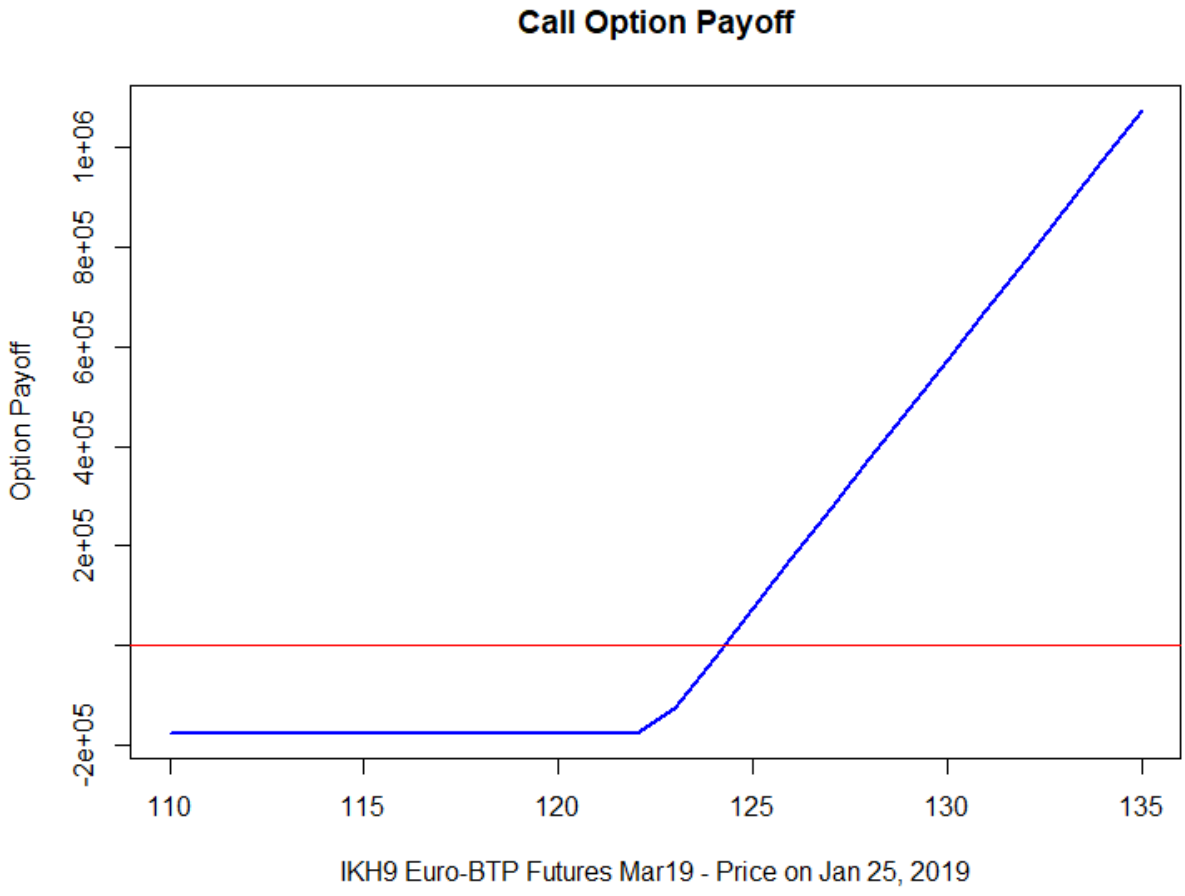


Figure 10: Call Option Payoff (Absolute Payoff)

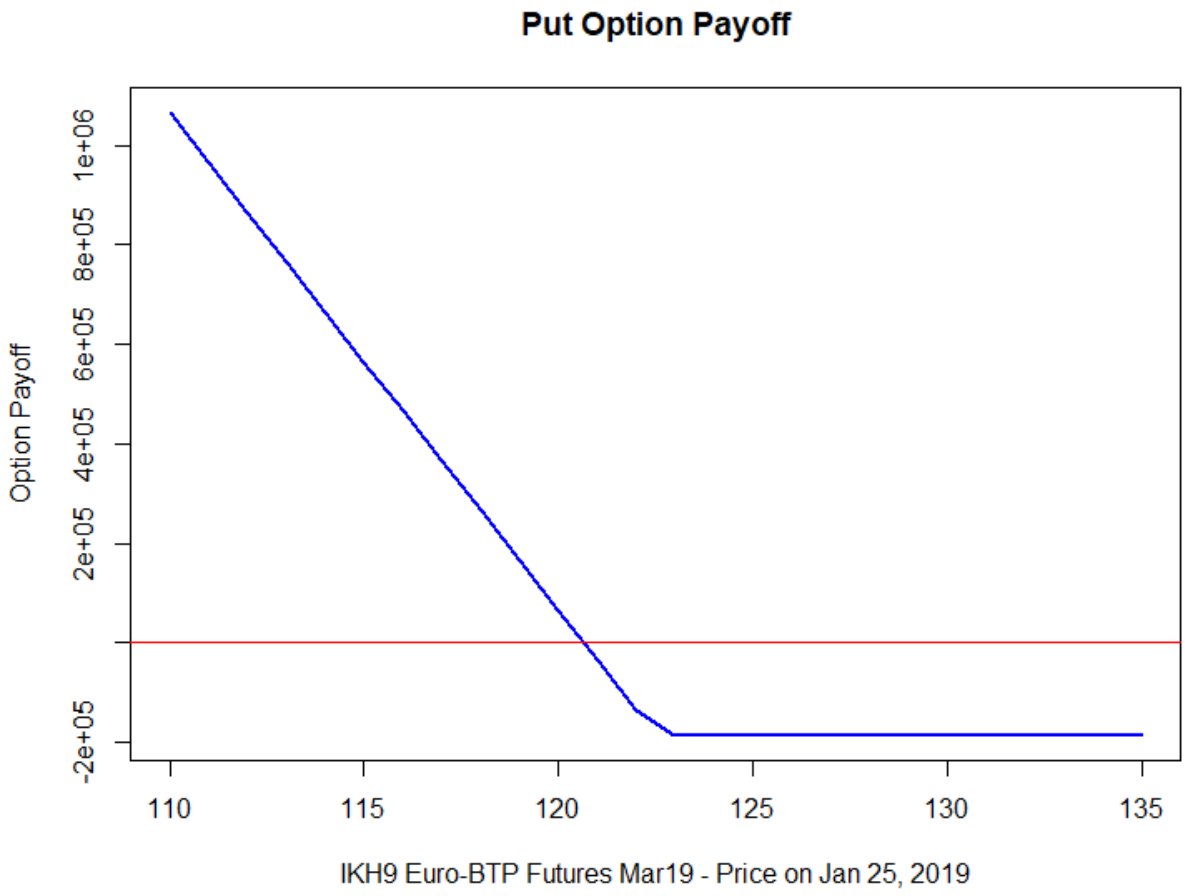


Figure 11: Put Option Payoff (Absolute Payoff)

As depicted in figures 10/11, a call option (with parameters from table 1) will yield a profit if the IKH9 Euro-BTP futures contract moves above ~€124 on or before January 25, 2019. Likewise, a put option (with similar parameters) will yield a profit if the futures contract moves below ~€121. If the futures price does not breach these bounds, the total loss will be limited to €176,000 for the call strategy and €185,000 for the put strategy; total possible losses will of course be below that of a straddle strategy, but these two strategies only make money if the futures price moves in one and only one direction. The straddle strategy, as discussed earlier, is a better option for traders who do not have any private information about future price directions but who do expect an elevated level of volatility. The standalone call or put strategies are more suitable for traders with private information about the future state of Italian affairs, but are – once again – not market neutral strategies.

3.2.6 Option Strategy #3: Short Straddle

So far, the paper has focused on option strategies where the underlying assumptions are short-term swings in prices and a high level of volatility. This is, admittedly, what media commentators have proselytized recently; yet, this information is indeed priced in by market makers and option writers. For those who suspect implied volatility in option prices are too high due to all the craze and scare surrounding Italy's current situation, and who think market conditions will calm down in the month or two to come, may pursue a short straddle. As discussed earlier, a short straddle strategy – where you write both a call and put option – will make money if prices do not move much; consequently, if traders expect the benchmark 10-year yield, and by extension the IKH9 Euro-BTP futures price, to stay relatively calm until late January, they may collect €361,000 in premiums with such a short straddle strategy. However, if the futures price moves significantly, they may face sizeable losses.

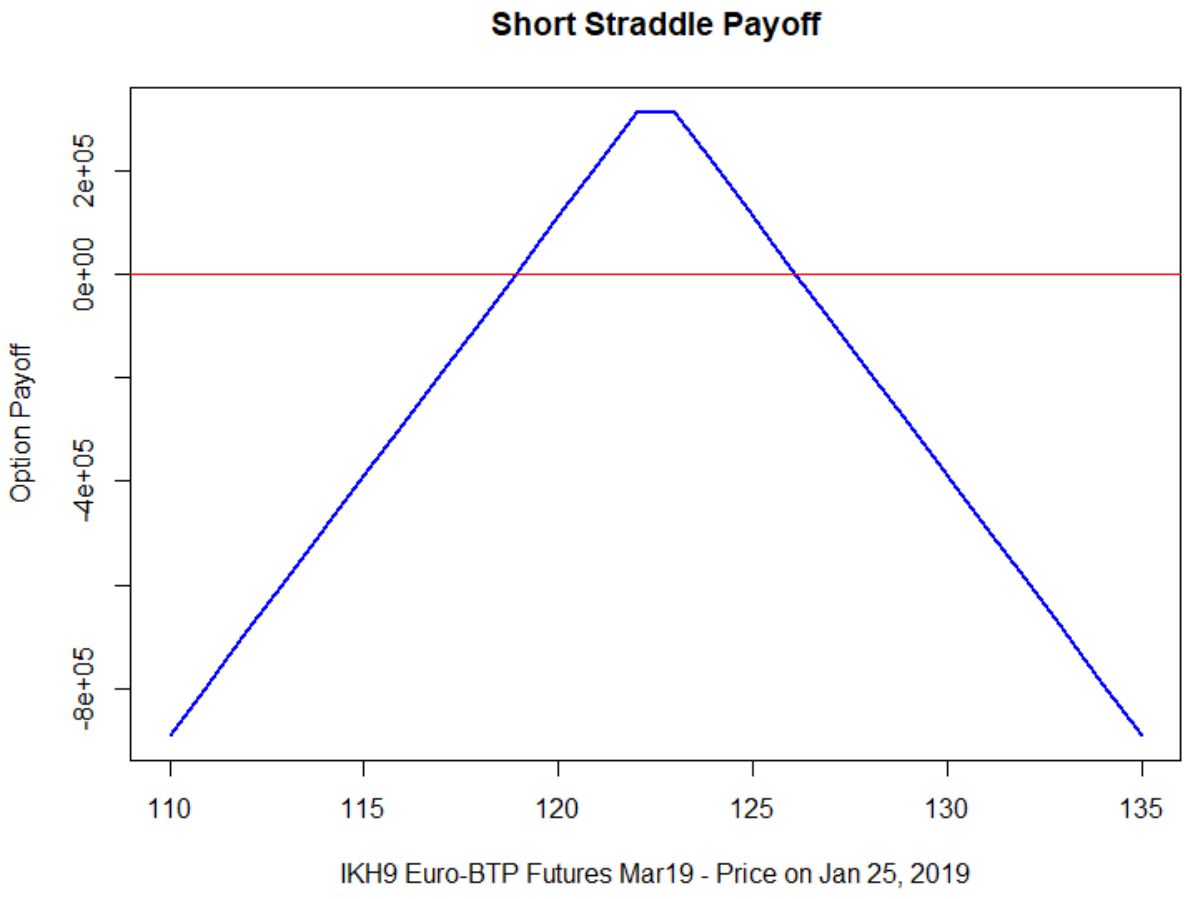


Figure 12: Short Straddle Payoff (Absolute Payoff)

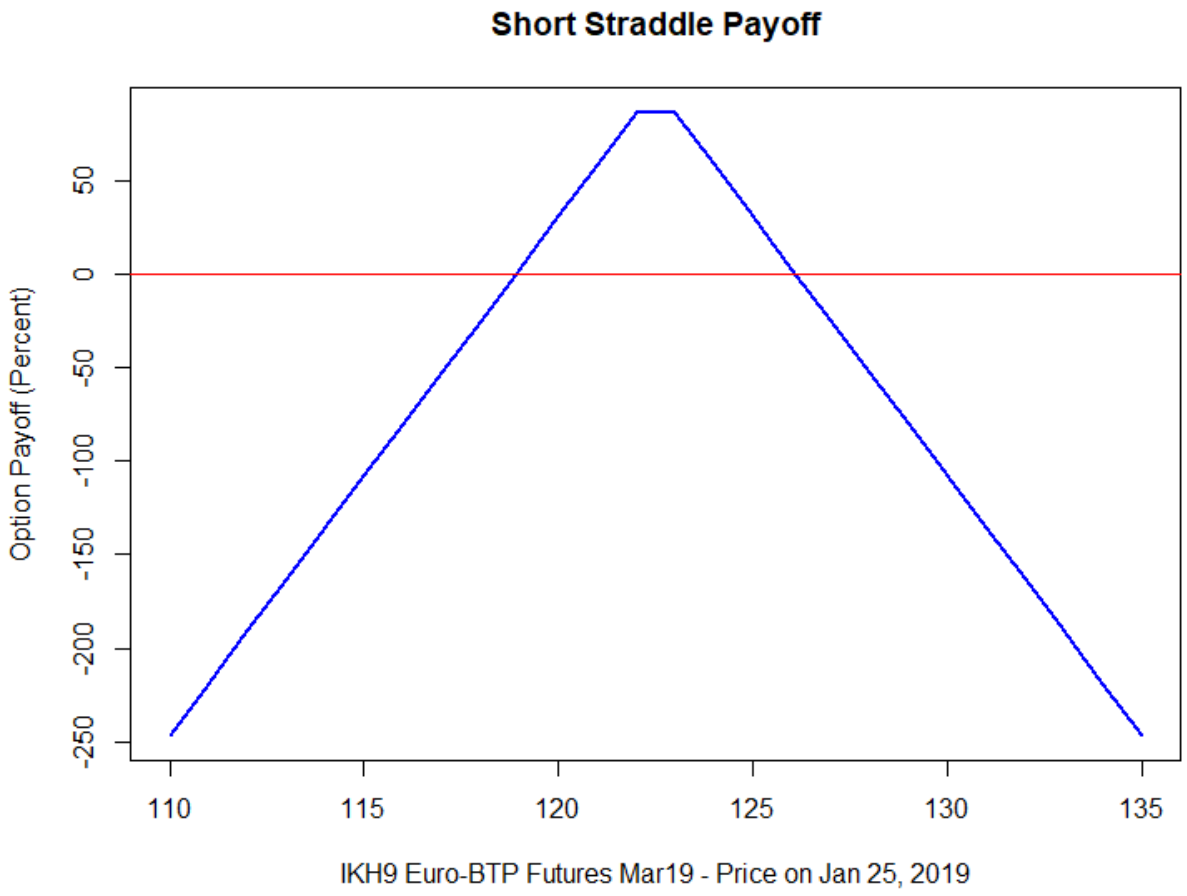


Figure 13: Short Straddle Payoff (Percent Return)

In figures 12 to 13, the short straddle strategy is illustrated. Since it is simply the "opposite" of the normal straddle, the futures price needs to stay within the €119-€126 range in order for the strategy to be profitable. If prices do not move at all, the strategy yields a profit of €361,000. Nevertheless, traders who pursue this strategy must have very strong convictions about future price stability and, by extension, strong convictions that implied volatility is too high; the downside risk is technically unlimited, and traders may face excruciating losses if the futures price drop to, say, €110 or jumps back to earlier levels of €135. Yet, the strategy is certainly viable because there is undoubtedly a real possibility that irrational market participants extrapolate past volatility into the future without paying attention to the underlying realities. Traders who believe the next few months will be more normal, and that the current level of implied volatility is unwarranted, should opt for this straddle.

3.3 Statistical Analysis of Option Strategies

3.3.1 Backtesting & Methodology

In the preceding sections, the paper laid out how different option strategies will perform given the development of the underlying futures price. However no one can predict the future Italian 10-year yield and by extension the price of the Euro-BTP futures contract. In order to find out which strategy traders should pursue, this section will present a backtest of the long straddle and short straddle strategies. Traders with strong convictions about future volatility may be satisfied with the information presented in the previous section; this backtest, however, which only focuses on nondirectional strategies, will be useful for traders with less strong convictions about future volatility, and who wish to base the trades on information about the relative performance of the strategies in 2018.

In order to avoid the *ex-post* benefit of hindsight, the backtests will both be based on a fairly simple strategy. In the strategy, a trader who pursues a long (short) straddle will buy (sell) options ca. two months before expiry, which corresponds to the analysis in the preceding section. At every expiry date, the trader will buy (sell) new options for two months, thus creating a continuous position. If we then start on Jan 2, 2018, the first trading day of the year, the trader will first buy (sell) options with expiry on Feb 23 – the expiration date for the Feb 2018 options on Euro-BTP futures. On Feb 23, the trader will again buy (sell) options with expiry on Apr 20, which is the expiration date for the Apr 2018 options. This will continue throughout 2018, with the remaining dates being Jun 22 (for Jun 2018 options), Aug 24 (for Aug 2018 options), and Oct 26 (for Oct 2018 options). Hence, the trader pursues the strategies on a continuous, rolling two-months basis, with five distinct terms.

The strategy specifically assumes that the trader who pursues the long (short) straddle buys (sells) at-the-money options (i.e., one call and one put) on Jan 2, Feb 23, Apr 20, Jun 22, and Aug 24. If the options turn in-the-money they may certainly be exercised, but the backtest will still show what the positions are worth until expiry. As for the underlying Euro-BTP futures contract, the backtest will use the price of the current rolling, generic futures contract at each point in time, i.e., the one that the options are written on. With this, the backtest will use the actual option prices on the days the positions are established (obtained from Eurex Exchange) to compute the value of the strategies at each day between Jan 2 and Oct 26. As a result, the reader will be able to see what a two-month long/short straddle strategy were worth on each day during 2018, and from that draw conclusions.

3.3.2 Long Straddle Position Value

On the basis of the methodology explained above, figure 14 illustrates the long straddle strategy's value at each point in time, as well as the Euro-BTP futures price. From the figure it is evident that the long straddle established on Jan 2 with expiration on Feb 23 was unprofitable; in the middle of the period it got close to zero (-€65,680), but at expiry the position value – option value minus the premiums paid – was -€253,680. The position established on Feb 23 with expiration on Apr 20 did somewhat better with a position value of -€32,400 at expiry. Yet the next position, established on Apr 20 with expiration on Jun 22, yielded a substantial profit with position value of €1,431,340 in early June; the position value was $1,011,340 at expiry. The following position, however, established on Jun 22 with expiration on Aug 24, did not yield a profit; the position value was close to zero in mid-Aug (-€42,620), but was -€165,620 on expiry. Lastly, the position established on Aug 24 with expiration on Oct 26 did not yield a profit, with a net position value of -€286,340 on expiry.

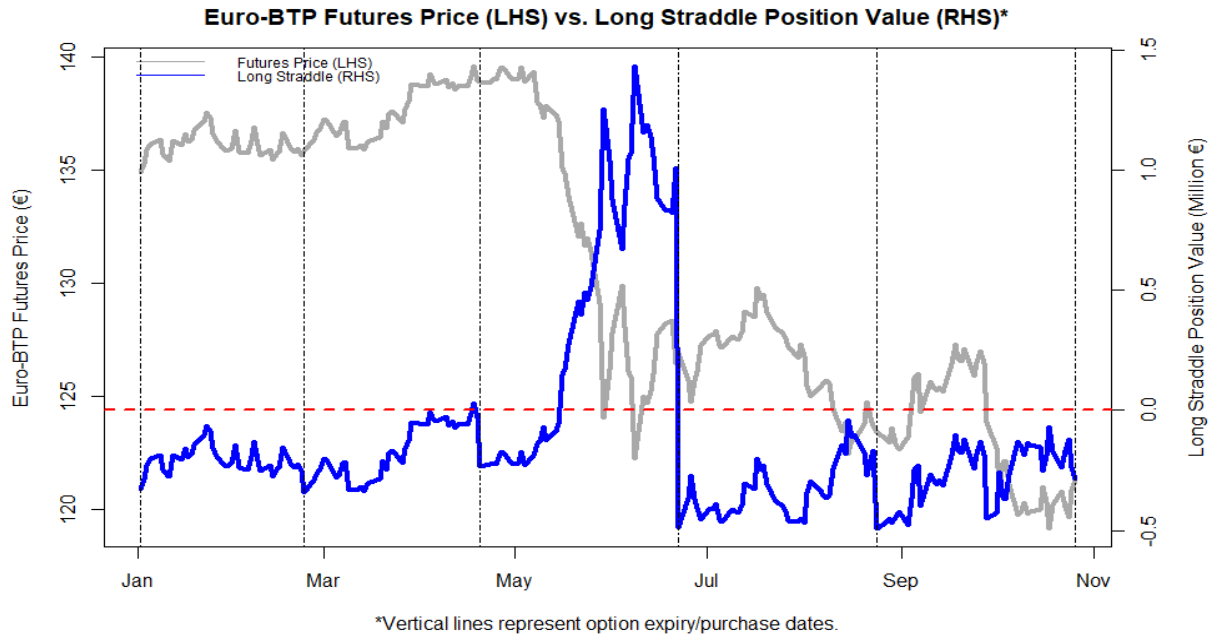


Figure 14: Long Straddle Position Value (€, MM)

In sum, then, a two-month long straddle yielded losses in four out of five periods, but yielded great profits in early Jun. If the trader exercised every option at expiry, he or she would have made a net

profit of €273,300. The spike in volatility in early Jun made the long straddle extremely valuable, and made up for the other losses. Indeed, the long straddle could have yielded a greater total profit if the trader had exercised the Jun 22 option when it was worth €1,431,340, but this is easier to say *ex-post* with the benefit of hindsight. Yet, even with an exercise-at-expiry strategy the long straddle was profitable over the course of 2018 due to a marked drop in the Euro-BTP futures price in Jun.

3.3.3 Short Straddle Position Value

Figure 15 illustrates the short straddle's position value at each point in time throughout 2018. From the figure one can see that the short straddle established on Jan 2 with expiration on Feb 23 had a positive (€253,680) position value at expiry, but that the position value was closer to zero at some point. The short straddle established on Feb 23 with expiration on Apr 20 also had a positive position value at expiry, albeit only $32,400. The next straddle, however, established on Apr 20 with expiration on Jun 22, yielded a significant loss. Here, the most negative position value reached -€1,431,340, and the position value at expiry was -€1,011,340; there is certainly a chance that the options were called when the position value was most negative, so this is a significant loss. In the following periods, however, the short straddle performed better; the position established on Jun 22 with expiration on Aug 24 had a value of €165,620 on expiry, while the last position – established on Aug 24 with expiration on Oct 26 – had a value of €286,340 on expiry. Thus, the short straddle yielded greater profit after the mid-year volatility spike, but still lost €273,300 over the whole year.

While the short straddle strategy yielded a negative net profit throughout 2018 when applied on a rolling two-month basis, it is also evident from figure 15 that the strategy's profitability seems to have increased after the mid-year spike in volatility. This is because the premiums collected from writing options increased after the volatility spike; implied volatility rose. Looking forward, then, it is worth asking if implied volatility is overestimated, thereby making a short straddle more attractive. While behavioral biases such as loss aversion would lead one to think that implied volatility may be overestimated in terms of market stress, research in fact suggest otherwise; Kahneman et al. argues that investors tend to underestimate risk when facing uncertainty,[21] while Kownatzki finds that implied volatility on S&P 500 index options (VIX) consistently underestimates volatility

[21] Kahneman & Riepe (1998).

during volatile periods.[22] Therefore, a short straddle strategy will be very risky to pursue in the current market environment, and may again easily yield losses like the ones seen during mid-2018.

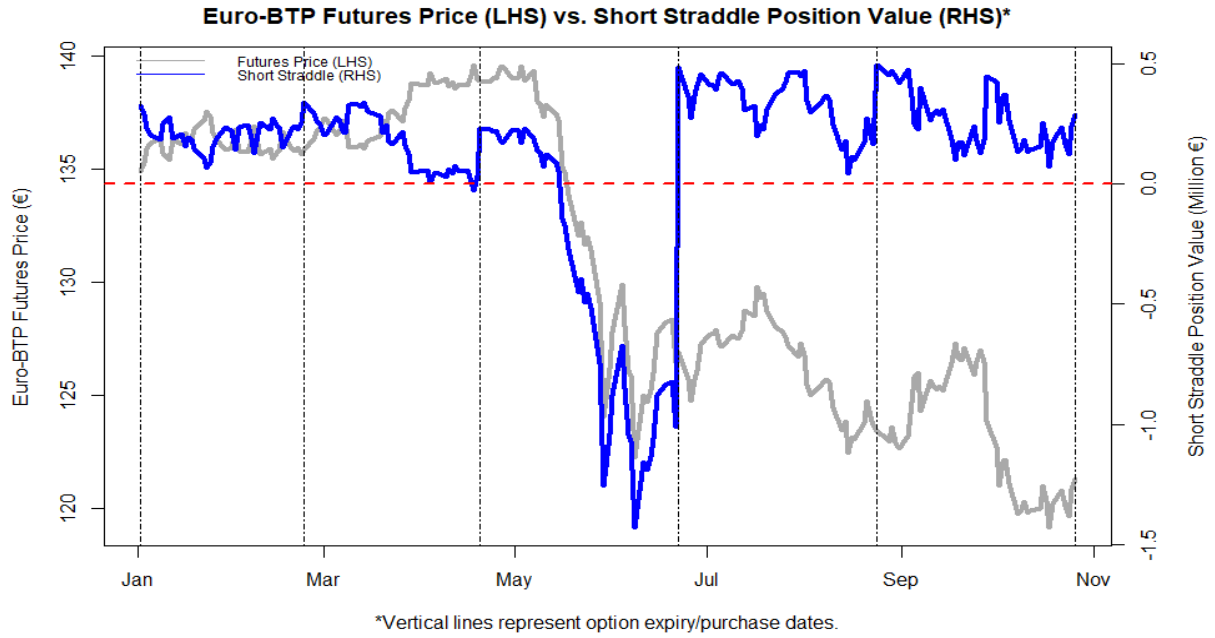


Figure 15: Short Straddle Position Value (€, MM)

As a result, a long straddle seems like the best strategy to pursue in the current markets. There are clear signs in the data that market participants underestimated volatility after the election in March, causing the long straddle to be very profitable in the following period. Of course, some may argue that this was a one-time event, and it is certainly easy to say, *ex-post*, what strategy worked better; with the current market environment, however, there are no reasons why further political developments cannot lead to an abrupt movement in the 10-year yield. Indeed, few expect Italy's problems to be solved in the near future, and another rapid movement in the 10-year yield would yield profit, which could easily make up for losses incurred in the periods when the yield does not swing. Yet, if Italy's problems are in fact solved rapidly, the yield will likely fall towards more normal levels, in which case the futures price would rise rapidly. The long straddle would make money here, too.

[22] Kownatzki (2016).

3.3.4 10-Year Yield & Straddle Strategy

If traders opt for a long straddle, section 3.2.4 illustrated that such a strategy will return a profit if and only if the IKH9 Euro-BTP futures price moves below €119 or above €126. This is undeniably valuable information for traders who expect elevated levels of volatility in Italian markets and who seek to profit from it. However most traders are, understandably, not all too familiar with the IKH9 Euro-BTP futures price, so it will be valuable for traders to have the "below-€119-or-above-€126" thresholds expressed in terms of Italy's 10-year government bond yield. Italy's benchmark 10-year yield is widely cited in financial press, and most traders pay attention to – or are at least somewhat familiar with – this yield. In figure 16 we have graphed the 10-year yield for 2018; as evident from the chart, the 10-year yield spiked in May and has been volatile since – just like the IKH9 contract.

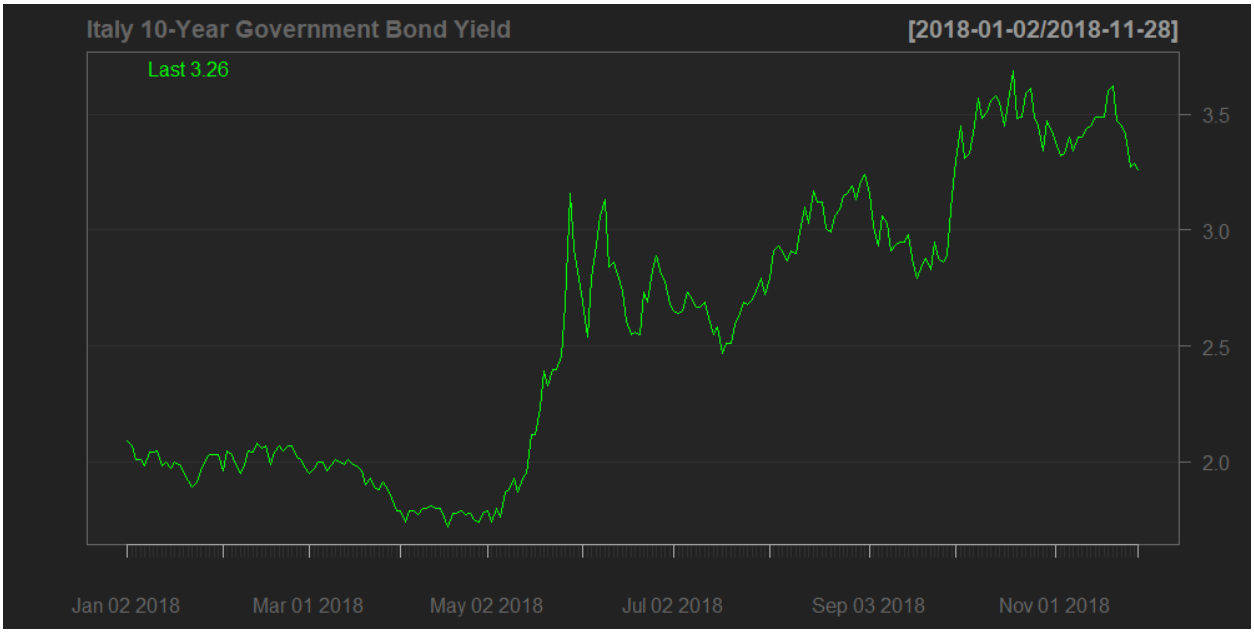


Figure 16: Italy 10-Year Benchmark Yield from 2018-01-02 to 2018-11-28 (Source: The Bloomberg)

In order to express the "below-€119-or-above-€126" IKH9 Euro-BTP futures price range in terms of Italy's 10-year benchmark yield, we have regressed the futures prices on the 10-year yield. The two are obviously almost perfectly negatively related, but not quite 100% because the IKH9 futures contract is based on government bonds with 8.5 to 11 years remaining maturity. Figure 17 depicts the relationship, and the correlation coefficient turns out to be -0.94. From the regression model it

is evident that the "below-€119-or-above-€126" IKH9 Euro-BTP futures price range corresponds to an Italian 10-year benchmark yield below 2.54% or over 3.45%. Therefore, extending the results from the option straddle payoff diagram in figures 8 and 9, traders will profit from the straddle if Italy's 10-year benchmark yield drops below 2.54% or jumps above 3.45%. This will certainly not always be the case in practice, but the yield-range gives traders a useful outlook; most traders will have an opinion about possible movements in Italy's benchmark 10-year yield, and the yield-range may make traders' lives easier because they can pay attention to the 10-year yield only or perhaps even simulate future 10-year yields and – from that – make decisions regarding a straddle strategy.

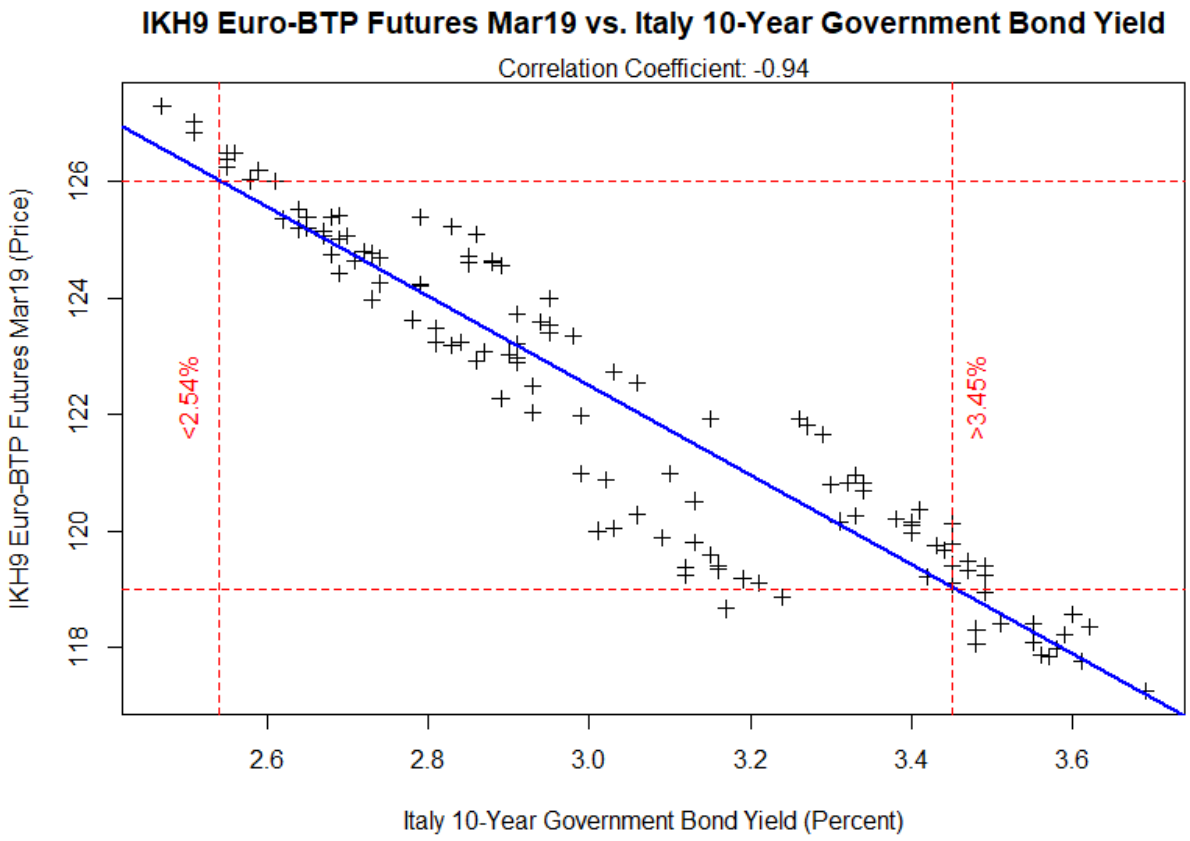


Figure 17: Linear Regression - IKH9 Euro-BTP Futures Mar19 vs. Italy 10-Year Benchmark Yield

The above linear regression may of course be made more precise by considering the fact that bond prices and yields do not have a linear relationship. More precise estimates can be made by using a quadratic regression model or even a more general nonlinear model. Here, a linear model suffices.

Table 2 below gives an overview of the straddle strategy's payoff in terms of the Italian benchmark 10-year yield. The table may perhaps be useful for traders who wish to look further into the matter.

Table 2: Italy's 10-Year Benchmark Yield vs. Long Straddle Payoff (Based on Regression Model)

Italy 10-Year Government Bond Yield	Long Straddle Payoff
4.50%	€791,320.75
4.40%	€714,522.00
4.30%	€637,723.25
4.20%	€560,924.50
4.10%	€484,125.75
4.00%	€407,327.00
3.90%	€330,528.25
3.80%	€253,729.50
3.70%	€176,930.75
3.60%	€100,132.00
3.50%	€23,333.25
3.40%	(€53,465.50)
3.30%	(€130,264.25)
3.20%	(€207,063.00)
3.10%	(€283,861.75)
3.00%	(€361,000.00)
2.90%	(€284,540.75)
2.80%	(€207,742.00)
2.70%	(€130,943.25)
2.60%	(€54,144.50)
2.50%	€22,654.25
2.40%	€99,453.00
2.30%	€176,251.75
2.20%	€253,050.50
2.10%	€329,849.25
2.00%	€406,648.00
1.90%	€483,446.75
1.80%	€560,245.50
1.70%	€637,044.25
1.60%	€713,843.00
1.50%	€790,641.75

4 Conclusion

Based on the analysis in the preceding sections, the long straddle strategy seems to be the best way for traders to profit from volatility in the Italian sovereign bond market. The long straddle strategy generated significant profit on a rolling two-months basis over 2018 due to spikes in volatility. Of course, this does not guarantee that the strategy will work in the future, but with elevated levels of volatility there is certainly a chance that the long straddle will yield a profit in the months to come.

Still, it is important to emphasize that the backtest has limitations. First, since it is concerned with the last ten months, the sample period is very short; this makes it difficult to draw any conclusions based on the data alone. Besides, since the options on the Euro-BTP futures contracts are American options, it is difficult to estimate the past payoffs correctly because different traders may exercise the options at different times. Moreover, a one-off spike in volatility – as seen in mid-2018 – does not guarantee that similar spikes will happen in the future, in which case the long straddle can lose money over long periods. Yet, as was argued earlier, such spikes are not unlikely to happen again.

With 2018 coming to an end, Italian PM Giuseppe Conte have expressed confidence that an agreement soon will be reached on disputed spending plans. Still, it remains to see whether the European Commission will accept a budget deficit target greater than 2 percent.[23] Nevertheless, the positive statement from the PM and Rome's decision to trim its 2019 deficit target incurred slight optimism as some debt driven investors returned to the Italian debt market.[24] Still, Italy certainly has a troublesome future ahead: a fundamentally weak economy and world-leading debt ratios; a populistic government; right-wing movements; and a possible EU penalty.[25] Indeed, €400bn need to be raised in 2019 for debt repayments and spending, and will be more challenging as the ECB bond purchase program will have ended by then.[26] If borrowing costs rise, Italy may face severe fiscal difficulties.

In conclusion, then, a lot of uncertainty remains, and there are clearly potential events in the future that could bring back the level of volatility seen in mid-2018. This is good for traders who plan to pursue a long straddle. The outlook ahead makes the strategy viable as a potential source of alpha.

[23] Follain, John. "Conte Says His Budget Deficit Offer Is the Best Italy Can Do." *Bloomberg*. Dec 14, 2018.
[24] Rao, Sujata. "Bond Vigilantes Reckon Their Job Is Done in Italy." *Reuters*. Dec 14, 2018.
[25] Rao, Sujata. "Bond Vigilantes Reckon Their Job Is Done in Italy." *Reuters*. Dec 14, 2018.
[26] Rao, Sujata. "Bond Vigilantes Reckon Their Job Is Done in Italy." *Reuters*. Dec 14, 2018.

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All economic/market data, including futures/options prices, are taken from Bloomberg's Terminal as well as from Eurex Exchange directly. Figures, graphs and tables – except for the ones in section 2.2 from Chicago Mercantile Exchange – are produced by the authors with the software "R".

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