The Buy-Write Strategy: Effect of Asset Class and Investor Sentiment

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โอลิเวอร์ พาลเมอร์ : กลยุทธ์การซื้อขาย : ผลของกลุ่มสินทรัพย์และความรู้สึกของนักลงทุน (The Buy-Write Strategy: Effect of Asset Class and Investor Sentiment) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร. สันติ ถิรพัฒน์, หน้า.

จุดประสงค์ของวิทยานิพนธ์เล่มนี้คือ ขยายความกลยุทธ์การซื้อขายจากผลจากการวิจัยที่มีผู้สำรวจไว้แล้ว โดยการตรวจสอบจากผลของกลุ่มสินทรัพย์และความรู้สึกของนักลงทุนต่อกลยุทธ์วิธีในการบรรลุเป้าหมาย จากการสำรวจผู้วิจัยได้ผลสรุปว่าไม่มีหลักฐานที่พิสูจน์ได้ว่าผลของกลุ่มสินทรัพย์มีผลกระทบต่อกลยุทธ์การซื้อขายที่ซึ่งผลลัพธ์ได้ตรงกันข้ามกับผลการวิจัยก่อนหน้านี้ อย่างไรก็ตาม ผู้วิจัยมีความเห็นว่าความสัมพันธ์ระหว่างกลยุทธ์การซื้อขายกับความรู้สึกของนักลงทุนเป็นสิ่งที่สอดคล้องกันกับการค้นคว้าก่อนหน้านี้

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Existing research focuses on buy-write strategy performance when index options are used as the underlying asset, finding positive excess risk-adjusted returns which are suggestive of option overpricing. My purpose is to extend this literature by conducting a thorough analysis of strategy performance when individual stock options are used instead of index options. Moreover, I examine whether underlying asset class and investor sentiment has an effect on buy-write performance. Using US data from 2008 - 2015, I sort S&P 500 constituents to form portfolios of large, small, growth and value stocks and test for differences in buy-write performance. The returns of each portfolio are then regressed against 2 separate proxies of investor sentiment and several control variables to test the effects of investor sentiment. Contrary to aforementioned buy-write research, I find no evidence of excess risk-adjusted returns, likely due to the implied vs. realised volatility anomaly which is observed in index options but not stock options. Despite existing evidence that options on small and value stocks are expensive relative to large and growth stocks, I find no evidence that firm characteristic has an effect on buy-write performance. This is potentially explained by the relative illiquidity of small and value options resulting in increased trading costs which are not accounted for in previous studies. Consistent with the literature, my results show that in general, investor sentiment has a positive relationship with buy-write returns, especially for small and value stocks. Additional sub-sample analysis shows that during a market downturn the effect of investor sentiment is much stronger, likely due the limited ability of arbitrageurs to exploit mispriced securities. During times of low market volatility the effect of investor sentiment becomes lagged and much weaker in magnitude.

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CHAPTER 1
INTRODUCTION

1.1 Background and Problem Review

The buy-write or covered call strategy is a passive investment tool consisting of a long position in the underlying asset and a short position in a near-term out-of-the-money call option. Typically, it is used by investors who are moderately bullish in sentiment and who are willing to sacrifice upside potential gains in order to net the premium received from selling the call option, thus providing a cushion for any downside losses. In other words investors want to boost their income whilst simultaneously reducing portfolio volatility.

Historically, the strategy did not generate a particular amount of interest amongst investors with many academics arguing that the reduction in portfolio risk is accompanied by a disproportional reduction in returns which more than offsets the risk reducing benefits. However in more recent times and particularly since the study of Whaley (2002), the strategy has grown in popularity and is now widely accepted as a highly effective passive options-based investment strategy. So much so that following the successfulness of the study, the Chicago Board Options Exchange (CBOE) launched the BuyWrite Index (BXM)[1] as a benchmark for measuring performance of buy-write strategies. The reason for the growth in popularity is perhaps down to the significance of Whaley’s findings, he found that on average between 1988

[1] “The BXM is a benchmark index designed to track the performance of a hypothetical buy-write strategy on the S&P 500 index.” (CBOE, 2002)

and 2001 the buy-write strategy outperformed the underlying S&P 500 index by 0.2% on a risk adjusted returns basis even after adjusting for trading costs. A number of subsequent studies have found results consistent with this in other developed markets and across more recent time periods[2], leaving the usefulness of the strategy in no doubt. But how this strategy is able to consistently outperform the market index would appear to be in violation of the efficient market hypothesis (EMH).

To understand how this may be possible let us identify the sources of strategy returns. There are two sources of return, first the amount of premium received from selling the option and second the appreciation or depreciation in the price of the underlying asset. Upside gain is capped at the strike price of the call option that is sold. Therefore performance in comparison with a straight long position in the underlying relies on the amount of premium received from writing the call option which is suggestive of widespread and systematic overpricing of index call options. Whaley (2002) and O’Connell & O’Grady (2014) conclude that the excess returns can be explained by the excessive implied volatility of index options which are used to construct the buy-write strategy. On average when compared with the subsequent realized volatility of the underlying index, index option implied volatility is higher. In other words, investors consistently overestimate the future volatility of the underlying index. A number of studies find similar and other anomalies in the options market.

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[2] See Ibbotson (2004), Callan Associates (2006), Asset consulting group (2012), O’Connell and O’Grady (2014)

Bollen & Whaley (2004) find that buying pressure from investors on index options drives the shape of the implied volatility function, which suggests that increased buying demand tends to drive up option prices. There is evidence that investors misestimate future volatility due to overreactions to current stock returns information (Barberis and Huang, 2001). In addition, there is research to suggest that there are differing degrees of mispricing between growth index options and value index options, as demonstrated by Blackburn, Goetzmann & Ukhov (2009). More specifically they identify clientele effects between investors in growth indexes and investors in value indexes, with growth index investors displaying a lower level of risk aversion than value index investors. They then show that by selling growth index options and buying value index options, positive abnormal returns can be generated, hence growth index options tend to be overpriced relative to value index options. Versluis, Lehnert & Wolff (2010) extend Black & Scholes 1972 option pricing framework by incorporating the principles of cumulative prospect theory (Tversky & Kahneman 1992) into their model. Their model fits market index option prices significantly better than the Black and Scholes model showing that behavioral factors do have an effect on option pricing. The role of investor sentiment in asset pricing is also a well-researched topic with strong evidence of a relationship with security prices. For clarity, when I say investor sentiment I refer to the mood or feeling of investors with regard to future market prices. High/bullish/optimistic sentiment means investors expect prices to rise, low/bearish/pessimistic sentiment means investors expect prices to fall. Han (2008) finds evidence that in times of bullish sentiment, investors tend to bid up the prices of index call options. Lemmon & Ni (2010) identify a positive relationship between stock option prices and investor sentiment caused by an increase in speculative demand in bullish market conditions. Additionally investor demand for growth index options vastly increases in bullish times, whereas value index option demand remains relatively constant (Coakley, Dotsis, Liu, Zhai, 2014). All of these studies support Garleanu, Pedersen & Poteshman's (2009) demand based approach to asset pricing. Their model shows that demand pressure on an option contract increases its price by a magnitude equal to the variance of the unhedgeable component of the option. The key idea behind this part of my study is that increased sentiment leads to increased demand leading to increased option expensiveness and increased buy-write returns.

This study examines the performance of the buy-write strategy when four different classes of underlying asset are used, I will compare portfolios consisting of small stocks, large stocks, growth stocks and value stocks. The existing literature on asset class and option expensiveness is thin with only a handful of studies addressing the issue which provides additional motivation for my study. First I compare the performance of each asset class portfolio against a long only position in the underlying portfolio to identify any excess risk-adjusted returns. Second I compare the buy-write performance of large vs. small and growth vs. value stocks by forming long-short portfolios of buy-write excess returns. Third I investigate the role of investor sentiment on buy-write returns using 2 separate proxies for investor sentiment. As a measure of individual investor sentiment I use the University of Michigan Consumer

Sentiment Index and as a measure of institutional sentiment I use the Investors Intelligence Bull Bear spread. Finally, I repeat the above focussing on two different sub-sample periods, firstly I examine a period of relative low sentiment around the crisis period (2008-2011) and secondly I examine a period of relative high sentiment (2012-2015) to observe any differing effects that may occur due to changing market conditions.

1.2 Objectives

The objectives of my study are threefold. Firstly, I want to thoroughly assess the performance of the buy-write strategy when different classes of asset are used as the underlying to identify the usefulness of my proposed variations. Secondly, I hope to identify mispricing (if any) in call options of different asset class. Thirdly I aim to provide additional evidence regarding the current explanations for mispricing. This can have wide reaching implications for all types of investors, particularly those who have a preference for investing in certain asset classes by potentially providing a means of exploiting asset mispricing to enhance portfolio returns. In essence this could spawn new variations on the buy-write strategy, providing investors with new passive options-based investment strategies to optimise their portfolios.

1.3 Contributions

Despite the evidence for varying degrees of option mispricing for differing asset classes there has not been any published studies in the US market addressing the performance of the buy-write strategy when different asset classes are used as the underlying. Also, as far as I know, all published research on the buy-write strategy using US data focuses on the use of index options; there are no studies on its performance using equity options as the underlying asset. Logic would suggest that buy-write performance should increase with the degree of overpricing, therefore as certain asset classes appear to be more vulnerable to mispricing than others we could see variation in buy-write excess returns (Risk-adjusted returns of buy-write portfolio – risk-adjusted returns of long only position in the underlying portfolio). Based on the strong evidence for the existence of a relationship between sentiment and option expensiveness we should see similar variations in times of high optimism (Bullishness) and low optimism (Bearishness). It is these “gaps” in the literature my study fills.

CHAPTER 2

LITERATURE REVIEW

The literature relevant to this research spans across several areas, therefore I split my review into sections. I will discuss each in turn starting with the history of the buy-write strategy and its performance, followed by a review of asset mispricing in the stock market and the possible explanations behind the size and book-to-market effects. Next, I summarize the literature regarding the mispricing of options and then explore previous research on the role of investor sentiment in mispricing.

2.1 The Buy-Write Strategy

In the early days of the covered call strategy it was generally rejected by academics due to the risk-return trade-off nature of the strategy. The view was that the strategy could reduce risk, but only by giving up a disproportionate amount of potential returns. However as time progressed investors started to see the usefulness of the strategy, particularly when Whaley was commissioned by the CBOE to construct the BXM index in 2002. More importantly he found that the buy-write strategy using the S&P 500 as the underlying asset earned excess risk-adjusted returns compared to a buy and hold position in the S&P 500. By the principles of the EMH this should not happen and has led to questions regarding the efficiency of index option pricing. Subsequent to Whaley's findings several other studies on the US market were undertaken which reinforce his results. In 2004 a case study was undertaken by Ibbotson Associates examining a 16 year time period from 1988-2004. Their results support Whaley's findings and add to them. First they show that the buy-write strategy can be used as an effective substitute for large cap stocks in a standard investment portfolio. Second, by considering performance measures such as the Stutzer Index (2000) and Leland's Alpha (1999), they show that levels of skew and kurtosis do not materially affect buy-write performance. More recently, the Asset Consulting Group (2012) extended the time period even further and still found results consistent with Whaley's original research. Additionally there have been a number of studies regarding buy-write index strategies in different markets which also come to the same conclusion. For example, O'Connell & O'Grady (2014) study buy-write performance using the Australian S&P/ASX 200 XBW Index from 1991-2013 finding that the buy-write strategy offered superior returns at a lower standard deviation too.

However the source of this outperformance is not so obvious. The fact that the buy-write strategy is able to consistently outperform its underlying index would appear to contradict the EMH. To test this is not possible due to the joint hypothesis problem, in other words we cannot tell if the EMH is wrong or our portfolio performance measures are inaccurate. One such observation that is consistent across studies is that the volatility implied from the call option price tends to exceed its realized volatility[3], suggesting that call options are traded at a price exceeding their fair value. It seems to be this

[3] See Fanelli (1990), Schneeweis and Spurgin (2001), Whaley (2002), Bollen and Whaley (2004), Feldman and Roy (2004), Callan Associates (2006), O'Connell O'Grady (2014).

overpricing that drives buy-write excess returns relative to the underlying index.

2.2 Mispricing in the Stock Market

A majority of the mispricing literature comes from the stock market and there are two main points of view regarding the subject, the EMH point of view and the behavioral point of view. Research results are mixed. Certain studies investigating the size and book-to-market effects support that the superior returns of small and value stocks is compensation for increased risk exposure (Bauman, Conover, Miller 1998; Fama & French 1998), whereas behavioral studies find contradicting evidence and offer different explanations. LSV (1994) examine contrarian investment strategies with regards to value and growth stocks finding "little, if any" evidence to show that value strategies are riskier. They argue that investors overreact to both stocks that have good past performance and those with poor past performance, as a result investors bid up prices of growth stocks and sell down prices of value stocks. Also they hypothesize that small stocks outperform large stocks due to investors having a preference for larger stocks, such that they also bid up the price of these assets. Similarly Thaler (1985; 1987) follows a similar line of thought by showing that extreme losers outperform other stocks in the future. Further evidence challenging Fama & French's explanation is provided by Daniel & Titman (1997), "it is the characteristics rather than the covariance structure of returns that appear to explain the cross-sectional variation in stock returns".

La Porta (1996) conducts event studies around earnings announcements which suggest that the market is overly optimistic about the earnings of growth stocks and overly pessimistic about the earnings of value stocks. Skinner & Sloan (2002) support this argument also, by showing that growth stocks react asymmetrically to negative earnings surprises. More recently this has been extended to the options market with findings suggesting that unsophisticated option market investors overreact to past information and wrongly believe that mispriced stocks will move further away from fair value when news becomes available (Mahani & Poteshman, 2008). He, Lee & Wei (2010) compare informational related reactions of growth and value stocks by using options on the Nasdaq 100 and Russell 2000 growth indices as proxies, finding a stronger reaction from the growth index when compared to the Russell 2000 value index.

These studies are not conclusive, but they provide evidence that behavioral factors such as investor preference, optimism and overreaction are potential explanations for why we observe mispricing. Further, if we consider the fact that in general option implied volatility exceeds realized volatility, then this would suggest that the mispricing of options is not attributable to any unobserved risk factors, rather that there are other behavioral variables driving this mispricing.

2.3 Option Mispricing

A majority of the literature on options mispricing is behavioral in nature and focuses on the use of options written against a market index rather than individual stocks. In Whaley's 2002 study he attributes the excess risk-adjusted returns of the buy-write strategy to the implied vs. realized volatility anomaly. The implied volatility of the index options he used exceeded their subsequent realized volatility, an observation also noted in a small handful of previous studies[4] and numerous subsequent studies. Bollen & Whaley (2004) examine the implied vs. realized volatility relationship for S&P 500 index options and the 20 largest component stocks of the S&P 500. They show that on average implied less realized volatility is positive for S&P 500 options but negative for the individual stock options, suggesting index options are expensive and individual stock options are cheap. Further they compare how index options and individual stock options react to changes in net buying demand from investors. They find a significant difference in their implied volatility functions (IVF), concluding that demand for index puts drives the index IVF and demand for stock calls drives stock IVF. Bakshi, Kapadia & Madan (2003) compare the prices of OEX and 30 individual stock options, finding that the volatility skew of equity options is flatter than that of index options. These studies highlight the differential properties and pricing of index and individual stock options giving me reason to believe that buy-write performance may vary when stock options are used instead of index options. But, it should be noted that these two studies only look at options on the largest stocks of the S&P 100/500; therefore they tell us nothing about small, growth and value stock options.

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[4] See Stux & Farnelli (1990) and Schneeweis & Spurgin (2001)

Interestingly, there is evidence to suggest that options on growth and value indices display differing degrees of mispricing. Take Blackburn, Goetzmann & Ukhov (2009) for example, who use options trading data to identify clientele effects with regards to risk preference. More specifically they find that value investors are more risk averse compared to growth investors, suggesting growth investors are willing to pay a higher price for the same level of risk than an average value investor. Indeed it would seem so, by buying value index options and selling growth index options they generated positive abnormal returns.

Pietro & Vainberg (2006) find results that contradict Blackburn, Goetzmann & Ukhov (2009); however they use individual stock options rather than index options. Pietro & Vainberg construct synthetic variance swap positions where the holder pays implied volatility and receives realized volatility to examine the pricing of systematic variance risk of equity options, finding that firm characteristics are linked to option prices. By analyzing the returns of these synthetic variance swaps they conclude that small stocks are overpriced relative to large stocks and value stocks are overpriced relative to growth stocks. Also they confirm that equity options appear to be cheap relative to index options, therefore Bollen & Whaley's (2004) and Bakshi, Kapadia & Madan's (2003) results appear to hold when different types of stock are considered. Additional studies provide support for Pietro and Vainberg's findings. Vilkov (2008) conducts a comprehensive analysis of the variance risk premium, finding supporting evidence for growth and value stocks but not small and large stocks. Carr & Wu (2009) also find cross-sectional variation in variance risk premia of 35 individual stock options.

Such anomalies and market deviations from the Black and Scholes pricing model have motivated researchers to devise alternative asset pricing models in an attempt to improve the fit of the Black Scholes model and identify factors which drive option mispricing. The most recent attempt takes the ideas of cumulative prospect theory and incorporates them into the Black Scholes model to capture behavioral factors such as risk attitude, mental accounting and probability perception (Wolff et al., 2010). Cumulative prospect theory (Tversky & Kahneman 1992) is an extension of their original prospect theory (1979) with the same underlying principles. Contrary to traditional utility theory, prospect theory declares that investor have an asymmetric S-shaped utility function which is concave in the domain of gains and convex in the domain of losses around a certain reference point, meaning individuals risk attitude changes depending on if they perceive themselves to be in the domain of gains or losses. As such they value prospects differently depending on this perception. By accounting for these risk attitudes, Wolff's model fits market options prices more accurately than Black Scholes, finding that more risk averse behavior from option sellers leads to higher call option prices.

2.4 Investor Sentiment and Option Mispricing

Several studies investigate the role of investor sentiment on options pricing, providing evidence to support the existence of a relationship. Han

(2008) examines whether investor sentiment has an effect on the price of S&P 500 index options. The answer is yes, investor sentiment impacts the volatility smile and risk-neutral skewness derived from S&P 500 option prices. Put simply, when investor sentiment increases, so do option prices. Han’s findings have been extended by Coakley et al. (2014) to address the issue of whether sentiment effects growth and value index options asymmetrically. They show that growth index option prices have a positive relationship with investor sentiment, whereas value index option prices have a surprisingly negative relationship. In 2007 Lakonishok et al. assessed option trading during the dot com boom around 1997-2000, finding that unsophisticated investors drastically increased their purchases of call options on growth stocks, but not value stocks which provides a potential explanation for Coakley’s results. Perhaps investor preference gravitates towards growth stocks in times of high sentiment. Related research from Lemmon & Ni (2010) shows that demand for index options is not actually effected by sentiment, whereas the demand for stock options is positively related to sentiment measures. They attribute this to the trading activities of unsophisticated investors who tend to speculate on market movements, whereas index options are more typically traded by institutional investors for hedging purposes. Put simply, demand for stock options increases with sentiment leading to increased call option prices. This concept is the basis of Garleanu, Pedersen & Poteshman’s (2009) study who find a positive relationship between option prices and investor buying demand.

CHAPTER 3
HYPOTHESIS DEVELOPMENT

Below I state each hypothesis, followed by an explanation which justifies my expectations. Bear in mind that the performance of the buy-write strategy in comparison with a straight long position in the underlying relies on the amount of premium received from writing the call option. Therefore if we observe a higher degree of overpricing then we will observe higher buy-write strategy returns.

Hypothesis 1: Buy-write strategy using small stocks as the underlying asset will outperform strategies using large stocks as the underlying.

There is evidence to suggest that options on small stocks are more expensive than options on large stocks. Pietro & Vainberg (2006) examine the cross-sectional variation in variance risk premia, identifying such a link between firm characteristics and option mispricing. They conjecture that investors overestimate the risk of small stocks, therefore they are willing to overpay for options on small stocks. Further research from Carr & Wu (2009) also finds that firm characteristics can explain a small portion of variance risk premia. Based on the sources of buy-write strategy returns discussed in the introduction I would expect that a small stock buy-write should outperform a large stock buy-write on a risk adjusted excess returns basis. Since small stock options appear to be more expensive than large stock options, the premium from writing the option is higher, leading to superior buy-write returns. Since I judge performance based on the excess risk-adjusted returns, the performance of a long-only position in the large, small, growth and value portfolios are irrelevant and are simply used as a benchmark to measure buy-write performance.

Hypothesis 2: Buy-write strategies with value stocks as the underlying asset will outperform strategies using growth stocks as the underlying.

Pietro & Vainberg (2006) also find that as with small stocks, investors overestimate the volatility of value stocks, as such they overpay for options on value stocks. Therefore since value options seem to be overpriced, I would expect the value stock buy-write portfolio to outperform the growth stock buy-write portfolio.

Hypothesis 3: In periods where investor sentiment is high the buy-write strategy will produce higher returns than when investor sentiment is low.

Several studies have shown that investor sentiment has an effect on trading in the option market. In particular Han (2008) finds that in times when sentiment is bullish, S&P 500 index call option prices increase. Garleanu, Pedersen, & Poteshman (2009) find similar results for equity options, using an increased demand for call options in bullish times as an explanation. Lemmon & Ni (2010) also find that speculative demand is linked to investor sentiment. In addition they find evidence that stocks which have a high concentration of speculative trading are more sensitive to investor sentiment; such stocks include “smaller size stocks”, but it is also stated that certain large stocks may be affected too. More recently Coakley et al. (2014) observed that sentiment has a positive impact on the price of growth index options and perhaps surprisingly a negative impact on value index options.

The literature suggests that investors bid up call option prices of both index and equity options when optimism is high and that growth, small and value stocks are most sensitive to investor sentiment. Therefore it is my expectation the buy-write strategy will perform better in times of high optimism due to an increased demand for call options driving up prices. This effect should be particularly large for growth stocks since overly optimistic investors tend to migrate towards growth stocks.

CHAPTER 4
DATA AND METHODOLOGY

4.1 Data Collection and Variables

To form my portfolios of assets I take my data from all firms of the S&P 500 before manually sorting them by the desired characteristic of each portfolio. For each stock I require its book-to-market ratio and market capitalization for sorting purposes. Also required is the daily price series for each stock, since we will be back testing trading strategies it is important to use the unadjusted price as this is the price that would have been used to settle the option at the time of expiry. I manually adjust for the effects of stock splits on the call option settlement. Further, I need the price of the nearest term out-of-the-money call option with one month until expiry starting from the same day that the previous option expires (available from data stream). To benchmark performance of each buy-write portfolio, I compare its performance to that of a long only position in the underlying portfolio. Also, the BXM can be conveniently used as an additional benchmark for measuring the performance of each buy-write portfolio. The BXM is an index representing a theoretical covered call strategy on the S&P 500 index intended as a benchmark for investors to measure the performance of their options-based strategies; therefore we can use it to gauge the performance of each buy-write portfolio relative to the index strategy. Historic BXM data can be obtained from the CBOE website.

Also needed are proxies for measuring investor sentiment. Following the choices of Lemmon & Ni (2010) and Coakley et al. (2014) I use two measures. First, the University of Michigan consumer sentiment index (CS). It is constructed by surveying households regarding their views on the outlook of the financial market making it a suitable proxy for individual investor sentiment. Next, as a proxy for institutional sentiment I will use the Investors Intelligence Bull-Bear Spread (BB) which is based on a survey of independent market newsletter authors who are regarded as market professionals, hence its usefulness in measuring institutional sentiment. In my regression model, I also use the CBOE Market Volatility Index (VIX) as a control variable. VIX is a measure of implied volatility based on index options of the S&P 500. More specifically, it measures investors' expectations of future volatility for the next 30 days. Since expectations of future volatility have an effect on option prices VIX is used to control for this factor. Also in my regression model I use the Fama & French 3 factor variables, which can be obtained from the Wharton Research Data Services (WRDS) database.

In addition to measuring performance over the full 7 year period I also divide the sample into sub-samples in order to capture the effects of differing investor sentiment. More specifically I will split the sample into 2 periods to examine each market state individually. First I will look at June 2008-December 2011, i.e. the period during and following the crisis. Secondly I will look at January 2012 – May 2015 i.e. the period of low market volatility and increasing sentiment as the economy recovers from the crisis.

4.1.2 Portfolio Formation

First and foremost I form 4 portfolios of stocks based on their underlying asset class (Large, small, growth and value). I sort the data based on firm size and book-to-market ratio since these are the factors that I wish to capture employing a two pass sort or “slicing” technique as used by Fama & French in their 1992 paper to measure the effects of size and book-to-market ratio on stock returns. To form my size based portfolios I first sort the S&P 500 universe by book-to-market ratio. Second I separate the ranked firms into deciles before re-ranking each decile by size, high to low. I then take the top ten percent of stocks in each sorted decile to form a large size, mixed book-to-market portfolio and the bottom ten percent of stocks in each decile to form a small size mixed book-to-market portfolio (See figure 1). By forming size portfolios with mixed book-to-market values I effectively control for any interaction between the two, which could distort my results. To form my high and low book-to-market portfolios I repeat the same process but sorting by size first, then by book-to-market ratio. The result will be 4 portfolios of approximately 50 stocks. Since small stocks can grow large and growth stocks can become value stocks or vice versa, I rebalance each portfolio at regular intervals. By rebalancing at the end of each year, I ensure that my small portfolio remains small and my growth portfolio remains growth etc. For the stock weighting within each portfolio I use equal weighting to avoid any size related biases. Therefore when I calculate portfolio buy-write returns, I effectively get the average performance of a buy-write strategy on each asset class.

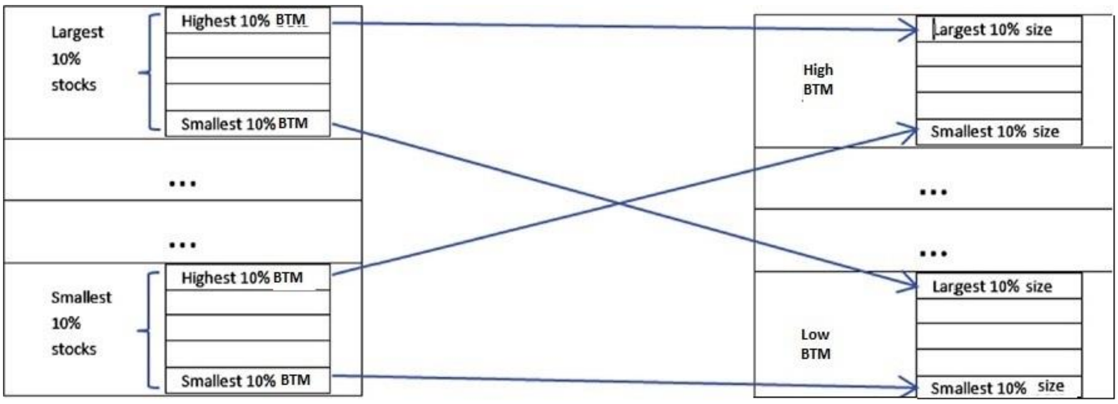

Figure 1. Source – Fischer and Wermers 2013

4.2 Data Analysis

4.2.1 Buy-Write Returns Calculation

Once my data is sorted into the appropriate portfolio I proceed to calculate the buy-write performance of the portfolio as well as the performance of a long-only position in the underlying portfolio which is to be used to benchmark the buy-write performance of each portfolio. I follow the methodology of Whaley's 2002 study, however adjustments are required since I use weekly returns instead of monthly returns and since I use a portfolio of equity options instead of a single index option. Effectively I calculate the performance of a buy-write strategy on each individual stock in the portfolio and take the average returns in order to derive portfolio performance. For each stock I use the nearest out-of-the-money call option with one month to expiry which is written on the day the previous contract expires (typically the third Friday of each month).

To calculate the daily returns of the underlying portfolio I simply take the daily price series for each stock and compute as follows

$$R_{i,t} = \frac{S_t - S_{t-1} + D_t}{S_{t-1}} \qquad (1)$$

where S_t is stock price on the current day, S_{t-1} is stock price on the previous day and D_t is the cash dividend (if any) paid on the current day. Note that this method assumes that any dividends paid are reinvested back into the stock instantaneously. Subsequently we simply take the average returns of each stock in the portfolio which can easily be done by

$$R_{p,t} = \sum_{i=1}^{N} \frac{R_{i,t}}{N} \qquad (2)$$

where N is the number of stocks in the portfolio. Next, I compute the returns from the buy-write strategy on each stock following a similar process to above, except adjusting for the value of the call option.

$$R_{BWi,t} = \frac{S_t - C_t}{S_{t-1} - C_{t-1}} - 1 \qquad (3)$$

C_t represents the price of the call option on the current day and C_{t-1} represents the price 1 day prior. On the day the call option is written the bid price is used after which the price used is the arithmetic average of the last bid-ask quotes on each day reported before 4PM, see equation (4). Therefore a trading cost of half the bid-ask spread is accounted for in my results. Since the short position in the call option is held, if $C_t > C_{t-1}$ then money is lost from the option position and vice versa. In other words, on days the price of the call option falls, the buy-write will outperform the underlying and on days it rises the underlying will outperform.

$$C = \frac{Bid_{4PM} + Ask_{4PM}}{2} \qquad (4)$$

If the strike price (X) of the expiring call option (y) is less than the closing settlement price (CSP) then there will be a settlement obligation (SO) since the strategy is short in the call option. If CSP>X, the settlement obligation is the difference between X and CSP and is 0 otherwise (see equation 5). The settlement obligation is used as the option price on the day of expiry.

$$SO_y = max(0, CSP - X) \qquad (5)$$

Finally the portfolio buy-write returns are computed simply by taking the average return from each stock in the portfolio.

$$R_{BWp,t} = \sum_{i=1}^{N} \frac{R_{BWi,t}}{N} \qquad (6)$$

Then before performance evaluation I convert daily returns to weekly returns to reduce statistical noise, whilst still providing a substantial amount of observations for my subsequent statistical analysis.

$$R_{Weekly} = \prod_{t=1}^{5} (1 + R_{Daily,t}) - 1 \qquad (7)$$

4.2.2 Buy-Write Portfolio Performance and Evaluation

Following this I conduct portfolio performance and evaluation of each portfolio. To measure performance I utilise the most common measures of portfolio performance for comparability with previous and future studies. These measures are; Sharpe ratio (1966), M^2 ratio (1997), Treynor ratio (1965) and Jensen's alpha (1968). See equations below.

$$S = \frac{R_p - R_f}{\sigma_p} \qquad (8)$$

$$M^2 = \left(R_p - R_f\right)\left(\frac{\sigma_m}{\sigma_p}\right) - \left(R_m - R_f\right) \qquad (9)$$

$$T = \frac{R_p - R_f}{\beta_p} \qquad (10)$$

$$\alpha_{BW} = \left(R_{BW} - R_f\right) - \beta_{BW}\left(R_{LO} - R_f\right) \qquad (11)$$

R_{BW}, R_f and R_{LO} represent daily returns of the buy-write (BW) portfolio, risk free investment and long-only (LO) portfolio returns respectively. The σ_p and σ_m variables represent standard deviation of the BW portfolio and market benchmark. β_p denotes the systematic risk between the BW portfolio and the LO portfolio which I estimate using a standard OLS regression.

The performance of the BW portfolio depends on how well it compares to the LO portfolio, therefore performance measures are calculated for both the BW portfolio and the LO portfolio. The difference between the BW portfolio and LO portfolio performance measures is taken as the excess risk-adjusted returns which is then used to assess buy-write strategy performance. Where appropriate, I test for a statistical difference between the BW performance and LO performance. Any positive excess returns would suggest outperformance and call option overpricing.

In order to test my hypotheses I construct a long-short portfolio to identify the effect of asset class on buy-write performance. For each asset class I construct the excess returns series by deducting LO returns from BW returns (BW-LO). To answer hypothesis 1, I take a long position in the large portfolio excess returns (BW_{Large} - LO_{Large}) and a short position in the small portfolio excess returns (BW_{Small} - LO_{Small}), I then test the average returns of this long-short portfolio for statistical significance. If I find significant average returns then this would suggest that there is a difference in buy-write performance when large and small stocks are used as the underlying. For hypothesis 2 I do the same, taking a long position in growth excess returns (BW_{Growth} – LO_{Growth}) and a short position in value excess returns (BW_{Value} – LO_{Value}). Comparing excess risk-adjusted buy-write returns between different asset class portfolios gives a simple comparison of performance and acts as a proxy to determine differences in how investors value call options of different asset class.

Both Whaley (2002) and O'Connell & O'Grady (2014) express concern about the aforementioned performance measures with regards to the fact that investors have differing preferences towards upside and downside risk.

Traditional standard deviation assumes that investors view positive and negative deviations in the same way, in other words deviation in any direction is bad. However this is far from the case in reality, in actual fact “Investors are willing to pay for the chance of a large positive return (i.e. positive skewness), holding other factors constant, but will want to be paid for negative skewness”(Whaley,2002). As traditional performance measures don’t account for this, risk-adjusted performance may be biased. Therefore as a robustness check I calculate Markowitz’s semi standard deviation (SSD) (1959) which I then use to calculate the Sortino ratio (1983). The Sortino ratio is similar to the Sharpe ratio, but uses semi standard deviation rather than standard deviation.

$$SSD = \sqrt{\frac{\sum_{i=1}^{N}\left(R_{i,t}-\mu_{i,t}\right)^2}{N}} \quad \text{For } R_{i,t} < \mu_{i,t} \text{ only.} \qquad (12)$$

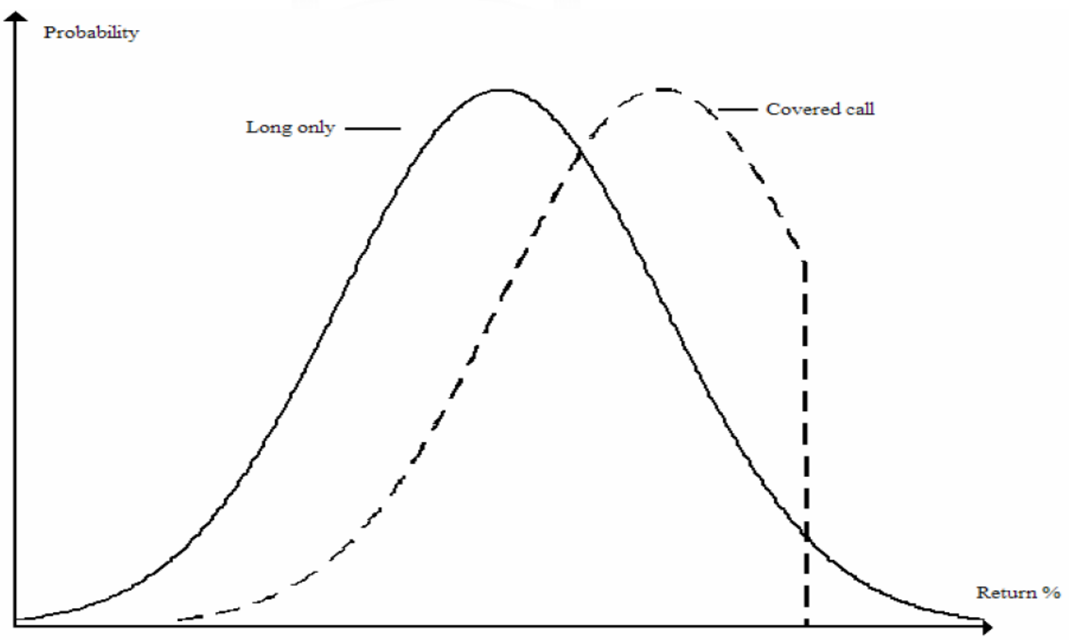

Figure 2. Source – Groothaert and Thomas 2003

SSD only accounts for undesirable negative deviations from the mean, thus adjusting for the risk attitude of investors. This is especially important as buy-write strategy returns tend to be negatively skewed due to the limited upside of the returns distribution, symbolizing the asymmetry that SSD adjusts for. See figure 2 for a visual representation.

4.2.3 Measuring the effect of investor sentiment

Finally I observe the influence of investor sentiment or investor optimism on each BW portfolio. To do this I extend the Fama French 3 factor model (1993) to include the VIX as a control variable, a proxy for investor sentiment and a lagged proxy for investor sentiment. Investors may overpay for options because of two reasons, first they may overestimate the future volatility of the option and second they may be overly optimistic regarding the upward price movement of the underlying asset. Since I want to measure the latter, VIX is a useful control for the former. As previously mentioned, the CS and BB are used as proxies for measuring investor sentiment and BW portfolio returns are used as the dependent variable. I use the Fama French 3 factor variables since my portfolios are size and BTM orientated, therefore these factors should capture any return not attributable to sentiment. Any relationship with investor sentiment is easily identified by observing the coefficient of the sentiment variables. Therefore, to answer hypothesis 3, I will do exactly this. For the CS and BB, a positive coefficient suggests that buy-write performance improves in times of high optimism and a negative coefficient suggests the opposite. See below for the proposed regression model.

$$R_{BWp,t} = \alpha_p + \beta_p\left(R_m - R_f\right) + s(SMB) + h(HML) + v(VIX) + o(sent) + p(sent\ t - 1) + \varepsilon_{i,t} \quad (13)$$

SMB and HML refer to the Fama French size and book-to-market research factors, VIX refers to the CBOE Market Volatility Index, sent refers to the sentiment index and sent t-1 refers to the lagged sentiment variable. For each portfolio I run the regression twice, once with the CS as the sentiment variable and once with the BB as the sentiment variable, thus the differential effects of individual and institutional sentiment are easily compared and aggregated to consider market wide sentiment.

Additionally I will split my sample into two sub-sample periods in order to limit the effects of changing sentiment over time and observe how the effects vary depending on market conditions. For each period I re-run the above regression. First, I examine June 2008 – December 2011, a period of rapidly falling and subsequently low sentiment following the onset of the financial crisis. Second December 2011 – May 2015, a period of rising sentiment as the global economy recovers after the crisis.

CHAPTER 5
RESULTS

Stocks for which data was unavailable were omitted from the dataset. Typically data was not available because of bankruptcy in the middle of the rebalancing period or due to mergers and acquisitions. If a company was involved in a merger or acquisition then it was omitted due to the subsequent change in company fundamentals following the event. It is important to note that if the bid price was not available on the date the call option was written then the option fair value[5] is used instead to ensure that results remain accurate and free from bias.

5.1 Descriptive Statistics

Table 2a and 2b show the descriptive statistics of both the long only and buy-write portfolios for each asset class. In table 2a results from the whole sample period are included, however table 2b omits the year 2008. This is because it can be clearly seen that the extreme returns in 2008 had a huge destabilising effect on the standard deviations of the all portfolios, therefore meaningful conclusions would be difficult to establish if we include this period. O'Connell & O'Grady (2014) note that in times of extreme volatility, buy-write strategy performance is poor compared to a long only position in the underlying despite the downside protection the strategy offers. They speculate that this is due the fact that a buy-write strategy is a combination of two

[5] DataStream fair value is calculated using the Black Scholes Model.

positions (short call and long stock) that in normal times would be uncorrelated with each other, but under extremely volatile conditions the correlation between the two instruments converges to one, which results in an increased number of left tail returns. For this reason, I will focus my analysis on the period excluding 2008. For robustness see table 1 showing the ranking of excess risk adjusted performance in the sample including 2008 and the sample excluding 2008. By taking the Sharpe Ratio of the buy-write portfolio and deducting the Sharpe Ratio of the long-only portfolio we obtain excess risk adjusted returns of the buy-write strategy. When these excess risk-adjusted returns are ranked from largest to smallest, we can see that there is no change in the order between the two samples, thus showing that excluding 2008 from the sample has no effect on the overall relative performance of each portfolio.

Table 1

Excess Sharpe Ratio Ranking In Sample Periods

2008-2015			2009-2015		
BW-LO Ranking	**Portfolio**	**Excess SR**	**BW-LO Ranking**	**Portfolio**	**Excess SR**
1	Growth	0.007	1	Growth	0.019
2	Large	0.006	2	Large	0.011
3	Value	-0.003	3	Value	0.008
4	Small	-0.003	4	Small	0.007

Table 2a
Descriptive Statistics of Buy-Write and Long-Only Returns of Each Portfolio Jan 2008 - May 2015

	Growth		Value		Large		Small	
	LO	*BW*	*LO*	*BW*	*LO*	*BW*	*LO*	*BW*
Mean	0.269%	0.229%	0.405%	0.317%	0.225%	0.198%	0.322%	0.250%
Standard Deviation	2.786%	2.201%	5.134%	4.177%	3.204%	2.585%	4.067%	3.280%
Variance	0.078%	0.048%	0.264%	0.174%	0.103%	0.067%	0.165%	0.108%
Kurtosis	5.019	9.669	10.282	12.852	10.004	14.590	4.299	6.683
Skewness	-0.315	-0.983	0.444	-0.183	0.093	-0.571	0.107	-0.175
Number of Weeks	360	360	360	360	360	360	360	360

Table 2b
Descriptive Statistics of Buy-Write and Long-Only Returns of Each Portfolio Jan 2009 - May 2015

	Growth		Value		Large		Small	
	LO	*BW*	*LO*	*BW*	*LO*	*BW*	*LO*	*BW*
Mean	0.383%	0.321%	0.482%	0.394%	0.309%	0.262%	0.474%	0.381%
Standard Deviation	2.322%	1.743%	4.145%	3.178%	2.677%	2.081%	3.487%	2.674%
Variance	0.054%	0.030%	0.172%	0.101%	0.072%	0.043%	0.122%	0.072%
Kurtosis	0.9993	2.5266	9.4081	11.5850	6.7725	9.1546	2.4125	5.0482
Skewness	-0.0482	-0.2657	0.8698	0.7773	0.5557	0.6249	0.1781	0.2317
Number of Weeks	335	335	335	335	335	335	335	335

Overall, the descriptive statistics are consistent with the risk and returns reducing properties of the buy-write strategy. When comparing the mean returns and standard deviations of each asset class we observe higher means for the long-only portfolio and lower standard deviations for the buy-write portfolio. For growth stocks the long-only portfolio returned on average 0.383% per week with a standard deviation of 2.322%, compared with 0.321% and 1.743% for the buy-write portfolio. Value stocks showed a larger average return than growth stocks with the long-only portfolio returning an average of 0.482% and the buy-write portfolio 0.394%; however the standard deviation was also larger with values of 4.145% and 3.178% respectively. This indicates that although value strategies exhibited higher returns, they were also fundamentally more risky in the period examined. Returns for the large portfolios were 0.309% for the long-only portfolio and 0.262% for the buy-write, with standard deviations of 2.677% and 2.081%. Similar to the growth vs. value contrast, small stocks showed higher average returns, but higher standard deviations also. The long-only portfolio returned 0.474% with a standard deviation of 3.487% and the buy-write portfolio returned 0.381% with standard deviation of 2.674%. The magnitude of these differences will be addressed shortly. In addition all portfolios exhibited higher returns than the market portfolios, but with higher standard deviation.

The kurtosis values show that the distributions of buy-write returns tend to be more peaked than long-only returns. This is not a surprise since the strategy's upside limitation causes a clustering of returns at the right tail of the distribution leading to truncation of the right tail and a more peaked distribution. Refer back to figure 2 for a visual representation. The skewness trends are mixed across all portfolios. Referring again to figure 2, we would expect the buy-write portfolio returns distribution to be more negatively skewed relative to the long-only portfolio; however this is only the case for growth and value asset classes in the 2009-2015 period. This might be unexpected, but it is not unusual. I use weekly returns but the life of the call option is one month, therefore fluctuations in call option price and returns before expiry likely explain this anomaly. Further the differing skewness could be explained by slight variations in the level of option moneyness used in each portfolio. I used the nearest available out-of-the money call option for each stock in each portfolio, but for the more illiquid stocks, a narrower range of strike prices are available meaning that the strike price used may be further out of the money than more liquid stocks. The moneyness of the option affects the point at which returns become clustered which in turn affects the skewness of the distribution.

In general the descriptive statistics show nothing out of the ordinary. The buy-write portfolios have lower returns and standard deviations and more peaked returns distributions than the long-only portfolios, with mixed results on the level of skewness. Also small and value stocks have higher mean returns than large and growth stocks, albeit with larger standard deviations too, which is consistent with existing conjecture.

5.2 Strategy Performance

Table 3 shows a comprehensive overview of performance measures for each portfolio in the 2009-2015 period, as well as the excess buy-write performance simply calculated by deducting long-only performance from buy-write performance. Where appropriate, t-statistics are shown in the parenthesis below the performance measure, with significant statistics shown in bold text. For testing the difference between standard deviations, f-statistics are provided instead. All means are significant at a 95% level at the very least; this is something that cannot be said if we include 2008 in the sample. The results when 2008 is included can be found in the appendix. However, although the means are significant, the difference between buy-write and long-only mean returns is only significant for growth stocks and the BXM index. This is likely due to the higher standard deviation of value, large and small stocks coupled with a lack of observations in my sample, but due to the nature of the strategy in the long run the true mean of the long-only portfolio is likely greater than the mean of the buy-write portfolio. I do find a statistical difference between the standard deviations of the buy-write and long-only portfolios though; this is expected due to the risk reducing benefits previously discussed. Interestingly, when we consider downside deviation (downside risk or semi-standard deviation) we can see that for each asset class, the risk reducing benefits are reduced compared to the typical standard deviation measure. This is in contrast to the difference between the BXM and S&P 500, the difference between downside deviations is more negative than the difference between normal standard deviation, therefore when we consider

Table 3
Buy-Write Vs. Long-Only Performance Jan 2009 - May 2015
Where appropriate t-statistics are shown in parenthesis. For testing the difference between standard deviations the F-Statistic is used. Significant values are highlighted in bold.

	Mean	**SD**	**Downside Risk**	**Sharpe Ratio**	**M2 Ratio**	**Jensen's Alpha**	**Treynor Ratio**
Growth							
BW	**0.321%**	1.743%	1.856%	**0.184**	0.0013	0.0004	0.0044
	(3.37)			**(3.24)**		(1.78)	
LO	**0.383%**	2.322%	2.345%	**0.165**	0.0009		0.0038
	(3.02)			**(2.98)**			
BW-LO	-0.062%	**-0.580%**	-0.489%	0.0191	0.0004		0.0006
	(-1.65)	**(1.78) F**		(0.80)			
Value							
BW	**0.394%**	3.178%	3.083%	**0.124**	-0.0001	0.0004	0.0053
	(2.27)			**(2.30)**		(0.84)	
LO	**0.482%**	4.145%	3.848%	**0.116**	-0.0003		0.0048
	(2.13)			**(2.18)**			
BW-LO	-0.088%	**-0.967%**	-0.765%	0.008	0.0002		0.0005
	(-1.27)	**(1.70)F**		(0.40)			
Large							
BW	**0.262%**	2.081%	2.084%	**0.125**	-0.0001	0.0003	0.0034
	(2.30)			**(2.33)**		(1.17)	
LO	**0.309%**	2.677%	2.617%	**0.115**	-0.0003		0.0031
	(2.11)			**(2.13)**			
BW-LO	-0.047%	**-0.596%**	-0.533%	0.011	0.0002		0.0004
	(-1.16)	**(1.65) F**		(0.59)			
Small							
BW	**0.381%**	2.674%	2.703%	**0.142**	0.0003	0.0003	0.0051
	(2.61)			**(2.60)**		(0.79)	
LO	**0.474%**	3.487%	3.445%	**0.136**	0.0002		0.0047
	(2.49)			**(2.49)**			
BW-LO	-0.093%	**-0.813%**	-0.742%	0.007	0.0002		0.0004
	(-1.60)	**(1.70) F**		(0.30)			
BXM							
BXM	**0.226%**	1.602%	1.806%	**0.141**	0.0003	0.0009	0.0049
	(2.58)			**(2.47)**		(1.35)	
S&P500	**0.296%**	2.311%	2.562%	**0.128**	0.0000		0.0030
	(2.35)			**(2.25)**			
BXM-S&P500	-0.070%	**-0.709%**	-0.757%	0.013	0.0003		0.0019
	(-4.15)	**(2.08) F**		(0.26)			

downside deviation alone, the risk reducing properties of the buy-write strategy are enhanced. This is potentially explained by the negative skewness of the S&P 500 returns distribution since its downside deviation is higher than its standard deviation.

Now let us turn our attention to the risk-adjusted performance measures starting with the total risk measures. We find that the Sharpe Ratio for each portfolio is statistically significant[6], but as previously explained it is the excess risk-adjusted returns that should be used to determine the effectiveness of the buy-write strategy. The excess Sharpe Ratio is 0.0191 for growth stocks, 0.008 for value stocks, 0.011 for large stocks and 0.007 for small stocks, taken as given these results show that on average the buy-write strategy outperforms its underlying stock on a risk-adjusted basis suggesting a systematic mispricing of equity call options. However statistically speaking, there is no significant difference in the risk-adjusted performance of the long-only and buy-write portfolios since the t-statistics are nowhere near significant. Therefore it is likely that these results are simply due to chance or market volatility and that equity call options are fairly priced in the period examined.

The systematic performance measures lead to a similar conclusion. I calculate Jensen's Alpha by taking the buy-write returns as the independent variable and the returns of the long-only portfolio as the dependent variable; hence the alpha value can be interpreted as the excess return of the buy-write

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[6] Sharpe Ratios are tested for significance using software by Mr J.D Opdyke available from http://www.datamineit.com/ which is used and explained in his 2007 paper "Comparing Sharpe ratios: So where are the *p*-values?" *Journal of Asset Management* (2007) **8,** 308–336

portfolio. For each asset class, the alpha values are slightly positive which again suggests outperformance; however there is again a lack of statistical significance to back up this observation. For the large portfolio we observe an alpha of 0.0004 with a t-statistic of 1.78 which is significant at a 90% level, but this is not enough to conclude that the buy-write portfolio outperforms the underlying. Jensen's Alpha only accounts for systematic risk exposure and the other performance measures considered do not support this conclusion. The Treynor Ratio values also show slender excess returns for the buy-write strategy.

Further, I consider buy-write strategy performance in 2 sub-sample periods, the highly volatile 2008-2011 period and the 2012-2015 period of historically low volatility (See table 4). During the market downturn the buy-write strategy displays higher returns than the long-only position for the growth, large, small and index portfolios, however due to the extreme volatility there is no statistical significance. This is not surprising as this is exactly what the strategy is designed for, to offer a cushion against downside losses. Similar results are also found for the risk-adjusted performance measures, for each portfolio there is a slight increase in excess risk-adjusted return compared to the full sample period, but again this is not statistically significant. Nevertheless the results are suggestive that buy-write performance is better than long-only performance during a bear market which is consistent with previous buy-write studies. When considering the 2012-2015 period, the opposite is true. Long-only average returns now exceed buy-write returns and risk-adjusted performance is higher than the full sample period for both long-only and buy-write portfolios. For each asset class, excess buy-write Sharpe Ratio becomes negative but not significant. For large, small and value asset classes, Jensen's Alpha is slightly negative and significant at a 95% level providing weak evidence of buy-write underperformance in the market upturn. Again, this is consistent with the properties of the buy-write strategy, since buy-write returns are capped at the strike price of the written call option; the strategy will likely underperform when long-only returns exceed the call option strike price and market conditions are generally bullish.

For robustness I also calculate the performance measures using monthly returns instead of weekly returns. I do this because the buy-write strategy is an expiry trading strategy; therefore fluctuations in returns in between the purchase and expiration of the strategy are irrelevant and may just be adding noise to the data. Further we can only gauge if an option is overpriced by comparing the price paid to its value at maturity. A call option is overpriced if its implied volatility exceeds the underlying's subsequent realized volatility over the options life, therefore any overpricing can only be determined at the maturity of the option. I take the call option expiry dates as the month start/end point in my returns calculations thus ensuring noise free data. The full sample and sub-sample results are shown in tables 5 and 6 respectively. The monthly results are largely consistent with the weekly returns showing slightly positive excess risk-adjusted returns, but with no statistical significance to back this up.

Table 4
Buy-Write Vs. Long-Only Sub-Sample Performance

The table shows the excess buy-write performance (BW-LO) in 2008 - 2011 and 2012 – 2015. Where appropriate t-statistics are shown in parenthesis. For testing the difference between standard deviations the F-Statistic is used. Significant values are highlighted in bold.

08-11	**Mean**	**SD**	**Downside Risk**	**Sharpe Ratio**	**M2 Ratio**	**Jensen's Alpha**	**Treynor Ratio**
Growth							
BW-LO	0.047%	**-0.673%**	-0.490%	0.0280	0.0010	0.0008	0.0010
	(0.67)	**(1.53)F**		(1.39)		(1.89)	
Value							
BW-LO	-0.008%	**-1.226%**	-0.743%	0.012	0.0004	0.0008	0.0009
	(-0.06)	**(1.48)F**		(0.63)		(0.87)	
Large							
BW-LO	0.063%	**-0.789%**	-0.483%	0.026	0.0009	0.0009	0.0011
	(0.79)	**(1.51)F**		(1.47)		(1.90)	
Small							
BW-LO	0.035%	**-0.954%**	-0.507%	0.019	0.0007	0.0009	0.0011
	(0.34)	**(1.49)F**		(1.00)		(1.27)	
BXM							
BXM-S&P500	0.051%	**-0.744%**	-0.379%	0.016	0.0006	0.0006	0.0006
	(0.32)	**(1.60)F**		(0.38)		(0.45)	

12-15	**Mean**	**SD**	**Downside Risk**	**Sharpe Ratio**	**M2 Ratio**	**Jensen's Alpha**	**Treynor Ratio**
Growth							
BW-LO	**-0.131%**	**-0.513%**	-0.499%	-0.0178	-0.0003	-0.0001	-0.0002
	(-2.79)	**(2.05)F**		(0.50)		(-0.60)	
Value							
BW-LO	**-0.171%**	**-0.595%**	-0.486%	-0.043	-0.0007	**-0.0006**	-0.0009
	(-2.94)	**(1.84)F**		(1.51)		**(-1.96)**	
Large							
BW-LO	**-0.120%**	**-0.377%**	-0.300%	-0.039	-0.0006	**-0.0004**	-0.0005
	(-3.47)	**(1.77)F**		(1.26)		**(-2.30)**	
Small							
BW-LO	**-0.184%**	**-0.598%**	-0.493%	-0.049	-0.0008	**-0.0007**	-0.0010
	(-3.15)	**(1.88)F**		(1.69)		**(-2.16)**	
BXM							
BXM-S&P500	-0.127%	**-0.594%**	-0.600%	-0.022	-0.0004	0.0006	0.0014
	(-1.27)	**(2.46)F**		(0.21)		(0.98)	

Table 5
Monthly Compounded Buy-Write Vs. Long-Only Performance Jan 2009 - May 2015
Where appropriate t-statistics are shown in parenthesis. For testing the difference between standard deviations the F-Statistic is used. Significant values are highlighted in bold.

	Mean	SD	Downside Risk	Sharpe Ratio	M2 Ratio	Jensen's Alpha	Treynor Ratio
Growth							
BW	**1.374%**	3.345%	4.094%	**0.409**	0.0045	0.0021	0.0193
	(3.60)			**(2.40)**		(1.77)	
LO	**1.640%**	4.509%	4.939%	**0.363**	0.0026		0.0164
	(3.19)			**(2.62)**			
BW-LO	-0.266%	**-1.164%**	-0.845%	0.0468	0.0019		0.0029
	(-1.43)	**(1.82)F**		(0.39)			
Value							
BW	**1.626%**	6.313%	6.387%	**0.257**	-0.0018	0.0022	0.0235
	(2.26)			**(2.08)**		(1.04)	
LO	**2.038%**	8.776%	7.874%	**0.232**	-0.0028		0.0203
	(2.04)			**(2.12)**			
BW-LO	-0.412%	**-2.463%**	-1.487%	0.025	0.0010		0.0032
	(-1.11)	**(1.93)F**		(0.41)			
Large							
BW	**1.101%**	3.771%	4.695%	**0.291**	-0.0004	0.0013	0.0146
	(2.56)			**(2.21)**		(1.13)	
LO	**1.293%**	4.856%	5.517%	**0.265**	-0.0014		0.0129
	(2.34)			**(2.16)**			
BW-LO	-0.192%	-1.085%	-0.822%	0.026	0.0011		0.0017
	(-1.08)	(1.66)F		(0.36)			
Small							
BW	**1.616%**	5.394%	5.963%	**0.299**	0.0000	0.0020	0.0229
	(2.63)			**(2.26)**		(1.18)	
LO	**2.015%**	7.407%	7.107%	**0.271**	-0.0012		0.0201
	(2.39)			**(2.33)**			
BW-LO	-0.399%	**-2.012%**	-1.143%	0.027	0.0011		0.0028
	(-1.33)	**(1.89)F**		(0.35)			
BXM							
BXM	**0.975%**	2.771%	4.122%	**0.350**	0.0000	0.0033	0.0186
	(3.09)			**(2.23)**		(1.57)	
S&P500	**1.239%**	4.123%	4.751%	**0.300**	0.0000		0.0123
	(2.64)			**(2.38)**			
BXM-S&P500	-0.264%	**-1.352%**	-0.629%	0.051	0.0000		0.0063
	(-0.88)	**(2.21)F**		(0.40)			

Table 6
Monthly Compounded Buy-Write Vs. Long-Only Sub-Sample Performance
The table shows the excess buy-write performance (BW-LO) in 2008 - 2011 and 2012 – 2015. Where appropriate t-statistics are shown in parenthesis. For testing the difference between standard deviations the F-Statistic is used. Significant values are highlighted in bold.

08-11	**Mean**	**SD**	**Downside Risk**	**Sharpe Ratio**	**M2 Ratio**	**Jensen's Alpha**	**Treynor Ratio**
Growth							
BW-LO	0.224%	**-1.361%**	-0.193%	0.0583	0.0040	**0.0037**	0.0045
	(0.79)	**(1.50)F**		(1.11)		**(2.09)**	
Value							
BW-LO	-0.091%	**-3.182%**	-1.092%	0.027	0.0018	0.0035	0.0045
	(-0.14)	**(1.62)F**		(0.48)		(0.88)	
Large							
BW-LO	0.322%	-1.366%	-1.155%	0.062	0.0042	**0.0042**	0.0051
	(1.10)	(1.46)F		(1.45)		**(2.27)**	
Small							
BW-LO	0.135%	**-2.337%**	0.240%	0.037	0.0025	0.0038	0.0047
	(0.28)	**(1.54)F**		(0.75)		(1.36)	
BXM							
BXM-S&P500	0.249%	**-1.537%**	-0.617%	0.044	0.0000	0.0023	0.0032
	(0.51)	**(1.67)F**		(0.56)		(0.62)	

12-15	**Mean**	**SD**	**Downside Risk**	**Sharpe Ratio**	**M2 Ratio**	**Jensen's Alpha**	**Treynor Ratio**
Growth							
BW-LO	**-0.592%**	**-1.301%**	-0.566%	-0.0055	-0.0002	0.0002	0.0004
	(-2.35)	**(2.38)F**		(0.05)		(0.22)	
Value							
BW-LO	**-0.773%**	**-1.686%**	-1.356%	-0.063	-0.0023	-0.0020	-0.0030
	(-2.38)	**(2.12)F**		(0.64)		(-1.27)	
Large							
BW-LO	**-0.547%**	**-1.068%**	-0.686%	-0.048	-0.0017	-0.0009	-0.0013
	(-2.72)	**(2.11)F**		(0.36)		(-0.93)	
Small							
BW-LO	**-0.858%**	**-1.912%**	-0.809%	-0.060	-0.0022	-0.0016	-0.0026
	(-2.41)	**(2.46)F**		(0.56)		(-1.05)	
BXM							
BXM-S&P500	-0.576%	**-1.525%**	-0.848%	0.011	0.0000	0.0018	0.0039
	(-1.58)	**(3.06)F**		(0.05)		(0.87)	

To summarize, all performance measures indicate that the buy-write portfolios slightly outperform the underlying portfolios on a risk-adjusted basis for all asset classes in the full sample period. But due to a lack of statistical significance, this conclusion cannot be made; it would appear that the difference in risk-adjusted performance is not significantly different from zero. Previous studies using index options claim that the strategy outperforms the underlying, so an important question is why don't we observe such outperformance using equity options? A likely explanation is that the relationship between implied and realized volatility is different for index and stock options. This difference stems from investors motivations for buying these two types of options and investors willingness to pay a volatility risk premium on index options for hedging purposes. Although, despite the claims of previous studies, in the time period examined the BXM index does not outperform the S&P 500 with any statistical significance. Therefore is it possible that the buy-write strategy is not a market beating strategy after all? Or is it just that in more recent times the strategy has not performed as well as it used to? This question will be expanded upon in the discussion section along with other potential explanations for the above results.

5.3 Effect of firm characteristic on buy-write performance and option expensiveness

Recall hypotheses 1 and 2.

Hypothesis 1: Buy-write strategy using small stocks as the underlying asset will outperform strategies using large stocks as the underlying.

Hypothesis 2: Buy-write strategies with value stocks as the underlying asset will outperform strategies using growth stocks as the underlying.

These hypotheses were based on previous research that suggests that call options on small and value stocks are expensive compared to call options on large and growth stocks[7]. In more detail, investors tend to overestimate the future volatility of small and value stocks causing them to pay more for call options. Table 7 shows the results of the inter-class comparison between these asset class portfolios. I took the excess buy-write returns (buy-write returns – long only returns) of each asset class and then formed a long short portfolio to test for any difference in buy-write excess returns. Similar results are obtained when 2008 is included in the sample which can be found in the appendix. Where appropriate, t-statistics are provided in the parenthesis.

Table 7
Growth Vs. Value and Large vs. Small Performance Comparison Jan 2009 - May 2015
The table shows the average returns of long-short buy-write excess return portfolios based on firm characteristic. Buy-write excess returns are calculated by subtracting long-only portfolio returns from buy-write portfolio returns (BW-LO). T-statistics in parenthesis.

	Growth (BW-LO) - Value (BW-LO)	**Large (BW-LO) - Small (BW-LO)**
Mean (Weekly)	0.026% (0.46)	0.046% (1.24)
Mean (Monthly)	0.146% (0.50)	0.207% (1.31)

7 See Pietro & Vainberg (2006), Carr & Wu (2009), Blackburn, Goetzmann, Ukhov (2009)

As shown by table 7, by taking a long position in excess buy-write returns of growth stocks and a short position in excess buy-write returns of value stocks on average, slender positive returns will be generated. The same is true but with slightly higher average returns when a long position is taken in large excess returns and a short position is taken in small excess returns. Unfortunately the t-statistics again prevent any solid conclusions being made; there is a high probability that there is in actual fact no difference in the effectiveness of the strategy when different asset classes are used as the underlying. These results are not consistent with the previous research or my hypotheses. A possible reason for this could be that the greater illiquidity of value and small stock options penalises the short call option returns which offsets the expensiveness of the option. Also this could be due to differential end-user demand between the time period examined by Pietro & Vainberg (2006) and the time period examined by me. Pietro and Vainberg's sample is taken from 1996-2004, in this period value stocks outperformed growth and small stocks outperformed large stocks, in the period 2009-2015 this trend is reversed with growth outperforming value and large outperforming small[8]. I will expand on this further in the discussion section.

In summary, there is no statistic difference between the effectiveness of the buy-write strategy when different asset classes are used. Therefore I am forced to reject hypotheses 1 and 2.

[8] Based on returns of Vanguard Russell indices. See appendix for details.

5.4 Effect of Investor Sentiment

To gauge the effect of investor sentiment I take buy-write returns as the dependent variable and the independent variables include the Fama French 3 factor variables, the Vix index to control for any returns that could be caused by changes in investors' expectations of future volatility, the sentiment proxy and a one period lag of the sentiment proxy. By observing the coefficient of the sentiment proxy I can determine the effect of investor sentiment on buy-write performance. The regression is run twice for each asset class, once using the University of Michigan Consumer Sentiment Index (CSS) and once using the II Bull-Bear Spread (BB). Table 8 shows the coefficients of the sentiment indexes in various sub-sample periods. T-statistics are given in parenthesis below the coefficient value.

Looking at the full sample period between 2008 and 2015, there is a strong positive relationship between buy-write returns and the CSS for each asset class, particularly value and small stocks. The value portfolio has a coefficient of 0.3858, and the small portfolio has a coefficient of 0.2853, whereas the large portfolio has a coefficient of 0.1671 and the growth portfolio has a coefficient of 0.1469. All values are significant at a 99% confidence level. Also the lag variable for the small portfolio is positive and significant at a 95% level, suggesting that it takes time for the effects of sentiment to be realised in small stock buy-write returns. When 2008 is excluded from the sample the trend is the same. There is still a positive, statistically significant relationship for each asset class; however the relationship is substantially weaker than when 2008 is included. The coefficients for each class fall to 0.2601 for value, 0.2038 for small, 0.1115 for large and 0.0896 for growth and now none of the lag terms are significant. Considering both sample periods, on the whole the results suggest that individual investor sentiment has a positive effect on buy-write returns, especially for value and small stocks.

Table 8
Buy-Write Portfolio Investor Sentiment Coefficients

The table shows the coefficients of each sentiment measure when buy-write portfolio returns are regressed on investor sentiment and a number of control variables. Also included are the lagged variable coefficients, denoted by (t-1). BB represents Investors Intelligence Bull-Bear Spread; CSS represents the University of Michigan Consumer Sentiment Index. T-statistics in parenthesis, significant results in bold.

08-15	BB	BB(t-1)	CSS	CSS(t-1)
Growth	0.000 (-0.23)	-0.001 (-0.33)	**0.147** **(2.86)**	0.058 (1.21)
Value	**0.013** **(3.50)**	0.001 (0.27)	**0.386** **(3.38)**	0.154 (1.44)
Large	**0.007** **(3.57)**	-0.001 (-0.6)	**0.167** **(3.06)**	0.048 (0.94)
Small	0.003 (0.89)	-0.001 (-0.18)	**0.285** **(3.39)**	**0.161** **(2.04)**

09-15	BB	BB(t-1)	CSS	CSS(t-1)
Growth	-0.001 (-0.89)	-0.001 (-0.86)	**0.090** **(2.19)**	0.011 (0.26)
Value	**0.010** **(3.29)**	0.000 (0.15)	**0.260** **(2.94)**	0.021 (0.24)
Large	**0.004** **(2.55)**	-0.003 (-1.77)	**0.111** **(2.45)**	0.011 (0.25)
Small	0.003 (1.07)	0.002 (0.63)	**0.204** **(3.00)**	0.073 (1.09)

08-11	BB	BB(t-1)	CSS	CSS(t-1)
Growth	0.000 (0.17)	0.001 (0.3)	**0.215** **(2.43)**	0.078 (1.05)
Value	**0.020** **(3.35)**	0.003 (0.58)	**0.628** **(3.1)**	0.173 (1.02)
Large	**0.010** **(3.42)**	0.000 (0.07)	**0.263** **(2.8)**	0.036 (0.46)
Small	0.005 (1.14)	0.001 (0.24)	**0.440** **(2.93)**	0.189 (1.50)

12-15	BB	BB(t-1)	CSS	CSS(t-1)
Growth	-0.002 (-0.77)	-0.002 (-1.13)	-0.019 (-0.41)	0.017 (0.34)
Value	0.000 (-0.01)	-0.002 (-0.54)	-0.002 (-0.02)	**0.159** **(2.06)**
Large	0.000 (0.30)	-0.002 (-1.78)	-0.031 (-0.65)	0.072 (1.40)
Small	0.000 (0.02)	-0.002 (-0.71)	0.003 (0.06)	**0.116** **(1.98)**

Interestingly the BB coefficients give slightly differing results. Between 2008 and 2015, there is no relationship between the BB and buy-write returns for growth and small portfolios, however for large and value stocks there is a positive relationship significant at a 99% confidence level. Again the relationship is particularly strong for value stocks with a coefficient of 0.0135, compared to a coefficient of 0.0068 for large stocks. Similarly when 2008 is excluded from the sample, the trend is the same, but the relationship is weaker. The coefficient becomes 0.0104 for value and 0.0043 for large. In both periods, there is no relationship between the lagged BB variable and buy-write returns for all asset classes. The results show a positive relationship between institutional investor sentiment and buy-write returns of large and value stocks, but no relationship for small and growth stocks. It is perhaps not surprising to see a positive relationship between institutional sentiment and large buy-write returns since institutional investors tend to focus their investing in large stocks, but it is surprising to see an even stronger relationship for the value portfolio.

Recall hypothesis 3.

Hypothesis 3: In periods where investor sentiment is high the buy-write strategy will produce higher returns than when investor sentiment is low.

Based on the majority of positive, significant coefficients I believe this is sufficient to accept hypothesis 3.

To deepen my analysis I re-ran each regression after dividing the sample into sub-periods. The sub-sample periods examined are from the middle of 2008 to the end of 2011 and from the start of 2012 to the middle of 2015. By examining a period of relative low sentiment following the 2008 crisis and a period of relative high sentiment as the recovery begins to kick in, I hope to separate the effects of changes in sentiment over time.

For the 2008-2011 period we see the same results as the full sample period, positive, significant coefficients for the CSS variable of all portfolios and for the BB variable there are positive, significant coefficients for the value and large portfolios only. However, each coefficient is considerably larger than the full sample period. The CSS coefficients are 0.6281 for value, 0.4395 for small, 0.2628 for large and 0.2147 for growth. The BB coefficients are 0.0201 for value and 0.0100 for large. When comparing this to the 2012-2015 period the difference is clear. Looking at the BB variable, none of the coefficients are statistically different from zero which can also be said of the lag variable. Further, for the CSS variable there are no significant results, but the lag variable returned positive coefficients for value and small stocks. The lagged CSS coefficient is 0.1591 for value and 0.1158 for small, both of which are significant at a 95% level.

These results suggest that in times of low sentiment or investor pessimism, sentiment has a strong influence on buy-write return. However, in times of high investor sentiment or when investors are optimistic, sentiment has a much weaker influence on buy-write returns. Further, individual investor sentiment appears to have more of an impact than institutional investor sentiment. The CSS measure affects all types of stock in the low sentiment period with large positive coefficients, whereas the BB measure appears to only affect large and value stocks with coefficients somewhat smaller than their CSS counterparts. In the high sentiment period, institutional sentiment has no effect on buy-write returns of any portfolio and individual investor sentiment only has a lagged effect on small and value stocks. Small and value stocks seem to be more sensitive to changes in individual sentiment than large and growth stocks. This makes sense since individual investors tend to focus their speculating activities on smaller and value orientated stocks.

For completeness I also consider the effect of sentiment on the long-only returns of each portfolio. In the full sample period (See table 9) the BB index displays coefficients of similar magnitude to the buy-write portfolios. However the CSS coefficients are noticeably larger for the long-only portfolios suggesting that the effect of investor sentiment is stronger for a long stock position than a buy-write position. In the sample excluding 2008, the CSS coefficients are 0.1345 for growth, 0.3998 for value, 0.1454 for large and 0.3102 for small. The corresponding buy-write coefficients are 0.0896 for growth, 0.2601 for value, 0.1115 for large and 0.2038 for the small portfolio. In other words, writing call options on a portfolio of stocks appears to reduce, but not eliminate the effect of investor sentiment on portfolio returns. The sub-sample analysis results also provide evidence for this conjecture. The 2008-2011 coefficients for the long only portfolio are larger than the buy-write coefficients particularly for value and small stocks. The 2012-2015 coefficients are generally larger too, although the only value stock lagged CSS variable is significant.

Since investor sentiment appears to have a stronger effect on the long-only portfolio than the buy-write portfolio, this provides additional weight to the sub-sample buy-write performance results. In the market downturn, a period where investor sentiment is falling, the long-only returns are hit harder than the buy-write returns, contributing to the seemingly superior buy-write performance. In the subsequent recovery period where investor sentiment is rising, long-only returns profit from the increasing sentiment more than buy-write returns, therefore contributing to seemingly superior long-only returns.

The coefficients of each control variable for each sentiment regression are available in the appendix. Generally, the long-only portfolios are more sensitive to the market, SMB and HML than the buy-write portfolios. This makes sense since the short call position is likely negatively correlated to market returns whereas the long stock position is likely positively correlated. Therefore the short call position reduces the sensitivity of the buy-write portfolio. There is no clear trend regarding the coefficients of the VIX with a mixture of positive, negative and insignificant results. However finding meaning in the VIX coefficients would be difficult anyway, although it is primarily a measure of investors' expectations of future volatility, it is also negatively correlated to market returns, therefore we cannot be certain which aspect is captured by the VIX.

Table 9
Long-Only Portfolio Investor Sentiment Coefficients

The table shows the coefficients of each sentiment measure when long-only portfolio returns are regressed on investor sentiment and a number of control variables. Also included are the lagged variable coefficients, denoted by (t-1). BB represents Investors Intelligence Bull-Bear Spread; CSS represents the University of Michigan Consumer Sentiment Index. T-statistics in parenthesis, significant results in bold.

08-15	BB	BB(t-1)	CSS	CSS(t-1)
Growth	-0.001	-0.002	**0.176**	0.033
	(-0.54)	(-1.05)	**(2.54)**	(0.50)
Value	**0.013**	0.001	**0.530**	0.162
	(3.37)	(0.13)	**(3.62)**	(1.18)
Large	**0.004**	-0.001	**0.196**	0.045
	(2.63)	(-0.92)	**(2.78)**	(0.67)
Small	0.004	-0.001	**0.363**	0.145
	(1.20)	(-0.18)	**(3.28)**	(1.40)

	BB	BB(t-1)	CSS	CSS(t-1)
Growth	-0.001	-0.002	**0.134**	-0.062
	(-0.95)	(-1.19)	**(2.25)**	(-1.05)
Value	**0.012**	0.001	**0.400**	0.025
	(3.54)	(0.27)	**(3.18)**	(0.21)
Large	**0.003**	-0.002	**0.145**	-0.024
	(1.80)	(-1.69)	**(2.35)**	(-0.39)
Small	0.004	0.001	**0.310**	0.034
	(1.30)	(0.44)	**(3.16)**	(0.35)

08-11	BB	BB(t-1)	CSS	CSS(t-1)
Growth	-0.002	-0.002	**0.244**	0.046
	(-0.67)	(-0.81)	**(2.05)**	(0.46)
Value	**0.020**	0.002	**0.809**	0.157
	(3.36)	(0.31)	**(3.12)**	(0.72)
Large	**0.006**	-0.001	**0.291**	0.024
	(2.43)	(-0.41)	**(2.39)**	(0.23)
Small	0.006	0.000	**0.532**	0.156
	(1.08)	(-0.08)	**(2.71)**	(0.95)

12-15	BB	BB(t-1)	CSS	CSS(t-1)
Growth	0.001	-0.001	0.036	0.017
	(0.25)	(-0.29)	(0.48)	(0.21)
Value	-0.002	-0.001	0.135	**0.245**
	(-0.43)	(-0.37)	(1.21)	**(2.04)**
Large	0.001	-0.001	0.027	0.088
	(0.57)	(-0.91)	(0.36)	(1.11)
Small	0.003	0.000	0.113	0.164
	(0.60)	(-0.11)	(1.15)	(1.55)

CHAPTER 6
DISCUSSION

6.1 Buy-Write Performance, comparison with previous studies

As we have seen, my results somewhat contradict the notion that investors can earn abnormal risk-adjusted returns by writing call options. This being said, there is a fundamental difference between previous studies and my study, whereas previous studies focus on the use of index options, I focus my analysis on individual equity options. Although the pricing principles of both types of option are the same, there are some slight differences that may explain the differential performance between index and equity buy-write strategies. Essentially, option mispricing can be identified by observing the relationship between the implied and realised volatility of the option. If the volatility implied from the option price exceeds its realised volatility then it is clear from the Black Scholes model that this option is overpriced since the investor pays for volatility that subsequently falls short of the actual volatility over the life of the option. Current literature has identified overpricing in index options[9] by looking at this relationship between implied and realised volatility. Generally for index options, implied volatility tends to exceed realised volatility, however no such trend has been identified for equity options. When this relationship is examined for equity options, it has been found that implied

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[9] See Bollen & Whaley (2004), Bakshi, Kapadia, Madan (2003), Constantinides, Jackwerth, Perrakis (2009) to name just a few.

volatility rarely exceeds realised volatility[10] suggesting that index options are expensive relative to equity options. Therefore, in order to understand my results we must understand the potential reasons why the implied vs. realised volatility relationship differs between index and equity options.

Perhaps the most accepted explanation in the literature is the existence of a volatility risk premium which investors are willing to pay on index options but not equity options because of the formers usefulness in hedging against adverse market movements. More specifically index options and market volatility are negatively correlated; therefore options with positive vega can offer an effective hedge against stock prices. The higher the vega, the better the hedge and the higher the premium that investors are willing to pay. Driessen, Maenhout, Vilkov (2009) identify a large volatility risk premium on index options, but no such risk premium on equity options of all index components. Further they show that by selling index options and buying equity options substantial excess returns can be generated with a large Sharpe Ratio. They conclude that index options are expensive compared to equity options "because they allow investors to hedge against positive market wide correlation shocks and the ensuing loss in diversification benefits." Bakshi & Kapadia (2003) provide more evidence for this hypothesis, they show that at-the-money call options are more expensive than out-of-the-money calls and since at-the-money-calls have higher exposure to market volatility, the expensiveness is caused by a volatility risk premium. Other

[10] See Bollen & Whaley (2004), Bakshi, Kapadia, Madan (2003), Garleanu, Pedersen, Poteshman (2007), Driessen, Maenhout, Vilkov (2009).

recent papers from Vilkov (2008) and Carr & Wu (2009) amongst others also prove additional evidence to support this theory. Simply put, the volatility risk premium could explain the difference in buy-write performance between an index and equity portfolio. Since investors are willing to pay this premium, index option writers can collect it and earn abnormal returns, whereas equity option writers cannot collect any premium hence the differential performance.

Bollen & Whaley (2004) compare implied and realised volatilities for index and equity options, finding that for index options implied – realised volatility is positive, whereas for at-the-money and out-of-the money equity options implied – realised volatility is negative. They offer an alternative explanation for this relationship. They conjecture that by supplying liquidity to option markets, market makers will often end up with large positions, either long or short in particular options. Therefore they need to hedge this risk exposure and as such require compensation for their hedging costs. Take the S&P 500 as an example, this is a market predominantly made up of buyers; therefore market makers are likely to end up with a net short position in S&P 500 options. In this situation market makers will set prices in a way that compensates them for the additional hedging costs which of course leads to an increase in implied volatility, Green & Figlewski (1999) refer to this as a volatility mark-up. Lakonishok et al. (2007) investigate option market activity with regard to buying and selling volume finding that for non-market makers, written positions are more common than bought positions. Following this logic and considering that participants in the equity options market are typically unsophisticated investors, it is likely that the equity options market is not as buyer dominated as the index options market or may even be dominated by sellers. Also given that equity options are less effective at hedging market volatility it makes sense that there is no volatility mark-up embedded into their prices.

A closely related study to Bollen & Whaley's work is Garleanu, Pedersen & Poteshman's 2009 paper regarding demand-based option pricing. Garleanu, Pedersen & Poteshman (2009) identify a link between end user demand and option expensiveness, attributing index option expensiveness to a misalignment of investor demand between index options and equity options. More specifically, index options have a net positive end-user demand and equity options have a slightly negative end-user demand. This is consistent with the finding of Lakonishok et al (2007) that written calls are more common than bought calls in the equity options market. It is this differential end-user demand that explains the implied vs. realised volatility anomaly. They reason that market makers inability to perfectly hedge risk exposures, coupled with their risk aversion provide the conditions for end-user demand to effect option prices. Further they find that option prices are more sensitive to demand following market maker losses and subsequent increased risk aversion, providing additional weight to their theory. In short, the option expensiveness of index options compared to equity options is due to their positive end-user demand; this gives another potential explanation for my results.

Despite the above, in the time period that I examine the risk-adjusted performance of a buy-write strategy on the S&P 500 is not statistically different from that of the underlying index. As with the equity portfolios, the buy-write strategy outperforms slightly, but without statistical significance this claim simply cannot be made. Further having looked through the previous studies of Whaley (2002), Callan Associates (2006) and O'Connell & O'Grady (2014) there is no sign of statistical testing to back up their claims regarding the performance of the buy-write strategy. Therefore I replicated Whaley's 2002 study as well as a longer, more up to date time period and tested for statistical difference in risk-adjusted performance between the BXM and S&P 500, the results are shown below in table 10.

Table 10
Replication of Whaley (2002)
The table shows the risk-adjusted performance of the BXM and S&P 500 in 1988-2001 and 1988 - 2014. T-statistics in parenthesis and statistically significant values in bold.

	Sharpe Ratio 1988-2001	**Sharpe Ratio 1988-2014**
BXM	**0.249** **(2.61)**	**0.176** **(2.77)**
S&P 500	**0.182** **(2.21)**	**0.155** **(2.63)**
BXM - S&P 500	0.067 (1.00)	0.021 (0.55)

After testing the monthly Sharpe Ratio's it becomes apparent that although the BXM outperforms, Whaley's claims are not backed up with statistical significance. The BXM has an excess Sharpe Ratio of 0.067, but an accompanying t-statistic of 1.00. When the study is replicated using a 26 year period from 1988-2014the excess Sharpe Ratio is 0.021 with a t-statistic of

0.55. The index buy-write strategy does consistently display positive excess risk-adjusted returns over a long time period, but the magnitude is very small and without statistical significance they could very possible be down to chance. This being said, the implied vs. realized volatility anomaly still exists, however the studies that identified this relationship[11] use the bid ask midpoint in their calculation of implied volatility, whereas aforementioned studies of buy-write performance use the bid price on the date that the call option is written. Thus a trading cost equal to half of the bid ask spread is implicit in Whaley's results as well as the results of this study. The implication of this is that index options are expensive, but the costs of trading provide a counterweight to this expensiveness, therefore statistically speaking, it would appear that the index buy-write strategy is not market beating, earning abnormal risk-adjusted returns that are not statistically different from 0.

6.2 Effect of firm characteristic on buy-write performance and option expensiveness

The difference in index and equity buy-write performance although relevant, is not the main focus of my study. As we have seen already, there is no difference between excess risk-adjusted buy-write returns for growth, value, small and large stocks. This is in contrast to previous literature which I used to form my hypotheses. Pietro & Vainberg (2006) showed that options on small and value stocks are expensive relative to large and growth stocks with Carr & Wu (2009) confirming their observations for growth and value

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[11] Bollen & Whaley (2004), Bakshi, Kapadia, Madan (2003), Constantinides, Jackwerth, Perrakis (2009)

stocks, but not small and large stocks. If anything my results suggest the opposite; a long position in growth excess buy-write returns and short value excess buy-write returns earns a weekly return of 0.026% and for a long position in large and short in small a weekly return of 0.046% is generated.

I have highlighted already that a potential explanation for this could be the difference in the relative performance of growth, value, large and small stocks between the two sample periods. In the period used by Pietro & Vainberg (1996-2004) value stocks outperformed growth stocks and small stocks slightly outperformed large stocks. In my sample period the opposite is true, growth outperformed value and large outperformed small. Recall the findings of Barberis & Huang (2001) that investors misestimate future volatility due to overreactions to current stock returns and of La Porta (1996) that investors are overly optimistic about stocks with high past performance and overly pessimistic about stocks with low past performance. Assuming this holds true it could explain the contradictory findings. Hypothetically speaking, when value and small stocks outperformed growth and large stocks, investors overreacted to this information, thus overestimating the upward volatility of value and small stocks and overpaying for call options. The opposite is true when growth and large outperformed value and small stocks.

Another potential reason is that the relative illiquidity of value and small options compared to growth and large options has an offsetting effect on their expensiveness. Garleanu, Pedersen, Poteshman (2009) note that market makers tend to hold a net long position in equity options due to the popularity of option writing by market participants, also they may be willing to pay less for options which are difficult to delta hedge. Therefore market makers likely require compensation for the difficulty in hedging illiquid options leading to an increased bid ask spread and higher trading costs for option traders. Since my results account for a trading cost equal to half the bid ask spread, the larger the spread, the larger the trading cost. Hence the costs of writing value and small options are higher than the costs of writing large and growth options which has a penalizing effect on buy-write excess returns. Goyal & Soretto (2009) also note the increasing impact of trading costs for more illiquid options. Pietro & Vainberg (2006) and Carr & Wu (2009) create synthetic variance swaps based on the implied volatility backed out of the option prices and compare variance swap returns where the investors pays the implied volatility and receives the realized volatility. In their calculation of implied volatility they use the bid ask midpoint, therefore their results do not account for this trading cost meaning their results are likely biased towards small and value options. My results suggest that after adjusting for this trading cost, there is no relationship between firm characteristic and option expensiveness.

6.3 Effect of Investor Sentiment

As hypothesized, I found a positive relationship between investor sentiment and buy-write returns. Further, individual investor sentiment has an impact on all asset classes, whereas institutional investor sentiment affects large and value stocks only. This is consistent with a demand-based approach to option pricing as set out by Garleanu, Pedersen, Poteshman

(2009). Their theory suggests that increased option end-user demand causes an increase in option expensiveness relative to when end-user demand is lower. My results also support the findings of Lemmon and Ni (2010) that investor sentiment positively affects call option prices due to an increase in the speculative activity of individual investors in times of high sentiment. These findings provide a logical explanation for my results, namely that increased investor sentiment influences the speculative activities of individual investors making them more likely to purchase stock call options. Due to increased call option demand, call option expensiveness increases and therefore option writers command a higher premium from selling call options, which leads to increased buy-write returns.

Interestingly, my results indicate that buy-write portfolios using value and small stocks as the underlying are more sensitive to individual investor sentiment than portfolios of growth and large stocks. This is consistent with the notion that individual investors typically speculate on stocks small in nature or financially distressed stocks due to their limited financial resources. Baker & Wurgler (2006) note that stocks that are hard to value and difficult to arbitrage such as small, young, highly volatile, extreme growth and distressed stocks are amongst those most sensitive to investor sentiment, which gives additional weight to my results. However, Lakonishok et al. (2007) associate greater option market activity with momentum, growth and highly volatile stocks. Also they find that during the stock market bubble of the late 1990's and early 2000's, investors increased their purchases of calls on growth stocks but not value stocks. More recently, Coakley et al. (2014) identify a positive relationship between sentiment and growth index option prices but no such relationship for value option prices. Therefore it is surprising to see that individual investor sentiment actually effects growth stocks the least out of all asset classes. A possible explanation for this could be the relative fall of value stocks during the 2008 crisis. According to Lee, Strong & Zhu (2014), prior to the onset of the crisis value stocks consistently outperformed growth, however during the crisis this trend reversed. Due to the lack of liquidity, value or distressed stocks suffered much more than growth stocks. Therefore since value stocks exhibited a larger reaction to the crisis, it likely resulted in a stronger relationship between falling investor sentiment and buy-write returns. Alternatively, referring back to Baker & Wurgler's 2006 conjecture, perhaps value and small stocks are simply harder to value and more difficult to arbitrage than growth and large stocks, therefore making them more vulnerable to changes in sentiment. Lemmon & Ni (2010) also find that the effect of sentiment is strongest on options with higher market-maker hedging costs, therefore since it is more expensive to hedge illiquid options such as small and value, the effect of sentiment is stronger.

The relationship between individual investor sentiment and buy-write returns is understandably stronger than the relationship with institutional sentiment. Individual investors typically use stock options for speculative purposes, whereas institutional investors tend to trade index options for hedging reasons. This being said, there is still a relationship between institutional sentiment and buy-write returns for large and value stocks. Since institutional investors tend to focus on larger stocks it makes sense to see a relationship here, but the relationship with value stocks is surprising and again perhaps explainable by the poor performance of value stocks during the crisis.

The two sub-sample periods examined show quite differing results, between 2008-2011 sentiment has a strong positive effect on all portfolios; however between 2012 and 2015 the relationship is lagged and considerably weaker, with only value and small stocks being affected. Han (2008) explains that investor sentiment has a stronger effect when there are more limits to arbitrage. In a market downturn, arbitrageurs are likely to be more capital constrained which limits their ability to exploit mispriced securities, therefore sentiment has a stronger effect. Another potential explanation could be that investors became overly pessimistic in response to the extreme bad news of the crisis and in more recent times investors have been slow to react to changes in their sentiment. There is much evidence for investor overreaction in crisis periods; to name a few, Michayluk & Neuhauser (2006) examine stock returns after the 1997 Asian financial crisis finding evidence of overreaction and short-term return reversals. Chan (2003) finds that investors overreact to price shocks causing excess trading volume and volatility leading to a reversal effect. The Griffin Tversky Theory (1992) predicts that news with more strength will provoke a larger reaction from investors; therefore infrequent strong news events should generate an overreaction. Based on this literature and assuming that investors do overreact in crisis periods; investors became overly pessimistic during the 2008 crisis leading to panic selling and a market overreaction. As such demand for call options fell disproportionally, leading to lower call option prices and therefore reduced buy-write returns. In short, the strong news of the crisis is responsible for the overreaction of investors with regards to sentiment and their trading activities, thus leading to a stronger relationship between buy-write returns and investor sentiment between 2008 and 2011. Further, Chan (2003) also finds that smaller and illiquid stocks exhibit stronger overreaction effects which could provide an alternative explanation of why buy-write returns of small and value stocks were more sensitive to investor sentiment in this time period.

Contrary to this, 2012-2015 was a period of historically low market volatility[12] with no events even close to the 2008 crisis in terms of magnitude and severity; therefore this period represents relatively normal market conditions. Under these conditions the effect of institutional sentiment disappears and the effect of individual investor sentiment on large and growth portfolios disappears also. The effect of individual investor sentiment on small and value portfolios becomes lagged and weaker in magnitude. This implies that during stable market conditions, investors are slow to react to changes in their sentiment and tend to hesitate before trading on their renewed market view.

12 See appendix for Vix index levels over the sample period.

CHAPTER 7
CONCLUSION

In this study I have examined the performance of the buy-write strategy when different classes of stock are used as the underlying asset and also considered the effect of investor sentiment on buy-write returns. I build on previous buy-write strategy research from Whaley (2002), Callan Associates (2006), O'Connell and O'Grady (2014) and others who find that the buy-write index strategy outperforms the underlying index on a risk-adjusted returns basis. My results show no such risk-adjusted excess returns when various classes of stock options are used instead of an index. This differing performance is likely due to the implied vs. realised volatility anomaly which literature has shown to be apparent in index options but not stock options. Alternatively, I question the validity of the aforementioned literature by testing their previously untested results for statistical significance and find that their claims are not backed up with statistical significance. Further, I test the difference between the performance of the strategy when large and small and growth and value stocks are used, finding that asset class has no significant effect on buy-write performance. In other words, there appears to be no difference in the way investor's value call options on various asset classes which is contradictory to Pietro & Vainberg (2006) and Carr & Wu (2009). I speculate that our differing results could be due to higher transaction costs for illiquid stocks that are accounted for in my research model, but not theirs or the relative performance of value and growth stocks in our sample periods.

Consistent with my expectations I find that investor sentiment generally has a positive effect on buy-write returns. Individual investor sentiment exerts a positive influence on buy-write returns across all asset classes, whereas institutional sentiment only influences large and surprisingly value stocks. This is consistent with previous studies which look at the effect of investor sentiment on call option prices. Interestingly small and value stocks are shown to be most sensitive to investor sentiment, which I attribute to the limits to arbitrage faced by arbitrageurs when trying to exploit these stocks. During the crisis period the relationship between investor sentiment and buy-write returns is particularly strong which could be explained by increased limits to arbitrage and investor overreaction which tend to occur in a strong market downturn. When considering 2012-2015 only, sentiment has a lagged effect on value and small stocks suggesting that investors are hesitant in their speculative trading in periods of low market volatility. Overall, the sentiment results are complimentary to buy-write strategy performance. Since my sample is a period of relatively low investor sentiment, this could contribute to the lack of excess risk-adjusted buy-write performance.

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APPENDIX

Appendix I
Buy-Write Vs. Long-Only Performance Jun 2008 - May 2015

	Mean	SD	Downside Risk	Sharpe Ratio	M2 Ratio	Jensen's Alpha	Treynor Ratio
Growth							
BW	**0.229%**	2.201%	2.432%	0.103	0.0013	0.0002	0.0029
	(1.97)			(1.82)		(0.84)	
LO	0.269%	2.786%	2.962%	0.095	0.0011		0.0027
	(1.83)			(1.77)			
BW-LO	-0.04%	**-0.586%**	-0.530%	0.0073	0.0002		0.0003
	(-0.94)	**(-1.60) F**		(0.41)			
Value							
BW	0.317%	4.177%	4.311%	0.075	0.0006	0.0000	0.0040
	(1.44)			(1.39)		(-0.08)	
LO	0.405%	5.134%	4.930%	0.078	0.0007		0.0040
	(1.50)			(1.49)			
BW-LO	-0.08%	**-0.957%**	-0.619%	-0.003	-0.0001		-0.0001
	(-1.19)	**(-1.51) F**		(-0.22)			
Large							
BW	0.198%	2.585%	2.790%	0.076	0.0006	0.0002	0.0025
	(1.45)			(1.37)		(0.75)	
LO	0.225%	3.204%	3.212%	0.069	0.0004		0.0022
	(1.33)			(1.30)			
BW-LO	-0.02%	**-0.619%**	-0.421%	0.006	0.0002		0.0002
	(-0.61)	**(-1.54) F**		(-0.44)			
Small							
BW	0.250%	3.280%	3.521%	0.075	0.0006	0.0000	0.0031
	(1.44)			(1.40)		(-0.08)	
LO	0.322%	4.067%	4.082%	0.079	0.0007		0.0032
	(1.50)			(1.48)			
BW-LO	-0.07%	**-0.786%**	-0.560%	-0.003	-0.0001		0.0000
	(-1.20)	**(-1.54) F**		(-0.23)			
BXM							
BXM	0.120%	2.139%	2.803%	0.055	0.0000	0.0003	0.0020
	(1.06)			(0.93)		(0.39)	
S&P500	0.156%	2.790%	3.385%	0.055	0.0000		0.0015
	(1.01)			(0.99)			
BXM-S&P500	-0.03%	**-0.652%**	-0.582%	0.000	0.0000		0.0005
	(-0.38)	**(-1.70) F**		(-0.02)			

Appendix II

Monthly Compounded Buy-Write Vs. Long-Only Performance Jun 2008 - May 2015

	Mean	SD	Downside Risk	Sharpe Ratio	M2 Ratio	Jensen's Alpha	Treynor Ratio
Growth							
BW	0.999%	4.590%	6.522%	0.215	0.0053	0.0010	0.0129
	(1.98)			(1.55)		(0.85)	
LO	1.178%	5.856%	7.196%	0.199	0.0044		0.0117
	(1.83)			(1.56)			
BW-LO	-0.179%	-1.266%	-0.674%	0.0159	0.0009		0.0013
	(-0.95)	(1.63)F		(0.26)			
Value							
BW	1.383%	8.633%	9.458%	0.159	0.0022	0.0002	0.0182
	(1.46)			(1.33)		(0.07)	
LO	1.812%	11.132%	10.873%	0.162	0.0023		0.0180
	(1.48)			(1.44)			
BW-LO	-0.428%	-2.499%	-1.414%	-0.003	-0.0002		0.0002
	(-1.17)	(1.66)F		(0.07)			
Large							
BW	0.838%	4.935%	6.254%	0.168	0.0027	0.0009	0.0105
	(1.55)			(1.36)		(0.81)	
LO	0.945%	6.123%	7.153%	0.153	0.0018		0.0093
	(1.41)			(1.28)			
BW-LO	-0.107%	-1.188%	-0.899%	0.015	0.0008		0.0011
	(-0.6)	(1.54)F		(0.35)			
Small							
BW	1.133%	7.286%	9.189%	0.154	0.0019	0.0000	0.0147
	(1.42)			(1.24)		(-0.02)	
LO	1.489%	9.313%	9.779%	0.159	0.0022		0.0148
	(1.46)			(1.36)			
BW-LO	-0.356%	-2.027%	-0.589%	-0.005	-0.0003		-0.0001
	(-1.21)	(1.63)F		(0.13)			
BXM							
BXM	0.501%	3.988%	6.763%	0.123	0.0000	0.0008	0.0077
	(1.14)			(0.91)		(0.37)	
S&P500	0.659%	5.455%	7.003%	0.119	0.0000		0.0065
	(1.10)			(0.96)			
BXM-S&P500	-0.159%	-1.467%	-0.240%	0.004	0.0000		0.0012
	(-0.52)	(1.87)F		(0.03)			

Appendix II

Growth Vs. Value and Large vs. Small Performance Comparison Jun 2008 - May 2015

	Growth (BW-LO) - Value (BW-LO)	Large (BW-LO) - Small (BW-LO)
Mean (Weekly)	0.048% (0.77)	0.045% (1.21)
Mean (Monthly)	0.249% (0.85)	0.249% (1.57)

Appendix III

Returns of Vanguard Asset Class Funds from 1996-2004 and 2009-2015

	Russell 3000® Growth Index	Russell 3000® Value Index	Russell Large Cap	Russell Small Cap
1996-2004	9.70%	12.58%	11.40%	11.90%
2009-2015	11.47%	8.94%	17.54%	17.24%

Appendix IV

Full Sample Buy-Write Bull-Bear Spread Sentiment Coefficients For All Variables

08-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.001	0.759	0.026	-0.153	-0.004	0.000	-0.001
	(1.87)	(37.63)	(0.87)	(-5.77)	(-1.21)	(-0.23)	(-0.33)
Value	0.001	1.099	-0.069	0.939	0.016	0.013	0.001
	(0.79)	(25.66)	(-1.10)	(16.61)	(2.31)	(3.50)	(0.27)
Large	0.000	0.829	-0.260	0.237	0.003	0.007	-0.001
	(0.50)	(39.15)	(-8.39)	(8.48)	(0.76)	(3.57)	(-0.60)
Small	0.000	0.951	0.327	0.252	-0.002	0.003	-0.001
	(0.44)	(26.96)	(6.32)	(5.42)	(-0.27)	(0.89)	(-0.18)

09-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.001	0.674	0.071	-0.198	-0.010	-0.001	-0.001
	(3.03)	(32.44)	(2.44)	(-7.78)	(-3.31)	(-0.89)	(-0.86)
Value	0.001	0.990	-0.012	0.791	0.007	0.010	0.000
	(0.82)	(23.82)	(-0.20)	(15.51)	(1.23)	(3.29)	(0.15)
Large	0.000	0.793	-0.172	0.217	0.002	0.004	-0.003
	(0.04)	(35.56)	(-5.51)	(7.95)	(0.65)	(2.55)	(-1.77)
Small	0.001	0.910	0.214	0.215	-0.005	0.003	0.002
	(1.04)	(24.10)	(4.05)	(4.65)	(-0.87)	(1.07)	(0.63)

Appendix V
Full Sample Buy-Write Consumer Sentiment Index Sentiment Coefficients For All Variables

08-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.011	0.807	0.045	-0.126	-0.004	0.147	0.058
	(1.99)	(39.13)	(1.01)	(-4.98)	(-1.07)	(2.86)	(1.21)
Value	0.009	1.234	-0.021	0.940	0.035	0.386	0.154
	(1.12)	(29.61)	(-0.55)	(16.90)	(2.76)	(3.38)	(1.44)
Large	0.006	0.904	-0.252	0.301	0.040	0.167	0.048
	(0.77)	(39.87)	(-7.82)	(8.87)	(1.12)	(3.06)	(0.94)
Small	0.008	0.887	0.278	0.301	0.000	0.285	0.161
	(0.68)	(24.78)	(5.86)	(6.54)	(0.12)	(3.39)	(2.04)

09-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.012	0.676	0.072	-0.104	0.024	0.090	0.011
	(3.54)	(31.12)	(2.77)	(-4.37)	(0.54)	(2.19)	(0.26)
Value	0.004	1.173	-0.005	0.919	-0.001	0.260	0.021
	(0.95)	(27.53)	(-0.04)	(17.54)	(-0.38)	(2.94)	(0.24)
Large	0.019	0.793	-0.164	0.224	-0.004	0.111	0.011
	(0.22)	(33.54)	(-5.27)	(8.12)	(-0.63)	(2.45)	(0.25)
Small	0.007	1.006	0.164	0.286	0.007	0.204	0.073
	(1.53)	(26.00)	(2.88)	(6.42)	(0.39)	(3.00)	(1.09)

Appendix VI

Sub-Sample Buy-Write Bull-Bear Spread Sentiment Coefficients For All Variables

08-11	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.002 (2.68)	0.775 (28.30)	0.017 (0.38)	-0.168 (-4.60)	-0.006 (-1.19)	0.000 (0.17)	0.001 (0.3)
Value	0.003 (2.23)	1.111 (18.30)	-0.137 (-1.42)	0.994 (12.29)	0.020 (1.68)	0.020 (3.35)	0.003 (0.58)
Large	0.001 (2.27)	0.843 (28.49)	-0.324 (-6.90)	0.242 (6.13)	0.000 (-0.05)	0.010 (3.42)	0.000 (0.07)
Small	0.002 (1.47)	0.995 (20.58)	0.394 (5.13)	0.214 (3.33)	0.005 (0.55)	0.005 (1.14)	0.001 (0.24)

12-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.000 (0.96)	0.594 (16.17)	0.027 (0.77)	-0.205 (-5.07)	-0.014 (-3.52)	-0.002 (-0.77)	-0.002 (-1.13)
Value	-0.001 (-1.91)	0.880 (16.07)	0.056 (1.08)	0.546 (9.08)	-0.007 (-1.13)	0.000 (-0.01)	-0.002 (-0.54)
Large	0.000 (-1.18)	0.627 (24.55)	-0.146 (-6.05)	0.083 (2.97)	-0.011 (-4.00)	0.000 (0.30)	-0.002 (-1.78)
Small	0.000 (-0.34)	0.690 (11.06)	0.197 (3.34)	0.223 (3.25)	-0.025 (-3.61)	0.000 (0.02)	-0.002 (-0.71)

Appendix VII
Sub-Sample Buy-Write Consumer Sentiment Index Sentiment Coefficients For All Variables

08-11	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.008	0.914	0.021	0.066	0.000	0.215	0.078
	(3.01)	(29.12)	(0.65)	(0.88)	(0.06)	(2.43)	(1.05)
Value	0.004	1.124	-0.197	1.035	0.021	0.628	0.173
	(2.28)	(19.23)	(-1.67)	(14.94)	(1.71)	(3.10)	(1.02)
Large	0.006	1.043	-0.290	0.423	0.001	0.263	0.036
	(2.43)	(29.45)	(-5.76)	(7.11)	(0.36)	(2.80)	(0.46)
Small	0.006	1.114	0.476	0.300	0.004	0.440	0.189
	(1.62)	(22.73)	(5.71)	(3.64)	(0.49)	(2.93)	(1.50)

12-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.016	0.614	-0.002	-0.327	0.011	-0.019	0.017
	(1.22)	(17.43)	(-0.34)	(-7.43)	(0.73)	(-0.41)	(0.34)
Value	0.006	0.804	0.097	0.568	-0.003	-0.002	0.159
	(0.44)	(14.29)	(1.54)	(9.65)	(-0.87)	(-0.02)	(2.06)
Large	0.001	0.643	-0.224	0.079	0.016	-0.031	0.072
	(0.12)	(24.71)	(-6.69)	(2.44)	(0.67)	(-0.65)	(1.40)
Small	0.006	0.726	0.199	0.266	0.012	0.003	0.116
	(0.43)	(13.92)	(3.36)	(3.45)	(0.57)	(0.06)	(1.98)

Appendix VIII

Full Sample Long-Only Bull-Bear Spread Sentiment Coefficients For All Variables

08-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.001	0.982	0.111	-0.250	-0.004	-0.001	-0.002
	(1.55)	(48.98)	(3.78)	(-9.44)	(-1.12)	(-0.54)	(-1.05)
Value	0.001	1.291	0.075	1.358	0.023	0.013	0.001
	(1.34)	(29.80)	(1.18)	(23.75)	(3.18)	(3.37)	(0.13)
Large	0.000	1.059	-0.251	0.331	0.010	0.004	-0.001
	(-0.19)	(58.60)	(-9.48)	(13.86)	(3.49)	(2.63)	(-0.92)
Small	0.000	1.160	0.492	0.370	-0.002	0.004	-0.001
	(0.67)	(29.72)	(8.61)	(7.19)	(-0.36)	(1.20)	(-0.18)

09-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.001	0.966	0.066	-0.328	-0.006	-0.001	-0.002
	(1.70)	(46.78)	(2.29)	(-12.98)	(-2.20)	(-0.95)	(-1.19)
Value	0.000	1.295	0.009	1.177	0.019	0.012	0.001
	(0.30)	(28.82)	(0.14)	(21.40)	(3.01)	(3.54)	(0.27)
Large	-0.001	1.094	-0.254	0.280	0.013	0.003	-0.002
	(-2.01)	(57.86)	(-9.60)	(12.10)	(4.77)	(1.80)	(-1.69)
Small	0.000	1.235	0.309	0.319	0.003	0.004	0.001
	(0.40)	(29.84)	(5.34)	(6.29)	(0.48)	(1.30)	(0.44)

Appendix IX
Full Sample Long-Only Consumer Sentiment Index Sentiment Coefficients For All Variables

08-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	-0.004	1.226	0.129	-0.151	0.033	0.176	0.033
	(-1.65)	(51.53)	(3.93)	(-7.86)	(0.44)	(2.54)	(0.50)
Value	0.013	1.666	0.017	1.206	0.041	0.530	0.162
	(1.52)	(32.02)	(0.54)	(21.32)	(5.00)	(3.62)	(1.18)
Large	0.014	0.919	-0.187	0.346	0.017	0.196	0.045
	(0.59)	(54.11)	(-7.85)	(14.76)	(3.97)	(2.78)	(0.67)
Small	-0.001	1.213	0.465	0.535	0.020	0.363	0.145
	(-0.33)	(30.12)	(7.515	(9.44)	(0.66)	(3.28)	(1.40)

09-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.009	1.163	0.158	-0.323	-0.014	0.134	-0.062
	(1.83)	(44.52)	(3.95)	(-10.65)	(-3.12)	(2.25)	(-1.05)
Value	0.003	1.333	0.172	1.384	0.005	0.400	0.025
	(0.53)	(21.39))	(0.77)	(24.32)	(2.43)	(3.18)	(0.21)
Large	0.004	0.990	-0.188	0.291	0.030	0.145	-0.024
	(0.81)	(52.14)	(-5.37)	(12.14)	(4.94)	(2.35)	(-0.39)
Small	0.008	1.302	0.387	0.576	-0.007	0.310	0.034
	(1.00)	(29.04)	(5.81)	(7.88)	(-0.44)	(3.16)	(0.35)

Appendix X

Sub-Sample Long-Only Bull-Bear Spread Sentiment Coefficients For All Variables

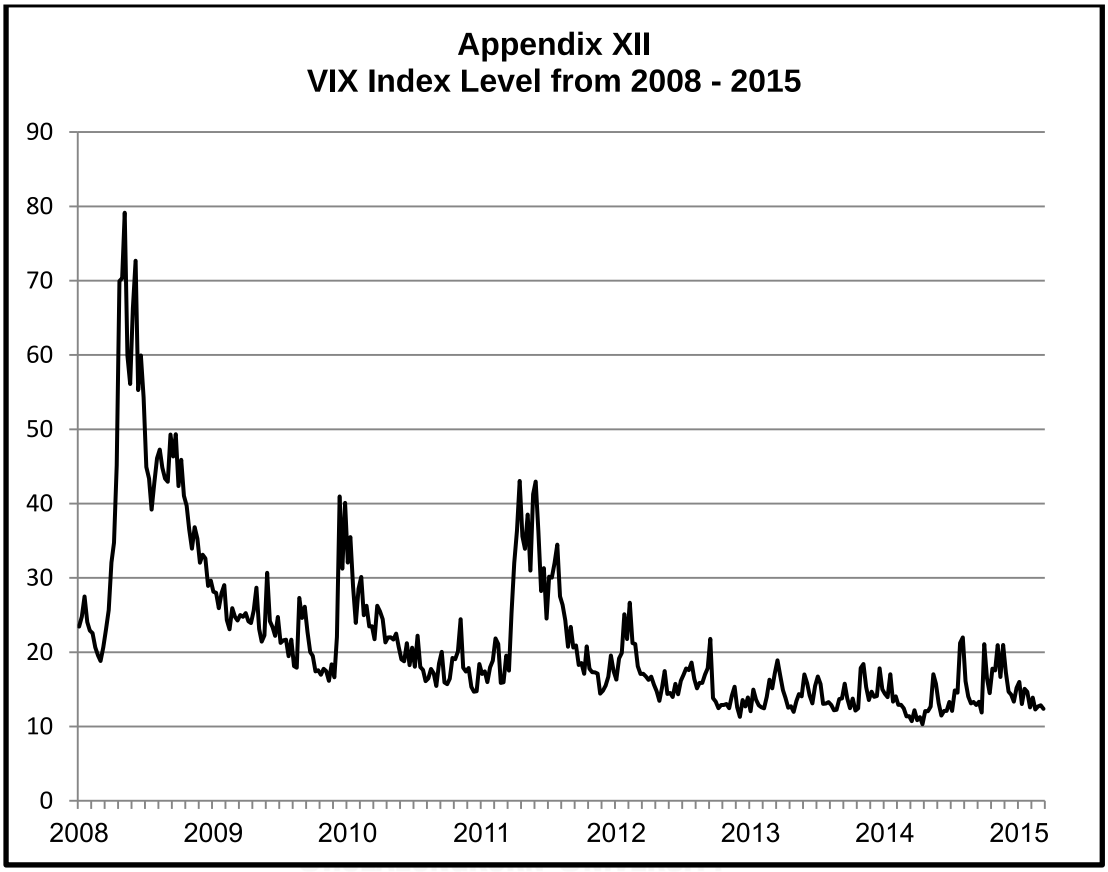
08-11	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.001	0.975	0.144	-0.233	-0.004	-0.002	-0.002
	(1.62)	(38.04)	(3.54)	(-6.84)	(-0.79)	(-0.67)	(-0.81)
Value	0.003	1.279	0.041	1.461	0.036	0.020	0.002
	(2.06)	(21.33)	(0.43)	(18.28)	(3.00)	(3.36)	(0.31)
Large	0.001	1.062	-0.280	0.366	0.013	0.006	-0.001
	(1.07)	(41.49)	(-6.88)	(10.74)	(2.52)	(2.43)	(-0.41)
Small	0.001	1.174	0.596	0.365	0.007	0.006	0.000
	(0.75)	(21.91)	(7.00)	(5.12)	(0.70)	(1.08)	(-0.08)

12-15	Alpha	Beta	SMB	HML	VIX	BB	BB (t-1)
Growth	0.000	0.992	0.022	-0.334	-0.003	0.001	-0.001
	(0.21)	(20.87)	(0.48)	(-6.39)	(-0.56)	(0.25)	(-0.29)
Value	-0.001	1.316	0.157	0.915	0.010	-0.002	-0.001
	(-1.43)	(20.50)	(2.59)	(12.97)	(1.36)	(-0.43)	(-0.37)
Large	0.000	0.947	-0.196	0.114	-0.002	0.001	-0.001
	(-1.33)	(40.22)	(-8.80)	(4.39)	(-0.82)	(0.57)	(-0.91)
Small	0.000	1.156	0.296	0.355	-0.009	0.003	0.000
	(-0.25)	(15.19)	(4.11)	(4.25)	(-1.10)	(0.60)	(-0.11)

Appendix XI
Sub-Sample Long-Only Consumer Sentiment Index Sentiment Coefficients For All Variables

08-11	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.017	1.097	0.202	-0.066	0.016	0.244	0.046
	(1.91)	(42.75)	(4.61)	(-3.21)	(0.52)	(2.05)	(0.46)
Value	0.008	1.469	0.055	1.536	0.051	0.809	0.157
	(2.76)	(25.39)	(0.72)	(21.11)	(3.71)	(3.12)	(0.72)
Large	0.002	1.044	-0.194	0.189	0.007	0.291	0.024
	(1.13)	(34.92)	(-4.31)	(8.51)	(1.88)	(2.39)	(0.23)
Small	0.011	1.298	0.636	0.330	0.032	0.532	0.156
	(1.02)	(19.32)	(7.84)	(4.76)	(0.33)	(2.71)	(0.95)

12-15	Alpha	Beta	SMB	HML	VIX	CSS	CSS (t-1)
Growth	0.009	1.132	0.011	-0.411	-0.006	0.036	0.017
	(0.96)	(24.22)	(0.32)	(-7.12)	(-0.99)	(0.48)	(0.21)
Value	-0.001	1.268	0.187	1.012	0.028	0.135	0.245
	(-1.22)	(18.36)	(3.00)	(13.12)	(1.58)	(1.21)	(2.04)
Large	0.008	1.058	-0.149	0.223	0.010	0.027	0.088
	(0.99)	(43.96)	(-6.24)	(8.01)	(0.28)	(0.36)	(1.11)
Small	0.000	1.198	0.351	0.606	0.006	0.113	0.164
	(-0.10)	(17.42)	(4.76)	(7.24)	(0.74)	(1.15)	(1.55)


Appendix XII
VIX Index Level from 2008 - 2015
90
80
70
60
50
40
30
20
10
0
2008
2009
2010
2011
2012
2013
2014
2015

VITA

Mr Oliver Palmer was born in York, United Kingdom on 28th June 1992. He studied at All Saints RC School up to the age of 18 leaving in July 2010. A few months later he embarked upon the study of his bachelor degree in Accounting & Finance at the University of East Anglia, Norwich, United Kingdom. Following his graduation, Oliver expressed a desire to specialise in finance and applied for a place on the Master of Science in Finance program at Chulalongkorn University, Thailand. He was successful in his application and began studying in June of 2014.