The Risk and Return Characteristics of the Buy Write Strategy On The Russell 2000 Index

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January 2007

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Abstract

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Using data from January 18, 1996 to November 16, 2006, we construct and evaluate returns on a buy-write strategy on the Russell 2000 index. The results demonstrate that the strategy has consistently outperformed the Russell 2000 index on a risk adjusted basis, when implemented with one month to expiration calls and when performance is evaluated using standard performance measures. The outperformance is robust to measures which specifically consider the non-normal distribution of the strategy's returns. However, the consistent performance advantage does not remain if we utilize two month to expiration calls.

To evaluate the performance in varying market conditions, we break our sample into sub-periods. Specifically, one of the worst market conditions for the buy-write strategy is February 2003 to November 2006, when the Russell 2000 experiences a high sustained growth at a relatively low volatility. Even in this market environment, we find that the buy-write strategy outperforms the Russell 2000 on a risk adjusted basis, returning two-thirds of the index return at half its volatility.

We provide insight into the sources of the performance. On average, written calls end up in-the-money and transaction costs of writing the call at the bid further increases the losses. However, the buy-write strategy benefits by writing calls at an implied volatility higher than the realized volatility. In fact, we find that the contribution of the volatility risk premium - the difference between implied and realized volatility - is typically larger than the net losses incurred by the call position or the transaction costs. It appears that the existence of the risk premium is critical to the performance of the strategy. In fact, the (Leland's) alpha of the strategy is typically significantly smaller than the risk premium, implying that the buy-write strategy would not provide excess returns in the absence of the risk premium.

1 Introduction

The purpose of this paper is to assess the risk and return characteristics of the passive buy-write strategy on the Russell 2000 index. The buy-write strategy entails the writing of a call on an equity index against a long position in the same underlying equity index. The strategy is usually implemented passively, without explicitly incorporating market timing.

The paper is motivated by the significant recent interest the use of buy-write strategies for investment purposes. In light of the growing investment interest, the CBOE has recently introduced a number of buy-write indices based on a variety of equity indices such as the S&P 500, the Dow Jones Industrial Average, the Nasdaq 100 and, most recently in May 2006, the Russell 2000. In addition, funds based on a buy-write strategy have been proposed by a number of firms, including Eaton Vance and Blackrock.[1] Although a number of papers have examined the returns on the strategy for the S&P 500,[2] the risk and return characteristics of the buy-write strategy on the Russell 2000 have not been extensively examined. Previous studies have consistently found that the buy-write strategy on the S&P 500 outperformed the S&P 500 on a risk adjusted basis. It is certainly worthwhile to determine whether the results associated with the earlier papers are robust across other indices.

More generally, the analysis of the returns of the buy-write strategy also allows us insight into how options are priced and traded in the market. If the assumptions underlying the Black Scholes analysis held precisely, it would be straightforward to understand the returns of a buy-write strategy. In practice, however, the returns are impacted by both transaction costs and the actual market value of the options, which tends to be higher than the prices suggested by the Black Scholes formula. This price differential manifests itself in implied volatilities that are consistently higher than realized historical volatilities. Our objective is to use the analysis of the buy-write strategy to provide insight into the economic importance of these potentially offsetting effects.

We provide a comprehensive analysis of the buy-write strategy for the Russell 2000 over the period from January 19, 1996 to November 17, 2006. The length of the sample period allows us to assess the performance in different market conditions. In addition, we provide a comparison of the strategy over a range of implementations with differing call strikes and

[1] See "Buy-Write Funds: Blast from the Industry's Past," *New York Times*, October 15, 2006.

[2] See Whaley (2002), Feldman and Roy (2004), and more recently, Renicker and Mallick (2005), and Hill et al (2006).

maturities.

Consistent with the previous literature, we find that the buy-write strategy may outperform the index. However, the performance depends on the option selection criteria of the particular implementation. We find that the 1-month at-the-money strategy outperforms the index using a variety of measures. More significantly, it outperforms the index in possibly the worst market environment for the strategy, when the index experiences large sustained positive returns with low volatility. Over the 45 month period from February 20, 2003 to November 16, 2006 the Russell 2000 had an annualized return of 24.82% and a volatility of 15.34%. Even in this unfavorable market environment, the buy-write strategy returned almost three-quarters of the market return at about half the latter's volatility, easily outperforming the market by standard measures.

As mentioned earlier, the selection criteria for the calls are important in determining the strategy's returns. This is the case because both transaction costs and the volatility risk premium (the premium of implied volatility over realized volatility) have a significant impact on returns, and the magnitude of both these factors varies significantly across options with differing moneyness and time to expiration. In fact, the risk premium of the call is critical to the returns of the strategy as our results suggest that the strategy would not outperform the index if options were priced at realized volatility.

Overall, we find that the buy-write strategy can outperform the underlying index. However, both transaction costs and the choice of the option contract are central factors in determining the performance.

2 Data and Methodology

For this study, we utilized option data from Optionmetrics. The dataset comprises of closing bids and offers of all options and indices quoted across all the exchanges for the period from January 1996 to December 2006. The OptionMetrics data also provides us with computed implied volatilities. The returns on the Russell 2000 are combined with a daily cash dividend to create a total return index. Daily data is utilized to allow us to create monthly index returns from expiration to expiration. We chose this methodology rather than month end to month end returns to more closely match the order flow and cash flow of the buy-write

strategy.[3] The dividend stream is computed as the difference between the Russell 2000 index value with dividends and the Russell 2000 index value without dividends.[4] The total return index, combined with the returns of the short call positions, determines the returns of our buy-write strategy.

For the analysis, we construct a buy-write index, closely following the methodology in Whaley (2002). The CBOE indices are also based on a similar methodology. Details of the index construction are as follows: Once each month, at the close on the day before the expiring option settles (usually the third Thursday of the month), a new call is written. The monthly return of the index is then constructed as,

$$\mathrm{R}_t = \frac{(RUT_t + Div_t - (Call_t - Call_{t-1}))}{(RUT_{t-1} - Call_{t-1})}, \tag{1}$$

We compare several different implementations of the index. First, for each maturity, we construct 5 indices corresponding to the at-the-money as well as 2% and 5% in- and out-the money calls, respectively. We use two different maturities, one-month and two-month, so that we have a total of 10 indices. The main body of the paper includes the results for the 1-month at-the-money and 2% away from the money strategies. The results for the additional implementations are provided in the appendices. For all strategies, the option is held until expiration. The short call position is closed at the intrinsic value of the call. There is a slight inaccuracy imposed by this procedure. Although in practice, the call is settled based on the Russell 2000 component trade prices on the morning of the day before expiration, we are effectively settling the options based on the closing prices of the previous day. We do this because our options dataset does not include opening prices. In order to include a representation of transaction costs, the new call is written at the current bid. If a two month call was written, then the call is marked-to-market for return calculations at the mid-point between the bid and the ask for the month end between the call writing and the call expiration.

In performing our analysis, we face a data limitation in that bid-ask quotes across all strikes are not available over the entire period (although the data availability improves significantly in more recent years). To ensure that the index is investable, we always use an available bid for writing the call. The two month implementations also require a bid and ask at the end of the first of the two months for accurate return calculations. For the sake

[3]For the sake of simplicity, throughout this paper all references to 'month' or 'month end' will imply our expiration to expiration monthly periods.

[4]Both of these indices are available on the Russell website.

of consistency, we select options for all strategies that have quotes at the beginning and end of the month the call is written.[5] If a specific option quote is not available, we substitute it by the option of the nearest available strike. For away from the money calls, we substituted the next available strike towards the at-the-money. For the at-the-money calls, we used the closest available strike. This procedure for the substitution of strikes biases our away-from-the-money indices to be more similar to the at-the-money index. Table 1 provides details of how often we had to substitute alterative strikes as well as the average deviation from the desired strike. On average, across all the indices we construct, the number of alternate strikes was 28, with an average non-zero deviation of .1 from the desired strike. However, the number of substitutions and the magnitude of deviation from the desired strike varies significantly across the different strategy implementations. For one of the expirations, the two month strategy had to be executed using two consecutive one month to expiration calls, since as no two month to expiration call data was available on the call writing date. While all the strategies required some substitutions, the 1-month at-the-money strategy is the most pure of the buy-write strategies we consider, with a mean deviation from the desired strike of -0.8. In a practical application of these strategies, one would not encounter these quote availability limitations. The strategy could be implemented at the desired strikes, since the market would provide the required quotes.

The returns of the strategy will be impacted by both transaction costs as well as any consistent deviation of the implied volatility from the historical realized volatility. The primary transaction cost associated with the implementation of the strategy is the bid-ask spread of the option. To understand the impact of the bid-ask spread as well as to allow for the possibility that a call may be written within the spread, we calculate the returns using two different procedures. In the first, we assume the calls are written at the bid. In the second we assume the calls are written at the mid point between the bid and ask. Figure 1 provides a graphical presentation of the cumulative impact of the difference between these two treatments for the one-month at-the-money buy-write strategy. It is evident from the graph that if we disregard transaction costs, the cumulative growth of the at-the-money buy-write strategy over the 10 plus years of our study is very close to that of the Russell 2000, with far less volatility. The significance of the impact of transaction costs is also quite clear.

Table 2 provides summary statistics relating to transaction costs and volatilities. We

[5] If we were to relax the quote requirement for the one-month calls, and only demand a quote on the day the call is written, we would have 3 to 7 fewer strike substitutions for each strategy.

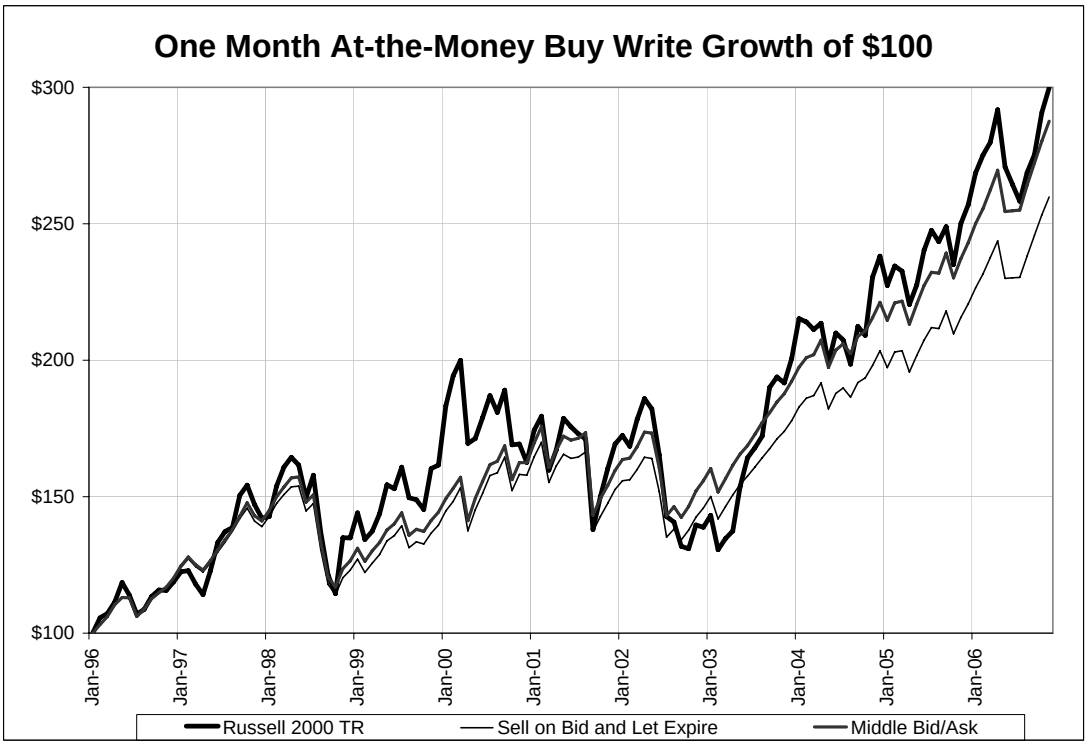

Figure 1: Growth of $100 in the one month at-the-money buy-write strategy, considering different treatments of transaction costs.

Table 1: Alternate Strikes

Strategy	Mean Deviation From Strike	Number of Alternates Used	Mean Non-Zero Deviation
1 Month			
5% OTM	-5.2	46	-14.8
2% OTM	-2.5	26	-12.5
ATM	-0.8	42	-2.6
2% ITM	3.9	36	14.0
5% ITM	4.2	37	15.0
2 Month			
5% OTM	1.5	20	5.0
2% OTM	1.4	17	5.3
ATM	1.4	21	4.3
2% ITM	-1.2	13	-6.2
5% ITM	-2.8	21	-8.8
Mean	0.0	28	-0.1

The table summarizes the number of times the desired strike for construction an index was not available as well as the average deviation from the desired strike.

report the net of the Black Scholes implied volatility over the realized volatility for the remaining maturity of the option, as well as the average percentage bid-ask spread for the calls that we write (on the day the call is written).

The bid-ask spread for the 1-month options range from 5.64% to 12.28%, smaller for calls that are more in-the-money. The percentage spreads for the 2-month options are lower than those for the 1-month options, ranging from 4.97% to 9.75%. The spread for the at-the-money 1-month and 2-month options (the main options of interest) are 8.29% and 7.69%, respectively.

As has been documented in the literature for options on the S&P (for example, see Bakshi and Kapadia (2003)), the Black Scholes implied volatility is consistently higher than the historical realized volatility over the remaining lifetime of the option. The average volatility risk premium (defined as the implied volatility less the realized volatility) is 4.43% and 4.02% for the at-the-money option for the 1-month and 2-month times to expiration, respectively. The magnitude of this difference is higher than that documented previously for the options on S&P 500 and the S&P 100 (SPX and OEX, respectively). Since this is one of the drivers of the buy-write strategy returns, the larger volatility risk premium would be expected to help provide a favorable environment for the implementation of the strategy.

Table 2: Bid Ask Spreads and Volatility Differentials

Strategy	Volatility Risk Premium	Bid Ask Spread
1 Month		
5% OTM	3.16%	12.28%
2% OTM	4.01%	9.27%
ATM	4.43%	8.29 %
2% ITM	5.44%	7.05 %
5% ITM	7.03%	5.64 %
2 Month		
5% OTM	1.56%	9.75%
2% OTM	2.38%	8.47 %
ATM	4.02%	7.69 %
2% ITM	3.80%	6.40 %
5% ITM	5.19%	4.97 %

The volatility risk premium is the average Black Scholes implied volatility minus the return volatility realized over the remaining lifetime of the option. Bid-ask spread is defined as the difference between the bid and the ask as a percentage of the midpoint between the bid and the ask.

3 Risk and Return Characteristics

3.1 Full Sample Results

Tables 3 provides summary statistics for the 1-month buy-write strategy for the entire sample period from January 18, 1996 to November 16, 2006. We report both average returns and volatility for each strategy implementation. As the returns on the buy-write strategy are not normally distributed, we also report the higher moments of the distribution including the excess kurtosis and the skewness. Since volatility may not be a effective measure of risk for non-normal distributions, we report alternative measures such as the range of the realized return distribution and the maximum drawdown and run up.

The annualized return for the at-the-money 1-month strategy over the 130 months of our sample period is 9.21% compared to the Russell 2000 return of 10.67%. The higher (lower) the strike compared to the at-the-money strike, the further (closer) are the returns of the strategy to those of the index. This is not surprising. As the written option is more out of the money, the "delta" of the net position (long index, short call) is closer to 1. Similarly, the greater the written option is in the money, the "delta" of the net position is closer to 0. In what follows, we will focus mostly on the strategy for the at-the-money option although we continue to report the numbers for other strikes. Details for the 5%

Table 3: Summary Statistics for the One Month to Expiration Buy Write Strategies - Jan 18, 1996 to Nov 16, 2006

	Russell 2000	2% OTM	ATM	2% ITM
Annualized Return	10.67%	10.60%	9.21%	9.60%
Annualized Standard Deviation	20.52%	14.85%	13.36%	11.98%
Mean Monthly Return	1.03%	0.94%	0.81%	0.83%
Median Monthly Return	2.18%	2.75%	2.34%	1.68%
Monthly Standard Deviation	5.92%	4.29%	3.86%	3.46%
Skewness	-0.60	-1.92	-2.10	-2.29
Excess Kurtosis	1.09	3.91	4.85	6.34
Maximum Monthly Return	17.93%	6.00%	5.63%	5.63%
Minimum Monthly Return	-19.41%	-18.24%	-17.46%	-16.30%
Maximum Drawdown	-34.70%	-27.18%	-25.87%	-21.36%
Maximum Run Up	79.14%	73.85%	68.53%	68.54%
Number of Months	130	130	130	130

This table provides summary statistics for the at-the-money and 2% in-the-money and out-of-the-money 1-month buy-write strategies for the entire sample period.

away from the money and all 2-month strategies are provided in the appendices.

It is of great interest that the volatility of the strategy for the at-the-money option is so much lower than of the index. The annualized volatility for the 1-month at-the-money buy-write strategy is 13.36% compared to 20.52% for the Russell 2000. However, the mean return and volatility are not sufficient to characterize the distribution of returns since the buy-write strategy's return distribution would be non-normal even if the underlying Russell 2000 distribution was normal. In fact, the Jarque Bera statistic (that tests for normality of the distribution) is 223 for the at-the-money strategy compared to 14.2 for the Russell 2000, indicating that the at-the-money buy-write strategy returns are highly non-normal.[6] The buy-write strategy's returns are significantly more fat-tailed and negatively skewed than the returns of the index. The excess kurtosis and skewness of the at-the-money strategy are 4.85 and -2.10 compared with 1.09 and -0.60 for the underlying index.

Given that the return distribution is non-normal, it is particularly important to consider measures of risk other than volatility. Table 3 reports the minimum monthly return and the maximum drawdown over the full period. The worst monthly return for the at-the-money strategy is -17.46%, which is better than the worst monthly return of -19.41% for the Russell 2000. The largest drawdown for the at-the-money strategy is -25.87% compared with the maximum drawdown of -34.70% for the index. Conversely, the best monthly return and

[6]See appendices for details of non-normality.

maximum run up is higher for the index at 17.93% and 79.14%, compared with 5.63% and 68.53%, respectively, for the at-the-money strategy. These alternative measures also suggest that the buy-write strategy had a lower realized risk over this period when compared to the underlying index.

3.2 Buy Write Strategy in Unfavorable Market Environment

The performance of the buy-write strategy is sensitive to market conditions. In particular, we expect the strategy to underperform relative to the index in an upward trending market. To observe the magnitude of such an impact, we split the data period into two sub-periods: January 18, 1996 to February 20, 2003 and February 20, 2003 to November 16, 2006, and report the results in Tables 4 and 5 for the 1-month strategy. The break point was chosen specifically because of the strong and steady 3 plus year run up the Russell 2000 experienced from its local minimum in February 2003 (as can be observed in Figure 1). This period is the epitome of a unfavorable environment for the performance of a buy-write strategy (relative to the performance of the underlying index). The annualized return for the Russell over this 45 month period was 24.82%. In comparison, the annualized return in the earlier period is 3.84%. In addition, the run up occurs with low volatility - the annualized volatility in the February 2003 to November 2006 period is 15.34% compared with 22.69% for the earlier period of January 1996 to February 2003. Thus, focusing on the results from February 2003 to November 2006 allows us to understand how "badly" the buy-write strategy performed relative to the index in one of the least favorable 45 month periods in our entire sample period.

Interestingly, even in this unfavorable market environment, Table 5 shows that the at-the-money buy-write strategy performs credibly, with an annualized return of 17.51%, or about two-thirds of the return of the index. The annualized volatility of the strategy was only 8.00% compared to the Russell's volatility of 15.34%. In other words, the buy-write strategy achieved over two-thirds of the index return at about half the index volatility. Finally, from Table 4, over the earlier and longer period from January 1996 to February 2003, the buy-write strategy had an annualized return of 5.06%, versus the 3.84% return of the index. What is even more interesting is that this higher return was achieved at a significantly lower volatility of 15.41% compared with the index volatility of 22.69%. A further illustration of this relationship is provided in figures 2 and 3. Figure 2 illustrates the 2 year rolling average returns of the at-the-money buy-write strategy. While the absolute

Table 4: Summary Statistics for the One Month to Expiration Buy Write Strategies - Jan 18, 1996 to Feb 20, 2003

	Russell 2000	2% OTM	ATM	2% ITM
Annualized Return	3.84%	6.19%	5.06%	5.74%
Annualized Standard Deviation	22.69%	17.00%	15.41%	14.13%
Mean Monthly Return	0.53%	0.63%	0.52%	0.55%
Median Monthly Return	1.48%	2.72%	2.40%	1.78%
Monthly Standard Deviation	6.55%	4.91%	4.45%	4.08%
Skewness	-0.55	-1.72	-1.84	-1.94
Excess Kurtosis	0.72	2.65	3.24	3.90
Maximum Monthly Return	17.93%	6.00%	5.63%	5.63%
Minimum Monthly Return	-19.41%	-18.24%	-17.46%	-16.30%
Maximum Drawdown	-34.70%	-27.18%	-25.87%	-21.36%
Maximum Run Up	60.95%	51.94%	47.35%	45.82%
Number of Months	85	85	85	85

This table provides summary statistics for the at-the-money and 2% in-the-money and out-of-the-money 1-month buy-write strategies for the first of the two sub-periods.

performance gap between the buy-write and the Russell 2000 fluctuates significantly, the gap is often extremely small. In fact, during the unfavorable later period, the gap is frequently non-existent or negative. In contrast, figure 3 shows a quite consistently wide volatility gap between the buy-write and the Russell 2000, with the buy-write typically exhibiting a 5 to 10% lower rolling volatility.

4 Performance Measures

The previous analysis suggests that the returns of the buy-write strategy are achieved at a significantly lower risk, implying that the buy-write strategy may match or outperform the underlying index on a risk adjusted basis using standard measures. In this section, we evaluate the performance using a number of different performance measures that have been previously used in the literature.

Specifically, we consider two sets of measures. The first set of performance measures is appropriate when returns are (approximately) normally distributed. These include the Sharpe ratio, Jensen's alpha, the M^2 and the Treynor ratio. The second set of performance measures, which comprise of Leland's alpha and the Stutzer index, is robust against a deviation from normality. The former is a robust alternative for Jensen's alpha and the latter is an alternative for the Sharpe ratio. Table 6 summarizes the results for the 1-month

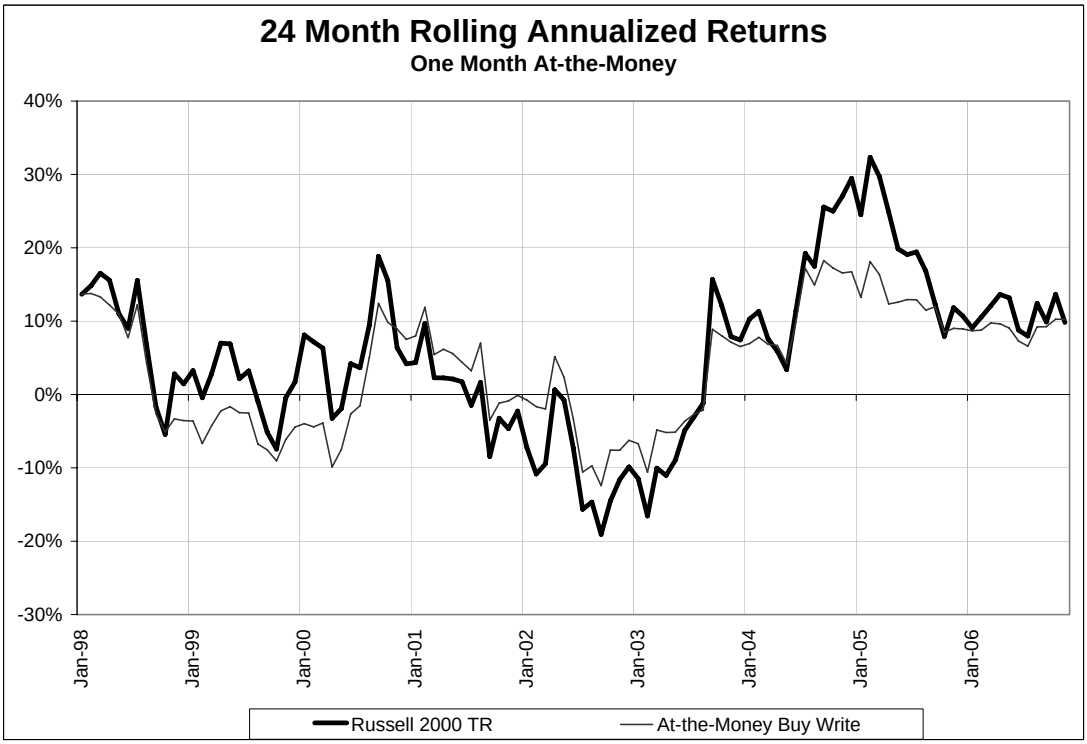

Figure 2: 24 month rolling annualized returns for the one month at-the-money buy-write strategy, and the underlying Russell 2000 Index.

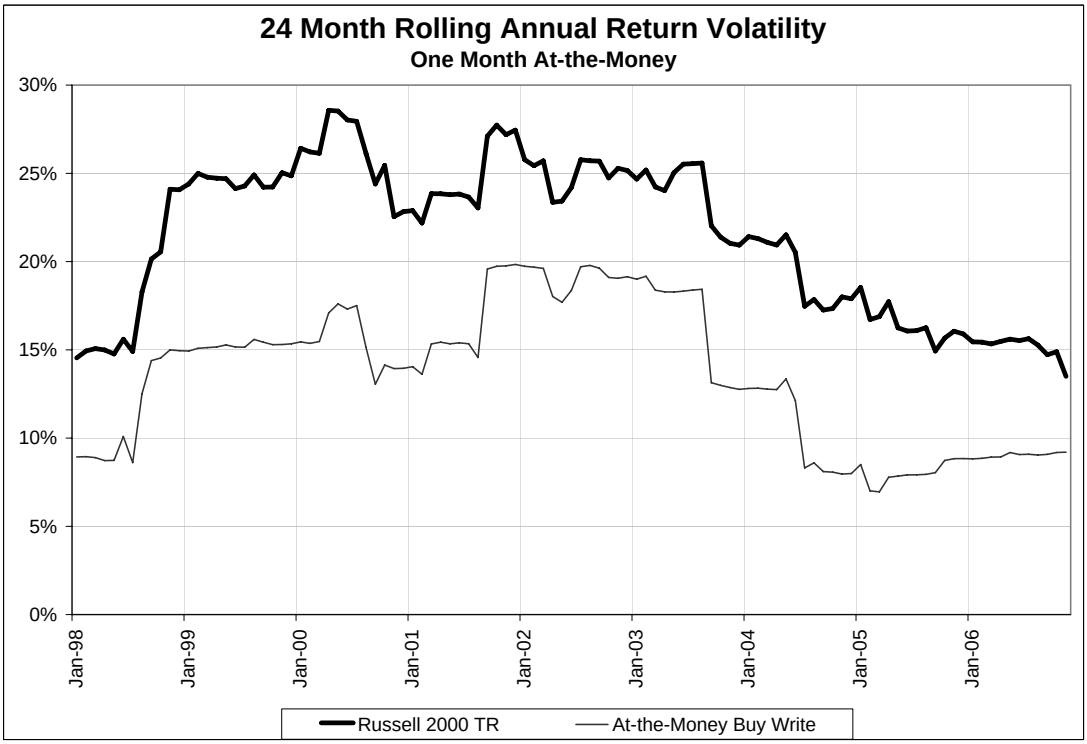

Figure 3: 24 month rolling annualized standard deviation of returns for the one month at-the-money buy-write strategy, and the underlying Russell 2000 Index.

Table 5: Summary Statistics for the One Month to Expiration Buy Write Strategies - Feb 20, 2003 to Nov 16, 2006

	Russell 2000	2% OTM	ATM	2% ITM
Annualized Return	24.82%	19.45%	17.51%	17.28%
Annualized Standard Deviation	15.34%	9.40%	8.00%	5.88%
Mean Monthly Return	1.96%	1.53%	1.38%	1.35%
Median Monthly Return	2.46%	2.80%	2.25%	1.50%
Monthly Standard Deviation	4.43%	2.71%	2.31%	1.70%
Skewness	-0.09	-1.44	-1.82	-1.31
Excess Kurtosis	-0.13	1.18	2.45	2.68
Maximum Monthly Return	11.86%	4.22%	3.39%	4.78%
Minimum Monthly Return	-7.18%	-6.19%	-5.65%	-4.14%
Maximum Drawdown	-11.50%	-7.32%	-5.65%	-4.14%
Maximum Run Up	60.75%	50.80%	47.13%	46.13%
Number of Months	45	45	45	45

This table provides summary statistics for the at-the-money and 2% in-the-money and out-of-the-money 1-month buy-write strategies for the second of the two sub-periods.

at and 2% away from the money strategies. Similar results for the other strategies can be found in the appendices.

Interestingly, every performance measure indicates that the at-the-money buy-write strategy outperforms the underlying index. The Sharpe ratio for the strategy is 0.132, higher than the 0.122 ratio of the Russell 2000 index. The Jensen's monthly alpha is a positive 9.7 basis points. The M^2 and Treynor ratio are consistent in their indication of buy-write strategy outperformance.

More significantly, the results do not change when the robust measures are used for performance analysis. The monthly Leland's alpha is a positive 7.0 basis points, and the Stutzer index is .127, somewhat higher than the .120 for the underlying index. The results for the sub-periods similarly indicate that the buy-write strategy outperforms. It is particularly significant that the outperformance is the highest for the period from February 2003 to November 2006, when the underlying index had a strong bullish run with low volatility. Leland's alpha for this sub-period is over 30 basis points, and the Stutzer index is 0.46 compared with 0.40 for the underlying Russell 2000 index.

Table 6: Monthly Risk Adjusted Performance Measures for the One Month to Expiration Buy Write Strategy - Jan 18, 1996 to Nov 16, 2006

		Russell 2000	2% OTM	ATM	2% ITM
Biased Measures Under Non-normality	1/18/1996 to 11/16/2006				
	Sharpe Ratio	0.122	0.148	0.132	0.151
	Jensen's Alpha		0.168%	0.097%	0.179%
	Beta	1.000	0.646	0.573	0.478
	M^2		0.155%	0.062%	0.176%
	Treynor Ratio	0.007	0.010	0.009	0.011
Unbiased Measures Under Non-normality	1/18/1996 to 11/16/2006				
	Leland's Alpha	0.000%	0.141%	0.070%	0.151%
	Leland's Beta	1.000	0.684	0.610	0.517
	Stutzer Index	0.120	0.142	0.127	0.144
	1/18/1996 to 2/20/2003				
	Leland's Alpha	0.000%	0.149%	0.050%	0.101%
	Leland's Beta	0.998	0.697	0.624	0.546
	Stutzer Index	0.027	0.055	0.036	0.048
	2/20/2003 to 11/16/2006				
	Leland's Alpha	-0.007%	0.296%	0.305%	0.596%
	Leland's Beta	1.004	0.583	0.493	0.310
	Stutzer Index	0.396	0.447	0.455	0.596

This table summarizes the performance measures for the at-the-money and 2% in-the-money and out-of-the-money 1-month buy-write strategies for the entire sample period and the two sub-periods.

5 Return Attribution

In order to better understand the drivers of returns, we break the buy-write returns down into their source components. The most obvious (and most significant) source of returns is the movement of the underlying Russell 2000 index. In addition to this obvious source, we attempt to isolate two other factors which contribute to the returns. We had previously observed that option writing is subject to significant transaction costs. These costs may have a significant negative impact on returns. On the other hand, option writing potentially benefits from the fact that implied volatilities are typically higher than historical realized volatilities. This section of the paper focuses on understanding the relative contribution of these two factors to the performance of the strategy.

We begin by breaking down the buy-write strategy return into the Russell 2000 returns, the transaction cost returns and the call returns. We then further decompose the call return into the returns at the realized volatility, the returns from the volatility risk premium of the call, and once again, the transaction cost returns.

We first decompose the buy-write return into its components, expressing each component as a partial return on the total investment in the strategy (long index, short call). In this framework, the buy-write returns consist of the following:

1. The returns generated by the long position in the underlying Russell 2000 index.

$$\mathrm{R}_{Russell_t} = \frac{(RUT_t - RUT_{t-1})}{(RUT_{t-1} - Call_{t-1})}, \tag{2}$$

2. The returns that would be generated by selling the call at the midpoint of the bid ask spread.

$$\mathrm{R}_{Call_t} = \frac{-(Call@Mid_t - Call@Mid_{t-1}))}{(RUT_{t-1} - Call_{t-1})}, \tag{3}$$

3. The (negative) returns generated by selling the call at the bid, rather than the mid-point of the bid and ask.

$$\mathrm{R}_{Transaction_t} = \frac{\frac{(Call@Bid_{t-1} - Call@Ask_{t-1})}{2}}{(RUT_{t-1} - Call_{t-1})}, \tag{4}$$

The total return of the buy-write index is given as:

$$\mathrm{R}_t = (R_{Russell_t} + R_{Call_t} + R_{Transaction_t}), \tag{5}$$

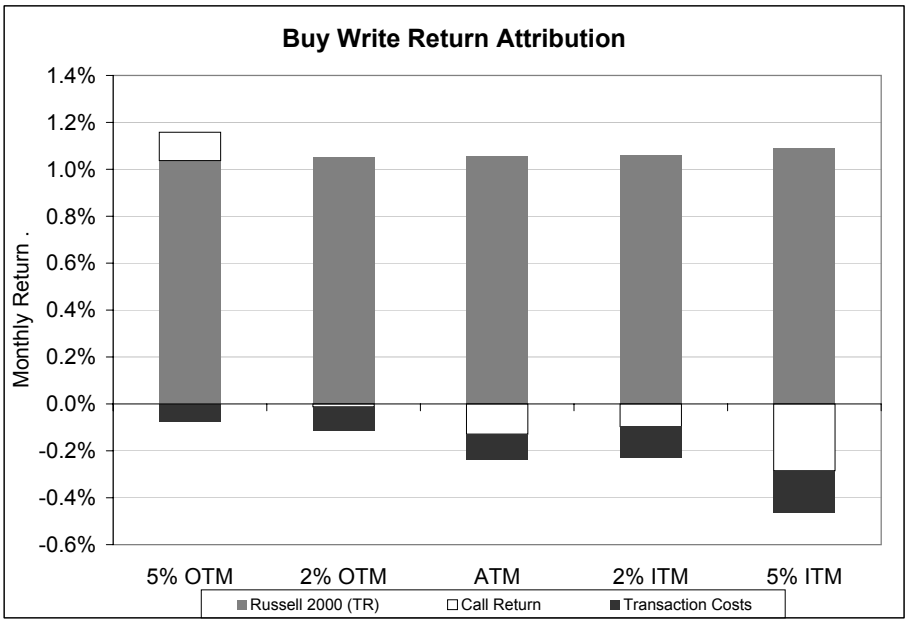

Figure 4: Attribution of buy-write strategy returns.

Figure 4 illustrates this return decomposition. We can see that the underlying Russell 2000 index is by far the main contributor to the overall returns of the buy-write strategy, averaging just over 1% per month.[7]

Except for the 5% out of the money one-month strategy, all the strategies presented in the chart experience an average before transaction cost loss from the call position, typically around .1% per month. It also evident that transaction costs have a very significant contribution to returns. In fact for most of the strategies, the impact of transaction costs is almost the same as the loss generated by the call position.

We now further decompose the call returns. The call returns consist of the following:

1. Returns that would be generated if the calls had been sold at the Black Scholes price

[7]It is worthwhile to note that the Russell 2000 returns vary slightly from strategy to strategy due to the different call premiums affecting the net investment position each month, and therefore the basis by which the return is calculated.

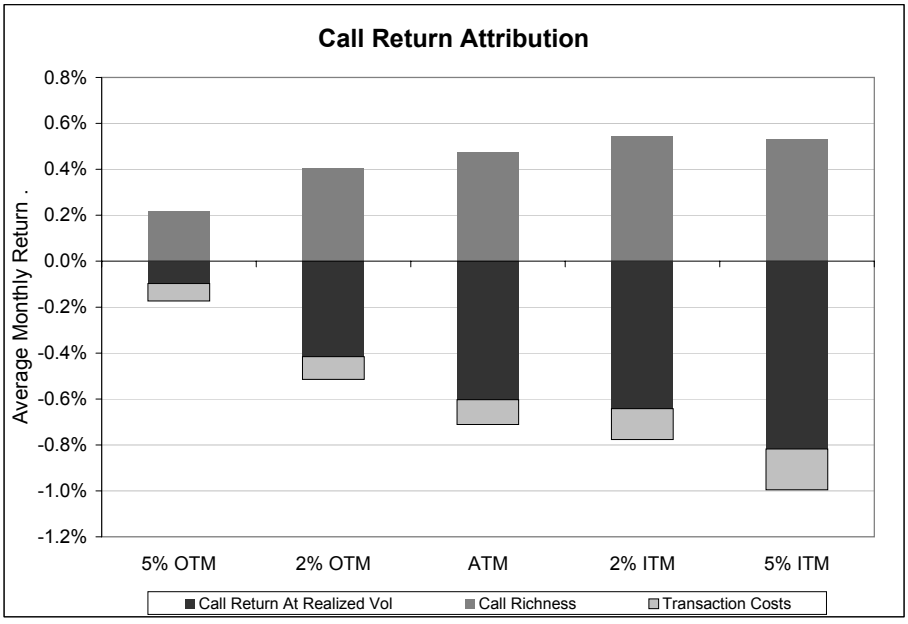

Figure 5: Attribution of call returns.

associated with the realized volatility over the holding period of the call position.

$$\mathrm{R}_{Realized_t} = \frac{-(Call@Realized_t - Call@Realized_{t-1})}{(RUT_{t-1} - Call_{t-1})}, \tag{6}$$

2. The extra returns that are generated by selling the call at the Black Scholes implied volatility rather than selling at the realized volatility. We referred to this differential earlier as the volatility risk premium of the call. This is the difference between selling at the midpoint of the bid ask spread and selling at the Black Scholes price associated with the realized volatility. On average, this would represent the volatility risk premium.

$$\mathrm{R}_{Premium_t} = \frac{-(Call@Mid_t - Call@Mid_{t-1}))}{(RUT_{t-1} - Call_{t-1})} - R_{Realized_t}, \tag{7}$$

3. The (negative) returns from selling the call at the bid, rather than the midpoint of the bid and ask.

$$\mathrm{R}_{Transaction_t} = \frac{\frac{(Call@Bid_{t-1} - Call@Ask_{t-1})}{2}}{(RUT_{t-1} - Call_{t-1})}, \tag{8}$$

Therefore, the total return of the written calls are given by:

$$\mathrm{R}_{Call_t} = (R_{Realized_t} + R_{Premium_t} + R_{Transaction_t}), \tag{9}$$

Figure 5 provides a clear illustration of the attribution of the call returns. It is immediately evident that in all cases, the calls would generate a significant loss if sold at the Black Scholes price suggested by the realized volatility. We can see an average monthly loss of .10% to .82% at the realized volatility, without even including transaction costs. It is interesting that the volatility risk premium of the call is reasonably close in magnitude to the call loss at the realized volatility. In fact we can see that the return generated by the risk premium of the call greatly reduces the losses of the calls. For example, the 2% out of the money one month strategy's call losses are cut in half from .48% to .24%.

This return attribution analysis illustrates the importance of the volatility risk premium to the returns on the buy-write strategy. While the primary driver of the returns is clearly the Russell 2000 index, the volatility premium may be the source of the alpha which we see generated by the buy-write strategy.

6 Conclusion

We examine the returns on buy-write strategies on the Russell 2000 over the period 1996-2006. Overall, our results suggest that the buy-write strategy can outperform the index under standard performance measures. This outperformance also holds during the unfavorable market conditions of February 2003 to November 2006, where the Russell 2000 was steadily trending upwards. The outperformance is largely limited to writing 1-month calls while the strategy of writing 2-month calls typically underperforms both the 1-month strategy and the index.

To provide economic insight into the performance of the strategy, we investigate the components of the returns. Although the main driver of the return is the underlying index, both transaction costs and the option volatility risk premium (defined as the implied volatility less the realized volatility) are critical to the performance of the strategy. Our results indicate that if the option was written at the Black Scholes price associated with the realized volatility, the buy-write strategy would underperform the index over our sample period. It is clearly evident that the method of execution of the strategy as well as the choice of the options has a large impact on the performance of the strategy. In this light, we have provided a somewhat conservative analysis of the buy-write strategy's performance, in the sense that our implementation does not allow for an active selection of the moneyness or time to expiration of the calls. There is some evidence in the literature that a more active approach to call selection can result in significantly higher absolute and risk adjusted returns.[8]

[8] See Renicker and Mallick (2005).

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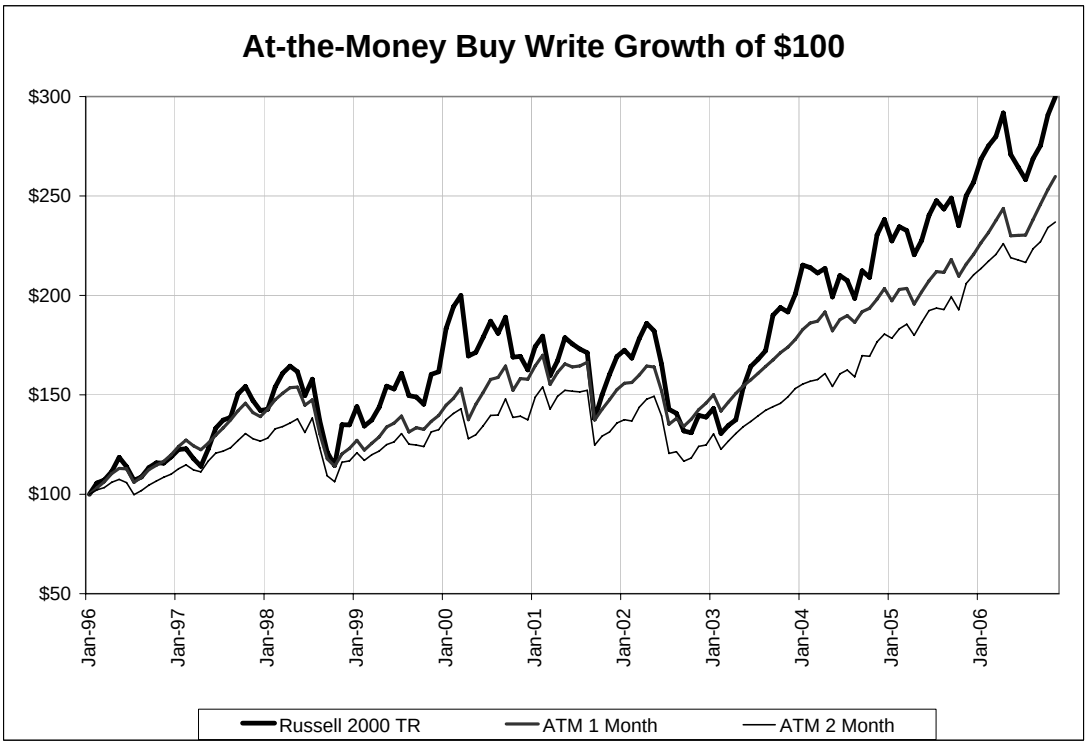

Figure 6: Growth of $100 in the Two Month and One Month At-the-Money buy-write Strategy.

7 Appendices

7.1 Appendix A : 2-Month Strategies

In contrast to the 1-month strategy, the 2-month at-the-money strategy, in general, underperforms. The underperformance holds for both the entire period as well as the longer of the two sub-period of January 1996 to February 2003. It is only in the shorter sub-periods of February 2003 to November 2006 that the 2-month at-the-money strategy outperforms the Russell 2000 index. Certainly, at least part of this underperformance is due to the fact that the 2-month implementation adjusts the strikes less frequently so has a greater opportunity for the out-of-the-money call to expire deep in-the-money.

Table 7: Summary Statistics for the Two Month to Expiration Buy Write Strategies - Jan 18, 1996 to Nov 16, 2006

	Russell 2000	2% OTM	ATM	2% ITM
Annualized Return	10.67%	8.35%	8.29%	7.29%
Annualized Standard Deviation	20.52%	14.38%	13.77%	11.78%
Mean Monthly Return	1.03%	0.76%	0.75%	0.65%
Median Monthly Return	2.18%	1.61%	1.53%	1.22%
Monthly Standard Deviation	5.92%	4.15%	3.97%	3.40%
Skewness	-0.60	-1.72	-1.81	-2.54
Excess Kurtosis	1.09	4.50	5.32	9.08
Maximum Monthly Return	17.93%	9.21%	9.21%	7.53%
Minimum Monthly Return	-19.41%	-18.13%	-18.13%	-17.37%
Maximum Drawdown	-34.70%	-24.13%	-24.26%	-23.82%
Maximum Run Up	79.14%	66.70%	65.85%	60.06%
Number of Months	130	130	130	130

This table provides summary statistics for the at-the-money and 2% in-the-money and out-of-the-money 2-month buy-write strategies for the entire sample period.

Table 8: Monthly Risk Adjusted Performance Measures for the Two Month to Expiration Buy Write Strategy - Jan 18, 1996 to Nov 16, 2006

		Russell 2000	2% OTM	ATM	2% ITM
Biased Measures Under Non-normality	1/18/1996 to 11/16/2006				
	Sharpe Ratio	0.122	0.109	0.111	0.101
	Jensen's Alpha		-0.008%	0.007%	-0.007%
	Beta	1.000	0.642	0.604	0.486
	M^2		-0.073%	-0.061%	-0.123%
	Treynor Ratio	0.007	0.007	0.007	0.007
Unbiased Measures Under Non-normality	1/18/1996 to 11/16/2006				
	Leland's Alpha	0.000%	-0.029%	-0.016%	-0.032%
	Leland's Beta	1.000	0.671	0.634	0.521
	Stutzer Index	0.120	0.106	0.108	0.097
	1/18/1996 to 2/20/2003				
	Leland's Alpha	0.000%	-0.131%	-0.121%	-0.163%
	Leland's Beta	0.998	0.688	0.658	0.550
	Stutzer Index	0.027	-0.002	-0.001	-0.017
	2/20/2003 to 11/16/2006				
	Leland's Alpha	-0.007%	0.399%	0.484%	0.607%
	Leland's Beta	1.004	0.533	0.459	0.291
	Stutzer Index	0.396	0.501	0.544	0.667

This table summarizes the performance measures for the at-the-money and 2% in-the-money and out-of-the-money 2-month buy-write strategies for the entire sample period and the two sub-periods.

Table 9: Summary Statistics for the Deep ITM and OTM Buy Write Strategies - Jan 18, 1996 to Nov 16, 2006

	1-Month 5% OTM	1-Month 5% ITM	Russell 2000	2-Month 5% OTM	2-Month 5% ITM
Annualized Return	12.17%	7.31%	10.67%	9.38%	6.15%
Annualized Standard Deviation	16.74%	9.12%	20.52%	16.37%	9.81%
Mean Monthly Return	1.08%	0.63%	1.03%	0.87%	0.54%
Median Monthly Return	2.76%	1.05%	2.18%	2.04%	1.01%
Monthly Standard Deviation	4.83%	2.63%	5.92%	4.73%	2.83%
Skewness	-1.42	-3.20	-0.60	-1.31	-3.31
Excess Kurtosis	2.00	12.46	1.09	2.88	14.71
Maximum Monthly Return	7.36%	4.28%	17.93%	12.61%	6.25%
Minimum Monthly Return	-18.24%	-14.76%	-19.41%	-19.03%	-16.21%
Maximum Drawdown	-29.07%	-16.88%	-34.70%	-27.12%	-21.83%
Maximum Run Up	79.02%	57.66%	79.14%	71.94%	53.15%
Number of Months	130	130	130	130	130

The table provides summary statistics for the deep in-the-money and deep out-of-the-money 1-month and 2-month buy-write strategies for the entire sample period.

7.2 Appendix B : Deep ITM and OTM strategies

For the sake of completeness, in this section we have provided the results of the 5% away from the money 1-month and 2-month strategies.

Table 10: Monthly Risk Adjusted Performance Measures for the Deep ITM and OTM Buy Write Strategies - Jan 18, 1996 to Nov 16, 2006

	1-Month 5% OTM	1-Month 5% ITM	Russell 2000	2-Month 5% OTM	2-Month 5% ITM
Biased Measures Under Non-normality 1/18/1996 to 11/16/2006					
Sharpe Ratio	0.161	0.121	0.122	0.118	0.083
Jensen's Alpha	0.226%	0.092%		0.015%	-0.029%
Beta	0.764	0.317	1.000	0.756	0.366
M^2	0.231	-0.001%		-0.019%	-0.228%
Treynor Ratio	0.010	0.010	0.007	0.007	0.006
Unbiased Measures 1/18/1996 to 11/16/2006					
Leland's Alpha	0.205%	0.065%	0.000%	-0.001%	-0.053%
Leland's Beta	0.792	0.353	1.000	0.779	0.400
Stutzer Index	0.156	0.115	0.120	0.116	0.080
1/18/1996 to 2/20/2003					
Leland's Alpha	0.235%	0.052%	0.000%	-0.068%	-0.148%
Leland's Beta	0.796	0.392	0.998	0.790	0.437
Stutzer Index	0.069	0.038	0.027	0.041	-0.021
2/20/2003 to 11/16/2006					
Leland's Alpha	0.212%	0.535%	-0.007%	0.279%	0.577%
Leland's Beta	0.757	0.091	1.004	0.688	0.134
Stutzer Index	0.424	0.744	0.396	0.458	0.821

This table summarizes the performance measures for the deep in-the-money and deep out-of-the-money 1-month and 2-month buy-write strategies for the entire sample period and the two sub-periods.

Table 11: Jarque Bera Test of Normality - Jan 18, 1996 to Nov 16, 2006

Strategy	Jarque Bera Statistic	P-Value
1 Month		
5% OTM	65.2	0.000%
2% OTM	162.2	0.000%
ATM	222.9	0.000%
2% ITM	331.4	0.000%
5% ITM	1063.7	0.000%
2 Month		
5% OTM	82.1	0.000%
2% OTM	173.5	0.000%
ATM	224.3	0.000%
2% ITM	586.6	0.000%
5% ITM	1410.0	0.000%
Russell 2000	14.2	0.082%

This table summarizes the results of the tests for normality. A larger Jarque Bera statistic implies less likelihood of normality

7.3 Appendix C : Tests of Normality

In the body of the paper, we make the assertion that the distribution of the returns of the buy-write strategy is non-normal. This appendix addresses this issue. The results of the Jarque Bera test of normality can be found in table 11. All the buy-write strategies are found to have highly non-normal return distributions. It is clear that the further the calls are in-the-money, the more non-normal the return distribution. This is not surprising, since the further in-the-money strategies will write calls with a larger delta and thus the calls will have a greater impact on the strategy's returns. A graphical presentation of the observed distribution for the 1-month, strategies is provided in figures 7 through 9. The non-normality is evident in the stark contrast between the buy-write distributions and the constructed normal distributions.

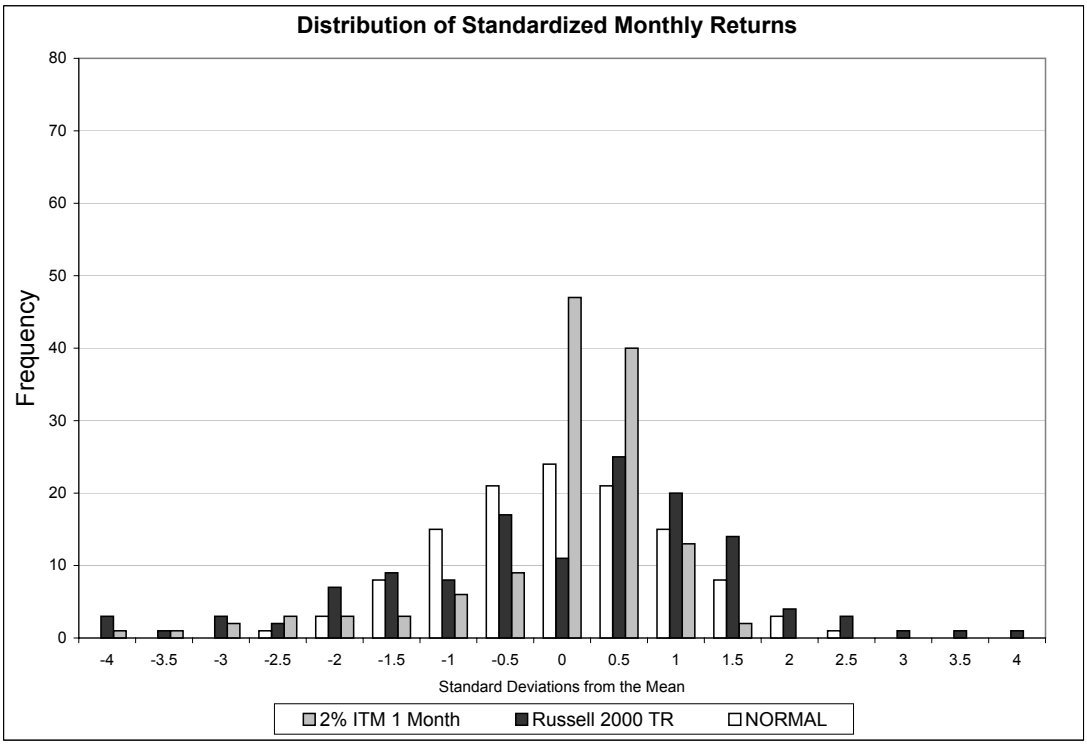

Figure 7: Observed Return Distribution of the One Month 2% In-the-Money buy-write Strategy.

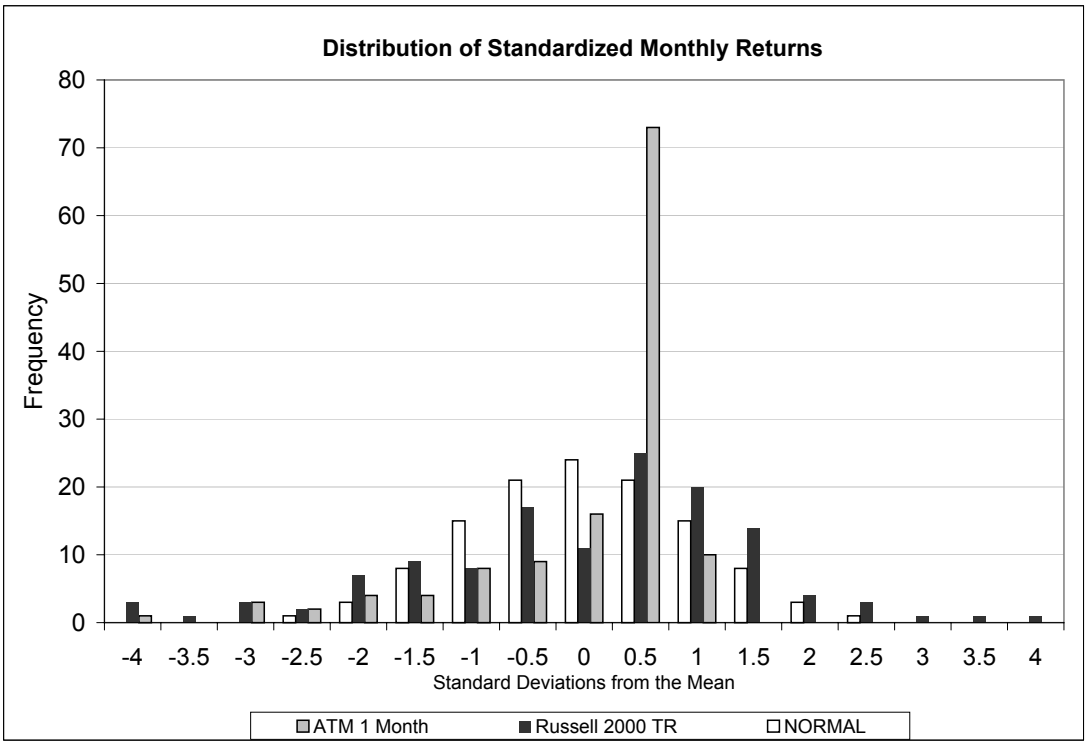

Figure 8: Observed Return Distribution of the One Month At-the-Money buy-write Strategy.

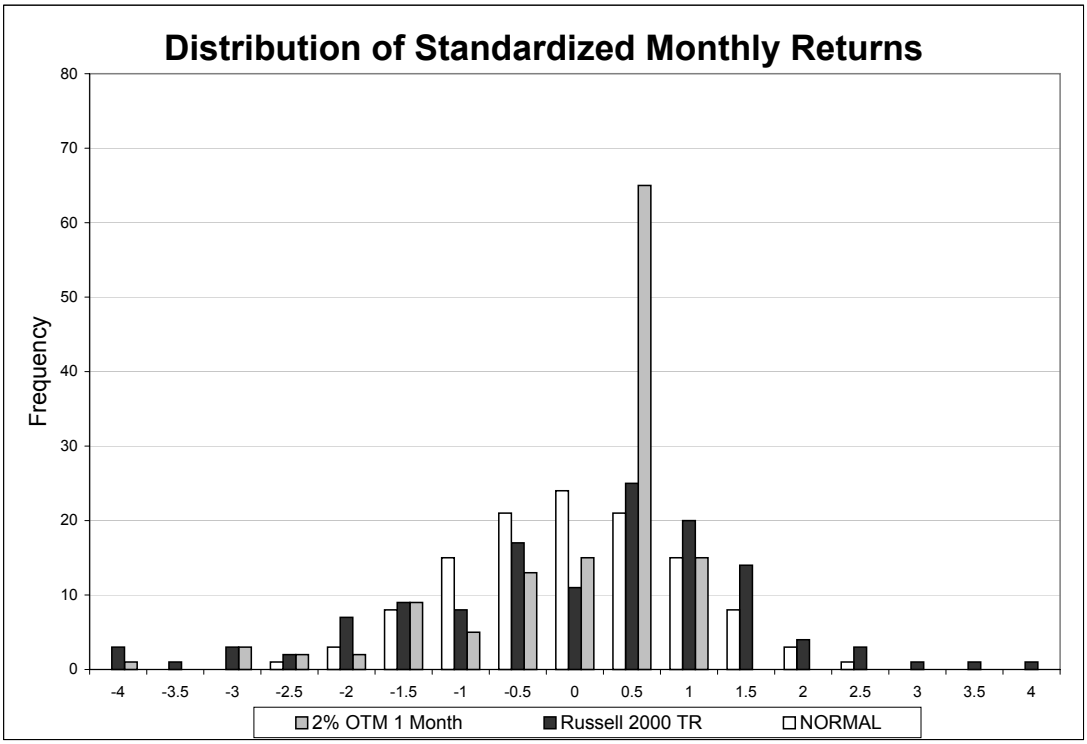

Figure 9: Observed Return Distribution of the One Month 2% Out-of-the-Money Buy-Write Strategy.