Covered Call writing: impossible in theory, valuable in practice

The world's most popular option strategy, tested for the Amsterdam Stock Exchange

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Abstract

This paper researches whether the popular option strategy called Covered Call Writing outperforms traditional investment strategies such as the Buy and Hold strategy. Covered Call Writing is a strategy where an investor writes call options on stocks held by him in a portfolio. This is done to hedge an investment and hence decrease the overall risk of a portfolio. In practice it is a popular strategy since it decreases the risk of a portfolio, but without a decrease in return. According to classical economic theories this should not be possible. A decrease in risk should ceteris paribus imply a decrease in return. In other words, beating the market should not be possible. Therefore, I have made a model that can backtest this strategy in order to compare the results to those of a portfolio that uses the Buy and Hold strategy. This is done with data from the Amsterdam Stock Exchange, with different forms of volatility. The volatility of the Amsterdam Stock Exchange, and another volatility that consists of a smaller amount of stocks from the five biggest listed companies in the Netherlands. The results showed that when one uses the volatility of the entire index, the Covered Call strategy does not show returns similar to that of Buy and Hold strategies. Based on the sample in this research sample, results were consequently lower than the Buy and Hold strategy and showed that the Covered Call strategy does not work in that situation. However, when using the volatility of the five biggest companies listed on the AEX, the results were very similar to the returns of the more traditional strategies, but with lower risk. It would therefore be an interesting strategy for investors to use.

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List of abbreviations

AEX	Amsterdam Exchange index
ATM	At the Money
BHS	Buy and Hold Strategy
CCS	Covered Call Strategy
EMH	Efficient Market Hypothesis
ITM	In the Money
MW	Meijers Weijerman Vermogensbeheer
OTM	Out of the Money

1. Introduction

Investors are always interested in opportunities to increase the return of their portfolio while decreasing their risks. Over the years, the Covered Call Strategy (hereafter referred to as CCS) has become a popular strategy for investors to hedge their risks. A Covered Call is a call option that is written by an investor on a stock in his portfolio. While CCS hedges your investment, it comes with the disadvantage that – in case of a steep increase in share price – the upside potential is limited.

Although CCS is a popular strategy in practice, surprisingly little academic studies have proven its relevance. The Efficient Market Hypothesis (hereafter referred to as EMH) states that Covered Call writing should not outperform traditional Buy and Hold Strategies (hereafter referred to as BHS) in practice; the reduced risk ceteris paribus limits the return. According to the EMH, it is not possible to 'beat the market' by picking specific stocks or employing strategies like the CCS. EMH states that an investor can only obtain a higher return by investing in riskier investments.

Strategies such as the January effect or the end of the year effect that outperform the market consistently, quite often disappear over time as the market adjusts itself to it (Gu, 2003). Interestingly enough, this has not happened so far for CCS, while it has been a commonly employed strategy for over 30 years now (Mueller, 1981).

Although used for a long time, CCS is yet a scientifically unproven strategy. This thesis contributes to the existing academic literature by demonstrating that CCS can beat the market. The methodology to deliver this evidence encompasses an identification of the different kind of Covered Calls that are written in practice. Together with my supervisor Dr. Ronald Huisman, my fellow student Ms. Anne-Merel van den Berg, and with the assistance of Meijers Weijerman Vermogensbeheer (hereafter referred to as MW), I will empirically test the relevance of CCS in practice at MW.

But first allow me to explain what MW does. MW is a capital management firm that manages private wealth. MW assures its clients a constant flow of income on a monthly basis. In order to live up to this promise, MW uses the money that clients put in on account of their own investment strategy; the CCS.

The main questions that are being posed are whether there is an additional strategy to which type of call is most profitable to write, meaning what is the degree of moneyness of an option. Should one just cover his own investment, or be more specific in picking the moneyness. In my research, the focus will be on the degree of 'moneyness'. Moneyness is the percentage difference between a discounted strike price and the actual price of the stock. It is the essential value of an option in the present situation (Corrado & Su, 1997). There are three different kinds of moneyness. In the Money (ITM), At the Money (ATM) or Out of the Money (OTM). ITM implies the call price is below the current stock price. Conversely, OTM means it is above the current price. When a call is ATM, the call price is equal to the current stock price. The focus in this research lies on the question whether it is better to write the call options ATM or OTM.

To investigate the importance of moneyness when writing a call option for CCS, my research question is as follows:

"What is the moneyness strategy behind Covered Call writing and what importance holds the degree of moneyness?"

The focus will be on the following two strategies:

Strategy 1: Writing a selection of Covered Calls with a difference in the degree of moneyness.
Strategy 2: Only writing Covered Calls with a certain degree of moneyness.

In order to accurately address the research question, the focus will be on back-testing the performance of this strategy over the course of ten years with the AEX index price[1]. I will do this

[1] As mentioned before, AEX is an abbreviation for Amsterdam Stock Exchange, where the 25 companies with the biggest market caps that are listed in the Netherlands are traded.

by comparing results from CCS to a stand investing strategy, the Buy and Hold Strategy (hereafter referred to as BHS). So far, little public research has been done on this subject, specifically. Especially the focus on shares listed on the AEX index is underexposed in the literature. This likewise upholds for research with a focus on the degree of moneyness. However, there are plenty of similar papers that have been written on Covered Call writing in particular. In this research these papers will be used and extended by focusing on the moneyness of Covered Calls.

The main conclusion from this paper is that when backtesting the strategy only using AEX data, the CCS does not outperform BHS. Thereby it is found that the strategy does not work and should not be used by investors. However, I also tested CCS with the use of volatility that is not for all the AEX stocks, but for a smaller group of stocks from the AEX's biggest companies. When backtesting using this volatility, CCS and BHS have very similar returns. Also the risk is lower for CCS, this does make it a less risky strategy. This is the strategy that is as close as we could test to the strategy used by MW and therefore we can conclude that their strategy works.

After this short introduction in section one, my thesis will be structured as follows. Section two will be my literature review, in which I use academic articles to give academic meaning to my research question. I will also look at empirical research that has be done before. Section three includes my data and methodology where I explain how I retrieved my data, as well as that I explain how my own empirical research will be worked out. Section four consists of my results and in section five I will conclude this research. Finally, the implications and directions for future research are discussed in section six.

2. Literature overview

In this chapter the concept of CCS will be outlined. Furthermore, a small explanation of the EMH, will be given. The reason it is important to give a good view of these two aspects is because, following the EMH, CCS should not outperform BHS in practice. Then I will give a short explanation of the volatility of an index or a specific company's share and why it is important for calculating the price of an option. Finally, I will give the results of previous research and a short conclusion.

2.1 Covered Call writing

According to Board et al (2010) CCS is the strategy where an investor owns a company's stock and writes a call option upon that stock. There are different forms of Covered Calls that can be written. There are buy-writes and over-writes. In short, a buy-write is when an investor buys the company's shares and simultaneously writes the call option on those shares. An over-write is when the investor already owns the company's share and decides to write a call option afterwards. (Board, Sutcliffe, & Patrinos, 2010).

Figelman (2008) states that when an investor uses the CCS, several scenarios may occur. First, chances are high that it will outperform the index during both flat equity markets, and down equity markets. This is because the option is not called so the writer is left with the premium CCS will significantly underperform the index in the case of extreme up equity markets, as the writer will have to sell his share at a price below the price that is paid on the market. However, there is a slight difference in the research of Figelman and the strategy implemented by MW. Figelman buys the index, writes the call option and uses the received fees to immediately reinvest in the index. MW writes the call and then uses the fees they receive to return to their investors (Figelman, 2008).

McIntyre presses on the popularity of Covered Call writing amongst investors, both private and institutionally. He claims that using this strategy improves the overall returns during times of a downward sloping equity market, as mentioned by Figelman. Another aspect McIntyre

underlines, is the fact that the strategy can only be denominated as Covered Call writing when the number of options does not exceed the number of shares that one owns of the particular company in his portfolio (McIntyre & Jackson, 2006).

According to Mueller there are two benefits for investors when using the CCS. The first benefit is that one is in some way insured against losses on shares by being paid an option premium, as mentioned by other discussed authors. There is a risk of losing money in the portfolio without a loss of cash. This means it is acceptable for an investor to accept the loss on his shares as long as it is equal or smaller than the option premium that he is being paid. Furthermore, the money that is received in the form of an option premium, can be used as credit when purchasing the stock. In this way the actual amount of equity that the investor uses, is smaller. This implies greater returns on equity when profits are realized. This procedure almost seems too good to be true, since there is a hedge against loss in the case of a decline in share prices and a higher return on equity in the case of an increase. However, the ultimate potential for profits is limited. As soon as the option is written and sold, there is a maximum to the profits (Mueller, 1981).

Hoffman and Fischer are one of the few writing about the behavioural aspects of Covered Call writing. They claim it is a popular tool for the risk averse investor. According to them, the overall result is similar to that of the BHS, but people prefer the CCS because of its hedging component. They state that Covered Call writing is the world's most popular option strategy. However they also state that the Covered Call writers earn money because they give up their upside potential in their investment, as it is supposed to be according to classic financial theories such as the EMH(Hoffman & Fischer, 2012).

2.2 Covered Call writing and the EMH

Li gives an introduction to the EMH in which he states that share prices integrate all information so quick, that the price for which a stock is listed, is always the right price. The EMH states that the market is so efficient information wise, that investors cannot predict the future. Basically, this means that security prices should show completely random behaviour (Li, 2013)

To explain you a bit more about the combination of CCS and EMH, I would like to introduce L'Habitant. This academic performed his research in the year 2000. He acknowledged that when one follows the EMH, CCS, or hedging the investment in a similar way, should not improve the returns. This is in the case the risks are lower than when one does not use this strategy. In theory the EMH should show us that when options are traded at the right cost, the risk reward features would be right on the line of the EMH (l'Habitant, 2000).

According to Hoffman both the EMH and the Black and Scholes option pricing theory state that CCS does not improve returns in a mean variance framework. The Black and Scholes model is a model first introduced in 1973 and is still used today for pricing options. The classic economic theories state that the outcome of using the Black and Scholes model for options should reflect its potential and it should reflect the trade-off between risk and return. (Hoffman & Fischer, 2012).

O'Connell and O'Grady write about how CCS was initially rejected by academics as Black and Scholes did in their publications. They distrusted the value of CCS since the reduction in risk was supposed to entail a reduction in return. Over time, while financial markets and models for option pricing became more sophisticated, the strategy did start to pay off, while it still violates some of the key assumptions of the EMH (O'Connell & O'Grady, 2009).

2.3 Volatility

The volatility of a stock tells us something about the variance in the rate of return of a stock. It is a historical value that every stock has that can show us how a stock performed over the past few years. Companies with highly volatile prices, have a stock that has big gaps in the prices that were paid on the market. Companies with a lower volatility, do not have this as much. Therefore high volatility stock is perceived as riskier than low volatility stock. Therefore, the historical volatility of a stock is of great importance for the calculation of option prices, which is done using the Black & Scholes model. In the next paragraph I will elaborate further on why the volatility is important for investors (Black & Scholes, 1973).

Another reason why Covered Call writing strategies are so lucrative is that they exploit the fact that traders and investors are always in fear of financial downfall. Options hold a premium for the volatility, which it is expected to overcome over the duration of the option time. The premium is a reflection of the risks that an option writer is willing to take. In case there is a sudden move in the share price, which would lead to a loss for him. To put it in perspective, earlier financial crashes have led to options containing a premium (Hill, Balasubramanian, Gregory, & Tierens, 2006).

2.4 Results from previous research

Benesh and Compton concluded in their paper that average returns from CCS are lower because of the fact that one takes away the upside potential of the concerning investment. The premiums that were received from writing the call options on their portfolio were not enough to pay for the difference in price. However, they did do their research during a bull market, meaning that there were sharp increases in the share prices. Benesh is one of the few that goes into detail on moneyness, which is most relevant for the research question in my thesis. He tested the strategy for ITM, ATM en OTM options. ITM options performed worst, whereas ATM and OTM options performed best. The OTM call options seem to perform optimally when the market is going up. The premiums might be lower but one does not lose as much of the upside potential (Benesh & Compton, 2000).

O'Connell and O'Grady (2009) performed research very similar to my research yet they focused on the Australian exchange. The authors examined the performance of CCS as they bought the Australian index and wrote options that were just out of the money. They had three portfolios: one CCS portfolio, one BHS portfolio and one risk free portfolio. They studied the Australian market from 1991 until 2006 and concluded that CCS outperforms BHS, both on risk and return basis. The results are proven to be abnormal and therefore they are not in line with the EMH (O'Connell & O'Grady, 2009).

O'Connell and O'Grady used the methodology of Whaley from his research in 2002. Whaley researched the CCS with 13 years of S&P 500 data, after the "Buy Write Monthly Index" (BXM)

was introduced to the Chicago option exchange. It occurred to him that the BXM had a monthly return that was very close to the return of the S&P 500 portfolio over the same period, with only two-thirds the level of standard deviation of the return. Taking this into advance, he concluded that the performances are very similar but the risk is lower with CCS than in the case of the BHS (Whaley, 2002).

Leggio and Lien also used the S&P 500 for their research. They initially believed that the CCS is a strategy that does not enhance portfolio performance, yet afterwards they concluded that it does. If options were actually priced using the Black Scholes model, mean-variance analysis should show that an investment strategy that reduces the risk and maintains return levels does not exist. However, option writers tend to overprice their options to cover their uncertainty. They accept that CCS does not outperform BHS, yet it does match it with a lower risk. With options written for only a month, the investor utility is significantly improved using the covered call strategy (Leggio & Lien, 2002).

2.5 Conclusions

CCS is a strategy where an investor writes call options on stock owned by him. By doing this, he tries to reduce the risk of his portfolio, without a significant reduction in return. The latter forms a strategy that should not work successfully in practice according to the EMH. The EMH states that with a reduction in risk, there is a reduction in return. This is on the condition that one is as well informed as every other investor on the market. One of the reasons this strategy does work in practice could be the fact that options are not fairly priced with the Black & Scholes model anymore. Writers tend to overprice them and therefore make the strategy work, while classic economic theory states that it should not. The majority of the articles used for this research had to conclude that the CCS does have similar returns, as any BHS with a lower risk. It was tested in multiple markets worldwide and for multiple degrees of moneyness but not yet for the Amsterdam Exchange, which is what I will do.

3. Data and methodology

In this chapter I will explain what data I used exactly and where I retrieved it from. After this I will explain what the data is used for. I will enlighten about the methods that I have used for calculating the performance of both strategies and what kind of tests were used to proof my case.

3.1 Data

For back-testing the CCS, data from the AEX is needed as are the option prices at the relevant time. I will backtest the performance of the AEX over the course of the last ten years. This implies that monthly closing prices on the day that MW normally writes their call options (which is practically every third Friday of the month) are needed. This is data that can easily be retrieved from a financial database such as Bloomberg. Retrieving the option data is more difficult. MW used their own connections to retrieve this data from Euronext. The following data is used:

- AEX closing prices of every third Friday of the month starting on 18-06-2004 until 19-06-2015.
- With these closing prices, the closest strike price that comes with the index price can be computed. This was rounded up to the closest "5". Basically, an index price of 312.6, implies that the option strike price is set at 315 and so forth.
- With the strike price of the option, I can find the price that this option will cost.

3.2 Methodology

The reason I need 11 years of data for 10 years of back-testing is the fact that in my research I will backtest 120 unique years. So testing from by example august 2006 until august 2007, and doing this for every month over 10 years, gives me 120 years. Keeping the positions in both the CCS as well as the BHS, creates the possibility where known anomalies regarding timing, can be ruled out. Thus with 11 years of data and 120 returns on how the strategy would have performed over the last years, one should have a good image on the extent that CCS actually works and whether it really does outperform BHS.

At the request of MW, it will be analysed whether it matters when an option has a certain degree of moneyness. Therefore, in this research it will be tested with options that are ATM, with a moneyness of 0%, as well as options that are OTM, with a moneyness of 1% and 2%.The actual working of MW is not the same as my research since they do not buy the AEX index. One rather picks his own basket of shares from the AEX and therefore deals with different volatilities. Hence, in this research three extra sets of the 120 years with a different volatility, are also calculated. This volatility is a combination of five of the biggest companies that are listed on the AEX. This slightly higher volatility raises the option premiums received by MW and therefore their returns. The best way of testing this strategy would be with the option prices of every specific share that they have used over the past years. However, from the perspective of the usable data, it would make matters much more difficult. Hence, this is the best estimate one could make within the limits of the available data and therefore it should be a more realistic approach to what MW actually does.

3.2.1 Steps

These are the exact steps I used for calculating the returns of the two strategies:

1. Retrieve AEX closing prices
2. Calculate return BHS
3. Retrieve option price
4. Match closing price and option price
5. Calculate return of CCS
6. Pick the five biggest companies listed on the AEX
7. Calculate average volatility
8. Divide this average through AEX volatility
9. Recalculate option price by multiplying it with the factor from step 8
10. Recalculate return of Covered Call strategy

To test these results for their statistical significance a number of tests will also be performed. Previous results showed that simple *F* and *t* tests did not prove any significant results. Therefore, these basic tests will not be used and instead I calculated a series of ratios that have proven to

give a good view of results where both risk and return are represented properly (Board, Sutcliffe, & Patrinos, 2010). These ratios are the following: Sharpe ratio, M2 ratio, Treynor ratio and the Jensen's Alpha. I will now give a short explanation of what each of these ratios does specifically.

3.2.2 Sharpe ratio

The Sharpe Ratio is a measure for calculating risk-adjusted return and the latter has become the industry standard for such calculations. It was developed by Nobel laureate William F. Sharpe and forms the average return earned in excess of the risk-free rate per unit of volatility or total risk. Subtracting the risk-free rate from the mean return, the performance associated with risk-taking activities can be isolated. One intuition of this calculation is that a portfolio engaging in "zero risk" investment, such as the purchase of U.S. Treasury bills for which the expected return is the risk-free rate, has a Sharpe ratio of exactly zero. Generally, the greater the value of the Sharpe ratio, the more attractive the risk-adjusted return. This leads to the following:

$$Sharpe\ ratio = \frac{\bar{R}_p - \bar{R}_f}{\sigma_p}$$

Where R_p is the mean portfolio return, R_f is the Risk Free rate and sigma p is the standard deviation of the portfolio return.

3.2.3 Modigliani and Miller M2 ratio

The Modigliani and Miller M2 ratio is a calculation to determine the risk-adjusted returns of a portfolio. It measures the returns of the portfolio, adjusted for the risk of the portfolio compared to a certain benchmark such as the market. It is very similar to the Sharpe ratio, but the difference lies in the fact that the outcome of the M2 ratio is a percentage instead of a number. This makes it easier for investors to use in practise. The M2 ratio is calculated as follows:

$$M^2 = \left(\bar{R}_p - \bar{R}_f\right)\left(\frac{\sigma_M}{\sigma_P}\right) - (\bar{R}_m - \bar{R}_f)$$

Where R_p is the mean portfolio return, R_f is the Risk Free rate and R_m is the Market return. The sigmas m and s are the standard deviations of the market and the portfolio.

3.2.4 Treynor ratio

This ratio invented by Jack Treynor, can measure the excess return of an asset per unit of risk, over that of a risk-free asset. The Treynor ratio is calculated as follows:

$$Treynor\ ratio = \frac{\bar{R}_p - \bar{R}_f}{\beta_p}$$

Where R_p is the mean portfolio return, R_f is the Risk Free rate and the Beta P is the Beta of the portfolio.

3.2.5 Jensen's Alpha

This is a risk-adjusted performance measure that represents the average return on a portfolio over and above. It is predicted by the capital asset pricing model (CAPM), given the portfolio's beta and the average market return. It is the portfolio's alpha.

$$Jensen's\ Alpha = \bar{R}_p - \bar{R}_f - \beta_p(\bar{R}_m - \bar{R}_f)$$

Where R_p is the mean portfolio return, R_f is the Risk Free rate and R_m is the Market return. The Beta P is the Beta of the portfolio.

In order to perform these tests, it is essential to have a risk free rate. In this research, the risk free rate for the Netherlands is chosen since the Dutch stock market is being analysed. According to Bloomberg, the Risk Free Rate for the Netherlands is 0.859%.

3.2.3 Chi Squared Test

In order to test these results for statistical significance I will test them using a Chi Squared Test. Using all the outcomes from the different ratios I can rank the results by moneyness. So we can say if a moneyness of by example 0% has the highest Sharpe ratio and has therefore "won" from 1% and 2%. We count the amount of 0% wins and compare this to the expected amount. Using

the Chi Square test, we can calculate a P-value. Using a significance level of 5%, or 0.05, we can tell if the results are significant.

4. Results

In this chapter I will show the results from my calculations, on which I elaborated in previous chapter. I am showing tables with results and beneath this I explain what all the numbers mean. At first I will show the results of backtesting both CCS (Covered Call Strategy) and BHS (Buy and Hold Strategy). After this I show the outcomes of the four mentioned ratios and I explain what their results mean. First I will do this for the AEX volatility, followed by the Big Five volatility. I start this chapter with the elaboration of an important term for the results, that of the zero cases.

4.1 Zero price cases

As discussed earlier, the maximum exercise price that I tested upon is the OTM option of 2%. The reason for this are the so-called zero price cases. A zero price case occurs when an option is not priced in the market. In my research I could see that when one wants to write options that are further out of the money, less prices are available and therefore they are not written. When an option is not written I have to keep this option out of my dataset. As zero price case cannot be prevented I had to accept that there will always be a part of the data that cannot be used. The degrees of moneyness of by example 5% and 10% would give me 20.3% and 40.6% zero cases. To prevent this gap in my data and to keep the results of my tests as reliable as possible, I set my moneyness maximum at 2%, which gives a percentage of zero prices of 8.3%. To check, I did calculate the returns with exercise prices of 5% and 10% above the current share price. The results, although less reliable, did not differ much from the results with the prices that are less out of the money.

4.2 AEX volatility

In this paragraph I will review the results of my tests where the volatility of the AEX is used. I tested the CCS with three degrees of moneyness, 0%, 1% and 2%. For every degree of moneyness there are two tables with results. The first table gives the moneyness and the maturity of the options that were used. You can also see the percentage of zero cases (% Zero c(X)). This

shows us how many options we could not price due to the fact that they are not being traded. In the second table we see the returns of both strategies. The returns of CCS that change due to a difference in moneyness, and the returns of BHS.BHS returns are the same for all the tests, as nothing changes in the use of the strategy. As mentioned before, I will not be performing the standard statistical tests on my results as previous literature has shown that they are not relevant. They only look at returns, but the important aspect of CCS is that there is a combination of return and risk reduction. Therefore there will be no results in the form of a *p* value and a significance level that is directly related to the returns. Instead of these tests I calculated several ratios, which I will elaborate on later in this chapter and that can give us a level of significance in another way.

Moneyness	**0%**	**ATM = 0%**
Time to maturity	1	**months (1,2)**
% Zero c(X)	3.8%	

Table 1: ATM options returns (AEX vol.)

Return		
	CCS	**BHS**
Average return	-0.32%	4.91%
Standard Deviation	15.32%	21.52%
Skewness	-0.5409	-0.9055
Kurtosis	1.2239	0.8619

Table 2: ATM options compared for CCS and BHS (AEX vol.)

In table 1 we see that the moneyness is set at 0% and that there are zero cases for 3.8% of our options. This means that we could not price 3.8% of the options. In table 2 we see the results for

the ATM option. The holding time is set at one month, as it will be for all the calculations done in this research.

In average, the returns for the BHS outperformed the CCS. One can even note that, on average, CCS performed negatively. This means that you would have actually lost money if you used CCS over the last 11 years. However, the return of the BHS did perform positively, with an average return of 4.91%. I can conclude that BHS was the winning strategy in this situation.

Moneyness	**1%**	**ATM = 0%**
Time to Maturity	1	**Months (1,2)**
% Zero c(X)	3.8%	

Table 3: 1% OTM options returns (AEX vol.)

Return		
	CCS	**BHS**
Average return	0.49%	4.91%
Standard deviation	16.47%	21.52%
Skewness	-0.8078	-0.9055
Kurtosis	1.0468	0.8619

Table 4: 1% OTM options compared for CCS and BHS (AEX vol.)

In table 3 we see that the moneyness is set at 0% and that there are zero cases for 3.8% of our options. In table 4 we see the results of this OTM option. Here you can see that the CCS performed a bit better than when one writes ATM options. With the moneyness set at 1%, I got a slim positive result. CCS performed better when options are written OTM then when one writes ATM options, but the average return of CCS is still far from as good as that of the BHS. Again, I can conclude that BHS was the winning strategy in this situation.

Moneyness	**2%**	**ATM = 0%**
Time to maturity	1	**Months(1,2)**
% Zero c(X)	8.3%	

Table 5: 2% OTM options returns (AEX vol.)

Return		
	CCS	**BHS**
Average return	2.03%	4.91%
Standard deviation	19.21%	21.52%
Skewness	-0.1231	-0.9055
Kurtosis	1.1503	0.8619

Table 6: 2% OTM options compared for CCS and BHS (AEX vol.)

In table 6 we see that the moneyness is set at 0% and that there are zero cases for 8.3% of our options. In table 7 we see the results of this OTM option. As you can see, the average return is again slightly higher, but still not even close to the return from the BHS. And yet again I can conclude that BHS was the winning strategy in this situation.

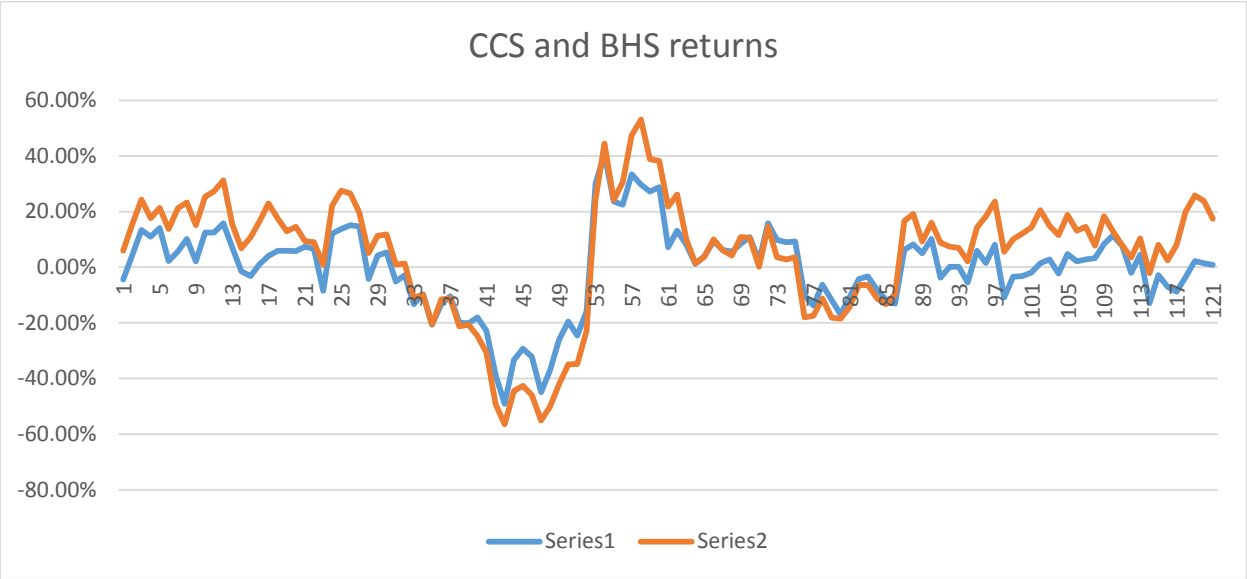

Figure 1: The returns of both BHS and CCS over 120 different years (AEX vol.)

Series 1 is CCS

Series 2 is BHS

In figure 1 you can see the results of both strategies over the last ten years. One can see that the results are in line with the EMH when testing this theory. It shows that the return is lower with CCS than with BHS. However, we see that the spread is also smaller. So the risk is lower. With lower risks come lower returns according to the EMH and that seems to be the case here.

4.3 Big Five volatility

Consequently, as to the previous paragraph, I performed a second round of calculations. This time I used the volatility of a smaller basket of AEX stocks. I picked the five biggest companies that are listed on the AEX and called them the "Big Five". These are in succession Ahold, ASML, Philips, Royal Dutch Shell and Unilever. I did this to give a better view of the investment strategy that is used by MW.

Company	Volatility 260 days		
Ahold	0.24	Average	0.258
ASML	0.31	St. dev	0.029
Philips	0.24	Avg/AEX	1.29
RD Shell	0.27		
Unilever	0.23		
AEX	0.2		

Table 7: The companies used for the "BIG 5" volatility

In table 7 we see an overview of the different volatilities. As one can see, the volatilities of the Big Five are all slightly higher than the AEX volatility. As mentioned earlier, the volatility is an important aspect for calculating the option price. The higher the volatility the higher the premium that is being paid. The results are as follows.

Moneyness	**0%**	**ATM = 0%**
Time to maturity	1	**Months(1,2)**
% Zero c(X)	3.8%	

Table 8: ATM options returns (BIG5 vol.)

Return		
	CCS	**BHS**
Average return	5.83%	4.91%
Standard deviation	15.76%	21.52%
Skewness	0.0868	-0.9055
Kurtosis	1.7509	0.8619

Table 9: ATM options compared for CCS and BHS (BIG5 vol.)

In table 8 we see that the moneyness is set at 0% and that there are zero cases for 3.8% of our options. In table 9 we see the results of this OTM option. Here one can see that when the option is written ATM, the average results come closer to each other. CCS has an almost 1% higher return here than the return of the BHS and so we can conclude that CCS is the winning strategy in this situation.

Moneyness	**1%**	**ATM = 0%**
Time to maturity	1	**Months(1,2)**
% Zero c(X)	3.8%	

Table 10: 1% OTM options returns

Return		
	CCS	**BHS**
Average return	4.96%	4.91%
Standard deviation	16.65%	21.52%
Skewness	-0.3475	-0.9055
Kurtosis	1.1078	0.8619

Table 11: 1% OTM options compared for CCS and BHS (BIG5 vol.)

In table 10 we see that the moneyness is set at 0% and that there are zero cases for 3.8% of our options. In table 11 we see the results of this OTM option. Again, the CCS is a preferable strategy as it clearly outperforms BHS. However, the difference is much smaller than in the previous scenario. Hence, the OTM option in this case does not perform as well as the ATM options do.

Moneyness	**2%**	**ATM = 0%**
Time to maturity	1	**Months(1,2)**
% Zero c(X)	8.3%	

Table 12: 2% OTM options returns

Covered		
	CCS	**BHS**
Average return	5.31%	4.91%
Standard deviation	19.67%	21.52%
Skewness	0.3192	-0.9055
Kurtosis	1.5585	0.8619

Table 13: 2% OTM options compared for CCS and BHS (BIG5 vol.)

In table 12 we see that the moneyness is set at 0% and that there are zero cases for 3.8% of our options. In table 13 we see the results of this OTM option. Again one can perceive an outperformance by CCS yet again not as high as stated in the scenario where options were written ATM.

These results seem to be more in line with what is written in previous academic papers. This proofs that the CCS is a strategy that reduces the risk but does not reduce the return. It is perceived that the written options show results that are close to the results that would be achieved with the BHS. They even seem to slightly outperform the BHS every time.

The problem lies in the fact that all these results are dependent on the stock that an investor chooses for the volatility. In this research, the biggest companies that are listed on the AEX are chosen and it is no surprise that these all have higher volatilities than the smaller list companies.

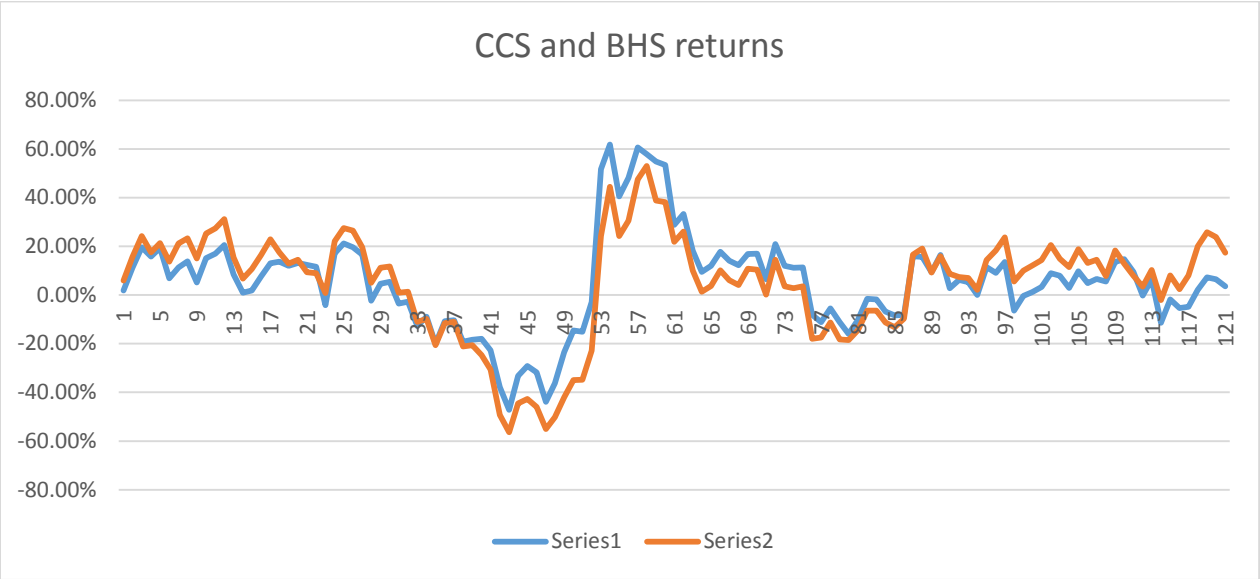

Figure 2: The returns of both BHS and CCS over 120 different years (BIG5 vol.)

Series 1 is CCS

Series 2 is BHS

In figure 2 we can again see the results for both strategies, now adjusted to the Big Five volatility. The lines are a bit more aligned than they were in the previous chart yet still it seems that the CCS tends to remain closer to the X axis. So the spread of the CCS is still smaller as we can see but the results are closer to each other. This would be in favour of the CCS and in contradicts what the EMH says.

4.4 Test results

4.4.1 Sharpe ratio

AEX volatility			**Big Five volatility**		
At the money	**0%**		**At the money**	**0%**	
Buy and Hold strategy	Average	3.95%	**Buy and Hold strategy**	Average	3.95%
	Standard deviation	21%		Standard deviation	21%
	Sharpe ratio	0.18		Sharpe ratio	0.18
Covered Call strategy	Average	-1%	**Covered Call strategy**	Average	3%
	Standard deviation	15%		Standard deviation	16%
	Sharpe ratio	-0.0773		Sharpe ratio	0.2073

Table 14: ATM Sharpe ratio results (AEX vol.

AEX Volatility			Big Five volatility		
Out of the money	**1%**		**At the money**	**1%**	
Buy and Hold strategy	Average	3.95%	**Buy and Hold strategy**	Average	3.95%
	Standard deviation	21%		Standard deviation	21%
	Sharpe ratio	0.18		Sharpe ratio	0.18
Covered Call strategy	Average	0%	**Covered Call strategy**	Average	3%
	Standard deviation	16%		Standard deviation	17%
	Sharpe ratio	-0.0229		Sharpe ratio	0.1716

Table 15: 1% OTM Sharpe ratio results (AEX vol.)

AEX volatility			Big Five volatility		
At the money	**2%**		**At the money**	**2%**	
Buy and Hold strategy	Average	3.95%	Buy and Hold strategy	Average	3.95%
	Standard deviation	21%		Standard deviation	21%
	Sharpe ratio	0.18		Sharpe ratio	0.18
Covered Call strategy	Average	1%	Covered Call strategy	Average	4%
	Standard deviation	19%		Standard deviation	20%
	Sharpe ratio	0.0614		Sharpe ratio	0.1816

Table 16: 2% OTM Sharpe ratio results (AEX vol.)

In table 14, 15 and 16 we see the calculations of the Sharpe ratio of the strategies for both volatilities. On the left there are the results from options that used the AEX volatility and on the right there are the options that used the Big 5 volatility.

The Sharpe ratio tells us about the risk return characteristics of a portfolio. The higher the Sharpe ratio the better. For the AEX volatility you can see that the Sharpe ratio rises, the further an option is written OTM. From this I can conclude that, when using the volatility of the AEX index, it would be better for an investor to write the option OTM instead of ATM. The outcomes for the Big Five volatility are slightly different. For ATM options the Sharpe ratio is the highest.

Followed by the 2% OTM option and last is the 1% OTM option. One could say that it is better to write options ATM when using Big Five volatility, but the outcomes were all very similar and a higher ITM option seemed to perform better than a lower one, which again is closer to the ATM option, which performed best.

4.4.2 Treynor ratio

AEX volatility	Moneyness	Treynor ratio	Big Five volatility	Moneyness	Treynor ratio
	0%	0.49339		0%	-0.04299
	1%	0.00234		1%	0.07485
	2%	0.00574		2%	-0.01358

Table 17: Treynor ratio results

In table 17 we see our calculations of the Treynor ratio. The Treynor ratio works similar to the Sharpe ratio, the higher the outcome the better. From the AEX volatility the outcome is obvious, where the ATM option seem to far outperform the ITM options. It is more complex to draw a conclusion from the outcomes for the Big Five volatility. This time the one percent moneyness portfolio performed best, with the ATM option performing the worst.

4.4.3 M2 ratio

AEX volatility	Moneyness	M^2 ratio	Big Five volatility	Moneyness	M^2 ratio
	0%	-0.08%		0%	5.31%
	1%	0.37%		1%	4.55%
	2%	2.18%		2%	4.76%

Table 18: M2 ratio results

In table 18 the outcomes of the M2 ratios are shown. The M2 ratio is also a measure to analyze returns adjusted for the risk that is in the portfolio, compared to the return of BHS. The advantage of the M2 ratio, compared to the Sharpe ratio is that the outcome is a percentage instead of a number. This makes it easier to use and it therefore gives a better view. The higher the percentage, the higher the return of a portfolio. The first thing to see is that the AEX volatility does not perform well, with outcomes for ATM options being negative. The ITM results are not better, but I can conclude that the higher the moneyness, the higher the result. From the outcomes for the Big Five volatility one can conclude that the outcomes are again very close to each other. Again, the ATM options perform best.

4.4.4 Jensen's Alpha

AEX volatility	Moneyness	Jensen's Alpha	Big Five volatility	Moneyness	Jensen's Alpha
	0%	-3.81%		0%	0.667%
	1%	-3.26%		1%	0.01%
	2%	-2.14%		2%	0.27%

Table 19: Jensen's Alpha results

In table 19 we see the outcomes from Jensen's Alpha, which is another, and our last, ratio that gives the returns of a portfolio, adjusted for its risk. Again it is a percentage that gives us the outcome. When the percentage is positive, this means that the investor has beaten the market, when it is negative, this implies that he did not. You can see that all the AEX volatility outcomes are negative, so there the market was not beaten, as could have been expected from earlier mentioned findings. The highest moneyness performed the best, so I can conclude that this would be the best option. The Big Five volatility performed better. All the outcomes are positive, so here the market was in fact beaten.

The ATM option performed best, followed by the 2% option. I conclude that the best choice would be to write calls ATM. In table 20 there is an overview of all the outcomes for the different ratios, rated from one to three. One being the best performing degree of moneyness, three being the worst. Sorted on whether they are from the AEX volatility group or the "Big Five" volatility group.

		1	**2**	**3**
Sharpe	AEX	2%	1%	0%
	BIG5	0%	2%	1%
Treynor	AEX	0%	2%	1%
	BIG5	1%	2%	0%
M2	AEX	0%	1%	2%
	BIG5	0%	2%	1%
Jensen	AEX	0%	2%	1%
	BIG5	1%	2%	0%

Table 20: Ratio results in ranking by degree of moneyness

4.5 Chi Squared Test

With these results we can perform a Chi Squared test. I will do this for the total number of outcomes, so for AEX and Big Five combined, and this gives us a P-value. In order for the results to be significant, so to certainly say if we prefer one degree of moneyness over another, the P-value must be lower than 0.05.

All					
Actual	**0%**	5	0	3	8
	1%	2	2	4	8
	2%	1	6	1	8
		8	8	8	24
Expected	**0%**	2.67	2.67	2.67	8
	1%	2.67	2.67	2.67	8
	2%	2.67	2.67	2.67	8
		8	8	8	24
		p	**0.0174**		

Table 21: Chi Square test results

In table 21 we see the results of our calculations using the Chi Square test. Here we see that the P-value is lower than our *alpha* of 0.05, making the outcome of this test statistically significant. So we can conclude that the number of times that the ATM option has "won" is actually because the ATM option tend to pay out better returns than the OTM options. So we can conclude from this that one should write ATM options when using CCS, instead of using OTM options.

4.6 Continued existence of MW

We can see from the results that when purely focused on the index, CCS underperforms when compared to the BHS. Therefore, one can question why MW still exists. Their main strategy is the CCS and they, as a company, have been performing well over the past few years. As mentioned earlier, testing purely on the index is not what MW does. Therefore, we picked a second, smaller, basket of stocks. The difference here is the volatility that the basket of stock has compared to that of the AEX. This is also the reason that the same tests with a different volatility have been done which led to results that are much more in line with the results from MW.

According to my research, CCS, using only the index, does not work and therefore cannot survive in the long-term. If one follows the results, you should start thinking about a different strategy as an institutional investor. However, when the volatility was changed, a large shift in the return of Covered Call writing appeared. They are all close to the return on BHS and are even slightly higher. This is the strategy that MW uses in practice, so they have a strategy which is less risky than traditional strategies, generating a similar return. Meaning, that they are beating the market and should keep doing what they are doing.

5. Conclusion

In this paper I examined the results of using CCS on the AEX Index, compared to using BHS on the same index. Together with Ronald Huisman, Anne-Merel van den Berg and MW I developed a model that helped us to backtest the strategy as used by MW and many other institutional investors. We have done this to show to potential investors that CCS works, even though classical economic theories such as the EMH state that it does not. The idea that one earns the same returns while decreasing his risk is not something that fits into the theories of the classical economists.

I backtested that CCS in two different ways. One was by using the AEX index, with the volatility of the entire index. The second way was by using the AEX index, but the volatility of a basket of shares, which is basically what MW does. This basket of shares, which I called the "Big Five", should be a representation of the basket of shares that MW uses for its own investments. It consists of the five biggest companies that are listed on the AEX.

From the first calculation I conclude that CCS does not outperform BHS. After back-testing it with use of the AEX index, one can state that the return of Covered Call strategies has a significantly lower average return in the 120 identical years that it is used. Our second round of calculations shows a much better return on the CCS. When you increase the volatility to a level that is supposed to be that of MW's basket of shares, the returns do outperform that of BHS. In this situation the CCS is a valuable strategy as it reduces the investor's risk, without reducing its returns. So if what I did is in line with the strategy that MW actually uses and our assumptions on volatility are correct, MW has a strategy that has proven itself over the last ten years.

Regarding the degree of moneyness of the options that are written. I have found that the returns from using CCS are always very close to the returns from BHS. I checked for different values of moneyness, with even some extreme values which did not exactly fit in our data and they all kept close to returns from BHS.

In chapter one I introduced the following research question:

"What is the moneyness strategy behind Covered Call writing and what importance holds the degree of moneyness?"

With a focus on the following two strategies:

Strategy 1: Writing a selection of Covered Calls with a difference in the degree of moneyness.
Strategy 2: Only writing Covered Calls with a certain degree of moneyness.

		1	**2**	**3**
Sharpe	AEX	2%	1%	0%
	BIG5	0%	2%	1%
Treynor	AEX	0%	2%	1%
	BIG5	1%	2%	0%
M2	AEX	0%	1%	2%
	BIG5	0%	2%	1%
Jensen	AEX	0%	2%	1%
	BIG5	1%	2%	0%

Table 22: Ratio in results in ranking by degrees of moneyness

In table 22 you can see that the ratings in the outcomes are pretty random. Five out of eight of the results show that the ATM options seem to perform best. To prove this statistically I performed a Chi Square Test which calculates if the outcomes are a coincidence or not. The results turned out to be significant and therefore they show that five out of eight "wins" for the ATM option, prove that one should write ATM options when using CCS, based on this dataset.

Assuming MW uses a strategy that is similar to my basket of shares strategy, using the CCS with Big Five volatility, they are using a strategy that has proven itself over the last ten years to be the most profitable.

6. Direction for future research

Beforehand I knew that what I would be testing, is not identical to what MW has done over the past years. Using the actual basket of shares that MW uses to backtest the results, would be closer to what MW actually does. This would have been the ideal way of back-testing their own strategy. However, in this research it was soon concluded that this would make matters very difficult from the perspective of the given data. If a researcher does have access to databases that can provide this information and is willing to pay the high price for this data, it might make sense to do the same research again. What I did here is as close as one can get to the MW strategy, within the limitations of our data. I believe that it gives a good view of what they do as well as that the results are a good approximation of their results.

Regarding the zero cases when backtesting the strategy, there is not much that can be done. Picking an exercise price that is further out of the money, gives us a smaller dataset. They simply price those options less. As discussed, I did perform the research with higher prices but it did not change much for the results.

7. Acknowledgement

This master thesis would never have been realized without the support and help of the following people.

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