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AUTHOR:

Hammad Siddiqi

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Schools of Economics and Political Science

The University of Queensland

St Lucia

Brisbane

Australia 4072

Web: www.uq.edu.au

Mental Accounting: A New Behavioral Explanation of Covered Call Performance

Hammad Siddiqi

University of Queensland

h.siddiqi@uq.edu.au

The empirical performance of covered call writing is quite puzzling in the traditional finance framework. Covered call writing is typically a risk reducing strategy so its expected return should be less than the expected return on the underlying in an efficient market. However, recent empirical evidence suggests (covering a period from 1988 onwards) that the covered call writing has nearly the same return as the underlying whereas the standard deviation of returns is considerably less. Market professionals consider a call option to be a surrogate for the underlying. Such mental accounting of a call option with the underlying has strong support in laboratory experiments. We show that such mental accounting embodied in the principle, *assets with similar payoffs must have the same expected returns,* provides a new behavioral explanation for the puzzling empirical performance of covered call writing.

JEL: G13, G12

Keywords: Covered Call, Generalized Principle of No-Arbitrage, Analogy Making, Mental Accounting, Binomial Model, Trinomial Model, Black Scholes

Mental Accounting: A New Behavioral Explanation of Covered Call Performance

The profitability of covered call writing is puzzling in the standard finance framework. Whaley (2002) shows that BXM (a Buy Write Monthly Index tracking a Covered Call on S&P 500) not only has lower risk when compared with the index, it also outperforms the index in terms of returns. Similar conclusions are reached in studies by Feldman and Roy (2004) and Callan Associates (2006). In the Black Scholes framework, the covered call strategy is expected to have lower risk as well as lower return when compared with buying the index only. See Black (1975). In fact, in an efficient market, the risk adjusted return from covered call writing should be no different than the risk adjusted return from just holding the index.

Since the start of listed option trading in 1973, covered call writing has been one of the most popular option trading strategies, accounting for a large volume of calls written. See Lakonishok et al (2007). Shefrin and Statman (1993) apply prospect theory and hedonic framing to provide a behavioral explanation for the popularity of the covered call strategy. Hoffman and Fischer (2012) carry out a survey based empirical examination of the arguments in Shefrin and Statman (1993).

In this article, we add to this literature by providing a new behavioral explanation for the profitability of covered call writing. In contrast with Shefrin and Statman (1993) who focus on the reasons for the popularity of the strategy, we look at the question of why covered call writing is more profitable than what the standard finance theory predicts. Our explanation is based on mental accounting of a call option with its underlying.

The fundamental principle of finance is the law of one price that states *assets with identical state-wise payoffs must have the same price*, or equivalently *assets with identical state-wise payoffs must have identical state-wise returns.* The law of one price is also referred to as the principle of no-arbitrage because if assets with identical state-wise payoffs have different prices, then one can make riskless profit by short-selling the expensive asset and buying the cheaper one. Suppose one cannot find another asset identical to a given asset, so the law of one price cannot be applied. How can the given asset be priced in such a situation? Experimental evidence suggests that when the principle of no-arbitrage cannot be applied, people rely on a weaker version of the principle, which can be termed the generalized principle of no-arbitrage or analogy making. See Siddiqi (2012) and Siddiqi (2011). The generalized principle of no-arbitrage or analogy making states *assets with similar state-wise payoffs must have the same state-wise returns on average* or equivalently *assets with similar state-wise payoffs must have the same expected returns.* The theoretical foundations of this experimentally observed rule are provided by the notion of mental accounting (Thaler (1980), Thaler (1999), discussion in Rockenbach (2004)), and categorization theories of cognitive science (Hendersen and Peterson (1992)). See Siddiqi (2013) for details.

In this article, we assume, in line with the experimental evidence (see Rockenback (2004), Siddiqi (2012), and Siddiqi (2011)), that people cannot manufacture an asset identical to a call option by using the underlying and a risk-free bond. Hence, they cannot apply the principle of no-arbitrage to price a call option. Instead, in line with the experimental evidence, they apply the generalized principle of no-arbitrage or analogy making to price a call option. We show that, in this set-up, the covered call strategy outperforms the strategy of holding the underlying only.

Thaler (1999) defines mental accounting as the set of cognitive operations used by individuals to organize, evaluate, and keep track of financial activities. Applications of mental accounting generally involve two phases in the decision process: 1) Editing phase in which items are grouped into mental accounts. 2) Evaluation phase in which an attribute is evaluated in comparison with the reference value of the relevant mental account. The generalized principle of no-arbitrage which says *assets with similar state-wise payoffs must have the same expected returns* is a statement about the two phases. In the editing phase, assets that are perceived to have similar payoffs are placed in the same mental account. In the evaluation phase, an attribute, expected return, is assessed in comparison with the reference value of that particular mental account. Hence, the generalized principle of no-arbitrage or analogy making is a statement about the relevance of mental accounting for asset pricing in a specific way.

The first experiment to show that mental accounting matters for pricing a call option is Rockenbach (2004) who finds that the hypothesis of mental accounting of a call option with the underlying explains the data best, which implies that participants demand the same expected return from a call option as available on the underlying. Experiments reported in Siddiqi (2012) and Siddiqi (2011) explore this further and find that the mental accounting of a call option with its underlying is due to the similarity in payoffs (one pays more when the other pays more, pays less when the other pays less) between the two assets as adding a third risky asset with dissimilar payoffs has no effect.

A call option is widely believed to be a surrogate for the underlying stock by market professionals as it pays more when the stock pays more and it pays less when the stock pays less.[1] Early academic work in behavioral finance has hinted at the possibility of such mental accounting based on similarity judgments. In particular, Shefrin and Statman (1993) mention that features of similarity are likely to play a crucial role in the creation of mental accounts. They note that a call option on the stock of X Company has two key features, one identifying it as a call option and the other identifying it as relating to the stock of the X Company. Investors are more likely to co-categorize the call option with a share of the X Company than with a share of another firm. We follow Shefrin and Statman (1993) and Siddiqi (2013) in taking the similarity between a call option and its underlying as given. We follow Siddiqi (2013) in applying the generalized principle of no-arbitrage or analogy making to value options.

Analogy making is applied when one cannot find another asset identical to a given asset which one is trying to value. There are two possibilities: 1) The identical asset exists, but one is unable to find it. 2) The identical asset does not even exist in theory. Section 2 provides a numerical example of both cases to bring out the difference between the principle of no-arbitrage and the generalized principle of no-arbitrage or analogy making. Section 3 provides a two period binomial illustration of the first case, and shows that covered call writing outperforms the underlying holding strategy if analogy making determines call prices. Section 4 illustrates the second case with a two period trinomial example and compares the performance of covered call writing with the strategy of holding the underlying. It shows that covered call writing has superior performance. Whereas sections 3 and 4 look at discrete cases, section 5 examines the profitability of covered call in the continuous limit, and shows that covered call writing has superior performance under analogy making. Section 6 concludes.

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[1] As illustrative examples of professional traders considering a call option to be a surrogate of the underlying, see the following posts:
http://ezinearticles.com/?Call-Options-As-an-Alternative-to-Buying-the-Underlying-Security&id=4274772,
http://www.investingblog.org/archives/194/deep-in-the-money-options/,
http://www.triplescreenmethod.com/TradersCorner/TC052705.asp,
http://daytrading.about.com/od/stocks/a/OptionsInvest.htm

2. Analogy Making vs. No-Arbitrage

Suppose there are only two assets, which are a risky stock (S) and a risk-free bond (B). The stock has a price of \$40 today. In the next period, the stock could either go up to \$80 (the red state) or go down to \$25 (the blue state). Each state has a 50% chance of occurring. The bond costs \$10 today and it also pays \$10 in the next period implying a risk free rate of zero. Suppose a new asset "A" is introduced. The asset "A" pays \$70 in the red state and \$15 in the blue state. Note that "A" is equivalent to a call option on S with a striking price of 10. How much should one be willing to pay for it?

The principle of no-arbitrage, *assets with identical state-wise payoffs must have the same price,* or equivalently, *assets with identical state-wise payoffs must have identical state-wise returns*, can be applied here. One can create a new asset with state-wise payoffs identical to A by buying one unit of S and shorting one unit of B. In the Red state, S gives 80 and one pays 10 on account of shorting one unit of B, resulting in a net payoff of 70. In the Blue state, S gives 25 and one pays 10 on account of shorting one unit of B, resulting in a net payoff of 15. Hence, the state-wise payoffs of the asset, 1S minus 1B, are identical to the state-wise payoffs of A. Hence, the no-arbitrage price of A should be equal to the price of 1S minus 1B, which is equal to 30. The Red state return of asset (1S-1B) is 2.33. The Blue state return of asset (1S-1B) is 0.5. The price of A that gives the same state-wise returns is 30.

In practice, constructing a portfolio that replicates "A" is no easy task. When simple tasks such as the one described above are presented to participants in a series of experiments, they seem to rely on analogy-making to figure out their willingness to pay. See Rockenbach (2004), Siddiqi (2011), and Siddiqi (2012). So, instead of trying to construct a replicating portfolio which is identical to asset "A", people find an actual asset similar to "A" and price "A" in analogy with that asset. That is, they rely on the principle of analogy: *assets with similar state-wise payoffs must have the same state-wise returns on average,* or equivalently, *assets with similar state-wise payoffs must have the same expected returns.*

Asset "A" is similar to asset S. It pays more when asset S pays more and it pays less when asset S pays less. Expected return from S is 1.3125 $\left(\frac{0.5\times 80+0.5\times 25}{40}\right)$. According to the principle of analogy, A's price should be such that it offers the same expected return as S. That is, the right price for A is \$32.381.

In the above example, we assumed that people can't find the identical exist; however, the identical asset does exist. As shown above, the identical asset to A can be created by buying one unit of S and shorting one unit of B. One can easily think of a scenario in which the identical exist does not even exist so the question of finding it does not even arise. Just add another state to the above scenario: the Green state, in which the payoff from S is 5 and the payoff from A is 0. Assume that all three states are equally likely to occur. There is no combination of S and B that replicates the payoffs from A; hence, the law of one price cannot be applied to value asset A. However, the generalized principle of no-arbitrage or analogy making can still be applied as payoffs from A are similar to payoffs from S. With the introduction of the Green state, the expected return from S is $\left(\frac{0.333\times 80+0.333\times 25+0.333\times 5}{40}\right) = 0.912$. So, the analogy based price of A is $31.067.

3. The Performance of Covered Call Writing: The Binomial Case

To see how mental accounting reflected in the generalized principle of no-arbitrage, *assets with similar state-wise payoffs must have the same expected return,* affects the profitability of covered call writing, we examine its performance in a two period binomial model. Figure 1 shows the price of call option both under no-arbitrage (Call-NA) as well as under analogy making (Call-AN) in each box. Without loss of generality, we have assumed that the risk-free interest rate is zero, and there are no dividends.

Figure 2 shows the performance of covered call writing, in which, the call option described in figure 1 is written and one unit of the underlying is bought. The payoff from covered call writing when the call price is determined via no-arbitrage is denoted by Ccall-NA, and the corresponding analogy based payoffs are denoted by Ccall-AN. Table 1 shows the one period expected return (net) as we move along the binomial tree. For reference, one period expected return (net) on the underlying in figures 1 and 2 is 0.3125. Hence, under analogy making, the expected return from covered call writing is the same as the expected return from the underlying, whereas, under no-arbitrage, the expected return from covered call writing is considerably lower.

Expected Return (One Period)		
Stock Price	Covered Call (No Arbitrage)	Covered Call (Analogy Making)
40	0.041	0.3125
80	0	0.3125
25	0.059	0.3125

Table 1

Table 2 shows the standard deviation of one period returns from covered call under no-arbitrage vs. analogy making. For reference, the standard deviation of one period returns on the underlying in figures 1 and 2 is 0.6875. Clearly, the expected return from covered call writing under analogy making is the same as the expected return on the underlying, however, the standard deviation from covered call writing is considerably lower.

Standard Deviation of Returns (One Period)		
Stock Price	Covered Call (No Arbitrage)	Covered Call (Analogy Making)
40	0.09	0.08
80	0	0
25	0.13	0.16

Table 2

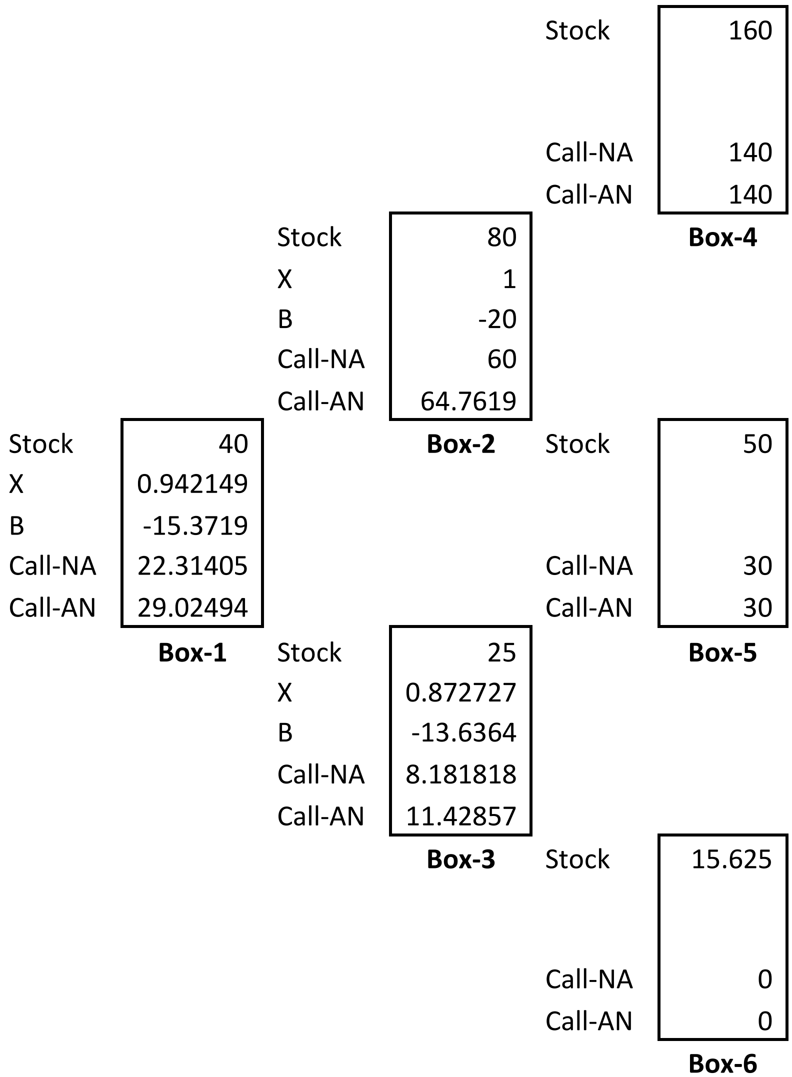

Figure 1

A two period binomial model with the following parameter values: Up factor=2, Down factor=0.625, Strike=20, Risk-free interest rate=0, Up probability=0.5, Current stock price=40

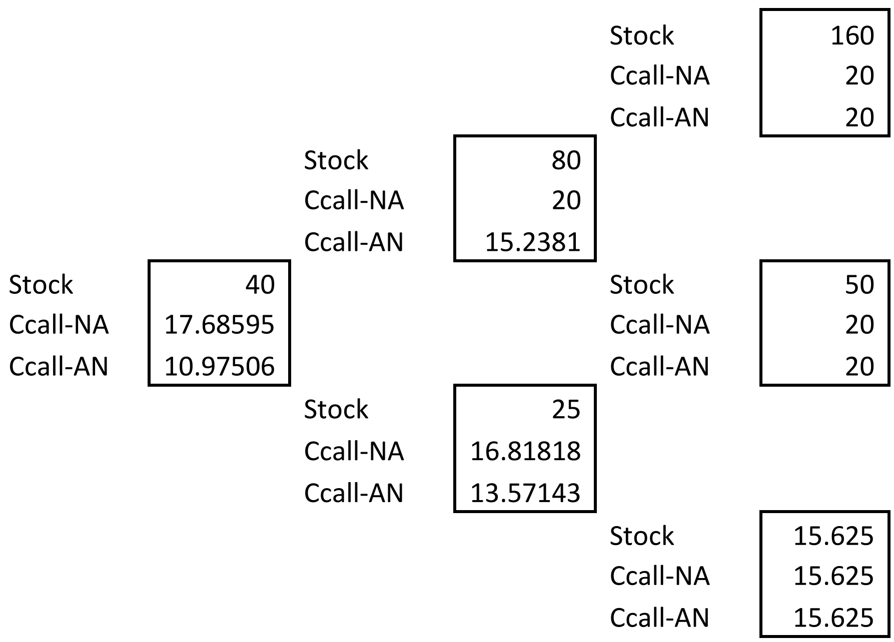

Figure 2

Payoffs from covered call writing under no-arbitrage vs. payoffs from covered call writing under analogy making. The binomial parameters are the same as in figure 1.

4. The Performance of Covered Call Writing: The Trinomial Case

The binomial case considered earlier is the prototype for a situation in which an asset identical to a given call option exists. The assumption made in the previous section, in accordance with experimental evidence (Rockenbach (2004), Siddiqi (2012), Siddiqi (2011)), is that people cannot find the identical asset even though the identical asset exists. In this section, we consider a trinomial case, in which the identical asset does not even exist.

Figure 3 shows a two period trinomial tree along with call prices and corresponding covered call payoffs under analogy making. As the principle of no-arbitrage cannot be applied, we refer to the call prices obtained via analogy making simply as call.

Table 3 shows the expected return as well as standard deviation (per trinomial period) from covered call writing under analogy making. For reference, the expected return per trinomial period from the underlying is 0.1667, and the standard deviation of returns per trinomial period from the underlying is 0.62361.

Covered Call Writing under Analogy Making		
Stock Price	Expected Return	Standard Deviation
40	0.1667	0.097
80	0.1667	0
20	0.1667	0.33

Table 3

As can be seen from table 3, covered call writing has the same expected return as the underlying, however, it has a considerably lower standard deviation of returns.

				Stock	160
				Call	140
				Covered Call	20
		Stock	80	Stock	80
		Call	62.85714	Call	60
		Covered Call	17.14286	Covered Call	20
Stock	40	Stock	40	Stock	40
Call	26.12245	Call	22.85714	Call	20
Covered Call	13.87755	Covered Call	17.14286	Covered Call	20
		Stock	20	Stock	20
		Call	5.714286	Call	0
		Covered Call	14.28571	Covered Call	20
				Stock	10
				Call	0
				Covered Call	10

Figure 3

A trinomial tree with the following parameter values: Up=2, Middle=1, Down=0.5, Risk-free interest rate=0, Strike=20, Current stock price=40. Each state (up, middle, or down) is equally likely to occur.

5. The Performance of Covered Call Writing: The Continuous Limit

Previous two sections have looked at the performance of covered call writing with discrete binomial and trinomial cases. Section 3 looks at the discrete binomial case (an asset with identical payoffs to the given call option exists), whereas section 4 looks at the discrete trinomial case (an asset with identical payoffs to the given call option does not exist). In both cases, the expected return from covered call writing is the same as the expected return from the underlying, whereas the standard deviation of returns is considerably less. In this section, we examine the profitability of covered call writing in the continuous limit.

The Black Scholes model (Black and Scholes (1973) and Merton (1973)) is derived based on the assumption that a call option is valued by applying the principle of no-arbitrage; *assets with identical state-wise payoffs must have identical returns.* It assumes that by using a combination of the underlying and a risk-free asset, payoffs from a call option can be exactly replicated. Hence, a (continuously adjusted) combination of the underlying and a risk-free asset creates an asset with state-wise payoffs identical to a call option. Cox, Ross, and Rubinstein (1979) show that this assumption is equivalent to assuming a two-state or binomial discrete process for the underlying as any other process would imply that the identical asset does not exist.

The value of a covered call strategy (S denotes stock, C denotes call) can be written as:

$$V = S - C \tag{1}$$

Substituting the Black Scholes formula for the call option in (1):

$$V = S - \left\{SN(d_1) - Ke^{-r(T-t)}N(d_2)\right\}$$

$$=> V = \left(1 - N(d_1)\right)S + N(d_2)Ke^{-r(T-t)} \tag{2}$$

To consider the impact of covered call writing in the Black Scholes world, initially assume that only the underlying is bought and held. This is equivalent to putting $N(d_1)$ and $N(d_2)$ equal to zero in equation (2). Now, consider a situation in which a call option is also written on the underlying stock. As equation (2) shows, this amounts to reducing the weight of the stock and increasing the weight of the risk free asset in the portfolio. That is, the weight of the stock in the portfolio is now $1 - N(d_1)$ instead of 1, whereas the weight of the risk-free asset is now $N(d_2)$ instead of 0. The return on the risk-free asset is typically lower than the return on the stock, which means that the expected return from covered call writing should typically be lower than the expected return form just holding the underlying stock. With the passage of time and changes in the stock price, the respective weights of the underlying and the risk-free asset change, however, as long as there is a positive weight on the risk-free asset, the expected return from covered call should be lower than the expected return from just holding the underlying. Similarly, covered call writing also reduces volatility as the risk-free asset gives a constant payoff. As covered call writing is expected to reduce returns, the popularity and widespread use of covered call writing is quite puzzling in the Black Scholes context.

If mental accounting determines the price of a call option, then there are two possibilities in the discrete space: 1) The identical asset exists but one cannot find it. 2) The identical asset does not even exist. Section 3 considered the first case, and section 4 looked at the second case. In both cases, the principle of no-arbitrage cannot be applied, instead, in line with experimental evidence; people tend to price a call option by applying the generalized principle of no-arbitrage or analogy making: *assets with similar state-wise payoffs must have the same expected return*. Not only subjects in experiments consider a call option to be similar to the underlying, market professionals also consider a call to be a surrogate for the underlying.

Siddiqi (2013) derives the option pricing formula when mental accounting matters, and shows that in the continuous limit, it does not matter whether the identical asset exists or not. In both cases one obtains the following price for a European call option:

$$C = SN(d_1) - Ke^{-(r+\delta)(T-t)}N(d_2) \tag{3}$$

where $d_1 = \frac{ln(S/K)+(r+\delta+\frac{\sigma^2}{2})(T-t)}{\sigma\sqrt{T-t}}$ *and* $d_2 = \frac{ln\left(\frac{S}{K}\right)+\left(r+\delta-\frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}$

and δ *is the risk-premium on the underlying.*

As can be seen, the mental accounting formula is exactly identical to the Black Scholes formula except for the appearance of δ, which is the risk premium on the underlying.

Substituting (3) in (1) and simplifying:

$$V = \left(1 - N(d_1)\right)S + N(d_2)Ke^{-(r+\delta)(T-t)} \tag{4}$$

As (4) shows, under mental accounting, covered call writing is equivalent to reducing the weight on the underlying, and increasing the weight on a hypothetical risk-free asset that offers the same return as the expected return on the stock $(r + \delta)$. With the passage of time and changes in the stock price, the weights change, however, the expected return from covered call always equals the expected return from the underlying. A positive weight on the risk-free asset in (4) means lower volatility also. Hence, if mental accounting determines call prices, then the popularity of the covered call writing is not puzzling as it clearly outperforms just holding the underlying.

6. Summary

The profitability of covered call writing is quite puzzling in the traditional finance framework. A call option is widely believed to be a surrogate for the underlying stock by market professionals. We show that such mental accounting of a call option with its underlying reflected in the generalized principle of no-arbitrage, *assets with similar state-wise payoffs must have the same expected return,* resolves the puzzle that arises in the standard finance framework. We illustrate the results through binomial and trinomial cases, followed by a discussion of the continuous limit. Hence, we offer a new behavioral explanation of the profitability of covered call writing.

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