A “Devil's Bargain”: When Generating Income Undermines Investment Returns[‡]

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ABSTRACT

Many investors are motivated by passive income. Dividend income seeking strategies have a long history. More recently, interest in derivative income strategies – such as covered calls and put underwriting – continues to develop. Do high derivative income covered calls tend to deliver higher total returns? No. In fact, the relationship goes the other way. We demonstrate a strong negative mechanical relationship between expected total return and derivative income for covered call strategies. We empirically validate this relationship over a nearly 25-year period on S&P 500 Index covered call strategies. Those who have sought out and allocated to such strategies without accounting for this tradeoff might have made a devil’s bargain.

KEYWORDS: Covered Call, Covered Calls, Call Overwriting, Overwriting, Options, Volatility Risk Premium, Variance Risk Premium, BuyWrite, Buy-Write, PutWrite, Put-Write, Yield, Income, Derivative Income.

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Introduction

Many investors, particularly in the retail community, appear to be enamored by the yield generated by options strategies, particularly covered calls. Consider the following headline from a recent U.S. News article: "7 High-Yield Covered Call ETFs Income Investors Will Love[1]," with the sub-head "These ETFs employ derivative overlays to significantly enhance their yields." Morningstar has an entire category dedicated to "derivative income" strategies, currently rating 82 different funds. The market has demanded income products and asset managers have been more than happy to oblige.

Covered call strategies, depending on their implementation, can be an appropriate allocation within well-constructed, diversified investor portfolios. They have positive equity exposure – which delivers equity risk premium – and when writing equity index options, they are short equity index volatility, which delivers volatility risk premium. In fact, for many investors, a covered call (or put underwriting) strategy is perhaps the most natural and accessible approach to earn the volatility risk premium. However, shorting volatility to earn the volatility risk premium is an esoteric concept that is unfamiliar and confusing to many institutional investors and to most retail investors. So, these strategies are typically instead presented in a way that is more familiar and accessible to these audiences – they're "income-generating" strategies.

Framed in such a way, revealed preferences – as indicated by net fund flows – suggest these strategies deliver something that is highly sought out and valued by their investors. Derivative income isn't the only source of *adjustable* income for investors. In fact, it's the new kid to the party. Dividends have long been a go to source for income-seeking investors and naturally the market has accommodated this demand too.

Harris, Hartzmark, and Solomon (2015) explored dividend-income window dressing, where some mutual funds strategically purchase and liquidate dividend-paying stocks around their ex-div dates to enhance portfolio dividend yield. Not surprisingly, the authors found that targeting higher dividend yield using such an approach is typically associated with a more significant turnover – therefore higher trading costs. In addition, these unqualified dividends are tax-inefficient because they are treated as realized ordinary income and the additional turnover can lead to heightened realization of capital gains. In other words, there are strategies investment managers can and have used to enhance dividend yield, but doing so can be detrimental to net realized performance.

Just as is the case for dividend income asset managers, those who implement derivative income seeking covered call strategies have considerable control over the yield they seek to generate.[2] Call option prices

[1] https://money.usnews.com/investing/slideshows/high-yield-covered-call-etfs-income-investors-will-love

[2] The properties of covered call writing strategies have been extensively studied. In a new methodology, Israelov and Nielsen (2015) deconstruct the returns of the strategy into its *passive equity*, the *active equity* and the *short volatility* components,

monotonically decrease in strike, holding the option maturity fixed. Do you want higher income? It's easy, just pick a lower strike. If you want to moderate the income, that's easy too – just select a higher strike.

Exhibit 1 shows out-of-the-money call option prices for the S&P 500 Index (SPX) on July 21, 2023, for an August 18, 2023 maturity. On that date, the S&P 500 Index had a value of 4536.34. If someone wanted to target a 1% monthly (12% annualized) derivative income, they'd select a strike price of 4565 and get pretty close by receiving 46.10 in option premium. If instead, they wanted a 0.5% monthly (6% annualized) derivative income, a strike price of 4620 would achieve their goal.

INSERT EXHIBIT 1 HERE

Generating derivative income is so easy!

Is there a catch? It seems like there should be a catch. It can't be this easy, can it?

Well, there's one tiny detail – a footnote perhaps – that's worth mentioning. On average, the round-trip transaction of selling an S&P 500 index call option *has lost money*. And – this is key – the more yield the strategy has generated, the higher the losses! The high-yield covered call underperformed the low-yield covered call, and materially so. As we said, a minor detail, a triviality really, but mentioned for the sake of completeness.

Consider for example a goal of generating a 6% annualized derivative yield by selling index call options. Each month, a strike is selected to sell a call option with a targeted price that is 0.50% of the SPX index value. Over the period from 1999 to 2023, these options settled at maturity with a value of 0.54% of the SPX index value versus an average sale price of 0.49% of the SPX index value. The P&L from selling the call option was a *loss* of 0.05% per month or an annualized loss of 0.60%. What if we targeted a 12% annualized yield (1% monthly) instead? These options settled on average for 1.09%, leading to a 0.09% monthly loss, or a 1.08% annualized loss. Higher yield led to bigger losses. The recent period was even worse. Over the period 2011 to 2023, the 6% yield-targeting call-selling strategy had an annualized P&L of -3.1% and selling calls to generate 12% annualized yield lost 4.7% per annum.

So, it seems that selling calls generates yield, but loses money. And the more yield that it generates, the greater the losses. Is this empirical finding surprising? No, not at all. It is entirely expected behavior. Call options are positively exposed to their underlying assets – the term used to quantify this exposure is the Greek known as *delta*. The lower the call strike, the greater the call delta. A yield-generating strategy that

empirically demonstrating the strategy harvests two risk premia: the equity risk premium and the volatility risk premium. A similar observation is taken up by Miller, Jacobsen and de Vree (2021) in which the authors suggest an approach to tactically reduce the downside risk of the strategy. Israelov and Nielsen (2019) opine on the wrongful association between covered call premium and standard income. In addition, Liu and Poirier (2017) discuss the distributional properties of the income-seeking strategy under different targeted objectives, using S&P 500 Index options.

targets a specific yield will map to a particular strike that has an associated delta. Thus, someone who seeks a higher yield will select a lower strike, which is more exposed to the underlying equity. They are *shorting* this call option, meaning they are introducing *short* exposure to the underlying equity. Equities have an equity risk premium and being short equity delta should lead to negative expected returns. A high-yielding call selling strategy, by construction, has a larger short equity exposure leading to worse returns. It's a mechanical relationship and thus we should have high confidence in it.

There's a little more to the story. Introducing short underlying equity exposure is not the only impact arising from selling a call option. Option selling also introduces short volatility exposure.[3] The option Greek *gamma* quantifies the option's exposure to realized volatility and the Greek *vega* quantifies its exposure to implied volatility. Selling an option is short both volatilities. Equity index options tend to exhibit a volatility risk premium[4], meaning that their implied volatility tends to be higher than equity realized volatility. Thus, selling index options tends to be profitable (on a delta-adjusted basis) and profits tend to be greater – because exposure to volatility tends to be higher – the closer the option strike is to the equity index value.

Since yield-generating covered call strategies tend to focus on selling out-of-the-money call options, the higher-yielding strategies tend to be closer-to-the-money and thus have heightened short volatility exposure and higher volatility risk premium returns relative to their higher strike lower-yielding counterparts. The P&L impact from the short volatility exposure is positive and offsets the negative P&L impact from the short equity exposure. We show that the magnitude of this component is generally not large enough to overcome the return drag from being short equities.

You now have the intuition – the remainder of our paper provides the evidence and describes our methods. We'll begin with a toy example relying on the Black-Scholes-Merton model, which illustrates the intuitive relationships described above under somewhat realistic assumptions using a simplified model. We complete our analysis journey with a historical analysis of S&P 500 Index covered call strategies. And, of course, we'll offer some concluding thoughts.

Establishing Relevant Call Option Properties

A covered call is a popular, relatively easily implemented, option strategy. An underlying asset is owned – we'll focus our attention on an equity index (the S&P 500 Index). A call option is sold, and an

[3] See Israelov and Nielsen (2019).

[4] Several papers provide empirical evidence of the volatility risk premium. A dynamic view of the volatility risk premium has, for example, been developed by Bollerslev, Gibson and Zhou (2006), in which the authors propose a model for estimating the variance risk premium using option prices, then further studied in Bollerslev, Tauchen and Zhou (2009) and Zhou (2018).

option premium is received. That option is either European or American, meaning respectively, early option exercise is prohibited or allowed. And that option is either cash-settled or physically settled.

In the case of a cash-settled option, if the option matures in the money (meaning the S&P 500 Index value is greater than the strike price) then a cash transfer is made accordingly from the option seller to the option buyer. In the case of a physically settled option, if the call option is in the money, then it will likely be assigned, and the call option seller must sell their equity to the option holder at the designated strike price. Because the strategy intends to maintain a 100% equity position, the equity must be repurchased at the higher market price immediately after it was sold due to assignment, resulting in an effective economic loss because the investors own fewer shares of equity due to the round-trip equity trade at adverse prices. Or instead, the option seller can liquidate their short call position just before its expiration at a market price that reflects its moneyness and its remaining time to maturity.

For all intents and purposes, these are largely economically equivalent. The call option seller receives a premium (positive cash flow) at the time of sale and has a non-positive economic cash flow when they either buy back the call option or it settles according to its settlement procedures.

From the point of view of an equity investor who seeks to enhance their yield by selling call options (implementing a covered call strategy), we can ascertain the impact of that decision by focusing solely on the call option. Its impact on the strategy yield is determined by the price of the call option at the time of its sale. Its impact on the strategy's return is determined by the call option's profit and loss as determined by its sale price and its liquidation or settlement value. We therefore focus our attention specifically on the properties of the call options in the next section.

A Toy Model

We evaluate a simplified model to establish relevant call option characteristics. Consider an underlying index with a value of $1000. Its dividend yield is 2%. The risk-free rate is 3%. The expected equity return is 9%, reflecting a 6% equity risk premium (and a 0.4 Sharpe ratio given our volatility assumption). Equity volatility is 15% and equity implied volatility is 16% across a flat implied volatility surface, with the spread between implied and realized volatility representing a modest, but realistic volatility risk premium. We focus our attention on options with one month to maturity.

INSERT EXHIBIT 2 HERE

Using the assumptions above and the Black-Scholes-Merton model, we price the one-month call option across a range of strike prices. We divide the option price by the index value ($1,000), multiply by 12 to annualize, and plot in **Exhibit 2** the relationship between 'derivative yield' and call strike. It is evident – and there are no-arbitrage principles that guarantee this – that the derivative yield monotonically declines in call strike. Someone seeking a higher yield sells lower strike call options. This behavior is also consistent with what we previously observed in **Exhibit 1**.

Call options have positive exposure to their underlying asset, a relationship that is quantified by the Greek known as *delta*. In the left panel of **Exhibit 3,** we plot the call delta against the option strike, and in the right panel, we plot the annualized expected return impact of a short call option position (calculated as -12 times the option delta multiplied by the 6% equity risk premium). The bottom two plots of **Exhibit 3** repeat the exercise, but with *derivative yield* as the *x*-axis, using the relationship between call strike and derivative yield established in Exhibit 2 to make the swap.

INSERT EXHIBIT 3 HERE

The toy model in **Exhibit 3** beautifully represents the intuition we laid out earlier:

1. There is a strong and monotonic relationship between derivative yield and call strike.
2. There is a strong and monotonic relationship between call strike and equity exposure (option delta).
3. There is a trivial and mechanical relationship between equity exposure and the expected return impact attributed to equity exposure.
4. Thus, there is a strong and monotonic *negative* relationship between derivative yield and expected return impact attributed to equity exposure.

Let's continue by incorporating the impact of volatility risk premium. In the left panel of **Exhibit 4**, we plot the relationship between the call options' *gamma* (exposure to realized volatility) and *vega* (exposure to implied volatility) against the target derivative yield. In the right panel of Exhibit 4, we plot the annualized expected impact due to the volatility risk premium. This is calculated by pricing the option using implied volatility (as above), repricing the option using realized volatility, calculating the difference in yield, and annualizing by multiplying by 12.

INSERT EXHIBIT 4 HERE

If an option whose "fair" value as calculated by realized volatility is \$25 and whose market value as calculated by implied volatility is \$26, then the monthly gain due to the differential is \$1 (or \$12 annualized), representing a 1.2% (by dividing by the \$1000 equity index value) annualized profit due to the volatility risk premium. Here we see a non-monotonic relationship – barely so, but it would be more evident if targeting an even higher dividend yield with lower strikes that are increasingly in-the-money. Volatility risk premium contributes positively to a short call option's expected P&L, but the magnitude is at its peak when the option is near-the-money.

It's important to emphasize that this is a *toy* model. To keep it simple, we assumed a flat implied volatility surface. In reality, the S&P 500 Index tends to exhibit a smile, with implied volatility declining for further out-of-the-money call options. Thus, we'd expect the positive volatility risk premium returns for high strike, low derivative yield options to be relatively lower[5] than as shown in **Exhibit 4**.

In **Exhibit 5**, we combine the expected return impact attributed to the short equity exposure illustrated in Exhibit 3 with the expected return impact attributed to the short volatility exposure illustrated in Exhibit 4 to highlight the aggregate option impact. This plot resembles a stylized plot presented by Israelov and Nielsen (2019) and Sinclair (2020), except that it isolates the call option position, ignores the underlying equity position, and plots the relationship against derivative yield rather than call strike. We emphasize again that the plot directionally captures the underlying intuition and short call features, but the exact shape should not be taken too literally as it relies on some simplifying assumptions, such as a flat implied volatility surface.

Historical Analysis

Let's move beyond the toy model and see the behavior of covered calls on the S&P 500 Index.

Data and Methods

We focus on the S&P 500 Index and traditional S&P 500 index (SPX) options. S&P 500 Index option data are sourced from iVolatility, including mid-point prices and option Greeks. The S&P 500 Total Return and Price Indexes are from Reuters and risk-free rates of return are the 30-day Treasury bill returns provided by the French Data Library.

We analyze two time periods. The first period runs from January 3, 1999, to June 30, 2023, and the second window covers the more recent period from January 2, 2011, to June 30, 2023.

Our goal is to ascertain the relationship between different important call option characteristics and a target derivative yield. At each monthly rebalance, we sequentially select a monthly yield target, 0.10% to 1.5% – i.e., from 1.2% to 18% annualized yield – with a 10-basis point increment in monthly target yield. The special case of a monthly target of 0% corresponds to the baseline, which consists of holding only the index.

At the roll date, the new call option contract to be sold is the one that expires on the third Friday of the following month and whose premium is the closest to the target premium. As a result, for a given target, the time series of the returns overlap from January 2, 2011, onward. Each option contract is held until

[5] See Israelov and Tummala (2017).

expiration on its settlement date, and a new contract is sold at the end of the same day. We are more interested in performance differentials across strategies targeting different levels of derivative income than their absolute performance net of trading costs. For this reason, we have not adjusted strategy returns for transaction costs, since their impact on relative performance nets to zero (absent a view of cross-sectional differences in transaction costs across the implied volatility surface, which is beyond the scope of this paper).

Results

Historical Performance

In all the exhibits that follow, we plot relationships of important characteristics on the *y*-axis against the annualized derivative yield target on the *x*-axis. **Exhibit 6** plots the call strike moneyness across the range of target derivative yields. We see the expected monotonic relationship, with a 1.2% annualized yield leading to an average call strike that was 7.0% out-of-the-money over our full sample and 5.4% out-of-the-money over the more recent period. The very high yield (18% target) led to a nearly at-the-money call strike of 1.1% and 0.4% out-of-the-money on average during the two periods.

INSERT EXHIBIT 6 HERE

We're most interested in evaluating the relationship between total realized return and derivative yield. The left panel of **Exhibit 7** plots the average total realized return during the two sample periods and the right panel plots the average annualized alpha. The results quite closely conform to our expectations, albeit slightly imperfectly. Total returns decline with derivative yield, although over the full sample, generating modest income yield outperformed the zero-income yield (which is simply the S&P 500 Index) scenario. Generating 1.2% or 2.4% annualized yield, over the full sample, provided enough alpha from volatility risk premium to more than offset the loss in equity risk premium, and the covered call strategies outperformed the index by about 0.2% (a small fraction of the 1.2% or 2.4% generated yield, but outperformance none-the-less). Beyond this point, performance nearly monotonically declined with generated yield over the full sample. Over the recent sample, we see negative alpha across the board – the recent period was generally not profitable for S&P 500 short volatility strategies using index options. As a result, both components of the covered call – short equity and short equity volatility exposures – detracted from performance.

INSERT EXHIBIT 7 HERE

We expect a strong relationship between the covered call's exposure to equity (as represented by option delta or statistical beta) and **Exhibit 8** confirms that our expectations are met. Option deltas range from nearly 1.0 for the low-yield covered calls to approximately 0.5 for the high-yield (nearly at-the-money) covered calls. Equity betas are uniformly higher than equity deltas, another expected result arising from equities' negative skew and the associated empirical result that delta-neutral short volatility tends to exhibit positive equity beta[6]. We see that the high-yield covered calls tend to have equity betas closer to 0.75 versus a nearly 1.0 equity beta for the low-yield covered calls. Reduced equity exposure should result in reduced equity risk premium and lower returns, as we've reported above. For completeness, we plot in the right panel the relationship between target derivative yield and covered call volatility. The relationship is as expected – the higher-yielding strategy with lower equity exposure also realized lower volatility.

INSERT EXHIBIT 8 HERE

As we've discussed above, two primary components impact the covered calls' expected performance: lower equity exposure and short volatility exposure. We next seek to decompose the performance arising from selling the call options into these two components. **Exhibit 9** provides the decomposition across the two time periods. In both periods, short equity exposure detracted from performance, with a larger performance hit occurring with the higher-yielding strategies. In the full sample, the positive returns arising from short volatility exposure attenuated the losses from short equity exposure. In the recent sample, short volatility exposure exacerbated strategy losses.

INSERT EXHIBIT 9 HERE

Our historical analysis of covered calls written on the S&P 500 index further substantiates the intuition developed in our toy model. Holding the option maturity fixed, higher target derivative yields are associated with lower strategy returns because higher yields are delivered by selecting lower call strikes, which reduce the strategy's equity exposure and thereby reduce the equity risk premium it collects.

Additional Comments

Attractiveness of the Covered Call Strategy

One might interpret our analysis as a criticism of covered call strategies and especially a criticism of high yield covered calls. For the record, that would be a misinterpretation of our paper. We agree with the assessment provided by Israelov and Nielsen (2019). Equity index covered calls are long equity and short equity index volatility. As such, they should earn the equity risk premium and the equity volatility risk premium. For those investors who seek to include these two risk premia in their portfolios, depending on their overall goals, covered call strategies may very well be a good fit.

Here are the concerns we hope our paper helps to address via education. First, some investors might be attracted to covered calls for the wrong reason, seeking income rather than equity and volatility risk premia.

[6] See Hull and White (2017).

Second, that might lead to a potential misallocation to these risk premia versus a best-fit allocation when analyzed appropriately. Third, the portfolio construction itself might be sub-optimal if it is designed around a yield objective rather than an objective to optimally harvest the two risk premia.[7] Fourth, investors in these strategies might have optimistic return assumptions guided by stated and delivered derivative yield.

If they believe that higher yielding covered calls have higher returns instead of the reality that they have lower expected returns, then their allocation to the strategy might be higher than it would be otherwise and – to the extent they use the delivered yield to guide their spending decisions – they might be spending more than they would otherwise. Such a misunderstanding could lead to those individuals putting their long-term retirement portfolio health at risk.

Is It Even Income?

Israelov and Nielsen (2019) take issue with labeling covered call premium distributed as income. Selling a call option and receiving an option premium is quite different than receiving an equity dividend or a bond coupon. When someone opens a position by selling a call option, the trade hasn't ended, it has only begun. The seller has a liability that is not resolved until either the position is liquidated, or the option matures and is settled.

Our analysis above demonstrates that in the case of equity index options, on average, call options sold settle at a higher price than their initial sale price. As an example, on average, someone who sells an index call option for $1.00, receives upfront cash and then settles the call option at maturity one month later with a $1.09 outgoing cash flow. They sell for $1.00 and effectively buy it back for $1.09, losing $0.09 on the trade. Viewing the initial $1.00 inflow as income while conveniently ignoring the expected associated $1.09 outflow seems … odd.

Why does this matter? We believe many investors may have been conditioned to believe that a portfolio's income is sustainable over the long term without drawing down their principal. Treasury bonds pay coupons on an ongoing basis and the par value is returned to its investors at maturity. Dividend-paying stocks have historically had total returns that exceed their dividend yields, meaning it is likely that an investor who spends their entire dividend income is likely to see their portfolio value maintained or grow over time. If an investor carries over such beliefs to covered call strategies, they might find themselves in trouble.

As an example, we reported that the strategy providing 12% derivative yield had average annualized total returns of about 8-9% depending on the period. If an investor in such a strategy spent the entire

[7] We make no claims or inferences about the objectives underlying the portfolio construction of covered call funds that market themselves on their income or distributions.

derivative yield (and also the dividend yield), they would have seen their portfolio value materially decline over time. Total return is the sum of yield and price return. Such an aggressive strategy is likely to have negative price returns over time. In and of itself, that's neither good nor bad, it just is. However, investors in such a strategy who rely on its yield for their spending needs must understand and plan for its expected outcomes.

Devil's Bargain or Devil's Advocate?

We believe we have provided convincing evidence that, in the case of covered calls, higher derivative yield is negatively and mechanically associated with lower returns, hence the title of our paper, *Devil's Bargain*. Here we provide an important caveat and counterpoint. In our analysis, we hold option maturity fix. The single degree of freedom we apply to adjust the strategy's yield is the call option strike.

Of course, there exists another degree of freedom, the option's maturity.[8] One can achieve a higher overall annualized income by trading shorter-dated options instead of lower-strike options. As an example, one can achieve a 12% annualized yield by targeting a 1% monthly yield with monthly options or by targeting 0.23% weekly yield with weekly options, or 0.048% daily yield with daily options.

Adjusting the maturity of the options (alongside the strike to precisely achieve the targeted derivative yield) has a more complex impact on strategy exposures. The relationship between targeted derivative income and call strike is no longer monotonic when comparing across option maturities. Thus, the relationship between equity exposure and targeted derivative income is no longer monotonic. The nature of the short volatility exposure also changes. Moving to shorter-dated options to target higher income magnifies the strategy's *gamma* (exposure to realized volatility) while attenuating the strategy's *vega* (exposure to implied volatility). According to Israelov and Tummala (2017), annualized returns tend to be higher when selling shorter-dated index options, so it's possible that the volatility exposure leads to a positive relationship between income and return. They also show that shorter-dated options tend to have greater risk, so the higher income strategies might be riskier for the investor, which is different than when they target income by adjusting option strike rather than maturity.

Analyzing the role of maturity is beyond the scope of this paper, nonetheless, one can for instance use the toy model as a preview to understand its effect. **Exhibit 10** provides summary tables of the metrics of interests, namely moneyness, option greeks and risk premia, as a function of both the annualized yield target (3%, 6%, 9%, 12%, 15% and 18%) and the rebalancing frequency (biweekly, monthly, quarterly, annually)

[8] As a point of fact, as we were writing this paper, Defiance ETFs launched the QQQY ETF which – in their words – "QQQY, the first put-write ETF using daily options (0DTE) to seek enhanced income for investors. Paid Monthly…. The strategy's objective is to generate outsized monthly distributions by selling option premium on a daily basis. The fund uses daily options to realize rapid time decay by selling in the money puts with 0DTE." With initial monthly distributions exceeding 50% annualized.

using the toy model under the same input assumptions. Looking at one rebalancing frequency at the time, similar trends can again be observed. The moneyness of the call strike decreases with the yields, independently of the rebalancing frequency, and the call delta increases. The vega and gamma also increase alongside the yield target. As a result, the equity risk premium of the call writing decreases while the volatility risk premium increases. The combination of the two advocates in favor of the claim that the return decreases with the yield.

A cross-sectional view provides additional information. For lower yield targets, the moneyness increases monotonically with the holding period, as can be seen for the 3% yield target. For higher yield targets, the pattern is reversed. As far as the call *delta* is concerned, shorter-dated options allow investors to consider lower call deltas than with longer-dated options for the same yield target, which could result in smaller reductions to equity exposure. At the same time, the call option has higher realized volatility exposure for shorter-dated options and lower realized volatility exposure for longer-dated options, as indicated by the ranges of *gamma* – the opposite pattern exists for implied volatility, as represented by *vega*. Quite logically, shorter-dated options potentially provide higher volatility risk premium than longer-dated options.

Combined with the implications to equity exposure, there is a "sweet spot." Based on the model, coupling shorter-dated options with a modest yield target could be an appealing investment decision. However, other considerations need to be factored in. Firstly, the *toy model* fails to account for the fact that implied volatility tends to decrease with time-to-maturity. Instead, it is assumed to be flat. An implication of that is the true volatility risk premium earned with shorter-dated options might be lower than suggested by the toy model. Secondly, if you trade options more frequently, higher trading costs are likely to be realized which should else negatively impact returns.

We provide the following comment. For an investor or portfolio manager who implements an options strategy, such as a covered call, it should be preferred that they have a view on the appropriate exposure to delta, vega, and gamma, the optimal location on the volatility surface for selling options (strike and maturity), and then construct portfolios accordingly. They should have an intentional portfolio construction process. Setting a yield target and allowing portfolio exposures and option selling decisions to fall out of that process, being established unintentionally, is unlikely to have optimized characteristics.

INSERT EXHIBIT 10 HERE

Taxes

For many investors, investment-oriented taxes are an important consideration. Covered calls can be a rather tax-inefficient strategy, depending on how they are implemented. Our analysis shows that, on average, selling the call option has negative P&L because it has negative equity exposure. We can simplify our understanding by considering two scenarios: (1) the option expires out-of-the-money and is worthless, and (2) the option expires in-the-money and is assigned to the covered call seller, leading them to sell their stock at the strike price.

In the first example, the option premium is distributed to the investor if the strategy is implemented as an ETF or mutual fund and taxed as short- or long-term capital gains depending on its holding period. In this scenario, the investor may have an unrealized loss despite having a tax liability. With the option expiring worthless, it could have been the case that the underlying equity price declined in value. The investor has an unrealized capital loss in their stock, but a taxable event arising from the derivative income.

In the second example, the investor may have a capital gain or capital loss, depending on the strategy's implementation. If the call option is physically settled and held to maturity, then the investor has a taxable profit from the derivative income and the investor likely has a realized capital gain by selling their stock due to option exercise. The stock price has likely risen in value – by the call option being in-the-money – and is likely higher than the investor's cost basis, although this depends on the path. In such a case, option exercise forces the investor to realize a capital gain. On the other hand, if the call option is cash-settled, or if it is physically settled and sold at a loss before its expiration, then the investor could realize a capital loss, which could be used to offset capital gains elsewhere.

Taxes often increase complexity, but as a rule of thumb, a covered call strategy is likely to be tax-inefficient relative to the simpler strategy of owning the equity and liquidating as needed to fund any cash flow needs. In a quest for income, not only is a covered call investor likely accepting lower total gross returns, but they are also likely paying higher taxes along the way for the privilege.

Downside Beta

Covered calls cap the investors' upside participation while leaving them fully exposed to losses, less the call option premium received. It introduces undesirable asymmetric exposure, something the investor is compensated for by earning the volatility risk premium.

It is important that covered call investors recognize that they have asymmetric exposure, and the magnitude of the asymmetry is directly tied to the amount of derivative income they seek to achieve. To better highlight this effect, we turn to two refined measures of beta used in Ang, Chen and Xing (2006) and Fisher and D'Alessandro (2021): the upside beta and the downside beta. The upside beta, respectively downside beta, measures the equity beta of the strategy, provided that the daily market excess return is above the average return, respectively below the average return.

INSERT EXHIBIT 11 HERE

Exhibit 11 reports the historical downside beta and the upside beta against the yield target, across the two samples. Unsurprisingly, the two metrics monotonically decrease with derivative income, but importantly the spread between them increases with derivative income. As an example, compare the 6% derivative income strategy to its 18% counterpart over the full sample. With a 6% income, we see 92% upside exposure and 96% downside exposure. But with 18% income, we instead see 79% upside exposure and 87% downside exposure. Upside equity exposure declines faster than downside equity exposure as derivative income increases.

To better illustrate this relationship, **Exhibit 12** shows side-by-side the difference and the ratio between the downside beta and upside beta across the derivative yields. Both metrics monotonically increase with the target derivative income. In the full sample, the difference increases to 10 points, corresponding to a relative difference of 15%. In the short sample, the difference increases to 8 points or 10%.

INSERT EXHIBIT 12 HERE

Derivative income doesn't come for free. Selling options introduces short convexity, which creates an undesirable asymmetric exposure. The greater the derivative income, the less desirable the asymmetric exposure. This does not mean it's unwarranted. Investors are compensated for this because option prices tend to exhibit a volatility risk premium. But they should understand the bargain they are making when allocating to such a strategy.

Conclusion

One might have an impression that we look upon covered call strategies unfavorably. That is not our view. An equity index covered call provides investors with equity risk premium and volatility risk premium, two sources of return that are economically motivated and have a strong historical track record. For those investors who seek these risk premia, a covered call strategy can be a convenient packaging of these returns, depending on the overall allocations to these exposures an investor seeks.

Our concern is that it appears to be the case that many investors who allocate to such a strategy are not intentionally seeking volatility risk premia and a strategy implementation that is constructed to deliver the right level of volatility risk premia on the optimal part of the option volatility surface. Instead, many appear to be enamored by the strategy's ability to deliver high derivative income. To the extent people associate high derivative income with high expected total returns, they have made a grave error.

We demonstrate a strong *negative* mechanical relationship between covered call derivative income and its total return. We corroborate this mechanical relationship with a historical analysis of S&P 500 Index covered call strategies. In light of the modeled mechanical relationship that is validated empirically, we believe it is nearly irrefutable that *higher* derivative income covered call strategies should be expected to deliver *lower* returns.

Covered calls implemented to deliver higher derivative income should be expected to have (1) lower total returns, (2) higher tax realizations along the path, and (3) a more negatively skewed return profile. Investors who allocate to these strategies for their income alone, without accounting for these other considerations, might have made a devil's bargain.[9]

[9] For the sake of absolute clarity, the *devil* in this context is not the asset manager who offers such a derivative income strategy. Derivative income strategies are not inherently bad. In fact, these strategies may indeed be well-constructed portfolios, balancing risk allocations to equity and volatility risk premium, that are worthy of an allocation. The *devil* in this context symbolizes the internal force driving one to seek out yield to the detriment of their total performance.

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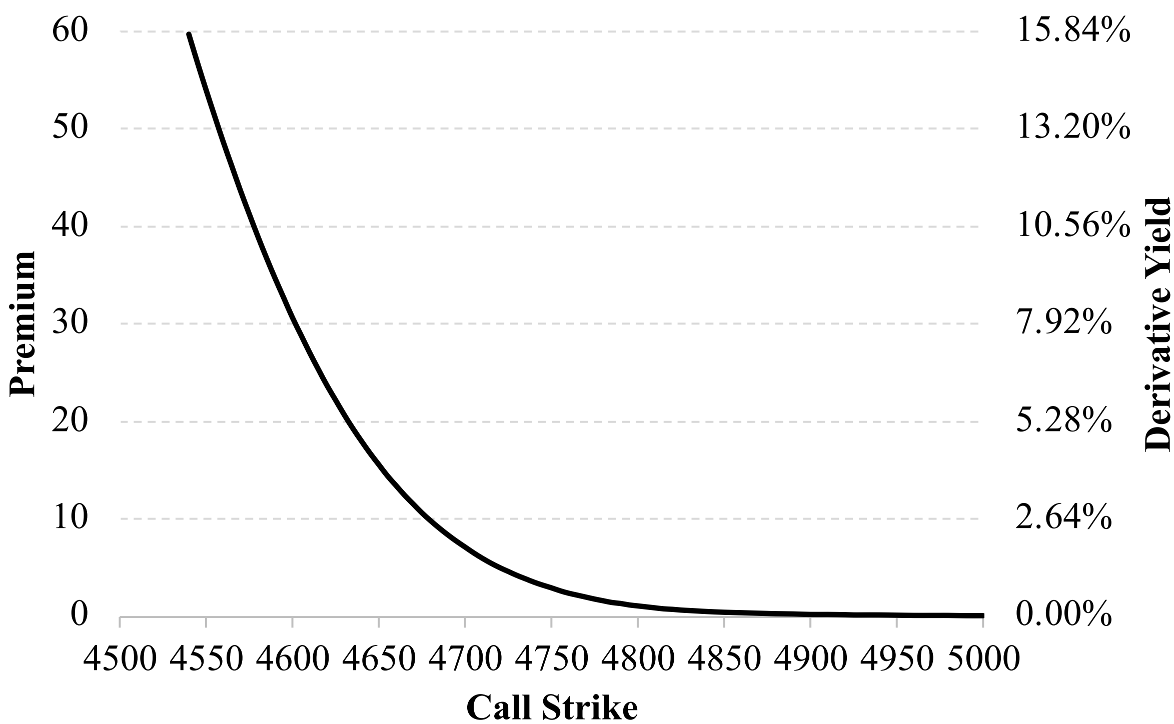
Exhibit 1: Call Option Premium and Derivative Yield vs. Call Strike

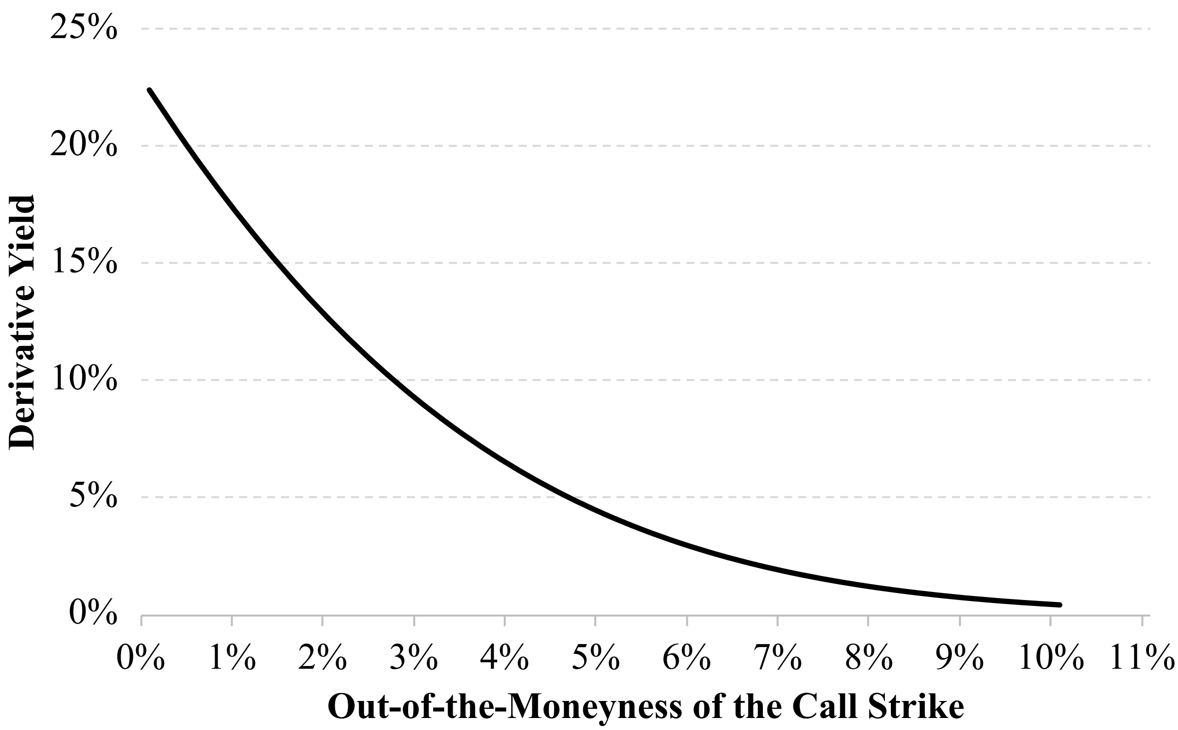
This exhibit displays the market call premium (left-hand *y*-axis) and the derivative yield (right-hand *y*-axis), defined as the call premium divided by the cost basis or current market value of the underlying stock multiplied by 12 on July 21, 2023, for S&P 500 Index call options expiring on August 18, 2023, across a range of positive moneyness. On that date, the S&P 500 closed at 4536.34.



Source: NDVR, iVolatility, Reuters.

Exhibit 2: Toy Model – Derivative Yield vs. Call Strike

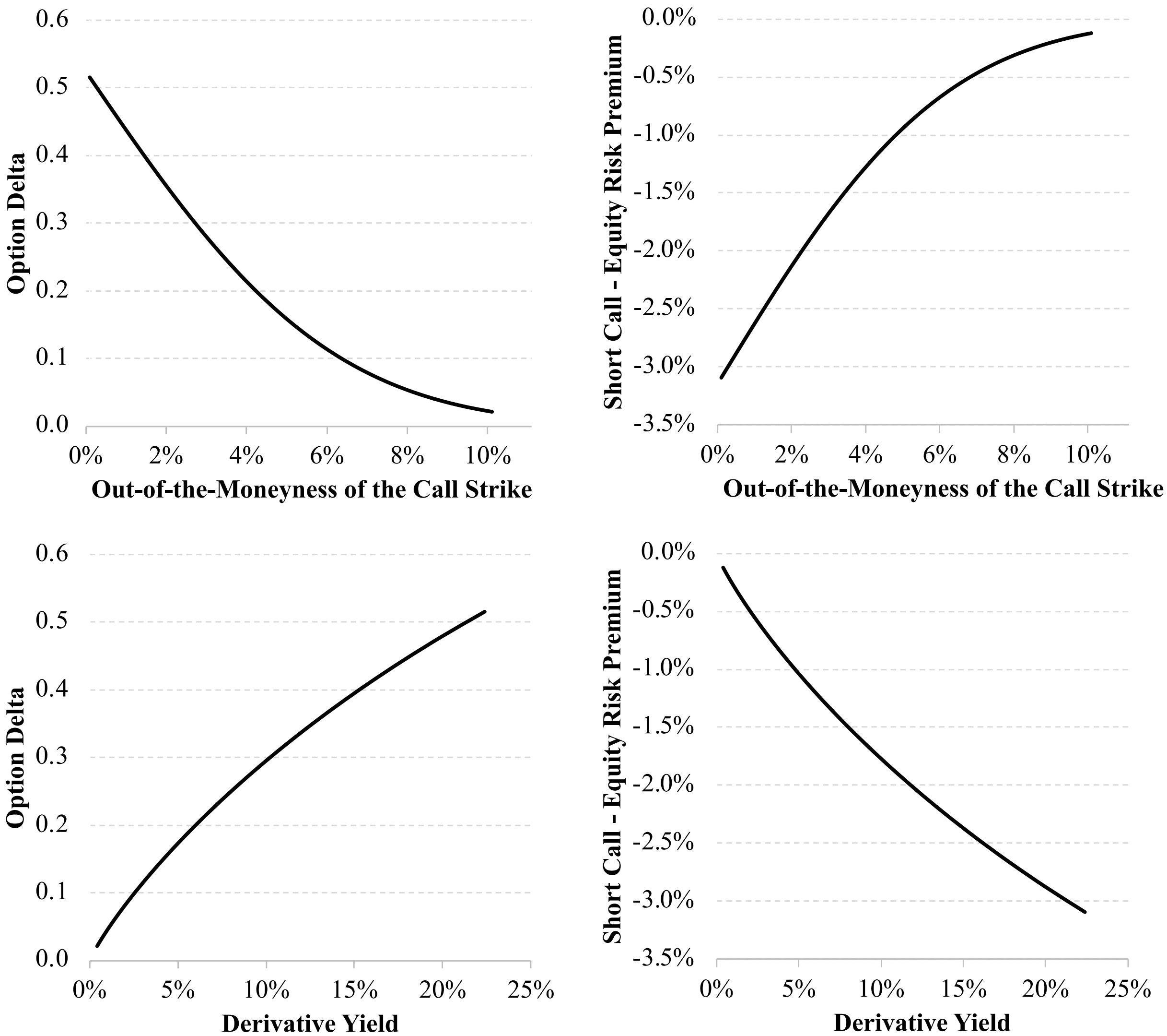
This exhibit shows the derivative yield, defined as the call premium divided by the underlying stock price annualized by 12, against the call strike, expressed as the strike price relative to the stock price, using the "toy model". We assume a 2% dividend yield, a 3% risk-free interest rate, and a flat 16% implied volatility. The time-to-maturity is equal to 30 calendar days.



Source: NDVR, iVolatility, Reuters.

Exhibit 3: Toy Model – Relationships Between Derivative Yield, Option Delta, and Equity Risk Premium

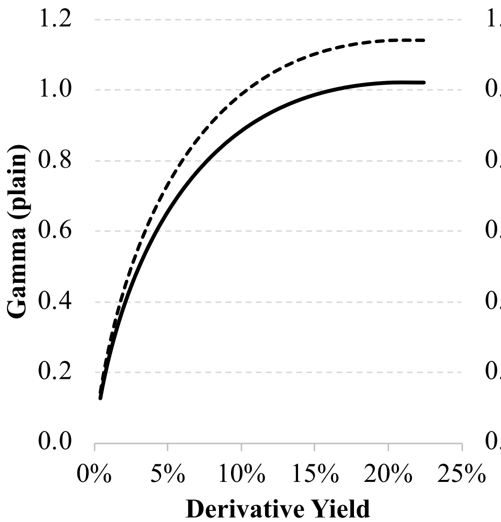
This exhibit reports the option delta and the equity risk premium, defined as the short call delta multiplied by the market risk premium, against the call strike (top), and the derivative yield (bottom), using the "toy model". The call strike is expressed relative to the stock price and the derivative yield is equal to the call premium divided by the underlying stock price, multiplied by 12. We assume a 2% dividend yield, a 3% risk-free interest rate, a 6% equity risk premium, and a flat 16% implied volatility. The time-to-maturity is equal to 30 calendar days.

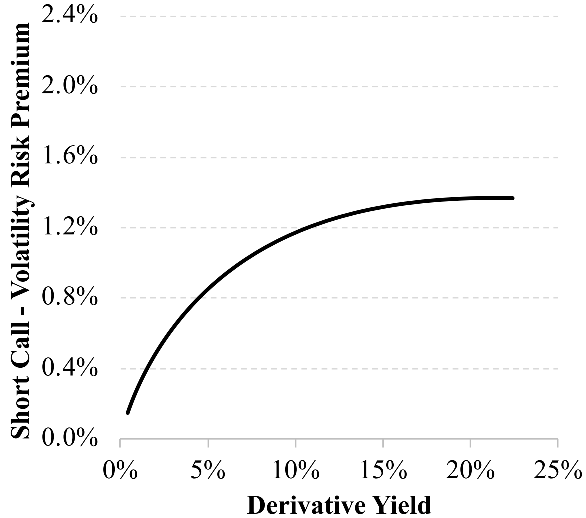


Source: NDVR, iVolatility, Reuters.

Exhibit 4: Toy Model – Derivative Yield and Volatility Risk Premium

This exhibit reports the option gamma, and vega against the derivative yield (left chart) and the volatility risk premium against the derivative yield (right chart), using the toy model assumptions. The volatility risk premium is defined as the difference between the call price under the implied volatility assumption and the call price under-realized volatility relative to the stock price, multiplied by 12. The derivative yield is equal to the call premium divided by the underlying stock price, annualized by 12. We assume a 2% dividend yield, a 3% risk-free interest rate, a 6% equity risk premium, and a flat 16% implied volatility. The time-to-maturity is equal to 30 calendar days.

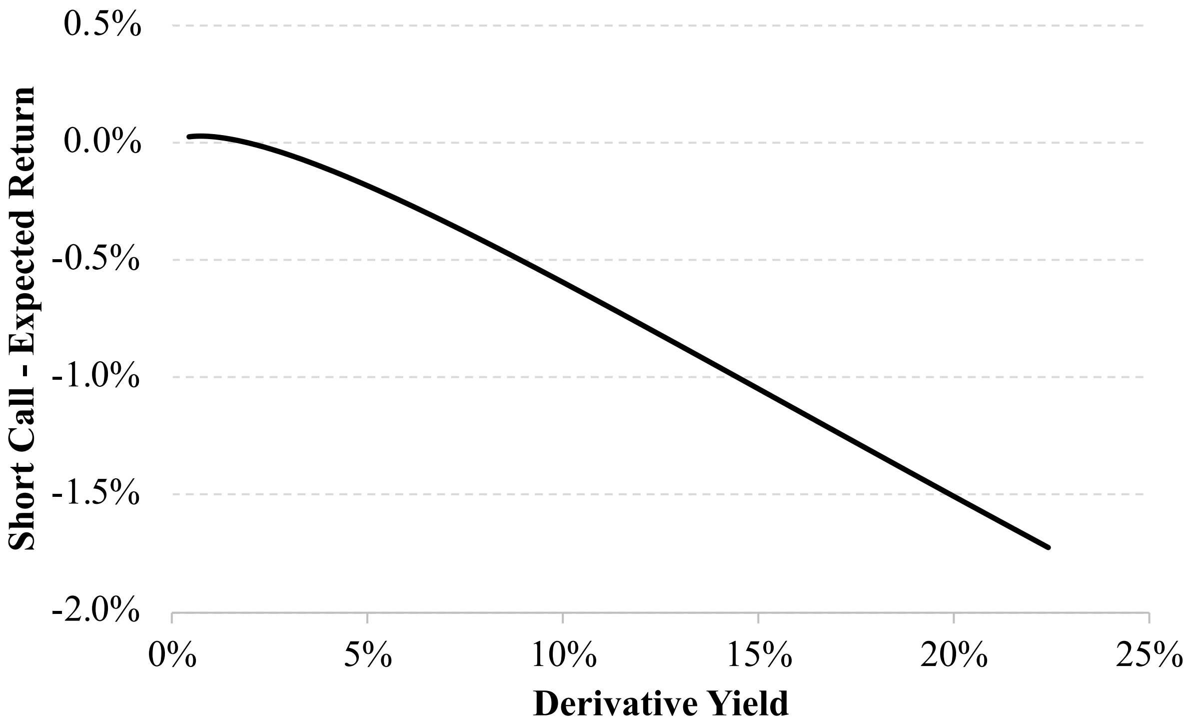




Source: NDVR, iVolatility, Reuters.

Exhibit 5: Toy Model – Derivative Yield and Short Call Expected Return

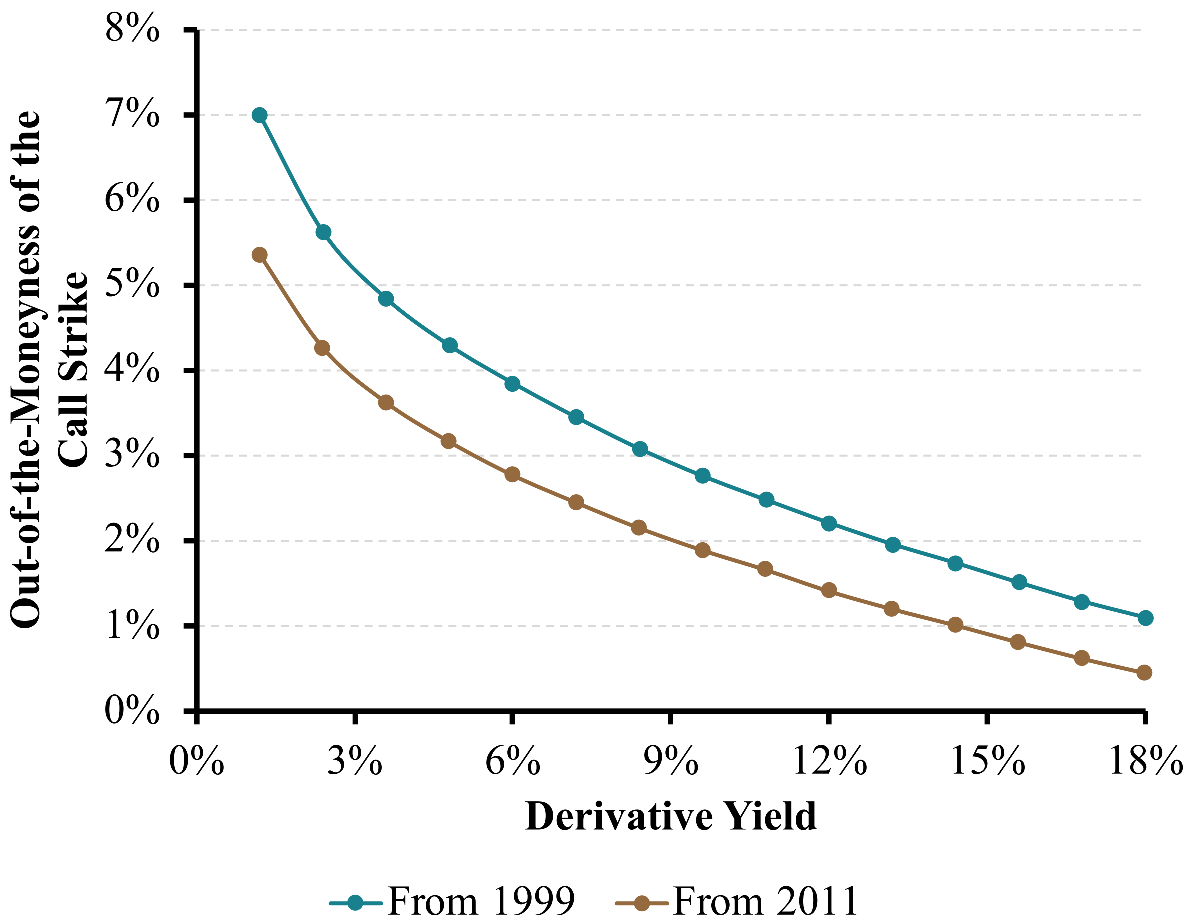
This exhibit reports the short call expected excess return against the derivative yield, using the toy model assumptions. The short call expected return is the sum of the equity risk premium, defined as the short call delta multiplied by the annualized market risk premium, and the volatility risk premium, defined as the difference between the call price under implied volatility assumption and the call price under-realized volatility relative to the stock price, annualized. The derivative yield is equal to the call premium divided by the underlying stock price, annualized by 12 We assume a 2% dividend yield, a 3% risk-free interest rate, a 6% equity risk premium, 15% equity realized volatility, and a flat 16% implied volatility. The time-to-maturity is equal to 30 calendar days.



Source: NDVR, iVolatility, Reuters.

Exhibit 6: Historical Analysis – Derivative Yield vs. Call Strike

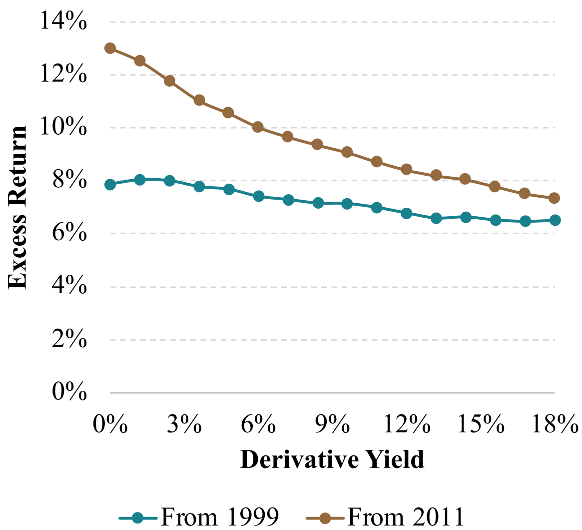
This exhibit displays the historical average of the call strike relative to the stock price against the derivative yield for covered calls on the S&P 500 Index options. The exhibit considers two time periods. The full sample covers dates from January 3, 1999, to June 30, 2023, and the recent sample goes from January 2, 2011, to June 30, 2023.

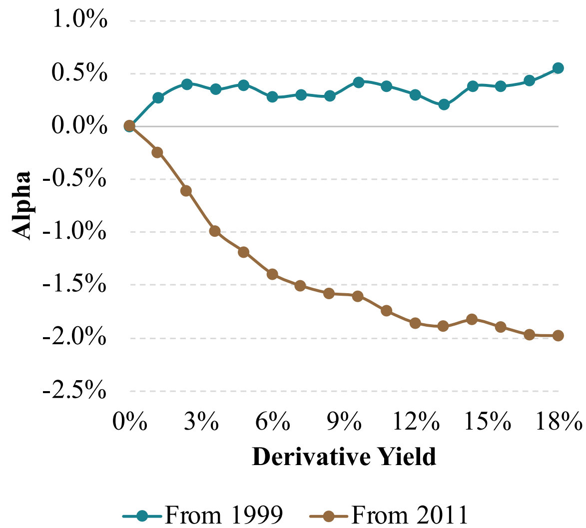


Source: NDVR, iVolatility, Reuters.

Exhibit 7: Historical Analysis – Derivative Yield vs. Excess Return and Realized Alpha

This exhibit shows the annualized excess return against the derivative yield on the left chart and the annualized alpha against the derivative yield on the right chart, for covered calls on the S&P 500 Index options. The exhibit considers two time periods. The full sample covers dates from January 3, 1999, to June 30, 2023, and the recent sample goes from January 2, 2011, to June 30, 2023.

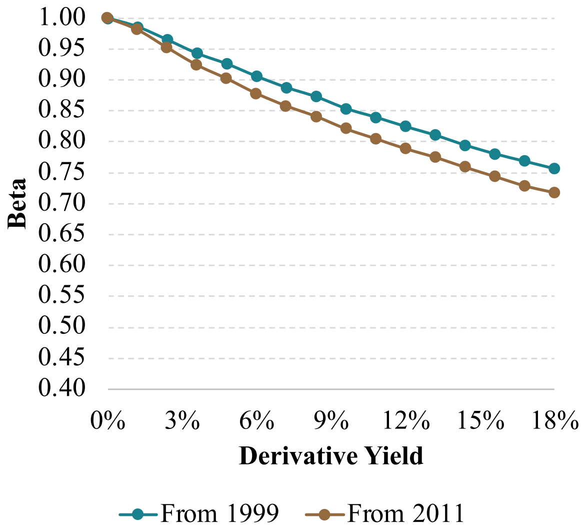


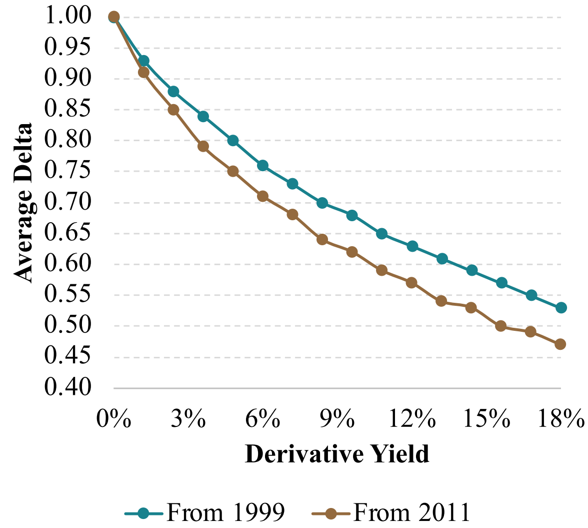


Source: NDVR, iVolatility, Reuters.

Exhibit 8: Historical Analysis – Derivative Yield vs. Beta and Average Delta

This exhibit shows the equity index beta against the derivative yield on the left chart and the average covered call delta against the derivative yield on the right chart, for covered calls on the S&P 500 Index options. The exhibit includes two time periods. The full sample covers dates from January 3, 1999, to June 30, 2023, and the recent sample goes from January 2, 2011, to June 30, 2023.

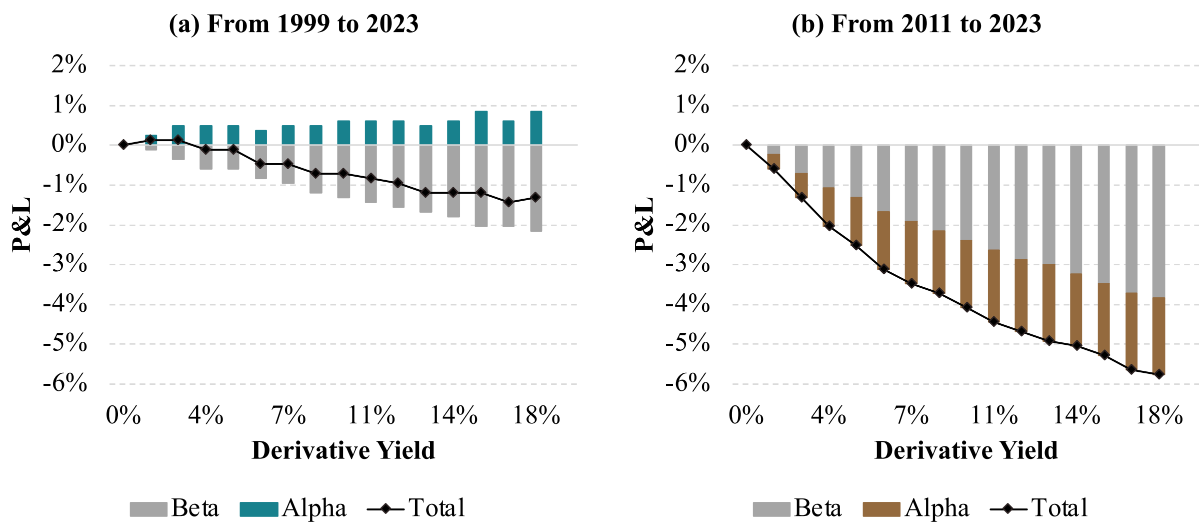




Source: NDVR, iVolatility, Reuters.

Exhibit 9: Historical Analysis – Derivative Yield vs. P&L Attributed to CAPM Alpha and Beta

This exhibit shows the average annualized profit and loss associated with call writing against the derivative yield respectively on (a) the full sample and (b) the recent period.



Source: NDVR, iVolatility, Reuters.

Exhibit 10: Toy Model – Call Writing at different rebalancing frequencies

This exhibit presents summary tables of covered call option properties for a range of derivative objectives and rebalancing schedules, under toy model assumptions. short call expected excess return against the derivative yield, using the toy model assumptions. The derivative targets are formulated as annualized yields. Sequentially, we report the call strike, the call option delta, the call option vega, the call option gamma, the equity risk premium – defined as the option delta multiplied by the market risk premium – the volatility risk premium – defined as the difference between the call price under implied volatility assumption and the call price under-realized volatility relative to the stock price, number of rebalancing cycles – We assume a 2% dividend yield, a 3% risk-free interest rate, a 6% equity risk premium, 15% equity realized volatility and a flat 16% implied volatility. The time-to-maturity is equal to 30 calendar days. Greyed cells (9% and 12% annualized derivative yield with yearly rebalance frequency) correspond to unfeasible strategies as the option selected is on average in-the-money instead of out-of-the-money.

Out-of-the-Moneyness of the Call Strike

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	4.5%	5.9%	8.1%	10.3%
6%	3.5%	4.1%	4.6%	1.6%
9%	2.8%	3.0%	2.3%	-4.3%
12%	2.2%	2.1%	0.6%	-9.0%
15%	1.8%	1.4%	-0.9%	-13.0%
18%	1.4%	0.8%	-2.2%	-16.7%

Option Delta

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	0.08	0.11	0.18	0.31
6%	0.15	0.20	0.31	0.51
9%	0.20	0.27	0.41	0.65
12%	0.25	0.34	0.50	0.75
15%	0.30	0.39	0.57	0.83
18%	0.34	0.45	0.64	0.88

Option Vega

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	0.30	0.55	1.30	3.50
6%	0.45	0.80	1.74	3.91
9%	0.55	0.95	1.92	3.58
12%	0.62	1.05	1.97	2.99
15%	0.68	1.10	1.94	2.33
18%	0.72	1.13	1.85	1.71

Option Gamma

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	0.5%	0.4%	0.3%	0.2%
6%	0.7%	0.6%	0.4%	0.2%
9%	0.9%	0.7%	0.5%	0.2%
12%	1.0%	0.8%	0.5%	0.2%
15%	1.1%	0.8%	0.5%	0.1%
18%	1.2%	0.9%	0.5%	0.1%

Short Call - Equity Risk Premium

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	-0.5%	-0.7%	-1.1%	-1.9%
6%	-0.9%	-1.2%	-1.8%	-3.0%
9%	-1.2%	-1.6%	-2.5%	-3.9%
12%	-1.5%	-2.0%	-3.0%	-4.5%
15%	-1.8%	-2.4%	-3.4%	-5.0%
18%	-2.0%	-2.7%	-3.8%	-5.3%

Short Call - Volatility Risk Premium

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	0.7%	0.6%	0.5%	0.3%
6%	1.1%	0.9%	0.7%	0.4%
9%	1.4%	1.1%	0.8%	0.4%
12%	1.6%	1.2%	0.8%	0.3%
15%	1.7%	1.3%	0.8%	0.2%
18%	1.8%	1.4%	0.7%	0.2%

Short Call - Expected Excess Return

Derivative Yield	Rebalance Frequency			
	2W	1M	3M	1Y
3%	0.2%	-0.1%	-0.6%	-1.5%
6%	0.2%	-0.3%	-1.2%	-2.7%
9%	0.2%	-0.5%	-1.7%	-3.5%
12%	0.1%	-0.8%	-2.2%	-4.2%
15%	0.0%	-1.0%	-2.7%	-4.7%
18%	-0.2%	-1.3%	-3.1%	-5.1%

Source: NDVR, iVolatility, Reuters.

Exhibit 11: Historical Analysis – Derivative Yield vs. Downside Beta and Upside Beta

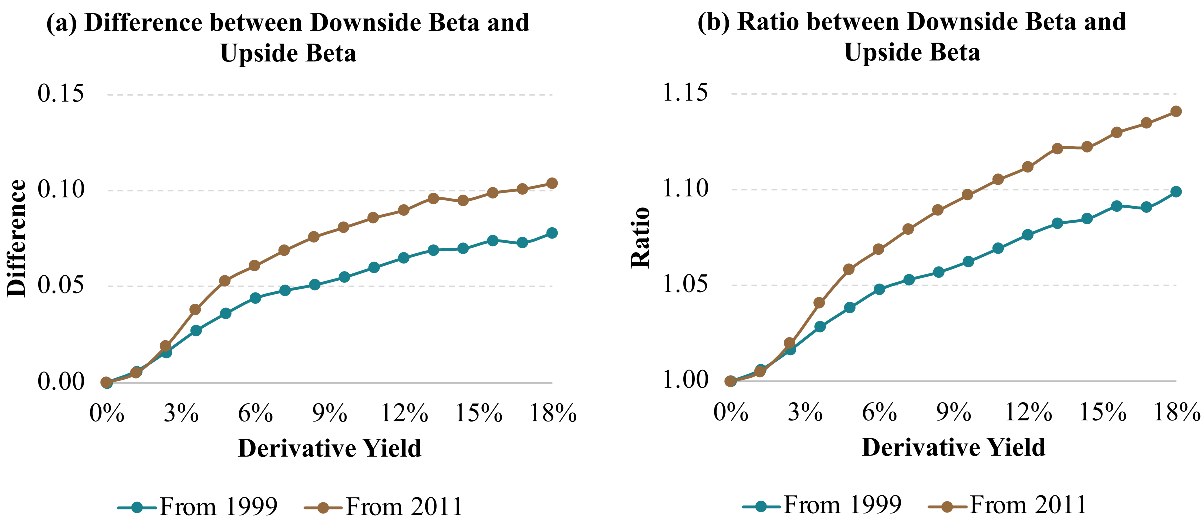
In this exhibit, we report the downside beta and upside beta as a function of the derivative yield on the S&P 500 Index covered calls. The exhibit includes two time periods. The full sample covers dates from January 3, 1999, to June 30, 2023, and the recent sample goes from January 2, 2011, to June 30, 2023.

Derivative Yield	Downside Beta		Upside Beta	
	From 1999	From 2011	From 1999	From 2011
0%	1.00	1.00	1.00	1.00
1%	1.00	1.00	0.99	1.00
2%	0.99	0.99	0.97	0.97
4%	0.98	0.97	0.95	0.94
5%	0.97	0.97	0.94	0.91
6%	0.96	0.95	0.92	0.89
7%	0.95	0.94	0.90	0.87
8%	0.95	0.93	0.89	0.85
10%	0.93	0.92	0.88	0.83
11%	0.93	0.91	0.87	0.82
12%	0.92	0.90	0.85	0.81
13%	0.91	0.89	0.84	0.79
14%	0.90	0.87	0.83	0.78
16%	0.89	0.86	0.81	0.76
17%	0.88	0.85	0.80	0.75
18%	0.87	0.84	0.79	0.74

Source: NDVR, iVolatility, Reuters.

Exhibit 12: Historical Analysis – Derivative Yield vs. Difference and Ratio of Downside Beta to Upside Beta

This exhibit shows (a) the difference and (b) the ratio between downside beta and upside beta against the derivative yield on the S&P 500 Index covered calls. The exhibit includes two time periods. The full sample covers dates from January 3, 1999, to June 30, 2023, and the recent sample goes from January 2, 2011, to June 30, 2023.



Source: NDVR, iVolatility, Reuters.