April 4, 2013

The Art of Put Selling: A 10 year study

Goldman Sachs

Options Research

The search for high yield, low volatility leads to put selling

We expect put selling to become an increasingly common strategy as the search for yield continues. Equity put selling provides a high current yield, low volatility returns, and outperforms both bonds and equity in flat market environments. We estimate that short puts account for 25% of all mutual fund option positions; another 60% of options positions are buy-writes which have a similar risk/return profile.

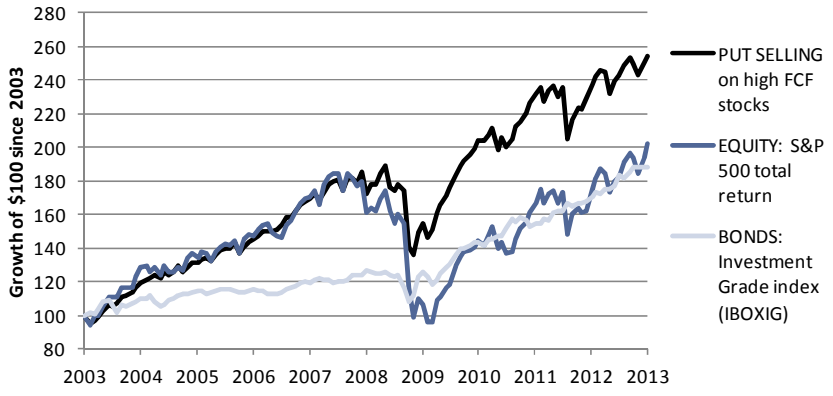
Selling puts: Higher yield and less risk than buying stocks

Over the past 10 years, selling listed 1-month at-the-money puts in S&P 500 stocks allowed investors to collect 3.4% per month in premiums and showed 7.1% annualized returns with a 12% standard deviation. Over the same period, the S&P 500 annualized total return was 7.3% with an 18% standard deviation. The put selling Sharpe ratio was 1.3 times the SPXTR. Many investors shy away from put selling because they view it as a "high risk strategy." Our results quantify the **risk reduction** and **lower draw-downs** of put selling strategies relative to stock portfolios.

Case Study: Using fundamentals to boost returns

We find that choosing **stocks** and **strikes** based on Free Cash Flow (FCF) yield dramatically improved put selling returns. Selling puts on stocks with FCF yield in the top quintile each month led to annualized return 250bps higher than the SPXTR and a Sharpe ratio 1.7 times the SPXTR. Further, choosing put strikes on each stock based on their FCF yield led to a Sharpe ratio 2.7 times the SPXTR.

FCF Put selling outperformed stocks by 250bps annually with lower vol
Put selling on high FCF stocks (top quintile), S&P 500, and iBoxx IG



Goldman Sachs Research; 1-month listed 50-delta put selling.

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Portfolio Manager Summary

We expect put selling to grow in popularity as investors search for strategies with (1) high current yield, (2) low volatility, and (3) strong returns in flat market environments. Put selling activity is most notable among investors with flexibility to invest across asset classes. We estimate that short puts account for 25% of all mutual fund option positions; another 60% are buy-write positions with a similar risk/return profile based on our analysis of SEC filings. Growth has come from both traditional equity investors in search of low volatility strategies as well as fixed income investors in search of yield with a margin of safety no longer provided by bonds with low absolute yields.

What is Put selling?
Selling a put option on a stock to collect a premium for agreeing to buy shares at a specific strike price should it drop below that level by expiration.
See page 17 for Basics of put selling.

In this report, we quantify three key benefits of put selling:

- **High current income:** Selling at-the-money puts allowed investors to collect 3.4% per month in income (40% annually) over the past 10 years. We believe these put premiums are an attractive source of yield for equity and fixed income investors alike.
- **Low volatility:** The volatility of a portfolio that sells at-the-money puts on S&P 500 stocks has been 12% over the past 10 years in comparison to 18% for the S&P 500 total return and 7% for the Investment Grade Bond index (iBoxx IG).
- **Strong returns above bonds, although modestly below stocks.** Selling at-the-money 1-month puts realized an annualized return of 7.1% vs. the total return of the S&P 500 of 7.3% and total return of the Investment Grade index (iBoxx IG) of 6.5%.

Stock/Strike Selection with Fundamentals

- **Choosing Stocks with high FCF yield has systematically improved** passive put selling results (added +250bps annually without adding volatility) and has greatly outperformed the risk adjusted returns of simple screening methodologies based on absolute implied volatility or market cap.
- **Choosing Strikes based on FCF yield improved put selling results further** to achieve a Sharpe ratio of 1.35 over the past 10 years, nearly triple the SPXTR.
- **Choosing Term:** We find selling 1-month options had higher returns and risk adjusted returns than 12-month over the past 10 years.

Risk/Pushback: Put selling is widely regarded as a "dangerous trade"

We believe put selling activity is constrained by the common misperception that selling puts carries higher risk than owning stocks. After all, if buying a put makes your portfolio safer, than shouldn't selling a put make your portfolio riskier. **In reality, selling fully-collateralized puts is less risky than buying stocks.** The premium collected acts like a cushion if shares should fall. In 2008, ATM put selling outperformed the SPXTR by 14%.

Volatility risk premium: Why put selling has higher risk-adjusted-returns than equity

Put sellers not only benefit from the equity risk premium (ERP) that drives stock returns over time, but also benefit from the volatility risk premium (VRP), which leads to systematically overpriced options. We illustrate the benefits by comparing the options implied and actual realized distribution of monthly returns over the past 10 years.

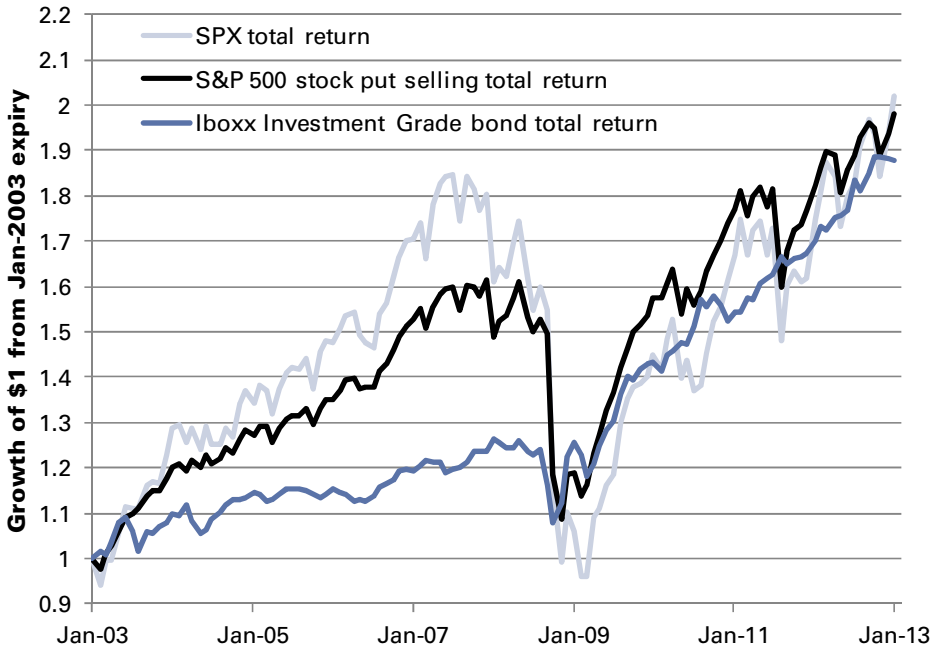
Key Risk: Put sellers risk losses if stocks drop below the strike price by more than the premium they have collected.

Options prices and volatility levels in this note are indicative only, and are based on our estimates of recent mid-market levels and exclude transaction costs, unless otherwise stated. Practical implementation of any trading strategy discussed herein may not be achievable and as a result, any projected results of any such trading strategy discussed herein may not be replicable.

Passive put selling returns over the past 10 years

Passive put selling generated annual returns of 7.1% over the past 10 years with monthly volatility one-third less the S&P 500. We estimate that selling 1-month at-the-money (ATM) puts on all optionable stocks in the S&P 500 collected an average of 40% in premium each year and generated a compound annual return of 7.1% over the past 10 years, roughly in-line with the annual returns of the S&P 500 total return of 7.3%. The volatility of this passive put selling strategy was 12% vs. the 18% volatility of the stock only strategy. Similarly, put selling had a higher Sharpe ratio than owning stocks (0.65 vs. 0.49). These returns include transaction costs and assume the put sales are fully-collateralized with 1-month Treasuries.

Exhibit 1: Put selling on S&P 500 stocks generated a 7.1% annual return with 12% volatility
Growth of $1 invested in a monthly rebalanced portfolio of ATM listed put sales on all optionable S&P 500 stocks vs the SPXTR vs iBoxx Investment grade bond total return



Source: Goldman Sachs Research, Bloomberg.

Relative to the Investment Grade bond index (iBoxx IG), put selling shows higher annual returns, but a lower Sharpe Ratio over the past 10 years.

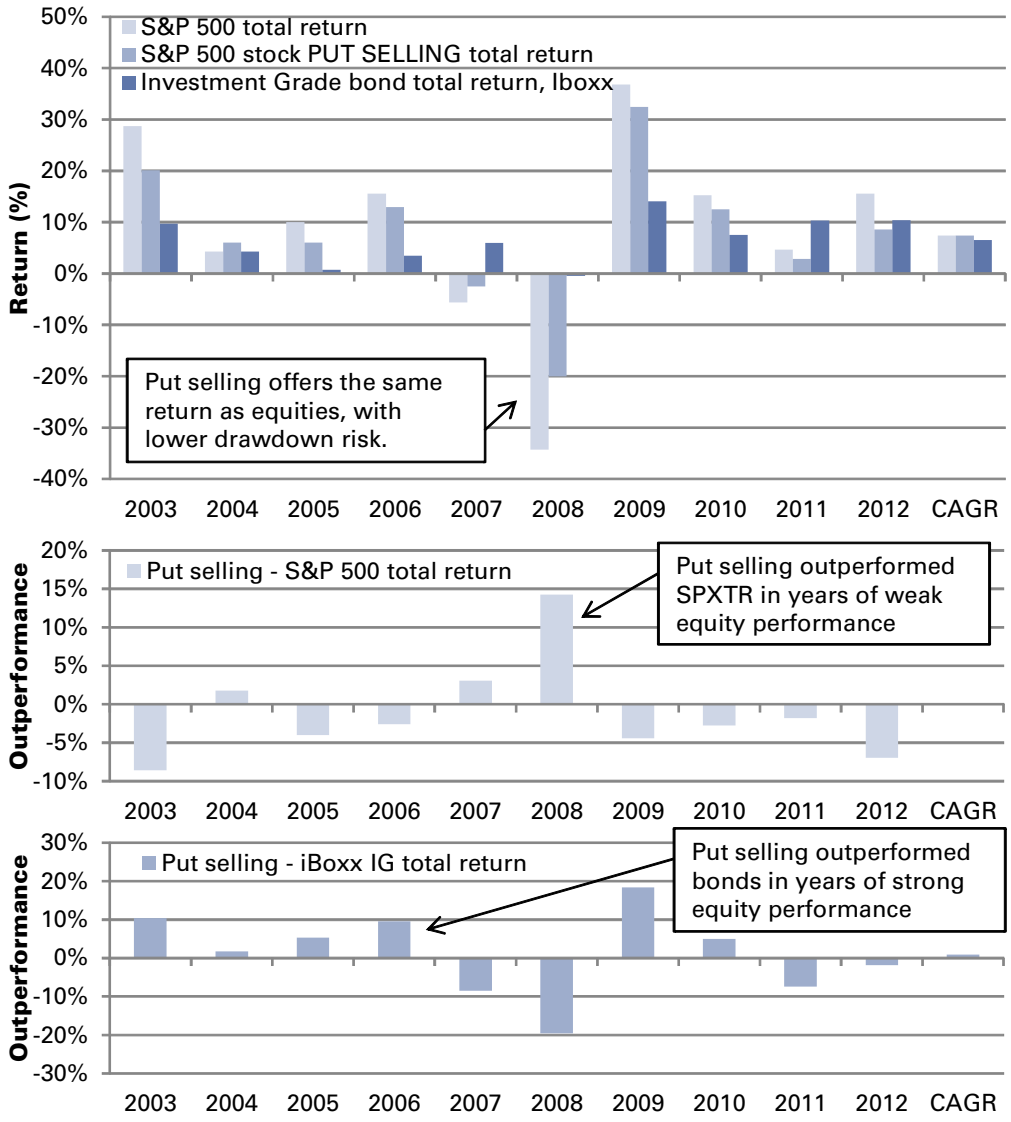
- IG bonds returned 6.5% over the same period with an annualized volatility of 7% leading to a Sharpe ratio of 0.94.
- Corporate bonds underperformed significantly from 2003-2007 as increasing corporate leverage and rapid earnings growth benefited equity strategies.
- Drawdowns for equity strategies in 2008 erased most of their outperformance.
- Since 2009, declining corporate leverage and interest rates have led to mark to market gains for bond holders that fall just shy of equity and ATM put selling returns.

Put selling across market environments

Put selling provides steady returns in bullish market environments and moderate draw-downs in sharp downside scenarios. In up months, put selling participated in 66% of the upside of the S&P 500, while in down months, put selling only participated in 55% of the downside of the S&P 500.

- **In years when the S&P 500 was up,** put selling underperformed equity by 3.7% on average while outperforming the Investment grade bond index by 5.1% on average. (Chart 2 in Exhibit 2)
- **In years when the S&P 500 was down** (2007 and 2008), put selling outperformed the S&P 500 total return by 3% and 14%, respectively, while underperforming the bond index by 8% and 20%, respectively. (Chart 3 in Exhibit 2)

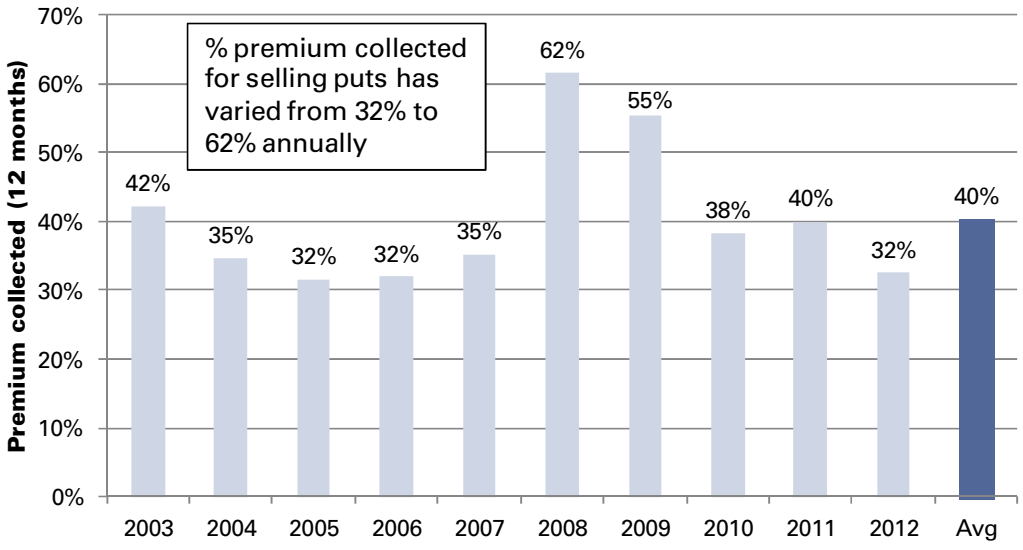
Exhibit 2: Put selling showed positive performance in 8 of the past 10 years
1-month ATM put selling vs. SPXTR vs. Investment Grade Bonds (iBoxx IG Index)



Source: Goldman Sachs Research.

Premiums collected across market environments: On average, 1-month ATM put selling generated premiums of 3.4% per month for an average annual premium of 40%. Monthly put premiums reached a maximum of 9.1% during the 2008 crisis, a low of 2.1% in early 2007, and 2.5% in the last month of 2012.

Exhibit 3: Put selling showed positive performance in 8 of the past 10 years
1-month ATM delta put selling vs. SPXTR vs. Investment Grade Bonds (iBoxx IG Index)



Source: Goldman Sachs Research.

Strike selection and impact on risk/return

Selling further out-of-the-money (OTM) puts increased the Sharpe ratio of the strategy, but reduced the absolute annual returns. We studied selling puts on all stocks in the S&P 500 at strike prices based on their moneyness (ATM to 15%OTM), their sensitivity to stock price moves (20-delta to 70-delta), and a target premium collected (1%-3% per month).

Strike choice methodologies vary across investor types and similarly we don't find a particular methodology dominates our study. Most fundamental investors prefer to target a particular moneyness when selling puts; Yield focused investors prefer to target a particular premium; and volatility traders tend to focus on delta targeting strategies. The data does not suggest that any particular standard strike targeting methodologies are superior to others.

Balancing return and Sharpe Ratio: While selling a 70-delta put provided the highest annualized return over the period (7.4%), it also had one of the lowest sharp ratios (+0.55). We find that selling 15% OTM puts or targeting premium collected each month provided the highest Sharpe Ratios at (+0.83 to +0.85), but shows the lowest absolute level of annualized return (+4.3% to 5.0%).

Exhibit 4: Fully Collateralized 1-month passive put selling performance from Jan-2003 to Jan-2013
1-mo put selling strategies, index weighted for all optionable stocks; closest listed strike to target delta, moneyness, premium

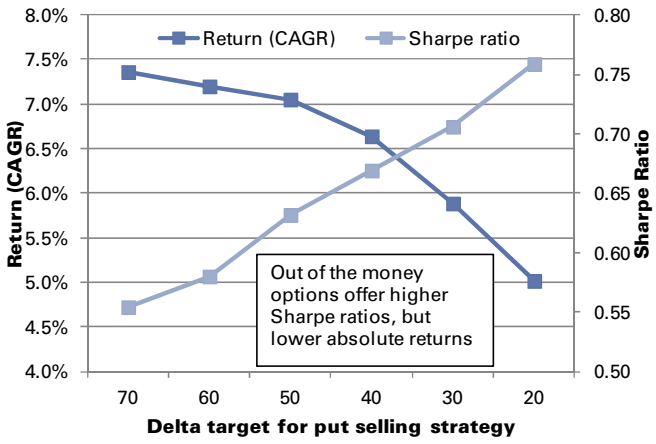
	Annualized		Monthly Return (%)						Option Statistics				SPXTR Risk	
	Compound Return (%)	StdDev	Sharpe Ratio	Mean	Median	Min	Max	StdDev	Avg. % OTM	Avg. Prem (%)	Bid-Ask Spread (%)	% times exercised	Equivalent CAGR	Risk Equivalent % collateralized
S&P 500TR	7.3%	18%	0.49	0.72%	1.7%	-24.9%	13.3%	5.1%						
Strategy: Specified Moneyness (1 month puts)														
0% OTM	7.1%	12%	0.65	0.63%	1.6%	-20.8%	9.1%	3.4%	-0.1%	3.4%	7.3%	45%	10.1%	67%
2% OTM	6.6%	11%	0.66	0.59%	1.4%	-20.1%	8.6%	3.1%	1.8%	2.6%	8.7%	35%	10.4%	60%
5% OTM	5.9%	9%	0.68	0.51%	1.1%	-18.4%	7.8%	2.6%	4.6%	1.8%	11.3%	23%	10.7%	51%
10% OTM	5.5%	7%	0.80	0.47%	0.9%	-15.5%	6.4%	2.0%	9.1%	1.1%	15.0%	12%	13.0%	40%
15% OTM	5.0%	6%	0.85	0.42%	0.7%	-14.2%	5.2%	1.7%	12.4%	0.9%	17.6%	10%	13.8%	34%
Strategy: Specified Delta (1 month puts)														
70Delta	7.4%	15%	0.55	0.69%	1.8%	-23.7%	11.3%	4.3%	-5.0%	6.5%	5.4%	70%	8.4%	85%
60Delta	7.1%	14%	0.57	0.65%	1.7%	-22.7%	10.9%	3.9%	-2.6%	4.8%	6.1%	58%	8.8%	78%
50Delta	7.1%	12%	0.63	0.63%	1.6%	-20.8%	9.9%	3.5%	-0.3%	3.5%	7.2%	46%	9.8%	68%
40Delta	6.6%	11%	0.67	0.59%	1.4%	-19.8%	8.4%	3.0%	2.0%	2.5%	8.6%	34%	10.5%	60%
30Delta	5.9%	9%	0.71	0.51%	1.2%	-17.8%	6.4%	2.5%	4.4%	1.7%	10.6%	24%	11.1%	49%
20Delta	5.0%	7%	0.76	0.43%	0.9%	-15.0%	4.7%	2.0%	7.2%	1.1%	13.3%	16%	12.1%	39%
Strategy: Specified Premium collected (1 month puts)														
1%Yield	4.3%	5%	0.83	0.37%	0.9%	-11.2%	3.1%	1.5%	8.5%	0.9%	14.5%	15%	13.4%	30%
2%Yield	5.8%	8%	0.79	0.50%	1.2%	-14.3%	3.1%	2.2%	4.7%	1.7%	10.2%	28%	12.8%	43%
3%Yield	6.8%	9%	0.75	0.59%	1.5%	-16.9%	3.8%	2.7%	2.2%	2.6%	8.1%	40%	12.0%	54%

Source: Goldman Sachs Research.

Put selling returns can be leveraged by holding less than 100% collateral. This proportionately increases the monthly return and volatility. ATM put selling (12% volatility) was a lower risk strategy than owning the S&P 500 (18% volatility). When comparing the return, it is important to compare strategies of equal risk. Leveraging put selling returns is accomplished by holding less collateral (typically cash or high grade bonds). For example an ATM put selling strategy collateralized with only $67 for every $100 in notional value of puts sold has a volatility of 18% and an annualized return of 10.1%. We view this as the "risk-equivalent" return to compare to an equity portfolio. In the right most columns of Exhibit 4 we show the "risk-equivalent" return and collateral level.

Some investors may not be permitted to leverage put selling returns. Generally, we find that mutual funds are required to fully-collateralize put sales with cash, treasuries or other high grade debt instruments. The ability for others to hold less than 100% collateral depends on exchange rules and collateral arrangements with their financial institution.

Exhibit 5: Strike selection is a tradeoff between potential return and Sharpe ratio
Annualized return and Sharpe ratio for 1-month put selling

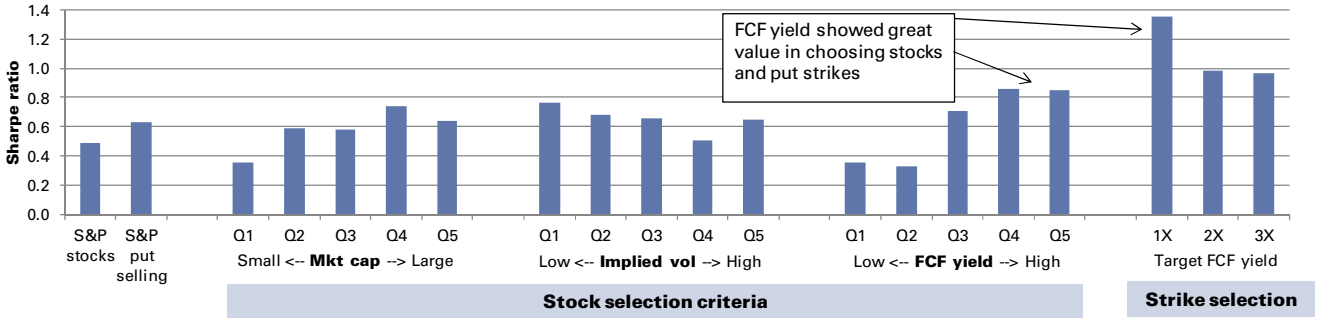


Source: Goldman Sachs Research.

Stock/Strike Selection: Fundamentals add value

We analyzed the patterns of profitability for put selling based on several fundamental and non-fundamental factors. We identify several basic attributes correlated with strong returns and risk adjusted returns including Free Cash Flow (FCF) yield, Market Cap, and Implied volatility. We find that high FCF yield provided the strongest and most consistent indicator of put selling performance. While we find many investors focus on selling puts on high implied volatility stocks, we do not find the Sharpe ratio of that strategy compelling when done systematically.

Exhibit 6: Stock and Strike selection methodology comparison
Sharpe ratio for S&P total return; S&P index weighted 50-delta put selling; equal weighted portfolios of 1-month 50-delta puts by quintile of factor; 1-month put selling on all optionable stocks targeting premium collected of 1x, 2x, 3x monthly FCF yield



Source: Goldman Sachs research, Bloomberg; High/low refer to the highest and lowest quintile of S&P 500 stocks on each metric.

Stock selection based on Implied Volatility and Market Cap

Selling puts on stocks with high FCF yields outperformed put selling strategies on low FCF yield stocks, showing both a higher absolute return and higher risk adjusted return. We estimate a 9.8% annualized return over the past 10 years for selling 50-delta puts on stocks in the highest quintile based on FCF yield. This return stream had a volatility of 12%, in line with the volatility of a broad put selling strategy over the same period. We believe FCF yield has been a valuable proxy for "margin of safety" in equity investments. Those companies with higher FCF yield likely have higher margins, declining leverage and a larger cash cushion than their peers. While FCF yield has also been correlated with stock outperformance over the period, we believe it is a particularly metric useful for identifying stocks with limited downside.

In our view, the exposure from put selling is most comparable to the yield derived from credit spreads. In fact, we have shown in our 2010 report, "Turning stocks into bonds using options" that bond returns can be replicated using stock and options.

Using implied volatility to choose put selling opportunities: Put selling on the highest implied volatility stocks resulted in stronger outperformance vs. put selling on the lower implied volatility stocks; however, the volatility of the returns of this strategy was higher, resulting in a modestly lower Sharpe ratio.

Using market cap to choose put selling opportunities: Larger market cap stocks appeared to offer higher risk-adjusted returns for put sellers than smaller cap stocks. The improvement in risk-adjusted returns is mainly derived from the lower volatility of the strategy; we find that the annualized returns are not significantly different across market cap.

Exhibit 7: FCF yield improved stock selection for put selling…the results using other factors was not as clear
50-delta equal weighted put selling based on implied volatility, market cap, and Free Cash Flow yield

	Annualized		Monthly Return (%)						Option Statistics				SPXTR Risk	
	Compound Return (%)	StdDev	Sharpe Ratio	Mean	Median	Min	Max	StdDev	Avg. % OTM	Avg. Prem (%)	Bid-Ask Spread (%)	% times exercised	Equivalent CAGR	Risk Equivalent % collateralized
S&P 500TR	7.3%	18%	0.49	0.72%	1.7%	-24.9%	13.3%	5.1%						
By Market Cap														
Quintile1 - Small	4.8%	18%	0.36	0.54%	1.8%	-25.6%	13.9%	5.2%	-1.0%	5.1%	13.2%	49%	4.7%	103%
Quintile2	8.0%	15%	0.59	0.75%	1.8%	-24.6%	13.6%	4.4%	-0.4%	4.2%	11.1%	47%	9.1%	86%
Quintile3	7.6%	15%	0.58	0.71%	1.9%	-27.0%	10.4%	4.2%	-0.3%	3.9%	10.1%	45%	8.9%	83%
Quintile4	8.8%	13%	0.74	0.78%	1.6%	-25.0%	10.3%	3.7%	-0.1%	3.6%	8.8%	45%	11.9%	72%
Quintile5 - Large	6.6%	11%	0.64	0.59%	1.4%	-18.7%	8.4%	3.2%	0.0%	3.1%	6.1%	45%	10.0%	62%
By Implied volatility														
Quintile1 - Low	6.2%	8%	0.76	0.53%	1.1%	-15.6%	5.8%	2.4%	-0.3%	2.5%	7.7%	47%	12.3%	48%
Quintile2	7.1%	11%	0.68	0.63%	1.5%	-19.1%	8.3%	3.2%	-0.1%	3.1%	7.5%	43%	10.7%	64%
Quintile3	7.9%	13%	0.66	0.71%	1.7%	-21.6%	10.2%	3.8%	0.0%	3.5%	7.2%	43%	10.3%	74%
Quintile4	7.1%	17%	0.50	0.70%	1.9%	-27.6%	12.5%	4.8%	0.1%	4.1%	6.9%	45%	7.4%	94%
Quintile5 - High	11.1%	20%	0.64	1.05%	2.2%	-26.1%	20.9%	5.7%	0.1%	5.5%	6.7%	46%	10.1%	112%
By Free Cash Flow Yield														
Quintile1 - Low	4.3%	16%	0.36	0.47%	1.5%	-28.3%	10.4%	4.5%	-0.2%	4.0%	8.2%	48%	4.7%	90%
Quintile2	3.6%	14%	0.33	0.38%	1.5%	-22.8%	10.9%	4.0%	-0.1%	3.5%	7.2%	47%	4.2%	79%
Quintile3	7.5%	11%	0.70	0.66%	1.5%	-21.3%	7.6%	3.3%	-0.1%	3.2%	7.3%	45%	11.2%	64%
Quintile4	8.8%	11%	0.86	0.75%	1.5%	-18.5%	8.5%	3.1%	0.0%	3.1%	7.3%	43%	14.2%	60%
Quintile5 - High	9.8%	12%	0.85	0.84%	1.8%	-19.2%	9.2%	3.5%	-0.1%	3.4%	7.1%	45%	14.0%	68%

Source: Goldman Sachs Research.

Strike Selection based on Free Cash Flow yield

Using FCF yield to identify put strikes to sell boosted risk adjusted returns further. In Exhibit 7 above, we chose stocks based on their FCF yield and studied selling 50-delta puts. In the test below (Exhibit 8), we instead include all stocks with positive FCF yield and choose the strike to sell based on the FCF yield of the company. Each month, we target selling 1 times, 2 times or 3 times the FCF yield. We find that selling 1-month puts to collect 1/12th of the FCF yield offered a 5.1% annualized yield with a 4% volatility, the highest Sharpe ratio among all of our studies. This is a more conservative strategy as it sells puts that are 10% out-of-the-money on average rather than ATM. We find that targeting 1 times FCF yield and holding 22% collateral achieved a 24% annualized return with a volatility risk in line with the S&P 500.

Forward estimates add even more alpha: Over the past 7 years where data is available, Goldman Sachs forward estimates of FCF yield improved strike election further, adding 10-30 bps annually to the returns using trailing FCF yield data to choose strikes. We focus on the 10 year data that uses trailing FCF yield to remain consistent with the rest of the analysis in this report. We have incorporated our analysts' forward estimates in our favorite put selling implementation, the "Bond Buyers Equity Basket." See our November 14, 2012 report for full details.

Alternative measures: Earnings yield. Other premium targeting strategies such as targeting Earnings yield also added value in our studies, but not as consistently as FCF yield. We find historically that FCF yield is a better measure of appropriate yield to target than Earnings yield, evidenced by higher average returns and Sharpe ratio put selling strategy. We believe these better results are justified given that cash flow measures are a better indicator that a company is deleveraging and generating a high cash return. While companies frequently manage to EPS targets to satisfy investors, FCF yield may be less "managed" than earnings and could therefore be a better gauge of company performance.

Exhibit 8: Free Cash Flow yield targeting improves on the risk-reward of put selling over passive strategies
Put selling on S&P 500 stocks based on 1, 2 and 3 times the trailing Free Cash Flow yield of the stock (index weighted)

	Annualized		Monthly Return (%)						Option Statistics				SPXTR Risk	
	Compound Return (%)	StdDev	Sharpe Ratio	Mean	Median	Min	Max	StdDev	Avg. % OTM	Avg. Prem (%)	Bid-Ask Spread (%)	% times exercised	Equivalent CAGR	Risk Equivalent % collateralized
S&P 500TR	7.3%	18%	0.49	0.72%	1.7%	-24.9%	13.3%	5.1%						
Strategy: Specified Premium based on Free Cash Flow yield (1 month puts)														
1xFCFY	5.1%	4%	1.35	0.43%	0.6%	-6.5%	3.4%	1.1%	10.2%	0.8%	16.2%	11%	24.3%	22%
2xFCFY	5.5%	6%	0.98	0.46%	0.9%	-10.9%	3.4%	1.6%	7.5%	1.1%	13.5%	18%	16.6%	32%
3xFCFY	6.3%	7%	0.96	0.53%	1.1%	-12.3%	3.7%	1.9%	5.8%	1.5%	11.9%	23%	16.2%	38%

Source: Goldman Sachs Research.

Term Selection: 1-month put selling outperforms 12-month

Selling puts once a year reduces operational costs and transaction costs, but returns have been lower than 1-month put selling over the past 10 years. In our view, 12-month put selling less efficiently harvests the volatility risk premium than 1-month put selling strategies. 12-month put selling on optionable S&P 500 stocks showed a compound annual growth rate of 6.3% with a standard deviation of 14% (50-delta).

In Exhibit 9, we show the performance summary for 12-month put selling strategies across both moneyness and delta targeting strategies. Similar to 1-month put selling, the Sharpe ratios for the further out of the money puts were higher; however, the absolute return was lower.

Advantages of 12-month put selling over 1-month put selling

Lower annual transaction costs: We estimate in 2012, 12-month put sellers spent 52 bps of the portfolio on bid-mid spread vs. 1-month put sellers which spent 72 bps(50-delta).

Fewer transactions mean lower operational costs for 12-month put selling relative to 1-month put selling.

Less path dependency in 12-month strategies benefits investors with long-term views. 1-month put selling strategies may underperform in highly volatile markets as losses in some months are not able to be made up in others; 12-month put selling returns are only realized once a year allowing for more month-to-month volatility.

Disadvantages of 12-month put selling over 1-month put selling

Lower premiums collected: Premium collected annually for selling 1-month 50-delta puts is 40% annually with the premium collected for selling 12-month 50-delta puts is only 14%. While a smaller number of 12-month put-sales experience losses than 1-month put-sales, this is not enough to erode the high level of premium collected for 1-month put-sales.

Lower average returns and lower Sharpe ratios for 12-month put selling relative to 1-month (table below).

Exhibit 9: Annual put selling reduces the number of transactions, but also has a lower average return
annualized return and standard deviation of 12-month put selling strategy on S&P 500 index weighted constituents, Jan-2003 to Jan-2013

	Annualized			Annual Return (%)					Option Statistics			
	Compound Return (%)	StdDev	Sharpe Ratio	Mean	Median	Min	Max	StdDev	Avg. % OTM	Avg. Prem (%)	Avg Bid-Ask Spread (%)	% Times exercised
S&P 500TR	7.3%	19%	0.47	9.1%	12.6%	-34.3%	36.8%	19.5%				
Strategy: Specified Moneyness (12 month puts)												
0% OTM	5.8%	13%	0.52	6.6%	9.0%	-23.1%	24.5%	12.7%	0%	11%	4.1%	36%
2% OTM	5.7%	12%	0.52	6.4%	8.8%	-22.5%	24.0%	12.3%	2%	11%	4.3%	33%
5% OTM	5.5%	12%	0.53	6.1%	8.4%	-21.2%	23.0%	11.6%	5%	9%	4.7%	28%
10% OTM	5.0%	10%	0.53	5.5%	7.5%	-18.5%	21.0%	10.3%	10%	7%	5.5%	23%
15% OTM	4.6%	9%	0.55	5.0%	6.5%	-16.3%	19.4%	9.2%	15%	6%	6.7%	18%
Strategy: Specified Delta (12 month puts)												
70Delta	7.1%	17%	0.50	8.5%	10.5%	-29.4%	33.9%	17.0%	-20%	24%	2.9%	68%
60Delta	6.9%	16%	0.51	8.1%	9.8%	-27.6%	32.7%	16.0%	-12%	19%	3.2%	56%
50Delta	6.3%	14%	0.50	7.3%	9.5%	-25.5%	29.5%	14.5%	-5%	14%	3.7%	44%
40Delta	5.6%	13%	0.50	6.4%	8.6%	-22.6%	25.3%	12.6%	2%	10%	4.4%	32%
30Delta	4.8%	10%	0.52	5.3%	7.3%	-18.4%	20.3%	10.1%	10%	7%	5.4%	23%
20Delta	3.8%	8%	0.54	4.1%	5.7%	-14.0%	14.7%	7.6%	19%	4%	7.4%	15%

Source: Goldman Sachs Research estimates.

Managing risk: Portfolio weighting to improve risk adjusted return

After determining which stocks and strikes to sell, the next question becomes how to assemble put sales in a portfolio. For the studies above, we have focused on equity index weighted exposure to aid in comparison with equity only portfolios. We find risk based weighting methodologies can improve the risk/return profile of put selling portfolios similar to stock portfolios. We use implied volatility and delta as a guide when assembling the portfolio and find that each improved the Sharpe ratio over the past decade.

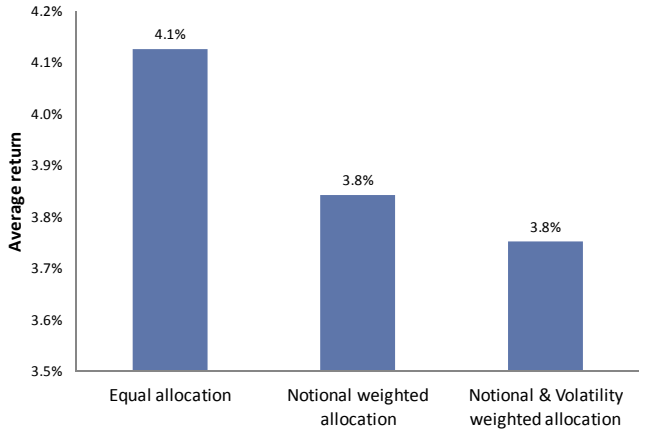
Risk based portfolio weighting for put sales

We use risk based portfolio weighting in the "Bond Buyers Equity Basket"; see November 14, 2012 report.

We base our portfolio weighting on the idea that ignoring difference in correlations among the assets, the minimum variance portfolio is the one where each asset has equal risk. Faced with a diverse group of stocks with put strikes that vary across these stocks, we define risk as the implied volatility of each stock multiplied by the delta of the put sale of the same stock. For instance, we would consider a 50-delta put sale on a 40 vol stock as twice as risky as a 50-delta put sale on a 20 vol stock and would therefore have half the weight in that put sale. Similarly, a 25-delta put sale on a 15 vol stock would have only half the risk of a 50-delta put sale on the same stock and would also warrant twice the weight. By equalizing the initial volatility adjusted delta risk to each stock in the portfolio, the initial risk to each asset is equal.

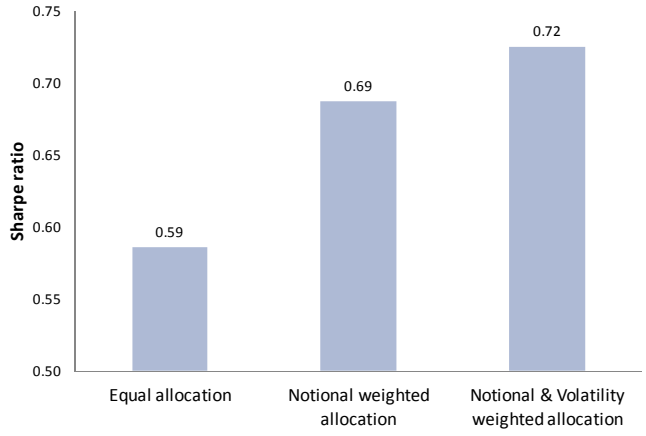
The risk neutral weighting methodology tends to overweight the lower delta, lower volatility put sales in the portfolio leading to a higher Sharpe ratio, despite a modestly lower average return. We estimate that an equal weighted portfolio of 12 month put sales with strikes based on the FCF yield of the underlying stock produced an average annualized return of 4.1% (0.59 Sharpe Ratio). Using the same stocks and strikes, but weighting the portfolio such that there was equal delta risk in each name led to a 3.8% annualized return with a Sharpe ratio of 0.69. Equal risk weighting determined by delta times 12-month implied volatility led to a return of 3.8% with a Sharpe Ratio of 0.72.

Exhibit 10: Equal risk allocation leads to only marginally lower average returns…
12m put selling annualized returns for equal dollar, equal notional exposure and volatility adjusted equal notional allocations using FCFY as target yields



Source: Goldman Sachs Research.

Exhibit 11: …but leads to an even higher Sharpe ratio
Sharpe ratio of 12m put selling for equal dollar, equal notional exposure and volatility adjusted equal notional allocations using FCFY as target yields

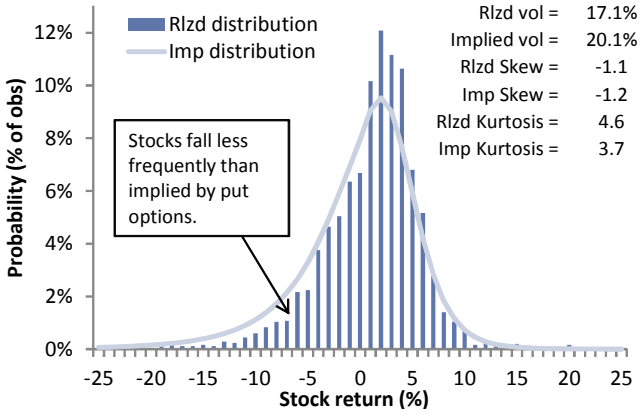


Source: Goldman Sachs Research.

The Volatility Risk Premium (VRP): Why put selling works

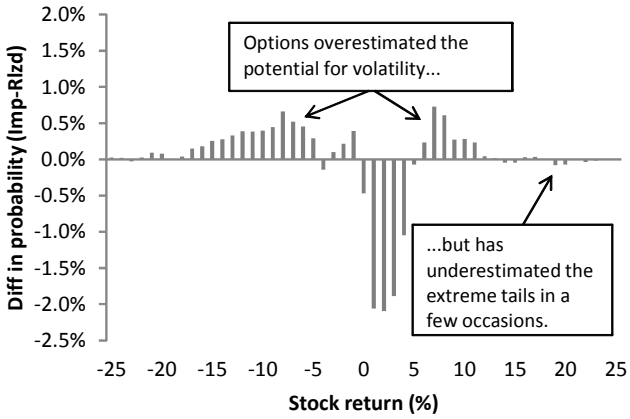
Put selling is one method of harvesting the Volatility Risk Premium (VRP). We analyze the shape of the options market implied distribution relative to realized distribution to illustrate the effects of the volatility risk premium. The VRP boosts the price of options across strikes, leading to an over-estimation of volatility. We illustrate these differences using SPX options over the past 10 years. While the VRP may vary in size across index and single stock options, our study above suggests that puts are systematically overvalued for both.

Exhibit 12: Options have overestimated volatility and skew over the past 10 years
Average month SPX implied distribution vs. SPX monthly realized return distribution 2003-2012



Source: Goldman Sachs Research.

Exhibit 13: Put selling takes advantage of the overestimation of downside volatility
Difference between the estimated implied and actual distribution of monthly returns.



Source: Goldman Sachs Research.

Over the past 10 years options markets have overestimated overall volatility and directional skew while moderately underestimating tail risk.

(1) Volatility: The average spread between 1-month volatility and subsequent realized volatility was 3.0 points over the 10 years of our study. The options market prices a wider distribution of returns than is typically realized by the equity market. In Exhibit 13 above, this can be seen as the positive difference to the left and right of center, as well as the negative difference in the middle. Over the past 10 years, the average 1-month ATM volatility has been 20.1% vs. subsequent realized volatility of 17.1%.

(2) Directional skew: The options market typically priced in a higher probability of down-moves vs. up moves. This can be seen by the positive bars to the left of center on the second chart above. The distribution of equity market returns had a downside skew over the period; however, the options market priced in greater skew than the market realized (options priced skew of -1.2 vs. -1.1 realized).

(3) Fat tails: Equity return distributions have realized more extreme moves than options markets implied over the past 10 years. We find that the options market modestly underestimated the potential for extreme moves over the past 10 years, in particular, the moves to the upside. Using kurtosis as a measure of tails, we find that the options market priced 3.7 kurtosis relative to the 4.6 realized over the period.

Why does the Volatility Risk Premium (VRP) exist?

See "Volatility as an Asset" November 15, 2007 for more on the Volatility Risk Premium (VRP)

The ability to hedge allows investment managers to externalize short-term equity market risk and focus on investing for the long term. As such, hedges are a useful tool, but are not free. In order to attain downside protection, investment managers must pay a premium for put hedges—one that is large enough to attract liquidity providers and/or investors to provide that protection. This cycle of supply and demand creates the Volatility Risk Premium (VRP) and drives the long-run returns for short index options strategies.

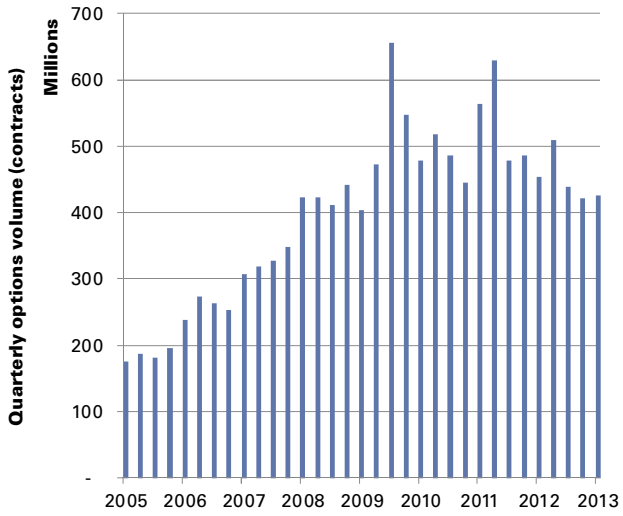
We are often asked why the VRP has not been "arbed" away. Historically, the supply from arbitrageurs has been small relative to hedging demand and there are limits to arbitrage. We believe investors are needed to fill in the gap. Even as investors become more involved in this market, as we show, only a small amount of short volatility exposure is needed to generate sizable returns within acceptable risk levels. This means that short volatility investors are unlikely to outsize the hedging market, in our view.

Transaction costs for options have fallen as liquidity has grown

Options liquidity has grown to a level that even the largest investors can find ample liquidity on a large number of stocks. Total options volume traded in all stocks has grown from about 737 million contracts in 2005 to 1.7 billion contracts in 2012.

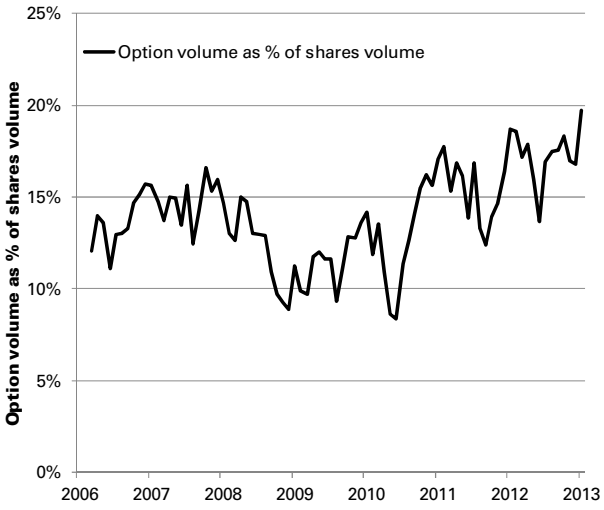
Option volumes have grown to 20% of the shares volumes. Investors are increasingly looking to options to gain exposure to stock moves or generate yield. We estimate that options volumes for single stocks have grown to 20% of the shares volumes on single stocks, up from 10% in 2010.

Exhibit 14: Option volumes doubled over the past 7 years
Quarterly options volumes in all common stocks



Source: OptionMetrics.

Exhibit 15: Option volumes now represent 20% of shares volumes
Monthly option volumes / monthly shares volumes

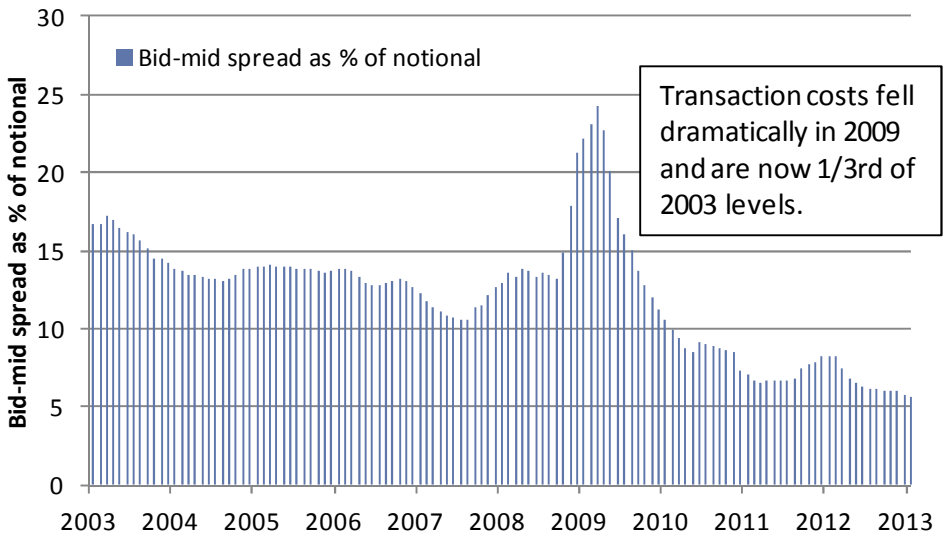


Source: OptionMetrics.

Over the past few years, there has been a dramatic decline in transaction costs for put sellers. Paying the bid-mid spread was a 14 bp monthly drag on a put selling portfolio from 2003-2008, but dropped to only a 6 bp drag in 2012. This reduction in drag is driven by sharply tighter bid-mid spreads. The bid-mid spread began to decline rapidly as a percentage of option premium in 2009. The returns in the studies above include these transaction costs.

We view the transaction costs in our study as conservative. The daily close data that underpins our analysis likely overstates transaction costs through time given the tendency for bid-offer spreads to be wider at the close than in the middle of the day. In that context, we view our results (which include these spreads, but not commissions) as conservative for small investors and likely good approximations for large investors that have the potential to move the market with their transactions.

Exhibit 16: Monthly bid-mid spread for selling puts on S&P 500 stocks over the past 10yrs
Trailing 6 month average bid-mid spread as a percent of the stock price on all S&P 500 stocks with options



Source: Goldman Sachs Research.

Appendix A: The Basics of Put Selling

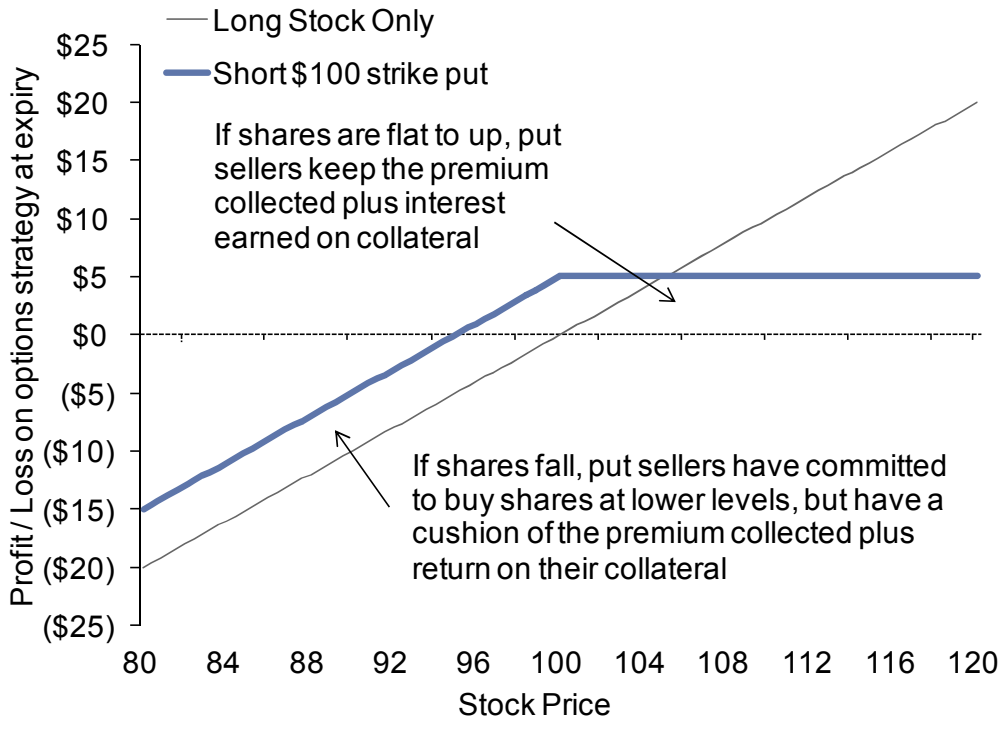
What is put selling? Selling a put option on a stock to collect a premium for agreeing to buy shares at a specific strike price should it drop below that level by expiration.

Example: Selling an at-the-money 1-month put. The payoff diagram below compares the exposure of a put sale to the underlying stock. In this example, the investor sells a put at a strike price equal to the current stock price that expires in 1-month. The put is referred to as an "at-the-money" because it is struck at the current stock price. If put option were struck below the current stock price, it would be considered an "out-of-the-money" (OTM) put; if above the strike price, it would be an "In-the-money" put. The investor achieves the maximum return if the stock is above the strike price at expiration. If shares are below the strike price at expiration, the intrinsic value of the short put position is the stock price minus the strike price plus the premium collected. The investor profits on the put sale as long as shares are above the strike price minus the premium collected (the "breakeven" point) at expiration.

Put sales offer lower risk than stock positions: Two features of put selling contribute to its lower risk than stock positions. (1) Put sellers collect an upfront premium, cushioning returns should the stock fall, (2) to the extent that the put sold is out-of-the-money, downside exposure to the stock will not begin until the stock has already begun to fall. This lower risk also lowers the potential return as the maximum return from the put sale is the premium collected; however, upside to the stock is theoretically unlimited.

Collateral held against a put sale influences returns on capital: This example assumes that the put sale is fully collateralized by cash equal to the strike price. While some amount of collateral is almost always required, some investors under-collateralize put selling strategies to effectively leverage their returns.

Exhibit 17: Put selling provides a fixed yield and outperforms stocks in a down market
Payoff diagram for a fully collateralized put sale vs stock



Source: Goldman Sachs Research estimates

Key terms:

Strike price: Stock price above/below which option would be valuable at expiration

Premium: Upfront revenue from initiating the sale of an options position. The option premium collected is a function of implied volatility and the forward price of the asset. Higher volatility implied by the options market leads to higher put premiums. The forward price is driven by expected dividends and interest rates. Higher expected dividends drive down the forward price, increasing the premium collected for a put. Higher interest rates increase the expected forward price of the asset, decreasing the put premium.

Term/option expiration: Length of time until options expire

Exercise: Converting options into stock at intrinsic value

Target yield from put sale: Put premium plus yield from collateral as % of total investment, i.e., equal to the collateral

Return from put sale: Put premium plus yield from collateral minus put payoff at expiration as % of total investment, i.e., equal to the collateral

Risks of put sale

Downside risk: Put sellers are exposed to downside risk if the stock price goes below put strike and can lose the amount of the strike price if the stock reaches zero at expiration. This loss may be partially offset by the premium collected at the initiation of the trade.

As a general rule of thumb, the best candidates for put selling strategy are the stocks that an investor believes have strong balance sheets, secure business models and have a low probability of entering distress. If an investor thinks that a stock has a strong upside, they should own the stock rather than sell puts to capture the strong upside potential.

Mark-to-market risk: Investors that sell puts take mark-to-market risk based on movements in a number of variables used to determine the time value embedded in an option including, implied volatility, interest rates, and expected dividends. The mark-to-market of a put sale can be adversely impacted if (1) stock falls (2) implied volatility rises, (3) interest rates fall, and/or (4) expected dividends rise.

Appendix B: Put Selling vs. Buy-write strategies

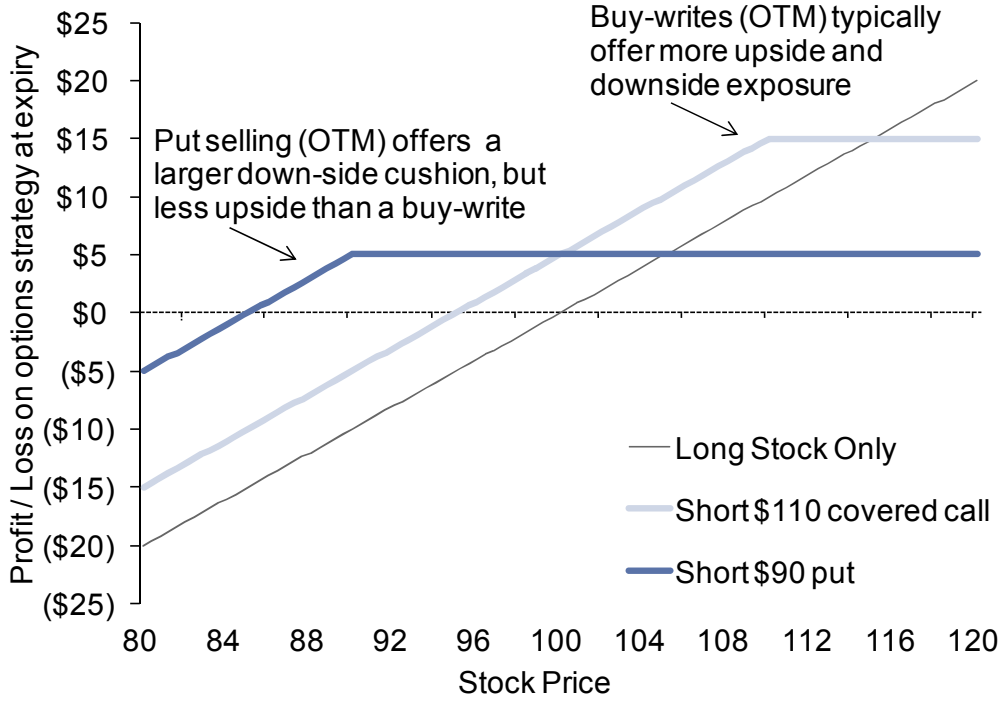
Put selling and covered call selling strategies offer similar risk/return profiles. In the absence of any arbitrage opportunities, a long stock+ short call strategy can be replicated using short put of the same strike and cash based on put-call parity relationship.

Put selling benefits from skew and collateral flexibility, but covered call selling outperforms if dividends are greater than expected.

Put selling tends to be a lower risk strategy than covered call selling strategies when both investors are focused on out-of-the-money strikes. In Exhibit 18 we show that when call and put strikes are both out-of-the-money, the payoffs of the two strategies diverge. OTM put selling provides higher downside cushion in an adverse market than OTM covered call selling, despite providing smaller upside potential.

Put selling benefits from skew and collateral flexibility, but covered call selling outperforms if dividends are greater than expected. Out of the money put sellers benefit from structural skew in the options market that leads out of the money puts to be overvalued relative to out of the money calls (see page 14 for discussion of the volatility risk premium). Put sellers often have the flexibility to own interest bearing securities as collateral, which can boost returns relative to a covered call selling structure. If dividends are paid as forecast at the beginning of the trade, they have a neutral effect on put sellers and covered call sellers; however, if dividends are larger than expected, this lowers the forward price of the asset and benefits call sellers over put sellers. Investors should favor covered call selling strategies on stocks they expect to pay larger dividends than are priced into the options market.

Exhibit 18: OTM overwriting has higher upside potential than OTM put sale but has lower downside protection
Example 10% OTM put selling and 10% OTM overwriting



Source: Goldman Sachs Research.

Appendix C: Methodology details and study overview

Methodology: We studied selling listed puts each month at expiration on each stock in the S&P 500 that expires at the next expiration date at the bid price listed on the close. We hold collateral equal to the strike price. We assume the collateral was held in 1-month treasuries over the period of the trade. On expiration, 1 month later, we calculated the intrinsic value of the combined position to determine the return over the period. We weight these monthly returns in the same weight as the stock was in the S&P 500 at the beginning of the period. In rare instances options data was not available for an underlier; in those cases, we omit the underlier and re-weight the remaining trades to continue to approximate the weighted index exposure.

Universe of stocks: We identify the constituents and index weights of each of the stocks in the S&P 500 at the beginning of each trade and include only those stocks in our analysis.

Dates, initiation/expiration: On each expiration date, we assume an investor sells a put that expires 1 month later, on the subsequent expiration day.

Strikes: We studied selling puts based on the moneyness (0%, 5%, 10% and 15% out-of-the-money relative to the spot price at initiation), the delta exposure of the call (70-delta to 20-delta), and the premium collected (1% per month to 3% per month).

Trade size: We assume the investor sells puts based on the weight of that stock in the S&P 500 at that time to allow for direct comparison with the S&P 500 index.

Price history: We use OptionMetrics daily-close listed bid and ask option price data where available and estimate prices using Goldman Sachs volatility surfaces and applying a bid-ask spread in-line with the bid-ask spread observed in OptionMetrics data for that period.

Sample period: We include observations from January 2003 to January 2013.

Dividends: We implicitly assume that dividends would be collected by stock holders but not by put sellers.

Disclosure Appendix

Reg AC

We, John Marshall, Krag Gregory, Ph.D. and Katherine Fogertey, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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Buying Options - Investors who buy call (put) options risk loss of the entire premium paid if the underlying security finishes below (above) the strike price at expiration. Investors who buy call or put spreads also risk a maximum loss of the premium paid. The maximum gain on a long call or put spread is the difference between the strike prices, less the premium paid.

Selling Options - Investors who sell calls on securities they do not own risk unlimited loss of the security price less the strike price. Investors who sell covered calls (sell calls while owning the underlying security) risk having to deliver the underlying security or pay the difference between the security price and the strike price, depending on whether the option is settled by physical delivery or cash-settled. Investors who sell puts risk loss of the strike price less the premium received for selling the put. Investors who sell put or call spreads risk a maximum loss of the difference between the strikes less the premium received, while their maximum gain is the premium received.

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