Embracing Downside Risk

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It is well known that investors have asymmetric risk preferences in bearing downside risk or participating in the upside. Options markets provide a useful and intuitive way to quantify these asymmetric preferences by way of the returns associated with being on either "side." We show this using equity index options and find that most of the empirical equity risk premium reflects compensation for downside risk—in fact, upside participation earned hardly any reward in the long run, reflecting an extreme asymmetry that might be surprising to some investors. We extend the analysis to other asset classes to show similar (though in some cases weaker) results. Data and economic theory suggest that investors who attempt to deal with downside risk by being long options should expect to underperform.

REFRAMING AN OLD PROBLEM

Many investors focus a great deal of effort on maximizing their upside participation while minimizing their downside risk. Options arguably provide the most direct downside hedge, but they do so at a significant cost, reflecting investor preferences. This cost, commonly referred to as the *volatility risk premium* and measured by the difference between the option's implied volatility and its underlying asset's realized volatility, is compensation paid by option

buyers to sellers for bearing undesirable downside risk.

The size of the volatility risk premium is related to investors' asymmetric risk preferences. Rather than measure the volatility risk premium as a volatility spread, we may instead use option prices to quantify the returns earned, respectively, for upside and downside risk exposures in a novel way that we hope resonates with investors. Our goal is to present the same information through a different lens to provide an intuitive measurement of the return impact of acting on one's asymmetric risk preference. In so doing, we find that downside risk is the main source of long-run rewards in equities and other asset classes. This result suggests that demand for upside participation is strong and tolerance for downside risk is weak. Long-term investors may be better off embracing the downside because hedging it would remove much, if not all, of the long-term returns.

We begin our investigation in equities. Most portfolios have an allocation to the S&P 500 or to something highly correlated to it. Many investors turn to equity index options to reduce their downside risk exposure while maintaining their upside participation. However, the historical magnitude of the volatility risk premium suggests that most of the empirical equity risk premium reflects compensation for downside risk—in fact, owning upside participation via long

call options or an S&P 500 allocation coupled with protective put options earned hardly any reward in the long run, reflecting an extreme asymmetry that might be surprising to some investors.

We extend our analysis to other asset classes, including fixed income, commodities, and credit, to show similar, if weaker, results. Data and economic theory suggest that investors who attempt to deal with downside risk by being long options should expect to underperform. On the other hand, those who seek out downside risk exposure by selling options should expect to outperform for the same reason.

To many, it may sound risky to actively seek out downside exposure. Yet, the insurance industry, for example, is seemingly devoted to accepting the risk of potentially significant loss for profits that are capped at moderately sized insurance premiums. Although it may appear rather unconventional to do so in financial markets, we show that the downside exposure associated with underwriting financial insurance offers greater rewards than does the sought-after upside participation.

SPLITTING THE ASSET

Equity index returns allow us to estimate the historical equity risk premium. Options on equity indexes supply the additional information required to estimate the upside and downside equity risk premiums.

The S&P 500 Index can be split into its upside and downside components: Begin with an S&P 500 allocation and then go long and short two identical call options (i.e., the two option positions perfectly net). The S&P 500 allocation coupled with the short call option is a *covered call position*, which has full downside participation and is capped upside. We refer to this as the *insurer component*, as it reflects the exposure provided by underwriting financial insurance and has materially more downside risk than upside participation. In contrast, the long call option has limited downside risk and unlimited upside participation. We refer to this as the *protected component*, as it has materially more upside participation than downside risk. Importantly, the combination of these two parts (the covered call and the long call) results exactly in the return of the index.

An alternative yet comparable approach obtains the protected component by purchasing a protective put option on an existing S&P 500 position and obtains the insurer component by selling a naked put option. Exhibit 1 illustrates the decomposition for a hypothetical scenario in which the option premium is $20 at a $100 strike.

QUANTIFYING THE ASYMMETRY

If options are priced with no additional risk premium (i.e., their implied volatilities match their underlying securities' realized volatilities), then both the insurer and

EXHIBIT 1
Illustrative Upside and Downside Profit and Loss (PnL) Decomposition

	Insurer Component		Protected Component
S&P 500 =	Covered Call	+	Long Call Option
S&P 500 =	Short Naked Put	+	S&P 500 with Protective Put
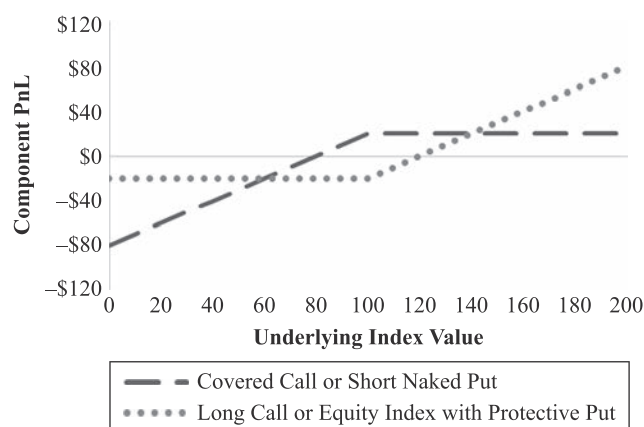
Note: For illustrative purposes only.
Source: AQR.

protected components' expected excess returns will be proportional to their equity betas. On the other hand, if investor preference for upside participation and downside risk mitigation leads to demand for options, the option prices will reflect this demand. The implied volatilities of options will tend to be higher than their underlying index's realized volatility, and downside exposure will tend to earn higher returns than upside participation.

Although many investors may know that downside exposure is more highly compensated, we show it empirically. Exhibit 2 reports summary statistics for the S&P 500 Index alongside its insurer and protected components.[1,2] Exhibit 3 plots the cumulative returns for the three exposures. Notably, nearly all of the S&P 500 Index's return may be attributed to its covered call component. In fact, because it has lower volatility (and volatility drag reduces compounded returns), the covered call has had only slightly lower cumulative returns than

E X H I B I T 2
Decomposed S&P 500 Index Properties, 1986–2014

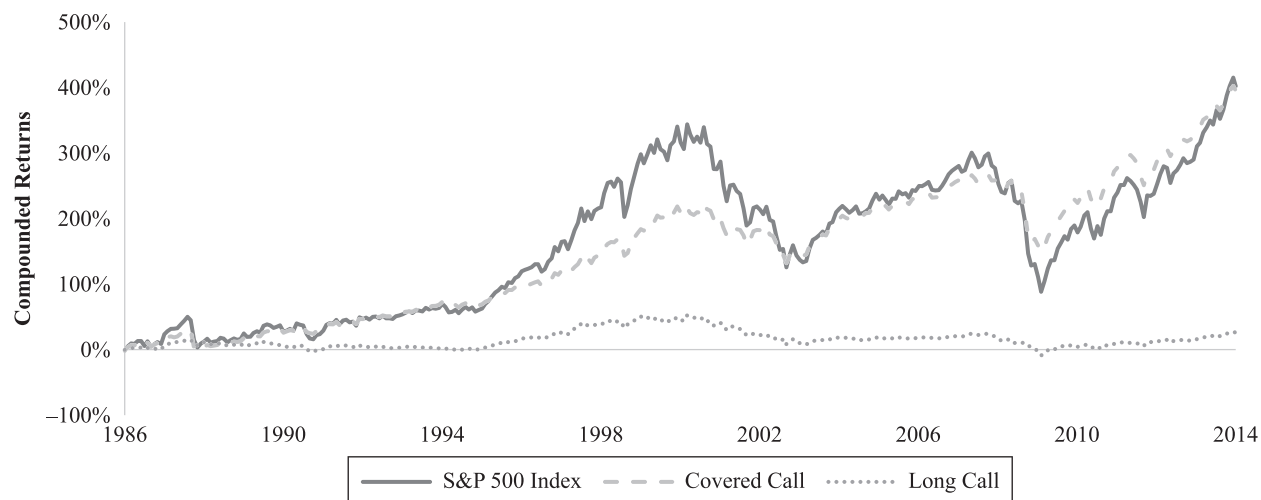|	Asset	Insurer Component	Protected Component
	S&P 500 Index	**Covered Call**	**Long Call**
Excess Return	7.6%	6.3%	1.3%
Excess Return (Geometric)	6.3%	6.0%	1.0%
Volatility	15.7%	9.7%	7.0%
Sharpe Ratio*	0.40	0.62	0.15
t-statistic of Excess Return	2.6	3.6	1.0
Beta to S&P 500 Index	1.00	0.59	0.41
Skew	–0.9	–2.2	–0.1
Correlation Between Covered and Long Calls		0.75	

Notes: For illustrative purposes only. Data from January 1986 through December 2014. For the period 1986–1996, the S&P 500 Index is proxied using S&P 100 returns and options. S&P 500 data are from OptionMetrics, and S&P 100 data are from Commodity Systems Inc. Broad-based securities indexes are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index. Beta, volatility, correlation, and skew were calculated using overlapping 21-day arithmetic returns. Excess return was calculated as the average annualized arithmetic daily excess return over the time period.

*The asymmetric nature of returns reduces Sharpe ratios' usefulness to compare returns in this exhibit.

Sources: AQR, OptionMetrics, and Commodity Systems Inc.

the S&P 500 Index. Although the potential for upside return capture may sound desirable, that component of the index's return has provided little reward. Furthermore, although the long call position contributes little reward, it does contribute risk. In fact, 41% of the S&P 500 Index's risk (here, beta) may be attributed to this exposure.[3] As Exhibit 1 suggests, the empirical results are similar for strategies that systematically buy puts to hedge out the downside—in both cases, average returns are meaningfully lower when investors reduce their downside risk.[4]

WHY DOES THIS WORK?

Behavioral finance argues that, all else equal, most people prefer optionality's positive skew over insurance provision's negative skew.[5] Option sellers are contractually obligated to buy or sell an asset at an unattractive price at the discretion of the option buyer. Given loss-averse preferences, it is clear why an option buyer would appreciate this arrangement. These same preferences make the arrangement less desirable to option sellers, who must be enticed to enter this deal. A risk premium embedded in option prices provides the necessary enticement.[6]

Option prices depend on the volatility of the underlying instrument—the more volatile the instrument, the more valuable the option. An option pricing model, such as the Black–Scholes model, may be used to back out the volatility implied by option prices. This implied volatility has historically been higher than realized volatility. The difference between the two is commonly referred to as the *volatility risk premium* and represents the compensation paid to option sellers by option buyers to entice the former's participation.

Exhibit 4 plots the historical realized volatility risk premium for the S&P 500 Index. The volatility risk premium has been positive 88% of the time and has averaged 3.4% per year but has suffered in especially bad times, such as fall 2008 and in sharp crashes, such as in October 1987. Traditional analyses of equity and volatility risk premiums use two assets (equity and equity options) to construct two distinct return series (equity returns and equity-neutral short volatility returns), which we show in Exhibit 5. Long equity earned 7.6% per year in excess of cash, with 15.7% annualized volatility (Sharpe ratio of 0.48). Short volatility earned 1.8% per year, with 2.9% annualized volatility (Sharpe ratio of 0.62).

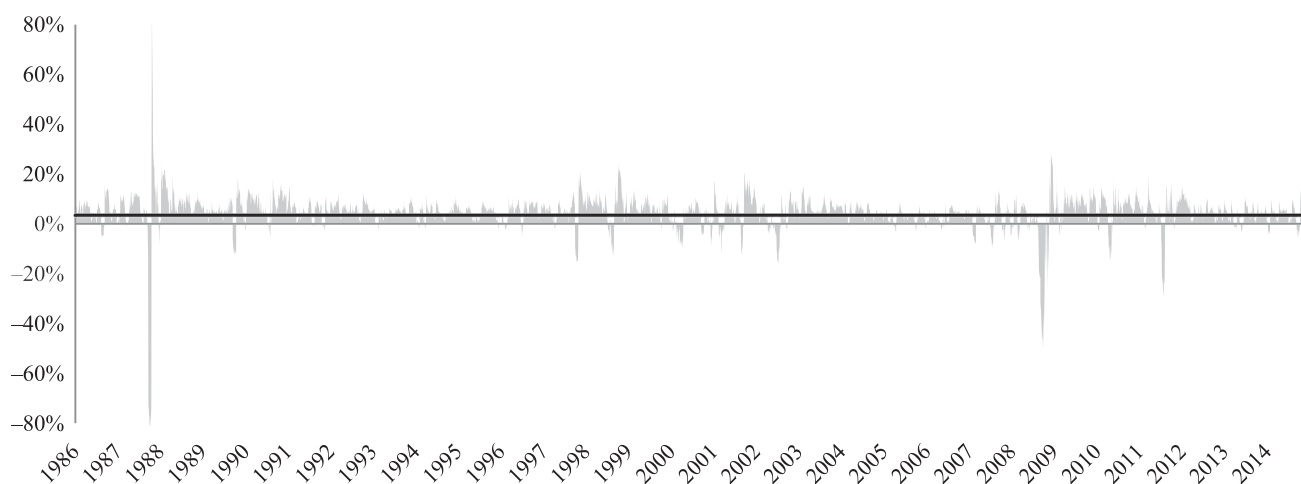**Decomposed S&P 500 Index Cumulative Returns**

Notes: For illustrative purposes only. For the period 1986–1996, the S&P 500 Index is proxied using S&P 100 returns and options. S&P 500 data are from OptionMetrics, and S&P 100 data are from Commodity Systems Inc.

Sources: AQR, OptionMetrics, and Commodity Systems Inc.

Volatility Risk Premium = VIX Index—Realized Volatility

Notes: Data from January 1986 through December 2014. Average volatility risk premium is calculated as the square root of the average squared value of the VIX Index, subtracting the square root of the average of the realized variances over concurrent time periods.

Source: AQR calculation based on VIX Index and subsequent one-month realized volatility, based on daily closing values.

Our goal, however, is to understand the return properties of downside equity exposure versus upside equity exposure. To do this, we decomposed the S&P 500 Index into a covered call (insurer component with capped gains) and a long call option (protected component with limited losses). Thus, in contrast to the traditional approach of separating long equity and short volatility return series, our decomposition uses the same

EXHIBIT 5
Long Equity and Short Volatility Cumulative Returns
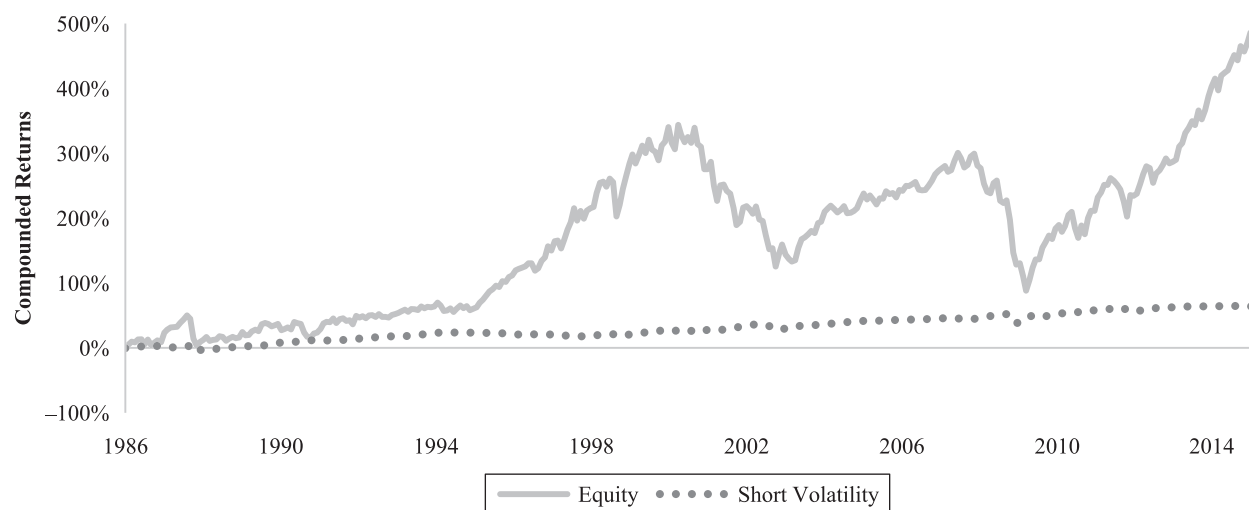
Notes: For illustrative purposes only. For the period 1986–1996, the S&P 500 Index is proxied using S&P 100 returns and options. S&P 500 data are from OptionMetrics, and S&P 100 data are from Commodity Systems Inc.

Sources: AQR, OptionMetrics, and Commodity Systems Inc.

two assets to construct the insurer and protected equity returns, which allows us to separate the returns of downside and upside equity exposure.

Our approach does not provide new information per se; rather, it reframes the volatility risk premium from the practical perspective of an investor who wants downside protection or an investor who is willing to sell it. To construct our decomposition, we used the same inputs (equity and equity options) that are traditionally used to construct long equity and short volatility returns. It is no different to say that there is a volatility risk premium than to say that downside risk offers better compensation than upside participation. What is the primitive, volatility risk premium or downside risk premium? We cannot say. What we do provide is useful context to the size of the volatility risk premium and its impact on returns for those who seek to limit their downside risk while maintaining their upside participation or those who seek to profit by underwriting financial insurance.

Both the covered call and the long call positions have equity exposure and earn the equity risk premium in proportion to their respective equity betas. The covered call and long call have, respectively, collected 4.5% and 3.1% per year (7.6% in total) in equity

risk premium.[7] However, the protected position (the long call option) is long volatility and therefore pays volatility risk premium to the covered call, which is short volatility, in the amount of 1.8% per year, leaving the long call with only 1.3% annual return. Thus, the volatility risk premium "payment" eats away most of the long call's equity risk compensation.[8]

The S&P 500 is risky, and investors are compensated for bearing this risk. However, this compensation is asymmetric, reflecting investor preferences. Purchasing put options to hedge downside risk while maintaining upside participation may sound like it provides a more appealing risk exposure, but it is an exposure that is expected to provide little return. On the flip side, the downside risk exposure achieved by selling put options or buying covered calls may sound unappealing, but doing so is how the bulk of the equity market's long-run return has been earned.

UPSIDE AND DOWNSIDE RISK PREMIUMS IN BONDS

We find broadly similar results across multiple asset classes: Downside risk exposure accounts for the majority of returns.

We start by turning toward fixed income, the other major asset class in traditional portfolios. Exhibit 6 reports the return characteristics for 10-year Treasury futures and for their decomposed upside and downside risk exposures.

Similar to our findings for the S&P 500, the bond insurer component had higher average returns than did its protected counterpart. The insurer component accounted for about 50% of bond variance but 62% of bond returns. Covered calls and long call options on bonds have each earned approximately 2.05% per year in bond risk premium[9] (over a 30-year bond-friendly period), but call buyers have paid about 50 basis points per year to call sellers as compensation for disproportionately bearing downside risk.

As is the case in equities, embracing downside risk in bonds seems to have provided higher returns, although the asymmetry between upside and downside rewards is less extreme. One reason for this may be that equity downside scenarios constitute worse "bad times" than bond downside scenarios for many investors given that equity risk tends to dominate most portfolios.

UPSIDE AND DOWNSIDE RISK PREMIUMS IN COMMODITY FUTURES

We now focus on gold and crude oil, both among the most actively traded commodities in option markets, which indicates that many investors seek to buy and sell insurance protection in these assets. Exhibits 7 and 8 report summary statistics for these assets alongside their insurer and protected components.

Both results are consistent with our findings in equities and bonds, but they are particularly striking for gold, the long call for which has zero excess return yet contributes 52% of the risk. Thus, the long call's entire return from beta, about 1.1% per year, is eaten up by the volatility risk premium. The results for crude oil are similar, although the long call's return from beta, about 4.9% per year, is only reduced to 4.1% after a 0.8% annual volatility risk premium is paid to the covered call.

UPSIDE AND DOWNSIDE RISK PREMIUMS IN CREDIT

For credit, we look at options on investment-grade credit default swaps (CDX). We find even more

EXHIBIT 6
Decomposed 10-Year Treasury Properties, 1986–2014

	Asset	Insurer Component	Protected Component
	10-Year Treasury	Covered Call	Long Call
Excess Return	4.1%	2.5%	1.6%
Volatility	6.4%	3.4%	3.3%
Sharpe Ratio*	0.64	0.77	0.47
Beta to 10-Year Treasury	1.00	0.50	0.50

Notes: For illustrative purposes only. Data from January 1986 through December 2014. Broad-based securities indexes are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index. Beta and volatility calculated using overlapping 21-day arithmetic returns. Excess return is calculated as the average annualized arithmetic daily excess return over the time period.

*The asymmetric nature of returns reduces the Sharpe ratio's usefulness to compare returns in this table.

Sources: AQR, Bloomberg, and CME Group.

EXHIBIT 7
Decomposed Gold Properties, 1986–2014

	Asset	Insurer Component	Protected Component
	Gold	Covered Call	Long Call
Excess Return	2.1%	2.1%	0.0%
Volatility	15.4%	7.9%	8.5%
Sharpe Ratio*	0.13	0.27	0.00
Beta to Gold	1.00	0.48	0.52

Notes: For illustrative purposes only. Broad-based securities indexes are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index. Beta and volatility calculated using overlapping 21-day arithmetic returns. Excess return is calculated as the average annualized arithmetic daily excess return over the time period.

*The asymmetric nature of returns reduces Sharpe ratios' usefulness to compare returns in this table.

Sources: AQR, Bloomberg, and CME Group.

pronounced asymmetry here than in other asset classes, including a negative average return for the protected component (over an admittedly short sample period). The very large gap between the insurer and protected components may reflect the exceptional market environment of 2008–2009. We also note several other caveats in Exhibit 9.

Exhibit 8
Decomposed Crude Oil Properties, 1987–2014

	Asset	Insurer Component	Protected Component
	Gold	Covered Call	Long Call
Excess Return	9.9%	5.8%	4.1%
Volatility	32.2%	17.1%	16.6%
Sharpe Ratio*	0.31	0.34	0.25
Beta to Crude Oil	1.00	0.51	0.49

Notes: For illustrative purposes only. Broad-based securities indexes are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index. Beta and volatility calculated using overlapping 21-day arithmetic returns. Excess return is calculated as the average annualized arithmetic daily excess return over the time period.

*The asymmetric nature of returns reduces the Sharpe ratio's usefulness to compare returns in this table.

Sources: AQR, Bloomberg, and CME Group.

Exhibit 9
Decomposed Credit Properties, July 2007–June 2015

	Asset	Insurer Component	Protected Component
	CDX	Covered Call	Long Call
Excess Return	1.0%	1.8%	–0.8%
Volatility	2.4%	1.9%	1.3%
Sharpe Ratio*	0.42	0.95	–0.59
Beta to CDX	1.00	0.66	0.34

Notes: For illustrative purposes only. Time series begins in July 2007 because of a lack of data before that point; we extend the series through June 2015 to capture as long a period as possible given the data limitations. Returns are monthly, but they are between maturity dates as opposed to month-end. They are also computed based on entering prices and terminal values at option expirations only (not marked-to-market). Upon option expiration, if no new at-the-money option is available, we hold nothing until one becomes available. Because of a lack of reliable daily data, the series is only rebalanced monthly and is not delta-hedged between rebalances. Price data before 2013 are less reliable, and there are discrepancies between sources; we use price data from J.P. Morgan. Broad-based securities indexes are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index. Beta and volatility calculated using monthly returns. Excess return is calculated as the average annualized arithmetic monthly excess return over the time period.

*The asymmetric nature of returns reduces the Sharpe ratio's usefulness to compare returns in this table.

Sources: AQR, J.P. Morgan, and Markit.

CONCLUSIONS

Economic theory and empirical evidence support the idea that investors should be compensated for bearing downside risk. Therefore, insurance that seeks to mitigate this risk should rationally come at a cost, which we show empirically for multiple asset classes. We find that in every case, risk-adjusted returns for the seemingly more desirable protected component (long call) are worse than that for the insurer component (covered call).

What could this mean for investor portfolios? In general, if the downside risk inherent in a given asset class is too much to bear, it is better simply to reduce the allocation to that asset class (i.e., to *de-risk*) rather than to buy insurance through options. Because the protected exposure has generated lower risk-adjusted returns, the de-risked portfolio should have a higher long-term average return for the same amount of risk taken.

Some investors might instead seek to be on the "other side" of those paying for insurance, and thus capture the volatility risk premium (e.g., through covered calls). For these investors, having losses solely experienced in "bad times" is likely to lead to higher long-term risk-adjusted returns.[10]

ENDNOTES

We thank Attakrit Asvanunt, Matthew Klein, and Harsha Tummala for help with analysis. We also thank Clifford Asness, Antti Ilmanen, and David Kabiller for helpful comments and suggestions. The views and opinions expressed herein are those of the authors and do not necessarily reflect the views of AQR Capital Management, LLC, its affiliates, or its employees. This document does not represent valuation judgments, investment advice, or research with respect to any financial instrument, issuer, security, or sector that may be described or referenced herein and does not represent a formal or official view of AQR.

[1]For the first decade of returns (1986–1996), we proxied the S&P 500 Index using the S&P 100 Index because options on the S&P 100 Index were more liquid and were frequently used during this period. For simplicity, in this article, we refer to the joint series as simply the S&P 500 Index.

[2]We attribute the S&P 500 Index's performance according to the preceding decomposition as follows: We begin with an S&P 500 Index position (or S&P 100 prior to 1996). Each day, we sell (and buy) the nearest maturity, monthly out-of-the-money call option with strike nearest to the index level and close out of the option position opened

on the prior day. These options are rolled daily in order to keep both the covered call and long call positions at-the-money. By construction, the returns of the two components combine to form the S&P 500 (or S&P 100) return. The daily rebalanced at-the-money covered call and long call portfolios we consider incur significant option trading costs. It is, however, possible to construct portfolios with very similar properties by trading a basket of one-month options, holding the options until their expiration, and dynamically hedging the equity exposure.

[3]We are not the first to show that S&P 500 at-the-money covered calls have returns comparable to those of the S&P 500 Index. Hill et al. [2006] also reported this result over the period from 1990 through 2005, and Kapadia and Szado [2012] reported a similar result for the Russell 2000 Index over the period from 1996 through 2011. However, we decompose the S&P 500 Index's return into its downside (covered call) and upside (long call) exposures, and in so doing show that downside risk is well compensated and upside participation is poorly compensated.

[4]See Berger, Nielsen, and Villalon [2011] and Asvanunt, Nielsen, and Villalon [2015] for the low returns to systematic protective put strategies. These studies highlighted some other strategies that reduce downside risk with less detrimental effects on return. AQR [2015] contrasts the ability of put options to protect against sudden drawdowns with trend-following strategies' ability to perform well in many protracted drawdowns while still earning positive long-run returns.

[5]See Kahneman and Tversky [1979] for different preferences in the domain of losses versus gains.

[6]Garleanu, Pedersen, and Poteshman [2009] presented a theoretical demand-based option pricing model showing how excessive demand for options leads to a volatility risk premium. Ilmanen [2012] asked, "Do financial markets reward buying or selling insurance and lottery tickets?" The author reported that selling insurance has provided positive long-run returns and buying insurance has delivered poor long-run returns (also see Ilmanen [2013] for a response to N.N. Taleb's [2013] criticism). Litterman [2011, p. 11] concluded his editorial titled "Who Should Hedge Tail Risk?" with the following: "My advice to long-term investors is that the next time someone knocks on the door selling a tail-risk insurance product, they should ask for a two-sided market. Perhaps the opportunity is on the other side."

[7]Calculated as beta multiplied by average excess return. For example, the covered call beta of 0.59 times the S&P 500 excess return of 7.6% equals 4.5%. The covered call average excess return of 6.3% in Exhibit 2 reflects both this equity risk premium contribution and a volatility risk premium.

[8]Israelov and Nielsen [2015] presented another performance attribution for covered calls in which the strategy's return is decomposed into *three* components: (1) long equity, (2) short volatility, and (3) equity timing. Their decomposition indicates that the S&P 500 at-the-money covered call has earned, on average, an annualized 3.2% in equity risk premium, 1.9% in volatility risk premium, and 0.6% in alpha from equity timing. Long equity, short volatility, and equity timing are responsible for, respectively, 65%, 7%, and 28% of the covered call's risk.

[9]Both covered calls and long calls have a bond beta near 0.5 that is multiplied by the 4.1% in-sample average excess return of the 10-year Treasury to give a bond risk premium contribution that is near 2.05% for both. Earning (paying) the volatility risk premium makes the covered call's (long call's) excess return somewhat higher (lower) than this.

[10]The fact that the risk in such volatility selling strategies is so painful makes it more likely that the risk premium will be sustained. Picking up pennies in front of a steamroller when the steamroller appears not at any arbitrary time but typically during financial crises—that warrants a risk premium. Of course, the sizing of this strategy within a portfolio must be carefully calibrated: Investors must ensure this strategy does not endanger their business. How to manage these risks is a topic for another article.

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