Managing Exposure to Extreme Markets

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Volatility in the equity markets has subsided, courtesy of a strong bull market and fading memories of the 2008 financial crisis. Risks remain, however, ranging from the turmoil in northern Africa to sovereign debt instability in Europe. Investors can take advantage of the complacency in the equity markets by purchasing inexpensive insurance against adverse events.

The most direct way to limit risk is through tail insurance. The simplest form of tail insurance is to purchase a derivative that limits portfolio losses under extreme adverse conditions.

In a previous article, I explored using put options on long-dated government bonds as a way to protect against a spike in interest rates. In this article, I explore tail insurance against a major decline in the S&P 500.

The most basic form of tail insurance is out-of-the-money (OTM) put options on an index ETF, such as the SPY. The goal of holding these put options is to limit the impact of extremely low-probability but tremendously severe events – so-called "black swans."

The challenge is that this type of protection against extreme market movements is usually expensive, a consideration I'll analyze in more detail later.

PIMCO, in particular, has popularized the concept of tail insurance. PIMCO launched its Global Multi Asset Fund (PGAIX) at the end of October 2008. One of the three explicit strategies this fund employs is to hedge against extreme outcomes with various forms of tail insurance. Since its launch, the fund has not out-performed a generic 60/40 portfolio (its stated benchmark), but we have not experienced sufficiently extreme market movements since the fund's launch to fairly evaluate the effectiveness of PIMCO's strategy.

PIMCO's approach emphasizes the importance of cheaply purchasing tail risk. In addition, PIMCO makes a point to analyze how a range of extreme scenarios can be managed and selects tail-risk instruments to fit specific worst-case scenarios. Doing so requires a probabilistic approach, which must be tempered by our limited ability to calculate the probabilities and severity of rare extreme events.

To evaluate the various forms of tail insurance available for protection against a major decline in the S&P500 (or any other market, for that matter), we must understand how options affect portfolio outcomes. In this article, I explore a series of ways to implement

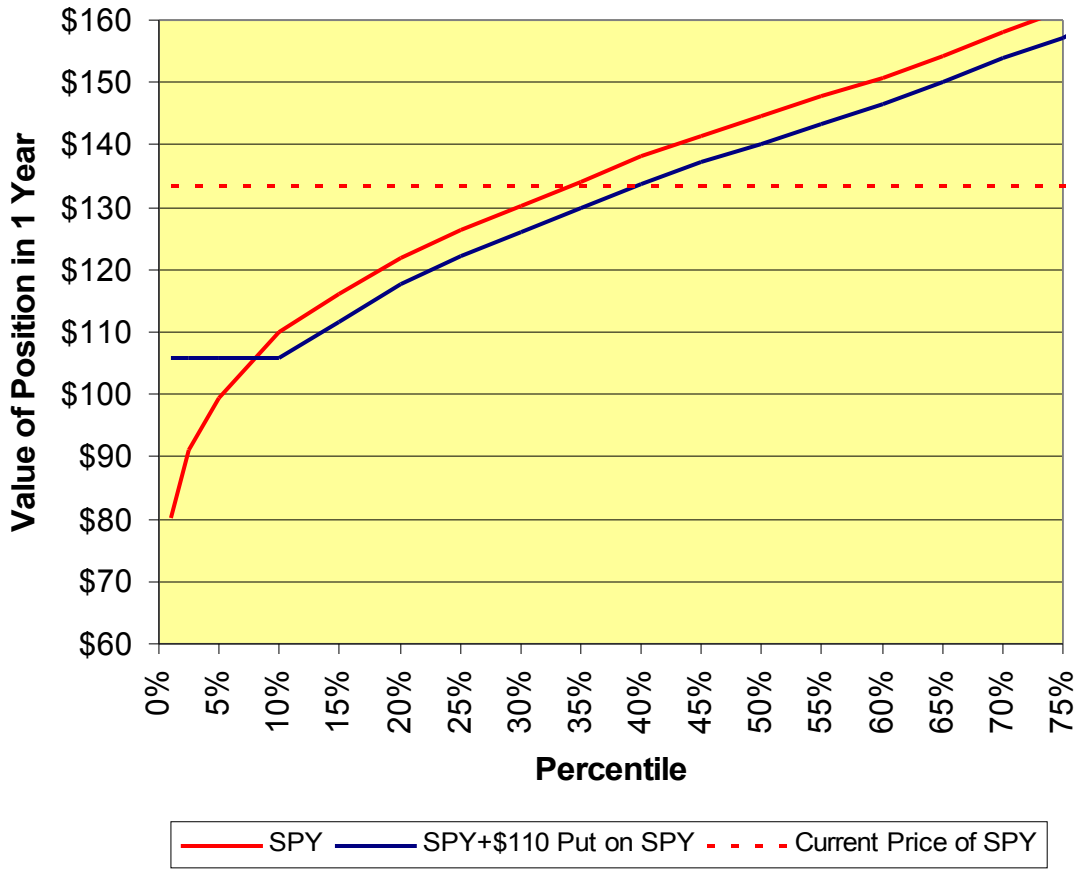
tail insurance against a decline in the S&P500, and I also consider the cost-effectiveness of each solution.

Understanding protective options

We will start with the simplest case. An investor who owns the S&P 500 via the ETF SPY can set a floor on his potential losses buying a put option on the ETF. The chart below shows a simulation of the future one-year outcomes for SPY, with and without the purchase of a one-year put option on SPY. This example estimates using current ask price for the put option – the actual price at which the put can be purchased – and the current implied volatility.

The chart below shows the estimated percentile probability of outcomes after one year. The 65th percentile outcome is for SPY is $155 after one year, for example. This means that there is a 65% probability that the price of SPY in 12 months will be at or below $155. Conversely, there is a 35% probability that SPY will be above $155 in 12 months.

One share of SPY vs. one share of SPY with a $110 put option



As of this writing, SPY is trading at $133.40, and a one-year put option on SPY with a strike of $110 costs $4.30. The put option, when combined with a share of SPY, puts a floor on the losses that can be incurred. The strike price of the option means that the option covers the potential for any decline in SPY below $110 at a cost equal to 3.2% of the value of a share of SPY.

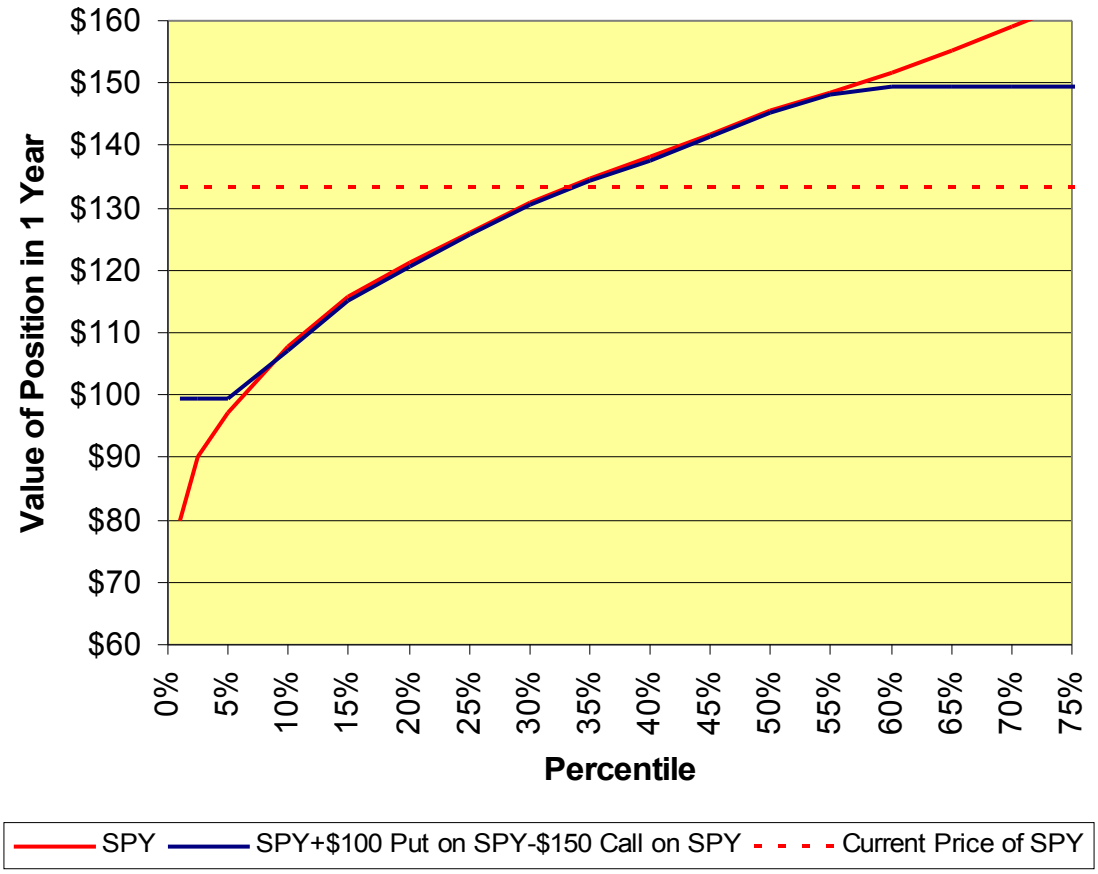
My estimate of the 1% worst-case for SPY, the lowest percentile I graph, over the next 12 months is approximately $80, a loss of 40%. I estimated this loss using current options prices and my asset pricing model, Quantext Portfolio Planner. Statistically, my confidence is not especially high that $80 is the worst 1-in-100 outcome over the next 12 months. Markets are famous for demonstrating that the probabilities of extreme events are not well understood. For our purposes, we are not going to try to model extreme events beyond what is forecast by the data, but we want to remember that they are lurking. It's important to maintain some humility regarding our calculations.

When we buy the put option and add it to the portfolio, we can immediately see the insurance effect. If the S&P 500 suffers a large loss, the hedged position cannot drop below $106, no matter how far down SPY goes. We also paid $4.30 for the put option, which leaves us with $105.70 in the absolute worst case.

The hedged portfolio (SPY plus $110 put) is very likely to be worth less than the share of SPY in one year. The value of SPY in the chart above is higher than the value of the hedged portfolio in 93% of the outcomes – the option only has a net positive payout in the worst 7% of cases for SPY.

After 12 months, the option expires, and we would have to purchase another put option if we wanted to maintain the tail insurance. Buying protective puts will deplete a portfolio over time.

One share of SPY vs. SPY + $100 Put + Short $150 Call



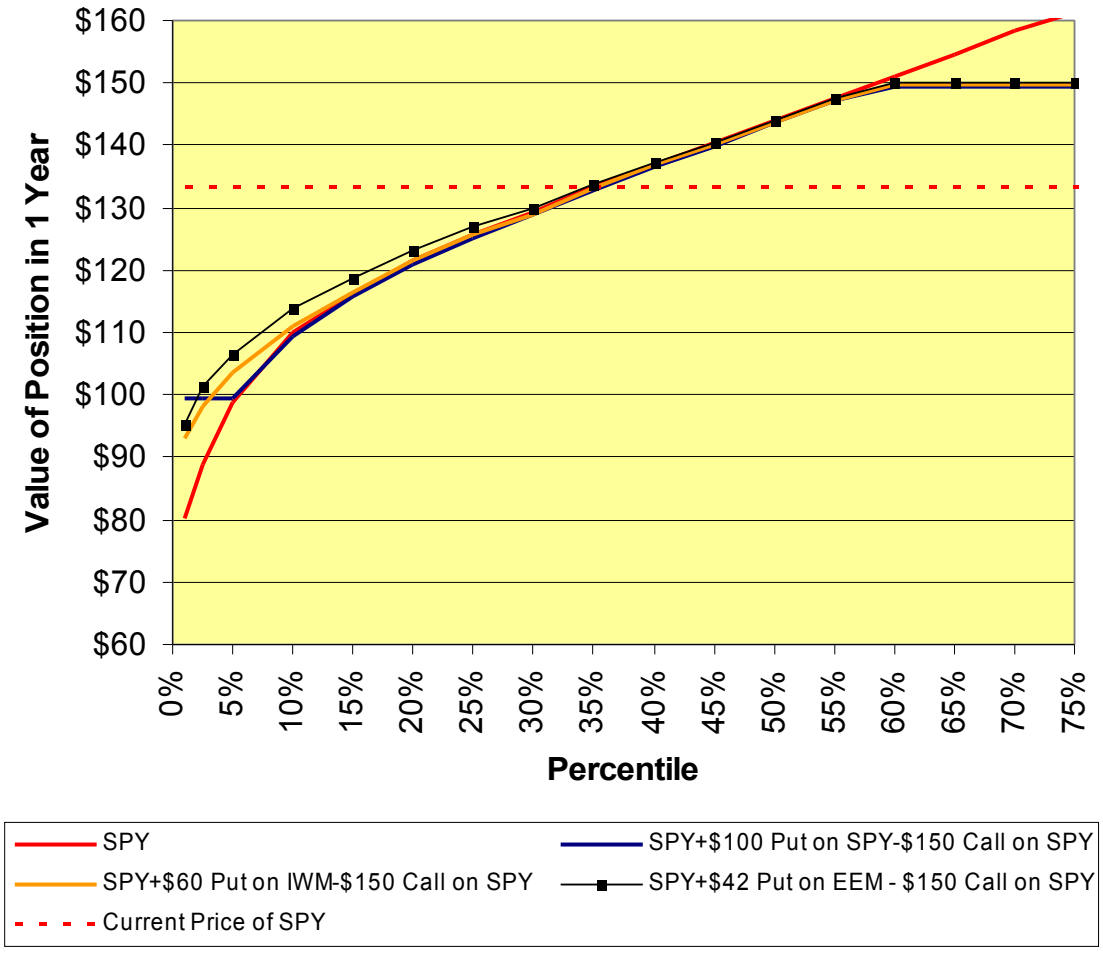
We can solve the problem of portfolio depletion if we finance the put option by selling a call option against the share of SPY. We can also choose a further out-of-the-money strike price for the put option to make the put option cheaper. The chart above shows the case in which we have sold a call with a strike of $150 and purchased a put with a strike of $100. We have protection against extreme adverse market moves, in exchange for which we have sold off the potential price appreciation above $150. The ask price for the one-year $100 put option on SPY is $2.70 (which means that the put option costs 2.0% of the value of a share of SPY). The call option with a strike at $150 can be sold for $2.30, slightly less than the value of the put, but largely offsetting the cost of the put. At the median (the 50th percentile), the hedged portfolio is almost indistinguishable from the unhedged position in SPY.

This tradeoff does not look a square deal. We are giving up all gains for market moves above $150 (12.4% above the current price) in exchange for protection against losses below $100 (25% below the current price). Indeed, put options are generally more expensive to buy than symmetrical call options are to sell. In technical terms, this effect is referred to as the volatility smirk.

Volatility smirk is a standard feature of equity markets, though the severity changes over time. The challenge is to determine whether the put options on SPY are worth their cost and whether the smirk is especially severe for the risk that we want to hedge.

Options on correlated indices

One alternative to buying put options on SPY is to buy OTM puts on other assets that highly correlate with it. Two such index ETFs are IWM (the Russell 2000, a proxy for US small-cap stocks) and EEM (the MSCI emerging market index). IWM has a 94% correlation to SPY, and EEM has a 90% correlation to SPY. We can look for put options on these two ETFs that have an ask price that is equal to what we can get by selling the $150 call on SPY. As of this writing, we can purchase a one-year, $42 put option on EEM (EEM is trading at $49.80 as of this writing) or a one-year $60 put option on IWM (IWM is trading at $85.20). The projected range of outcomes for these two alternatives is shown below.



Even though IWM and EEM are highly correlated to the S&P 500 (SPY), their imperfect correlation results in an imperfect hedge. For this reason, trying to hedge our exposure to the S&P500 using IWM or EEM does not provide the 'hard floor' on losses we get when we hedge SPY directly.

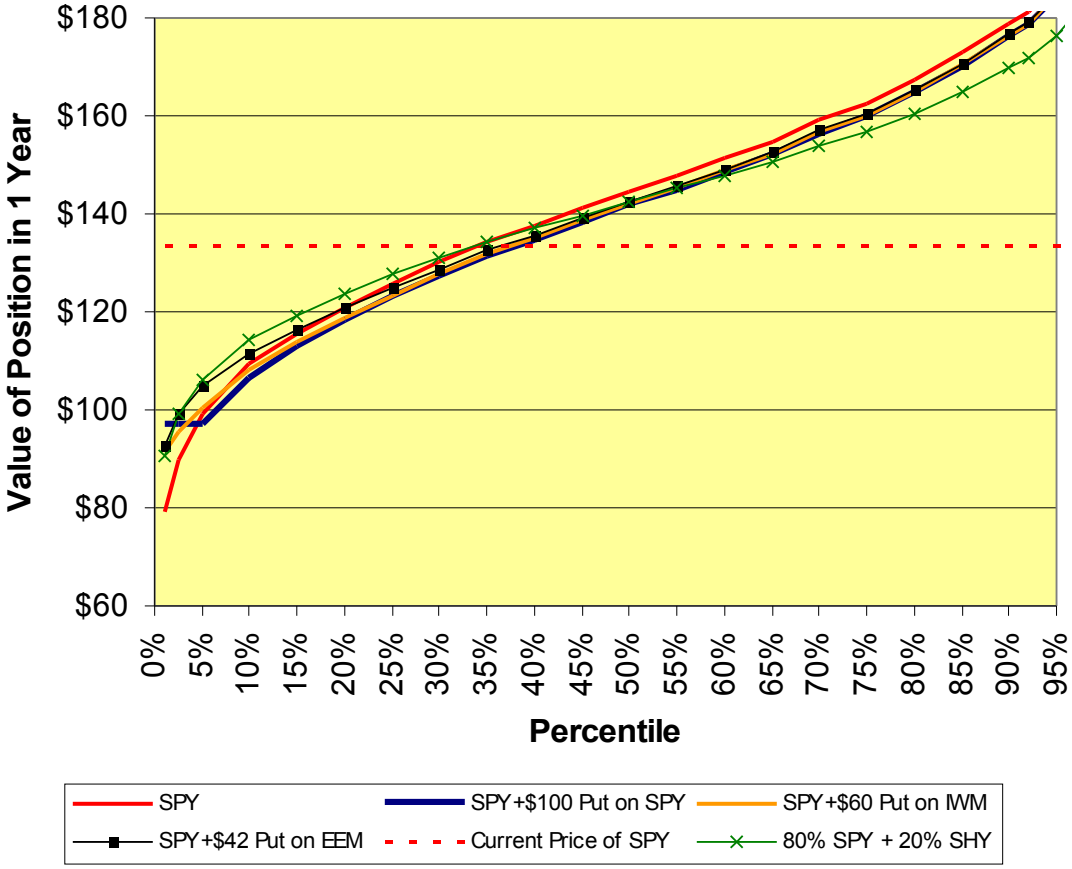
On the other hand, you get more downside protection in less-extreme cases by hedging with IWM and, especially, with EEM. From about the 5th percentile to the 20th percentile in the chart above, the outcomes for a combination of SPY with puts on EEM or IWM are higher than for SPY with a put on SPY. Given the uncertainties in these calculations, however, this apparent advantage is not guaranteed.

The results in the chart above were generated using a Monte Carlo simulation that accounts for the correlations between the S&P 500, the Russell 2000, and the MSCI Emerging Markets Index. The expected returns and volatilities were generated using Quantext Portfolio Planner and are consistent with the implied volatilities on the options on these index ETFs.

Using short-term bonds as a hedge

Another alternative to buying the put options on SPY or on highly correlated asset classes is to allocate part of the portfolio to a low-risk asset class, such as short-term bonds. The chart below compares four scenarios:

- A simple portfolio that is 80% allocated to SPY and 20% allocated to SHY, a short-term government bond index.
- An investment in SPY, with the purchase of the $100 put option on SPY,
- An investment in SPY with the purchase of the $42 put on EMM,
- An investment in SPY with the purchase of the $60 put on IWM.



Using short-term bonds for risk control provides similar 'soft' downside protection to buying put options on imperfectly correlated assets. The 80/20 portfolio gives up more of the market's upside than the portfolios hedged with put options. On the other hand, the median outcome (the 50th percentile) is essentially indistinguishable among all four of the scenarios above. In addition, the multi-period risk associated with having to repeatedly buy options is not present for the simple mix of SPY and SHY.

These examples illustrate the key issues that need to be addressed in managing tail risk in a portfolio using options.

It would be attractive to purchase put options on IWM or EEM rather than puts on SPY if those options were sufficiently cheaper than the put options on SPY, but that is not the case today. My analysis indicates that the options on SPY are fairly priced relative to other highly correlated equity indexes.

Given the lack of a solid floor provided by even highly correlated asset classes, a direct purchase of a put option on SPY is a good bet for tail insurance on broad equity exposure. Simply allocating a percentage to bonds does not provide the hard floor on losses either.

The $100 put option on SPY with a term of one year costs $2.70, equal to 2% of the current price of a share of SPY. For this $2.70, you get absolute protection from a decline in the S&P500 below $100. While OTM put options are typically expensive (e.g. the implied volatility of the puts is higher than the at-the-money options), the current over-pricing is not extreme.

One key consideration in the purchase of tail insurance is that market volatility changes dramatically through time. These changes are reflected in the prices of options on almost every asset class. In periods of low volatility, such as in early 2007 when VIX was around 10, options were cheap across asset classes. During periods of high volatility, like late 2008 when the market had crashed, VIX was above 80, and even the longest-dated options were very expensive. In November 2008, at-the-money (ATM) options on the S&P500 expiring in December 2009 had implied volatility of 45%. The equivalent put option to the $100 one-year put on SPY would have cost three times as much as it does today. The comparison is to an *equivalent* option because the market then was trading far below where it is today, so a similar OTM put option would have had a much lower strike price.

Protective options are much cheaper when the market has been going up and volatility is low, and these are the times when investors tend to be complacent. There is a simple analogy to hurricane insurance. People clamor to buy more insurance right after a hurricane hits. This behavioral flaw in the investors' interest in tail insurance has been widely noted. The longer it has been since a destructive hurricane, the fewer people want insurance, and prices drop.

Today, VIX is below 20, so tail protection is relatively cheap. That's not surprising. More surprising is that $100 put options on SPY expiring in December 2013 (2.7 years out) can be purchased at the same implied volatility (28%) as the one-year put options. These December 2013 put options can be purchased at a price of about $8.50 as of this writing, 6.4% of the current price of SPY. If market volatility rises in the next two years, these long-dated put options will appreciate in value.

Conclusions

A number of quantitative decisions factor into securing tail insurance against a large decline in equities. The first step is to look at the risk-return tradeoff of a direct purchase of a put option. Today, put options on the S&P 500 are attractively priced, but for the right price, the imperfect hedge provided by the put options on other, highly correlated markets would make sense, too. If the prevailing sentiment is more bullish on emerging markets than domestic equities, for example, put options on emerging markets could be a cheaper form of tail protection than put options on domestic equities. Similarly, if the correlation between EEM and SPY was higher and/or the implied volatility of emerging markets was lower, the put options on emerging markets might look more attractive than they do at this moment.

Overall, OTM put options on SPY are a reasonable deal at current prices. That said, the final comparison between an 80% SPY / 20% bond portfolio and hedging SPY with put options says that the option portfolio does not consistently dominate, given current prices. The primary advantage of tail insurance will be in the case of a major upward surge or a catastrophic decline in equity markets. The portfolio that is allocated 80% to SPY and 20% to bonds has a lower final value than any of the put-based solutions from the 65th percentile and higher (see previous chart). In an out-performing market (which we would equate to these higher percentile outcomes), owning a put option for tail protection is better than having a bond allocation.

In the majority of possible scenarios, simply managing risk with bonds will prove the most profitable. This point is confirmed by comparing the performance of PIMCO's Global Multi-Asset Fund (PGAIX) with Vanguard's 2010 Target Date Fund (VTENX) since the former's inception (see chart below). Recall that PGAIX employs tail insurance and aims to outperform a traditional stock-and-bond portfolio.

The Vanguard fund is one such simple mix of stocks and bonds. There has been substantial similarity in performance between these two funds, albeit with a period of divergence in mid-2010, and Vanguard's fund for the most part has outperformed consistently by a slim margin. This comparison does not disparage the tail insurance concept or its implementation by PIMCO. Quite to the contrary, the performance of a tail-hedged portfolio will be very similar to (but may lag behind) a portfolio in which risk is controlled via allocation to bonds *most of the time*. The only time that the value of tail insurance will be truly evident in performance is following a massive loss in the market.

Indeed, perhaps the greatest challenge for advisors who employ tail risk insurance is explaining to their clients where the true value lies.

Geoff Considine is the designer of Quantext Portfolio Planner, a portfolio analysis and management solution. More information is available at www.quantext.com.

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