Can You Hedge It with an ETF?

Testing The Efficacy of Exchange Traded Funds (ETFs) for Hedging Against Inflation, Volatility, a Weakening US Dollar, Geopolitical Risk & More

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Introduction

A portfolio hedge is a strategy for mitigating risk and preventing loss of capital in the face of varying market-wide or isolated risk factors. Mechanically, portfolio hedges use one investment or security to minimize the negative impact of adverse price swings in another investment within a portfolio. But a barrier to entry exists for a large number of advisors and investors: hedging often requires knowledge of, and access to, complex trading and portfolio construction techniques such as short selling, leverage, and financial derivatives. Additionally, these strategies can be expensive to implement and cause drag when the underlying asset performs.

Some risk factors that investors often wish to hedge against include inflation, market volatility, a weakening US Dollar, and geopolitical actions or threats. While it's not uncommon for concern over these risk factors to ebb and flow, when clients do raise questions and want to see action taken, what should advisors do?

Enter: our old friend the exchange traded fund, or ETF.

As advisors who aren't presently hedging with complex strategies likely have no plans to start, ETFs represent an actionable means for hedging risk factors and protecting portfolio value. Separately, while advisors who do hedge portfolios with short positions, derivatives, or other products are not likely to change their strategies based on this research, the impactfulness of a low cost and straightforward ETF hedge may still be of interest and worth consideration.

So just how badly do six common risk factors—inflation, volatility, market crashes, a weakening US Dollar, geopolitics, and climate change—affect the typical portfolio? Can existing ETF offerings effectively hedge against these risk factors? And if so, which ETF hedge at what allocation is most effective for risk management and performance benefits?

To help advisors and planners ascertain whether ETFs can be used to hedge risk factors, and better understand the efficacy of such portfolio hedges, this analysis seeks to answer these questions. Our findings shed light on the potential benefits and drawbacks of portfolio hedges using ETFs and may inform your own best practices for portfolio management.

Background & Information

A Sample 60/40 Portfolio, 60% equity and 40% fixed income, was created using five mutual funds (listed below) to represent the un-hedged risk and performance characteristics of an average portfolio. For each of the six risk factors examined, three to four ETF hedges were applied at 5%, 10%, and 15% allocations. Each ETF's ability to reduce risk exposure—as measured by Maximum Drawdown and 1-Year Standard Deviation of Daily Returns—and improve performance—given by absolute and annualized Total Return—was studied over three historically significant periods related to the six risk factors.

Periods of historical significance for each risk factor were determined using widely followed indicators like the US **Inflation Rate**, CBOE S&P 500 Volatility Index **(^VIX)**, and ICE US Dollar Index **(^DXY)**. Utilizing the benefits of historical data, hypothetical ETF hedges were entered and exited with perfect timing in order to capture the "best case" impact of each hedge.

When each ETF hedge was applied, the Sample 60/40 Portfolio's allocations to existing mutual fund holdings were decreased proportionately as the hedge was applied.

	Sample 60/40 Portfolio	5% ETF Hedge	10% ETF Hedge	15% ETF Hedge
Vanguard Total Stock Market Index (VTSMX)	35.00%	33.25%	31.50%	29.75%
Vanguard Total Bond Market Index (VBMFX)	30.00%	28.50%	27.00%	25.50%
Vanguard Total International Stock Index (VGTSX)	20.00%	19.00%	18.00%	17.00%
Vanguard Short-Term Bond Index (VBISX)	10.00%	9.50%	9.00%	8.50%
Vanguard Emerging Markets Stock Index (VEIEX)	5.00%	4.75%	4.50%	4.25%
ETF Hedge	-	5.00%	10.00%	15.00%

Key Findings

Across the six risk factors considered and three significant time periods related to each, some ETF hedging strategies were extremely effective at mitigating risk and improving portfolio performance, but other risk factors proved to be less manageable using ETFs. While these outcomes should not be extrapolated to the risk and performance impacts that every similar ETF might provide, they do provide a general sense of a given strategy's effectiveness.

1. Hedges against a stock market crash using a short S&P 500 ETF, gold ETFs, and cash were extremely effective for limiting max drawdowns and portfolio standard deviation

2. Inflation risks were hedged with moderate effectiveness using a commodities-focused ETF and Bitcoin, while the treasury inflation protected securities (TIPS) ETF and short-term fixed income ETF were less impactful

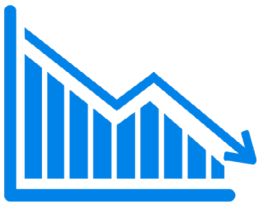
3. A precious metals ETF and gold ETF added risk management and improved performance to the Sample 60/40 Portfolio amid heightened concern over geopolitical risk, but a silver ETF delivered mixed results

4. ETF hedges against the market volatility, weakening US Dollar, and climate change risk factors were less reliable and in many cases had an adverse effect on portfolio risk and performance

How to Hedge Against...

Inflation

Volatility



Stock Market Crash

Weakening US Dollar

Geopolitical Risk

Climate Change

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Hedging Against Inflation

Hedging Against Inflation

Advisors and investors face the effects of inflation in both their daily lives and their portfolios. When the year-over-year **inflation rate** rises rapidly or moves beyond the Federal Reserve's target 2%, those effects become more noticeable and even painful. In a balanced portfolio, the market value of bond investments could decline, income can dry up, and rising costs cut into company profits and equity performance. To fight rising inflation, treasury inflation-protected securities (TIPS) and commodities have long been go-to options, while Bitcoin's finite supply—and high-flying performance—have made it an interesting addition to the conversation.

During the examined periods of rising inflation, hedging with Invesco DB Commodity Tracking (DBC) showed both risk and performance benefits. Bitcoin added significant upside with more severe drawdowns, while both iShares TIPS Bond ETF (TIP) and iShares 1-3 Year Treasury Bond ETF (SHY) offered marginal risk benefits but only marginally improved or hindered performance.

About the ETFs Used

Invesco DB Commodity Tracking (DBC)
- AUM (as of Oct 31, 2021): $2.91 billion
- Expense Ratio: 0.82%

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iShares 1-3 Year Treasury Bond ETF (SHY)
- AUM (as of Oct 31, 2021): $20.03 billion
- Expense Ratio: 0.15%

→ **See similar ETFs in YCharts**

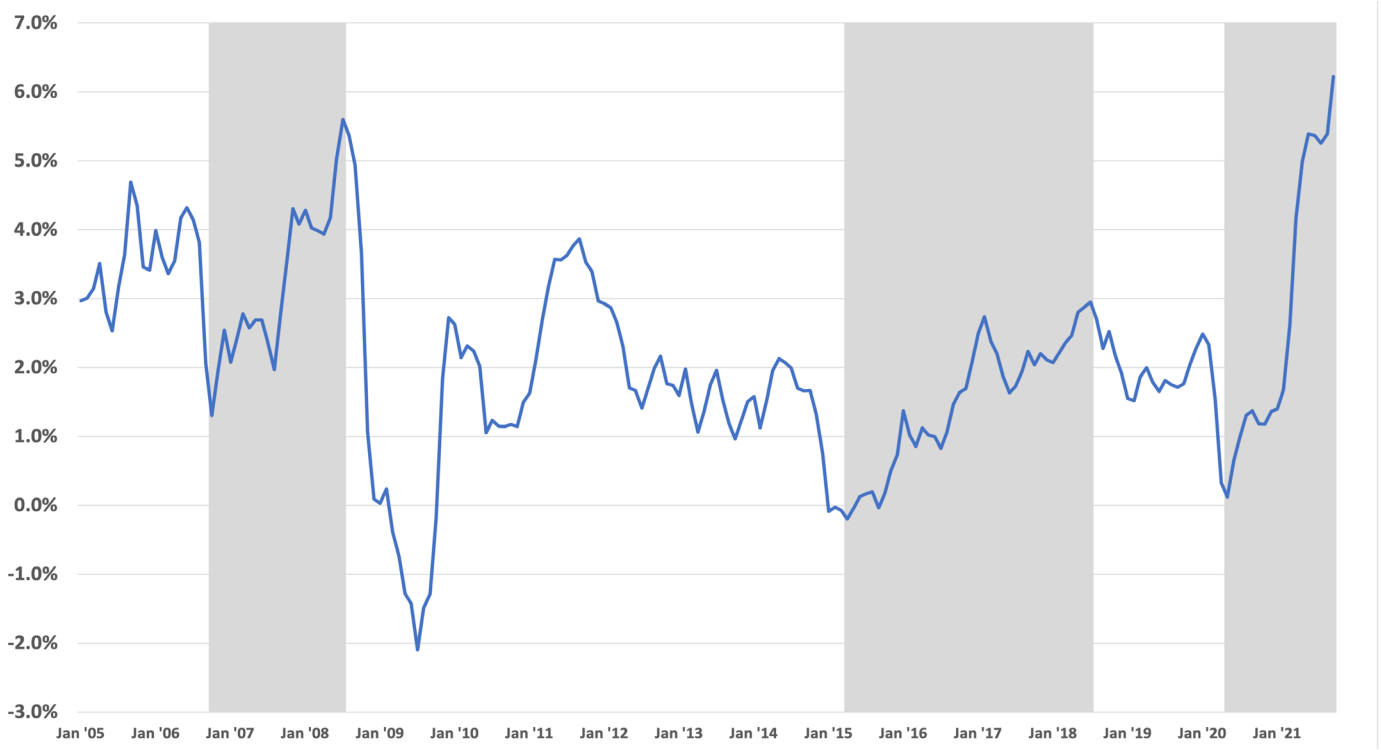
iShares TIPS Bond ETF (TIP)
- AUM (as of Oct 31, 2021): $35.77 billion
- Expense Ratio: 0.19%

→ **See similar ETFs in YCharts**

Bitcoin (BTC)
- To maximize available history, the actual **Bitcoin Price** was used as a proxy.

→ **See Crypto & Blockchain ETFs in YCharts**

Periods Tested for Hedging Inflation with ETFs



Periods Tested

- October 2006 - July 2008*
- April 2015 - July 2018
- May 2020 - October 2021

US Inflation Rates

* Bitcoin (BTC) hedge not shown because period predates its trading

Period 1: October 2006 - July 2008

In the 18 months from October 2006 to July 2008, inflation rose to 5.6% from a decade low of 1.3%. Examining each hedge's impact on the portfolio's max drawdown and standard deviation from late 2006 through mid 2008, the Invesco DB Commodity Tracking **(DBC)**, iShares TIPS Bond ETF **(TIP)** and iShares 1-3 Year Treasury Bond ETF **(SHY)** each offered a couple percentage points of downside protection and reduced risk relative to the benchmark. Though not reflected in standard deviation, DBC's benefits—and commodities' by extension—as an inflation hedge were strongest in limiting portfolio drawdown.

Inflation Hedge	October 2006 - July 2008	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-11.59%	0.55%
5% Hedge		
Invesco DB Commodity Tracking (DBC)	-8.83%	0.54%
iShares TIPS Bond ETF (TIP)	-10.56%	0.53%
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.83%	0.53%
10% Hedge		
Invesco DB Commodity Tracking (DBC)	-7.61%	0.53%
iShares TIPS Bond ETF (TIP)	-9.52%	0.50%
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.06%	0.51%
15% Hedge		
Invesco DB Commodity Tracking (DBC)	-7.12%	0.53%
iShares TIPS Bond ETF (TIP)	-8.47%	0.48%
iShares 1-3 Year Treasury Bond ETF (SHY)	-9.28%	0.49%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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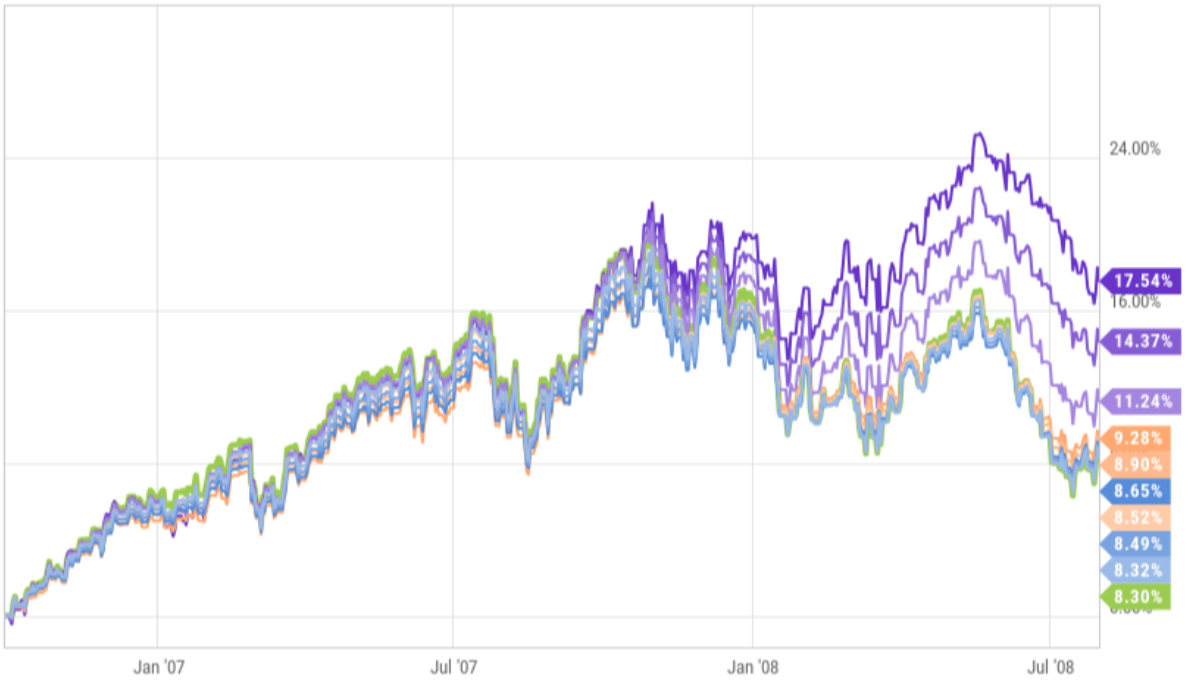
In a period where commodities offered superior downside protection (see risk table), a 15% allocation to Invesco DB Commodity Tracking **(DBC)** also delivered a 9.2% annualized total return versus the Sample Portfolio's 4.4%.

Each DBC, TIP, and SHY hedge improved portfolio performance across all allocation percentages, but TIP and SHY offered only marginally better returns.

Hedging Inflation With DBC, TIP, SHY & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	8.30%	4.44%
60/40 Sample Portfolio - 15% Inflation Hedge - DBC Total Return	17.54%	9.19%
60/40 Sample Portfolio - 10% Inflation Hedge - DBC Total Return	14.37%	7.58%
60/40 Sample Portfolio - 5% Inflation Hedge - DBC Total Return	11.24%	5.96%
60/40 Sample Portfolio - 15% Inflation Hedge - TIP Total Return	9.28%	4.94%
60/40 Sample Portfolio - 10% Inflation Hedge - TIP Total Return	8.90%	4.75%
60/40 Sample Portfolio - 5% Inflation Hedge - TIP Total Return	8.52%	4.55%
60/40 Sample Portfolio - 15% Inflation Hedge - SHY Total Return	8.65%	4.62%
60/40 Sample Portfolio - 10% Inflation Hedge - SHY Total Return	8.49%	4.53%
60/40 Sample Portfolio - 5% Inflation Hedge - SHY Total Return	8.32%	4.44%



Date Range: 09/29/2006 - 07/31/2008

Bitcoin (BTC) Hedge not shown because period predates it.

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Period 2: April 2015 - July 2018

In April 2015, the inflation rate actually stood at a deflationary -0.20% but rose steadily to 2.95% by July 2018. When hedging inflation with any allocation to **Bitcoin**, drawdowns and portfolio standard deviation worsened. Using a 10% hedge or greater, holding Bitcoin more than doubled the severity of the Sample Portfolio's max drawdown from April 2015 through July 2018.

While the Invesco DB Commodity Tracking **(DBC)** hedge also worsened drawdowns, allocations to iShares TIPS Bond ETF **(TIP)** and iShares 1-3 Year Treasury Bond ETF **(SHY)** yielded a marginally better standard deviation and lessened drawdowns by anywhere from 0.51 to 1.78 percentage points in the period.

Inflation Hedge	April 2015 - July 2018	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-11.56%	0.44%
5% Hedge		
Invesco DB Commodity Tracking (DBC)	-12.53%	0.44%
iShares TIPS Bond ETF (TIP)	-11.05%	0.42%
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.92%	0.42%
Bitcoin (BTC)	-17.42%	0.69%
10% Hedge		
Invesco DB Commodity Tracking (DBC)	-13.76%	0.44%
iShares TIPS Bond ETF (TIP)	-10.59%	0.40%
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.33%	0.40%
Bitcoin (BTC)	-24.96%	0.94%
15% Hedge		
Invesco DB Commodity Tracking (DBC)	-15.06%	0.45%
iShares TIPS Bond ETF (TIP)	-10.17%	0.38%
iShares 1-3 Year Treasury Bond ETF (SHY)	-9.74%	0.38%
Bitcoin (BTC)	-29.90%	1.16%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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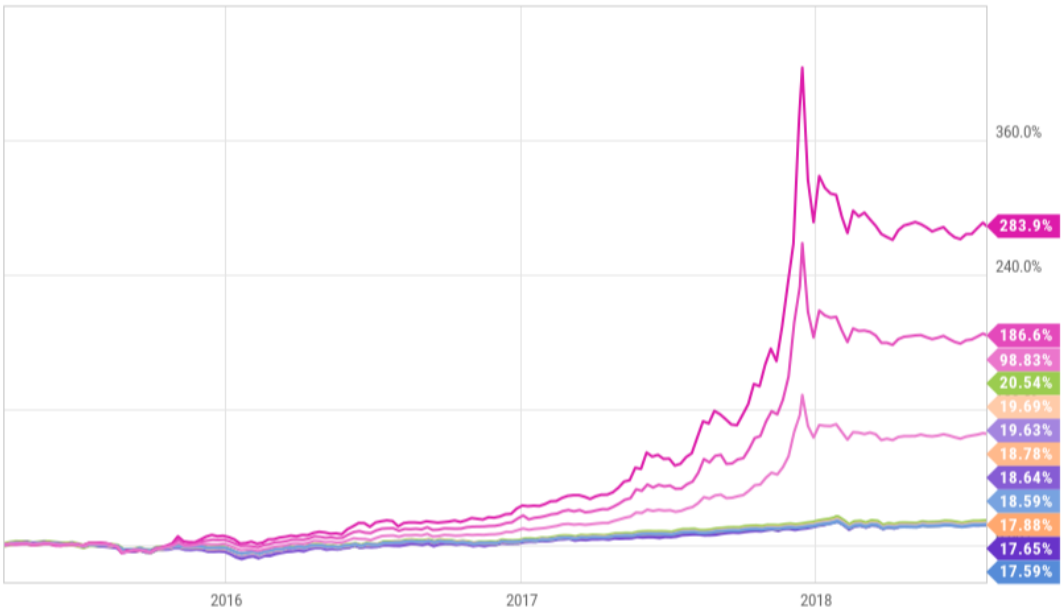
With the inflation rate moving upwards out of negative territory, hedging rising prices with **Bitcoin** was more of a timely trade than hedger of risk. While the Sample 60/40 Portfolio grew at a healthy 5.76% annual rate, even just a 5% allocation to Bitcoin easily quadrupled that performance.

While hedging with Bitcoin also more than doubled the portfolio's drawdowns (see risk table), hedging with commodities **(DBC)**, TIPS **(TIP)**, and short-term bonds **(SHY)** added no additional return in the period.

Hedging Inflation With DBC, TIP, SHY & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	20.54%	5.76%
60/40 Sample Portfolio - 15% Inflation Hedge - DBC Total Return	17.65%	5.00%
60/40 Sample Portfolio - 10% Inflation Hedge - DBC Total Return	18.64%	5.26%
60/40 Sample Portfolio - 5% Inflation Hedge - DBC Total Return	19.63%	5.52%
60/40 Sample Portfolio - 15% Inflation Hedge - TIP Total Return	17.88%	5.06%
60/40 Sample Portfolio - 10% Inflation Hedge - TIP Total Return	18.78%	5.30%
60/40 Sample Portfolio - 5% Inflation Hedge - TIP Total Return	19.69%	5.54%
60/40 Sample Portfolio - 15% Inflation Hedge - SHY Total Return	17.59%	4.98%
60/40 Sample Portfolio - 10% Inflation Hedge - SHY Total Return	18.59%	5.25%
60/40 Sample Portfolio - 15% Inflation Hedge - Bitcoin Total Return	283.9%	49.70%
60/40 Sample Portfolio - 10% Inflation Hedge - Bitcoin Total Return	186.6%	37.14%
60/40 Sample Portfolio - 5% Inflation Hedge - Bitcoin Total Return	98.83%	22.89%



Date Range: 04/01/2015 - 07/31/2018

Not shown for space limitations: 5% Inflation Hedge Using SHY; period performance: 19.59% or 5.51% annualized.

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Period 3: May 2020 - October 2021

Inflation rose most dramatically in the wake of the COVID-19 pandemic, starting at 0.1% in May 2020 and cresting 6.2% in October 2021. In that time, a Bitcoin portfolio hedge again worsened the Sample 60/40 Portfolio's standard deviation and max drawdown. Adding iShares TIPS Bond ETF **(TIP)** and iShares 1-3 Year Treasury Bond ETF **(SHY)** to the portfolio had a positive but minor effect, and the Invesco DB Commodity Tracking **(DBC)** hedge led to virtually no difference in terms of risk management.

Inflation Hedge	May 2020 - October 2021	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-4.57%	0.82%
5% Hedge		
Invesco DB Commodity Tracking (DBC)	-4.81%	0.84%
iShares TIPS Bond ETF (TIP)	-4.70%	0.83%
iShares 1-3 Year Treasury Bond ETF (SHY)	-4.68%	0.83%
Bitcoin (BTC)	-4.62%	0.87%
10% Hedge		
Invesco DB Commodity Tracking (DBC)	-4.75%	0.84%
iShares TIPS Bond ETF (TIP)	-4.50%	0.81%
iShares 1-3 Year Treasury Bond ETF (SHY)	-4.46%	0.81%
Bitcoin (BTC)	-7.91%	0.96%
15% Hedge		
Invesco DB Commodity Tracking (DBC)	-4.68%	0.85%
iShares TIPS Bond ETF (TIP)	-4.31%	0.80%
iShares 1-3 Year Treasury Bond ETF (SHY)	-4.24%	0.79%
Bitcoin (BTC)	-11.98%	1.09%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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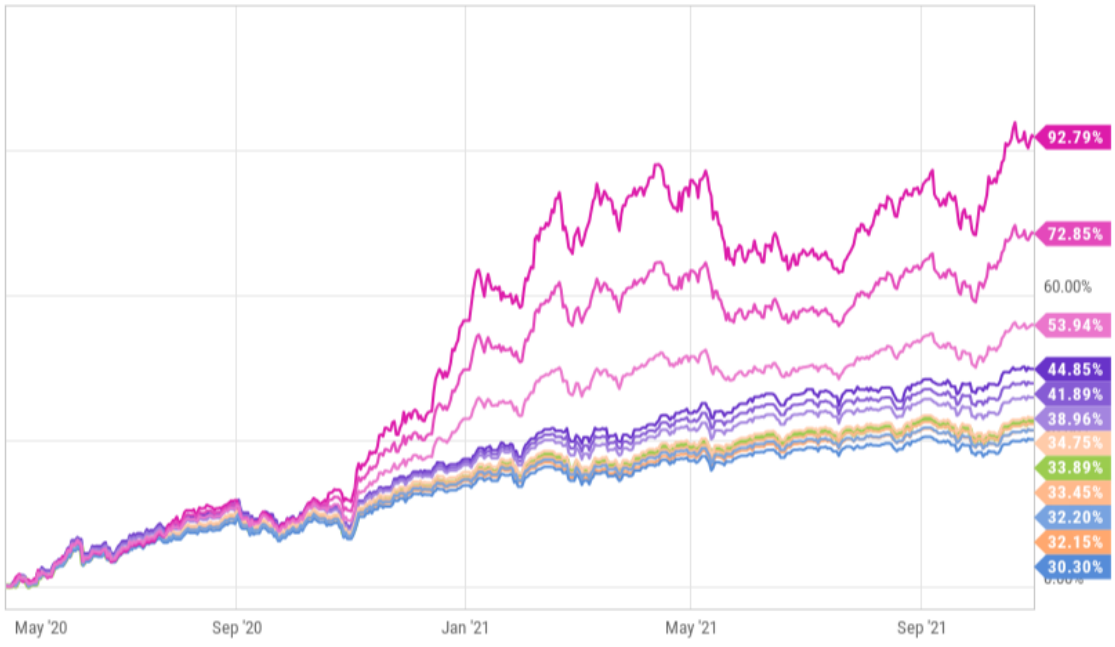
During a record-breaking rise in the inflation rate, a 5% hedge to Invesco's DB Commodity Tracking ETF **(DBC)** added 3 points of annual total return. A 15% hedge added 6.5 points and any allocation to DBC offered marginal risk benefits as well.

Bitcoin, however, once again stole the show. Albeit with noteworthy volatility, the leading cryptocurrency added significant outperformance to the portfolio while inflation rose to multi-decade high.

Hedging Inflation With DBC, TIP, SHY & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	33.89%	21.45%
60/40 Sample Portfolio - 15% Inflation Hedge - DBC Total Return	44.85%	27.99%
60/40 Sample Portfolio - 10% Inflation Hedge - DBC Total Return	41.89%	26.24%
60/40 Sample Portfolio - 5% Inflation Hedge - DBC Total Return	38.96%	24.50%
60/40 Sample Portfolio - 15% Inflation Hedge - TIP Total Return	32.15%	20.41%
60/40 Sample Portfolio - 10% Inflation Hedge - TIP Total Return	33.45%	21.19%
60/40 Sample Portfolio - 5% Inflation Hedge - TIP Total Return	34.75%	21.97%
60/40 Sample Portfolio - 15% Inflation Hedge - SHY Total Return	30.30%	19.28%
60/40 Sample Portfolio - 10% Inflation Hedge - SHY Total Return	32.20%	20.44%
60/40 Sample Portfolio - 15% Inflation Hedge - Bitcoin Total Return	92.79%	54.84%
60/40 Sample Portfolio - 10% Inflation Hedge - Bitcoin Total Return	72.85%	43.98%
60/40 Sample Portfolio - 5% Inflation Hedge - Bitcoin Total Return	53.94%	33.28%



Date Range: 05/01/2020 - 10/31/2021

Not shown for space limitations: 5% Inflation Hedge Using SHY; period performance: 34.12% or 21.60% annualized.

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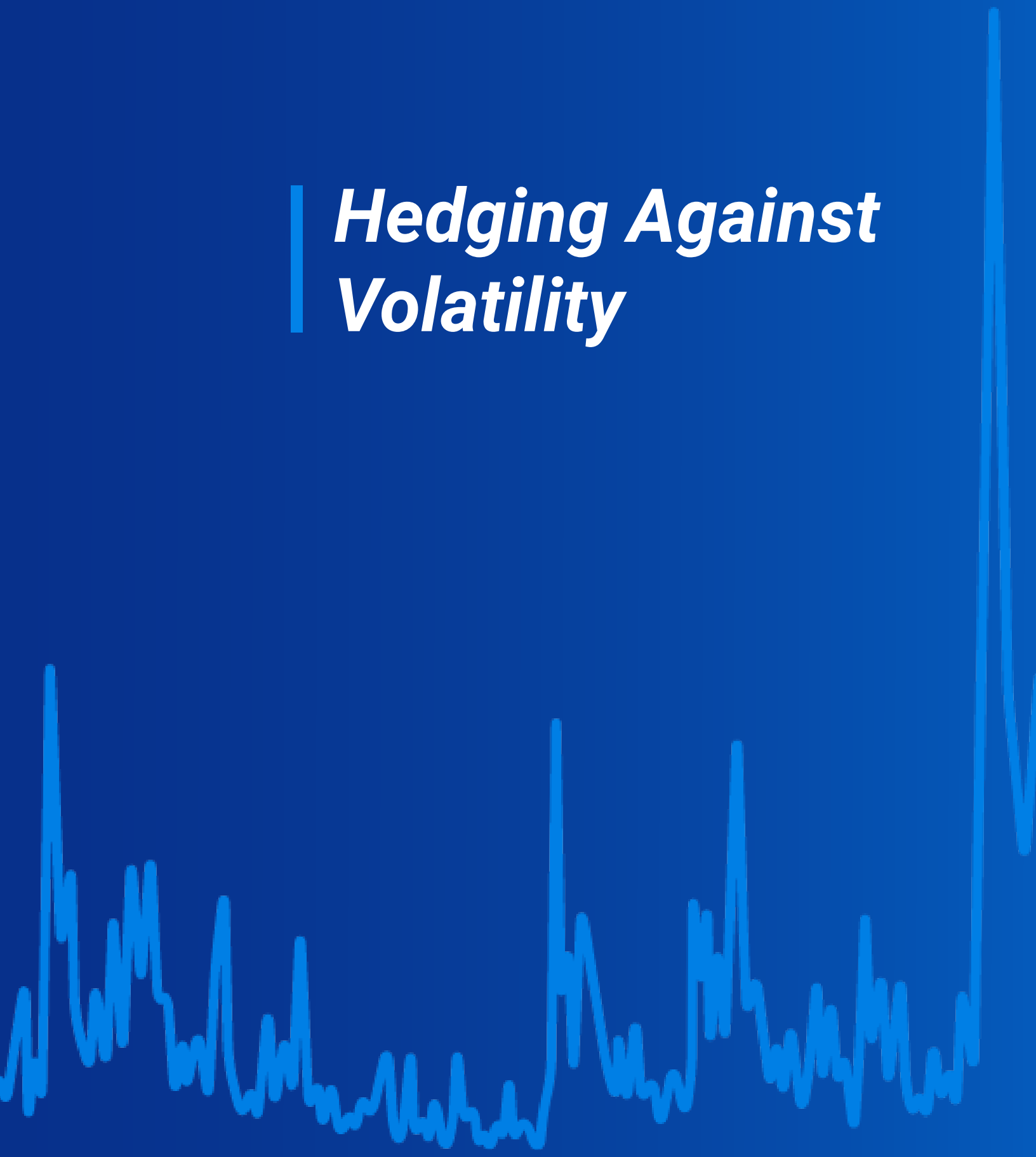
Hedging Against Volatility



Hedging Against Volatility

The CBOE S&P 500 Volatility Index **(^VIX)**, known as the "fear index", is calculated from activity and pricing on options contracts, and it's generally accepted that VIX levels below 20 indicate market stability and levels above 30 mark increased volatility. As advisors know, some investors just can't stomach the jerkiness of markets today and, more critically, volatility can also impact availability of capital. Purpose-built "limited volatility" or "low vol" funds, which screen out volatile stocks, have risen in popularity to join short-term treasuries as common volatility hedges. For opportunists, derivatives-based products like iPath® B S&P 500® VIX Short-Term Futures™ ETN **(VXX)** have emerged to offer upside when volatility surges.

Portfolio hedges using Cash and iShares 1-3 Year Treasury Bond ETF **(SHY)** offered stability when the VIX spiked, while Invesco S&P 500® Low Volatility ETF **(SPLV)** generally improved performance. The more complex iPath® B S&P 500® VIX Short-Term Futures™ ETN **(VXX)** added significant downside protection, but introduced more timing risk as it depreciates when the VIX falls from high values.

About the ETFs Used

iShares 1-3 Year Treasury Bond ETF (SHY)
- AUM (as of Oct 31, 2021): $20.03 billion
- Expense Ratio: 0.15%

→ **See similar ETFs in YCharts**

iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)
- AUM (as of Oct 31, 2021): $1.09 billion
- Expense Ratio: 0.89%

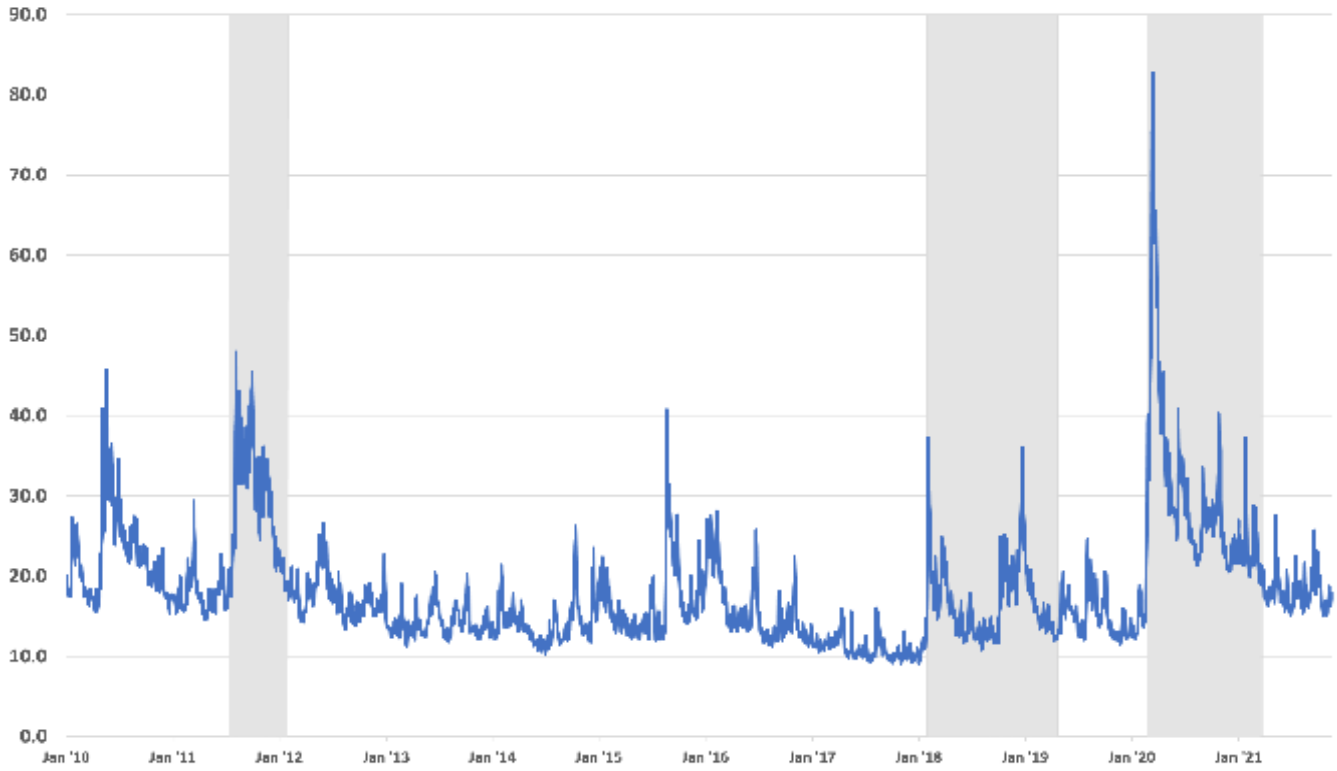
→ **See similar ETFs in YCharts**

Invesco S&P 500® Low Volatility ETF (SPLV)
- AUM (as of Oct 31, 2021): $8.06 billion
- Expense Ratio: 0.25%

→ **See similar ETFs in YCharts**

Cash
- As a proxy for holding cash in a portfolio, a YCharts **Custom Security** with a constant level of 1.00 and return of 0.0% was used.

Periods Tested for Hedging Volatility with ETFs



Periods Tested

- July 14, 2011 - February 3, 2012*
- January 31, 2018 - April 25, 2019
- February 24, 2020 - March 30, 2021

CBOE S&P 500 Volatility Index Level

* iPath B S&P 500 VIX S/T Futures ETN (VXX) hedge not shown because period predates its trading.

Period 1: July 14, 2011 - February 3, 2012

The **VIX** started July 2011 at a level of 15.87 but jumped to 48.00 five weeks later, moving quickly from the sub-20 "stable" band into the "high volatility" range above 30. In that time, the ETFs and Cash hedges had a beneficial impact on portfolio max drawdown and standard deviation. Hedging volatility with iShares 1-3 Year Treasury Bond ETF **(SHY)** was most effective and reduced the portfolio's max drawdown by 1.78 percentage points, while a Cash hedge providing nearly the same benefits. The purpose-built Invesco S&P 500® Low Volatility ETF **(SPLV)** also limited drawdowns but marginally worsened portfolio standard deviation.

Volatility Hedge	Jul 14, 2011 - Feb 3, 2012	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-12.06%	0.74%
5% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-11.45%	0.71%
Invesco S&P 500® Low Volatility ETF (SPLV)	-11.82%	0.74%
Cash	-11.47%	0.71%
10% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.84%	0.69%
Invesco S&P 500® Low Volatility ETF (SPLV)	-11.57%	0.75%
Cash	-10.87%	0.69%
15% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-10.22%	0.66%
Invesco S&P 500® Low Volatility ETF (SPLV)	-11.32%	0.75%
Cash	-10.28%	0.66%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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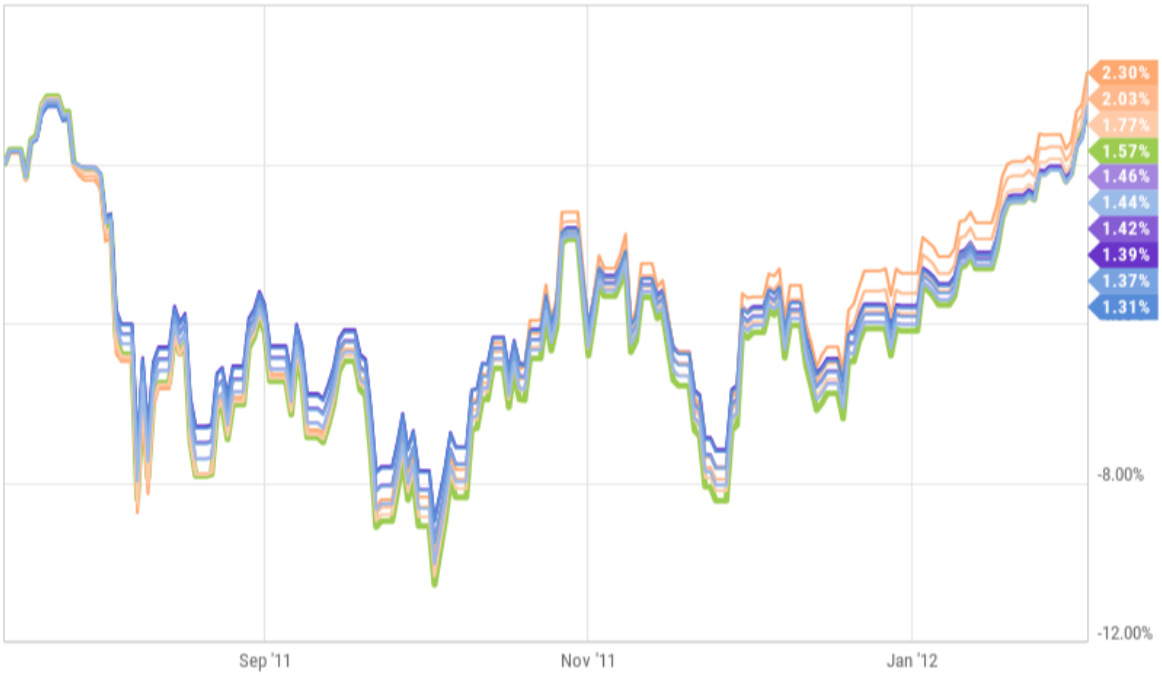
After the **VIX** spiked in mid-2011, the Invesco S&P 500® Low Volatility ETF **(SPLV)** slightly improved portfolio performance over the period examined, something **SHY** and a Cash hedge failed to do.

Overall, volatility hedges were not very impactful as the VIX wound down from its initial, dramatic spike. (Note: VXX hedge is not shown as this time period predates its trading.)

Hedging Volatility With SHY, SPLV, Cash & VXX

	VAL	ANN
60/40 Sample Portfolio Total Return	1.57%	2.82%
60/40 Sample Portfolio - 15% Volatility Hedge - SHY Total Return	1.39%	2.49%
60/40 Sample Portfolio - 10% Volatility Hedge - SHY Total Return	1.42%	2.56%
60/40 Sample Portfolio - 5% Volatility Hedge - SHY Total Return	1.46%	2.63%
60/40 Sample Portfolio - 15% Volatility Hedge - SPLV Total Return	2.30%	4.15%
60/40 Sample Portfolio - 10% Volatility Hedge - SPLV Total Return	2.03%	3.67%
60/40 Sample Portfolio - 5% Volatility Hedge - SPLV Total Return	1.77%	3.19%
60/40 Sample Portfolio - 15% Volatility Hedge - Cash Total Return	1.31%	2.35%
60/40 Sample Portfolio - 10% Volatility Hedge - Cash Total Return	1.37%	2.47%
60/40 Sample Portfolio - 5% Volatility Hedge - Cash Total Return	1.44%	2.58%



Date Range: 07/14/2011 - 02/03/2012

iPath B S&P 500 VIX S/T Futures ETN (VXX) Hedge not shown because period predates it.

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Period 2: January 31, 2018 - April 25, 2019

After declining consistently throughout 2017 and ending that year at just 11.04, the **VIX** spiked higher than 35 on two occasions in 2018 and echoed into 2019. In that timeframe the iPath® B S&P 500® VIX S/T Futs™ ETN **(VXX)** hedge proved to be the best volatility "smoother", but had unique impacts at different allocations. This is likely due to its direct inverse relationship to the VIX and the latter's two spikes in the period tested.

Cash and iShares 1-3 Year Treasury Bond ETF **(SHY)** hedges also added downside protection to the Sample 60/40 Portfolio, but hedging with Invesco S&P 500® Low Volatility ETF **(SPLV)** was relatively ineffective.

Volatility Hedge	Jan 31, 2018 - Apr 25, 2019	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-10.86%	0.43%
5% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-9.95%	0.41%
Invesco S&P 500® Low Volatility ETF (SPLV)	-10.38%	0.43%
Cash	-10.03%	0.41%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-7.14%	0.27%
10% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-9.35%	0.39%
Invesco S&P 500® Low Volatility ETF (SPLV)	-10.28%	0.44%
Cash	-9.50%	0.39%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-6.68%	0.33%
15% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-8.74%	0.37%
Invesco S&P 500® Low Volatility ETF (SPLV)	-10.27%	0.44%
Cash	-8.97%	0.37%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-10.09%	0.52%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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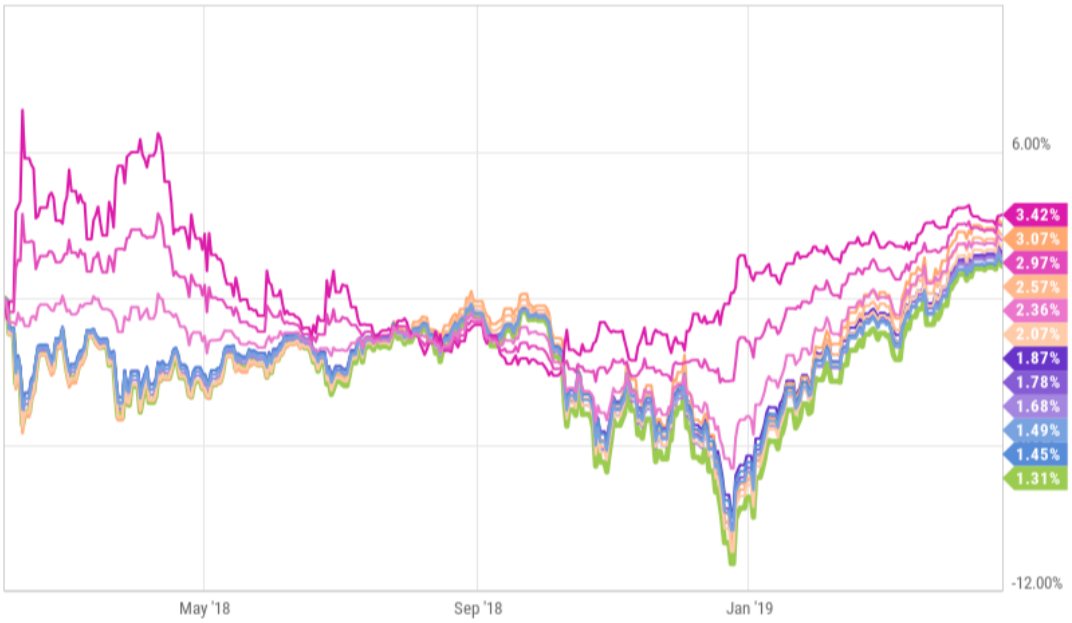
In a 15-month period containing two considerable and sudden spikes in the **VIX**, every hedge tested improved performance. However, allocations to the nascent iPath® B S&P 500® VIX S/T Futs™ ETN **(VXX)** and specialty Invesco S&P 500® Low Volatility ETF **(SPLV)** fared best.

In a unique period—in which the VIX rose, fell, then rose again, then fell again—it's easier to notice how hedging with VXX can negatively impact performance as the VIX snaps back from a harsh spike.

Hedging Volatility With SHY, SPLV, Cash & VXX

	VAL	ANN
60/40 Sample Portfolio Total Return	1.31%	1.06%
60/40 Sample Portfolio - 15% Volatility Hedge - SHY Total Return	1.87%	1.52%
60/40 Sample Portfolio - 10% Volatility Hedge - SHY Total Return	1.78%	1.44%
60/40 Sample Portfolio - 5% Volatility Hedge - SHY Total Return	1.68%	1.37%
60/40 Sample Portfolio - 15% Volatility Hedge - SPLV Total Return	3.07%	2.49%
60/40 Sample Portfolio - 10% Volatility Hedge - SPLV Total Return	2.57%	2.08%
60/40 Sample Portfolio - 5% Volatility Hedge - SPLV Total Return	2.07%	1.68%
60/40 Sample Portfolio - 15% Volatility Hedge - Cash Total Return	1.45%	1.17%
60/40 Sample Portfolio - 10% Volatility Hedge - Cash Total Return	1.49%	1.21%
60/40 Sample Portfolio - 15% Volatility Hedge - VXX Total Return	3.42%	2.77%
60/40 Sample Portfolio - 10% Volatility Hedge - VXX Total Return	2.97%	2.41%
60/40 Sample Portfolio - 5% Volatility Hedge - VXX Total Return	2.36%	1.91%



Date Range: 01/31/2018 - 04/25/2019

Not shown for space limitations: 5% Volatility Hedge Using Cash; period performance: 1.54% or 1.25% annualized.

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Period 3:
February 24, 2020 - March 30, 2021

The CBOE S&P 500 Volatility Index **(^VIX)** set an all-time record high of 82.69 on March 16, 2020, then lowered slowly but remained elevated through the start of 2021. Two volatility hedges stood out in the period, and for opposite reasons.

Although built for just this occasion, the Invesco S&P 500® Low Volatility ETF **(SPLV)** worsened max drawdown by more than a couple percentage points. At the same time, just a 5% hedge using the iPath® B S&P 500® VIX S/T Futs™ ETN **(VXX)** cut the Sample 60/40 Portfolio's drawdowns in half, and nearly did the same to portfolio standard deviation.

Volatility Hedge	Feb 24, 2020 - Mar 30, 2021 Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-18.76%	0.99%
5% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-18.02%	0.95%
Invesco S&P 500® Low Volatility ETF (SPLV)	-19.84%	1.04%
Cash	-18.11%	0.95%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-9.09%	0.59%
10% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-16.97%	0.90%
Invesco S&P 500® Low Volatility ETF (SPLV)	-20.62%	1.08%
Cash	-17.15%	0.90%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-10.04%	0.73%
15% Hedge		
iShares 1-3 Year Treasury Bond ETF (SHY)	-15.93%	0.85%
Invesco S&P 500® Low Volatility ETF (SPLV)	-21.40%	1.12%
Cash	-16.20%	0.85%
iPath® B S&P 500® VIX S/T Futs™ ETN (VXX)	-16.63%	1.09%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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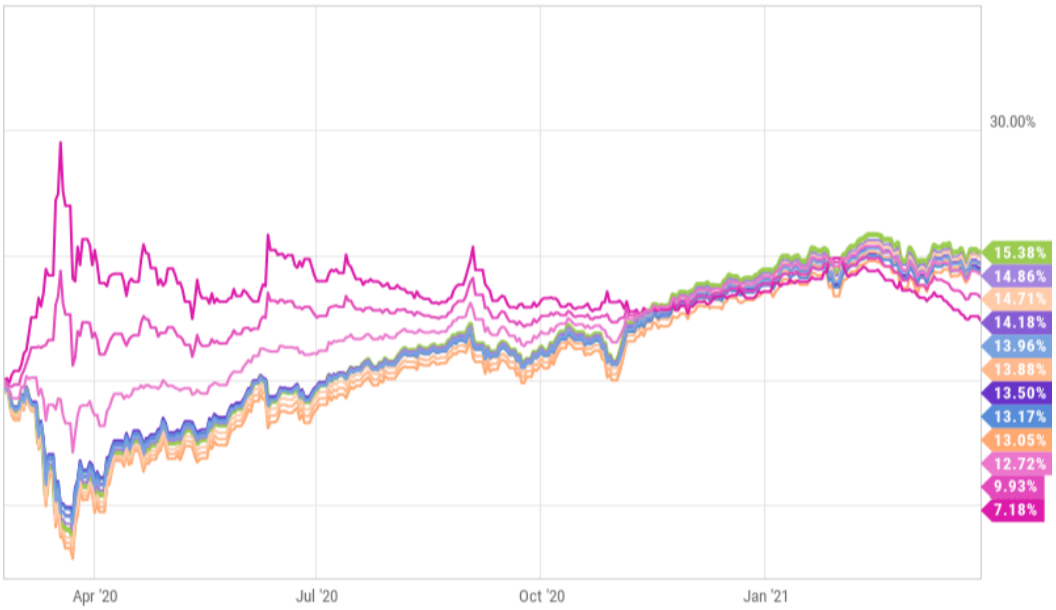
As the VIX fell from its record-high and "high volatility" territory, investors' confidence returned and each of the hedges examined finished with worse returns compared to the Sample 60/40 Portfolio.

During the record-setting VIX spike, hedges using the Invesco S&P 500® Low Volatility ETF **(SPLV)** not only dampened performance but also caused more severe drawdowns. The iPath® B S&P 500® VIX S/T Futs™ ETN **(VXX)** shone bright early on, but burned out quickly as the VIX and investor sentiment both reset.

Hedging Volatility With SHY, SPLV, Cash & VXX

	VAL	ANN
60/40 Sample Portfolio Total Return	15.38%	13.95%
60/40 Sample Portfolio - 15% Volatility Hedge - SHY Total Return	13.50%	12.25%
60/40 Sample Portfolio - 10% Volatility Hedge - SHY Total Return	14.18%	12.86%
60/40 Sample Portfolio - 5% Volatility Hedge - SHY Total Return	14.86%	13.47%
60/40 Sample Portfolio - 15% Volatility Hedge - SPLV Total Return	13.05%	11.84%
60/40 Sample Portfolio - 10% Volatility Hedge - SPLV Total Return	13.88%	12.59%
60/40 Sample Portfolio - 5% Volatility Hedge - SPLV Total Return	14.71%	13.34%
60/40 Sample Portfolio - 15% Volatility Hedge - Cash Total Return	13.17%	11.95%
60/40 Sample Portfolio - 10% Volatility Hedge - Cash Total Return	13.96%	12.66%
60/40 Sample Portfolio - 15% Volatility Hedge - VXX Total Return	7.18%	6.53%
60/40 Sample Portfolio - 10% Volatility Hedge - VXX Total Return	9.93%	9.02%
60/40 Sample Portfolio - 5% Volatility Hedge - VXX Total Return	12.72%	11.54%



Date Range: 02/24/2020 - 03/30/2021

Not shown for space limitations: 5% Volatility Hedge Using Cash; period performance: 14.75% or 13.37% annualized.

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Hedging Against A Stock Market Crash

Hedging Against A Stock Market Crash

The biggest stock market crashes in recent memory are still etched into investors' brains—the early 2000's Dot-Com bubble, 2008 Financial Crisis, and 2020 Coronavirus Pandemic each rattled markets and our daily lives in unique ways. There are numerous reasons to expect a pull-back in stocks, or investors may just be looking to lock-in gains after a run, but what's the best hedge when expecting a crash? Conventional wisdom points to Cash and Gold, but short market ETFs have made "fading the market" strategies easier to employ than ever.

During each of the stock market crashes examined, portfolio hedges using the ProShares Short S&P 500 ETF **(SH)** provided significant performance and risk benefits by limiting losses. Hedging with SPDR Gold Shares ETF **(GLD)** or a Cash position also protected portfolio value, but with less effect

About the ETFs Used

ProShares Short S&P 500 (SH)
- AUM (as of Oct 31, 2021): $1.42 billion
- Expense Ratio: 0.88%

→ **See similar ETFs in YCharts**

SPDR Gold Shares (GLD)
- AUM (as of Oct 31, 2021): $55.85 billion
- Expense Ratio: 0.40%

→ **See similar ETFs in YCharts**

Cash
- As a proxy for holding cash in a portfolio, a YCharts **Custom Security** with a constant level of 1.00 and return of 0.0% was used.

Periods Tested for Hedging A Stock Market Crash with ETFs

Periods Tested — **S&P 500 Level % Off High**

- October 9, 2007 - March 9, 2009
- September 20, 2018 - December 24, 2018
- February 19, 2020 - March 23, 2020

Period 1: October 9, 2007 - March 9, 2009

Since stock market crashes are relatively definitive trends (especially looking backwards), the risk benefits of hedging against a crash are more clear-cut compared to hedges against other types of risk.

During the stock market's drawn-out decline amid the Financial Crisis, hedges with the SPDR Gold Shares ETF **(GLD)** and Cash limited max drawdown and portfolio standard deviation to a similar degree. The ProShares Short S&P 500 ETF **(SH)** hedge stood apart though, with 5-15% allocations to SH minimizing drawdowns by anywhere from 4.75 to a very significant 14.39 percentage points.

Stock Market Crash Hedge	Oct 9, 2007 - Mar 9, 2009	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-35.97%	0.84%
5% Hedge		
ProShares Short S&P 500 (SH)	-31.22%	0.70%
SPDR Gold Shares (GLD)	-33.62%	0.80%
Cash	-34.20%	0.79%
10% Hedge		
ProShares Short S&P 500 (SH)	-26.49%	0.59%
SPDR Gold Shares (GLD)	-31.43%	0.78%
Cash	-32.58%	0.76%
15% Hedge		
ProShares Short S&P 500 (SH)	-21.58%	0.49%
SPDR Gold Shares (GLD)	-29.21%	0.76%
Cash	-30.95%	0.72%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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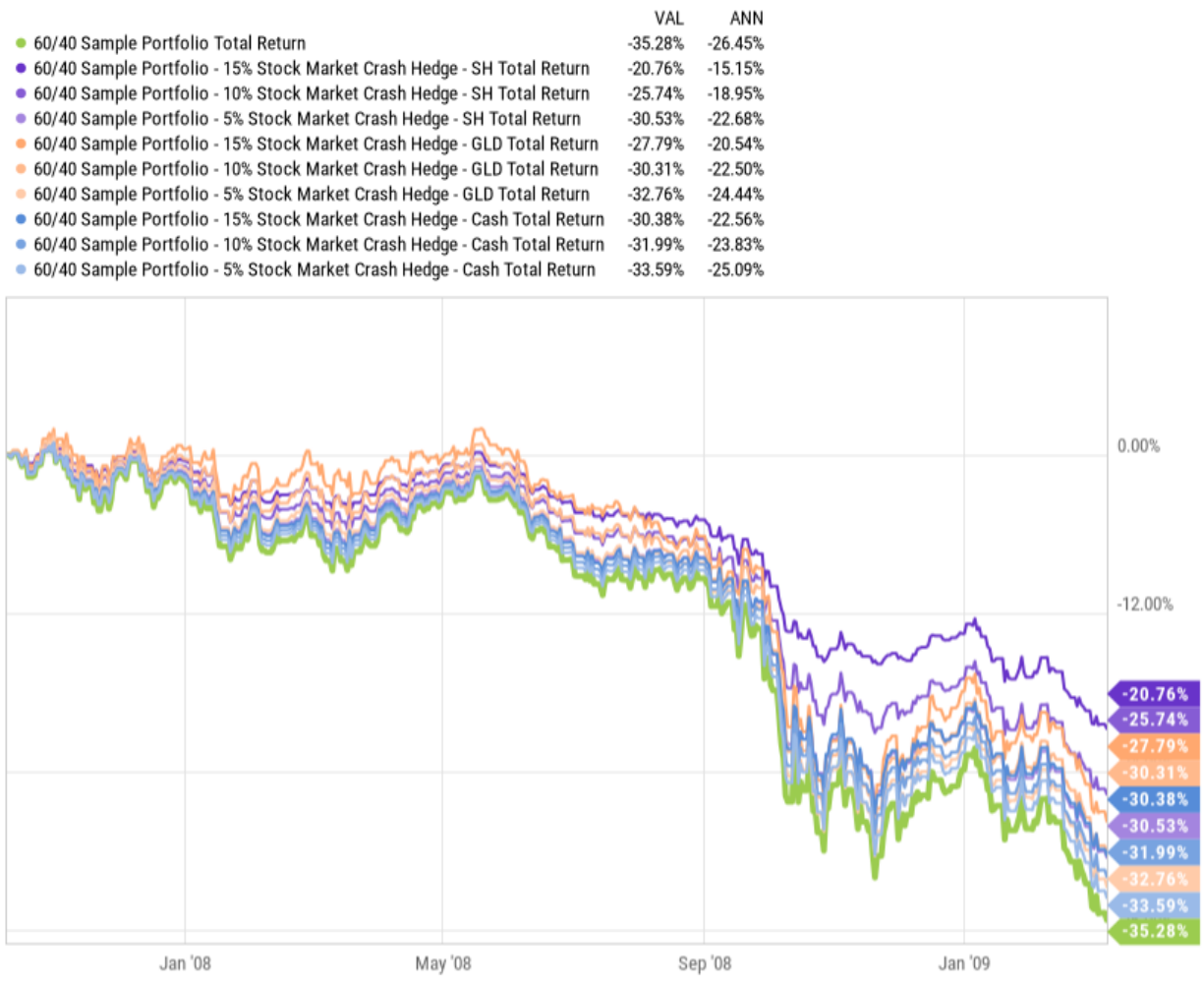
Peak to trough, the **S&P 500** fell 55.3% from October 9, 2007 to March 9, 2009. In that time, the Sample 60/40 Portfolio declined by 35.3% and hedges using the SPDR Gold Shares ETF **(GLD)**, ProShares Short S&P 500 ETF **(SH)**, and Cash each limited that fall.

While a 5% hedge using either ETF or Cash saved only a couple points of total return, a 15% hedge to GLD improved annual performance by 5.9 points and the same allocation to SH added 11.3 percentage points of net total return.

Hedging A Stock Market Crash With SH, GLD & Cash



Date Range: 10/09/2007 - 03/09/2009

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Period 2: September 20, 2018 - December 24, 2018

While it wasn't given a catchy name, the **S&P 500's** 19.4% drawdown in late 2018 came swiftly and had commentators wondering if the decade-long bull market was finally retreating. As it did during the Financial Crisis, a ProShares Short S&P 500 ETF **(SH)** hedge had the most beneficial impact on the Sample 60/40 Portfolio's risk characteristics. Notably, none of the hedges had a meaningful impact on standard deviation, likely due to the relatively short time frame of the period examined.

Stock Market Crash Hedge	Sep 20, 2018 - Dec 24, 2018	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-10.35%	0.47%
5% Hedge		
ProShares Short S&P 500 (SH)	-8.23%	0.45%
SPDR Gold Shares (GLD)	-9.13%	0.46%
Cash	-9.42%	0.46%
10% Hedge		
ProShares Short S&P 500 (SH)	-6.56%	0.44%
SPDR Gold Shares (GLD)	-8.36%	0.45%
Cash	-8.92%	0.45%
15% Hedge		
ProShares Short S&P 500 (SH)	-4.88%	0.43%
SPDR Gold Shares (GLD)	-7.61%	0.45%
Cash	-8.43%	0.45%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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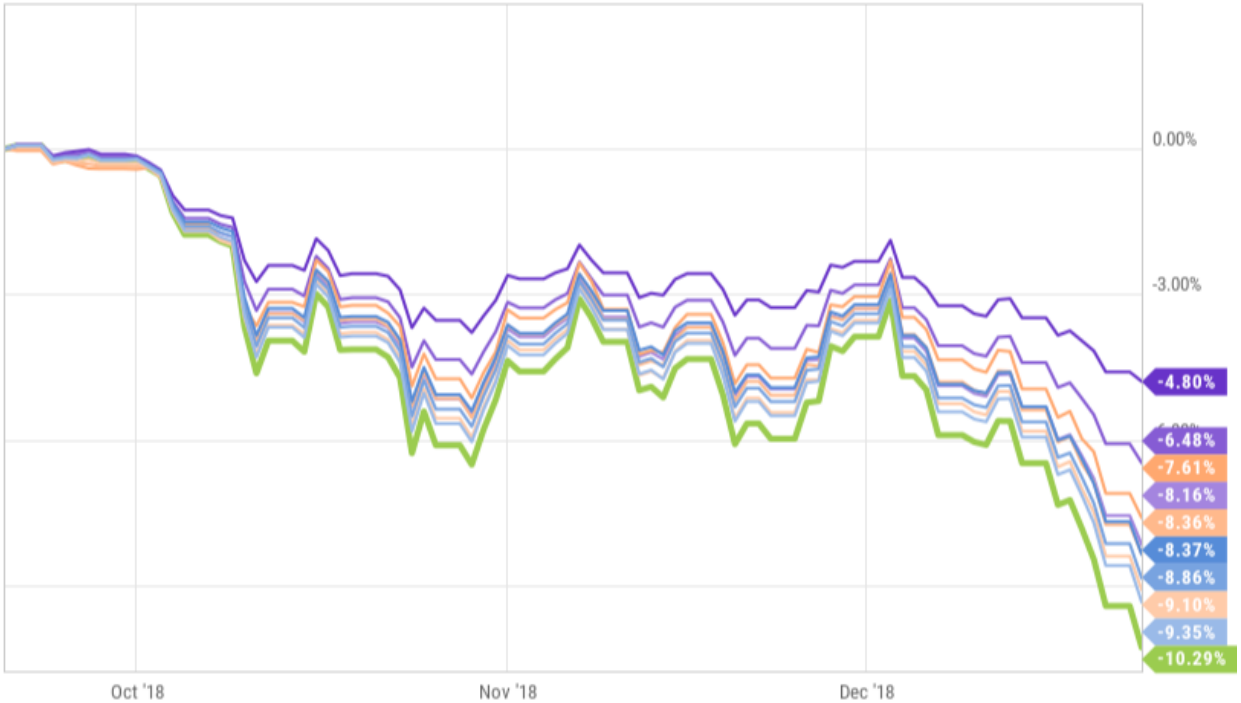
In what proved to be only a temporary correction, hedging with ProShares Short S&P 500 ETF **(SH)** turned the Sample 60/40 Portfolio's 10.3% fall into a more stomachable 4.8% dip. The SPDR Gold Shares ETF **(GLD)** and Cash hedges offered similar downside protection, with the former being slightly more effective than the latter, and especially at larger allocations.

Hedging A Stock Market Crash With SH, GLD & Cash

	VAL	ANN
60/40 Sample Portfolio Total Return	-10.29%	-34.10%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - SH Total Return	-4.80%	-17.21%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - SH Total Return	-6.48%	-22.69%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - SH Total Return	-8.16%	-27.90%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - GLD Total Return	-7.61%	-26.23%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - GLD Total Return	-8.36%	-28.48%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - GLD Total Return	-9.10%	-30.69%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - Cash Total Return	-8.37%	-28.52%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - Cash Total Return	-8.86%	-29.98%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - Cash Total Return	-9.35%	-31.42%



Date Range: 09/20/2018 - 12/24/2018

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Period 3: February 19, 2020 - March 23, 2020

The fastest, most dramatic stock market crash on record cut the **S&P 500's** value by 33.8% in just over a month's time. For the third time, the perfectly inverse ProShares Short S&P 500 ETF **(SH)** hedge provided the best downside protection and limited drawdowns significantly. The SPDR Gold Shares ETF **(GLD)** improved portfolio risk by relatively little, losing traditional safe haven status as COVID-19 ravaged nearly every asset class.

Stock Market Crash Hedge	Feb 19, 2020 - Mar 23, 2020	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-20.79%	0.44%
5% Hedge		
ProShares Short S&P 500 (SH)	-17.55%	0.42%
SPDR Gold Shares (GLD)	-19.84%	0.43%
Cash	-19.66%	0.43%
10% Hedge		
ProShares Short S&P 500 (SH)	-14.39%	0.41%
SPDR Gold Shares (GLD)	-18.99%	0.43%
Cash	-18.63%	0.43%
15% Hedge		
ProShares Short S&P 500 (SH)	-11.24%	0.40%
SPDR Gold Shares (GLD)	-18.13%	0.43%
Cash	-17.59%	0.42%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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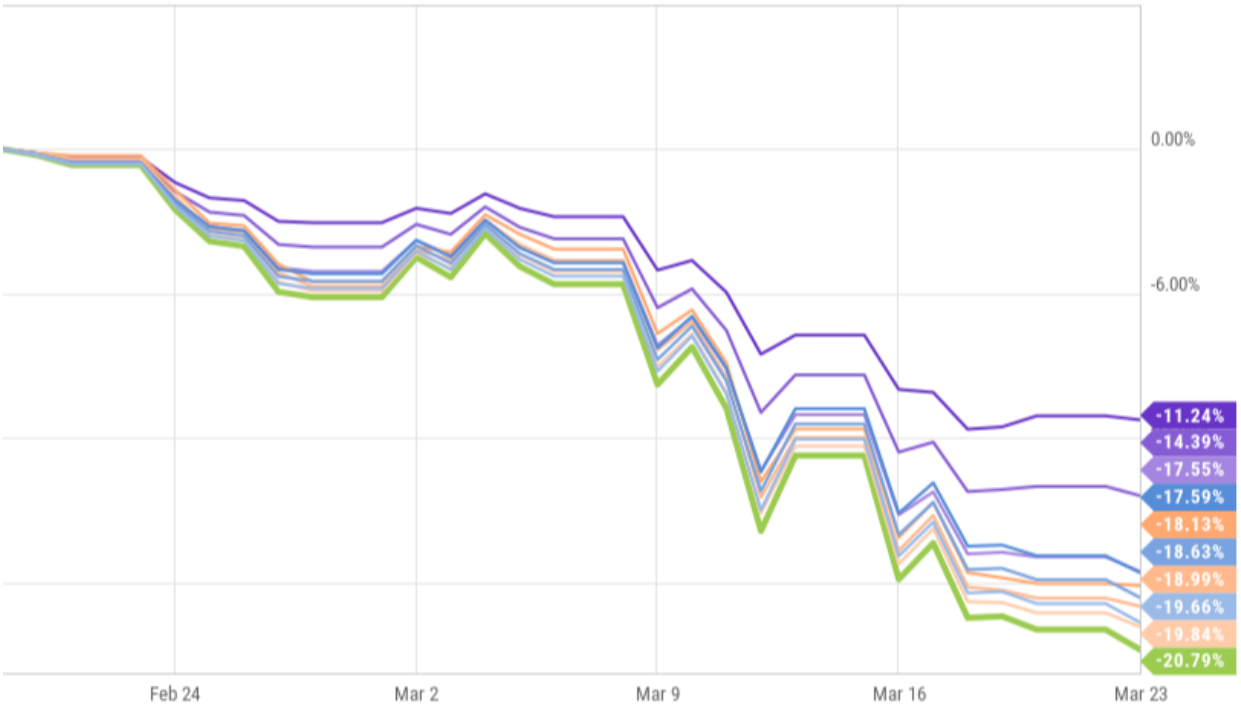
When the COVID-19 pandemic hobbled the world and investor sentiment in February and March 2020, nearly every asset class plunged and good hedges were relatively hard to come by. As such, hedges using the ProShares Short S&P 500 ETF **(SH)** performed best due to its direct inverse relationship with the index. From 5% to 15%, hedging a market crash with Cash

Hedging A Stock Market Crash With SH, GLD & Cash

	VAL	ANN
60/40 Sample Portfolio Total Return	-20.79%	-92.41%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - SH Total Return	-11.24%	-73.27%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - SH Total Return	-14.39%	-82.08%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - SH Total Return	-17.55%	-88.16%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - GLD Total Return	-18.13%	-89.06%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - GLD Total Return	-18.99%	-90.26%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - GLD Total Return	-19.84%	-91.34%
60/40 Sample Portfolio - 15% Stock Market Crash Hedge - Cash Total Return	-17.59%	-88.24%
60/40 Sample Portfolio - 10% Stock Market Crash Hedge - Cash Total Return	-18.63%	-89.77%
60/40 Sample Portfolio - 5% Stock Market Crash Hedge - Cash Total Return	-19.66%	-91.12%



Date Range: 02/19/2020 - 03/23/2020

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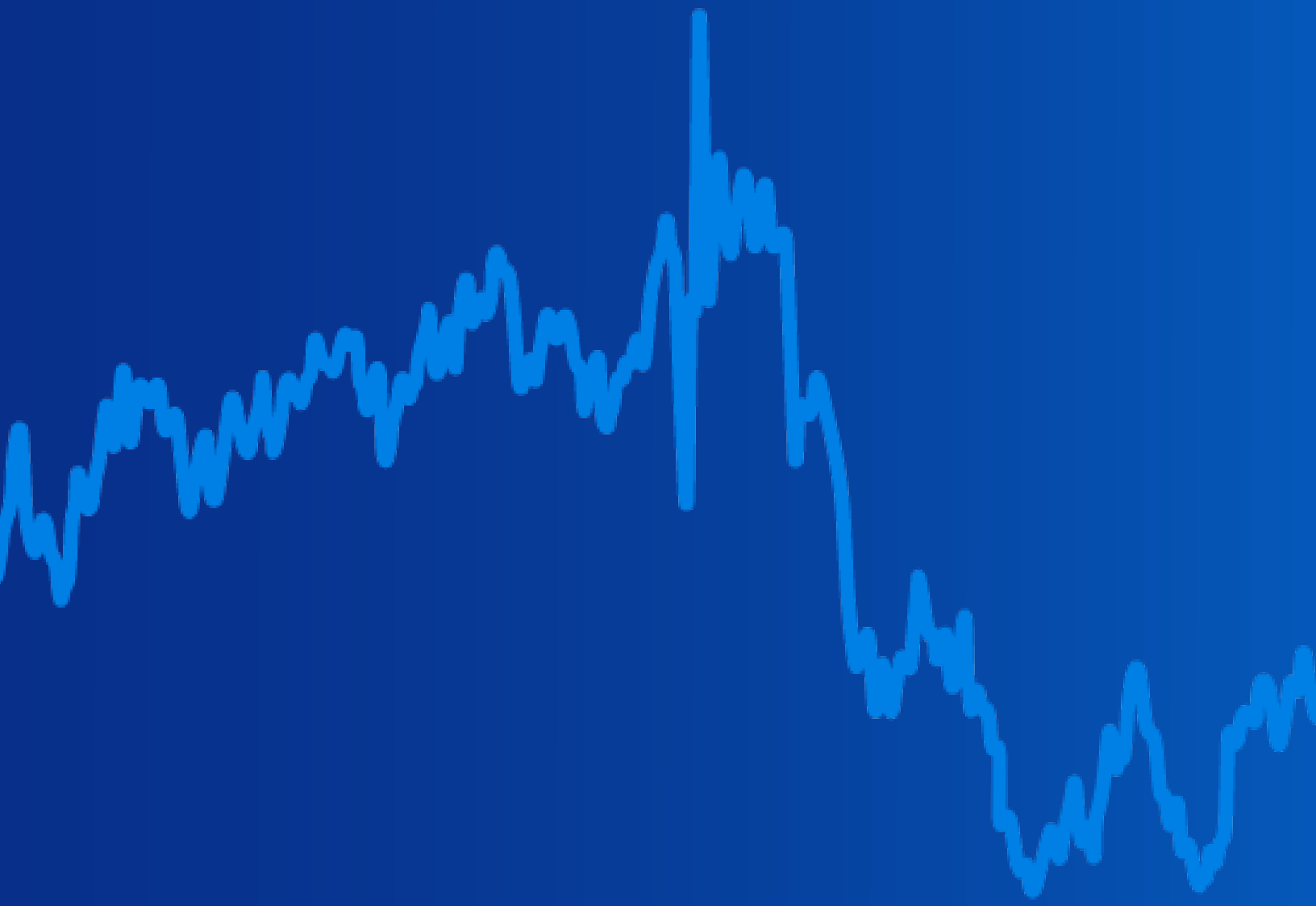
Hedging Against A Weakening US Dollar



Hedging Against A Weakening US Dollar

The ICE US Dollar Index **(^DXY)**, which falls as the US Dollar depreciates against six foreign currencies and rises when it appreciates, hit an all-time low in April 2008. Since then, the USD has mounted a rocky climb higher but suffered a material setback at the onset of the COVID-19 pandemic. Because a depreciating US Dollar offsets investment gains and makes goods nominally more expensive, finding an effective portfolio hedge is a worthwhile experiment. Investing in foreign equities is the most straightforward hedge for a weakening US Dollar, but ETFs like Invesco's DB US Dollar Bearish **(UDN)** enable a similarly direct approach.

In recent periods of US Dollar depreciation, portfolio hedges using the decentralized **Bitcoin** currency added significant upside but also introduced material risk to the Sample 60/40 Portfolio. ETF hedges against a weakening dollar were relatively ineffective in terms of risk management, but direct investments in foreign equities using Vanguard's FTSE Developed Markets ETF **(VEA)** added performance in two of the three periods tested.

About the ETFs Used

Vanguard FTSE Developed Markets ETF (VEA)
- AUM (as of Oct 31, 2021): $106.59 billion
- Expense Ratio: 0.05%

→ **See similar ETFs in YCharts**

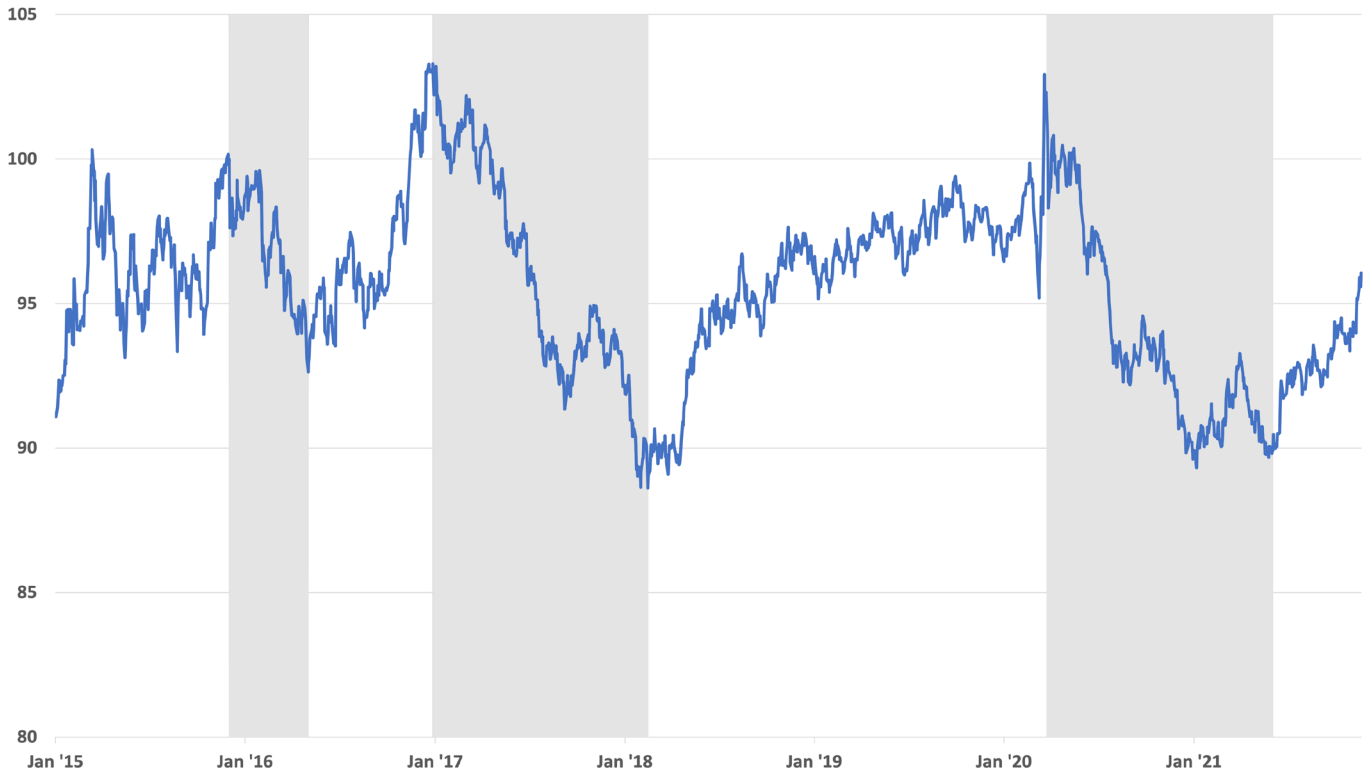
Bitcoin (BTC)
- To maximize available history, the actual **Bitcoin Price** was used.

→ **See Crypto & Blockchain ETFs in YCharts**

Invesco DB US Dollar Bearish (UDN)
- AUM (as of Oct 31, 2021): $59.85 billion
- Expense Ratio: 0.70%

→ **See similar ETFs in YCharts**

Periods Tested for Hedging A Weakening US Dollar with ETFs



Periods Tested **ICE US Dollar Index Level**

- December 1, 2015 - May 3, 2016
- December 28, 2016 - February 15, 2018
- March 24, 2020 - June 1, 2021

Period 1: December 1, 2015 - May 3, 2016

As the table's formatting shows, using ETFs and Bitcoin to hedge risk from a weakening US Dollar is neither easy nor effective. When the Dollar weakened rapidly in late 2015 and early 2016, Invesco's DB US Dollar Bearish **(UDN)** was most impactful at limiting drawdowns and portfolio standard deviation, but Vanguard's FTSE Developed Markets ETF **(VEA)** and **Bitcoin** consistently worsened risk metrics.

Weakening USD Hedge	Dec 1, 2015 - May 3, 2016 Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-8.08%	0.56%
5% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-8.44%	0.57%
Invesco DB US Dollar Bearish (UDN)	-7.47%	0.55%
Bitcoin (BTC)	-7.29%	0.56%
10% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-8.79%	0.58%
Invesco DB US Dollar Bearish (UDN)	-6.99%	0.54%
Bitcoin (BTC)	-7.63%	0.57%
15% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-9.14%	0.58%
Invesco DB US Dollar Bearish (UDN)	-6.56%	0.53%
Bitcoin (BTC)	-8.10%	0.60%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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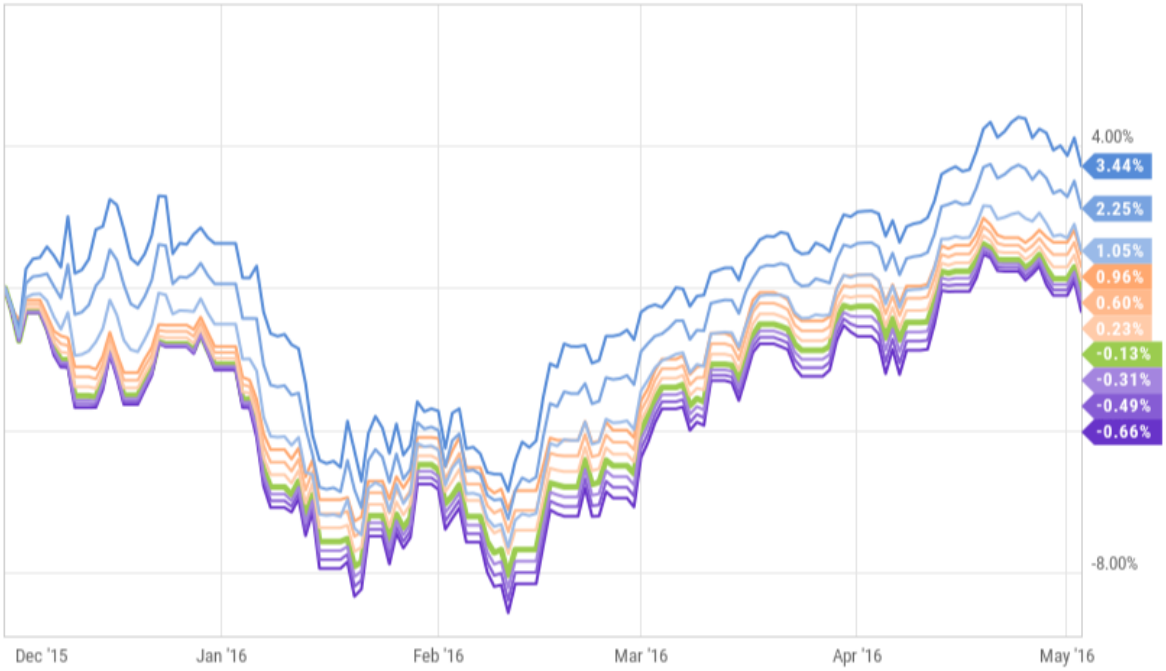
When the US Dollar declined in relative value from late 2015 to mid-2016, hedging the currency depreciation with international equities-focused Vanguard FTSE Developed Markets ETF **(VEA)** was a net drag on portfolio performance. In a short but rare period of understated performance from **Bitcoin**, hedges from 5-15% using Invesco's DB US Dollar Bearish **(UDN)** and Bitcoin were enough to turn the Sample 60/40 Portfolio positive for the period.

Hedging A Weakening US Dollar With VEA, UDN & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	-0.13%	-0.31%
60/40 Sample Portfolio - 15% Weakening USD Hedge - VEA Total Return	-0.66%	-1.56%
60/40 Sample Portfolio - 10% Weakening USD Hedge - VEA Total Return	-0.49%	-1.15%
60/40 Sample Portfolio - 5% Weakening USD Hedge - VEA Total Return	-0.31%	-0.74%
60/40 Sample Portfolio - 15% Weakening USD Hedge - UDN Total Return	0.96%	2.30%
60/40 Sample Portfolio - 10% Weakening USD Hedge - UDN Total Return	0.60%	1.42%
60/40 Sample Portfolio - 5% Weakening USD Hedge - UDN Total Return	0.23%	0.54%
60/40 Sample Portfolio - 15% Weakening USD Hedge - Bitcoin Total Return	3.44%	8.34%
60/40 Sample Portfolio - 10% Weakening USD Hedge - Bitcoin Total Return	2.25%	5.41%
60/40 Sample Portfolio - 5% Weakening USD Hedge - Bitcoin Total Return	1.05%	2.51%



Date Range: 12/01/2015 - 05/03/2016

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Period 2: December 28, 2016 - February 15, 2018

The US Dollar depreciated by as much as 13.8% against major international currencies from late 2016 to early 2018, as measured by the **ICE US Dollar Index**. Hedging that trend with foreign equities a la Vanguard's FTSE Developed Markets ETF **(VEA)** had a negative, yet nearly net-zero, effect on the Sample 60/40 Portfolio. Invesco's DB US Dollar Bearish **(UDN)** was a relatively more effective hedge than VEA, but not significant in comparison to the Sample 60/40 Portfolio.

Hedges using **Bitcoin** were much more dramatic, matching the cryptocurrency's reputation. Just a 5% allocation to Bitcoin more than doubled the portfolio's risk profile, and a 15% Bitcoin hedge worsened drawdowns and standard deviation by 4.5x and 3.4x, respectively.

Weakening USD Hedge	Dec 28, 2016 - Feb 15, 2018	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-6.31%	0.34%
5% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-6.47%	0.35%
Invesco DB US Dollar Bearish (UDN)	-6.06%	0.33%
Bitcoin (BTC)	-17.42%	0.62%
10% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-6.63%	0.35%
Invesco DB US Dollar Bearish (UDN)	-5.81%	0.33%
Bitcoin (BTC)	-24.19%	0.90%
15% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-6.79%	0.36%
Invesco DB US Dollar Bearish (UDN)	-5.56%	0.33%
Bitcoin (BTC)	-28.49%	1.14%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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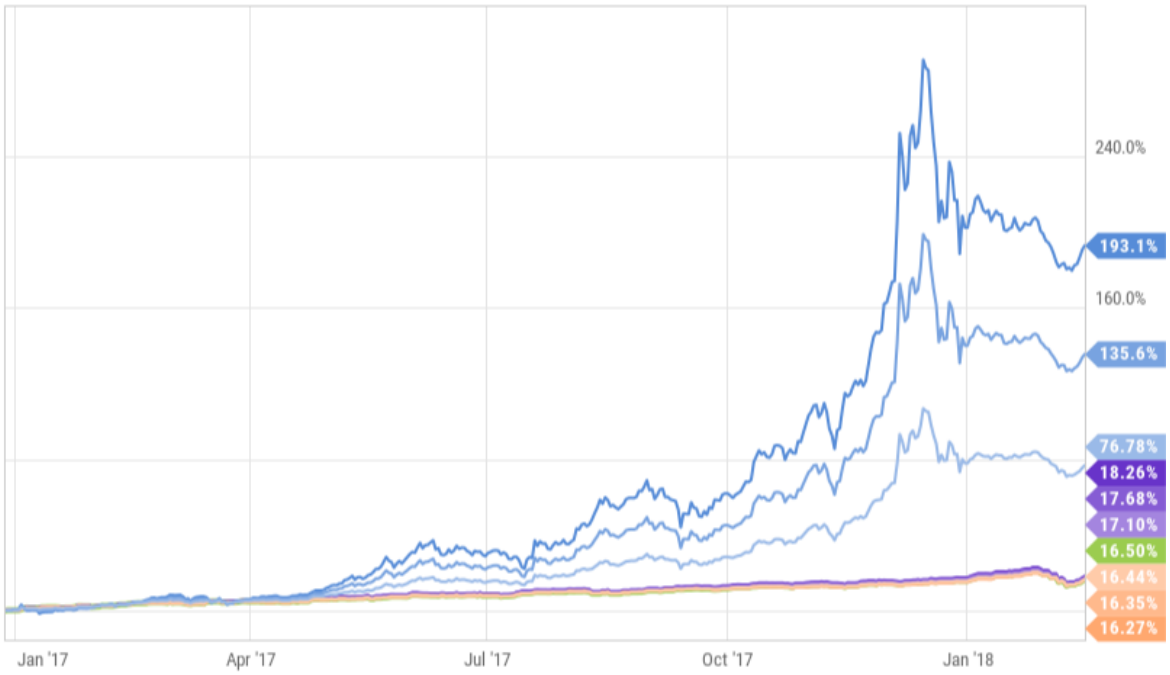
Over a more extended period of nearly 14 months, the Vanguard FTSE Developed Markets ETF **(VEA)** and Invesco's DB US Dollar Bearish **(UDN)** traded places from the first period examined, with VEA adding marginal performance benefits and UDN limiting returns.

But it was **Bitcoin** and its first major rally that stole the show. The Sample 60/40 Portfolio's annualized total return of 14.4% was dwarfed by even a 5% hedge using Bitcoin, which drove annualized portfolio returns to 65.3%. In this instance, "hedging" with Bitcoin went far beyond downside protection.

Hedging A Weakening US Dollar With VEA, UDN & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	16.50%	14.41%
60/40 Sample Portfolio - 15% Weakening USD Hedge - VEA Total Return	18.26%	15.93%
60/40 Sample Portfolio - 10% Weakening USD Hedge - VEA Total Return	17.68%	15.43%
60/40 Sample Portfolio - 5% Weakening USD Hedge - VEA Total Return	17.10%	14.93%
60/40 Sample Portfolio - 15% Weakening USD Hedge - UDN Total Return	16.27%	14.21%
60/40 Sample Portfolio - 10% Weakening USD Hedge - UDN Total Return	16.35%	14.29%
60/40 Sample Portfolio - 5% Weakening USD Hedge - UDN Total Return	16.44%	14.36%
60/40 Sample Portfolio - 15% Weakening USD Hedge - Bitcoin Total Return	193.1%	158.07%
60/40 Sample Portfolio - 10% Weakening USD Hedge - Bitcoin Total Return	135.6%	112.91%
60/40 Sample Portfolio - 5% Weakening USD Hedge - Bitcoin Total Return	76.78%	65.26%



Date Range: 12/28/2016 - 02/15/2018

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Period 3: March 24, 2020 - June 1, 2021

In February and March of 2020, the early days of the COVID-19 pandemic, the **ICE US Dollar Index** dropped sharply, spiked higher, then began a steady but steep decline before bottoming-out in May of 2021. As the Dollar slid against a basket of international currencies, none of the hedges tested consistently improved the Sample 60/40 Portfolio's max drawdown or standard deviation.

Hedges using the Vanguard FTSE Developed Markets ETF **(VEA)** and Invesco's DB US Dollar Bearish **(UDN)** were largely inconsequential, but **Bitcoin** added noticeable and undesirable volatility to the portfolio.

Weakening USD Hedge	Mar 24, 2020 - Jun 1, 2021	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-4.57%	0.95%
5% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-5.05%	1.01%
Invesco DB US Dollar Bearish (UDN)	-4.93%	0.98%
Bitcoin (BTC)	-4.68%	0.99%
10% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-5.03%	1.02%
Invesco DB US Dollar Bearish (UDN)	-4.79%	0.96%
Bitcoin (BTC)	-7.47%	1.03%
15% Hedge		
Vanguard FTSE Developed Markets ETF (VEA)	-5.01%	1.03%
Invesco DB US Dollar Bearish (UDN)	-4.65%	0.95%
Bitcoin (BTC)	-11.09%	1.10%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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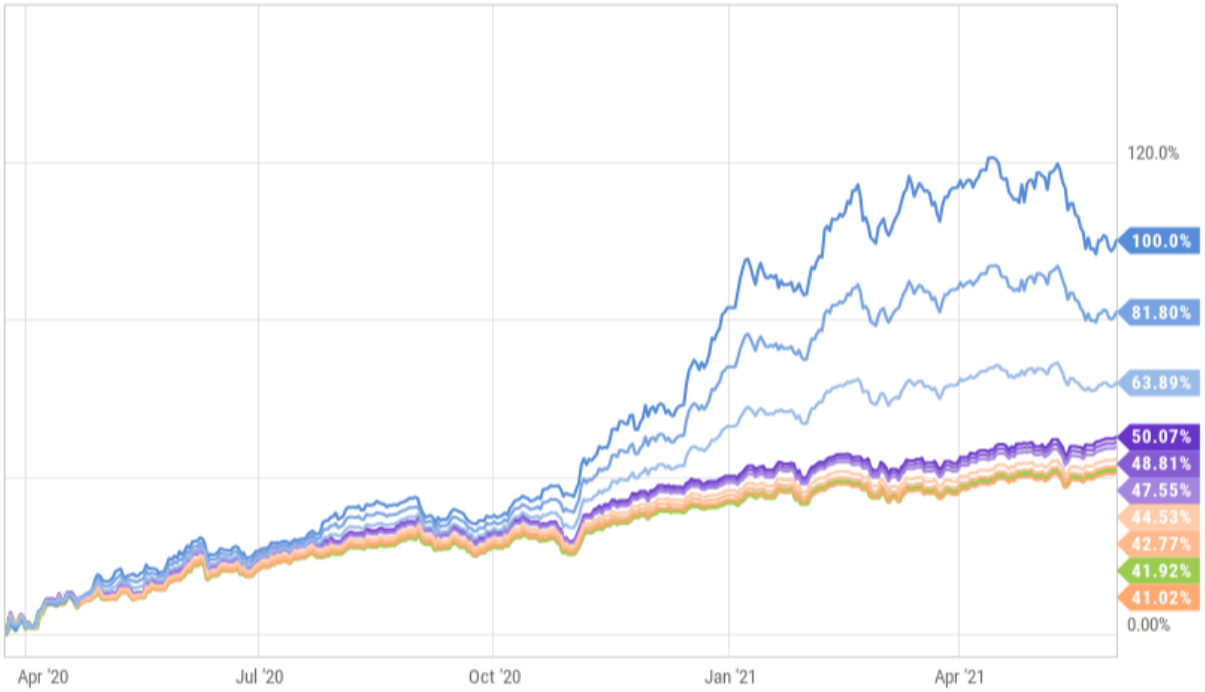
Hedges using **Bitcoin**, a famously decentralized store of value (and thus, so the argument goes, a hedge against any and all government turmoil) again added significant upside to the Sample Portfolio from 2020 to 2021. Vanguard's FTSE Developed Markets ETF **(VEA)** also proved to be an effective hedge in the COVID-19 era as other developed nations initially handled the pandemic better than the United States.

Hedging A Weakening US Dollar With VEA, UDN & Bitcoin

	VAL	ANN
60/40 Sample Portfolio Total Return	41.92%	34.24%
60/40 Sample Portfolio - 15% Weakening USD Hedge - VEA Total Return	50.07%	40.69%
60/40 Sample Portfolio - 10% Weakening USD Hedge - VEA Total Return	48.81%	39.70%
60/40 Sample Portfolio - 5% Weakening USD Hedge - VEA Total Return	47.55%	38.70%
60/40 Sample Portfolio - 15% Weakening USD Hedge - UDN Total Return	41.02%	33.52%
60/40 Sample Portfolio - 10% Weakening USD Hedge - UDN Total Return	42.77%	34.91%
60/40 Sample Portfolio - 5% Weakening USD Hedge - UDN Total Return	44.53%	36.31%
60/40 Sample Portfolio - 15% Weakening USD Hedge - Bitcoin Total Return	100.0%	79.15%
60/40 Sample Portfolio - 10% Weakening USD Hedge - Bitcoin Total Return	81.80%	65.32%
60/40 Sample Portfolio - 5% Weakening USD Hedge - Bitcoin Total Return	63.89%	51.51%



Date Range: 03/24/2020 - 06/01/2021

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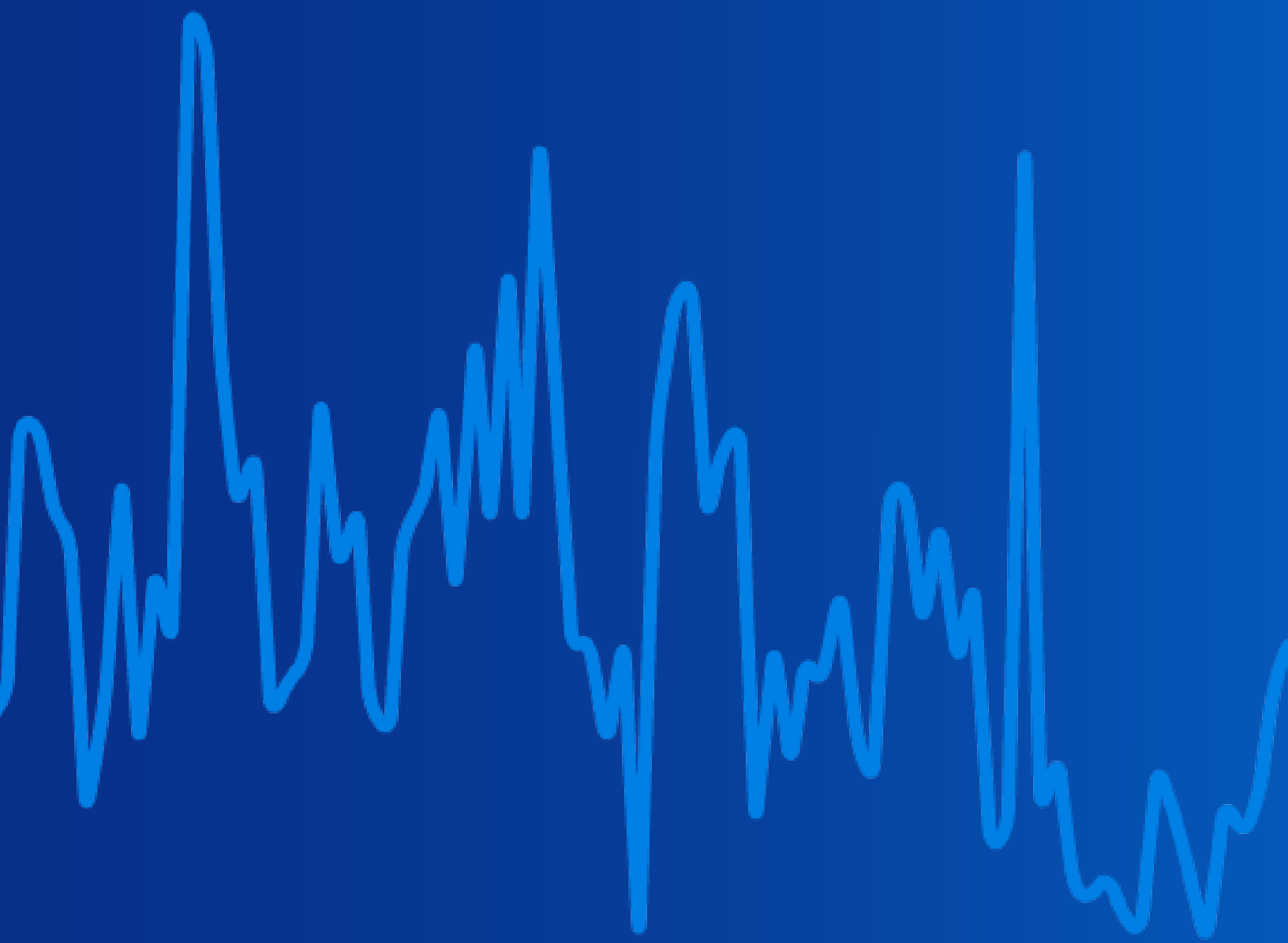
Hedging Against A Geopolitical Risk



Hedging Against Geopolitical Risk

The **Caldara and Iacoviello Geopolitical Risk Index (GPR)**, created and managed by **Dario Caldara** and **Matteo Iacoviello** of the Board of Governors of the Federal Reserve System, measures threats and acts related to wars, terrorism, and other tensions among countries and international actors. Often cited by investors and media as an input for investing decisions, geopolitical risk can heighten fears, make riskier investments less attractive, and lower consumer confidence. Precious metals, namely "safe havens" like silver and gold, are the most commonly used hedges against geopolitical risk.

Hedging against rising geopolitical risks, as measured by the GPR Index, was only moderately effective and also inconsistent across the three time periods examined. Larger hedges using iShares Silver Trust **(SLV)** worsened portfolio risk metrics in two of three periods, and improved portfolio performance only once. While the Invesco DB Precious Metals ETF **(DBP)** and SPDR Gold Shares **(GLD)** provided risk benefits beyond the Sample 60/40 Portfolio, they added marginal performance in two of three periods.

About the ETFs Used

Invesco DB Precious Metals (DBP)
- AUM (as of Oct 31, 2021): $116.10 million
- Expense Ratio: 0.68%

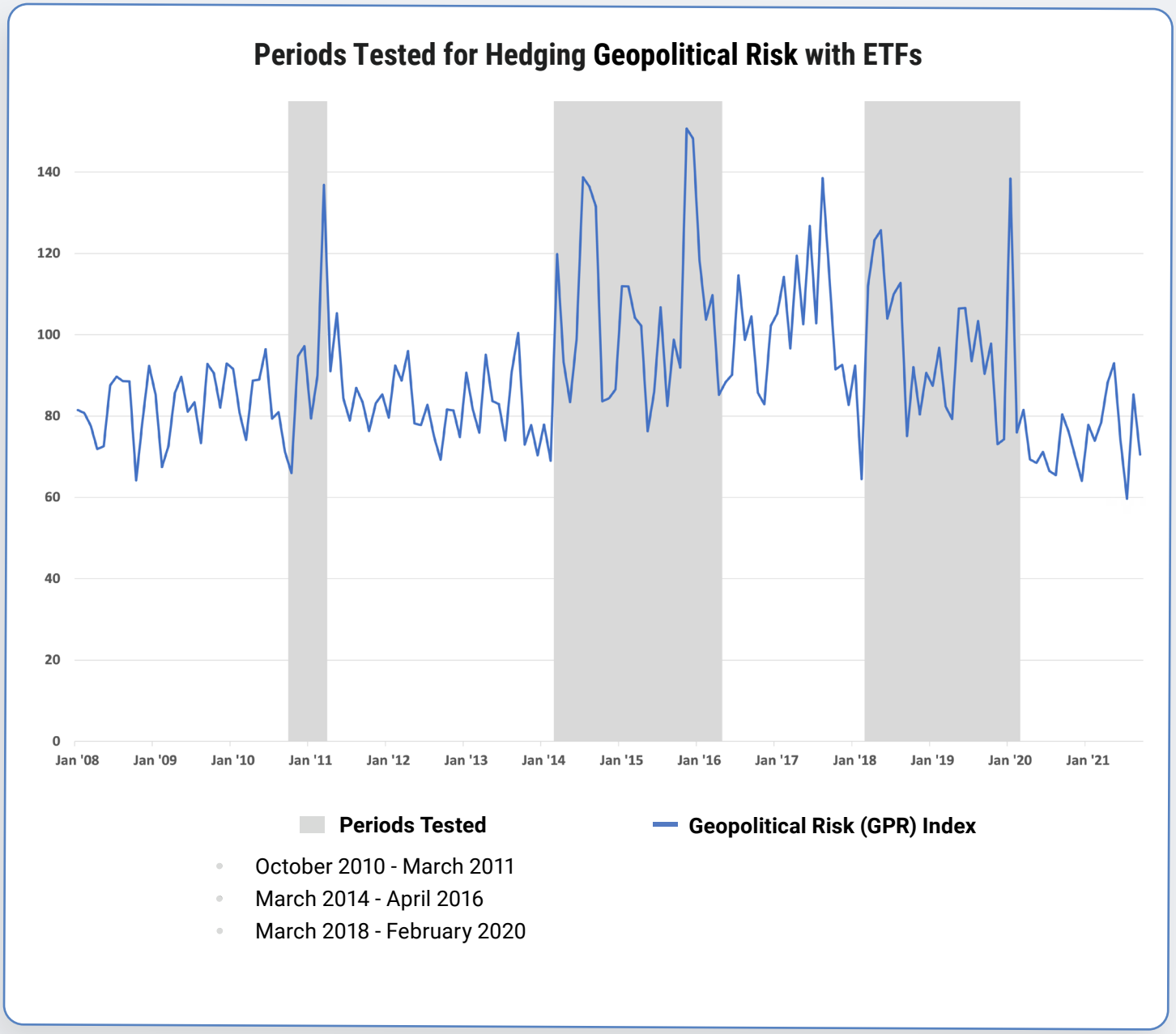
→ **See similar ETFs in YCharts**

iShares Silver Trust (SLV)
- AUM (as of Oct 31, 2021): $13.12 billion
- Expense Ratio: 0.50%

→ **See similar ETFs in YCharts**

SPDR Gold Shares (GLD)
- AUM (as of Oct 31, 2021): $55.85 billion
- Expense Ratio: 0.40%

→ **See similar ETFs in YCharts**


Periods Tested for Hedging Geopolitical Risk with ETFs
140
120
100
80
60
40
20
0
Jan '08
Jan '09
Jan '10
Jan '11
Jan '12
Jan '13
Jan '14
Jan '15
Jan '16
Jan '17
Jan '18
Jan '19
Jan '20
Jan '21
Periods Tested
Geopolitical Risk (GPR) Index
October 2010 - March 2011
March 2014 - April 2016
March 2018 - February 2020

Period 1: October 2010 - March 2011

The **GPR Index** began a rapid ascent in late 2010 and peaked in March 2011 when a coalition of NATO countries led a military intervention in Libya during the country's civil war.

While hedging geopolitical risk with the Invesco DB Precious Metals ETF **(DBP)** and SPDR Gold Shares **(GLD)** both provided consistent risk management benefits, iShares Silver Trust **(SLV)** actually worsened the portfolio's max drawdown and standard deviation in two of three periods examined. That said, drawdowns and standard deviation were only marginally impacted, positively or negatively, by hedging the Sample 60/40 Portfolio with these three ETFs.

Geopolitical Risk Hedge	October 2010 - March 2011	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-3.53%	0.66%
5% Hedge		
Invesco DB Precious Metals (DBP)	-3.28%	0.67%
SPDR Gold Shares (GLD)	-3.33%	0.66%
iShares Silver Trust (SLV)	-3.23%	0.68%
10% Hedge		
Invesco DB Precious Metals (DBP)	-3.22%	0.67%
SPDR Gold Shares (GLD)	-3.22%	0.67%
iShares Silver Trust (SLV)	-3.54%	0.69%
15% Hedge		
Invesco DB Precious Metals (DBP)	-3.34%	0.68%
SPDR Gold Shares (GLD)	-3.26%	0.67%
iShares Silver Trust (SLV)	-3.84%	0.71%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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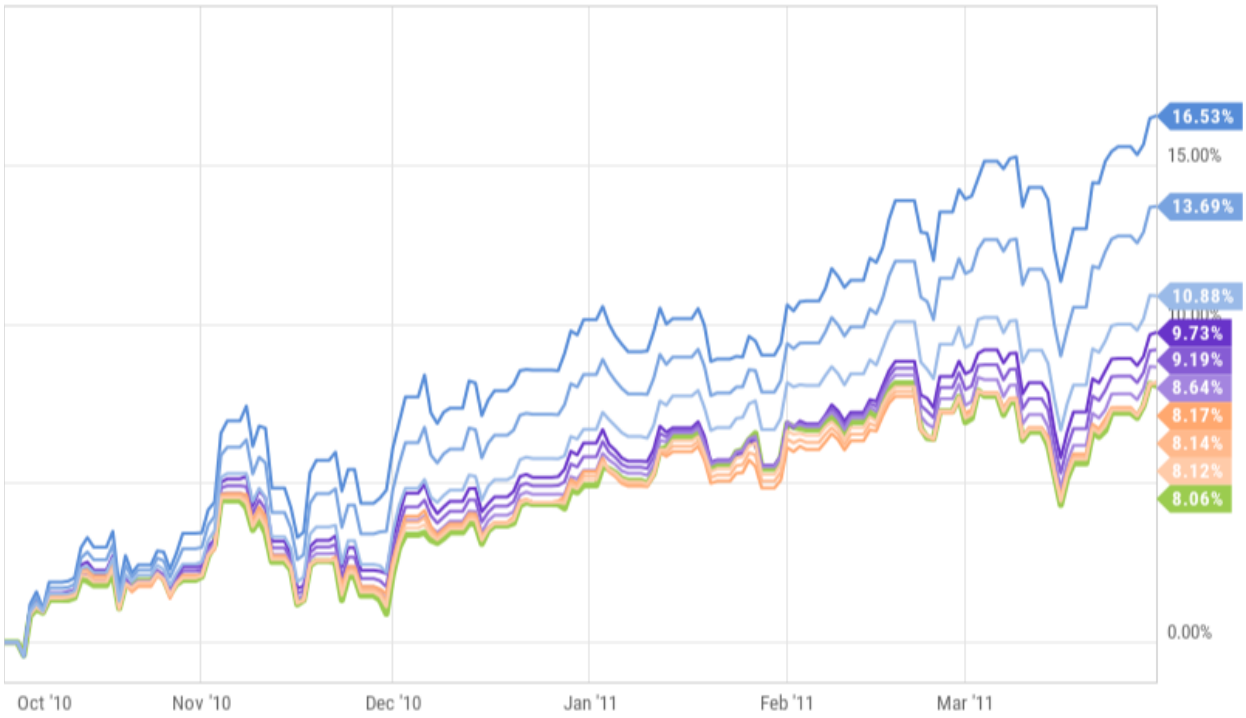
When the **GPR Index** spiked in late 2010, hedges using the Invesco DB Precious Metals ETF **(DBP)**, SPDR Gold Shares **(GLD)** and iShares Silver Trust **(SLV)** all increased performance of the Sample 60/40 Portfolio. A 15% allocation to SLV was particularly effective, more than doubling the portfolio's annualized total return from 16.91% to 36.14%.

Hedging Geopolitical Risk With DBP, GLD & SLV

	VAL	ANN
60/40 Sample Portfolio Total Return	8.06%	16.91%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - DBP Total Return	9.73%	20.59%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - DBP Total Return	9.19%	19.39%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - DBP Total Return	8.64%	18.19%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - GLD Total Return	8.17%	17.15%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - GLD Total Return	8.14%	17.10%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - GLD Total Return	8.12%	17.05%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - SLV Total Return	16.53%	36.14%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - SLV Total Return	13.69%	29.53%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - SLV Total Return	10.88%	23.15%



Date Range: 10/01/2010 - 03/31/2011

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Period 2: March 2014 - April 2016

The **GPR Index** remained at elevated levels for a period of more than two years, due in large part to **Russia's annexing of Crimea** in March 2014, **terrorist attacks** against the Charlie Hebdo publication in Paris in January 2015, and more **coordinated terrorist attacks throughout Paris** in November 2015.

In that time, hedging geopolitical risks with precious metals ETFs did not provide any noteworthy risk benefits. Even at a 15% allocation, the iShares Silver Trust **(SLV)** hedge worsened max drawdown in the period by just 91 basis points and SPDR Gold Shares **(GLD)** added only 59 basis points of downside protection.

Geopolitical Risk Hedge	March 2014 - April 2016	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-11.56%	0.45%
5% Hedge		
Invesco DB Precious Metals (DBP)	-11.25%	0.43%
SPDR Gold Shares (GLD)	-11.15%	0.43%
iShares Silver Trust (SLV)	-11.61%	0.44%
10% Hedge		
Invesco DB Precious Metals (DBP)	-11.30%	0.42%
SPDR Gold Shares (GLD)	-11.04%	0.42%
iShares Silver Trust (SLV)	-12.03%	0.44%
15% Hedge		
Invesco DB Precious Metals (DBP)	-11.35%	0.42%
SPDR Gold Shares (GLD)	-10.97%	0.41%
iShares Silver Trust (SLV)	-12.47%	0.45%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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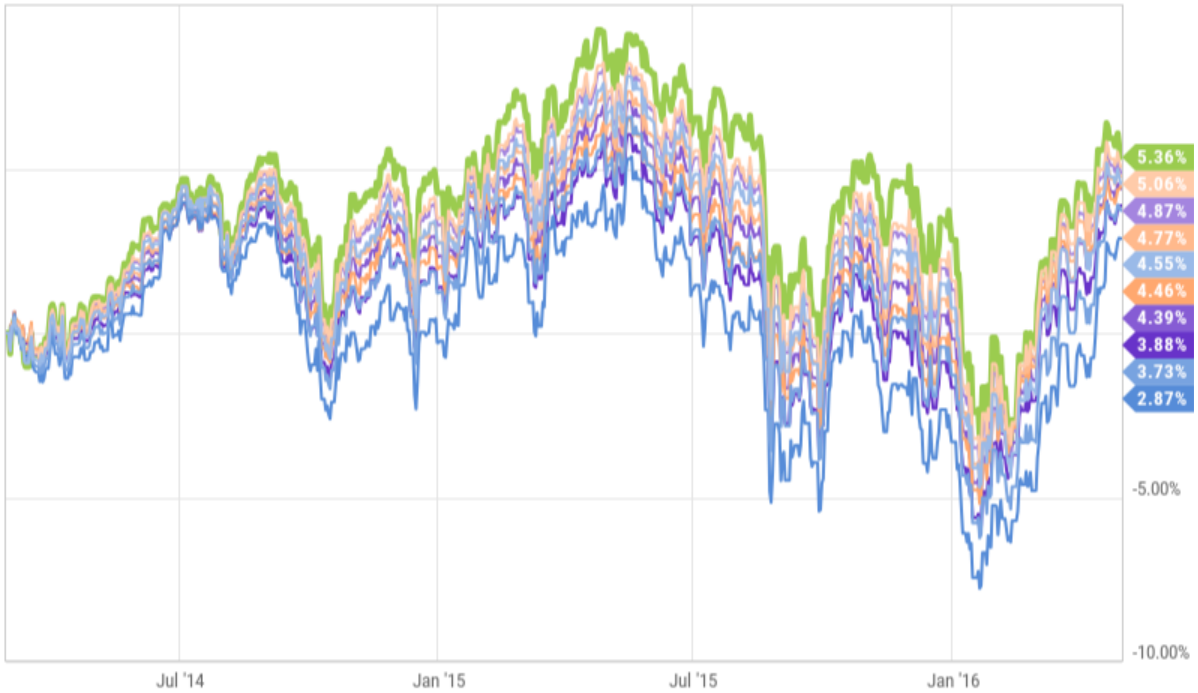
Over the two years starting March 2014, when the **GPR Index** stayed relatively elevated, none of the three precious metal ETF hedges—Invesco DB Precious Metals ETF **(DBP)**, SPDR Gold Shares **(GLD)** and iShares Silver Trust **(SLV)**—added performance benefits, and larger allocations led to worsened performance relative to the Sample 60/40 Portfolio.

Hedging Geopolitical Risk With DBP, GLD & SLV

	VAL	ANN
60/40 Sample Portfolio Total Return	5.36%	2.43%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - DBP Total Return	3.88%	1.77%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - DBP Total Return	4.39%	2.00%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - DBP Total Return	4.87%	2.22%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - GLD Total Return	4.46%	2.03%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - GLD Total Return	4.77%	2.17%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - GLD Total Return	5.06%	2.30%
60/40 Sample Portfolio - 15% Geopolitical Risk Hedge - SLV Total Return	2.87%	1.31%
60/40 Sample Portfolio - 10% Geopolitical Risk Hedge - SLV Total Return	3.73%	1.70%
60/40 Sample Portfolio - 5% Geopolitical Risk Hedge - SLV Total Return	4.55%	2.07%



Date Range: 02/28/2014 - 04/30/2016

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Period 3: March 2018 - February 2020

Sitting at a decade low in February 2018, the **GPR Index** jumped significantly the next month when the United States and allies carried out **missile strikes in Syria**. The indicator remained elevated for almost two years before another spike in February 2020, which followed **Iran's own strikes against** United States troops in Iraq.

Each of the Invesco DB Precious Metals ETF **(DBP)**, SPDR Gold Shares **(GLD)** and iShares Silver Trust **(SLV)** hedges had positive effects on drawdown and standard deviation. Where the Sample 60/40 portfolio drew down by as much as 10.58% in the period, the GLD hedge offered the biggest cushion of 1.9 percentage points.

Geopolitical Risk Hedge	March 2018 - February 2020	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-10.58%	0.47%
5% Hedge		
Invesco DB Precious Metals (DBP)	-9.87%	0.45%
SPDR Gold Shares (GLD)	-9.81%	0.45%
iShares Silver Trust (SLV)	-10.05%	0.45%
10% Hedge		
Invesco DB Precious Metals (DBP)	-9.23%	0.43%
SPDR Gold Shares (GLD)	-9.11%	0.43%
iShares Silver Trust (SLV)	-9.60%	0.45%
15% Hedge		
Invesco DB Precious Metals (DBP)	-8.99%	0.42%
SPDR Gold Shares (GLD)	-8.68%	0.42%
iShares Silver Trust (SLV)	-9.86%	0.45%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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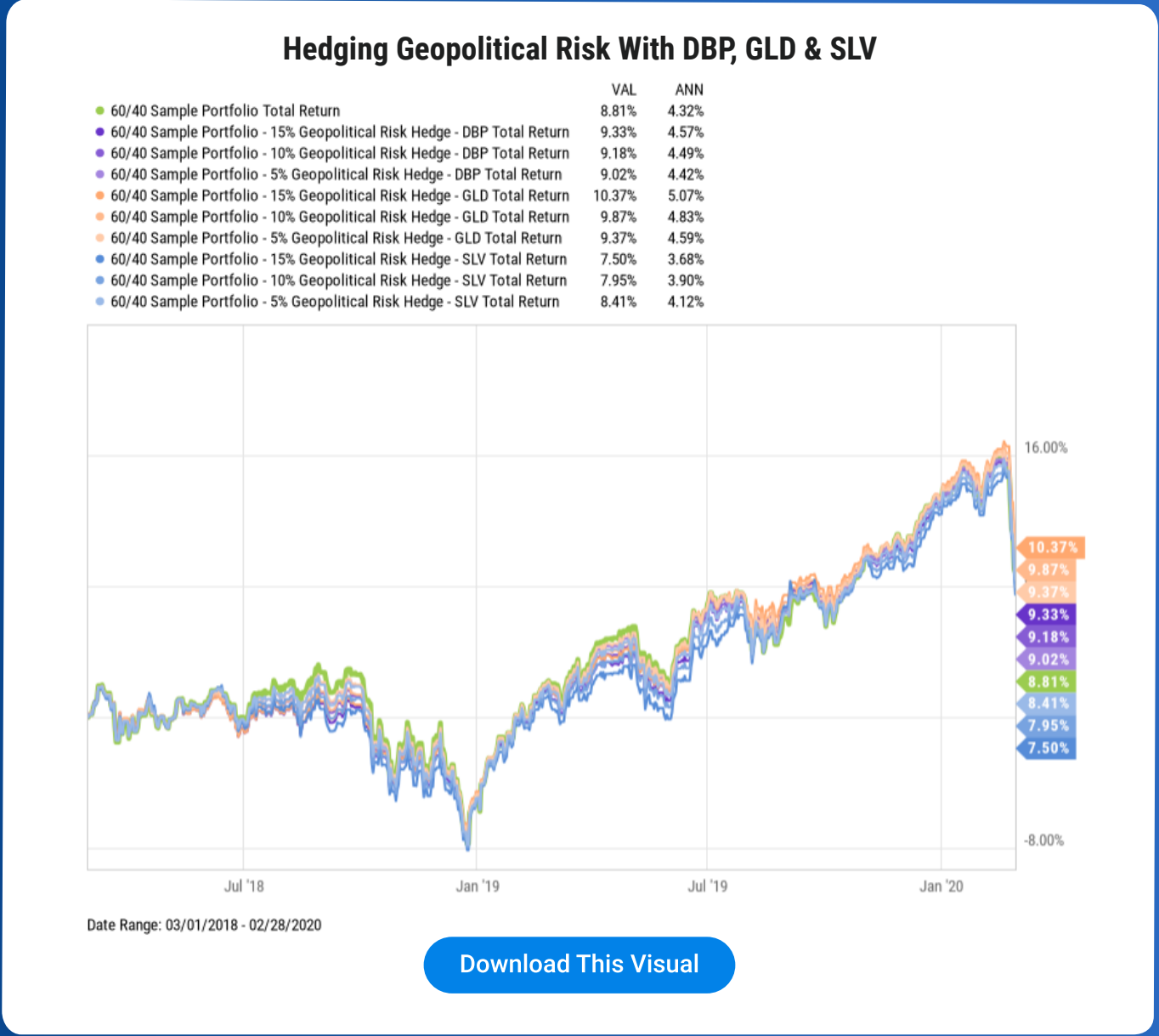
With the **GPR Index** floating at relatively heightened levels for almost two years, the Sample 60/40 Portfolio was outperforming the hedged portfolios through early 2019. But SPDR Gold Shares **(GLD)** and Invesco DB Precious Metals ETF **(DBP)** added to performance later in the examined time frame. Hedging with iShares Silver Trust **(SLV)** had a negative impact on the portfolio.



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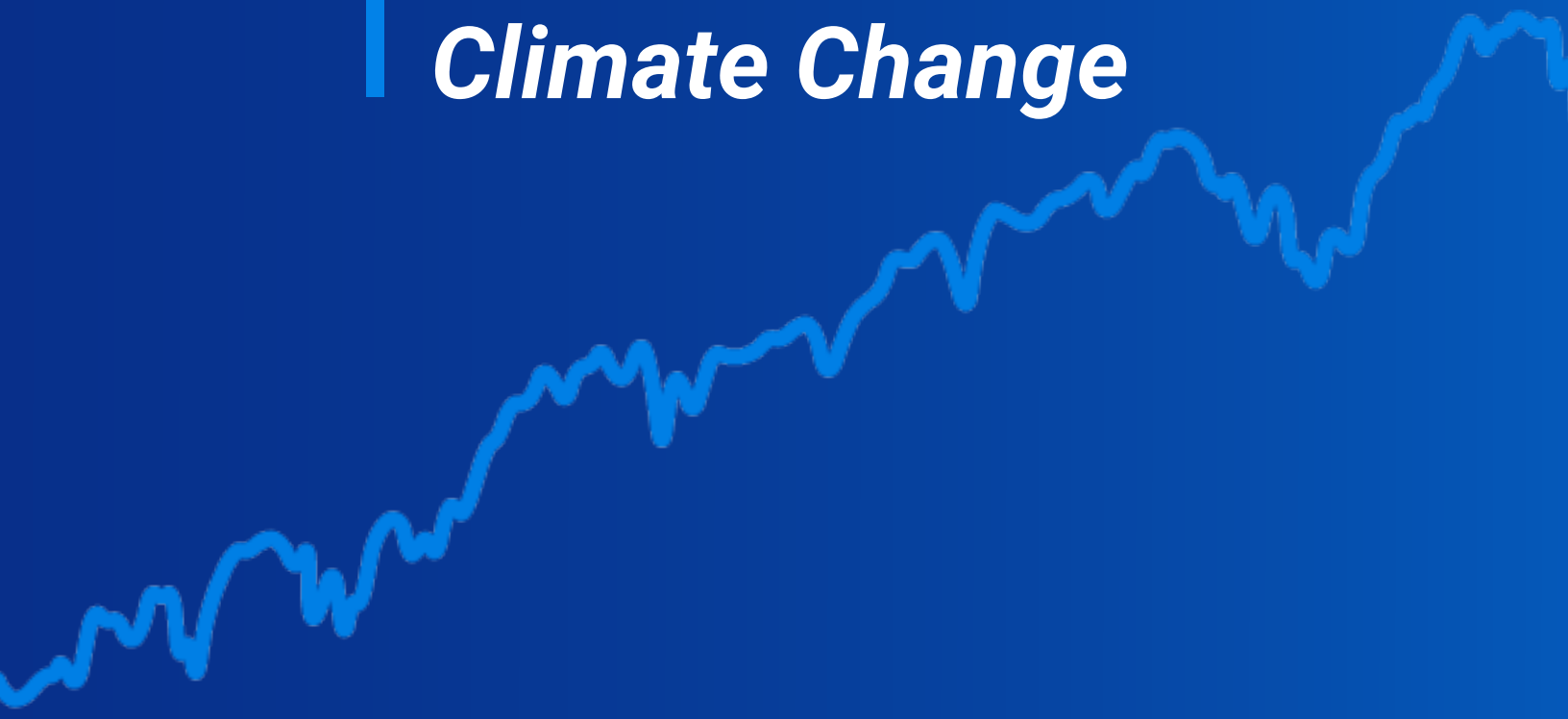
Hedging Against Climate Change



Hedging Against Climate Change

As investors continue to demand fund options that align with their beliefs and social priorities, more and more ETFs emerge including **environmental, social & governance (ESG)** concepts in their objectives. Seemingly the most visible of these factors is the "E" in ESG. Regulators and consumers are changing the traditional energy sector via carbon taxes and decreased demand for fossil fuels, respectively, while "green" and "clean" ETFs are aiming to limit these risks which total market ETFs are exposed to. Some, like the KraneShares Global Carbon ETF **(KRBN)**, intend to directly benefit from the transition to new industries, corporate practices, and regulatory environments. A case could be made for an "always on" climate change hedge, but this study considered portfolio hedges during periods of climate disasters and heightened concern about the effects of climate change. Namely, climate change hedges were tested during a record hurricane, wildfire season, and winter ice storm in the United States.

The four ETFs examined as hedges against climate change—iShares MSCI USA ESG Select ETF **(SUSA)**, iShares Global Clean Energy ETF **(ICLN)**, VanEck Low Carbon Energy ETF **(SMOG)**, and KraneShares Global Carbon ETF **(KRBN)**—employ different strategies in pursuit of a common goal, and none of the four improved the Sample 60/40 Portfolio's risk profile in any of the three periods examined. But fittingly, each hedging strategy added performance benefits during at least one of the climate disasters examined.

About the ETFs Used

iShares MSCI USA ESG Select ETF (SUSA)
- AUM (as of Oct 31, 2021): $4.10 billion
- Expense Ratio: 0.25%

→ **See similar ETFs in YCharts**

VanEck Low Carbon Energy ETF (SMOG)
- AUM (as of Oct 31, 2021): $ 331.14 million
- Expense Ratio: 0.62%

→ **See similar ETFs in YCharts**

iShares Global Clean Energy ETF (ICLN)
- AUM (as of Oct 31, 2021): $6.88 billion
- Expense Ratio: 0.42%

→ **See similar ETFs in YCharts**

KraneShares Global Carbon ETF (KRBN)
- AUM (as of Oct 31, 2021): $1.07 billion
- Expense Ratio: 0.78%

→ **See similar ETFs in YCharts**

S&P 500 Level Percent Change

Periods Tested

- July 24, 2020 - December 31, 2020
- February 11, 2021 - February 21, 2021
- August 18, 2021 - September 4, 2021

S&P 500 Level % Change

Period 1: July 24, 2020 - December 31, 2020

The **2020 wildfire season** in the Western United States was particularly severe. Taking at least 37 lives and causing an estimated $19.9 billion in damages, both climate change and insufficient forest management exacerbated the number and severity of wildfires in 2020.

The iShares MSCI USA ESG Select ETF **(SUSA)** hedge had the largest negative impact on max drawdown, adding 82 basis points to the downside, while iShares Global Clean Energy ETF **(ICLN)** hurt the Sample 60/40 Portfolio's average standard deviation throughout the period the most.

Climate Change Hedge	Jul 24, 2020 - Dec 31, 2020	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-4.57%	1.06%
5% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-4.84%	1.10%
iShares Global Clean Energy ETF (ICLN)	-4.62%	1.12%
VanEck Low Carbon Energy ETF (SMOG)	-4.80%	1.12%
KraneShares Global Carbon ETF (KRBN)	-4.64%	1.06%
10% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-5.12%	1.15%
iShares Global Clean Energy ETF (ICLN)	-4.66%	1.19%
VanEck Low Carbon Energy ETF (SMOG)	-5.01%	1.18%
KraneShares Global Carbon ETF (KRBN)	-4.87%	1.06%
15% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-5.39%	1.19%
iShares Global Clean Energy ETF (ICLN)	-4.71%	1.26%
VanEck Low Carbon Energy ETF (SMOG)	-5.23%	1.25%
KraneShares Global Carbon ETF (KRBN)	-5.18%	1.07%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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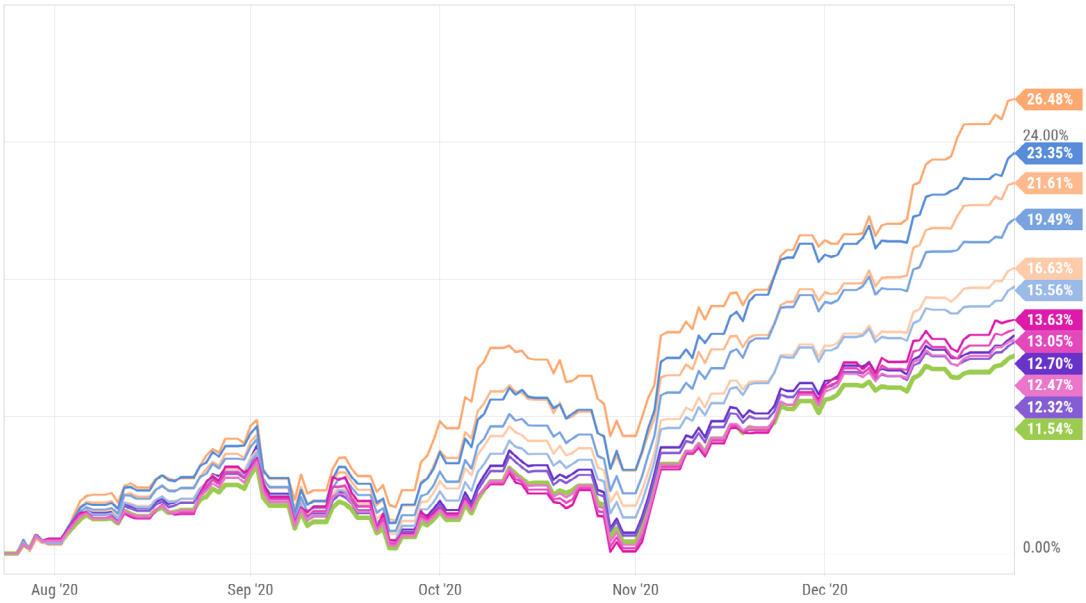
While the four ETF hedges did not provide benefits by way of their chief purpose, risk management, they all lifted portfolio performance amid **record wildfires in the Western US**. At a 15% allocation, the iShares Global Clean Energy ETF **(ICLN)** hedge improved annualized total returns by a staggering 42.6 percentage points. The VanEck Low Carbon Energy ETF **(SMOG)** hedge was similarly beneficial, and even more so at increasingly higher allocations.

Hedging Climate Change Risk With SUSA, ICLN, SMOG & KRBN

	VAL	ANN
60/40 Sample Portfolio Total Return	11.54%	28.30%
60/40 Sample Portfolio - 15% Climate Change Hedge - SUSA Total Return	12.70%	31.37%
60/40 Sample Portfolio - 10% Climate Change Hedge - SUSA Total Return	12.32%	30.35%
60/40 Sample Portfolio - 15% Climate Change Hedge - ICLN Total Return	26.48%	70.91%
60/40 Sample Portfolio - 10% Climate Change Hedge - ICLN Total Return	21.61%	56.26%
60/40 Sample Portfolio - 5% Climate Change Hedge - ICLN Total Return	16.63%	42.04%
60/40 Sample Portfolio - 15% Climate Change Hedge - SMOG Total Return	23.35%	61.39%
60/40 Sample Portfolio - 10% Climate Change Hedge - SMOG Total Return	19.49%	50.11%
60/40 Sample Portfolio - 5% Climate Change Hedge - SMOG Total Return	15.56%	39.08%
60/40 Sample Portfolio - 15% Climate Change Hedge - KRBN Total Return	13.63%	33.84%
60/40 Sample Portfolio - 10% Climate Change Hedge - KRBN Total Return	13.05%	32.29%
60/40 Sample Portfolio - 5% Climate Change Hedge - KRBN Total Return	12.47%	30.75%



Date Range: 07/24/2020 - 12/31/2020

Not shown for space limitations: 5% Climate Change Risk Hedge Using SUSA; period performance: 11.93% or 29.32% annualized.

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Period 2: February 11, 2020 - February 21, 2020

In February 2021, a severe winter and ice storm tormented most of North America for a week and a half. The costliest and deadliest in the US since 1993, **Winter Storm Uri** took 237 lives, caused an estimated $196.5 billion of damages, and led to sweeping blackouts across Texas and neighboring states. Winter storm (TX).

Over these ten days, the Sample 60/40 Portfolio was relatively undisturbed, and adding a climate change hedge in response to the winter storm actually worsened portfolio max drawdown and standard deviation. In fact, iShares Global Clean Energy ETF **(ICLN)** increased the Sample 60/40 Portfolio's max drawdown by more than 3x.

Climate Change Hedge	Feb 11, 2021 - Feb 21, 2021	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-0.55%	1.04%
5% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.56%	1.08%
iShares Global Clean Energy ETF (ICLN)	-0.93%	1.11%
VanEck Low Carbon Energy ETF (SMOG)	-0.85%	1.10%
KraneShares Global Carbon ETF (KRBN)	-0.74%	1.05%
10% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.57%	1.13%
iShares Global Clean Energy ETF (ICLN)	-1.35%	1.19%
VanEck Low Carbon Energy ETF (SMOG)	-1.16%	1.17%
KraneShares Global Carbon ETF (KRBN)	-0.99%	1.06%
15% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.57%	1.17%
iShares Global Clean Energy ETF (ICLN)	-1.84%	1.27%
VanEck Low Carbon Energy ETF (SMOG)	-1.46%	1.25%
KraneShares Global Carbon ETF (KRBN)	-1.25%	1.07%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation
Avg. 1Y Standard Deviation shown is for period 1/31/2021 - 2/28/2021

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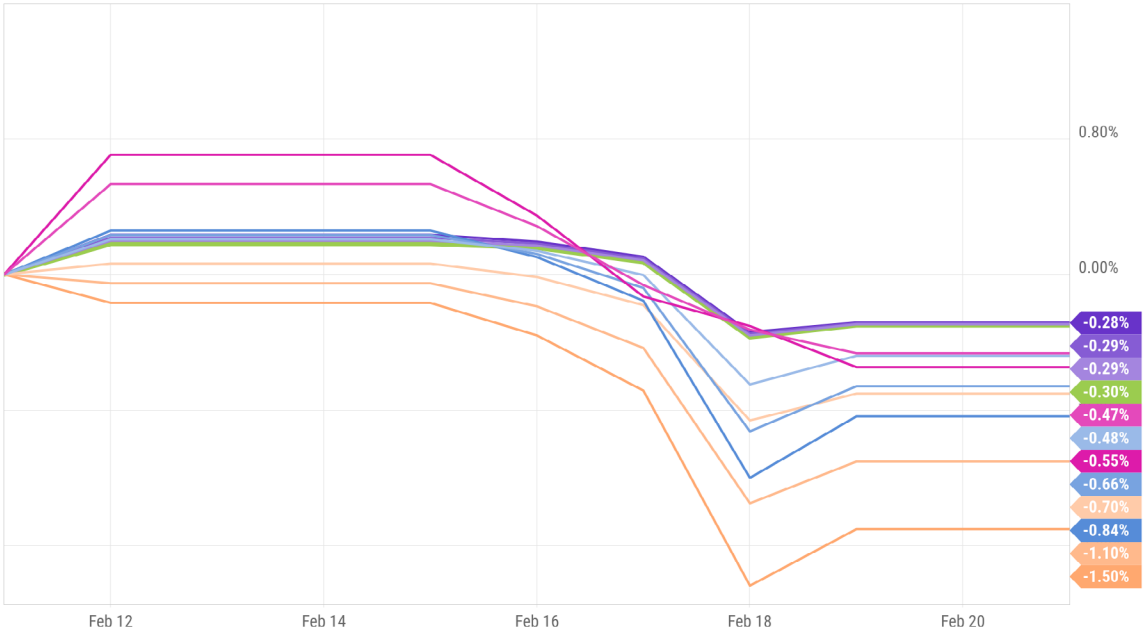
Considering the relatively short time frame, just ten days, during which **Winter Storm Uri** swept across the North American continent, the effects of each climate change hedge are relatively muted. Only the iShares MSCI USA ESG Select ETF **(SUSA)** hedge provided any performance benefit.

In addition to worsening drawdowns significantly, the iShares Global Clean Energy ETF **(ICLN)** hedge led to annualized performance that was 4-times worse than the Sample 60/40 Portfolio's in the period.

Hedging Climate Change Risk With SUSA, ICLN, SMOG & KRBN

	VAL	ANN
60/40 Sample Portfolio Total Return	-0.30%	-10.38%
60/40 Sample Portfolio - 15% Climate Change Hedge - SUSA Total Return	-0.28%	-9.86%
60/40 Sample Portfolio - 10% Climate Change Hedge - SUSA Total Return	-0.29%	-10.03%
60/40 Sample Portfolio - 5% Climate Change Hedge - SUSA Total Return	-0.29%	-10.20%
60/40 Sample Portfolio - 15% Climate Change Hedge - ICLN Total Return	-1.50%	-42.47%
60/40 Sample Portfolio - 10% Climate Change Hedge - ICLN Total Return	-1.10%	-33.33%
60/40 Sample Portfolio - 5% Climate Change Hedge - ICLN Total Return	-0.70%	-22.71%
60/40 Sample Portfolio - 15% Climate Change Hedge - SMOG Total Return	-0.84%	-26.44%
60/40 Sample Portfolio - 10% Climate Change Hedge - SMOG Total Return	-0.66%	-21.47%
60/40 Sample Portfolio - 5% Climate Change Hedge - SMOG Total Return	-0.48%	-16.12%
60/40 Sample Portfolio - 15% Climate Change Hedge - KRBN Total Return	-0.55%	-18.16%
60/40 Sample Portfolio - 10% Climate Change Hedge - KRBN Total Return	-0.47%	-15.67%



Date Range: 02/11/2021 - 02/21/2021

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Period 3: August 18, 2021 - September 4, 2021

As natural disasters of every sort become more intense as a result of climate change, **2021's Hurricane Ida** became the second-most damaging hurricane to hit Louisiana since Katrina in 2005.

While the Sample 60/40 Portfolio fell by a maximum of only 0.44% in the period, a short term hedge of 5-15% using KraneShares Global Carbon ETF **(KRBN)** worsened max drawdown by anywhere from 18 to 70 basis points. For the third of three periods tested, iShares Global Clean Energy ETF **(ICLN)** had the largest negative impact on the portfolio's average standard deviation.

Climate Change Hedge	Aug 18, 2021 - Sep 4, 2021	
	Period Max Drawdown	Avg. 1Y Standard Deviation
Original Portfolio		
60/40 Sample Portfolio	-0.44%	0.51%
5% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.45%	0.53%
iShares Global Clean Energy ETF (ICLN)	-0.46%	0.56%
VanEck Low Carbon Energy ETF (SMOG)	-0.47%	0.56%
KraneShares Global Carbon ETF (KRBN)	-0.62%	0.54%
10% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.46%	0.55%
iShares Global Clean Energy ETF (ICLN)	-0.49%	0.63%
VanEck Low Carbon Energy ETF (SMOG)	-0.50%	0.62%
KraneShares Global Carbon ETF (KRBN)	-0.88%	0.58%
15% Hedge		
iShares MSCI USA ESG Select ETF (SUSA)	-0.47%	0.56%
iShares Global Clean Energy ETF (ICLN)	-0.52%	0.70%
VanEck Low Carbon Energy ETF (SMOG)	-0.53%	0.69%
KraneShares Global Carbon ETF (KRBN)	-1.14%	0.63%

Green Highlight = lesser max drawdown or standard deviation
Red Highlight = greater max drawdown or standard deviation

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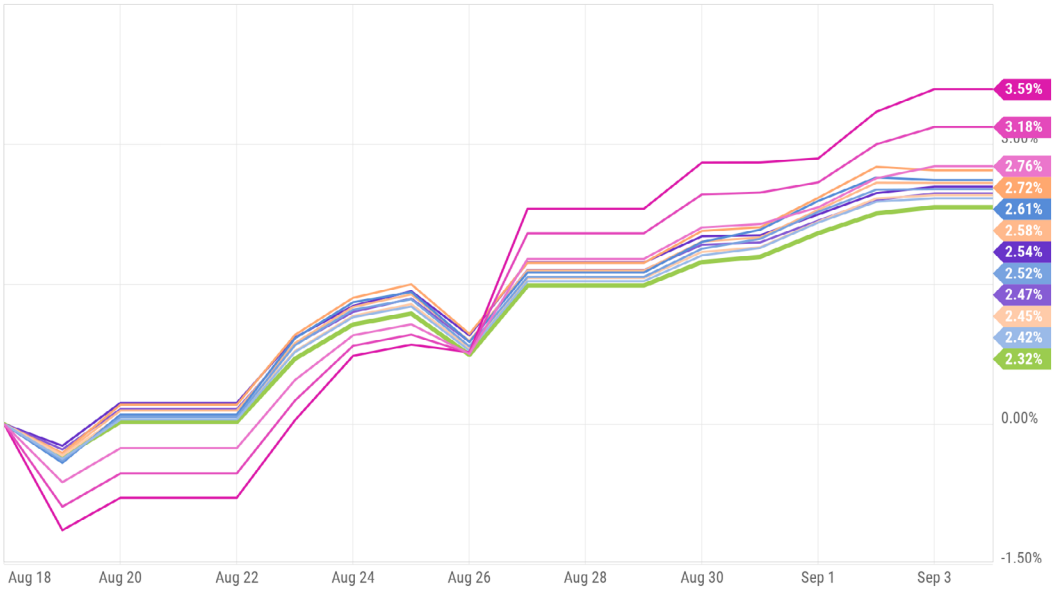
Although a KraneShares Global Carbon ETF **(KRBN)** hedge against climate change worsened the Sample 60/40 Portfolio's drawdown while **Hurricane Ida** struck the US and Mexico, it also added the most upside. A 15% allocation to KRBN added 1.27 percentage points of return in the period, or 49.4 percentage points on an annualized basis. Hedges using iShares MSCI USA ESG Select ETF **(SUSA)**, iShares Global Clean Energy ETF **(ICLN)**, and VanEck Low Carbon Energy ETF **(SMOG)** also added performance in the period.

Hedging Climate Change Risk With SUSA, ICLN, SMOG & KRBN

	VAL	ANN
60/40 Sample Portfolio Total Return	2.32%	63.79%
60/40 Sample Portfolio - 15% Climate Change Hedge - SUSA Total Return	2.54%	71.47%
60/40 Sample Portfolio - 10% Climate Change Hedge - SUSA Total Return	2.47%	68.91%
60/40 Sample Portfolio - 15% Climate Change Hedge - ICLN Total Return	2.72%	77.89%
60/40 Sample Portfolio - 10% Climate Change Hedge - ICLN Total Return	2.58%	72.94%
60/40 Sample Portfolio - 5% Climate Change Hedge - ICLN Total Return	2.45%	68.25%
60/40 Sample Portfolio - 15% Climate Change Hedge - SMOG Total Return	2.61%	74.03%
60/40 Sample Portfolio - 10% Climate Change Hedge - SMOG Total Return	2.52%	70.51%
60/40 Sample Portfolio - 5% Climate Change Hedge - SMOG Total Return	2.42%	67.10%
60/40 Sample Portfolio - 15% Climate Change Hedge - KRBN Total Return	3.59%	113.18%
60/40 Sample Portfolio - 10% Climate Change Hedge - KRBN Total Return	3.18%	96.00%
60/40 Sample Portfolio - 5% Climate Change Hedge - KRBN Total Return	2.76%	79.53%



Date Range: 08/18/2021 - 09/04/2021

Not shown for space limitations: 5% Climate Change Risk Hedge Using SUSA; period performance: 2.40% or 66.34% annualized.

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Conclusion

In conclusion, exchange traded funds (ETFs), cash and Bitcoin can be effective for hedging against a variety of risk factors—but timing, security selection, and relative allocation will heavily impact the outcome. Even among risk factors that appear to be suitable targets for ETF hedges (e.g. inflation), there was a noteworthy difference across the several ETFs that were studied.

Summarizing the various sections of this report, an ETF hedge may be worth consideration for protecting a portfolio against inflation, geopolitical risk, and stock market crashes. Conversely, this low cost and straightforward alternative to more traditional (albeit more complicated) hedging strategies proved less effective against risks from market volatility, climate change, and a weakening US dollar. Even still, this analysis and the different hedges' effects on portfolios can be used to demonstrate to clients that certain risk factors are known, but hedging against them is not worth the limited impact and "tinkering" with allocations.

While the main goal of a portfolio hedge is to manage risk and protect value, examining performance effects in conjunction revealed an interesting trend. Particularly true when hedging with Bitcoin and ETFs that invest in derivatives, portfolio risk metrics might worsen dramatically while significant performance improvements can be realized. Considering this fact, it may be more appropriate to view some ETF "hedges" not as hedges at all, but rather as "plays" that might perform well under certain risky conditions.

Before altering or implementing your portfolio hedging strategy, a few caveats from this analysis should be considered. Notably, timeframe bias likely exists and the exit and/or entry of any hedge will significantly impact results. Additionally, this study considered only a few portfolio-level metrics to ascertain a given hedge's effects. Risk management and performance can be more or less important from client to client. Similarly, the costs or difficulty of implementing an ETF hedge differs from advisor to advisor. Ultimately, advisors should choose a hedging strategy that best serves their clients' needs without putting undue strain on their own operations.

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