Cross Asset Hedging

Lagging FX vol & credit hedges attractive as geopolitical risks add to catalyst mix

Asset Allocation

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Global

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Hedging remains pertinent as geopolitical risks rise

Following the recent attacks on Saudi Arabia's oil production, Crude oil vol rose by the most since 2008 (Chart 1). While other assets saw sizeable vol gains too, very few join Crude vol in being above 10y+ median levels. Heading into year end, investors will likely remain wary of the potential for trade-war rhetoric to return as well as Brexit negotiations ahead of the 31-Oct deadline and any follow through on the geopolitical front. With risk assets like equities testing multi-year highs, hedging remains pertinent and we find the most value in select FX (e.g. EURUSD puts), Credit (US HY payers) and Equity hedges (HSCEI puts) across asset classes (Chart 2).

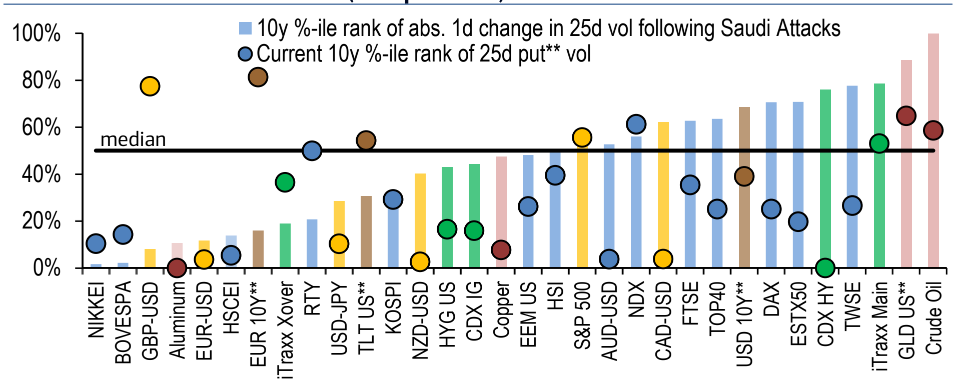
Efficacy of FX hedges has rarely been higher

Last month we highlighted FX hedges as most underpricing tail risk (after Aluminum puts) and indeed this has continued to be the case. With FX vol receding since its spike at the beginning of August, hedging tail risk with FX puts has become more attractive and indeed **EURUSD**, **NZDUSD** and **AUDUSD** puts are the top 3 tail hedges in our screen (Chart 2). More broadly, the average crash benefit of all FX hedges in our universe (ex. GBPUSD) has rarely been higher than it is currently – outside of 2019, this metric has only been higher during mid-2014 (Chart 3).

Rates vol (last year's low vol anchor) is no longer low

Since our last publication, cross asset vols have largely retreated; indeed only 7 of the 33 assets in our universe saw a pickup in vol after markets digested the Fed and ECB meetings in September. In contrast, interest rate vols (on USD, EUR swaptions & TLT) have continued to rise (Table 2) against a backdrop of greater divisions within central banks on policy paths and recent funding turmoil.

Chart 1: The attack on Saudi Arabian oil production caused one of the largest spikes in crude oil vol since '08. While many global assets saw large 1d moves in vol, crude remains as one of the few assets with vol above median levels (60th percentile)



Source: BofA Merrill Lynch Global Research. Data from 1-Feb-08 to 24-Sep-19. **3M 25% delta call volatility (receiver premia)

Table 1: X-asset vols & credit spreads

	Cur. level	1M chg.	%-ile
Global Equity Vol	15.1%	-2.1%	20%
Global FX Vol	8.1%	-0.5%	27%
Commodity Vol	22.4%	1.2%	38%
Global Rates Vol (bp)	62.7	4.7	43%
US IG Credit (bp)	61.3	1.6	19%
US HY Credit (bp)	330.0	-24.0	13%
iTraxx EU Main (bp)	55.4	-1.3	11%
iTraxx EU Xover (bp)	226.2	-55.7	1%

Equity Vol: SPX, SX5E, UKX, NKY & HSI 3M ATM vol
FX Vol: USDJPY, EURUSD & GBPUSD 3M ATM vol
Commodity Vol: Crude Oil, Gold & Copper 3M ATM vol
Rates Vol: ML Swaption 3M Vol Index US & EUR
Source: BofA Merrill Lynch Global Research. Data as of 24-Sep-19. %-iles are based on data since May-07.
*Change since 5-Aug-19.

Cross-asset tail hedging

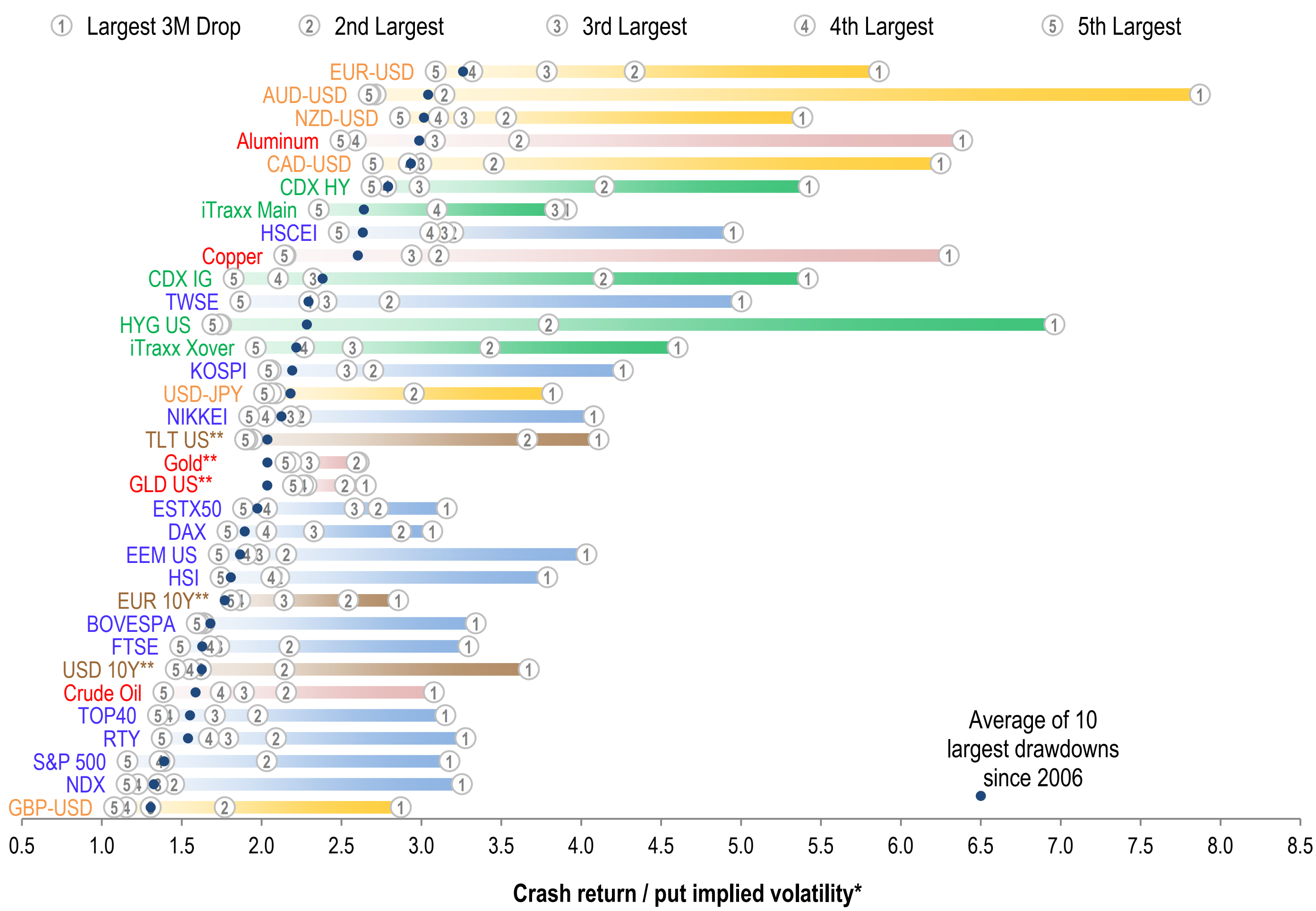
Identifying value in hedges across asset classes

Chart 2 shows crash returns of different assets during historical tail events per unit of current OTM option implied volatility. We measure tail events by the 10 largest 3M drops since Jan-06 (see Finding cheap hedges: the framework for how we algorithmically identify these events). Ranked by the average, the screen shows that the hedges which are most underpricing historical tail events are: **EURUSD, AUDUSD** and **NZDUSD puts.**

- **FX hedges continue to dominate the top of our tail hedging screen**. Indeed EURUSD, AUDUSD, NZDUSD and CADUSD have been in the top 8 cheapest tail hedges since our May19 report. Outside of 2019, the average tail hedge benefit offered by FX hedges in our universe (ex. Sterling) has only been greater during mid-2014 (Chart 3). Conversely, GBPUSD puts have ranked in the top 3 most expensive tail hedges since Jul19 as Brexit noise continues to dictate rhetoric.
- **Vols still below median levels post Saudi Arabia attack:** The shock to global oil supplies saw crude vol rise 9.3v on Monday to its 77th percentile. While many assets saw large 1d vol moves, few remain above median levels (Chart 1).
- **Rates saw a further rise in vol** since the spike at the beginning of August. EUR & USD 10Y's and TLT US account for 3 of 7 components where vols rose (Table 2).

Chart 2: Cross-asset tail hedging screen: FX puts are currently most underpricing tail risk and are led by EURUSD, AUDUSD and NZDUSD puts

For an explanation of how to interpret this chart see Finding cheap hedges: the framework.



Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *3M 25% delta put volatility for each asset, see Finding cheap hedges: the framework for more details on the methodology behind this diagram. **3M 25% delta call volatility (receiver premia) for TLT US, Gold and GLD US (USD & EUR 10Y rates). Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

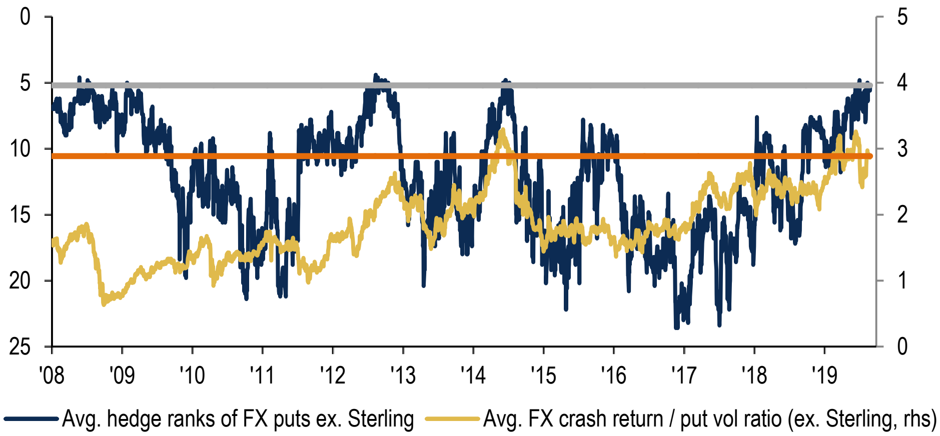
As a reference, Table 2 shows the largest drops (unless stated otherwise) within 3M in each asset class between '06 and '19, ranked in the same order as the assets in Chart 2.

Table 2: 10 largest 3M drawdowns across asset classes since Jan-06

Asset Name	Asset Category	10 Largest 3M drawdowns					3Mth 25 Delta Vol*	Vol Change†
EUR-USD	Currency	-17% (Oct-08) -8% (Jan-12)	-13% (Mar-15) -7% (Jul-12)	-11% (Jun-10) -7% (Oct-14)	-10% (Mar-09) -7% (Dec-16)	-9% (Feb-10) -7% (Nov-15)	5.8%	-1.1%
AUD-USD	Currency	-31% (Oct-08) -10% (Oct-08)	-12% (Jul-13) -9% (Aug-07)	-11% (May-10) -9% (Sep-15)	-11% (Feb-15) -8% (May-12)	-10% (Sep-11) -8% (Nov-11)	7.8%	-1.5%
NZD-USD	Currency	-22% (Nov-08) -11% (Oct-11)	-14% (Mar-09) -10% (Oct-14)	-13% (Jul-15) -10% (Aug-08)	-13% (Aug-07) -9% (May-12)	-12% (Apr-06) -9% (Jun-13)	8.2%	-1.1%
Aluminum	Commodity	-43% (Dec-08) -16% (Sep-08)	-24% (Jun-06) -16% (Oct-11)	-21% (Jun-10) -15% (Feb-06)	-17% (Aug-15) -15% (Sep-07)	-17% (Feb-09) -15% (Jun-12)	13.2%	-0.2%
CAD-USD	Currency	-18% (Oct-08) -8% (Jul-15)	-10% (Feb-15) -6% (Mar-09)	-9% (Jan-16) -6% (Aug-08)	-8% (Oct-11) -6% (Jan-14)	-8% (Dec-07) -6% (May-10)	5.8%	-0.3%
CDX HY	Credit	-18% (Dec-08) -8% (Jul-07)	-14% (Mar-09) -7% (May-10)	-10% (Oct-11) -7% (Nov-11)	-9% (Oct-09) -6% (Feb-10)	-9% (Mar-08) -5% (Jun-09)	44.7%	-12.5%
iTraxx Main	Credit	-4% (Sep-11) -2% (Mar-09)	-4% (Mar-08) -2% (Nov-11)	-4% (Dec-08) -2% (Feb-16)	-3% (May-12) -2% (Aug-07)	-2% (Jun-10) -1% (Jun-13)	60.6%	-14.0%
HSCEI	Hong Kong Equity	-46% (Oct-08) -21% (Mar-08)	-30% (Sep-15) -21% (Jan-09)	-30% (Jan-08) -17% (May-12)	-29% (Oct-11) -15% (Jun-06)	-23% (Jan-16) -15% (Jun-13)	18.3%	-2.3%
Copper	Commodity	-56% (Dec-08) -19% (Dec-07)	-28% (Jan-07) -17% (Jun-06)	-26% (Oct-11) -16% (Feb-15)	-19% (Jun-10) -16% (Jan-16)	-19% (Aug-15) -15% (Jul-18)	17.4%	-0.3%
CDX IG	Credit	-5% (Dec-08) -2% (Jun-10)	-4% (Mar-08) -2% (Aug-07)	-2% (Mar-09) -2% (Feb-16)	-2% (Jul-08) -2% (Jun-12)	-2% (Oct-11) -1% (Nov-07)	57.4%	-13.8%
TWSE	Taiwanese Equity	-37% (Nov-08) -13% (Oct-18)	-21% (Jul-08) -13% (Aug-07)	-18% (Jan-08) -13% (Feb-10)	-17% (Oct-11) -13% (Jun-06)	-14% (Aug-15) -12% (Jun-12)	14.5%	-0.9%
HYG US	US Credit	-28% (Nov-08) -7% (Aug-07)	-15% (Mar-09) -5% (Jul-08)	-7% (Jan-16) -5% (Feb-10)	-7% (Aug-11) -5% (May-10)	-7% (Nov-11) -5% (Feb-08)	8.0%	-2.8%
iTraxx Xover	Credit	-17% (Dec-08) -6% (Feb-16)	-12% (Sep-11) -6% (Nov-11)	-9% (Mar-08) -5% (May-12)	-8% (Aug-07) -4% (Mar-09)	-7% (Jun-10) -4% (Jun-13)	58.3%	**0.7%**
KOSPI	Korean Equity	-32% (Oct-08) -15% (Aug-07)	-20% (Aug-11) -14% (Mar-09)	-19% (Aug-08) -12% (Oct-18)	-15% (Jun-06) -11% (Aug-15)	-15% (Feb-08) -11% (May-12)	14.7%	-3.2%
USD-JPY	Currency	-15% (Dec-08) -8% (Jun-13)	-11% (Mar-08) -7% (May-06)	-8% (Apr-16) -7% (Sep-07)	-8% (Aug-16) -7% (Oct-09)	-8% (Sep-10) -6% (Mar-18)	7.8%	-1.7%
NIKKEI	Japanese Equity	-36% (Oct-08) -16% (Jun-13)	-20% (Feb-16) -16% (Jul-10)	-19% (Mar-08) -16% (Dec-18)	-18% (Mar-09) -15% (Jun-12)	-17% (Mar-11) -15% (Jun-06)	17.1%	-3.0%
TLT US**	Rates	30% (Dec-08) 14% (Jul-10)	27% (Sep-11) 10% (Jul-16)	14% (Aug-19) 10% (Feb-16)	14% (Jan-15) 8% (Sep-07)	14% (Jun-12) 8% (Jan-19)	14.3%	**1.4%**
Gold**	Commodity	25% (Feb-09) 20% (Nov-07)	25% (May-06) 18% (Mar-16)	22% (Sep-11) 16% (Aug-19)	21% (Mar-08) 14% (Jul-06)	21% (Nov-09) 14% (Oct-10)	18.9%	**1.7%**
GLD US**	Commodity	26% (May-06) 21% (Nov-09)	25% (Feb-09) 17% (Mar-16)	23% (Mar-08) 17% (Aug-19)	22% (Sep-11) 14% (Oct-10)	22% (Nov-07) 14% (Jul-06)	19.2%	**2.0%**
ESTX50	European Equity	-29% (Nov-08) -15% (Sep-15)	-25% (Sep-11) -14% (May-12)	-24% (Mar-09) -14% (Jul-08)	-19% (Mar-08) -12% (May-10)	-17% (Feb-16) -12% (Nov-11)	17.8%	-2.9%
DAX	German Equity	-29% (Nov-08) -16% (Sep-15)	-27% (Sep-11) -13% (Dec-18)	-22% (Mar-09) -13% (Jun-12)	-19% (Mar-08) -12% (Jul-08)	-17% (Feb-16) -12% (Nov-11)	18.5%	-2.4%
EEM US	Emerging Market Equity	-45% (Oct-08) -17% (Jan-16)	-24% (Sep-11) -15% (May-12)	-22% (Nov-08) -15% (Mar-09)	-21% (Jun-06) -14% (May-10)	-19% (Aug-15) -14% (Jan-08)	21.4%	-2.9%
HSI	Hong Kong Equity	-38% (Oct-08) -16% (Jan-16)	-21% (Oct-11) -15% (Jul-08)	-21% (Sep-15) -11% (May-12)	-21% (Mar-08) -11% (Jun-13)	-17% (Jan-09) -11% (Feb-10)	19.4%	-1.3%
EUR 10Y**	Rates	9% (Dec-08) 4% (Feb-16)	8% (Sep-11) 4% (Aug-14)	6% (Aug-19) 4% (Jan-15)	6% (Jun-12) 4% (May-10)	5% (Aug-10) 4% (Jan-12)	0.5%	**0.1%**
BOVESPA	Brazilian Equity	-40% (Oct-08) -18% (Jun-06)	-19% (Jun-12) -17% (Jun-18)	-19% (Oct-08) -17% (Aug-11)	-19% (Jan-16) -15% (May-10)	-19% (Jul-13) -15% (Aug-15)	22.7%	-3.1%
FTSE	UK Equity	-27% (Oct-08) -12% (Mar-08)	-18% (Mar-09) -10% (Aug-15)	-14% (Jul-08) -9% (May-12)	-14% (Aug-11) -9% (Aug-07)	-12% (Jul-10) -9% (Jun-13)	16.1%	-2.0%
USD 10Y**	Rates	17% (Dec-08) 6% (Feb-16)	10% (Sep-11) 5% (Jul-09)	7% (Aug-19) 5% (Jun-12)	7% (Jul-10) 5% (Jan-15)	7% (Jan-08) 5% (Sep-07)	0.7%	**0.0%**
Crude Oil	Commodity	-63% (Dec-08) -28% (Sep-08)	-44% (Jan-15) -25% (Nov-06)	-38% (Jan-16) -22% (Jun-12)	-35% (Dec-18) -21% (Oct-14)	-28% (Aug-15) -19% (May-10)	37.5%	**2.9%**
TOP40	South African Equity	-29% (Nov-08) -12% (Jun-06)	-19% (Aug-08) -11% (Aug-07)	-16% (Mar-09) -11% (Jan-16)	-13% (Jan-08) -11% (Aug-11)	-13% (Oct-18) -9% (May-10)	18.2%	-0.9%
RTY	US Small Cap Equity	-39% (Nov-08) -15% (Jan-08)	-25% (Mar-09) -15% (Jul-10)	-22% (Sep-11) -11% (Jun-06)	-20% (Dec-18) -11% (Aug-07)	-17% (Feb-16) -10% (Nov-11)	23.1%	-1.6%
S&P 500	US Equity	-33% (Nov-08) -11% (Mar-08)	-21% (Mar-09) -11% (Jul-08)	-14% (Aug-11) -9% (Jan-16)	-14% (Dec-18) -9% (Aug-15)	-12% (Jul-10) -8% (Feb-18)	20.0%	-3.2%
NDX	US Equity	-39% (Nov-08) -13% (Feb-16)	-18% (Mar-08) -13% (Jul-06)	-16% (Dec-18) -12% (Jul-10)	-15% (Mar-09) -10% (Aug-15)	-14% (Aug-11) -10% (Nov-12)	23.1%	-3.4%
GBP-USD	Currency	-19% (Nov-08) -7% (Jan-16)	-12% (Jul-16) -7% (Jun-18)	-9% (Jan-09) -6% (May-10)	-8% (Mar-10) -6% (Oct-16)	-7% (Mar-13) -6% (Oct-14)	13.1%	-0.4%

Source: BofA Merrill Lynch Global Research Data: 24-Sep-19. *Note that these are the actual 3Mth 25 delta implied vols (3M 25d Receiver premiums for USD & EUR 10Y rates) and not the adjusted vols used in the analysis as described in Finding cheap hedges: the framework. **Largest 3M *gains* since Jan-06. † Percentage point change in 3Mth 25 delta vols (premia for USD and EUR rates) since 5-Aug-19.

Chart 3: FX puts (ex. Sterling) are the near the best ranked they have been in our cross asset hedging screen and offer close to near record value (in terms of historical crash return / put vol)



Source: BofA Merrill Lynch Global Research. Data from 1-Feb-08 to 24-Sep-19

Hedging benchmarks w/out liquid options

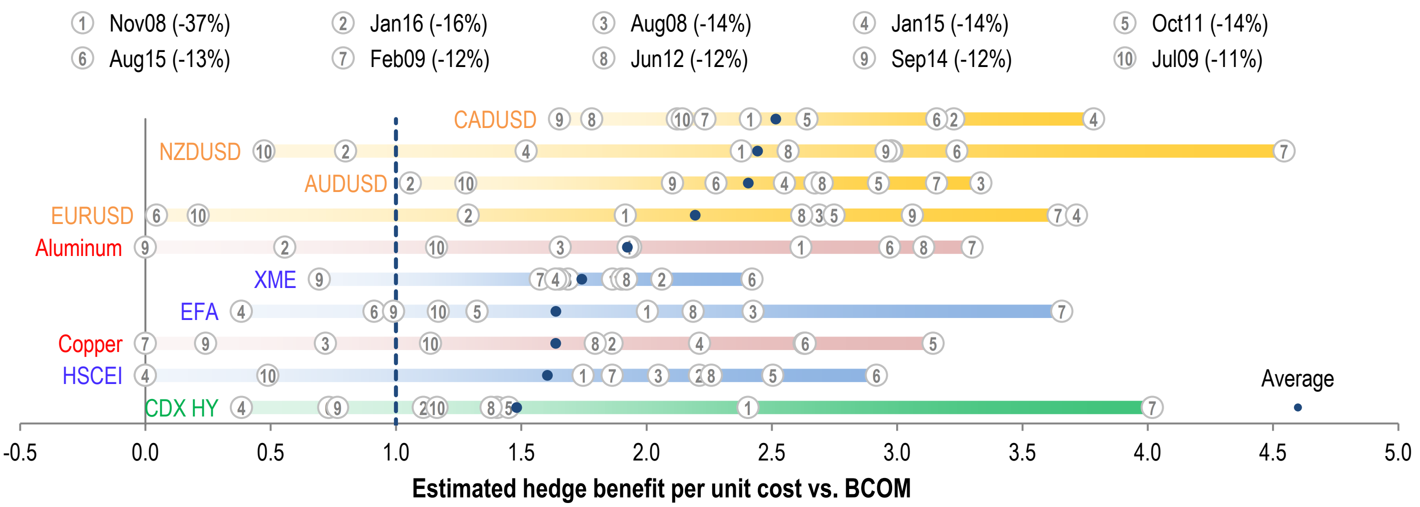
This section aims to identify the most efficient tail hedges for common constituents of broad cross asset portfolios. Importantly, the benchmarks we consider in Chart 4 to Chart 7 do not possess liquid option markets for comparison, meaning our standard proxy hedging screen is not applicable. Instead, we infer the relative efficacy of potential hedges by ranking their crash beta (as a proportion of their current implied volatility) during the 10 most severe declines of the benchmark. Whenever a proxy asset does not decline for a given sell-off in the benchmark, this hedge benefit is registered as 0, highlighting the basis risk of proxy hedging (see Method III in Finding cheap hedges: the framework for a detailed explanation). Note we use a wider universe of 70+ assets across cross asset ETFs, regional equity indices and equity sectors as opposed to the one in Table 2 when screening for proxy hedges, but only display the top 10 ranking proxies for simplicity. In addition, we now compute drawdowns (both here and in Chart 2) on total returns instead of price returns to better approximate option payouts when the forward is meaningfully dislocated from spot.

Hedging commodity exposure (BCOM)

Value in proxy hedging commodity exposure continues to be dominated by commodity-linked FX hedges. CADUSD puts offer the greatest hedge benefit and also the lowest basis risk during the top 10 largest BCOM drawdowns. Notably, hedges on individual commodities also rank well, led by Aluminum and Copper puts (yet carry a great deal of basis risk). Within equities, XME (US Metals & Mining) puts offer the highest hedge benefit.

Chart 4: Proxy hedge screen: Bloomberg Commodity Index

For an explanation of how to interpret this chart see Finding cheap hedges: the framework.



Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates). **Hedge benefit = Proxy return / [Benchmark return X Proxy 3M 25d vol] for each proxy and each of the 10 largest drawdowns of the benchmark. These are then normalized by the median level of the Average Hedge Benefit across all proxies.

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Table 3: Top 5 ranking BCOM proxy hedges

	10 largest 3M drawdowns													
Asset	Nov-08	Jan-16	Aug-08	Jan-15	Oct-11	Aug-15	Feb-09	Jun-12	Sep-14	Jul-09	Average crash beta*	R2	Avg crash beta / 3M 25d Vol	Normalised by median
BCOM	**-37.2%**	**-15.6%**	**-14.5%**	**-13.6%**	**-13.5%**	**-13.5%**	**-12.2%**	**-11.8%**	**-11.5%**	**-10.9%**	**1.0**	**-**	**-**	**-**
CADUSD	-15.5%	-8.7%	-5.3%	-8.9%	-6.2%	-7.4%	-4.7%	-3.6%	-3.3%	-4.0%	0.4	82%	7.5	2.5
NZDUSD	-21.9%	-3.1%	-10.7%	-5.1%	-10.0%	-10.8%	-13.7%	-7.5%	-8.4%	-1.3%	0.6	56%	7.3	2.4
AUDUSD	-23.5%	-3.9%	-11.4%	-8.2%	-9.4%	-7.3%	-9.1%	-7.5%	-5.7%	-3.3%	0.6	82%	7.1	2.4
EURUSD	-12.5%	-3.5%	-6.8%	-8.8%	-6.5%	-0.1%	-7.8%	-5.4%	-6.2%	-0.4%	0.4	40%	6.5	2.2
Aluminum	-39.2%	-3.5%	-9.7%	-10.6%	-10.6%	-16.2%	-16.3%	-14.8%	3.3%	-5.1%	0.8	69%	5.7	1.9

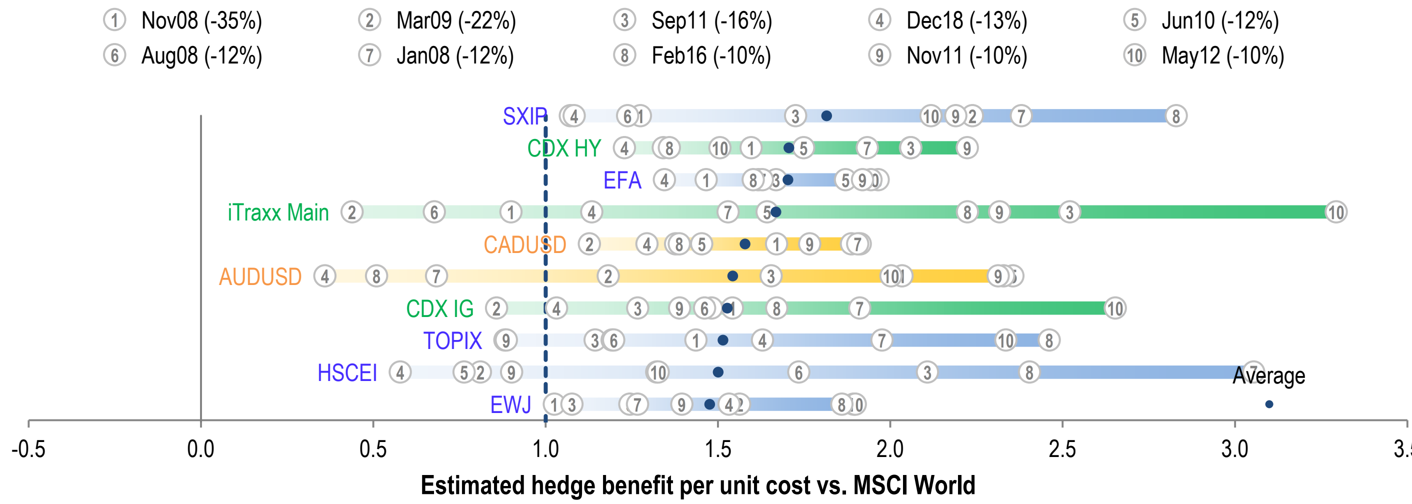
Source: BofA Merrill Lynch Global Research Data: 24-Sep-19. *Crash beta = max[0, Proxy return / Benchmark return].

Hedging global equities (MSCI World)

SXIP (European insurance) puts rank the highest among candidates for proxy hedging global equities and offer a hedge benefit of 1.8x times the median candidate during the MSCI World's top 10 largest drawdowns. CDX HY payers and EFA (Global developed markets ex-N. American equities) puts also offer significant benefit and have less basis risk than SXIP puts. CADUSD puts screen well as an FX alternative.

Chart 5: Proxy hedge screen: MSCI World Benchmark

For an explanation of how to interpret this chart see Finding cheap hedges: the framework.



Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates). **Hedge benefit = Proxy return / [Benchmark return X Proxy 3M 25d vol] for each proxy and each of the 10 largest drawdowns of the benchmark. These are then normalized by the median level of the Average Hedge Benefit across all proxies.

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Table 4: Top 5 ranking MSCI World proxy hedges

	10 largest 3M drawdowns													
Asset	**Nov-08**	**Mar-09**	**Sep-11**	**Dec-18**	**Jun-10**	**Aug-08**	**Jan-08**	**Feb-16**	**Nov-11**	**May-12**	**Average crash beta***	**R2**	**Avg crash beta / 3M 25d Vol**	**Normalised by median**
MSCI World	**-35.2%**	**-21.8%**	**-16.0%**	**-13.5%**	**-12.4%**	**-12.1%**	**-11.6%**	**-10.4%**	**-9.9%**	**-9.6%**	**1.0**	**-**	**-**	**-**
SXIP	-36.5%	-37.3%	-20.6%	-10.5%	-10.4%	-11.2%	-19.2%	-19.8%	-16.0%	-15.2%	1.3	66%	8.3	1.9
CDX HY	-16.9%	-13.5%	-9.9%	-5.0%	-6.6%	-4.9%	-6.8%	-4.3%	-6.6%	-4.4%	0.5	88%	7.5	1.7
EFA	-35.8%	-24.5%	-18.6%	-12.6%	-16.2%	-16.5%	-13.2%	-11.6%	-13.2%	-13.0%	1.2	96%	7.4	1.7
iTraxx Main	-3.3%	-0.9%	-3.8%	-1.4%	-2.0%	-0.8%	-1.6%	-2.0%	-2.1%	-3.0%	0.2	8%	7.6	1.7
CADUSD	-14.9%	-6.3%	-7.8%	-4.4%	-4.6%	-5.8%	-5.6%	-3.7%	-4.4%	-3.4%	0.4	88%	6.9	1.6

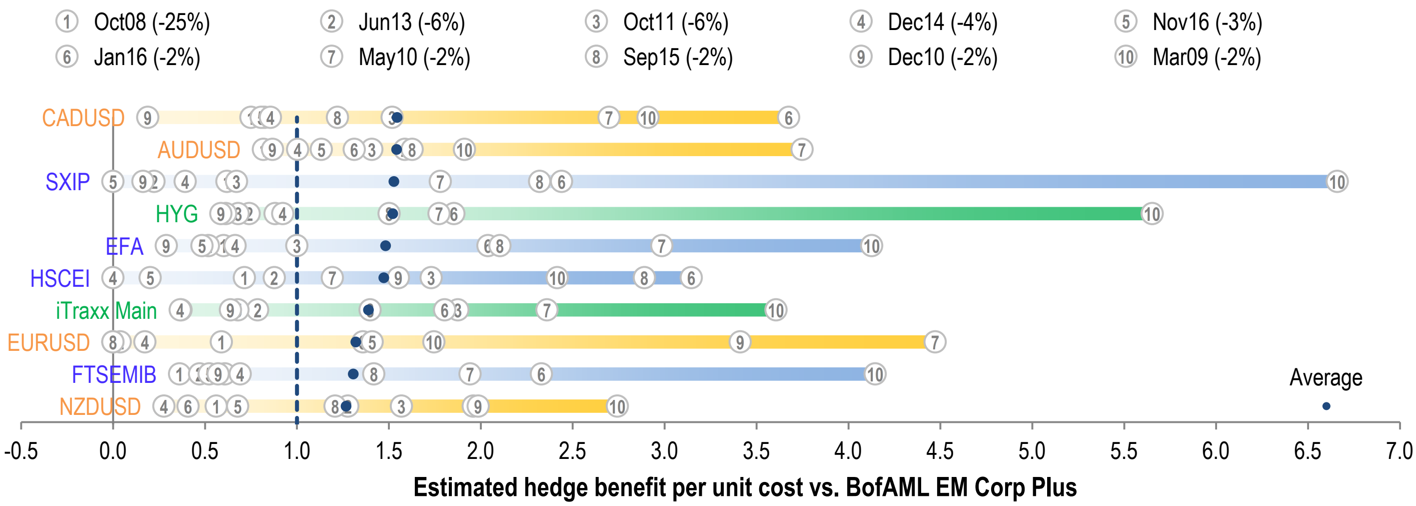
Source: BofA Merrill Lynch Global Research Data: 24-Sep-19. *Crash beta = max[0, Proxy return / Benchmark return].

Hedging EM Credit (BofAML EM Corporate Plus)

While CADUSD puts have the greatest average hedge benefit per unit cost as an EM Credit hedge, AUDUSD puts offer significantly less basis risk whilst still having an average hedge benefit of 1.5x the median hedge in our universe. Most other proxy hedging candidates come with a great deal of basis risk (e.g. during Oct08).

Chart 6: Proxy hedge screen: BofAML EM Corporate Plus Benchmark

For an explanation of how to interpret this chart see Finding cheap hedges: the framework.



Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates). **Hedge benefit = Proxy return / [Benchmark return X Proxy 3M 25d vol] for each proxy and each of the 10 largest drawdowns of the benchmark. These are then normalized by the median level of the Average Hedge Benefit across all proxies.

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Table 5: Top 5 ranking BofAML EM Corporate Plus proxy hedges

	10 largest 3M drawdowns													
Asset	Oct-08	Jun-13	Oct-11	Dec-14	Nov-16	Jan-16	May-10	Sep-15	Dec-10	Mar-09	Average crash beta*	R2	Avg crash beta / 3M 25d Vol	Normalised by median
BofAML EM Corp Plus	**-24.8%**	**-6.2%**	**-5.7%**	**-3.8%**	**-2.8%**	**-2.5%**	**-2.5%**	**-2.4%**	**-2.1%**	**-1.9%**	**1.0**	**-**	**-**	**-**
CADUSD	-14.1%	-3.8%	-6.5%	-2.4%	-1.7%	-6.9%	-5.0%	-2.2%	-0.3%	-4.1%	1.2	74%	20.0	1.5
AUDUSD	-21.0%	-10.1%	-8.3%	-3.9%	-3.2%	-3.4%	-9.5%	-4.1%	-1.9%	-3.7%	1.6	84%	20.0	1.5
SXIP	-36.1%	-2.9%	-8.5%	-3.1%	6.0%	-12.3%	-10.0%	-11.5%	-0.7%	-26.6%	3.3	43%	20.2	1.6
HYG	-23.0%	-4.8%	-4.1%	-3.7%	-1.8%	-4.8%	-4.6%	-3.8%	-1.3%	-11.1%	1.6	77%	19.7	1.5
EFA	-30.8%	-6.6%	-11.8%	-5.2%	-2.7%	-10.4%	-15.1%	-10.5%	-1.2%	-15.9%	3.1	62%	19.2	1.5

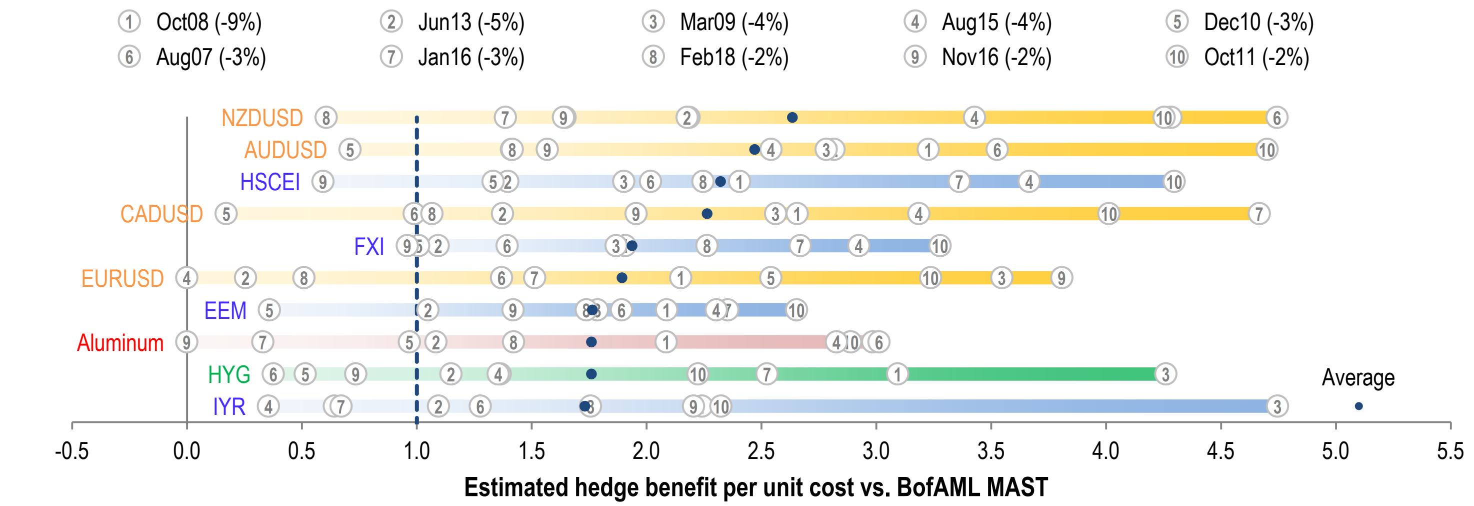
Source: BofA Merrill Lynch Global Research Data: 24-Sep-19. *Crash beta = max[0, Proxy return / Benchmark return].

Hedging a diversified multi-asset portfolio

Commodity-linked currency (NZDUSD, AUDUSD and CADUSD) puts continue to rank as the cheapest proxy hedges for popular diversified multi-asset portfolios (as represented by our BofAML MAST index). HSCEI and FXI (Chinese large-cap equities) puts also offer significant hedge benefit with less basis risk within the equity space.

Chart 7: Proxy hedge screen: BofAML MAST

For an explanation of how to interpret this chart see Finding cheap hedges: the framework.



Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Hedge benefit = Proxy return / [Benchmark return X Proxy 3M 25d vol] for each proxy and each of the 10 largest drawdowns of the benchmark. These are then normalized by the median level of the Average Hedge Benefit across all proxies.

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Table 6: Top 5 ranking BofAML MAST proxy hedges

Asset	10 largest 3M drawdowns										Average	R2	Avg crash beta /	Normalised
	Oct-08	Jun-13	Mar-09	Aug-15	Dec-10	Aug-07	Jan-16	Feb-18	Nov-16	Oct-11	crash beta*		3M 25d Vol	by median
BofAML MAST	-9.1%	-4.8%	-4.0%	-3.6%	-3.5%	-3.2%	-3.1%	-2.4%	-2.3%	-2.2%	1.0	-	-	-
NZDUSD	-16.7%	-8.7%	-14.3%	-10.4%	-4.8%	-12.6%	-3.6%	-1.2%	-3.1%	-7.9%	2.2	48%	26.6	2.6
AUDUSD	-23.6%	-10.8%	-8.9%	-7.4%	-2.0%	-8.9%	-3.6%	-2.8%	-2.9%	-8.3%	2.0	81%	24.9	2.5
HSCEI	-41.7%	-12.8%	-14.6%	-25.5%	-9.0%	-12.2%	-20.3%	-10.5%	-2.6%	-18.2%	4.5	64%	23.4	2.3
CADUSD	-14.2%	-3.9%	-6.0%	-6.8%	-0.4%	-1.8%	-8.6%	-1.5%	-2.6%	-5.2%	1.3	57%	22.8	2.3
FXI	-40.2%	-12.1%	-17.2%	-24.5%	-8.2%	-10.2%	-19.3%	-12.7%	-5.1%	-16.7%	4.5	64%	19.5	1.9

Source: BofA Merrill Lynch Global Research Data: 24-Sep-19. *Crash beta = max[0, Proxy return / Benchmark return].

Lowest cost cross-asset proxy hedges

Chart 8 through Chart 15 show ratios of historical crash betas (versus a benchmark) to relative hedge costs (see Benchmark proxy hedging in Finding cheap hedges: the framework for a detailed explanation of the methodology). Whenever a proxy asset does not decline for a given sell-off in the benchmark, this hedge benefit is registered as 0, highlighting the basis risk of proxy hedging.

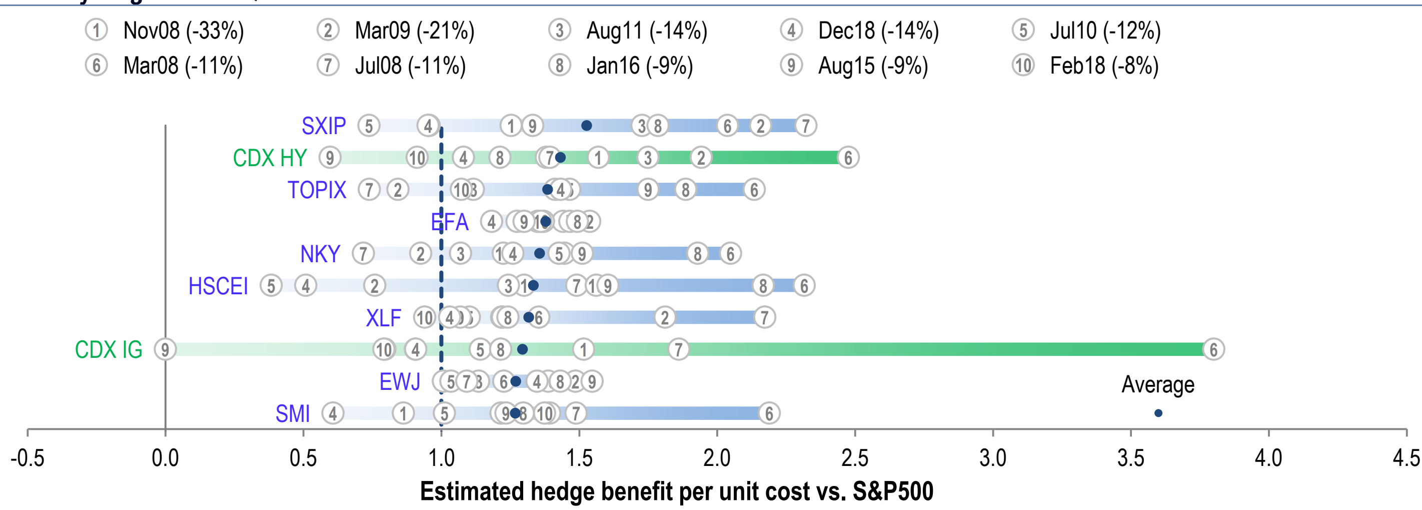
For appropriate proxy hedges, we look for:

1. **Average hedge benefit per unit cost > 1** (better value than the benchmark hedge)
2. **Closely distributed hedge benefits in past sell-offs** (consistency of proxy hedge)
3. **Min hedge benefit > 0** (low basis risk to benchmark)

Hedging US equities (S&P500)

SXIP (European Insurance) puts currently screen as having the highest average hedge-benefit for proxying protection on the S&P whilst also having relatively contained basis risk. At current levels, puts on EFA (Global developed markets ex-N. American equities) would have provided better protection than S&P puts during each of the 10 largest sell-offs in US large-caps, averaging 38% greater hedge benefit (per unit cost) over these sell offs. Financials in the US (XLF) also continue to screen well as a candidate for proxy hedging the S&P500.

Chart 8: Proxy hedge screen: S&P500 Benchmark



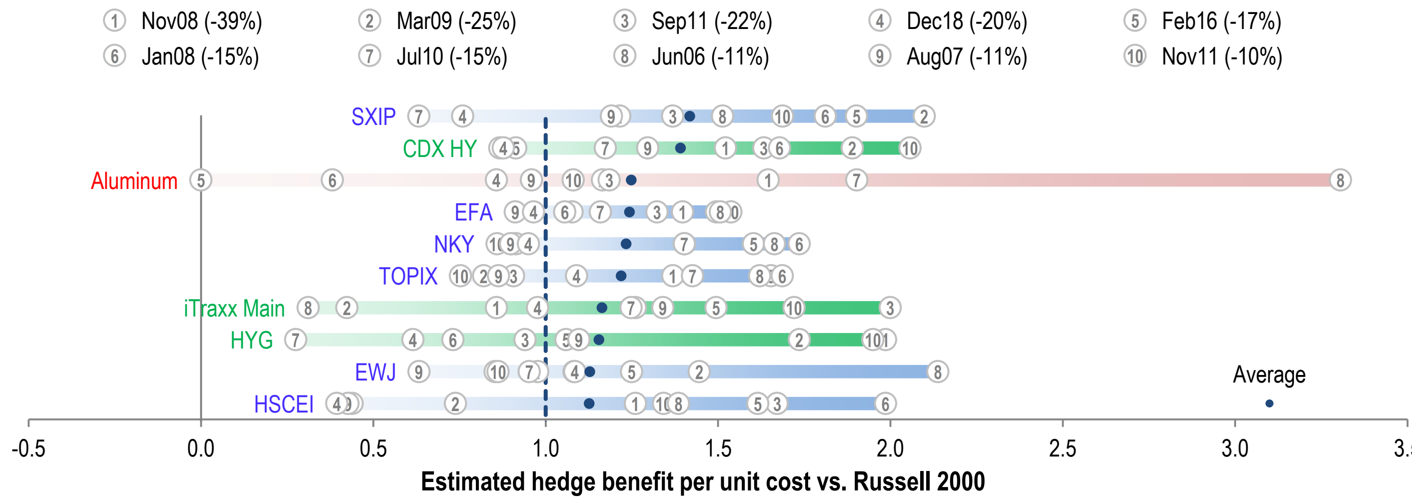
Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging US small/mid-cap equities (RTY)

EFA (Global developed markets ex-N. American equities) puts rank highly as a proxy-hedge for US small/mid-cap equities in terms of both high hedge-benefit, and low basis-risk compared to other assets. Indeed, they would have performed better than RTY puts in 8 of the largest 10 US small/mid cap drawdowns.

Chart 9: Proxy hedge screen: RTY Benchmark

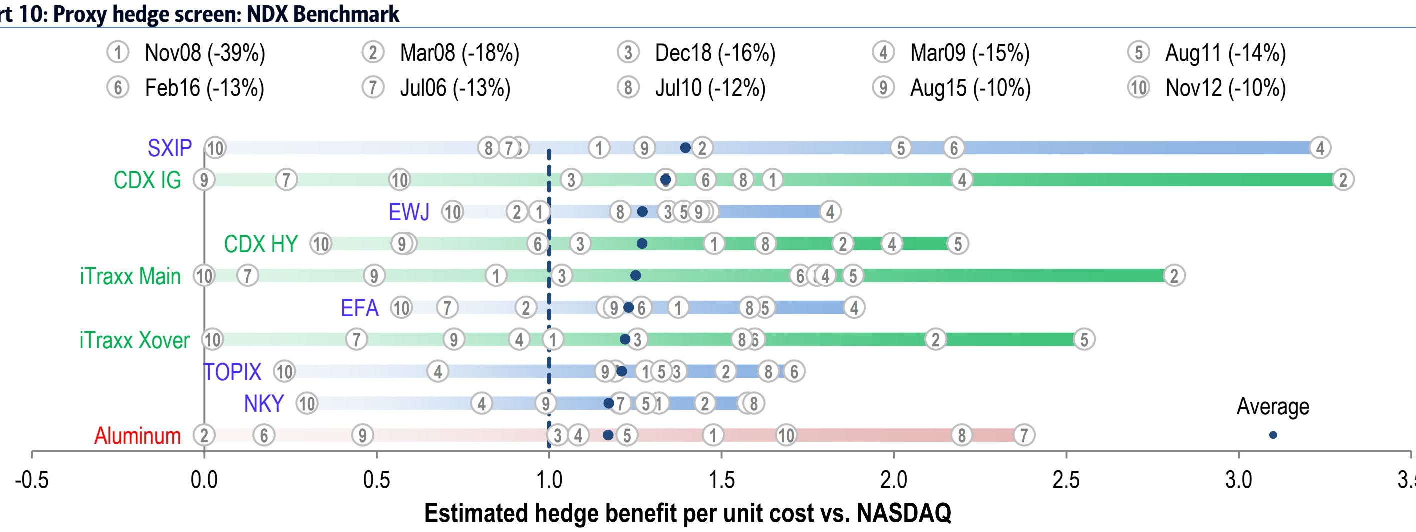


Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).
Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging US Tech (NDX)

US Tech puts continue to screen as one of the most expensive hedges in Chart 2 potentially making proxy hedging cost-effective. Indeed, many assets offer elevated hedge benefit on average during NDX drawdowns, however most come with significant basis risk and did not react in either Nov12 or Aug15. EWJ (Japan equity) puts currently have the most contained basis risk while still continuing to offer a large hedge benefit.

Chart 10: Proxy hedge screen: NDX Benchmark

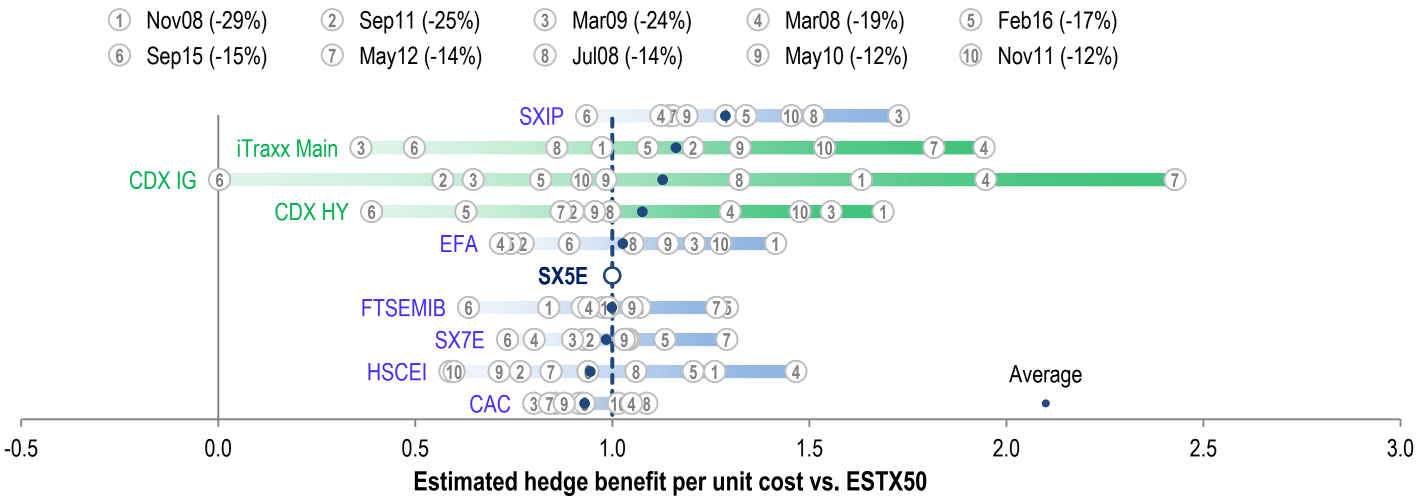


Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).
Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging European equities (Euro STOXX 50)

SXIP (European Insurance) puts screen as offering the highest hedge benefit during the ESTX50's 10 largest drawdowns and having offered better protection in 9 of the 10 largest drawdowns in the ESTX50 (excluding Sep15), come with the least basis risk. Credit payers also rank well, however their basis risk is much less contained than with the SXIP.

Chart 11: Proxy hedge screen: ESTX50 Benchmark

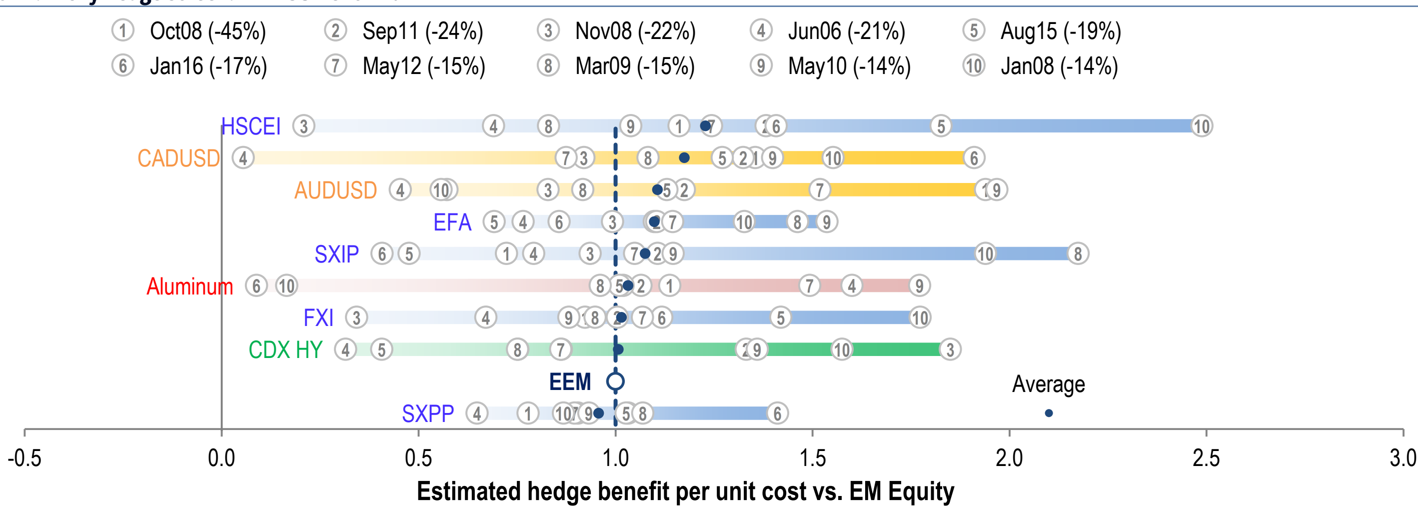


Source: BofA Merrill Lynch Global Research. Data: 24-Aug-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).
Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging Emerging market equity exposure (EEM)

Our screen for proxy hedging Emerging market equity exposure currently does not highlight any particularly effective proxy hedge. HSCEI and CADUSD puts offer the greatest (yet limited) hedge benefit per unit cost, however each come with significant basis risk.

Chart 12: Proxy hedge screen: EEM US Benchmark

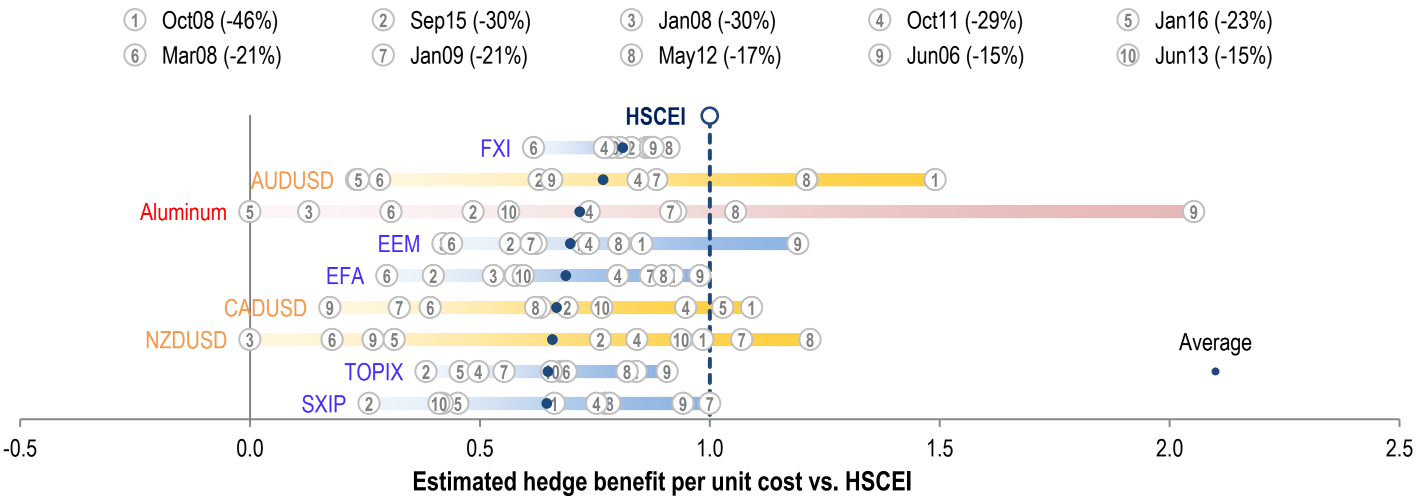


Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).
Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging Chinese equities (HSCEI)

HSCEI puts screen as the cheapest equity hedge in Chart 2 despite ongoing US-China trade risks. Consequently, proxy hedging is currently inefficient.

Chart 13: Proxy hedge screen: HSCEI Benchmark



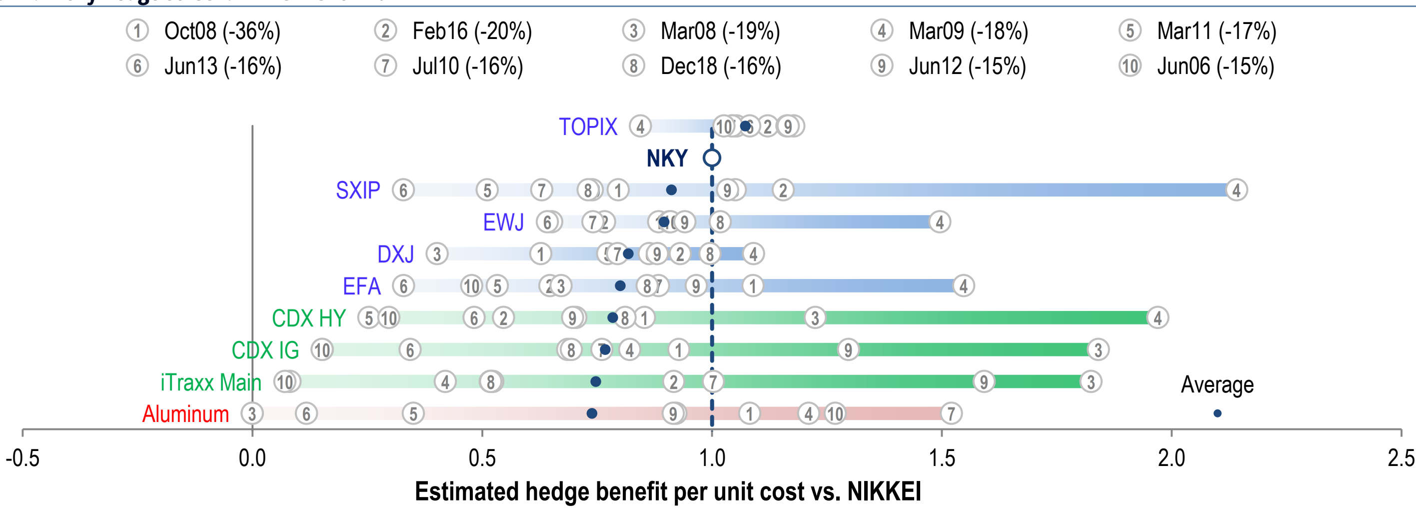
Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging Japanese equities (Nikkei)

Puts on TOPIX rank highly for proxy hedging the Nikkei, offering 7% better value than Nikkei puts, and generating greater hedge benefit in 9 of the 10 largest Nikkei sell-offs.

Chart 14: Proxy hedge screen: Nikkei Benchmark



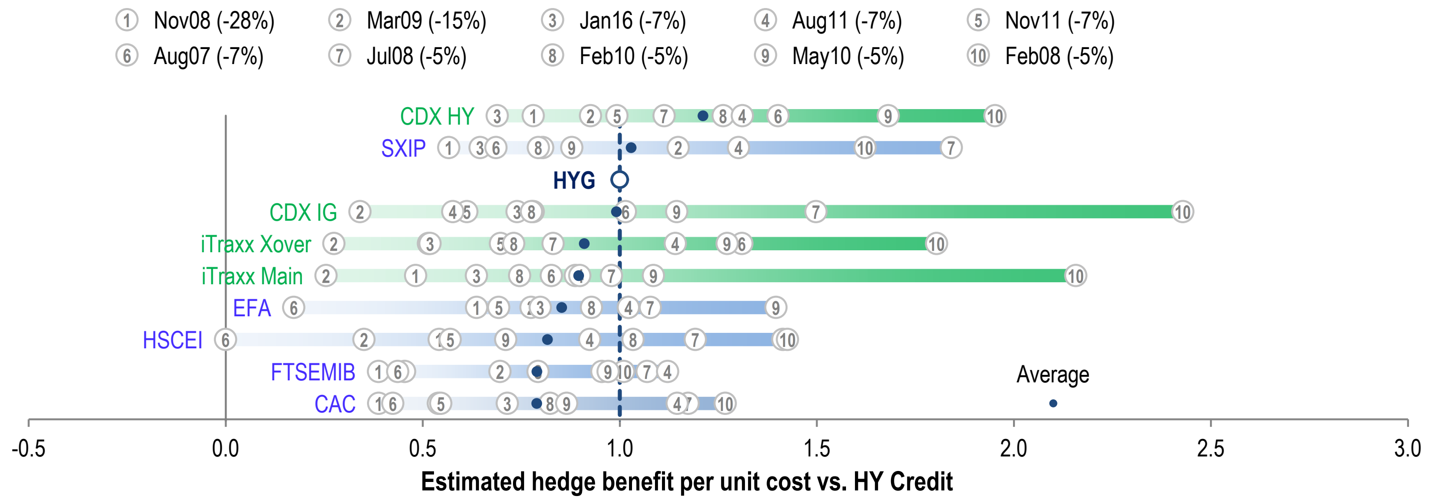
Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Hedging HY Credit

Screening relatively highly in our tail hedging screen (Chart 2), it is unsurprising to see credit hedges remain as effective proxies for HYG US. Currently US HY (CDX HY) payers are the most attractive proxy in terms of both high hedge benefit and low basis risk.

Chart 15: Proxy hedge screen: HY Credit Benchmark



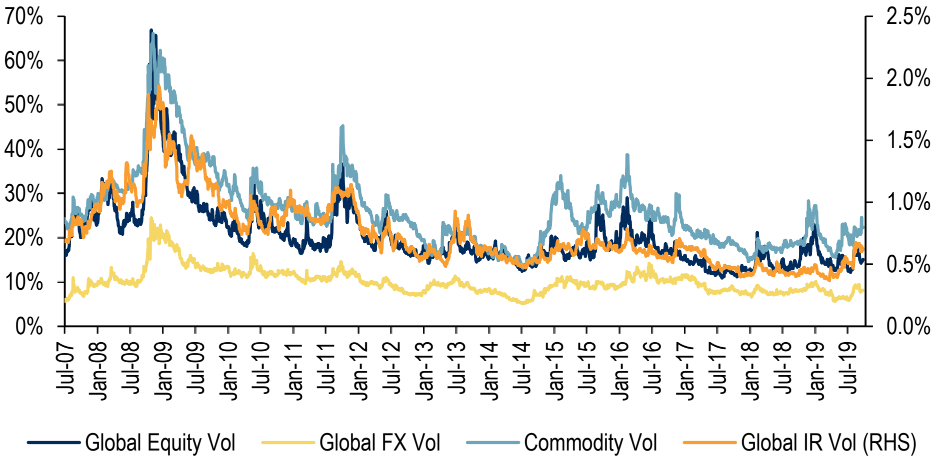
Source: BofA Merrill Lynch Global Research. Data: 24-Sep-19. *Call volatility (Receiver premia) used for TLT US, Gold and GLD US (EUR & USD 10Y rates).

Note: This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions.

Global cross-asset volatility trends

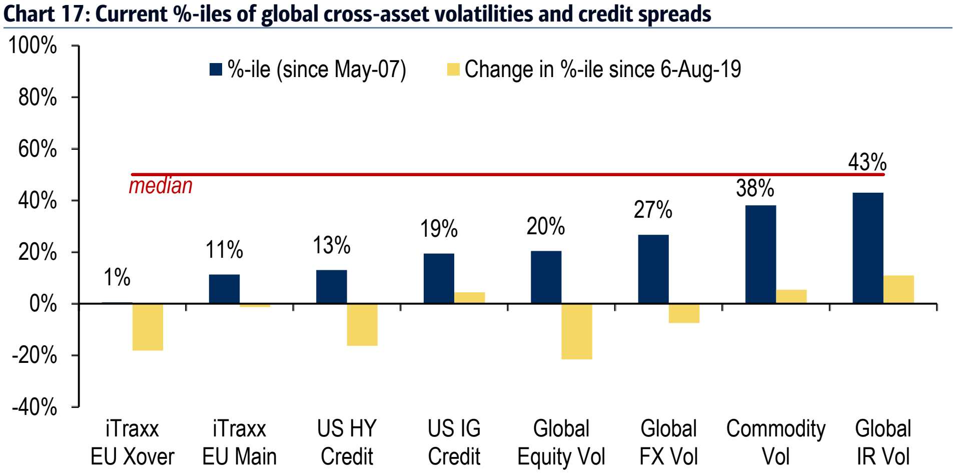
- Following the attack on Saudi Arabia's oil production, crude vol rose 10 vol points. While it has since retraced 7 vol points it has led commodity vol higher since our last report and Commodity vol is now the 2nd most stressed amongst asset classes lying in its 38th percentile since May-07 (Chart 17).
- Interest rate vol is also notably elevated and has rose the most since our last report to near median levels (since May-07). Conversely, Equity vols fell the most vs history, falling from their 42nd percentile to their 20th.
- Credit spreads are still the least stressed cross-asset risk metric falling to as low as their 1st percentile since May-07 (European HY). Notably, while the other credit metrics fell, US IG credit rose since early August.

Chart 16: History of global cross-asset implied volatilities



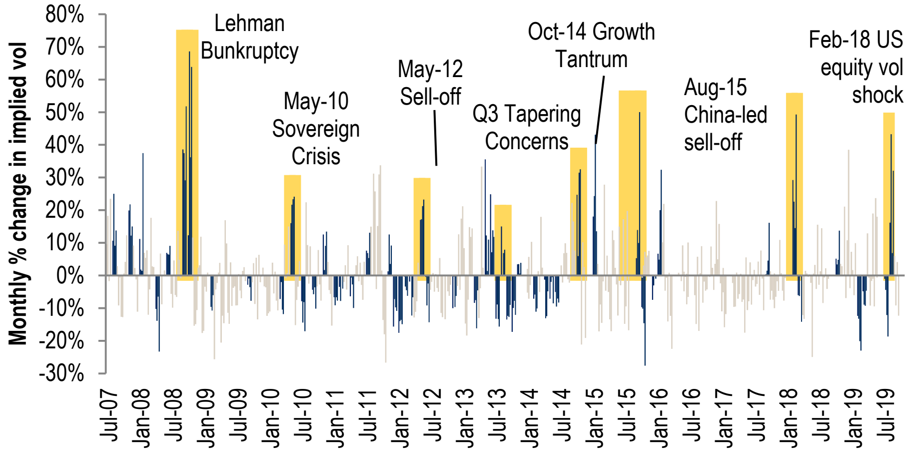
Source: BofA Merrill Lynch Global Research (data from 1-Jun-07 to 24-Sep-19). 3M ATM implied vols on Equities (S&P500, ESTX50, FTSE 100, Nikkei 225, HSI), Interest Rates (Europe and US), FX (EUR/USD, USD/JPY, GBP/USD) and Commodities (Crude Oil, Gold and Copper).

Chart 17: Current %-iles of global cross-asset volatilities and credit spreads



Source: BofA Merrill Lynch Global Research (data as of 24-Sep-19). 3M ATM implied vols on Equities (S&P500, ESTX50, FTSE 100, Nikkei 225, HSI), Interest Rates (Europe and US), FX (EUR/USD, USD/JPY, GBP/USD) and Commodities (Crude Oil, Gold and Copper).

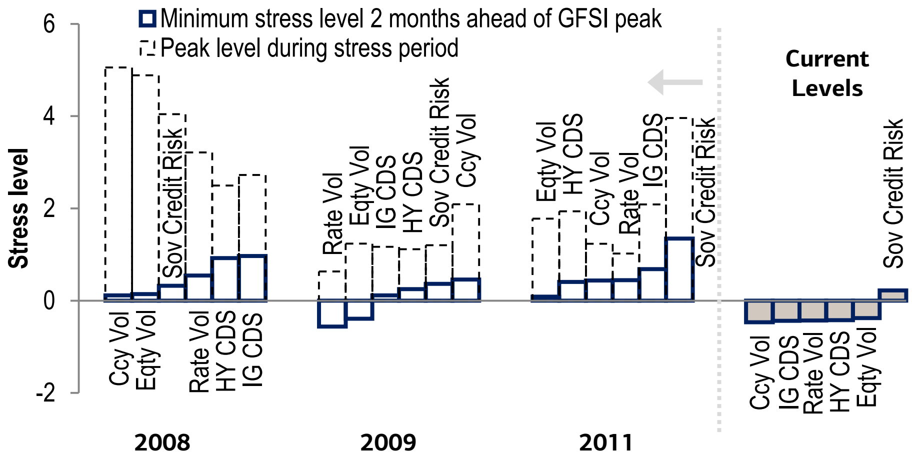
Chart 18: Month-on-month changes in cross-asset volatility, blue bars show when there is high correlation in asset volatility (i.e. all move in the same direction)



Source: BofA Merrill Lynch Global Research. Monthly data from 1-Jul-07 to 24-Sep-19.
Monthly % Change in 3M ATM implied volatilities on: Interest Rates (Europe and US), FX (EUR/USD, USD/JPY, GBP/USD), Commodities (Crude Oil, Gold and Copper) and Equities (S&P500, ESTX50, FTSE 100, Nikkei 225, HSI).

Chart 19: Min 2 months ahead of historical stress peaks, including current levels

The chart illustrates why it is useful to consider the relative pricing of options across asset classes to hedge against tail events: option markets often underestimate the severity of market shocks, and to different degrees. In 2008, currency and equity vols were the most optimistic ahead of the Lehman crisis and the most surprised after (rose to the highest levels).



Source: BofA Merrill Lynch Global Research (data as of 24-Sep-19). Z-scores calculated using data since 2001 (where available) as per the GFSI methodology.

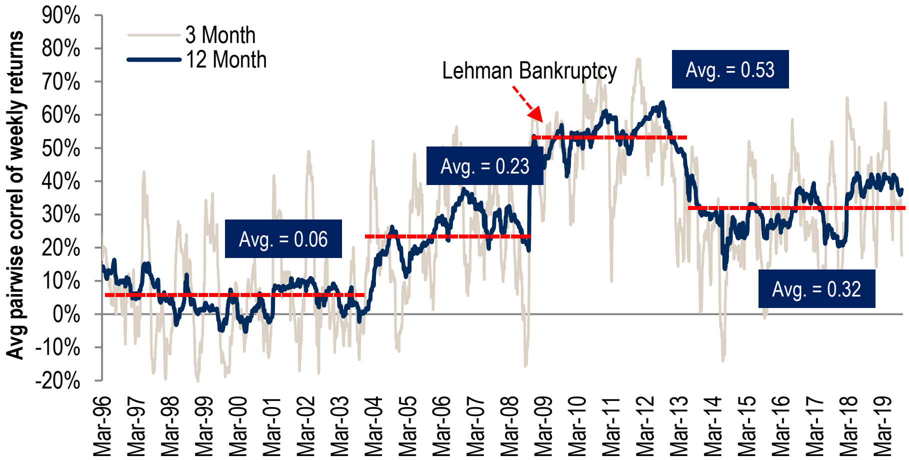
Global cross-asset correlation trends

- At 37%, 12M cross asset correlation remains slightly above the average level over the last 6y (of 32%).

Historically there have been 3 distinct cross asset correlation regimes since 1995. Interestingly, we see a broadly upward trend since Oct-03, well before the Lehman bankruptcy in Sep-08. This is related to the liquidity driven crush in asset risk-premia that helped drive investment leverage higher.

Long-term correlation established a new regime since 3Q13, similar to the '03 to '08 correlation environment.

Chart 20: Cross-asset (weekly return) correlation trends



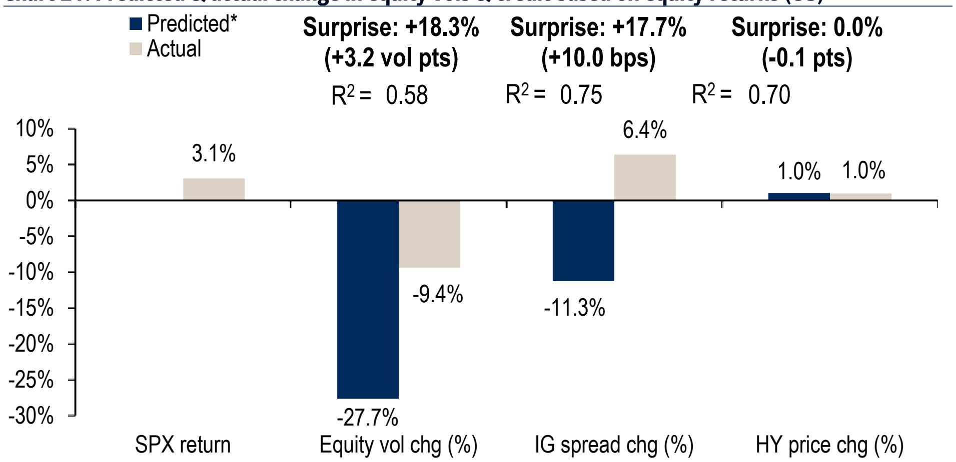
Source: BofA Merrill Lynch Global Research. Daily data from 1-Mar-96 to 24-Sep-19.
3M/1Y average pairwise correlation between the weekly returns of the Dollar Index (DXY, inverted), S&P Goldman Sachs Commodity Index (SPGSCITR), MSCI All Country World Index (MXWD) and the BofA Merrill Lynch US High Yield Master II Index (H0A0 Index).

Macro trends in equity vs credit markets

- US equity volatility fell roughly 3.2v less than expected following the 3% rally in the S&P500 since late-August. IG credit spreads actually expanded 4bps vs the 6bp contraction history would suggest.
- Akin to the US, despite also seeing a strong rally in the ESTX50 (+6%), European equity volatility fell 3v less than expected. European IG credit spreads also expanded despite the rally in equities.

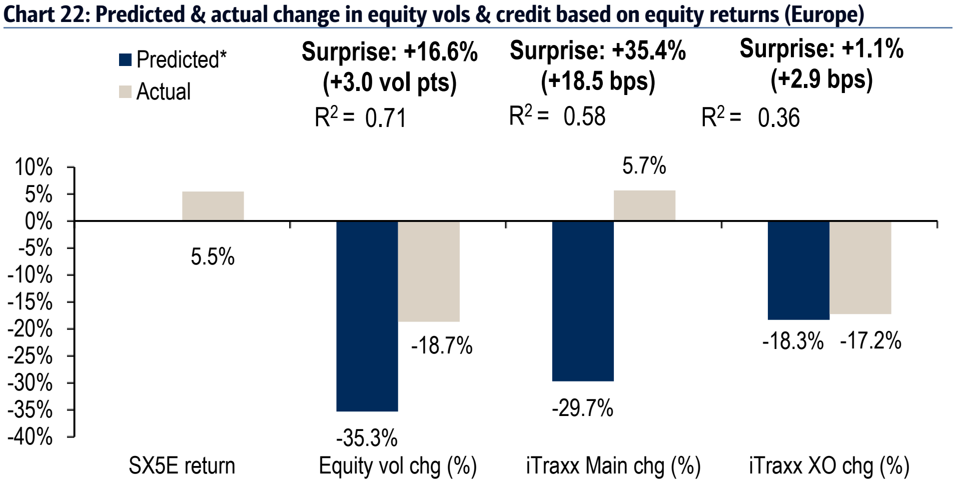
If equities decline, we expect the cost of hedging in the equity derivative and credit derivative markets to rise (and vice-versa for a rise in equities). Based on this relation, we regress historical changes in equity vol and CDS spreads against equity returns. The **bar charts below illustrate how the derivatives markets behaved in the past month relative to expectations** based on this regression.

Chart 21: Predicted & actual change in equity vols & credit based on equity returns (US)



Source: BofA Merrill Lynch Global Research. * Predicted 1-month change based on orthogonal regressions of i) changes in 3M ATM S&P500 vol, (bottom chart: ESTX50 vol), ii) Markit CDX North America Investment Grade CDS spread (bottom chart: iTraxx Crossover) and iii) Markit CDX North America High Yield CDS price index (bottom chart: iTraxx Main CDS) against S&P500 changes (bottom chart: ESTX50 changes), using 3 years of monthly data. Regression data is from 30-Sep-16 to 24-Sep-19. Actual 1-month data from 26-Aug-19 to 24-Sep-19.

Chart 22: Predicted & actual change in equity vols & credit based on equity returns (Europe)



Source: BofA Merrill Lynch Global Research. * Predicted 1-month change based on orthogonal regressions of i) changes in 3M ATM S&P500 vol, (bottom chart: ESTX50 vol), ii) Markit CDX North America Investment Grade CDS spread (bottom chart: iTraxx Crossover) and iii) Markit CDX North America High Yield CDS price index (bottom chart: iTraxx Main CDS) against S&P500 changes (bottom chart: ESTX50 changes), using 3 years of monthly data. Regression data is from 30-Sep-16 to 24-Sep-19. Actual 1-month data from 26-Aug-19 to 24-Sep-19.

Finding cheap hedges: the framework

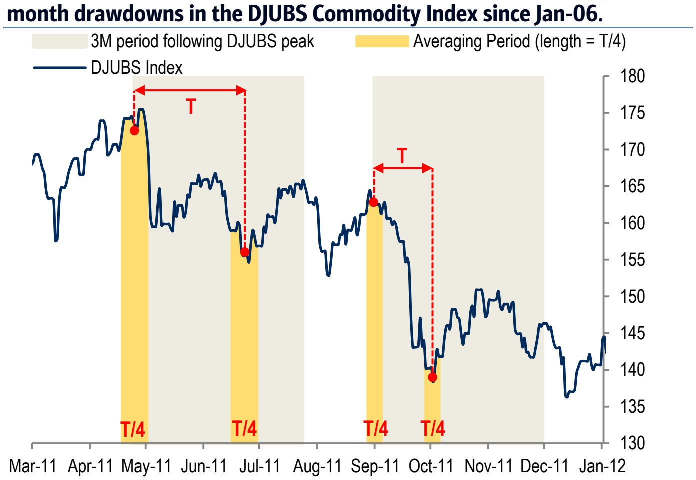
Method I: Cross asset tail hedging

Our cross asset tail hedging screen compares current put option costs to the magnitude of historical tail events in order to determine which options are most underpricing tail risk.

Interpreting the cross asset TH screen:

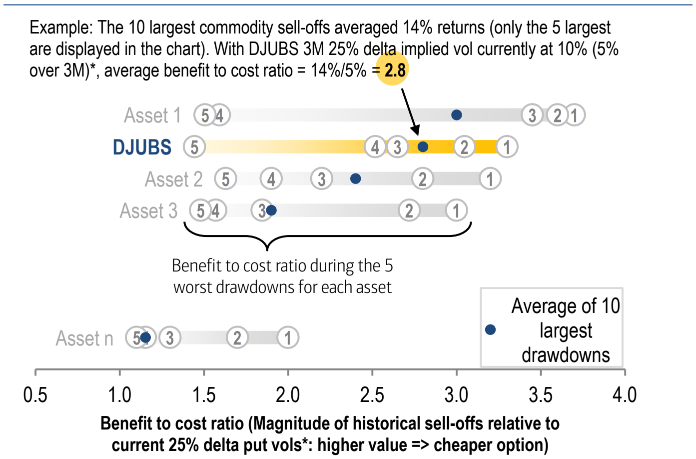
- Readings further to the right represent assets that are most underpricing historical tail events today
- An asset with a benefit-to-cost ratio of 2 indicates its options are half the price of an asset with a ratio of 1, assuming their historical tail returns were similar
- Looking across asset classes we perform a cost-benefit analysis comparing the cost of buying out-of-the-money put options to the magnitude of historical tail events, without consideration of hedging benchmarks. Assuming historical tail events represent the potential magnitude of future sell-offs, we look for options that are most underpricing downside risk.
- **Tail hedge benefit:** is measured by the magnitude of the 10 largest drawdowns occurring over non-overlapping 3-month periods since Jan-06 (Chart 23).
- **Hedging cost:** is measured by the current implied vol of 25 delta put options (*see footnote of Chart 24). We use out-of-the-money options as we are comparing their pricing of large downside risks. Equal delta options allow for easy comparison across assets.
- **High benefit / low cost:** The best value hedge is cheap to enter relative to its expected payoff in a tail event. The x-axis in the right-hand chart below maps out this ratio for past events and includes the average payout relative to today's put costs. Assets with points far to the right are most underpricing historical downside risks and hence represent best value.

Chart 23: This chart shows the 9th (Jul-11) and 3rd (Oct-11) largest 3-month drawdowns in the DJUBS Commodity Index since Jan-06.



Source: BofA Merrill Lynch Global Research. Put volatilities used here are for illustration and do not necessarily reflect current costs. Once a drawdown is identified to be within the top 10, the entire period shaded in grey is removed from the time series before identifying the next biggest drawdown.

Chart 24: This is a schematic illustrating how we calculate the benefit-to-cost ratio for each asset.



Source: BofA Merrill Lynch Global Research. *We make a slight adjustment to 25% delta vols in order to make the ratio of same delta vols equal to the ratio of option prices for two assets. This adjustment increases the volatility of high vol assets relative to lower vol assets (eg vol of credit spreads versus vol of currencies). Importantly, the adjustment is not dependent on the relative forward levels. Please ask us for more details.

Method II: Benchmark proxy hedging

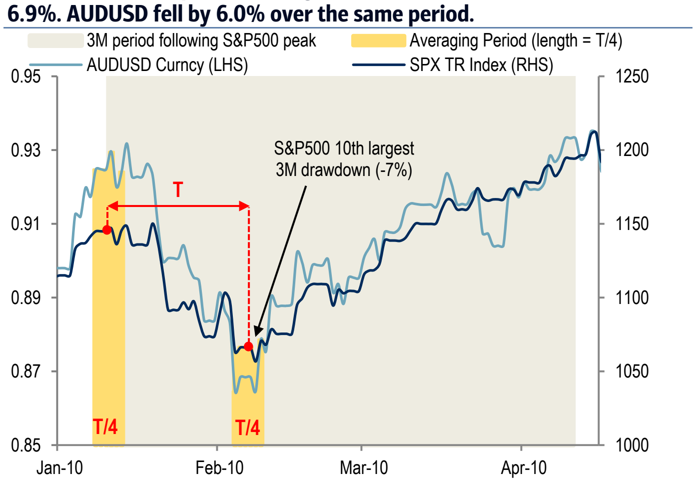
Interpreting the BPH screen:

- A reading > 1 indicates better value in the proxy put option vs. the benchmark
- Small variations along the x-axis mean the proxy has good tracking to the benchmark during large sell-offs
- All readings > 1 indicates the proxy has consistently been a better hedge at current pricing

For investors looking to hedge risk in a specific underlying benchmark, including equity, credit, commodity or currency, it is not only important to consider the cheapest options across asset classes, but also how the proxy asset correlates with the benchmark during times of stress. In severe risk-off events, asset correlations tend to 1 and proxy hedging can become attractive. Proxy hedging does not often work for small declines in benchmark assets due to the basis risk between asset classes.

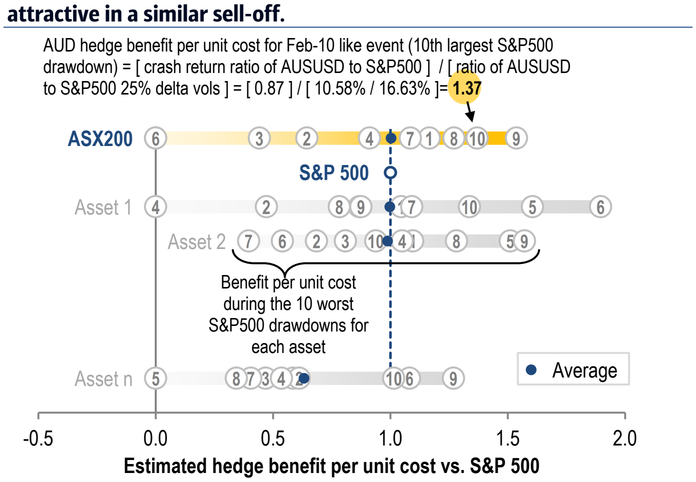
- Here, we identify options on proxy assets that our analysis shows can help hedge against declines in various benchmark assets, bearing in mind the trade-off between cost savings and tracking risk of the proxy asset.
- Proxy hedge benefit: We calculate how much proxy assets have fallen during the largest sell-offs in a benchmark asset (eg. S&P500, US HY Credit). "Crash betas" are computed based on the decline in the proxy and benchmark assets, respectively since Jan-05. For example, Chart 25 illustrates how the AUDUSD moved during the S&P500 sell-off in Feb-10.
- Relative hedge cost: The current ratio of 3M 25% delta put option implied volatility for the proxy vs. the benchmark.
- High benefit / low cost: Chart 26 summarizes how much the proxy asset declined during benchmark sell-offs relative to current option costs. A reading above 1 is desirable and means that proxy hedging would offer better value than put options on the benchmark, assuming relative asset performance is similar to the past during severe tail events.

Chart 25: S&P500 peak-to-trough return in the Feb-10 sell-off was -6.9%. AUDUSD fell by 6.0% over the same period.



Source: BofA Merrill Lynch Global Research. Average prices around the start and end points of the sell-off are used in order to allow for tracking and timing risk as well as removing noise.

Chart 26: Even though the S&P500 decline was larger, AUDUSD puts can be sufficiently cheaper than S&P500 puts to make AUDUSD puts more attractive in a similar sell-off.



Source: BofA Merrill Lynch Global Research. Put volatilities used here are for illustration and do not necessarily reflect current costs. *We make a slight adjustment to 25% delta vols in order to make the ratio of same delta vols equal to the ratio of option prices for two assets. This adjustment increases the volatility of high vol assets relative to lower vol assets (eg vol of credit spreads versus vol of currencies). Importantly, the adjustment is not dependent on the relative forward levels.

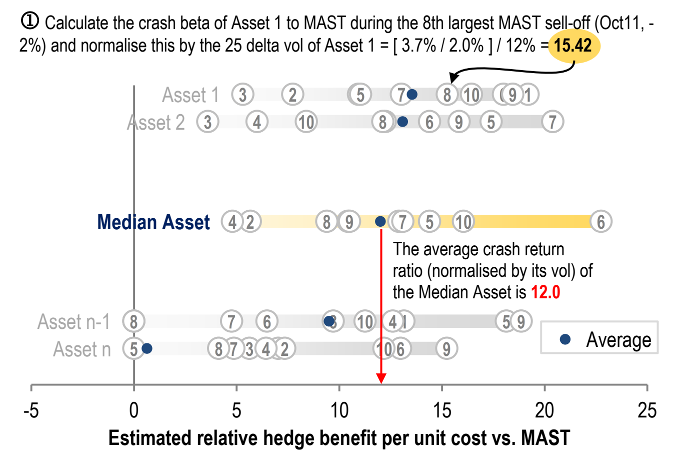
Method III: Hedging benchmarks w/out liquid options

If the benchmark does not have liquid options the best we can aim for is a relative ranking of potential proxy hedges, based on:

- The current cost of each proxy hedge (measured by their 3M 25 delta vols)
- The performance of each proxy hedge during the 10 largest historical drawdowns of the benchmark (measured by their crash beta)

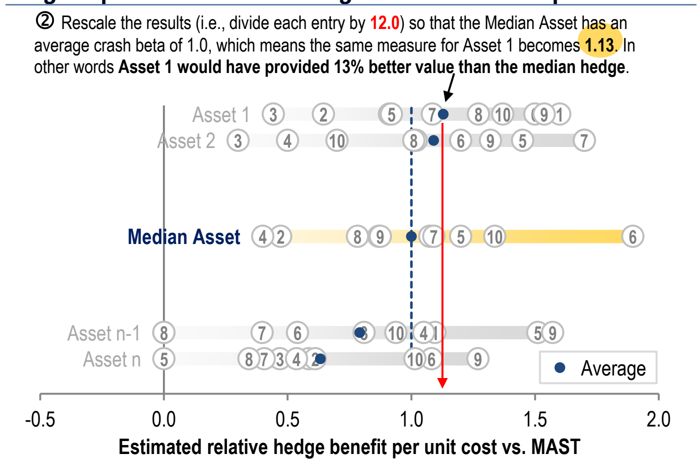
The interpretation is similar to the Benchmark Proxy Hedging case, with one important distinction: A reading of X>1 in Chart 28 means the proxy would have offered X times more hedge benefit per unit cost than the average benefit afforded by the median (i.e., middle ranking) asset in our screen.

Chart 27: The proxy hedges in our screen are ranked according to their average crash beta during the 10 largest BofAML MAST drawdowns since 2006 after being normalized by their respective 3M 25 delta vol



Source: BofA Merrill Lynch Global Research.

Chart 28: As a second step we rescale the results of Chart 27 by the average hedge benefit of the median asset. The ranking of the proxy hedges is preserved and the X-axis gains an intuitive interpretation



Source: BofA Merrill Lynch Global Research.

BofAML Ticker	Bloomberg ticker	Company name	Price
XOERF	XESX GY	EURO STOXX 50	EUR 37.39
HYG	HYG US	iShares iBoxx $ HYC	US$ 87.23
TLT	TLT US	iShares-Barclays 20+	US$ 141.47
EEM	EEM US	iShares-Emg Mkt	US$ 41.18
RSX	RSX US	MKT VECT - Russia	US$ 23.19
GLD	GLD US	SPDR Gold Trust	US$ 141.83

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