

Systematic Flows Monitor

Speed of trend reversals may be driving dispersion in CTA positioning and returns

Across asset classes price trends see significant volatility

This past week CTAs broadly saw declines on the back of multiple trend reversals across asset classes. While extraordinary, the moves this past week add to a collection of the many rapid reversals since President Trump's election win last November. Trend followers started the year stretched long USD, short bonds, and long US large cap equities. However, each of those trends reversed and USD is now short, bonds were covered and are turning long, and large cap US equities appear to be increasingly turning short. Of the two largest trends that emerged year-to-date, long Gold and long European equities, the latter also saw significant unwinds this past week while Gold's decline on Friday puts it very much at risk of stop-loss unwinds.

Tariff uncertainty spreads to trend follower positioning

The rapid shift in price trends has likely been a driver of dispersion across CTA strategies as positioning is less homogenous and depends on the various parameters that go into a specific trend following program. Our model uses a medium-term lookback for price trend and assumes more aggressive risk management along with dynamic volatility sizing. However, variations in each of those assumptions could lead to meaningful performance differentials year-to-date.

What we can say with more certainty on CTA positioning

Despite positioning not being in consensus across various CTA strategies, we can say with more certainty that US large cap equity shorts still have room to grow, European equities are closer to flat, and Japan is short. US Treasury bond futures longs could be accumulating, while Bund futures are stretched short. Gold longs are at risk of further unwinds, Copper longs likely saw unwinds, and Oil shorts could be re-accumulating. Against USD, longs in EUR and GBP are growing, and the JPY long remains stable.

SPX gamma may grow increasingly short in equity selloff

Equity markets have been in sharp decline since the administration unveiled a new round of tariffs aftermarket on Wednesday. During the selloff SPX gamma has been flat to modestly short, suggesting delta-hedging flows may have added to the equity decline but not significantly. Projecting Thursday's option positions forward with Friday's spot level suggests gamma may now be in the vicinity of short \$1-1.5bn (though new flows may quickly alter this picture). The combined VIX option & ETP gamma is also notably muted (99th 1y %ile); see our Option Positioning Daily Update report for more details.

Leveraged and Inverse ETFs hemorrhage AUM on declines

L&I ETFs saw AUM significantly decline with spot this week, but the complex's ability to impact markets remains. Over \$3.5bn SPX sold on Friday, the most since Jun 2020.

Trading ideas and investment strategies discussed herein may give rise to significant risk and are not suitable for all investors. Investors should have experience in relevant markets and the financial resources to absorb any losses arising from applying these ideas or strategies.

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Refer to important disclosures on page 27 to 29. Analyst Certification on page 26. 12813891

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04 April 2025

Equity Derivatives
Global

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A list of abbreviations used is available at the end of this report.

Current S&P 500 1-Day Systematic Flows

Volatility controlled funds could have larger unwinds

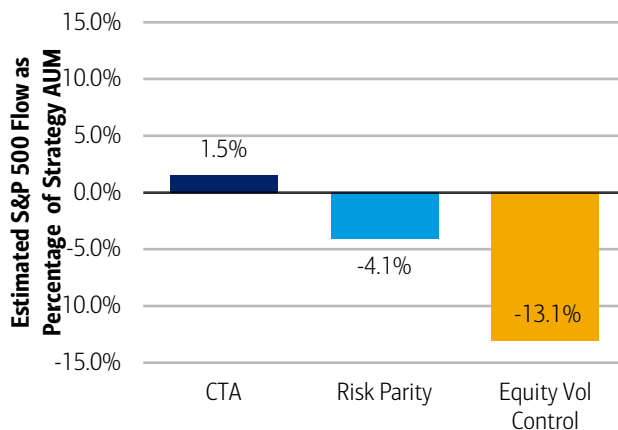
On Monday 7-Apr-2025 the S&P 500 could see larger unwinds from systematic strategies which use volatility to size, namely risk parity and equity vol control. CTAs which size on volatility could decrease shorts (so buying SPX) but that flow is smaller compared to the risk parity and equity vol control unwinds.

Projecting Thursday's option positions forward with Friday's spot level suggests gamma may now be in the vicinity of short \$1-1.5bn (though new flows may quickly alter this picture).

For those interested in more regular updates, contact us to be added to the distribution list for our Option Positioning Daily Update report.

Exhibit 1: Estimated 1-day S&P 500 Flow from CTAs, Risk Parity, and Equity Vol Control

Estimates are for Monday, 7-Apr-2025 and subject to change each day. To start the coming week we could see larger vol control unwinds in the S&P

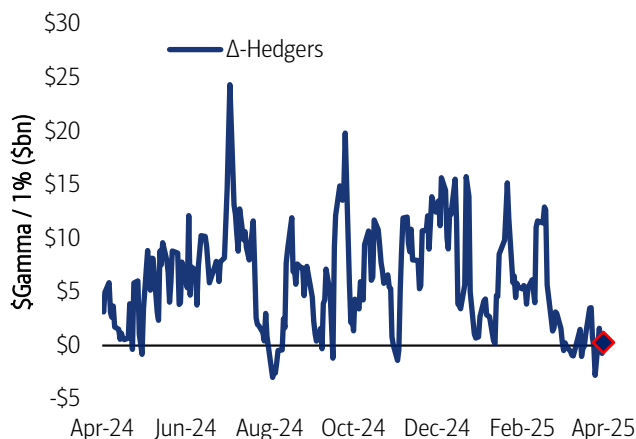


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 2: End-of-day SPX option gamma for delta-hedgers

EOD SPX gamma for Δ -Hedgers

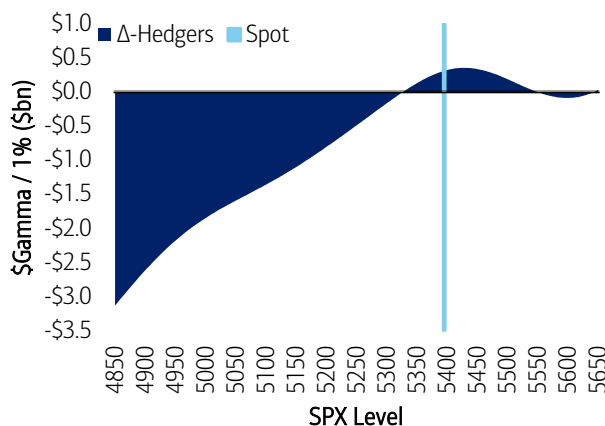


Source: BofA Global Research, CBOE. Data through 03-Apr-25.

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Exhibit 3: Current SPX gamma for delta-hedgers across spot levels

Current EOD SPX gamma for Δ -Hedgers after a hypothetical move in spot



Source: BofA Global Research, CBOE. Data for 03-Apr-25. Gamma is recomputed after each hypothetical move in spot holding fixed strike vols and option positions constant.

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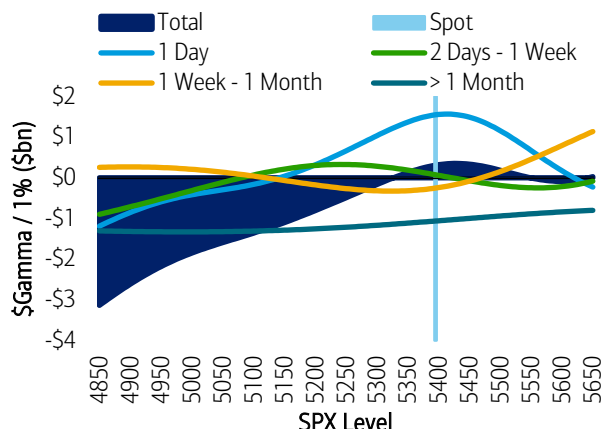


SPX Option Gamma Positioning

Using our SPX gamma levels (as shown in Exhibit 2), we then infer the likely impact of delta-hedging on the underlying equity market. Specifically, Exhibit 5 highlights our estimate for the impact of gamma (via delta-hedging with futures) on S&P 500 e-mini 1-month realized volatility if delta-hedging occurred only in the last hour, last 30-minutes, or last 15-minutes of the trading session. See the appendix for additional details on how the market impact analysis was conducted.

As an example, Exhibit 5 indicates that if delta-hedging was confined to the last 15-minutes of the trading day (15:45 to 16:00), then SPX gamma may have been responsible for a 0.3pt (1%) increase in S&P 500 e-mini realized vol over the past 1-month.

Exhibit 4: SPX gamma for delta-hedgers across spot levels & tenors
SPX gamma contribution of various tenors at different underlying levels

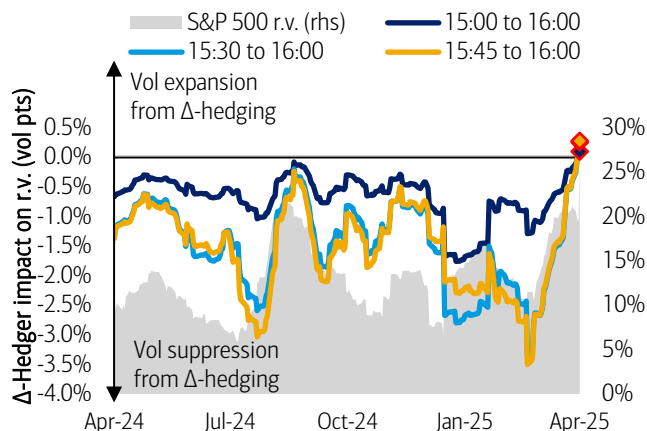


Source: BofA Global Research, CBOE. Data as of 03-Apr-25. Tenors are given in business days.

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Exhibit 5: Estimated impact of Δ -hedging on S&P 500 realized vol

Estimated impact of EOD SPX gamma on S&P 500 e-mini 1-month realized volatility via delta-hedging, with hedging confined to different time windows near the close (=market observed realized vol – estimated vol w/o Δ -hedgers)



Source: BofA Global Research, CBOE. Data as of 03-Apr-25.

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Trend Following (CTA) Model

For each component we apply our CTA model over the next five trading sessions under bullish, neutral, and bearish price paths. Exhibit 6 summarizes our model applied to 24 common CTA underlyings within equities, fixed income, commodities and FX.

To illustrate how to interpret Exhibit 6, using the EUR/USD row as an example, the takeaways are: (1) Our CTA model's EUR position is long vs USD, (2) The current trend signal is +67% where -100% is max short and +100% is max long, (3) Over the next 5 trading sessions and based on price paths using historical data, the trend signal is projected to increase on a bullish path and decrease on bearish to median price paths, and (4) a full unwind (sell trigger) of the long position could come with a 3.1% decline (1.0617 EUR/USD level).

Exhibit 6: Summary of BofA Trend Following (CTA) Model Positions, Projections, and Key Levels

An important consideration with buy & sell triggers is they are hard to model as they can vary based on trend-following model construction. Our analysis supports the idea that the further we get from our model's trigger, it's increasingly likely more (and eventually most) CTAs will have executed their position. Please see the appendix for details on how we determine trend strength, bearish/median/bullish price projections, and buy & sell triggers.

Asset Class	Underlying	Model CTA Position	Trend Strength	5-day Trend Projection			Current Spot	Sell Trigger	% -age	Buy Trigger	% -age
				Bearish	Median	Bullish					
Equities	S&P 500	Short	-46%	-58%	-69%	-56%	5074	--	--	--	--
	NASDAQ-100	Short	-55%	-68%	-64%	-51%	17398	--	--	--	--
	Russell 2000	Short	-76%	-56%	-76%	-75%	1827	--	--	--	--
	SX5E	Neutral	34%	-2%	12%	22%	4878	--	--	--	--
	SX7E	Neutral	68%	49%	57%	59%	165	--	--	--	--
	NIKKEI 225	Short	-57%	-77%	-79%	-60%	33781	--	--	--	--
Bonds	10yr Tsy Futures (TY)	Long	22%	24%	37%	44%	112.95	--	--	--	--
	Bund Futures (RX)	Neutral	-83%	-69%	-66%	-58%	130.37	--	--	--	--
	Korea Treasury Bond (KAA)	Long	53%	45%	56%	59%	120.05	117.83	-1.8%	--	--
	China 10yr Bond Futures (TFT)	Long	12%	25%	32%	40%	108.58	103.18	-5.0%	--	--
Commodities	Gold	Neutral	76%	71%	80%	78%	3057.4	--	--	--	--
	Oil	Short	-25%	-39%	-27%	-19%	62.6	--	--	--	--
	Aluminum	Neutral	3%	-59%	-56%	-35%	2419.4	--	--	--	--
	Copper (BCOM, HG)	Neutral	67%	41%	56%	63%	439.5	--	--	--	--
	Copper (GSCI, LP)	Neutral	28%	-9%	9%	14%	9331.3	--	--	--	--
	Soybeans	Short	-51%	-54%	-47%	-42%	977.3	--	--	--	--
	Soybean Oil	Neutral	-21%	-6%	4%	15%	45.7	--	--	--	--
	Soybean Meal	Short	-66%	-75%	-71%	-59%	283.7	--	--	302	6.6%
FX	EUR/USD	Long	67%	43%	64%	71%	1.0953	1.0617	-3.1%	--	--
	GBP/USD	Long	84%	67%	90%	81%	1.2874	1.2618	-2.0%	--	--
	AUD/USD	Short	-28%	-52%	-38%	-30%	0.6042	--	--	--	--
	USD/JPY	Short	-50%	-53%	-44%	-35%	146.9	--	--	154.1	4.9%
	USD/MXN	Long	12%	6%	17%	26%	20.4392	--	--	--	--
	USD/CAD	Long	44%	22%	36%	41%	1.4232	1.3952	-2.0%	--	--

Source: BofA Global Research. Data as of 4-Apr-2025.

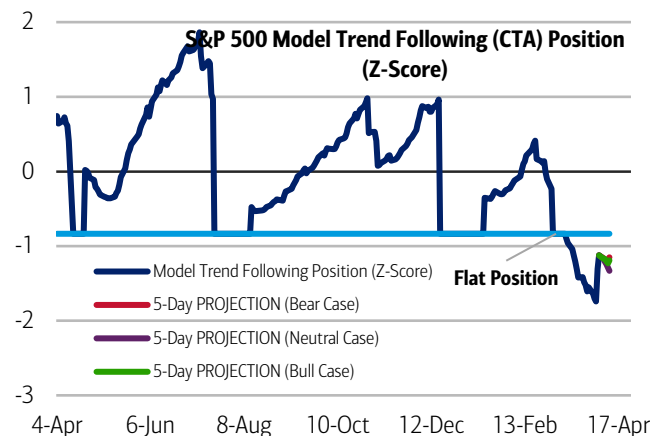
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Equities

Exhibit 7: BofA Model Trend Following (CTA) S&P 500 Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

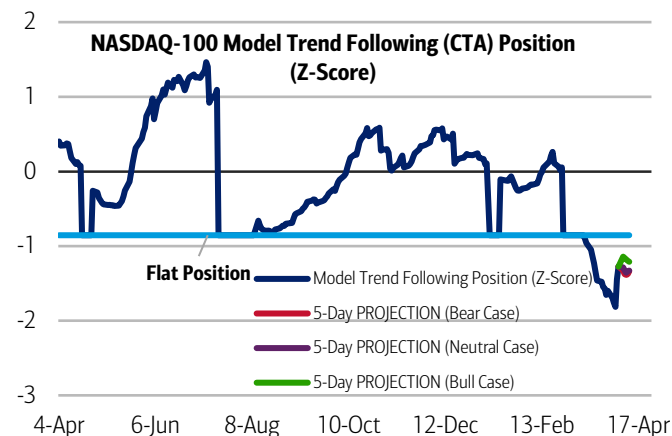


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 8: BofA Model Trend Following (CTA) NASDAQ-100 Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

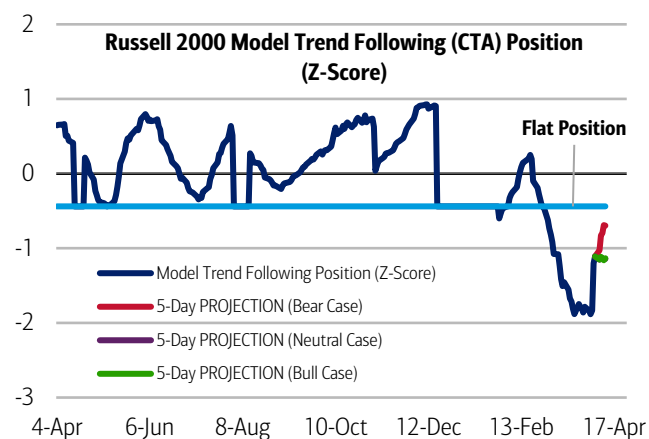


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 9: BofA Model Trend Following (CTA) Russell 2000 Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

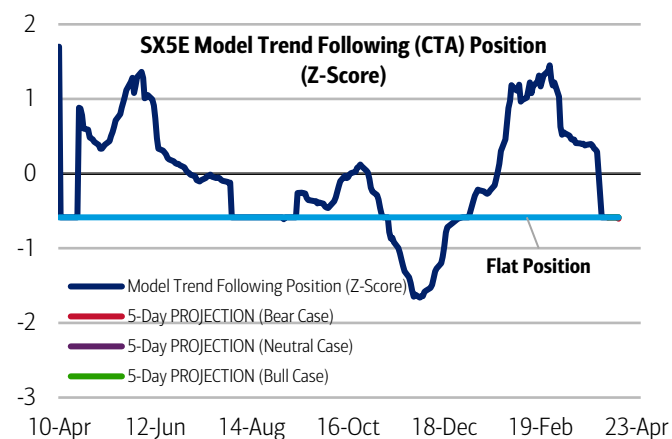


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 10: BofA Model Trend Following (CTA) ESTX50 Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



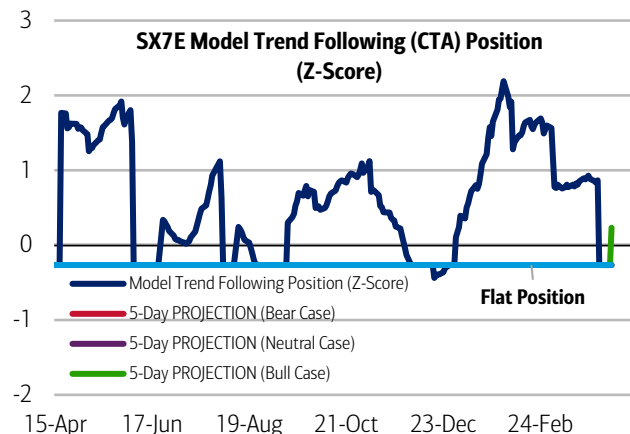
Source: BofA Global Research. Data as of 4-Apr-2025.

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Equities (continued)

Exhibit 11: BofA Model CTA EURO STOXX Banks Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

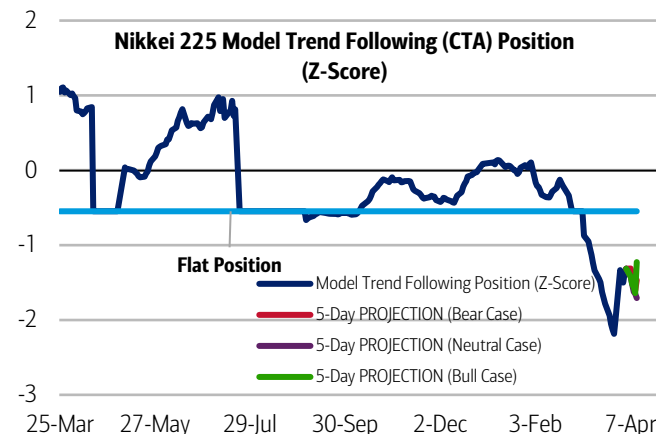


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 12: BofA Model Trend Following (CTA) NIKKEI 225 Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



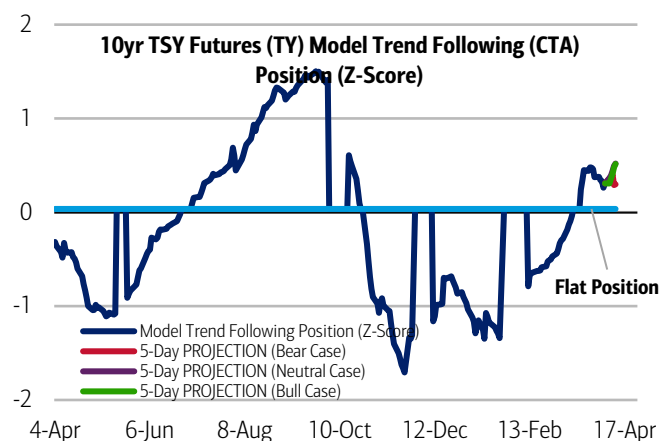
Source: BofA Global Research. Data as of 4-Apr-2025.

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Fixed Income

Exhibit 13: BofA Model Trend Following (CTA) TY Futures Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

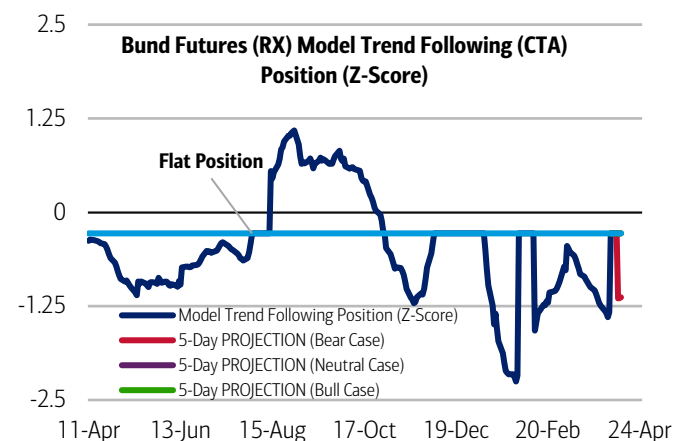


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 14: BofA Model Trend Following (CTA) Bund Futures Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



Source: BofA Global Research. Data as of 4-Apr-2025.

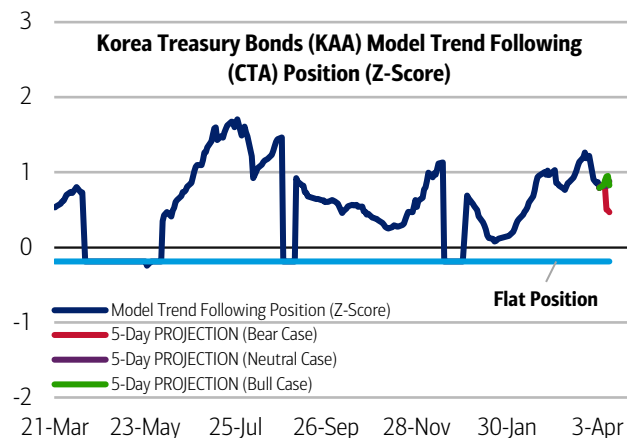
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Fixed Income (continued)

Exhibit 15: BofA Model Trend Following (CTA) KTB Futures Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

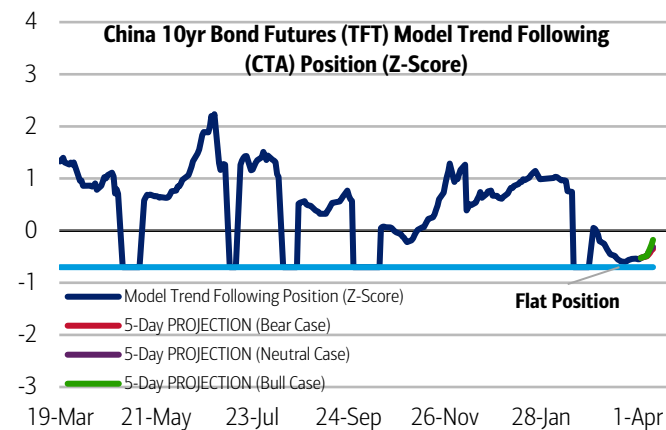


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 16: BofA Model Trend Following (CTA) China 10yr Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



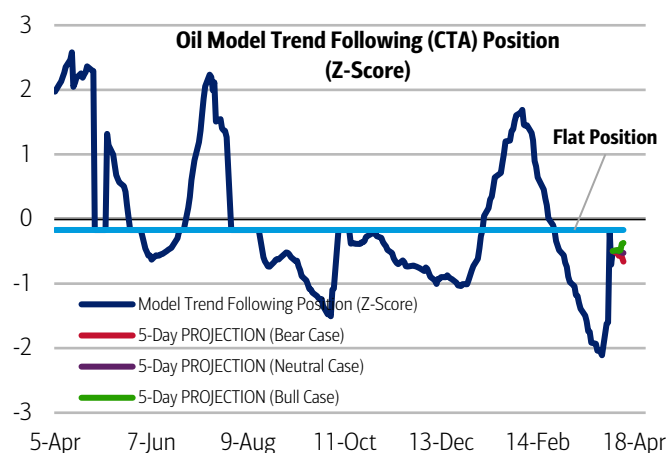
Source: BofA Global Research. Data as of 4-Apr-2025.

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Commodities

Exhibit 17: BofA Model Trend Following (CTA) Oil Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

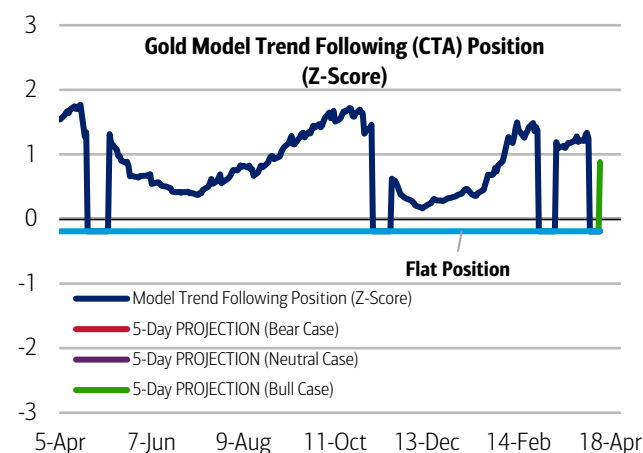


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 18: BofA Model Trend Following (CTA) Gold Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



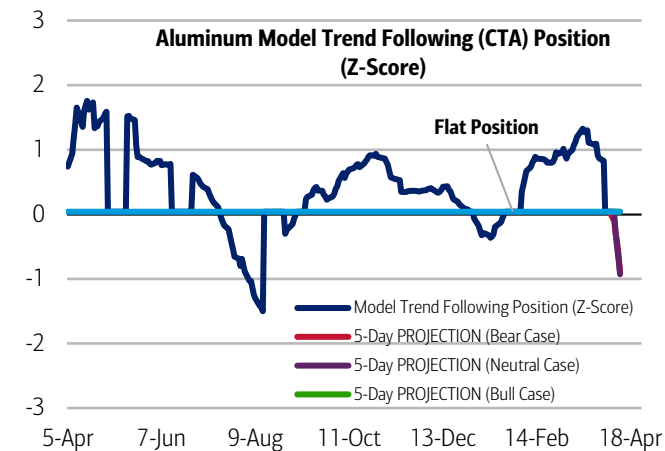
Source: BofA Global Research. Data as of 4-Apr-2025.

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Commodities (continued)

Exhibit 19: BofA Model Trend Following (CTA) Aluminum Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

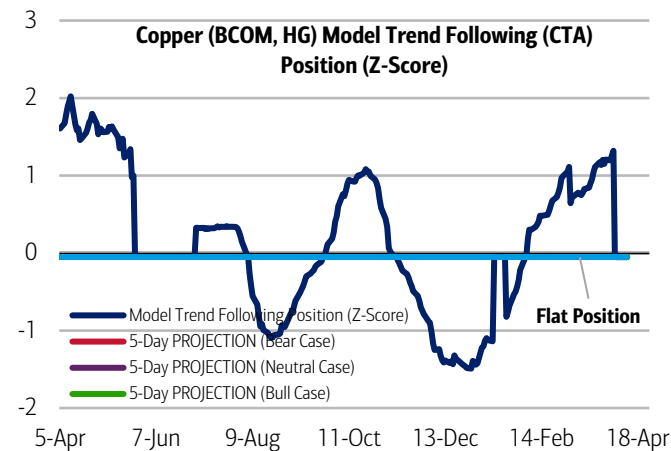


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 20: BofA Model Trend Following (CTA) Copper (HG) Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

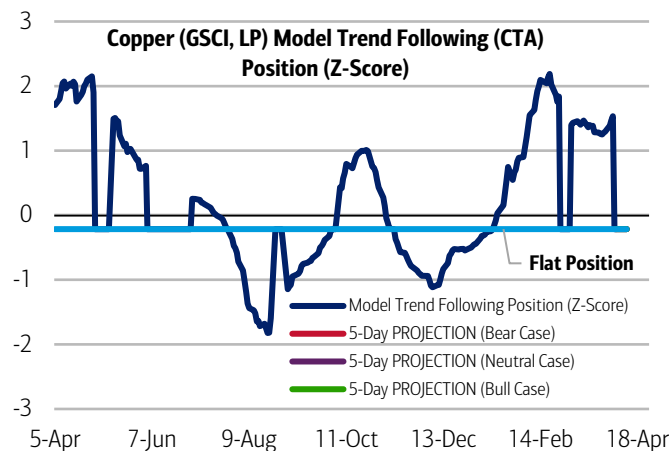


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 21: BofA Model Trend Following (CTA) Copper (LP) Position text

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

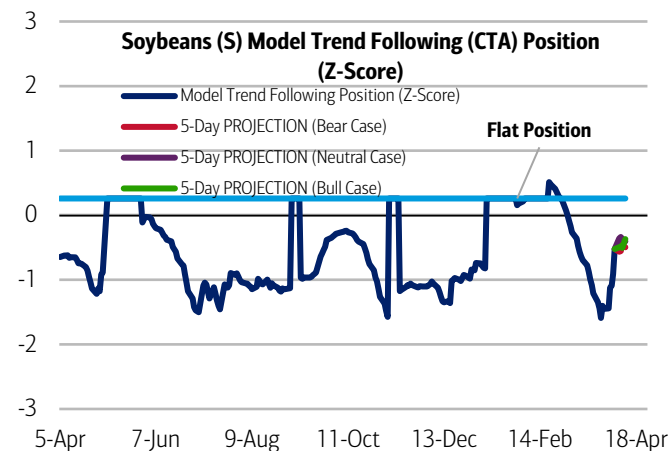


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 22: BofA Model Trend Following (CTA) Soybean (S) Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



Source: BofA Global Research. Data as of 4-Apr-2025.

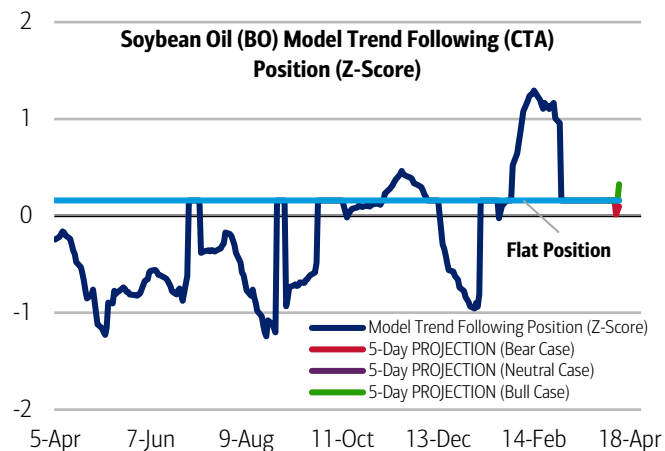
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Commodities (continued)

Exhibit 23: BofA Model Trend Following (CTA) Soybean Oil Position

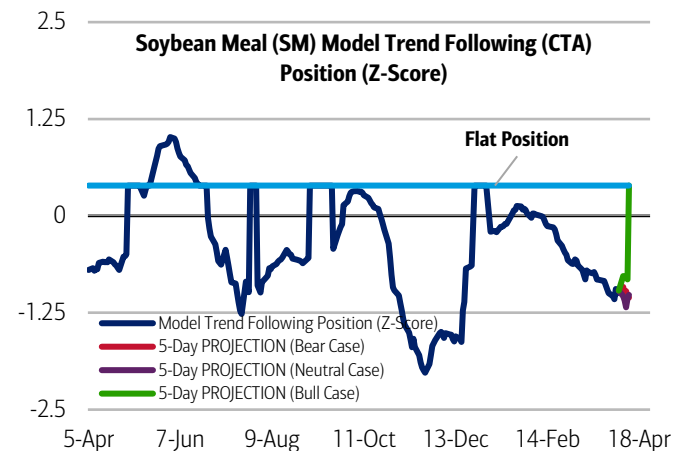
Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



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Exhibit 24: BofA Model Trend Following (CTA) Soybean Meal Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

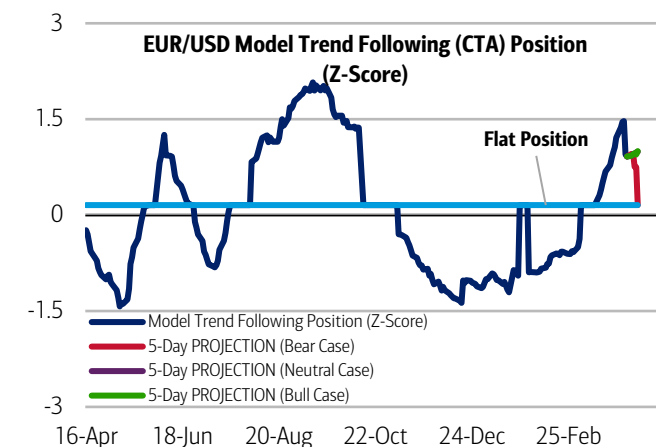


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Foreign Exchange (FX)

Exhibit 25: BofA Model Trend Following (CTA) EUR/USD Position

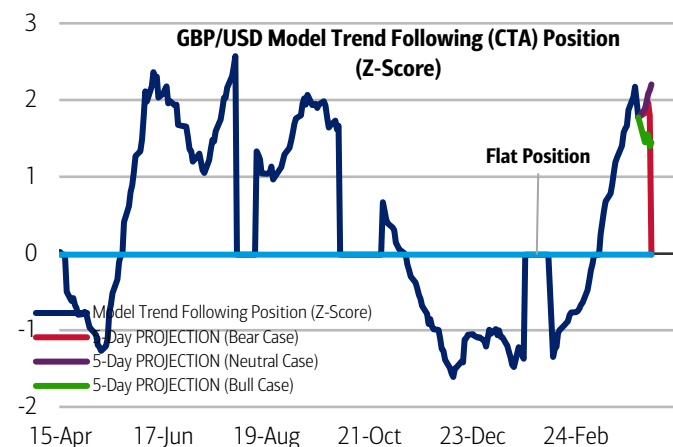
Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



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Exhibit 26: BofA Model Trend Following (CTA) GBP/USD Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

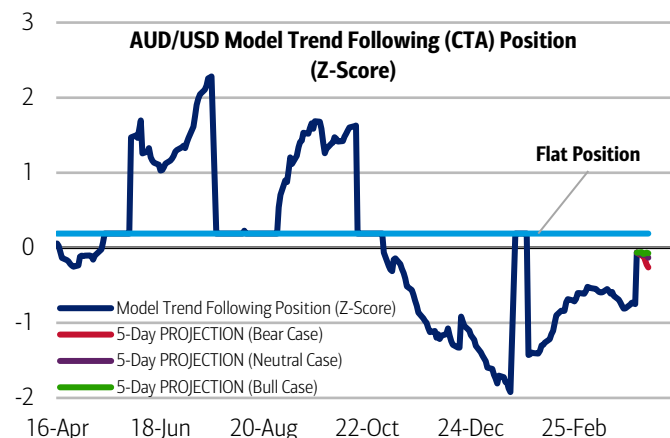


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FX (continued)

Exhibit 27: BofA Model Trend Following (CTA) AUD/USD Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

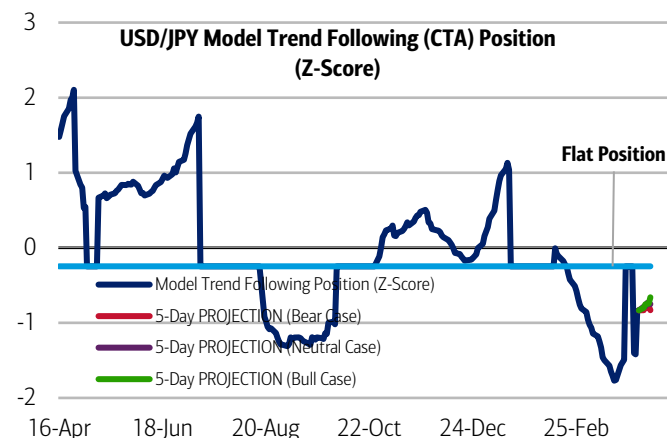


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 28: BofA Model Trend Following (CTA) USD/JPY Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

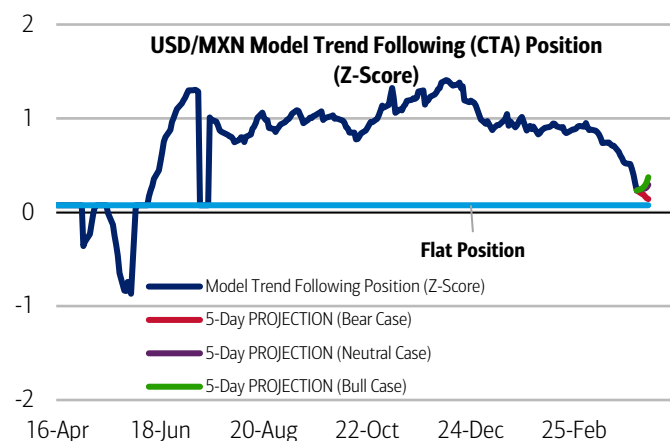


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 29: BofA Model Trend Following (CTA) USD/MXN Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios

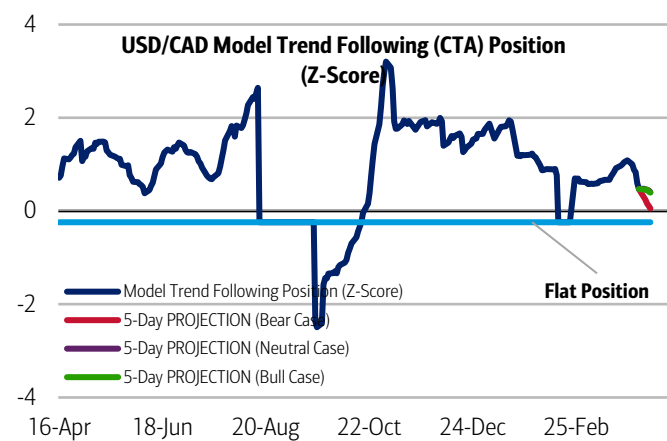


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 30: BofA Model Trend Following (CTA) USD/CAD Position

Z-score of position shown below along with projection of how the position could evolve over the next 5 trading sessions based on bullish, neutral, and bearish scenarios



Source: BofA Global Research. Data as of 4-Apr-2025.

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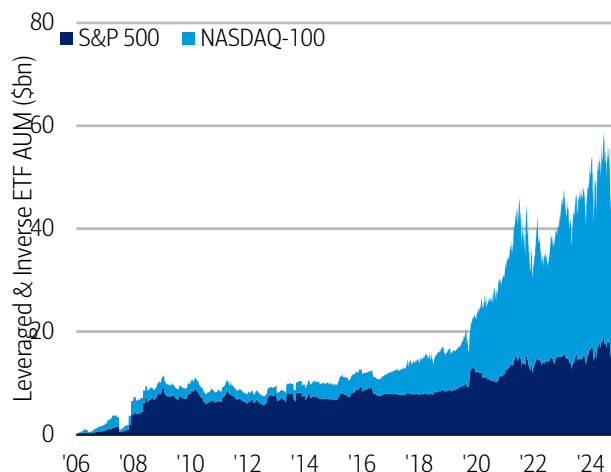


Leveraged and Inverse ETFs

Our analysis indicates that US based ETFs currently could be responsible for approximately \$638mn and \$1.4bn in S&P 500 and NASDAQ-100 buying (selling), respectively, per 1% move up (down) in the underlying index. This would equate to 3% and 19% of the average notional S&P 500 (ES) and NASDAQ-100 (NQ) futures traded from 3:55 PM to 4:00 PM over the last month. Although the amount of both S&P 500 and NASDAQ-100 futures that leveraged & inverse ETFs would theoretically need to trade for each 1% move decreased last week, the total notional sold on Friday was the highest since Jun 2020 for the S&P 500 and the highest on record for the NASDAQ-100.

Exhibit 31: S&P 500 and NASDAQ-100 leveraged & inverse ETF AUM

Total AUM in S&P 500 and NASDAQ-100 leveraged & inverse ETFs are approximately \$14bn and \$26bn, respectively



Source: BofA Global Research. Data as of 3-Apr-2025.

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There is now approximately \$40bn outstanding AUM in US domiciled S&P 500 and NASDAQ-100 leveraged and inverse ETFs, equating to over \$100bn notional for these two indices. These vehicles aim to provide investors with a daily return proportional to the return of their underlying index. For example, a 2x leveraged ETF targets a 2% increase for each 1% gain in its underlying index while a 2x inverse ETF targets a 2% decline for each 1% increase in the underlying.

Leveraged and inverse ETFs must systematically rebalance at the end of each trading day to achieve their daily leverage target. In fact, in these rebalances both leveraged and inverse ETFs will buy in a rising market and sell in a falling market (see example in the Appendix). Therefore, the rebalance has the potential to accelerate index gains or losses into the close if a significant amount of the underlying futures need to be bought or sold. Notably, our analysis cannot account for the creation or redemption of ETF shares on T and must rely on prior day AUM.

Exhibit 32: S&P 500 flow from leveraged & inverse ETFs per 1% move

Leveraged & inverse ETFs need to trade approximately \$638mn for every 1% the index moves. This is approximately \$115mn less than last week.

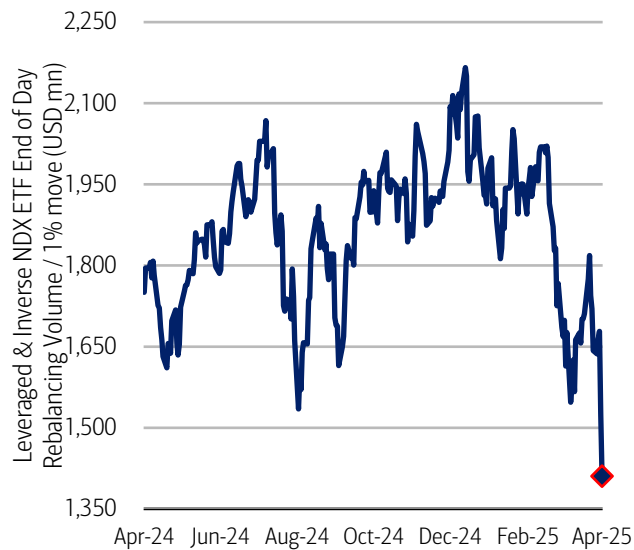


Source: BofA Global Research. This analysis only includes leveraged and inverse ETFs traded on US exchanges. Data as of 4-Apr-2025.

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Exhibit 33: NASDAQ-100 leveraged & inverse ETF flow per 1% move

Leveraged & inverse ETFs need to trade approximately \$1.4bn for every 1% the index moves. This is approximately \$232mn less than last week.



Source: BofA Global Research. This analysis only includes leveraged and inverse ETFs traded on US exchanges. Data as of 4-Apr-2025.

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The rebalance of leveraged and inverse ETFs may also amplify moves into the close at the single stock level. NVIDIA and Tesla currently top single stock leveraged and inverse ETF AUM with approximately \$3.7bn and \$4.9bn outstanding, respectively. Our analysis indicates that ETFs could be responsible for approximately \$86mn and \$136mn in NVDA and TSLA buying (selling), respectively, per 1% move up (down) in the underlying stock. This would equate to 2.8% and 7.2% of the average notional volume traded from 3:55 PM to 4:00 PM over the last month. The amount of NVDA and TSLA that leveraged and inverse ETF providers need to buy per 1% move decreased with spot over the last week.

Exhibit 34: NVIDIA flow from leveraged & inverse ETFs per 1% move

Leveraged & inverse ETFs need to trade approximately \$86mn for every 1% that NVDA moves. This is approximately \$27mn less than last week.



Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 35: Tesla flow from leveraged & inverse ETFs per 1% move

Leveraged & inverse ETFs need to trade approximately \$136mn for every 1% that TSLA moves. This is approximately \$12mn less than last week.



Source: BofA Global Research. Data as of 4-Apr-2025.

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Beyond NVDA and TSLA, leveraged and inverse ETFs have proliferated in other single stocks which we summarize in the table below. While most ETF providers achieve their stated return targets via swaps, some have recently begun employing short-dated, deep in the money calls and puts. Options can impact a fund's ability to achieve its stated leverage target, and although the delta hedge for these options will move in the same direction as the rebalance for the position on swap, it will not be of the same magnitude.

Exhibit 36: Single stock with over \$100mn in leveraged & inverse ETFs

MSTR was stock to see L&I ETF AUM grow over the last week as the stock advanced

	AUM (\$mn)	1w AUM chg (\$mn)	Rebalance*/1% move (\$mn)	1yr %ile of Rebalance Amount	Rebalance Amount/Last 5 min notional (%)
TSLA	4,901	-774	136.2	77	7.2
NVDA	3,742	-1276	85.5	18	2.8
MSTR	2,599	68	65.0	58	11.2
COIN	484	-68	10.5	21	6.3
PLTR	433	-143	9.2	80	1.9
SMCI	221	-33	4.4	84	3.6
AMZN	205	-56	4.6	44	0.3
GOOGL	203	-15	4.7	84	0.5
MSFT	181	-26	4.2	64	0.2
META	179	-51	4.3	46	0.4
AMD	175	-84	3.7	59	1.0
AAPL	107	-22	2.6	4	0.1

Source: BofA Global Research. *Theoretical rebalance amount assumes that leverage is achieved without options. This is a screen and 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. Data as of 4-Apr-2025.

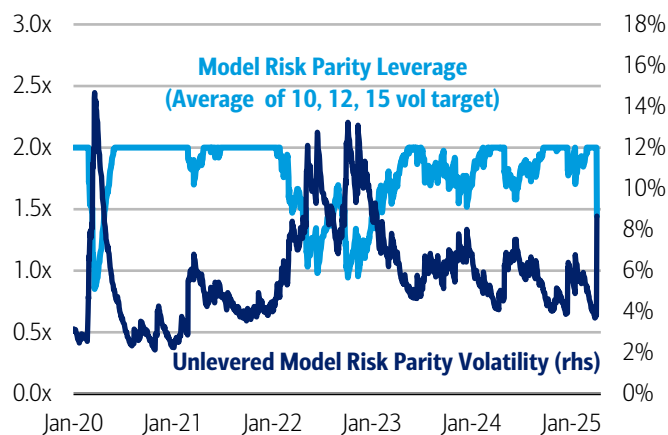
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Risk Parity Model

Exhibit 37: BofA Model Risk Parity Realized Volatility & Leverage

Our model risk parity leverage is a function of the prevailing volatility and below we show the average for three popular risk targets. Leverage could be unwound on the back of this week's increased volatility.

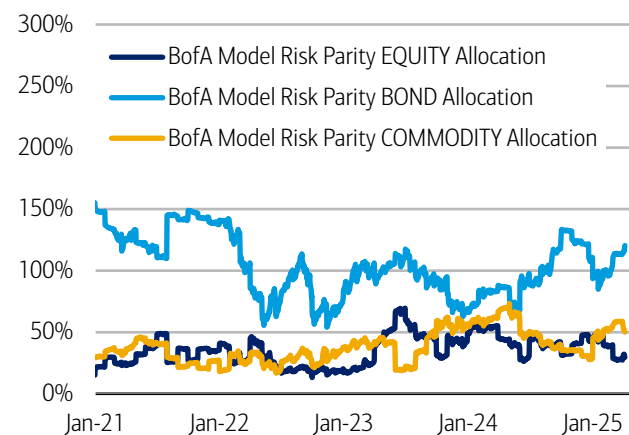


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 38: BofA Model Risk Parity Asset Class Allocations

Allocations are inversely proportional to an asset's volatility, that is, lower volatility assets have higher allocation. Risk parity commodity allocations are seeing a rise.



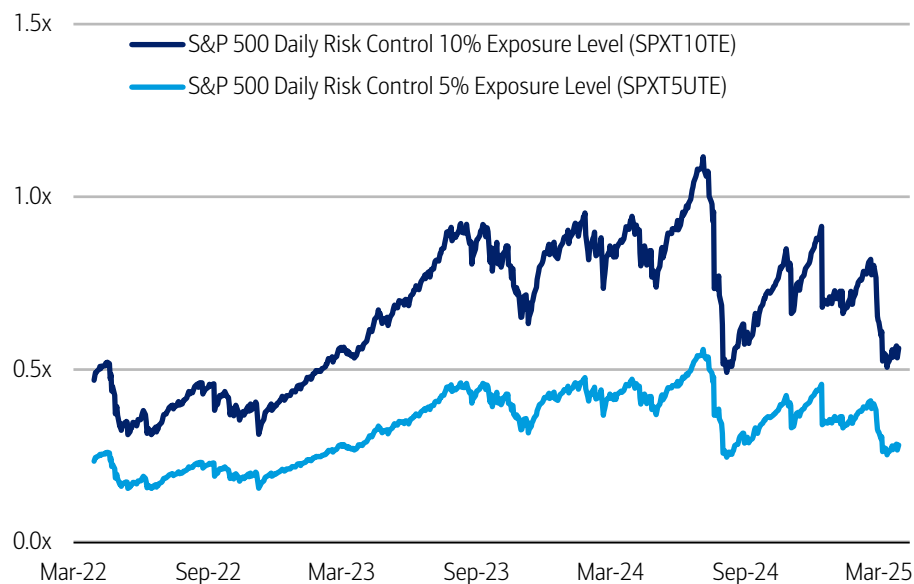
Source: BofA Global Research. Data as of 4-Apr-2025.

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S&P 500 Equity Vol Control

Exhibit 39: S&P 500 Daily Risk Control (10% and 5%) Exposure Level

To model equity vol control, we show the exposure for the S&P Daily Risk Control Index (both 10% and 5%). Leverage should see a larger decline heading into next week.



Source: BofA Global Research. Data as of 4-Apr-2025.

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Recent price action around CTA model trigger points

Exhibit 40: 10yr Tsy Futures (TY) trigger in week ending 31-Jan-2025

Continued gains after TY crosses our buy trigger during 27-Jan equity sell off



Source: BofA Global Research, Bloomberg

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Exhibit 41: AUD/USD trigger week ending 24-Jan-2025

AUD strengthens vs USD around our model's AUD buy to cover trigger



Source: BofA Global Research, Bloomberg

BoFA GLOBAL RESEARCH

Exhibit 42: 10yr Tsy Futures (TY) trigger in week ending 11-Oct-2024

Continued declines after TY crosses our sell trigger after the 4-Oct NFP print



Source: BofA Global Research, Bloomberg

BoFA GLOBAL RESEARCH

Exhibit 43: 10yr CGB trigger in week ending 27-Sep-2024

Accelerated declines near our model's trigger point



Source: BofA Global Research, Bloomberg

BoFA GLOBAL RESEARCH



CTA model trigger points (continued)

Exhibit 44: NASDAQ-100 trigger in week ending 19-Jul-2024

Continued declines after NDX crosses our model's sell trigger



Source: BofA Global Research, Bloomberg

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Exhibit 45: USD/JPY trigger week ending 19-Jul-2024

JPY strengthens vs USD around our model's JPY buy to cover trigger



Source: BofA Global Research, Bloomberg

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Exhibit 46: EURO STOXX 50 trigger in week ending 14-Jun-2024

Accelerated declines near our model's trigger point



Source: BofA Global Research, Bloomberg

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Exhibit 47: USD/MXN trigger week ending 7-Jun-2024

Increased MXN weakening vs USD around our model's MXN sell trigger



Source: BofA Global Research, Bloomberg

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CTA model trigger points (continued)

Exhibit 48: Soybean trigger in week ending 10-May-2024

Accelerated covering through our model's trigger



Source: BofA Global Research, Bloomberg

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Exhibit 49: USD/JPY stop loss triggered week ending 3-May-2024

JPY strengthening accelerates around our model's buy to cover trigger



Source: BofA Global Research, Bloomberg

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Exhibit 50: Crude Oil stop loss triggered week ending 3-May-24

Increased selling near our model's trigger point



Source: BofA Global Research, Bloomberg

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Exhibit 51: Cocoa stop loss triggered week ending 3-May-24

Increased selling near our model's trigger point



Source: BofA Global Research, Bloomberg

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CTA model trigger points (continued)

Exhibit 52: NKY stop loss triggered week ending 19-Apr-24

Increased selling near our model's trigger point



Source: BofA Global Research, Bloomberg

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Exhibit 53: SPX stop loss triggered week ending 19-Apr-24

Selling follows in each day after passing our model's trigger point



Source: BofA Global Research, Bloomberg

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Exhibit 54: USD/MXN stop loss triggered week ending 19-Apr-2024

Accelerated covering through our model's trigger



Source: BofA Global Research, Bloomberg

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Exhibit 55: SX7E stop loss triggered week ending 12-Apr-24

Increased selling at our model's trigger point



Source: BofA Global Research, Bloomberg

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CTA model trigger points (continued)

Exhibit 56: Ultra Long Term Tsy Futures (WN) trigger on 18-Jan-2024

WN futures featured in our daily update, please email us to be subscribed



Source: BofA Global Research, Bloomberg

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Exhibit 57: RTY stop loss triggered week ending 19-Jan-24

Increased selling at our model's trigger point



Source: BofA Global Research, Bloomberg

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Exhibit 58: KOSPI2 stop loss triggered week ending 19-Jan-24

KOSPI2 is featured in our daily update, please email us to be subscribed



Source: BofA Global Research, Bloomberg

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Exhibit 59: CHF/USD stop loss triggered week ending 19-Jan-24

CHF is included in our daily update, please email us to be subscribed



Source: BofA Global Research, Bloomberg

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Appendix

Background on trend following strategies (CTAs)

Trend following strategies have their roots in the commodity asset class as some of the earliest known applications were applied to futures within that asset class. Correspondingly, these trend following strategies were referred to as CTAs which is short for Commodity Trading Advisor. Today, however, global futures markets also comprise stock index, interest rate, currency, and commodity futures. To leverage the benefits of diversification that exists across these asset classes, trend following strategies have broadened their investment universe but are often still referred to as CTAs. Assets in trend following strategies are tracked in a database maintained by BarclayHedge and **as of 2024-Q4 stood at \$339.4bn.**

CTAs can be trend followers but also can be fundamental discretionary

CTA managers often implement rules-based systematic trend following strategies but also can make investment decisions based on fundamental analysis and market views. Those that are systematic could be allocating to futures across multiple asset classes as a function of both trend and volatility. Discretionary CTAs, on the other hand, may also allocate in some part or fully based on fundamentals and economic factors. This class of CTAs may become more concentrated in a given asset class based on outlook and may not be as broadly allocated across markets at any given period.

Benchmark CTA explained by x-asset, risk controlled, trend following

Despite the inclusion of fundamental, discretionary trading strategies and/or a focus on a subset of asset classes, our analysis suggests CTA performance can largely be explained by:

1. Investments across multiple asset classes (i.e., equity, interest rates, commodities, and currencies)
2. The use of trend following signals to determine long or short allocations
3. Risk control mechanisms to determine sizing and increase diversification.

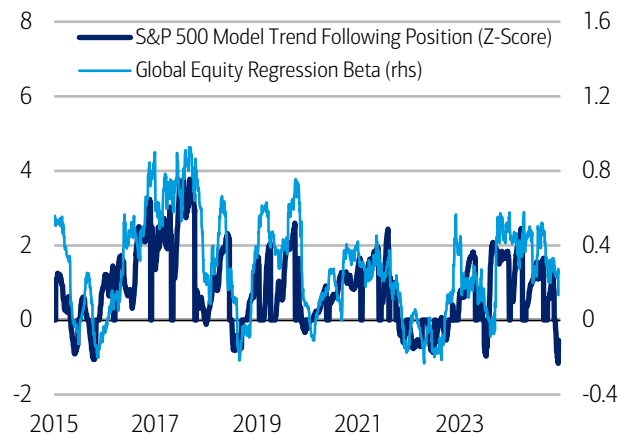
To this effect, we built a top-down multi-factor regression model to explain the performance of a representative benchmark CTA index using a set of cross-asset investments. The CTA benchmark we reference is the SG CTA Index which is comprised of approximately 20 of the largest CTAs by assets, reconstituted yearly with members held in equal weight, and published with daily data. Then, specifically, the multi-factor regression is of global equities, global bonds, commodities, and currency daily returns on the SG CTA index's daily returns. For more details on the top-down multi-factor regression and a discussion on CTA benchmarks, please see our report titled *Quantitative Investment Strategies Panorama*, "Trends aren't going out of fashion", pages 14-19 published in Mar-2017.

In Exhibit 60 and Exhibit 61 we show the regression beta of both global equities and bonds on the SG CTA Index alongside the z-score of our bottom-up estimate of CTA model sizing (the data displayed in the CTA section earlier) within the S&P 500 and TY futures respectively. Our bottom-up estimate of the position size is estimated by the ratio of component trend to its prevailing volatility. Importantly, our simple bottom-up estimate calculation closely tracks the respective regression betas over time.



Exhibit 60: BofA bottom-up model CTA allocation in the S&P 500 alongside a top-down regression beta of global equities on the SG CTA Index (a popular benchmark CTA index)

Our bottom-up model is in-line with a top-down regression

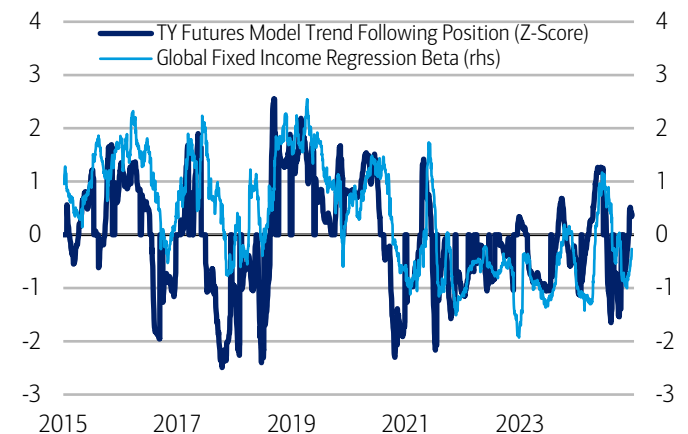


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 61: BofA bottom-up model CTA allocation in TY futures alongside a top-down regression beta of global bonds on the SG CTA Index (a popular benchmark CTA index)

Our bottom-up model is in-line with a top-down regression



Source: BofA Global Research. Data as of 4-Apr-2025.

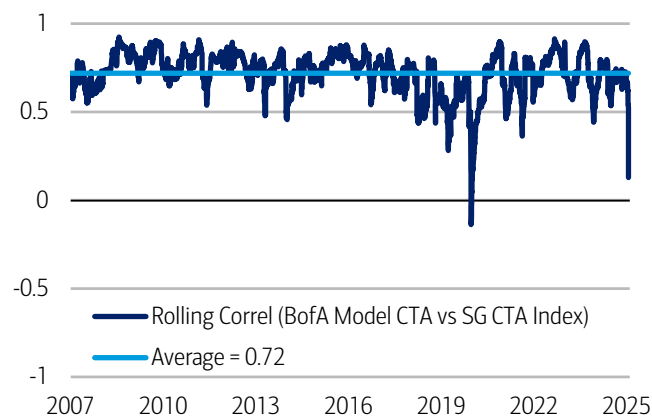
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BofA model CTA strategy tracks the benchmark index well

We also constructed a bottom-up CTA strategy using a wide range of futures investments across multiple asset classes. To do so, for each underlying we started with the trend/vol ratio, then assumed equal risk across asset classes and layered on top both rules for stop losses & subsequent re-initiation of positions. In Exhibit 62 and Exhibit 63 are the rolling correlation and beta of returns for our bottom-up CTA strategy and the SG CTA benchmark index. Correlation of daily returns averages around 0.7 with beta close to 1.

Exhibit 62: Rolling correl. of daily returns of BofA bottom-up model CTA strategy and the SG CTA Index (a popular benchmark CTA index)

Our bottom-up CTA model sized using trend/vol ratios, equal risk across asset classes, and with rules governing stop loss and re-initiation of positions tracks the benchmark CTA index well through time.

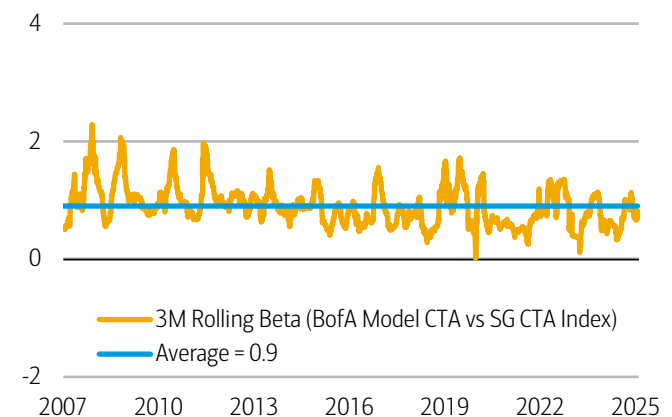


Source: BofA Global Research. Data as of 4-Apr-2025.

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Exhibit 63: Rolling 3M beta of daily returns of BofA bottom-up model CTA strategy and the SG CTA Index (a popular benchmark CTA index)

Our bottom-up CTA model sized using trend/vol ratios, equal risk across asset classes, and with rules governing stop loss and re-initiation of positions tracks the benchmark CTA index well through time.



Source: BofA Global Research. Data as of 4-Apr-2025.

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Background on risk parity strategies

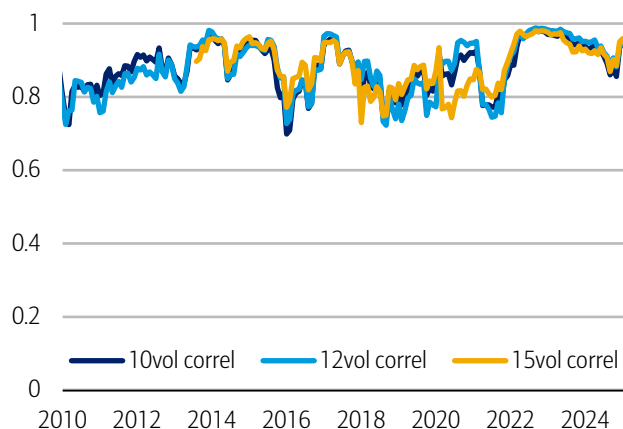
Similar to CTAs, our analysis indicates that risk parity strategies may allocate across the major asset classes and also size their positions as a function of prevailing volatility. However, risk parity strategies are agnostic to price trend and remain fully long each asset class. Risk parity strategies are popular for their ability to target diversification and have a strong track record of positive performance. In 2017, HFR (Hedge Fund Research) launched a suite of benchmark risk parity indices that are comprised of some of the largest risk parity funds. These benchmark indices are published monthly.

The BofA risk parity model is a simple risk parity application applied to equities (S&P 500), bonds (10Y Treasury Futures Total Return), and commodities (S&P GSCI index) rebalanced monthly using the prior three months of data to determine volatility and correlation forecasts. In Exhibit 65 through Exhibit 67 we show applications of the BofA risk parity model with risk targets of 10, 12, and 15 and in each case compare to the respective HFR risk parity benchmark over monthly periods. Then in Exhibit 64 is the rolling one-year correlation of prior twelve monthly returns for each HFR index and BofA model pair. Correlation tends to be high (> 0.8). As well, the betas are close to 1 with each model strategy closely fitting the respective HFR benchmark.

Unlike for CTAs, there is no database of risk parity funds from which we could gather an estimate of assets tracking the strategy. However, **commonly used estimates have ranged from \$200bn to \$750bn.**

Exhibit 64: Rolling 1-year correlation of HFR risk parity and BofA model risk parity monthly returns

HFR risk parity indices with 10, 12, and 15 vol are highly correlated to the respective BofA model risk parity strategies with similar vol targets.

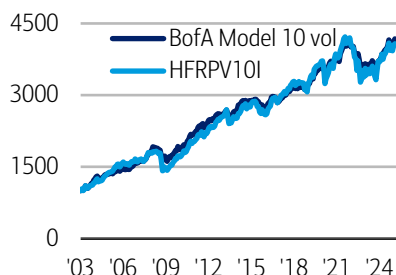


Source: BofA Global Research. Monthly data from Jan-2010. HFR institutional risk parity indices are used.

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Exhibit 65: BofA Model Risk Parity (10% vol target, 1.5x max leverage)

BofA model risk parity tracks the benchmark HFR risk parity index

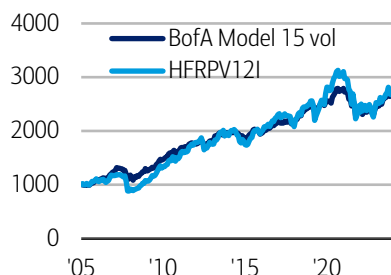


Source: BofA Global Research. Data as of 28-Feb-2025.

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Exhibit 66: BofA Model Risk Parity (12% vol target, 1.5x max leverage)

BofA model risk parity tracks the benchmark HFR risk parity index

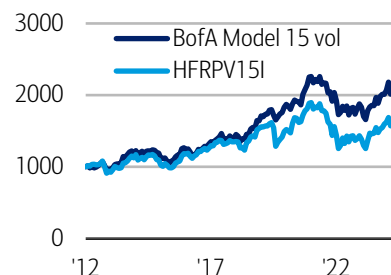


Source: BofA Global Research. Data as of 28-Feb-2025.

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Exhibit 67: BofA Model Risk Parity (15% vol target, 3.0x max leverage)

BofA model risk parity tracks the benchmark HFR risk parity index



Source: BofA Global Research. Data as of 28-Feb-2025.

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Background on equity vol control strategies

Equity vol control is a simpler quantitative strategy relative to CTAs and risk parity. This class of quant dynamically adjusts leverage to target a predefined level of risk based on prevailing equity volatility. For example, if the prevailing level of S&P 500 volatility was 20%, then an S&P 500 10% vol controlled strategy would set leverage to 0.5x, or 50% of total AUM. If on the other hand prevailing volatility was 5%, then leverage would be set to 2x, or 200% of total AUM. Equity vol control strategies are often applied to equity indices with the largest market cap and volumes in order to improve tradability. Risk targets tend to range from 5% to 15%. Versus CTAs and risk parity, assets in equity vol control are the least publicized **but estimates of \$300bn can be reasoned.**

CTA model parameters and outputs explained

Trend strength is calculated using a collection of moving average crosses

Our model trend following strategy requires the measurement of an asset's price trend and we do so using a collection of moving average crosses. The key parts of the calculation are the use of both near and far moving average crosses, weighted equally. A simple example of this would be to measure the 1-month, 3-month, and 10-month moving averages for an asset. Then we compare the 1-month to each the 3-month and 10-month where if it is higher we score it +1 and lower then -1. The two scores are then averaged such that if the 1-month was higher than both the 3- and 10-month the trend strength would be +1 (max long) and if the 1-month was lower than both the 3- and 10-month the trend strength would be -1 (max short). Our actual calculation uses a greater number of crosses and also prorates the crosses based on component volatility in order to make trend strength more continuous over time. Importantly, we do not use the spot price in any cross as our analysis leads us to conclude that actual trend following strategies do not as well.

Bearish/median/bullish price paths are determined using historical data

For each underlying that we apply our trend following model on we also show a projection of how the model position can evolve over the next five trading days. We do this by applying our CTA model on bearish, median, and bullish price paths over the next week. These price paths are determined using historical data for each underlying. Price paths are in part a function of the prevailing volatility of an asset so when determining the various paths we sample only those historical data where volatility is similar to current. Then from this subset of data we can determine low (bear), neutral (median), and high (high) price paths to apply one week ahead.

Rules governing buy and sell triggers in our CTA model

At any given point in time our bottom-up trend following model applied on an underlying asset can be either in a position (long or short) or flat. If in a position, then should a price trend strongly to reverse, our model could potentially hit a stop loss. We assume the stop loss is set such that in an extreme event where every component hits a stop loss simultaneously in the overall model, the loss to the portfolio is approximately 10%. For an underlying asset which our trend following model is currently flat, we assume re-entry occurs under two conditions. If the asset's price hits a local high and its trend strength is positive, a long is initiated. Vice-versa, if an asset hits a local low and its trend strength is negative, a short is initiated. The local high/low level can range from lookbacks over the prior five to ten days.

Timescale of leverage changes

CTAs, risk parity, and equity vol control strategies monitor and adjust leverage daily. However, the lag between a model prescribed change in leverage and the actual adjustment varies. Our models and analysis indicate that CTAs are the fastest to respond to model changes, potentially even intraday. Risk parity and equity vol control, however, tend to move slower with adjustments to leverage occurring in the one to two subsequent trading sessions.

Background on leveraged & inverse ETFs

Leveraged & inverse ETFs target a daily return equal to a positive or negative multiple of their underlying index. For both the S&P 500 and NASDAQ-100, the 3x long ETF is currently the most popular by AUM. Since their introduction in 2006, the total AUM in US based S&P 500 & NASDAQ-100 leveraged & inverse ETFs has grown to about **\$45bn**.

Leveraged & inverse ETFs rebalance daily to be able to achieve their desired daily return multiple on the following trading day. An example of this rebalancing is shown below and demonstrates that leveraged and inverse funds buy and sell on the same days.

Exhibit 68: Leveraged and inverse ETFs both buy in up markets and sell in down markets

Stylized example of leveraged and inverse ETF rebalancing flows for 2x long and 2x short ETFs

	Benchmark	2x Long ETF		2x Short ETF	
	Price	Price	Share Exposure & Rehedge	Price	Share Exposure & Rehedge
Day 1	\$100.00	\$100.00	Long $2 * 100/100 = 2.00$ Shares	\$100.00	Short $2 * 100/100 = 2.00$ Shares
Return	↓ +10%	↓ +20%		↓ -20%	
Day 2	\$110.00	\$120.00	Long $2 * 120 / 110 = 2.18$ Shares Buy 0.18 Shares at \$110	\$80.00	Short $2 * 80 / 110 = 1.45$ Shares Buy 0.55 Shares at \$110
Return	↓ -10%	↓ -20%		↓ +20%	
Day 3	\$99.00	\$96.00	Long $2 * 96 / 99 = 1.94$ Shares Sell 0.24 Shares at \$99	\$96.00	Short $2 * 96 / 99 = 1.94$ Shares Sell 0.49 Shares at \$99

Source: BofA Global Research.

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Note in the example above that although both the 2x long and short ETFs achieved their desired daily return, the return over the two trading days is not equivalent to +/- 2x the return of the benchmark over two days due to the effect of daily compounding.

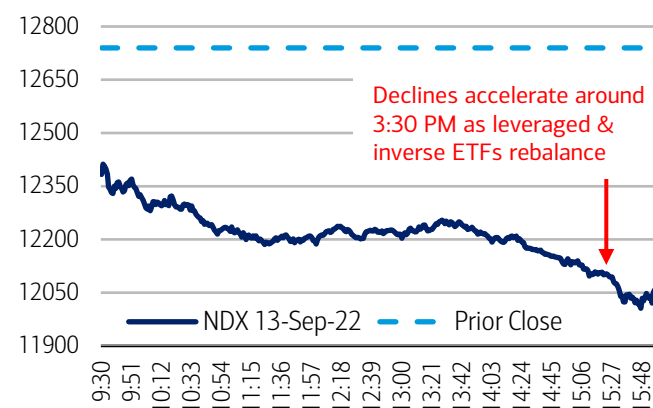
Investors using these vehicles should recognize that *returns over longer horizons will not be equal to the product of the return of the benchmark index and the ETF's leverage factor*.

Leveraged & inverse ETF rebalance can amplify moves in the underlying asset

We point to the NASDAQ-100 on 13-Sep-22 for one example of systematic flows from the leveraged & inverse ETF complex potentially extending large index moves at the end of the trading day. The index opened 2.8% lower from its prior close and then declined another 2.5% from the open to 3:30 PM. At this point, our data indicated that the leveraged & inverse ETF rebalance required approximately \$7.7bn notional NQ futures be sold into the close. This represented 60% of average notional NQ futures volume between 3:30 PM and 4:00PM over the prior month. As expected, futures volume into the close rose for the ETF rebalance with over \$20bn notional traded between 3:30 PM and 4:00 PM. As this systematic selling went through, the index declined another 34bps in the final half hour of trading.

Exhibit 69: Leveraged & inverse ETF rebalancing may have extended NASDAQ-100 losses on 13 Sep 2022

NASDAQ-100 intraday price on 13-Sep-22. The index declined 5.5% from its previous close and saw a dip lower at the end of the trading day



Source: BofA Global Research.

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Background on option positioning

Key highlights of our approach to option positioning include:

- Deriving gamma estimates based on signed volume data from the exchange rather than using models that risk mis-classifying option buys/sells
- Quantifying the impact of this gamma on S&P realized volatility by estimating the market impact of delta-hedging flows
- Including SPX ODTE gamma in the picture by accounting for gamma arising from both expiring & non-expiring options

Many market participants have long sought an accurate measure of option positioning to assess the impact that options and their subsequent hedging may have on both the underlying and derivative markets. Our aim here is to provide such estimates for the size and impact of the net gamma of delta-hedgers (often colloquially referred to as “dealer gamma”) for SPX options specifically.

At its core any approach to estimating option positioning tends to boil down to one key step: how do you determine if end-users are long or short a particular option? Market participants have addressed this question in a variety of ways historically. To give a few concrete examples (some with more merit than others) you could: (i) naively assume end-users buy all puts and sell all calls, (ii) categorize option trades based on their distance from the bid and ask, or (iii) use a local volatility surface to impute a buy or sell signal from changes in the volatility.

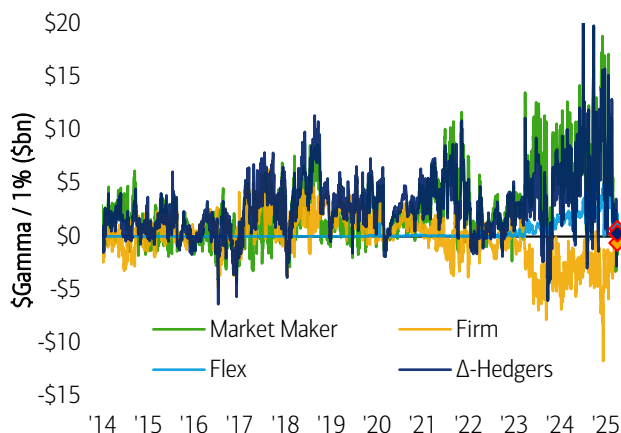
Instead of the aforementioned ideas, our position estimates are grounded in data directly from the exchange which classifies option trades as a buy or sell according to the exchange’s own records for 5 types of market participants: customers, pro-customers, broker-dealers, market makers, and firms. By way of example, customers (both regular and professionals) include a mix of retail and sophisticated players like hedge funds, market makers are the usual suspects, while broker-dealers and firms often (though not necessarily exclusively) capture a portion of the trading activities at banks.

Our gamma estimates combine the footprint of market makers and firms (as highlighted in Exhibit 70) under the assumption that market makers delta-hedge both regular and flex options (labelled as “Market Maker” & “Flex” respectively) while firms hedge only regular options. For clarity, a flex option is similar to a traditional (or regular) listed option, however, with a flex option the user may choose the expiration and strike (among other parameters) to be an expiry or strike that is not otherwise available in traditional options. We find that historically delta-hedgers as we’ve defined them tend to be skewed net long gamma from SPX options and in the +\$0-10bn range. For comparison Exhibit 71 shows the SPX gamma implied by the naïve assumption that end-users buy all puts and sell all calls which is often appreciably larger in magnitude than our estimate of SPX gamma for delta-hedgers.



Exhibit 70: Historical SPX gamma for Firms, MMs, Flex and Δ -Hedgers

Our estimates for Δ -Hedger (= firm + mm + flex) gamma assume that firms delta-hedge only regular options while market makers hedge regular & flex

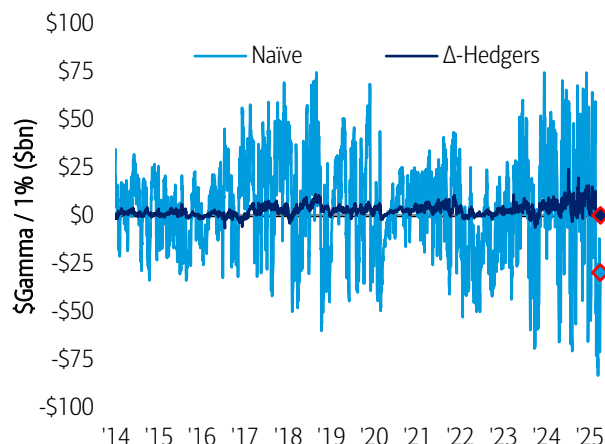


Source: BofA Global Research, CBOE. Data as of 03-Apr-25.

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Exhibit 71: Comparison of gamma for Δ -Hedgers with a naïve estimate

A naïve estimate of gamma which assumes end-users buy all puts and sell all calls tends to be larger in magnitude than our gamma level for Δ -Hedgers



Source: BofA Global Research, CBOE. Data as of 03-Apr-25 for the Δ -Hedger gamma level and as of 02-Apr-25 for the naïve gamma estimate.

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Quantifying the impact of gamma on realized volatility

To infer the impact of SPX option gamma on S&P 500 e-mini realized volatility (as presented in Exhibit 5) we perform the following steps: (i) Use the gamma level from the prior day's close and the subsequent realized equity move to estimate the delta that hedgers need to buy or sell. (ii) Quantify the market impact of trading the required delta in the S&P 500 e-mini futures market with trading confined to the last 1-hour, 30-minutes, or 15-minutes of the trading session. (iii) Calculate new hypothetical daily market returns after removing the impact from trading the delta. These new returns are then used to estimate the realized volatility in the absence of delta-hedgers.

A comment on model diversity and market impact

It is important to note that the analysis in this report on trend following and risk parity is based on one implementation of each class of strategy that attempts to track a respective benchmark for each. Actual trend following and risk parity strategies that compose the benchmark indices could vary in their rules-based implementations. This is an important consideration with regards to market impact from this class of strategies. That is, to the extent the models have more diversity, the potentially less impact they can have on the market as trading may not occur at the same levels and/or at the same time. This is a crucial point that is commonly not discussed surrounding this type of analysis.

Exhibit 72: List of abbreviations

Abbreviations used in this report

ODTE: zero-days-to-expiration	SG: Soc Gen
AUD: Australian dollar	SPX: S&P 500 Index
CTA: Commodity Trading Advisor	TSY: Treasury
CGB: China Government Bond	TU: 2-Year US Treasury Note Futures
FV: 5-Year US Treasury Note Futures	US: U.S. Treasury Bond Futures
JPY: Japanese Yen	USDJPY: United States Dollar/ Japanese Yen Cross
KTB: Korean Treasury Bond	UST: US Treasury
MXN: Mexican Peso	UXY: Ultra 10-Year US Treasury Note Futures
RTY: Russell 2000 Index	WN: CME Ultra Long Term U.S. Treasury Bond Future

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