Crisis dynamics: smiling in the face of adversity

CTAs in a crisis

In 2008, I was head of fixed income at Winton when the great financial crisis (GFC) struck. Most investment strategies were losing money while CTAs were smiling in the face of adversity. Incredibly, the world and his sister were withdrawing money from Winton. Many hedge funds had gated or slowed down withdrawals, and the liquid CTAs were used as an ATM.

David Harding, justly and presciently, refused to gate the fund: "It's their money and if they want it, they are welcome to it". CTAs manage liquidity very carefully: in each market we trade, we make sure we are not the dominant player. This paid off during the crisis: we were able to close positions without undue slippage. In retrospect, avoiding gating was not just doing right by our clients, but also an astute commercial decision: after the crisis passed, clients did come back, and in droves.

Just recently I was discussing a possible collapse of the US debt market and was asked: how would CTAs fare? I replied that my expectation is that CTAs would fare extremely well, but we would probably fail to notice their stellar performance as we would be too busy fighting the zombies in the streets.

The term "Crisis Alpha" was coined by Alex Greyserman and Katy Kaminski following the GFC, but can we define it formally? How much crisis alpha does a CTA typically exhibit?

The mathematics of a CTA

The mathematics of a CTA is straightforward. In each market, trend gross performance is small but positive, say 0.2 Sharpe per market. We diversify across 100 markets or so, culminating in volatility reduction of approximately 3.5 with a similar pick up in Sharpe:

$$\text{Unleveraged Aggregate Volatility} = \text{Average market volatility} / \text{Diversification}$$

$$\text{Fund Sharpe} = \text{Average market Sharpe} \times \text{Diversification}$$

This gives us a gross Fund Sharpe of 0.2 x 3.5 = 0.7. After costs, a liquid CTA net Sharpe is around 0.65. Voila!

From this lowly baseline, CTAs can distinguish themselves by having higher average market Sharpe, higher diversification, or lower costs (Or ideally, all three).

Market skew

Although a 0.65 Sharpe is not objectively amazing, on the upside this typical CTA will have a positive skew.

Trend following in individual markets usually results in a positive skew, since we pseudo-replicate a straddle, giving us a "mechanical" positive skew. I refer you to the excellent paper (https://arxiv.org/pdf/2101.01006) by Richard Martin where he analyses single-market trend skew in

great detail, and as a function of trend speed (the faster you trade, the more positive skew) and skew observation period (skew peaking around 3 to 6 months for mid-speed trend).

But what happens to skew at aggregate fund level?

Aggregate skew

Skew, like volatility, decays as we diversify. Assuming no co-skewness,

$$\text{Fund Skew} \leq \text{(Weighted) Average Market Skew / Diversification}^{1}$$

Single market skew makes a great talking point (Look at Cocoa! Wow!) but becomes less impactful as we diversify.

Indeed, for a CTA manager, the fund's performance and the fund's skew are in direct conflict! Performance *increases* with diversification while skew *decreases*. Of course, clients usually want both performance and skew. Fortunately, and weirdly, you *can* have the cake and eat it.

We ran a simulation over 101 liquid futures, removing some and allocating risk randomly to the remaining futures. We can calculate the resulting diversification, the average market skew and the resulting fund skew:

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[1] To prove this equation, let us bound the aggregate skew for an equally weighted portfolio (for variable weights the calculation is more involved). Trend has a positive correlation matrix so:

$$\text{Diversification} \leq \sqrt{n}$$

To ensure unit risk of overall fund returns, we leverage our portfolio by Diversification so our risk in each asset is Diversification/n.

$$\text{Fund Skew} = E(\text{Fund returns}^3) = (\text{Diversification}/n)^3 \sum E(\text{market returns}_i^3)$$

$$= (\text{Diversification}/n)^2 \sum \text{market\_skew}_i * (\text{Diversification}/n)$$

$$\leq 1/n \sum \text{market\_skew}_i * (\text{Diversification}/n)$$

$$= \text{Average market skew} * (\text{Diversification}/n)$$

$$\leq \text{Average market skew / Diversification}$$

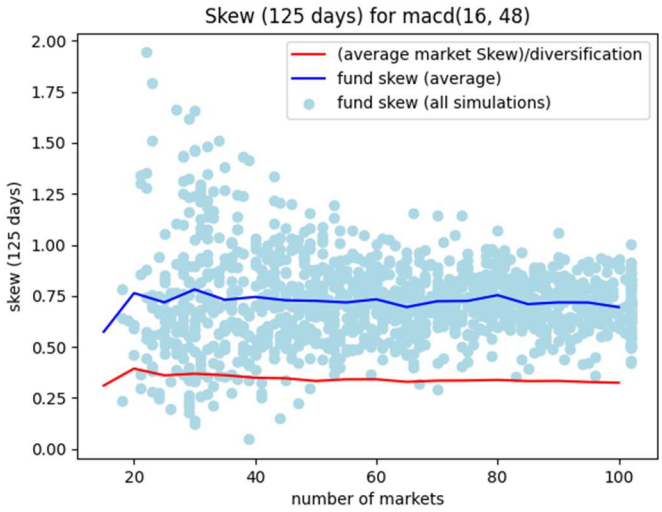

Figure 1: Average market skew (divided by diversification) and average fund skew for multiple simulations

We find that fund skew (in blue) is about twice what it should be (in red). Why is CTA fund skew much higher than it should be?

Index skew versus single stock skew

Luckily, to help us understand skew at aggregate level, we have a crystal ball to gaze into. The option market knows all about skew and there are options both at single-market level as well as aggregate index level.

Let us look at the S&P with its 500-odd constituents. We grab the implied vol surfaces for the index and its current individual constituents.

Diversification (reduction of variance) from single stock to index level

Each day, we calculate (market-cap-weighted) average market, at-the-money (ATM) variance and then compare it to the S&P ATM variance to get an idea of the implied diversification (ratio of the two volatility measures) across the S&P portfolio.

The diversification (volatility reduction) of 500 equity stocks is approximately 2, much lower than the diversification we get from trading 100 trend assets (where diversification is around 3.5). This is because equity stocks are more correlated than trend on a cross-asset-classes futures basket.

Skew

What is happening at the tails? We repeat the diversification calculation, for out-of-the-money (OTM) constituents implied variances versus the S&P index's out of the money implied variance.

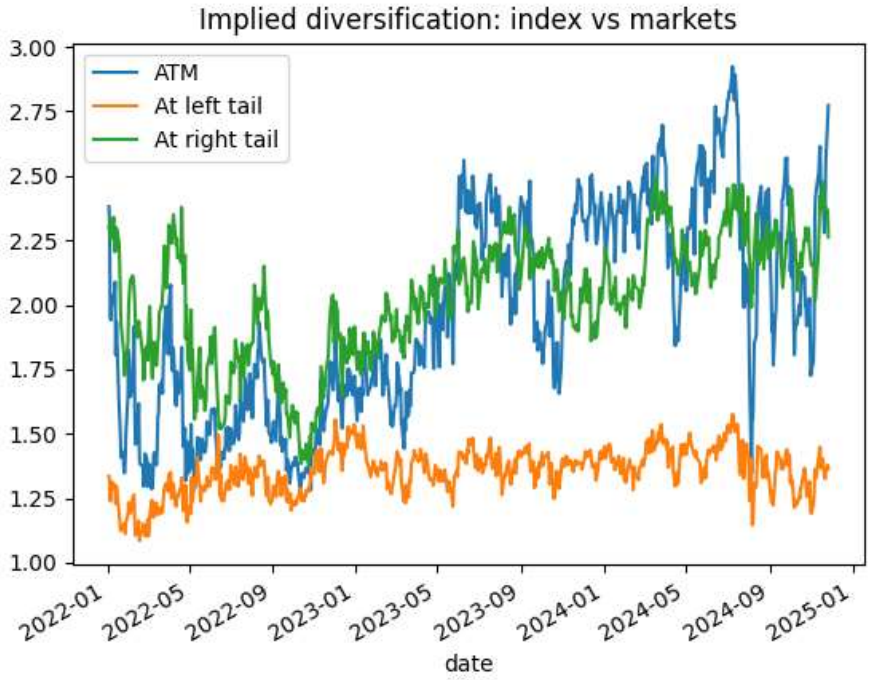

Figure 2: Implied diversification inferred as √(constituents implied ATM variance/S&P implied ATM variance). We then repeat this implied calculation at both tails of the distribution.

What do we find?

- The option market thinks that if prices go up (right tail OTM in green), the diversification we see between the stocks is maintained at roughly similar levels
- The option market thinks that if prices go down (left tail OTM in orange), they will go down almost "as one", correlations will spike, and diversification will plummet.

During equity crisis, correlations spike, making further equity losses both more likely and more severe.

Asymmetry and crisis dynamics

At Brevan, I was fortunate enough to work alongside Pat Hagan, the inventor of the SABR model. The stochastic volatility SABR model recognises asymmetry between up and down asset moves and attributes the observed options' left heavy tail to negative correlation between volatility and price: volatility rises as prices drop.

What we just identified is a second complimentary cause for asymmetry, but at aggregate level: correlations between markets are also negatively correlated to price moves. I think of this as "Crisis Dynamics"

As an aside, though very real, I am unaware of a stochastic correlation model with this asymmetry so if you are a PhD student looking for a thesis, such a model will improve on pricing of e.g. basket autocallables.

Crisis Dynamics and Crisis Alpha

So where does the additional CTA positive skew come from? In usual, normal, market conditions, the returns from each market we trade have a positive skew. This idiosyncratic skew, like Cocoa gains in early 2024, decays with diversification.

However, there is an additional source of positive skew for a CTA: As a crisis in a macro factor approaches, correlations between markets spike and CTAs are more likely to make more money across the board.

In extremis, this is crisis alpha: GFC, COVID. But crisis dynamics is not just about the fully blown crisis. Let us look at historic fund skew versus market skew over time, applied to monthly returns each year within an equally weighted, fast trend, portfolio:

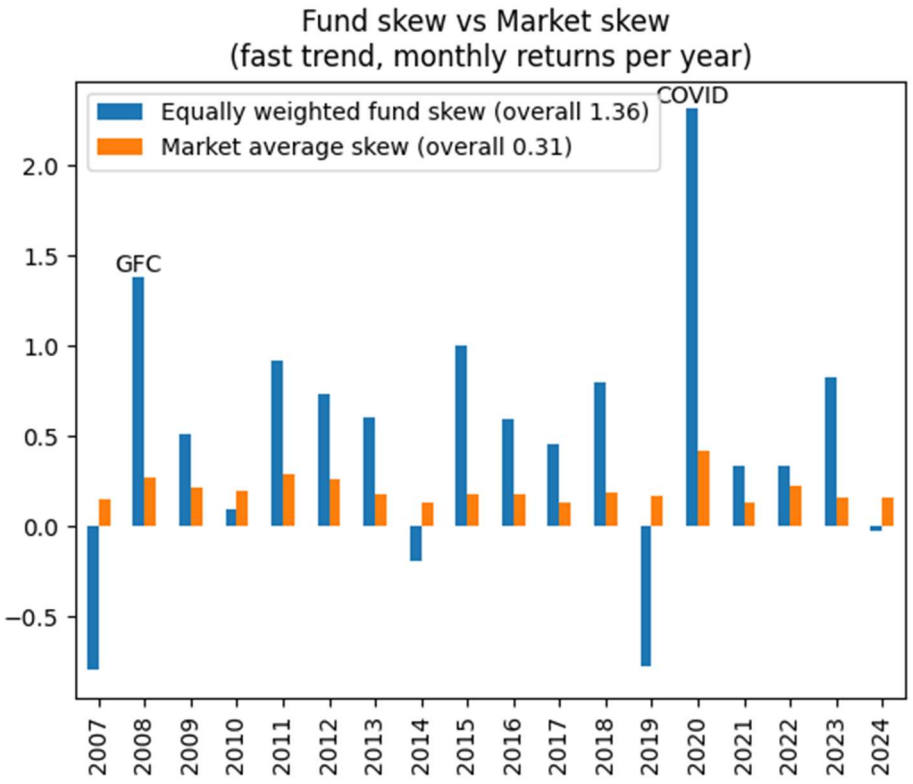

Figure 3: an equally weighted portfolio of 101 futures each trading a fast (4-12 MACD) trend. Although we see spikes in COVID and GFC, fund skew regularly exceeds the skew expected from average market skew/diversification

In most years, fund skew far exceeds what skew is expected from a static correlation structure: the dynamic way correlations respond to an impending crisis is what creates this excessive positive skew.

Asymmetry

Crisis dynamics is asymmetric by nature: an equity crash is much more "valuable" to a CTA than an equity rally, like the one we have seen in the last few years. Both the GFC and the recent phenomenal

equity rally are extreme events, but only a crash is associated with a spike in correlations. Indeed, skew in 2024 was negative!

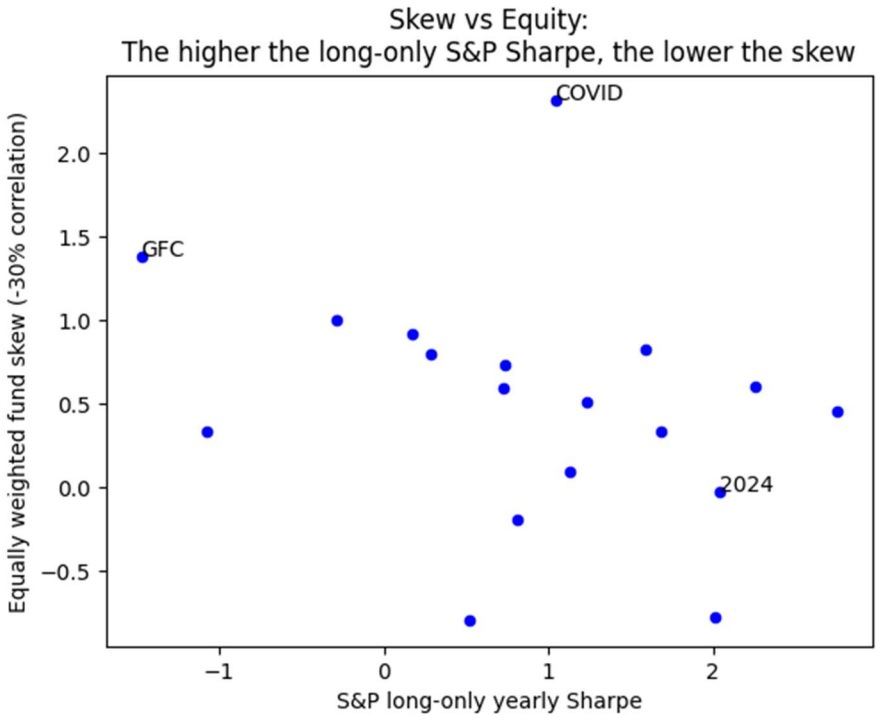

Figure 4: Periods with high equity Sharpe are associated with lower skew and vice versa.

You may think you should invest in a CTA because you are preparing for the zombie apocalypse (or treasury debt collapse) and want crisis alpha. But a CTA should also be on your shopping list for those less extreme "inflation is untethered" or "China is wobbling" events. CTAs crisis dynamics will tend to exhibit excessive positive skew precisely when the rest of your portfolio is less diversifying than you expected.

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