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# Unraveling the Myth of Front-Running CTAs: A Deep Dive into Market Realities

**(R.Koloshuk, A.Ijad, 2024)**

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# Unraveling the Myth of Front-Running CTAs: A Deep Dive into Market Realities

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## Abstract

This whitepaper investigates the assumption that Commodity Trading Advisors (CTAs) follow predictable patterns that can be exploited by "front-running strategies", more accurately referred to as "anticipatory trading strategies". We note a prevalence of market news and sell-side research recommending these anticipatory trading strategies that do not require high frequency trading (HFT) to generate profits, but rather are based on the concept that CTAs will respond to changes in market prices in a way that astute traders may anticipate. Through replicating Global CTA Positioning data—sourced from Goldman Sachs and Nomura—we examine whether systematic trend-following strategies can be effectively anticipated. We find that the notion that these strategies can be consistently exploited for outsized profits is largely unsupported by empirical evidence.

## Introduction

Sensational media headlines, such as "Quants Are Poised to Unleash a Wave of Cash in Stock Market"[8] or "Volatility Rocked Quants Threaten $170 Billion Selling Spree,"[9] often lead to oversimplified narratives around quantitative trading strategies, particularly those employed by Commodity Trading Advisors (CTAs). These narratives imply that CTA strategies make the market more predictable, inviting the possibility of 'front-running' their trades to exploit inefficiencies for profit.

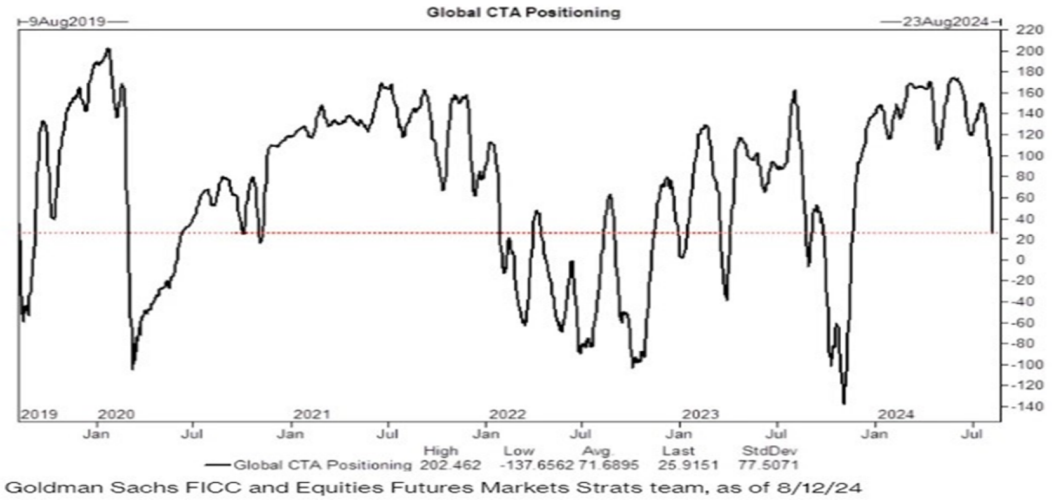
The underlying assumption is that CTAs, operating in a largely systematic manner, execute orders in predictable patterns that more nimble traders can anticipate. At WaveFront, we sought to rigorously investigate this premise by simulating CTA trend-following positioning and testing whether any consistent advantage could be derived from anticipating its order flows.

Our core research question: *Is it possible to systematically profit from anticipating trend-following CTAs by replicating their positioning and preempting their market actions?*

## Methodology

To assess the feasibility of front-running CTAs, we employed a multi-step approach, focusing on replicating Global CTA Positioning and subsequently testing potential profitability through systematic preemptive strategies.

**Figure 1: Global CTA Positioning Dec 2019 to Aug 2024**



Goldman Sachs FICC and Equities Futures Markets Strats team, as of 8/12/24

## *Data Collection*

The datasets, sourced from Goldman Sachs "Global CTA Positioning"[2] (2019 to 2024), Nomura "Net CTA EQUITY Only Estimated Exposure"[3] (2010 to 2023), and daily closing prices across various global equity futures markets. With this extracted and raw market data we were able to use an inference approach to reverse engineer a technical indicator/signal with a 0.86 correlation to the Goldman Sachs data and a 0.79 correlation to the Nomura data. The resultant indicator/signal was used to represent our estimation of CTA positioning in all subsequent testing.

*Moving Averages and Bollinger Bands Calculation*

**200-Day Simple Moving Average ($SMA_{200}$):** The 200-day simple moving average served as the long-term trendline, representing the average price over the past 200 days:

$$SMA_{200} = \frac{1}{200} \sum_{i=n-199}^{n} P_i$$

Where:

- $P_i$ is the closing price at day $i$
- $n$ is the current day.

**9-Day Simple Moving Average ($SMA_9$):** The 9-day simple moving average was used to capture short-term price trends:

$$SMA_9 = \frac{1}{9} \sum_{i=n-8}^{n} P_i$$

**Bollinger Bands:** Bollinger Bands provide dynamic upper and lower bounds based on the volatility of the asset. They were calculated as follows:

**Upper Bollinger Band** ($BB_{Upper}$):

$$BB_{Upper} = SMA_{200} + (2 \times \sigma_{200})$$

Where $\sigma_{200}$ is the standard deviation of the price over the last 200 days:

$$\sigma_{200} = \sqrt{\frac{1}{200} \sum_{i=n-199}^{n} (P_i - SMA_{200})^2}$$

**Lower Bollinger Band** ($BB_{Lower}$):

$$BB_{Lower} = SMA_{200} - (2 \times \sigma_{200})$$

These Bollinger Bands were used to define the range within which short-term price movements occur relative to the long-term trend.

*CTA Signal Calculation*

The CTA Signal ($CTA_{sig}$) was derived by normalizing the difference between the short-term moving average ($SMA_9$) and the long-term moving average ($SMA_{200}$), divided by half the distance between the upper and lower Bollinger Bands:

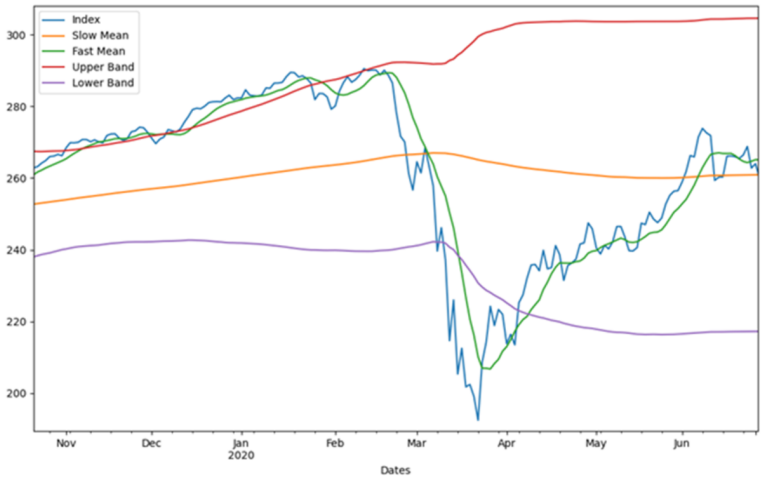
$$CTA_{sig} = \left[ \frac{SMA_9 - SMA_{200}}{BB_{Upper} - BB_{Lower}} \right] \div 2$$

Substituting the formulas for $(BB_{Upper})$ and $(BB_{Lower})$, we arrive at the following expanded version of the CTA Signal:

$$CTA_{sig} = \frac{SMA_9 - SMA_{200}}{2 \times \sigma_{200}}$$

This signal quantifies the relative positioning of the short-term moving average against the long-term moving average, scaled by the market's volatility.

**Figure 2: Visual display of trading CTA Position Data using a Bollinger Band and anticipatory "trigger levels" from the mean**




To Illustrate the rationale behind the Bollinger band method, we can begin by looking at **Figure 2** and assuming;

1. When the fast (9 day) moving average crosses the upper band, the trend follower will be in their maximum long position.
2. When the fast moving average is equal to the slow moving average, there is zero position and the trend follower is flat.
3. When the fast moving average is 50% of the way between the slow moving average and the upper band, we can assume that the trend follower is long 50% of their maximum position and vice versa (below the slow average) for a 50% short position.

*Signal Interpretation*

The signal values were interpreted as follows:

- **Positive CTAsig**: Indicates that the short-term moving average is above the long-term moving average, suggesting CTAs are long the market.
- **Negative CTAsig**: Indicates that the short-term moving average is below the long-term moving average, suggesting CTAs are short the market.

*Two visual comparisons:*

**Figure 3** compares our Global CTA signal (Chart A) to Goldman Sachs data (Chart B), and results in a 0.86 correlation:

Chart A (WaveFront CTAsig)

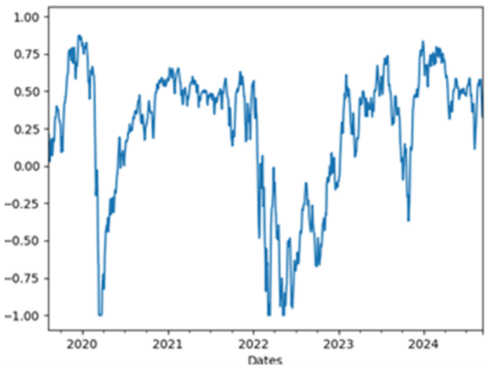



Chart B (Goldman Sachs CTA Positioning)

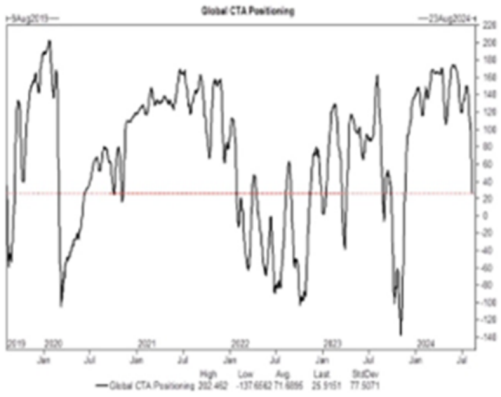



**Figure 4** compares our Global CTA signal (Chart A) to Nomura data (Chart C), and results in a 0.79 correlation:

Chart A (WaveFront CTAsig)

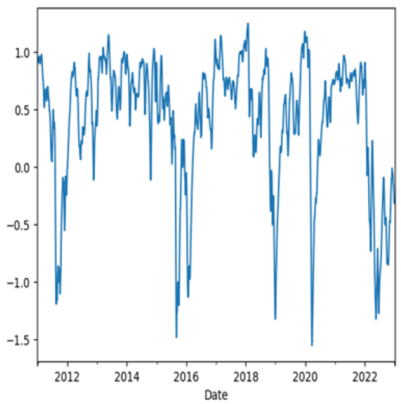
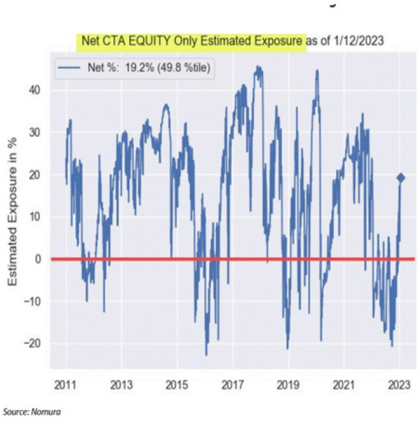



Chart C (Nomura CTA Positioning)



## Results & Analysis of Global CTA Positioning

The results of our analysis revealed a high (0.86) correlation between the Bollinger Band strategy and Goldman Sachs' "Global CTA Positioning"[2], confirming that this model serves as a reasonable proxy for replicating Goldman Sachs' estimation of CTA behavior. We found a 0.79 correlation between the same Bollinger Band strategy and Nomura's "Net CTA EQUITY Only Estimated Exposure"[3], further confirming that our signal is a reasonable proxy for industry estimations of CTA behavior.

Given that we were using image extracted data and calculating the correlation against the daily data from our signal, we felt that these were very strong correlations and based on these results we are highly skeptical that industry estimations of CTA behavior include any additional elements other than market prices. When it comes to testing strategies based on our own inferred 'WF Global CTA Positioning' signal, the high correlation of our signal to industry data, in addition to the lack of any lag in our signal, indicates that industry data for Global CTA Positioning and our WF Global CTA Positioning can be used interchangeably to test strategies and we would expect to see very similar results.

## Challenges in Defining a Front Running Strategy

Before testing the validity of the strategy, it is important to know that "front-running" is a term that is being used loosely, since this is technically not front running in a legal sense, but rather describes an *anticipatory trading strategy.*

In our situation, there is no way to anticipate the trend follower using the WF Global CTA Positioning indicator without an element of prediction. For example:

**1.The anticipatory trader has the ability to receive data before it impacts the models of price-based trend strategies.**

- In this scenario, the anticipatory trader can use their information edge to make boundless sums of money.
- If there is an entity who has data before the market can see it, such an entity does not need to concern themselves with what a trend-following CTA or any other manager is doing because they can use their time advantage to profit from all flows, such as a surprise earnings report or anything else that would cause a big move.
- We do not intend to test this by showing the results of applying perfect information.

**2.The anticipatory trader is looking at global CTA positioning data. When the trader sees that the positions are sharply increasing or decreasing (slope of Global CTA Positioning), then the trader trades in the direction of those flows expecting them to continue and thus be pushed into profitability by the trend follower.**

- In this scenario, the trader is doing the opposite of trading in anticipation of the trend follower and is guaranteeing themselves to be trading after the trend follower.
- In this scenario, for the CTA positioning to continue in the direction of the anticipatory trader's position, and thus make a profit, the trend must continue. By this logic, the anticipatory trader is becoming a 2nd order trend follower themselves.
- *We show the performance of this strategy in "Results #1 Trading the slope" below.*

**3.The anticipatory trader is looking at the same market data, using the same tools as the trend follower, but anticipating how the trend-follower will trade in realistic time.**

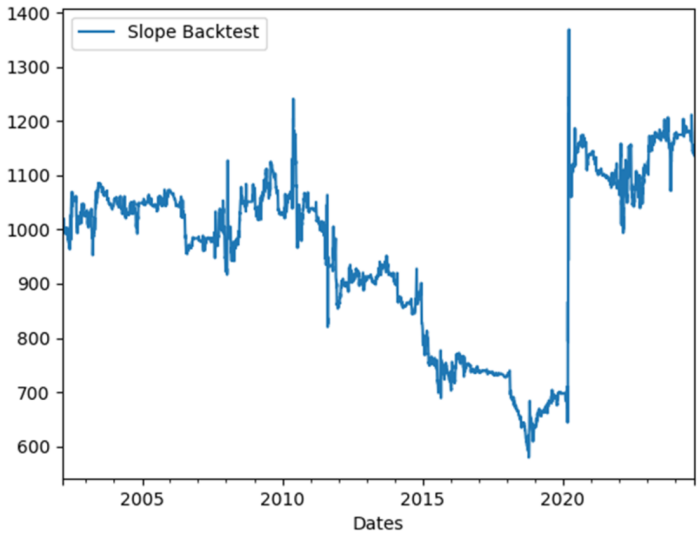
- If the anticipatory trader is unable to get market data ahead of the market, they will continuously hold a similar position as the trend follower, and thus also be implementing a form of trend following.
- The anticipatory trader may choose a modification to the trend-followers strategy, by transforming it into a 2nd order derivative of trend-following, that reaches a maximum position prior to 1st order trend strategy and exits the trade when the trend-follower is fully invested (long or short). This can be based on some chosen price levels that are 'inside' of the minimum and maximum Global CTA Positioning, and then take profits upon a trend strategy becoming fully invested (long or short), when Global CTA Positioning is near its maximum or minimum value. This 2nd order strategy is simple to test, and is still entirely price driven, with information that impacts the trading decisions being available to both the anticipatory trader and the CTA concurrently.
- We show the performance of this strategy in 'Results #2 CTA Pivot Levels' below.

## Results & Analysis of Strategies Applied to Global CTA Positioning

*Results #1 Trading the slope*

"Trading the slope" means that you assume that a trade is taking place by the anticipatory trader when there is a defined direction in the Global CTA positioning that they are assuming will continue.

**Figure 5: Performance of "Trading the slope"**



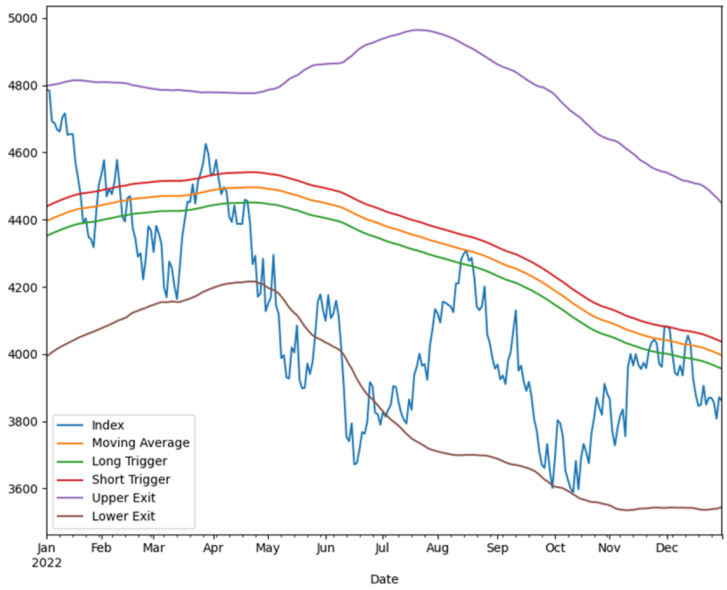

The irony in this approach is that you are doing the opposite of front-running – by jumping in after the trend follower and following their position. This does not seem to be a good approach to anticipatory trading, and we did not find any consistent profitability to using this approach. One aspect to this approach that was interesting was that it did perform quite well in the March 2020 COVID-19 selloff, and it is logical that this strategy could operate as a short-term risk management tool, however, it shares many similarities with simply using a shorter-term trend following strategy. We did not deem it necessary to run this strategy on additional markets. Further research into this strategy as a short-term risk management tool may be warranted but is beyond the scope of this paper.

*Results #2 CTA Pivot Levels*

To test the Pivot level approach, we need to define a pivot level as a signal to go long or short the market at a specific price, in anticipation of the market reaching said price and triggering CTA order flow to push the market further in the previously expressed trading direction.

To describe the logic of the trading strategy, **Figure 6** is a logical starting point:

**Figure 6: Visual display of trading "Trigger Levels" using a Bollinger Band and anticipatory "trigger levels" from the mean**




If we begin at the left of the graph, the Index (S&P 500 futures) is in a period of decline.

Intuitively, if the anticipatory trader wishes to get in before a perceived "trigger level", they will want to be short the market just before the market crosses a moving average from above since they believe that will trigger CTA capital to push the index further down in their desired direction.

The line above the moving average is hence a "short trigger".

1. The Index is the daily closing price of the S&P 500 first nearest futures contract.
2. The Moving Average is the 200-day moving average of the Index.
3. The Short Trigger is located 1% above the moving average as a trigger for the anticipatory trader to begin shorting the market – if the index crosses this line from above.
4. The Long Trigger is located 1% below the moving average as a trigger for the anticipatory trader to begin going long the market – if the index crosses this line from below.

After defining the lines in the chart above, we note that in a period in which the Short Trigger is crossed from above, and the anticipatory trader is now short the market, the same line will also act as a stop loss while they are short.

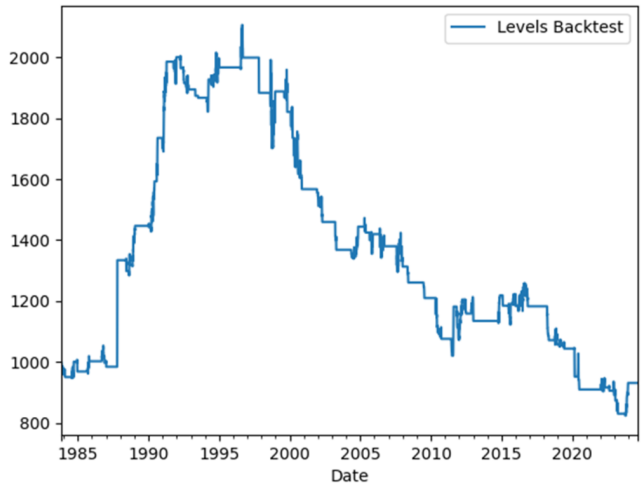
This means that if the market begins climbing after the short position is entered, the position is exited if it doubles back and crosses the same line from below.

The same is true for the Long Trigger line but in the opposite direction:

5. The Lower Exit is the 2 standard deviation line below the mean, at this point all the CTAs are perceived to have finished selling the market and are at their maximum short position, so the anticipatory trader is flat.
6. The Upper Exit is the 2 standard deviation line above the mean, at this point all the CTAs are perceived to have finished buying and are at their maximum long position, so the anticipatory trader is flat.

Below is the result of trading this strategy (**Figure 7**):

**Figure 7: Performance of trading the "Trigger Levels"**




This strategy performed very well in the 'Black Monday' 1987 crash, and this is intuitive, given that the strategy profits from sudden excursions from the long-term moving average. The positive and negative performing periods in the results above do not appear to correlate to trend-following CTA assets under management, otherwise we would expect to see a significant performance boost in the period since 2008. While this strategy has some interesting characteristics that may warrant further research, there is no indication that this strategy is capable of profiting from the anticipation of trend-following CTA order flows.

We feel it is important to note that the 'Pivot Levels' that resulted from the testing of this strategy did, indeed, look very similar to data we were able to source from sell-side research firms, such as Nomura, that purported to offer insights into key levels around which trend-following CTAs are anticipated to place the bulk of their orders.

Further research into this 'Pivot Level' strategy as a short-term risk management tool may be warranted but is beyond the scope of this paper. Certainly, the performance in the Black Monday crash would be evidence to that effect. However, the strategy did not perform well during the 2008 Global Financial Crisis, nor the COVID-19 pandemic, while trend-following CTAs performed exceptionally well in both those events.

## Alternative Methods for Analyzing CTA Positioning

In addition to the trend-following replication strategies we tested, several other methods could theoretically be used to predict or trade off CTA positioning. However, after careful consideration, we chose not to pursue these methods for backtesting, given their expected outcomes and the practical challenges involved. Below, we summarize these approaches and explain why they were excluded from our study:

### 1. Volume Spike Reactions

- Summary: This strategy relies on identifying volume spikes as potential signals of large CTA trades. By anticipating these trades, a trader might attempt to enter or exit positions just ahead of the CTA activity. Volume spikes could theoretically indicate large players, including CTAs, entering or exiting trades.
- Expected Outcome: Volume spikes are often triggered by many different market participants, not just CTAs. High-frequency traders, institutional desks, and retail participants also contribute to significant volume changes. Additionally, most CTAs gradually adjust their positions, limiting the potential for large, sudden volume surges that can be exploited. Therefore, any predictive edge from this method would likely be inconsistent, diluted by noise from other market players.
- Reason for Exclusion: Due to the widespread involvement of various market participants in creating volume spikes, isolating CTA-driven activity would be highly unreliable. As a result, the expected outcome is poor consistency and predictability, making it an unsuitable method for backtesting.

### 2. Commitment of Traders (CoT) Report Analysis

- Summary: The CoT report, published weekly by the CFTC[6], aggregates position data from large traders, including managed money, which often represents CTAs. By analyzing the shifts in these positions, traders could attempt to anticipate future CTA movements.
- Expected Outcome: The CoT report is delayed and aggregates data from various types of market participants, not just CTAs. Moreover, CTAs generally follow long-term trend strategies, so significant changes in positioning may have already been reflected in market prices by the time the report is released. Any insights gained from CoT data would therefore be lagging and less actionable.
- Reason for Exclusion: The lag in the data, combined with its aggregate nature, makes it difficult to derive timely or actionable trading signals from the CoT report. As a result, this method was deemed impractical for real-time trading or prediction of CTA movements and was excluded from our backtests.

**3. Volatility-Based Positioning**

- Summary: This method involves monitoring changes in market volatility as a proxy for potential CTA risk adjustments. As volatility rises, CTAs may reduce their exposure to maintain consistent risk targets. By tracking volatility shifts, a trader could attempt to anticipate CTA positioning changes.
- Expected Outcome: While volatility changes do prompt CTAs to adjust their positions, these adjustments are often gradual and spread across various asset classes for trend-followers. Timing trades based on volatility changes would likely yield inconsistent results, as CTAs reduce risk incrementally rather than through sudden, large moves. Furthermore, volatility spikes can quickly reverse, making it difficult to maintain a reliable edge.
- Reason for Exclusion: The gradual and complex nature of CTA adjustments in response to volatility, combined with the difficulty of timing trades effectively, makes this method unsuitable for systematic back-testing using our methods and data. Further work on volatility-based positioning in the context of volatility trading (i.e. VIX strategies) is warranted, but we deem it not relevant to our study of anticipating trend-following CTAs.

**Conclusion on Alternative Method Selection**

Ultimately, while these alternative methods offer potential insights into CTA behavior, each has inherent limitations that reduce their suitability for consistent, profitable trading, or do not apply to our study methods. Given the expected outcomes, we chose to focus our testing on more direct strategies like trend-following replication, which are better aligned with the systematic nature of the industry data we collected for 'Global CTA Positioning'. By excluding these alternative methods from our backtesting, we ensured a more focused and realistic analysis of the potential for anticipating CTA trading activity.

## Discussion: The Reality of CTA Impact on Markets

The findings from our study challenge the idea that there is any non-HFT mechanism or systematic strategy that can, or which has ever profited from anticipating the order flows of trend-following CTAs, but this does not address the realities of the impact of CTA orders in the markets. Indeed, every single transaction, no matter how small, moves markets to some degree, so we wanted to consider to what extent CTAs might be responsible for changes in stock prices.

Even under extreme assumptions—where every CTA employed systematic trend-following strategies, maximized their leverage, and traded their entire global equity exposure in only Emini S&P Futures—our analysis below shows that CTA activity would still represent only a fraction of total market volume.

The CTA industry manages approximately $358 billion in AUM[1]. By assigning a very high estimate to institutional mandates that employ trend strategies but do not report as CTAs, we might assume $1 trillion AUM is invested in trend strategies. Assuming all this capital was leveraged 5x and concentrated solely in Emini S&P Futures, it would account for a significant portion of daily market volume on peak days, per our estimated changes in WF Global CTA Positioning. However, this is far from reality. First, CTAs try to allocate across dozens or hundreds of instruments, representing multiple asset classes, and second, we rarely see CTAs using that level of leverage in equities.

Goldman Sachs, from whom we extracted our original 'Global CTA Positioning', does not refer specifically to US equity markets but to the entire global equity market. Simple heuristics we could use to determine what percentage of CTA equity exposure goes into Emini S&P futures range from less than 5% on the low-end (if all CTAs apply roughly equal risk weighting across the most liquid equity futures contracts) to 20% on the high-end (if most CTAs deploy risk based on liquidity). Even if CTAs represented $5 trillion in leveraged exposures, we would expect no more than $1 trillion of that to be in equities (based on equal risk weight across typical sectors traded by CTAs, where interest-rate futures are typically afforded the most leverage). By imputing a top decile change in our Global CTA Positioning signal and assuming 20% of CTA exposure goes into Emini S&Ps, we estimate this would account for 2.5% of daily volume on a big trading day for CTAs, or 1% of daily volume on an average day.

If we compare these simple heuristic estimates of CTA order volumes to actual holdings data from a large trend-following CTA, we can take a top-down approach to confirm our numbers. We looked at the AQR Managed Futures Strategy Fund[4] during a period when its equity exposure should have been near its maximum according to Goldman Sachs' 'Global CTA Positioning' data (at the end of 2024Q1). We found that it held $1.5 billion in AUM and was long 80 contracts of Emini S&P futures, with a notional value of $21 million.
Extrapolating from this data to the Emini exposure of the entire CTA industry as of 2024Q1 gives us only $3.1 billion in Emini exposure for reportable assets. Per our prior high-end estimates for non-reportable assets, this figure rises to $8.75 billion. These numbers are far smaller than the results of our simple heuristics. Indeed, if all CTAs were identical to AQR, then a top decile change in 'Global CTA Positioning' would represent only 0.19% of daily volume in Emini S&P Futures. We expect that the reality lies somewhere between these extremes, and that a large trading day for trend-following strategies in Emini S&P Futures represents perhaps 2% of daily volume. This is consistent with extrapolating from WaveFront's own trading model and estimating the impact of $1 trillion in AUM on Emini S&P Futures during a large trading day for our strategy.

## Conclusion & Recommendations

Our research demonstrates that the belief that CTA trend-following strategies can be correctly anticipated to generate consistent profits in equity markets is largely unfounded. Several methods we explored for estimating the size of CTA order volumes suggested that CTAs are not capable of causing large swings in equity markets. When we applied anticipatory trading strategies to our own WF Global CTA Positioning signal, we were unable to generate consistent profits. We were particularly surprised by the notion that there could be CTA 'pivot levels' or 'trigger levels' that, when reached, would result in specific price action in the markets due to CTA order volumes. Nothing in our analysis suggests that CTA pivot/trigger levels exist, nor does our firsthand knowledge of how CTAs operate their trading models hint at the possibility of such levels.

Regarding front-running CTA order flows, we feel compelled to borrow a line from Adam Savage and Jamie Hyneman[5]:

"This myth is busted."

At WaveFront, our systematic trend-following models are designed to adapt to the complexities of market dynamics, employing more sophisticated multi-factor approaches rather than relying on simplified assumptions. Our rigorous research and partnerships with experts, such as Dr. Adam Kolkiewicz, ensure that our strategies are robust across varying market conditions.

## Notes on futures versions of this paper

We are actively pursuing improvements to this paper and working towards a future version which may be submitted for publication in various research journals. Many of our methods, model assumptions, and formulas are not being published currently. If you would like to discuss this paper with us prior to publication, please contact *Amirali Ijad* at (647) 374-5388.

## References

1. BarclayHedge. (2024). **Managed Futures Industry Asset Under Management (AUM)**. Retrieved from https://www.barclayhedge.com

2. Goldman Sachs. (2019-2024). **Global CTA Positioning Reports**. Extracted data and analysis provided for internal use at WaveFront Global Asset Management.

3. Nomura. (2010-2023). **Net CTA EQUITY Only Estimated Exposure Reports**. Institutional data available through Nomura Group's internal subscription services.

4. AQR Capital Management. (2024). **AQR Managed Futures Strategy Fund Holdings Data**. Retrieved from https://www.aqr.com/strategy/managed-futures-strategy-fund

5. Savage, A., & Hyneman, J. (2003-2016). **MythBusters**. Discovery Channel.

6. CFTC. (n.d.). **Commitment of Traders (CoT) Reports**. U.S. Commodity Futures Trading Commission. Retrieved from https://www.cftc.gov/MarketReports/CommitmentsofTraders/index.htm

7. WaveFront Global Asset Management. (2024). **Internal Research on Anticipatory Trading and CTA Positioning**. Proprietary data and research conducted by WaveFront Global Asset Management.

8. https://www.bloomberg.com/news/articles/2024-08-15/quant-funds-are-poised-to-unleash-a-wave-of-cash-in-stock-market

9. https://www.bloomberg.com/news/articles/2024-08-05/volatility-rocked-quants-threaten-new-170-billion-selling-spree

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## About WaveFront GAM

WaveFront Global Asset Management Corp. is a privately-owned global asset management company based in Toronto, Canada. WaveFront's highly experienced team of investment professionals, bolstered by research relationships with faculty at the University of Waterloo and Princeton University, help us seek to deliver consistent and stable returns through various market and economic conditions.

Learn more at www.wavefrontgam.com