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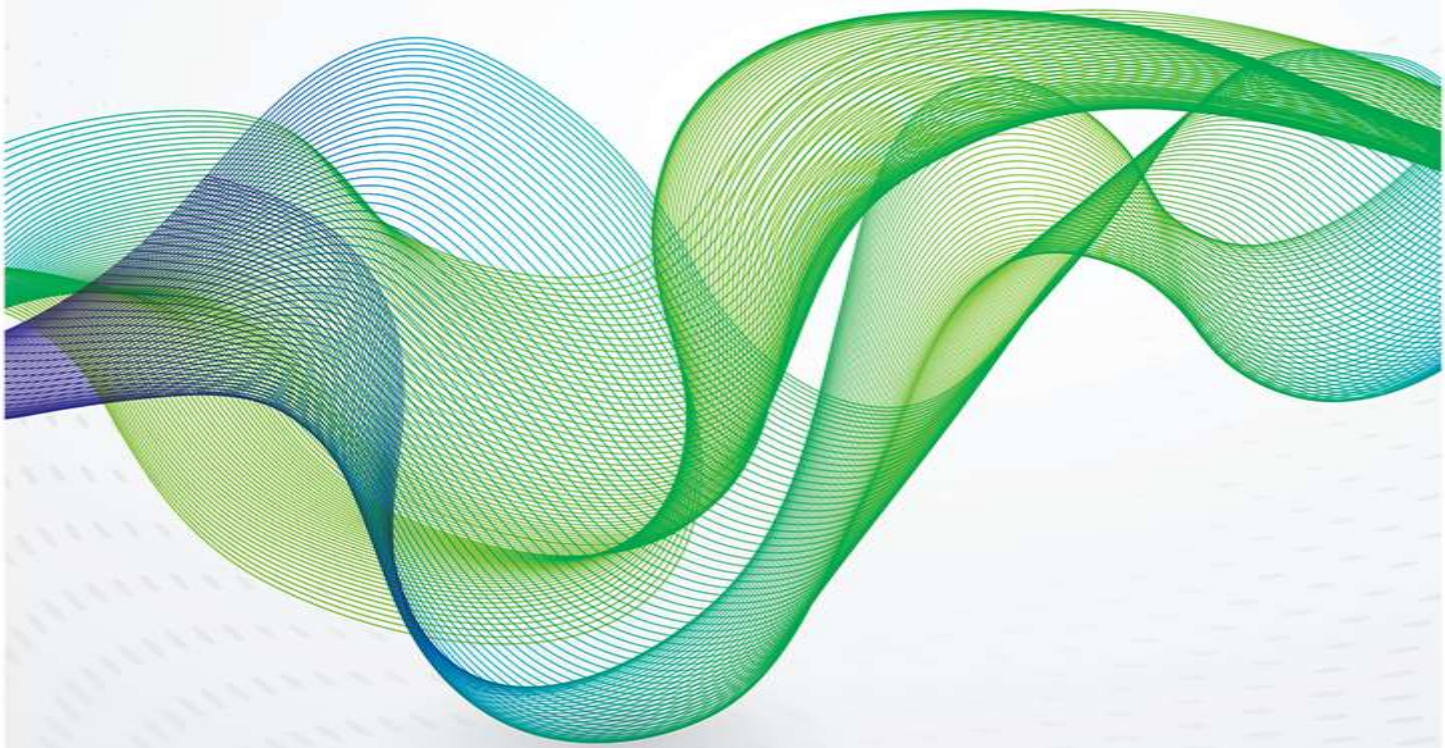
Energy Quantamentals: Who is Who in Financial Barrels?



OIES ENERGY COMMENT

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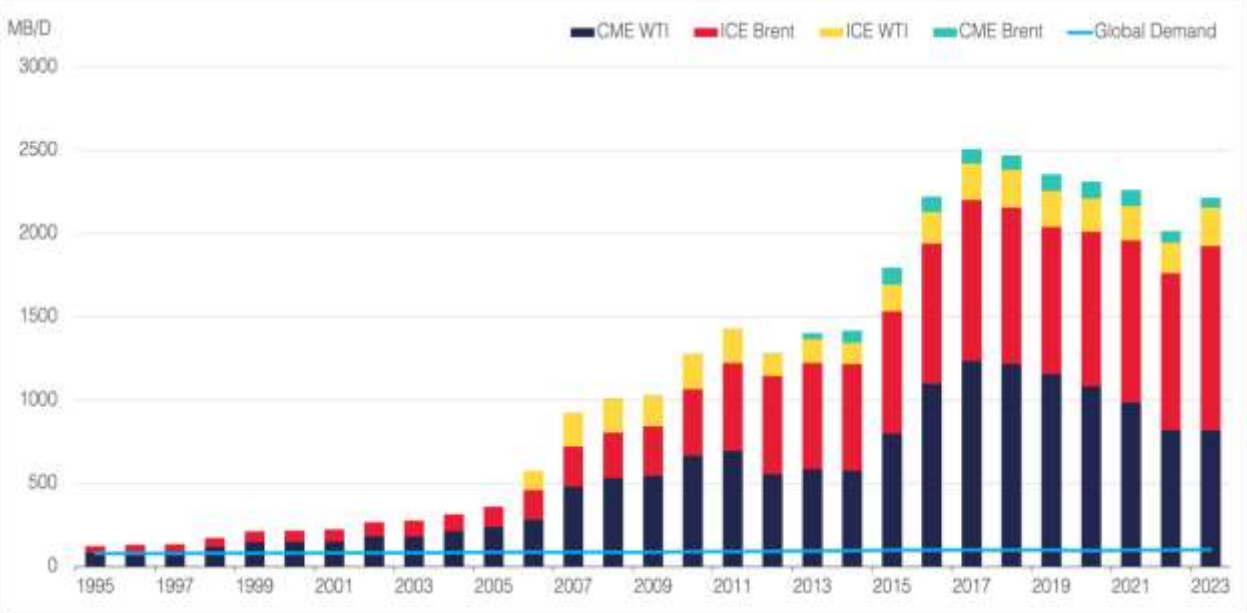
Introduction to Financial Barrels

For many years, the primary focus of oil market analysis has been on estimating the production and consumption of oil and forecasting their short-term evolution, as even subtle imbalances between supply and demand were widely perceived to determine the direction of oil prices. The focus, however, started to widen over the course of the last decade as new financial market participants entered the oil market. To model their behavior, an additional type of analysis has become essential: the analysis of supply and demand for financial barrels which are traded in the derivatives market.

To put things into perspective, the world currently consumes approximately one hundred million barrels of crude oil per day. In comparison, the daily trading volume of petroleum futures, options, and over-the-counter derivatives now exceeds five billion barrels per day. Figure 1 shows that WTI and Brent futures alone trade approximately 20-25 times more than the amount of global daily oil consumption.

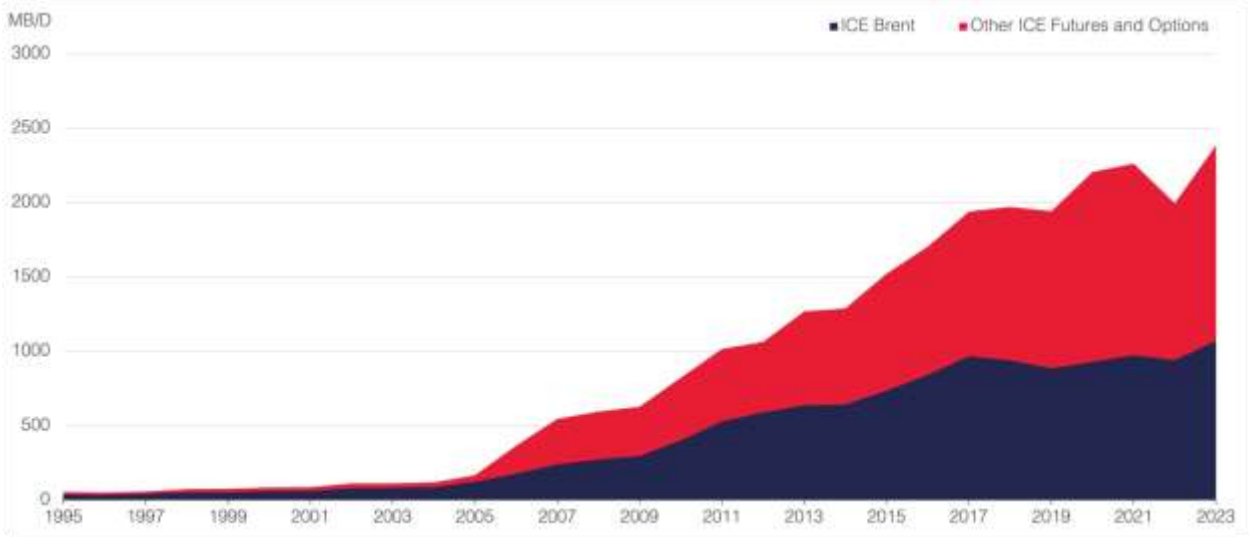
Figure 1: Daily WTI and Brent futures volumes vs global oil consumption



Source: CME, ICE, U.S. EIA. MB/D: Million barrels per day.

Furthermore, the combined trading volume of futures traded on other exchanges, such as Shanghai International Energy Exchange (INE), futures on other types of oil, such as Dubai and Murban, futures on refined products, such as gasoline and diesel, options, and over-the-counter derivatives is equally large. While we fully acknowledge that a direct comparison of physical consumption to daily trading volumes in derivatives markets should be taken with a grain of salt, it nevertheless highlights the growing importance of financial barrels in the oil market. After two decades of an unprecedented growth, the primary oil derivatives markets matured and over the last few years financial volumes of main WTI and Brent futures have largely stabilized. At the same time, the new energy markets, such as WTI futures contracts in Midland and Houston, and especially the market for Brent options continues to grow. In fact, the aggregate volume of all petroleum futures and options traded on ICE reached a new record high in 2023 (see Figure 2).

Figure 2: ICE average daily trading volumes



Source: ICE

The rapid growth in oil derivatives has been mostly driven by proliferation of quantitative and algorithmic trading which now makes up to 70% of the daily trading volume in futures market.[1] While the volumes of financial barrels are already very large relative to physical barrels, the oil derivative market pales in comparison to other financial markets, such as equities, foreign exchange and interest rates, which are also dominated by quantitative traders. As a relative newcomer to the world of quantitative trading, oil derivatives market still retains a significant growth potential. This growth could occur regardless of the pace of the energy transition for physical barrels. In fact, if the pace of the energy transition accelerates and the consumption of petroleum products starts declining, the relative importance of algo-driven financial barrels could further increase.

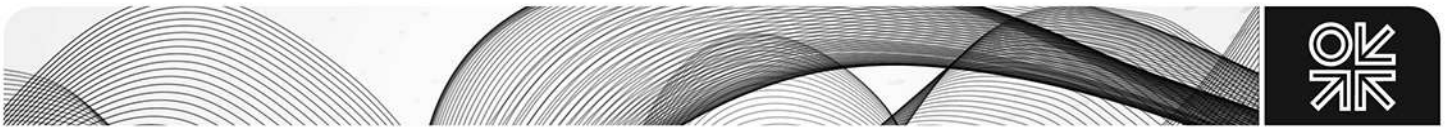
To better understand the behavior of non-fundamental oil traders, this paper launches a series of articles devoted to the analysis of financial barrels. Given the growing role of technology and quantitative trading in the oil market, these barrels evolved into "*virtual barrels*", as described in the author's recently released book on this topic.[2] In this series, we aim to further advance the understanding of this subject and illustrate applications of more technical concepts presented in the book to current market conditions.

The Invisible Hand of an Oil Speculator

Oil speculation has existed since the very first day when oil started to trade. Defining and detecting speculation and understanding the role of financial players in oil markets, however, have always been a difficult task and subject to heated debate. The last serious investigation of the role of speculators in the oil price formation was conducted in the aftermath of the 2008 global financial crisis when the price of WTI first exceeded $145 per barrel in July 2008 and then rapidly fell below $35 per barrel in a matter of several months. The sharp movements in oil prices could not be fully explained by using fundamental data alone. While the invisible hand of speculators was clearly present, proving it empirically has been difficult and oil experts have largely disagreed on the impact and the mechanisms through which speculators could impact

[1] D. K. Kumar and J. Fanzeres (2023), "Oil's wild rise is driven by a disruptive band of oil traders", Bloomberg, November 30. https://www.bloomberg.com/news/features/2023-12-01/oil-prices-face-wild-swings-with-bot-traders-driving-the-market?sref=TBiwIc5E

[2] See I. Bouchouev (2023), "Virtual Barrels", https://link.springer.com/book/10.1007/978-3-031-36151-7.



oil prices.[3] Some blamed long-only commodity index investors for pushing the price higher citing mostly anecdotal information obtained directly from market participants. Others rejected this hypothesis due to the lack of empirical support. The statistical analysis was also heavily constrained by the lack of relevant data, which made drawing any robust and definitive conclusions next to impossible.[4]

There is limited value in resurrecting this debate, as oil trading has dramatically changed over the last decade. Whatever happened then has almost no relevance to the market today. In fact, financial volumes have more than doubled since 2008-2009, driven predominantly by quantitative algorithms. These algorithms trade on much higher frequencies, which was not covered in prior studies. Large long-only institutional investors have also learnt their lesson. Their strategy of buying and rolling oil futures during the so-called period of "normal contango", typically defined between 2005 and 2018, would have lost on average more than 10% per year, almost entirely driven by the negative return resulting from rolling futures contracts (rolling from a lower priced to a higher priced futures contract).[5] Perhaps, the most striking example of such a catastrophic investment is the long-term track record of the largest oil ETF, the United States Oil (USO) Fund, which cumulatively lost 85% since its inception in 2007.[6] Despite such horrendous losses, financial investors did not abandon the oil market. Instead, they changed their strategy and have now become more nimble and dynamic.

It is always good to remember that trading futures represents a zero-sum game. If one trader is losing 10% by buying and rolling futures then another trader is making 10% by taking the other side of the trade. A third trader might be able to do even better, if the direction of the bet is somehow dynamically switched between a long and a short in a particularly 'smart' way. Not surprisingly, many sell-side banks and quantitative hedge funds, which collectively became known as CTAs (Commodity Trade Advisors), claimed to have discovered such 'smart' ways of switching between long and short positions based on certain quantitative models. We will discuss in a much greater detail in the following papers how true this claim is and to what extent it was a marketing gimmick. For now, it suffices to say that such claims were intriguing enough to sway pension funds and large institutional investors from switching from long-only oil allocations towards more dynamic long-short model-driven trading strategies.[7]

The Gordian Knot of Oil Positioning

The primary data sets used for understanding financial flows into oil derivatives are the Commitments of Traders (CoT) reports published weekly by CFTC and ICE for commodities listed, respectively, on U.S. and European futures exchanges. These reports originated in the 1920s for agricultural markets with the objective to segregate positions held by commercial (CM) and non-commercial (NC) market participants. The reports were subsequently extended to other commodities, including crude oil and oil products. For oil markets, distinguishing between CM and NC traders is easier said than done because of the existence of a large over-the-counter (OTC) market for energy derivatives. For many other commodities, OTC markets

[3] B. Fattouh, L. Kilian, and L. Mahadeva (2013), "The role of speculation in oil markets: What have we learned so far?", The Energy Journal, 34(3), pp. 7-33.

[4] The literature on commodity speculation during the early days of financialization is very broad, but among many others, we would like to highlight different opinions presented by M. Masters (2008), Testimony before the Committee on Homeland Security and Government Affairs, May 20; J. Hamilton (2009), "Causes and Consequences of the Oil Shock of 2007-2008", Brookings Papers on Economic Activity, 40(1), pp. 215-283; B. Fattouh, L. Kilian, and L. Mahadeva (2013), "The role of speculation in oil markets: What have we learned so far?", The Energy Journal, 34(3), pp. 7-33; L. Kilian and D. Murphy (2014), "The role of inventories and speculative trading in the global market for crude oil", Journal of Applied Econometrics, 29 (3), pp. 454-478; and C. Knittel and R. Pindyck (2016), "The simple economics of commodity price speculation", American Economic Journal: Macroeconomics, 8(2), pp. 85-110.

[5] I. Bouchouev (2023), "Virtual Barrels", pp. 75-78.

[6] See https://www.uscfinvestments.com/uso, accessed January 9, 2024.

[7] One of the drivers that attracted early financial investors to the oil market was their desire to use oil as a hedge against inflation, the investment thesis often associated with risk parity funds, colloquially referred to as "inflationistas." The concepts behind risk parity funds will be discussed later in the series. For now we only use the term to differentiate between long-only inflation hedgers and long-short dynamic CTAs which do not carry any explicit inflation hedging mandates.

either do not exist or they are heavily restricted by regulations which makes categorization of futures traders more intuitive. For example, in the agricultural markets, farmers are generally designated as CMs and financial speculators as NCs. In the oil market, however, such designations are much more cumbersome.[8]

In an attempt to bring additional transparency to financial flows in commodity futures, the regulatory reports were restructured to provide a more granular categorization of the main categories of market participants.[9] All futures traders carrying positions in excess of a certain minimum threshold are now split into four categories:

- Managed Money (MMs)
- Producers, Merchants, Processors, and Users (PMPUs)
- Swap Dealers (SDs)
- Other Reportables (OTHs)

Unfortunately, for the oil market these so-called disaggregated reports have not provided the desired detail and clarity. While MM category does include many traditional speculators such as registered hedge funds, it does not provide a complete picture. If a financial investor, such as a pension fund, invests in a risk parity strategy or in a long-short OTC investment product offered by the bank, then the futures are held effectively on behalf of such investors by SDs, the category that includes most banks and OTC market-makers. Furthermore, only MMs that are required to register with regulators are being reported in this bucket. For example, futures held by sovereign wealth funds and large non-US institutional investors in offshore entities could bypass registration requirements. Instead, these traders are reported under OTH. As discussed below, OTH category can also be as large as MM even though it is often mistakenly ignored by many analysts. It should also be noted that the sum of MM and OTH corresponds to the NC category in old legacy reports, and for many practical reasons it is often convenient to combine the two sub-groups and use NC as an aggregate proxy for hedge fund positioning.

The puzzle gets even harder when it comes to CM market participants. Given its name, one would naturally expect PMPU to capture futures held by producers and consumers. While this is indeed the case for many commodities that do not have large OTC markets, this term became a misnomer in the oil market. Very few producers and consumers of crude oil and refined products trade futures directly on organized exchanges, as doing so would expose them to substantial collateral requirements. Many oil producers, especially small ones, simply cannot afford posting any collateral besides their oil reserves, as their derivatives are often hedges against the expected production which is yet to come at some time in the future. To avoid the need to tie valuable cash in the form of exchange margins, producers and consumers instead trade OTC with SDs who effectively hold futures position on behalf of end-users. In addition to futures held for producers and consumers, SDs are also holding some futures for the subset of financial investors who opted to execute their investment strategies via OTC products offered by their banks. In other words, the universe of financial investors is split between those holding futures directly as MM or OTH and other group of investors whose trades are intermediated by SDs. This makes it very difficult to track investors' participation in the market.

Finally, even though PMPU category includes only very few actual producers, positions held by this group of traders are nevertheless very large. As discussed below, PMPU is arguably the largest category of market participants, a fact that may surprise many. The largest group of PMPU traders are hedgers of oil

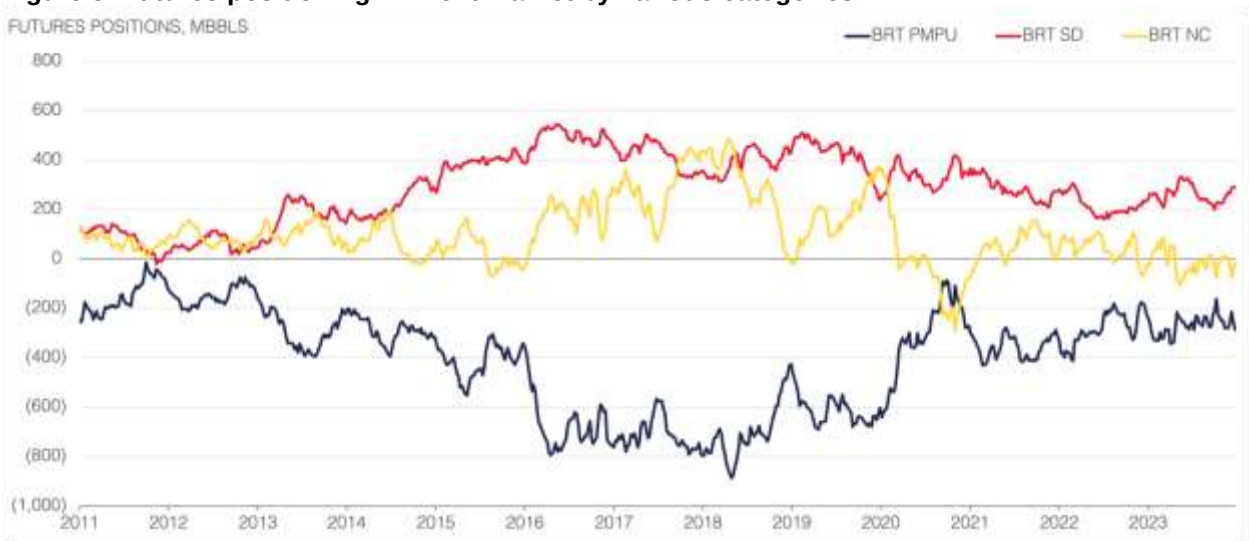
[8] This section borrows from I. Bouchouev (2023), "Virtual Barrels", pp. 128-134, which also describes systematic trading signals that use positioning indicators.

[9] More granular reports were introduced by CFTC in 2006, followed by ICE adopting the same methodology in 2011. The reports are available at https://www.cftc.gov/MarketReports/CommitmentsofTraders/index.htm
and https://www.ice.com/report/122

inventories, but they also happen to be among the largest speculators in the physical market. While net futures holdings by these highly sophisticated physical traders tend to be short given the nature of the inventory-hedging business, their positions are very dynamic, as the same trading desks often manage the inventory exposure and simultaneously run large speculative books.

While disentangling such a Gordian Knot of oil positioning may appear to be an unsurmountable task, it is still possible to make some important structural observations about participants in the Brent and WTI markets.[10] Figure 3 shows that the largest shorts in the Brent futures market are indeed PMPUs. This makes sense as practically every physical barrel in transit is hedged by selling futures, and most of physical barrels globally are priced off the waterborne Brent futures contract. The opposite side of these short positions is taken by SDs whose OTC market-making books in Europe and Asia are net long futures as they are dominated by consumer hedges, among which the airline industry contributes the most. Somewhat surprisingly, the combined position of Brent MM and OTH, shown here as NC, is rather modest, even though it is highly volatile.

Figure 3: Futures positioning in Brent market by various categories



Source: ICE. MBBLS: Million Barrels.

The market structure is different for WTI futures, as can be seen from Figure 4. Here, the largest shorts are represented by SDs. Their market-making books are dominated by futures hedges held against OTC deals with independent US and Canadian producers. Many of these producers are highly leveraged and their hedging is often required by their banks to approve lending. This is in contrast to many sovereign-controlled Brent-based producers who do not actively participate in the derivatives market. The largest structural longs in the WTI market are NCs. This group includes not only positions held by CTAs and risk parity funds but also futures hedges held against large WTI-based oil ETFs, such as the USO Fund. Similar to Brent, PMPU positions for WTI tend to be net short as they are dominated by inventory hedgers. However, the amount of inland WTI-based inventory hedging is much smaller, and inventory shorts are often offset by the long leg of WTI-Brent spread trades which is used to hedge the economics of U.S. export arbitrage.

[10] For simplicity, we only use holdings of Brent futures traded on ICE, and WTI futures traded on CME.

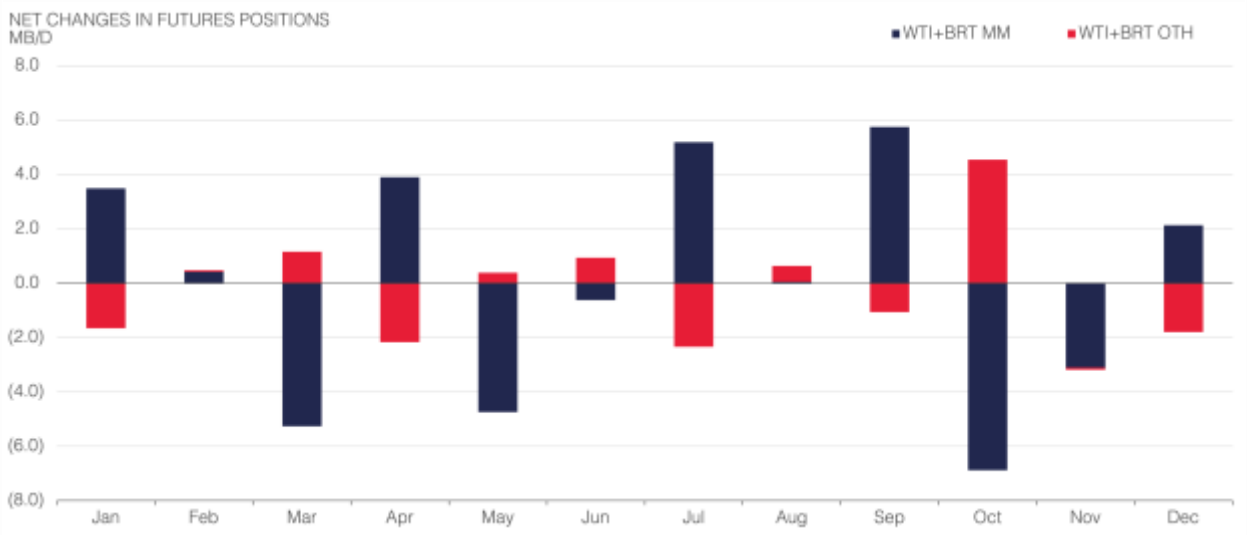
Figure 4: Futures positioning in WTI market by various categories

Source: CFTC

The Year in Review: Financial S&D in 2023

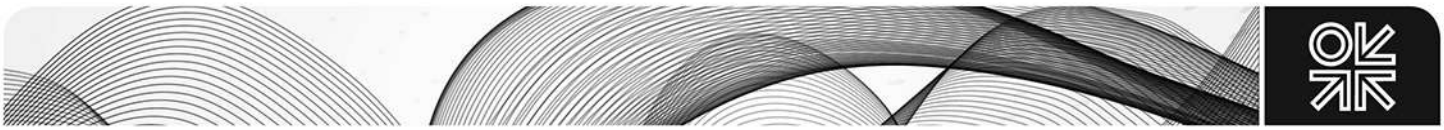
Having discussed the intricacies of the various categories, we highlight the importance of their contribution during the past year. To translate positions held by speculators, such as MM and OTH, into the language commonly used by fundamental analysts, we calculate monthly changes in their holdings and convert them into barrels per day. We use this metric to mimic the standard output of the fundamental analysis but apply it instead to measure supply and demand in financial barrels (see Figure 5).

Figure 5: Supply and demand of financial barrels in 2023



Source: Pentathlon Investments, CFTC, ICE

The most striking observation is the large magnitude of monthly fluctuations in financial supply & demand (S&D) as compared to imbalances in the physical market. For example, MMs, which are dominated by momentum-driven algorithmic hedge funds, sold 7 million of financial barrels per day in October and another 3 million per day in November, effectively contributing to, if not causing, the decline in prices during that



period. Such an aggressive selling was only partially offset by OTH, which during that time, represented retail and macro investors seeking to capitalize on OPEC's decision to cut production and tighter market fundamentals. Nevertheless, selling by systematic hedge funds more than offset the impact of OPEC+'s cuts and tighter market fundamentals on prices with Brent falling from the mid $90/barrel in October 2023 to the mid $70/barrel by the end of last year.

A key issue is what drives these large fluctuations in the financial S&D balances, and what might have triggered hedge funds decision to sell during that episode. They were clearly looking at some factors which were not well understood by fundamental traders. While the behavior of quantitative of hedge funds has traditionally been explained by simple trend following algorithms, their strategies evolved and became much more sophisticated. The next article will take a deeper look at how systematic hedge funds make their decisions.