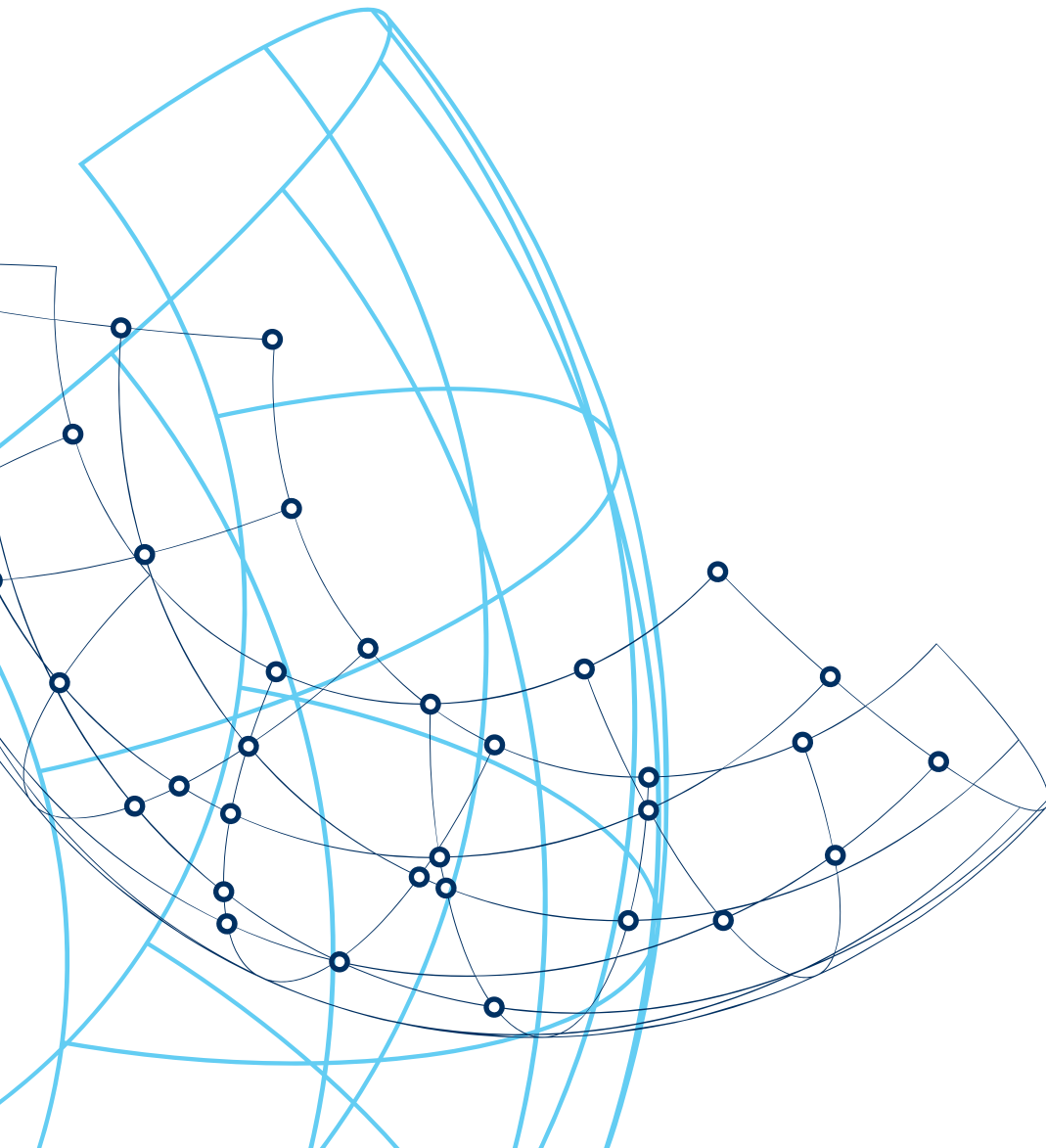


# Market Reactions to COVID-19

*A review of Q1 2020 as seen in the CME  
Market Sentiment Meter*



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## Abstract

The COVID-19 pandemic had a notable effect on the eight futures and options products tracked by 1QBit's CME Market Sentiment Meter. In some markets, such as U.S. equity index futures and U.S. interest rate futures, there were rapid increases in daily futures volumes as prices changed, and traders managed their evolving risk. The peaks in daily volume were followed by diminishments that varied from market to market, as well as changes in the volumes and positions observed in the corresponding options markets. The CME Market Sentiment Meter reported transitions from the Balanced state to the Anxious state in all products except soybeans and natural gas. The Anxious state is associated with an expectation of larger price movements, which were observed in the markets. In addition, it was seen that forward-looking activity moved from futures to options at a different rate for each product, and that market sentiments took time to become established.

**Keywords:** Market Sentiment Meter, Computational Finance, COVID-19, Coronavirus

## 1 Introduction

The central premise of 1QBit's CME Market Sentiment Meter (MSM) is that options prices and volumes reflect the aggregate sentiments of traders. In the first quarter of 2020, the MSM indicated a shift from the Balanced market state to the Anxious market state in all of its tracked products, except for soybeans and natural gas. There are four possible MSM market states: Complacent, Balanced, Anxious, and Conflicted. A description of the states and their interpretation is given in the Appendix A.

The MSM is computed daily for the following products, which are traded on the four Designated Contract Markets of the CME Group (NYMEX, COMEX, CBOT and CME):

- CBOT Corn futures (C<sup>1</sup>) and options
- NYMEX WTI Crude Oil futures (CL) and options
- CME Euro/USD FX futures (EC) and options
- CME S&P 500® Index E-Mini futures (ES) and options
- COMEX Gold futures (GC) and options
- NYMEX Henry Hub Natural Gas futures (NG) and options
- CBOT Soybean futures (S) and options
- CBOT 10-Year Treasury Note futures (TYF) and options

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<sup>1</sup>The CME DataMine product codes are used in this work. See Appendix B.

In the first quarter of 2020, all products tracked by the MSM were affected by the spread of COVID-19. Every day, it seemed, there was news of infection spreading to new locations, and of countermeasures being taken by governments [1]. Many of these countermeasures involved lockdowns, in which people were asked – and later ordered – to stay home. Large events were canceled. Travel was cut back. Businesses were closed. Workers were laid off. Households stocked up on food and other necessities. Governments began to spend more on medical supplies and public assistance in general.

Broadly speaking, as news came to the different futures markets, traders initially responded by adjusting their positions in the futures contracts themselves. Figure 1 shows the prices and daily volumes for all eight MSM products for the last quarter of 2019 and the first quarter of 2020. The volume in ten-year treasury note futures, for example, rose sharply to nearly five times its value at the start of the year. Yet within six weeks this increase had largely subsided. The traders went back to managing their risk with options, but at prices which implied that further moves were likely. The sentiment state in most markets went to Anxious and stayed there through to the end of the quarter.

This, however, is to paint the picture with a broad brush. There are differences between each market, and in looking at the COVID-19 timeline, important subtleties begin to emerge. There was also a weekend (February 29<sup>th</sup> to March 1<sup>st</sup> 2020) when most of the MSM-tracked markets moved gently in unison, and after which their price movements became perceptibly larger. This makes March 1<sup>st</sup> a convenient point of reference.

## 2 The Beginnings of COVID-19

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The year began with several political events that had impact on world markets. One example was the assassination of Qasem Soleimani – an Iranian major general in the Islamic Revolutionary Guard Corps – by means of a U.S. drone strike [2]. There were also events from past years which continued to resonate, such as the UK parliament voting to pass the Withdrawal Agreement Bill [3], which authorized the country’s departure from the European Union at the end of January.

All these, however, were soon overshadowed by COVID-19 and its rapid proliferation throughout the world.

Based on what we know at the time of writing [1], the first report of COVID-19 symptoms was made on December 8<sup>th</sup>, 2019 in Wuhan, China. It was not until January 8<sup>th</sup> 2020, however, that scientists in China reported the discovery of the novel coronavirus 2019-nCoV. The first death in China from 2019-nCoV was reported shortly afterward on January 9<sup>th</sup>.

The first case of 2019-nCoV outside of China was reported on January 13<sup>th</sup> 2020 in Thailand. The first case in the United States was reported on January 20<sup>th</sup> 2020.

There is a difference between news being reported and news having an effect. There have been other infectious diseases in recent history, such as the Severe Acute Respiratory Syndrome (SARS) in 2003, the Middle East Respiratory Syndrome (MERS) in 2012-2014, and Ebola, present for some time but with a recent outbreak in 2014. All were serious, but ultimately had little economic effect [4]. News about the coronavirus was inevitably seen against this backdrop of past events.

By January 23<sup>rd</sup> 2020, China had blocked travel in and out of Wuhan. By January 30<sup>th</sup>, the World Health Organization (WHO) had declared that the disease represented a “Public Health Emergency of International Concern”, and had given it its name (COVID-19). On January 31<sup>st</sup>, the United States Executive Branch announced a partial ban on travel between the United States and China. Evidently, this was different from what had occurred in past outbreaks.

We should note here that the products tracked by the CME Market Sentiment Meter are U.S. commodities traded on U.S. exchanges. However, in 2019 – the latest year for which we have statistics – roughly one out of every four CME Group trades was from a customer outside the United States. The percentage of international business done at the CME Group increases every year [5]. Equity index futures and treasury note futures in particular have grown rapidly.

International trading creates a feedback loop. Price discovery in U.S. regulated markets is visible to every trader in the world, but not every trader is awake and working at the same time. Approximately one third of the gold trading on COMEX takes place electronically during “Asia hours” [6]. An increased demand for gold futures in Asia will show up in U.S. prices. The action taking place in “U.S hours” will be seen later (and reacted to) by Asian traders. Each product has its own forms of feedback, and these affect the rates at which information flows from one part of the world to another.

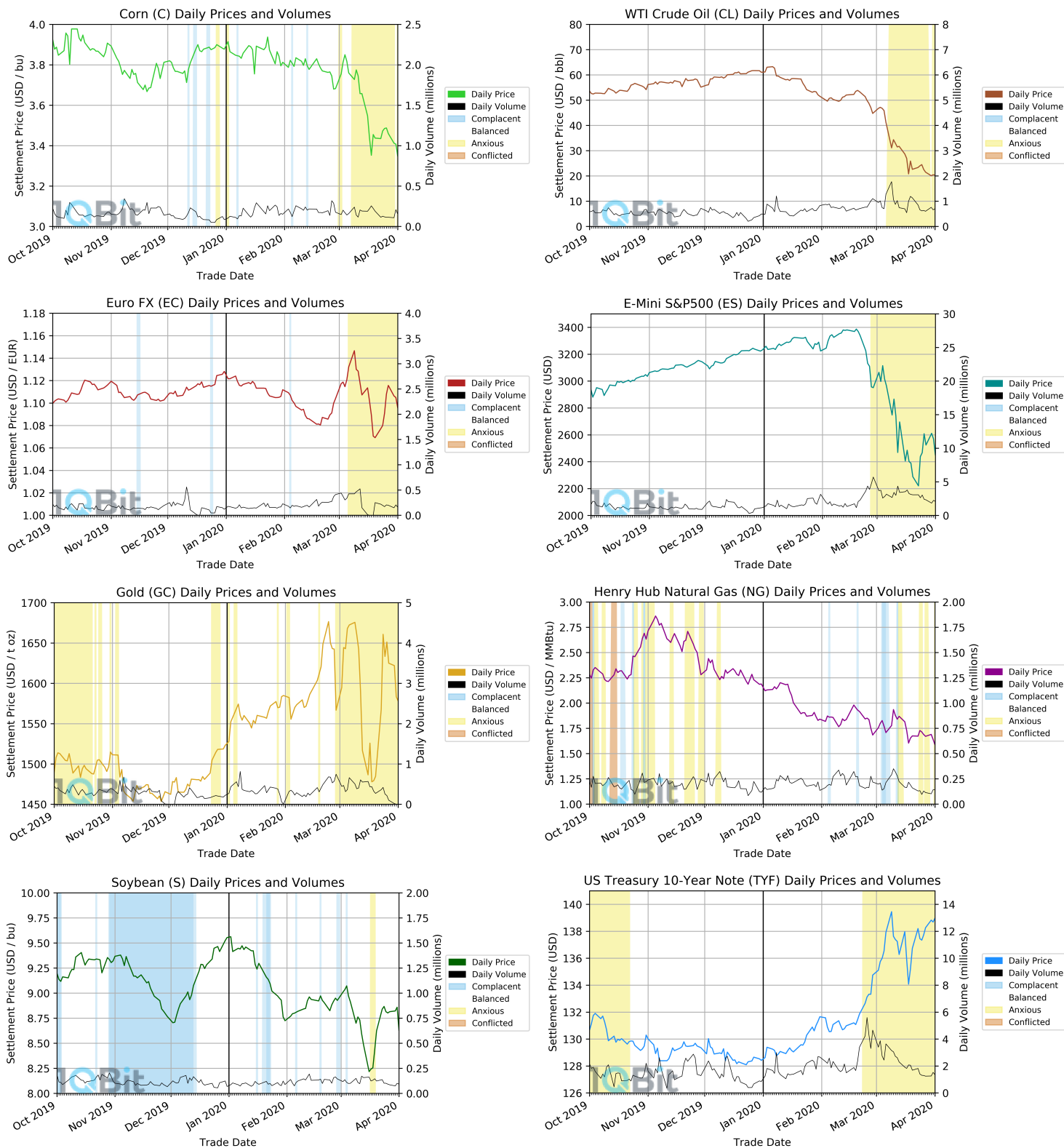


Figure 1: **Settlement Prices and Volumes.** Plotted are the settlement prices and volumes for the futures products (most active expiry) tracked by the MSM. Regions where the MSM is Complacent (Blue), Balanced (White), Anxious (Yellow), and Conflicted (Red) are highlighted.

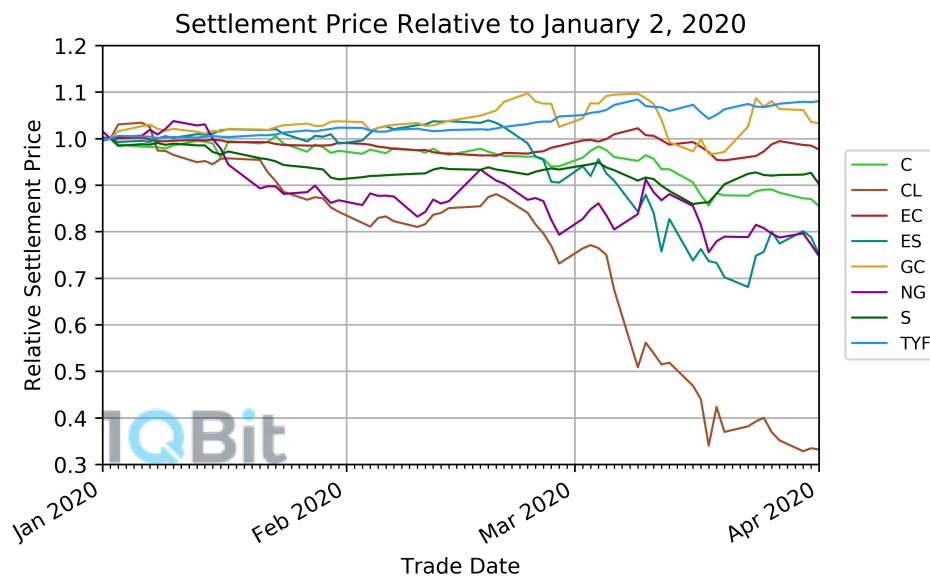


Figure 2: Q1 2020 Relative Price Movements. Plotted here are the settlement prices for selected futures products (most active expiry) relative to January 2<sup>nd</sup> 2020. It is evident that not all markets changed in exactly the same way, with some products falling less rapidly than others and with other products rising.

Thus, although the U.S. Federal Government was slower in responding to COVID-19 than governments in other parts of the world, the impact on markets was already being felt.

Figure 2 shows the prices of the CME MSM products plotted on a common vertical scale (the values are indexed to the start of the year). The fall in the price of WTI crude oil futures was large and significant. In contrast, the fluctuations in gold and Euro/USD FX futures (taken as examples) were large for those markets, but small in relation to the price changes seen in physical commodities more closely tied to the “real economy”.

### 3 The Month of January 2020

Two early indications of COVID-19 market changes came in WTI crude (CL) and gold (GC) futures.

The United States is one of the world’s ten largest oil exporters. Asia accounts for roughly half of U.S. oil exports, with most of this going to China [7]. As a result, Chinese refineries are directly exposed to price fluctuations in WTI crude, and this in turn exposes U.S. traders to changes in Chinese demand.

CL was on an upward trend in Q4 2019, closing the year with an overall increase. However, CL began to drop at a fast rate starting the second week of January 2020.

Part of this was due to the Saudi-Russian price war, when OPEC and allies agreed to cut oil production on January 1<sup>st</sup> 2020, and as Russia began to retaliate in the third week of January [8]. But these price war tensions became less important as Chinese consumption declined. The cancellation of domestic flights within China, and international flights in and out of China, reduced the demand for gasoline and jet fuel, and subsequently the demand for crude oil. China blocked people from travelling in and out of Wuhan on January 23<sup>rd</sup> 2020. The United States imposed partial restrictions on travel between China and the U.S. on January 31<sup>st</sup>.

The CME Market Sentiment Meter indicated that CL was in the Balanced state for January. It appeared that the price was dropping, but not in a way that seemed unusual for this volatile market.

In contrast, GC began rising in December 2019, despite beginning Q4 2019 with a downward trend. This trend in gold coincided with the cuts to the Federal Funds rates on September 19<sup>th</sup> [9] and on October 1<sup>st</sup> [10].

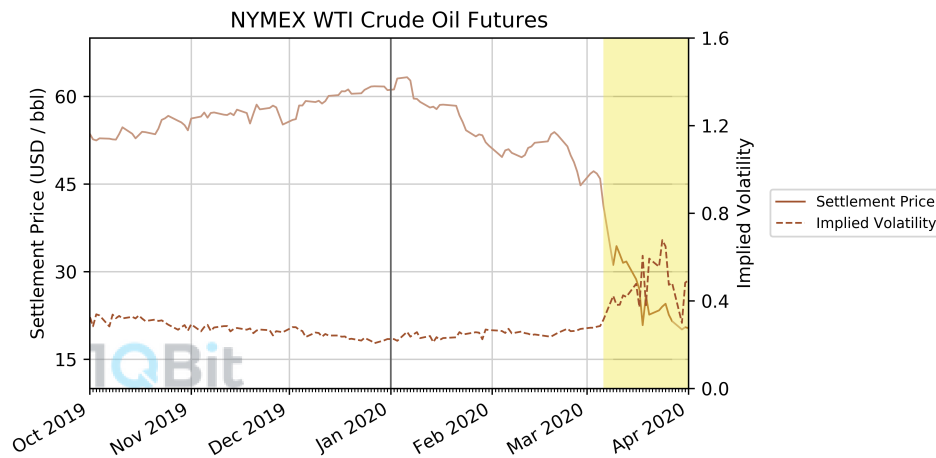


Figure 3: Q1 2020 CL Settlement Price and MSM Implied Volatility. The settlement price for WTI crude oil futures (most active expiry) (solid line) and the MSM implied volatility (dashed line) for Q1 2020. Regions where the MSM is Complacent (Blue), Balanced (White), Anxious (Yellow), and Conflicted (Red) are highlighted. Information and figures for other instruments are available from the 1QBit Finance Products team, please contact [msmsales@1qbit.com](mailto:msmsales@1qbit.com).

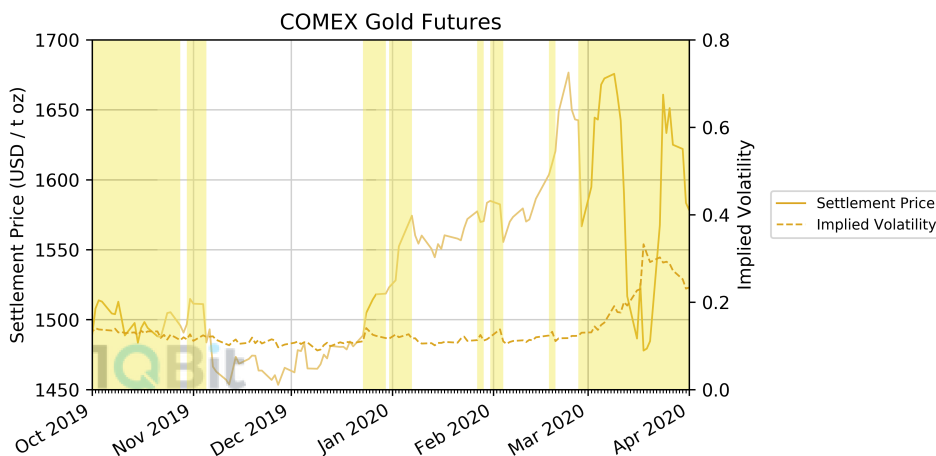


Figure 4: Q1 2020 GC Settlement Price and MSM Implied Volatility. The settlement price for COMEX gold futures (most active expiry) (solid line) and the MSM implied volatility (dashed line) for Q1 2020. Regions where the MSM is Complacent (Blue), Balanced (White), Anxious (Yellow), and Conflicted (Red) are highlighted. Information and figures for other instruments are available from the 1QBit Finance Products team, please contact [msmsales@1qbit.com](mailto:msmsales@1qbit.com).

A typical pattern in GC market states is a price move driving a transition from Balanced to Anxious. Specifically, the price move for extended periods of Anxious market states is a decline, followed by a consistent low period, ended by a rise to pre-drop levels, after which the market state may return to a calmer period that can be Balanced or even Complacent.

Changes in the price of gold<sup>2</sup> are sometimes associated with external events that make people feel a need for physical objects of known value. However, to look at these movements after the fact is sometimes to “discover” motivations that weren’t present at the time. Gold prices are subject to some unusual physical constraints. For example, and to look ahead, kilobars manufactured by Argor-Heraeus SA, one of the big Swiss refiners whose plant was closed for most of April, were reported by Bloomberg as selling for over 6% above spot [11].

<sup>2</sup>GC is listed in six standard months: February, April, June, August, October and December. It is also listed for the first three “serial months”, i.e. the current month and the two months that follow consecutively. The serial months include the standard months, so that a standard month can be present in the first, second or third serial position, creating a visible effect in the volume of the most active contract. When the nearest expiry is a serial month followed by a standard month, activity moves from the serial month to the standard month at a low volume in both. For details, consult the GC contract specification on the CME group website [12]: “Monthly contracts listed for 3 consecutive months, any Feb, Apr, Aug, Oct in the nearest 23 months and any Jun and Dec in the nearest 72 months”. Note that the listing of a contract says nothing about whether or not it will be traded.

## 4 The Month of February 2020

In February, the spread of COVID-19 continued rapidly and was accelerating as more cases were confirmed both in China and around the world. This caused governments to enact more travel bans, border closures, and limits on business activities. COVID-19 became a global issue.

The markets continued to react. Settlement prices continued to diverge (Fig. 2). However, for the first three weeks of February, there continued to be very little change in either the MSM market states or the associated risk-return curves. Activity in the futures markets did not result in changes to the options market until some time later.

This changed in the fourth week of February. Between February 21<sup>st</sup> and February 24<sup>th</sup> 2020 there was a sudden drop in the Dow Jones Industrial Average from 28993.22 to 27978.03 (prices at close). This drop was also seen in the S&P 500®, which dropped from 3337.75 to 3225.89 (prices at close).

Position changes in the stock market led to position changes in the stock options market, and then to position changes in options on stock index futures like the S&P 500® Index futures (ES) traded on the CME. Figure 5 shows the MSM risk-return curve for ES beginning to push outwards into negative territory. The traders anticipated both higher volatility and a (negative) directional change. February 24<sup>th</sup> 2020 (the right hand plot in Fig. 5) was actually the last date in February that the Sentiment Meter reported as Balanced.

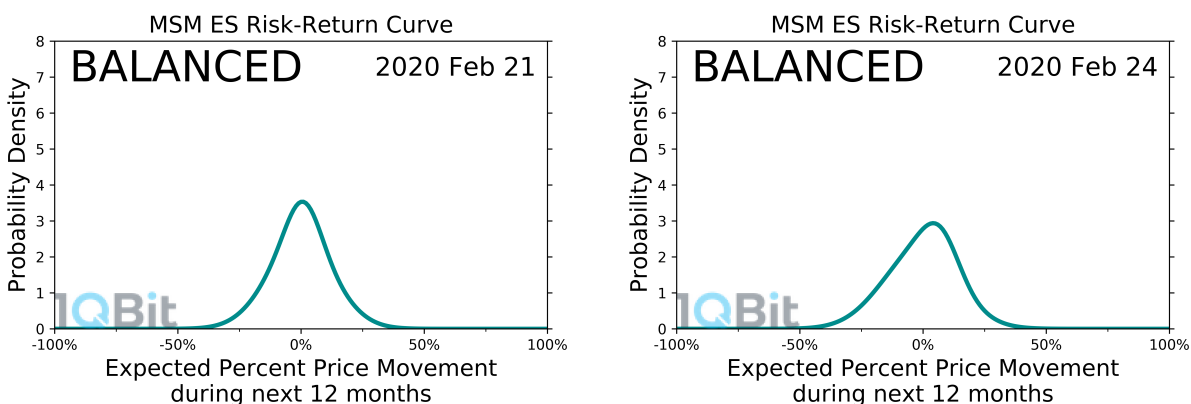


Figure 5: **February 21-24 2020 ES MSM States.** The MSM risk-return curves are shown for February 21<sup>st</sup> 2020 (left) and February 24<sup>th</sup> 2020 (right). There is a notable skewing of the distribution, following the sudden drop in the associated settlement price. Figures for other instruments available through [msmsales@iqbit.com](mailto:msmsales@iqbit.com)

Other products that are linked to the health of the U.S. economy, such as TYF, also saw evolution in their MSM market states and associated risk return curves. In particular, TYF saw its MSM market state evolve from Balanced to Anxious over the weekend of February 21<sup>st</sup> 2020, and preceded an increase in its settlement price.

The MSM sentiment state in S&P 500® E-mini index futures (ES) is frequently compared with indicators based on stock options, e.g. options on stocks that belong to the S&P 500® index. Both approaches have value. However, the options written on ES futures contracts tend to be traded further out the curve. MSM is, in a certain sense, “looking further ahead”.

While the markets move rather independently of one another in general, something uniquely interesting happened around the weekend of February 29<sup>th</sup> to March 1<sup>st</sup> 2020. In looking at the day-to-day relative price changes for the different products, most markets move in unison around the weekend of February 29<sup>th</sup> 2020. There is a unique rise, then fall, in most of the MSM products in the relative day-to-day change in settlement price (Fig. 6).

From this weekend onward, following the hump in relative day-to-day change, there are notable price moves, increases in the MSM implied volatilities, and evolution in the MSM market states from Balanced to Anxious, generally speaking, across all the products covered by the MSM. Some products saw rises, such as TYF, while most other products saw price falls.



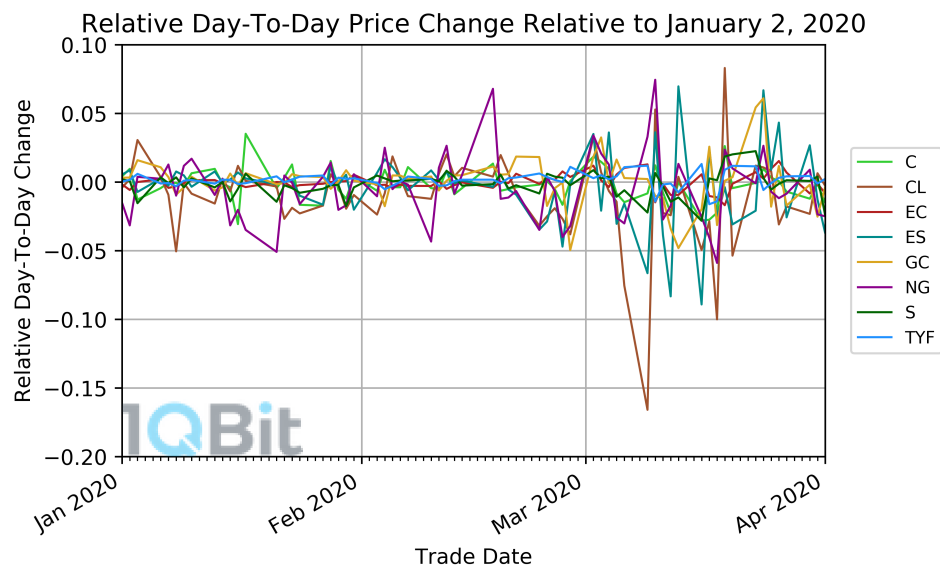


Figure 6: **Relative Day-To-Day Price Change.** Plotted here are the day-to-day change in futures settlement price (most active expiry) for the MSM products. On the weekend of February 29<sup>th</sup>-March 1<sup>st</sup> 2020, there was a common rise, then fall, in the relative price change.

Regarding the changes in the futures settlement prices, the sudden price moves seen in Fig. 2 and erratic behaviour seen in Fig. 6, is a clear indicator that the effects of COVID-19 were felt widely throughout the U.S. markets following this pivotal weekend. The subtleties of how the spread of COVID-19 is linked to the change in each product varies, as each product is different. For example, with CL, the Saudi-Russian price war which was previously the dominant cause in the movement of CL had been muted due to COVID-19. The extreme drop in demand for fuel, due to travel and flights being cancelled across the world in order to prevent the spread of the virus along with the slowing of many countries' economies, washed out any other influences in crude oil market.

The MSM market state for each product broadly evolved to the Anxious market states, which has an associated risk-return curve with a larger implied volatility. However, the Anxious market states arrived at different times for each product. For example, the Anxious market state arrived on March 9<sup>th</sup> 2020 for CL, while in ES it arrived on February 27<sup>th</sup>. In other cases, such as NG, it hardly arrived at all, with one Anxious day on March 13<sup>th</sup>, and three Anxious days spanning March 24<sup>th</sup> to 27<sup>th</sup>. This illustrates one of the challenges in using commodities as a leading indicator: What seems like a devastating price collapse in equities is "business as usual" in commodities, i.e. something that the market can address with established hedging techniques.

For ES, the market states shifted from Balanced to Anxious on February 27<sup>th</sup> 2020, which was maintained through to the end of the quarter. Gold's market states evolved from Balanced to Anxious on February 28<sup>th</sup>, which was maintained through to the end of the quarter. For TYF, the market states shifted from Balanced to Anxious on February 24<sup>th</sup>, which was maintained through to the end of the quarter.

Figures 1, 3, and 4 have been designed to show the relationship between daily settlement price, daily volume, and Market Sentiment State. The CME Market Sentiment Meter was developed originally from a study of futures and options settlement data in advance of events where the timing was known but the outcome was not (elections, referenda and economic announcements being cases in point). When the event comes as a surprise, the first response comes in the underlying futures product. Only after some time do the traders take positions in the corresponding options, from which the Market Sentiment Meter infers their aggregate sentiment.

The COVID-19 pandemic has given us an opportunity to see this effect in multiple markets, and in some cases the characteristic times associated with the response.



Product	Transition to Anxious
TYF	Feb. 24, 2020
ES	Feb. 27, 2020
GC	Feb. 28, 2020
EC	Mar. 6, 2020
C	Mar. 9, 2020
CL	Mar. 9, 2020
NG	Isolated Days Only
S	Isolated Days Only

Table 1: **Transition to Anxious Market States.** The products tracked by the MSM transition from Balanced to Anxious market states on different dates – due to each market’s unique factors – and remained that way through to the end of Q1 2020. For NG and S, there were only a few days on which there were Anxious market states, and did not stay that way through to the end of quarter.

## 5 The Month of March 2020

The Anxious state was established in corn on March 9<sup>th</sup> 2020. Forty percent of the U.S. crop goes to ethanol for motor transport fuel, and another forty percent goes to animal feed [13]. Much of the rest goes to the creation of high fructose corn syrup. The demand for corn is subject to many influences, including government regulation.

The Anxious state was also established WTI crude oil on March 9<sup>th</sup> and in Euro/USD FX futures on March 6<sup>th</sup>.

Natural gas was Balanced or Complacent, with the exception of March 13<sup>th</sup> 2020, and March 24<sup>th</sup> to March 27<sup>th</sup> (Anxious). Similarly, Soybeans were Balanced for the month, with exception of March 17<sup>th</sup> to March 19<sup>th</sup> (Anxious).

The natural gas futures contract used by the Market Sentiment Meter is the physically-delivered Henry Hub contract. This is largely a U.S. domestic product, i.e. not a global benchmark in the same way as WTI crude. China and Japan, for example, import natural gas primarily from Australia.

Similarly, in considering the price of U.S. soybean futures, note that China now imports the majority of its soybeans from Brazil. The U.S. soybean market does not respond to Chinese demand in the way it once did.

Inspection of the individual product charts in Fig. 1 shows that price movements in the Anxious State were larger than the price movements seen in the preceding Balanced state.

As March advanced, the daily volumes gradually returned to their “pre-COVID-19” values. Prices continued to respond to events, but there was no longer the large-scale shifting of positions in the futures markets.

TYF continued rising, which began to increase sharply mid February and ended March with a high compared to the beginning of Q1 2020. This sharp rise in settlement price was preceded by a large increase in the daily trade volume. This followed the U.S. Federal Reserve’s decision to sharply cut Federal Funds rates.

## 6 Conclusion

The central premise of 1QBit’s CME Market Sentiment Meter is that options prices and volumes reflect the aggregate sentiments of traders. In the first quarter of 2020, MSM indicated a shift from the Balanced to the Anxious state in all of the products it monitors, with the exception of soybeans and natural gas. The Anxious state is associated with an expectation of larger price movements.

There was a lag between the reporting of events in the media and a visible response in the futures markets. There was further lag between activity in the futures markets and the establishment of options positions from which aggregate sentiment can be inferred. In the case of COVID-19, the lags can be related to the slowly growing awareness that COVID-19 was different from previous outbreaks of infectious disease, and that its economic impact would be felt for some time. Forward-looking activity moves from futures to options in different ways for each product, at different rates. International trading carries information from one part of the world to another and is more present in some products than others. Market sentiment takes time to establish, and its informative power must be interpreted in this light.

## 7 2020 Q1 Summary of COVID-19 Events

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The following section contains a brief timeline of events in Q1 2020 that were widely reported.

- **January 8, 2020** Scientists in China report discovery of novel coronavirus 2019-nCoV.
- **January 9, 2020** First death from 2019-nCoV was reported by China.
- **January 13, 2020** First case of 2019-nCoV diagnosed outside of China, in Thailand.
- **January 20, 2020** First case of 2019-nCoV reported in the U.S.
- **January 23, 2020** China quarantines Wuhan, China, and begins shutting down transportation within, and in and out of the province.
- **January 30, 2020** COVID-19 outbreak declared a "Public Health. Emergency of International Concern".
- **February 5, 2020** 3100 more confirmed patients within China.
- **February 11, 2020** Oil prices reach one-year low, and continue falling.
- **February 25, 2020** U.S. health officials urge local governments, schools, and businesses to develop plans in case of potential outbreaks.
- **February 29, 2020** U.S. bans travel from Iran.
- **March 3, 2020** Federal Reserve cuts Federal Funds Rate to a range of 1.00 - 1.25%.
- **March 11, 2020** WHO declares pandemic status. U.S. suspends all travel from Europe for 30 days, except the UK.
- **March 13, 2020** U.S. declares national state of emergency.
- **March 15, 2020** Federal Reserve cuts Federal Funds Rate once again to a range of 0 - 0.25%.
- **March 27, 2020** U.S. passes and signs the Coronavirus Aid, Relief, and Economic Security Act.
- **March 30, 2020** U.S. extends national shutdown and social distancing until April 30.

## Acknowledgements

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The authors thank Blu Putnam, Arthur Yu, and Phil Goddard for their discussions in relation to the Market Sentiment Meter.

## A MSM Market States

The MSM models risk by allowing there to be multiple “schools of thought” for price movement. There are four possible “market states”: Complacent, Balanced, Anxious, and Conflicted. Graphical representations of the market states are found in Figs. 7-8. These are represented in a single Mixture Distribution. The Mixture Distribution represents the expected price movement over the next twelve months, so that its standard deviation can be directly compared to an annualized volatility. However, the Mixture Distribution may change daily, evolving over time as new information arises. The model works best for events in which the timing is known but the outcome is uncertain.

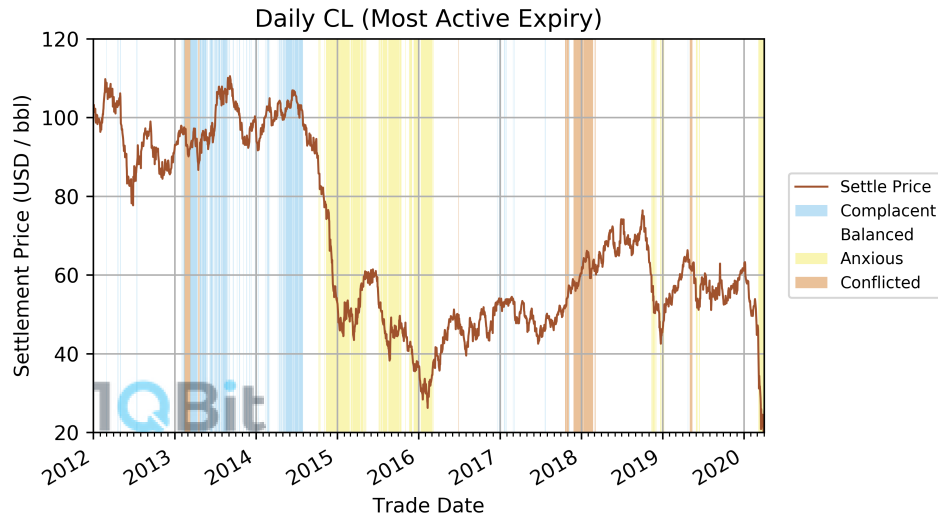


Figure 7: 2012-2020 Daily Settlement Price for CL (most active expiry) (Brown line). The shading indicates the market state. Regions where the MSM is Complacent (Blue), Balanced (White), Anxious (Yellow), and Conflicted (Red) are highlighted. Figures for other instruments available at <https://iqbit.com/market-sentiment-meter-msm/>.

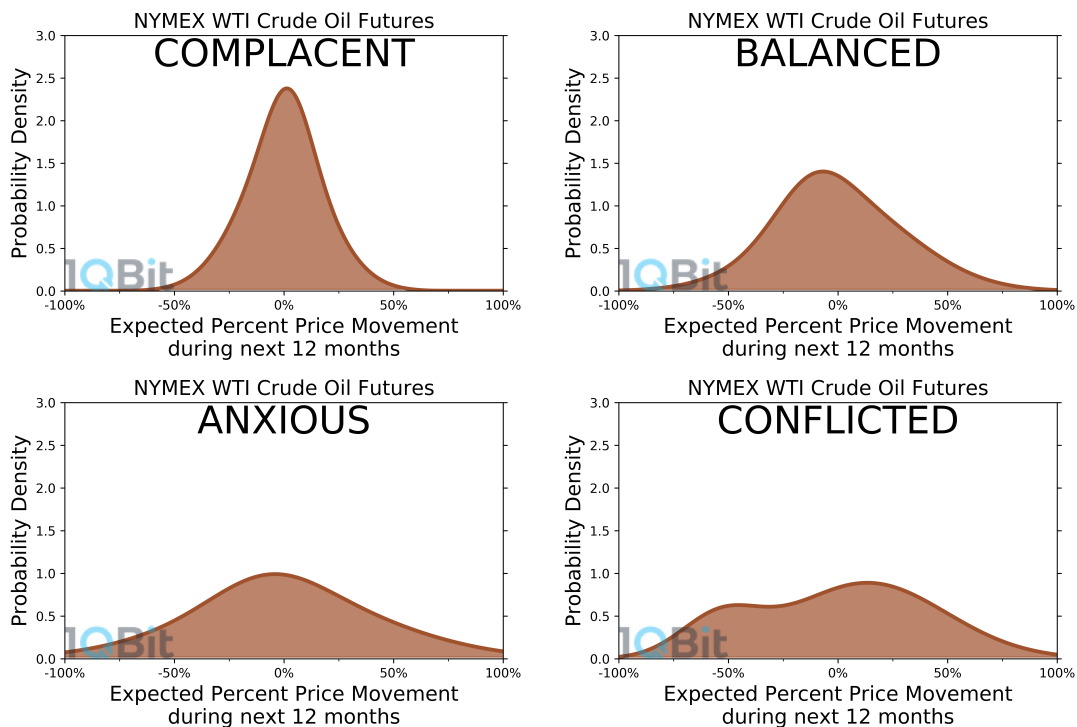


Figure 8: MSM Market States. Graphical representations of the risk-return curves for the four market states within the MSM: Complacent; Balanced; Anxious; and Conflicted states.

The Complacent market state is a “calm” state indicating that market participants have few concerns. Conceptually, it is when the schools of thought do not differ significantly, resulting in a tall and narrow distribution. The narrow width of the curve is a direct result of a small standard deviation, and generally indicates that there is only a small chance of a large price move.

The Balanced market state is the most common state. This distribution has a larger standard deviation than the Complacent state, indicating a larger difference in the schools of thought when compared to the Complacent state.

In the Anxious market state, the schools of thought are diverging, and result in a much broader risk-return curve. Indeed, the differing schools of thought can also skew the distribution and move the mean off centre, yielding information about the direction of a potential price move.

Most unique to the MSM model is the Conflicted market state. The defining feature of this, graphically, is the bi-modal nature of the distribution. For this situation, the schools of thought differ significantly and subsequently result in a large volatility. This may indicate a large price move.

## B CME DataMine Product Codes

Throughout the Historical Market Analyses, CME DataMine product codes are used to refer to the various products. For convenience, tabulated below is a list of CME DataMine product codes currently available through the Market Sentiment Meter.

DataMine Code	Futures Product Name
C	CBOT Corn
CL	NYMEX WTI Crude Oil
EC	CME Euro FX (USD per EUR)
ES	CME E-Mini S&P 500
GC	COMEX Gold
NG	NYMEX Henry Hub Natural Gas
S	CBOT Soybean
TYF	CBOT U.S. Treasury 10-Year Note

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