From Zero to 100: Crude Oil Price Changes in 2020–2022

Analyzing the Market Microstructure Implications of Oil Futures and Spot Prices for Market Participants

This article looks at how the escalation of the Russo-Ukrainian conflict and the ongoing response to the COVID-19 pandemic contributed to crude oil price volatility and a surge to over $120 a barrel in 2022. These high price levels, which have not been seen since 2008, occurred just two years after hitting an all-time low early in the pandemic and going into negative territory in April 2020. The article focuses on the market microstructure implications for futures market participants and how the prices have diverged between various global crude oil benchmarks.

Implications of sanctions on the global crude oil supply and other responses to the escalation of the Russo-Ukrainian conflict

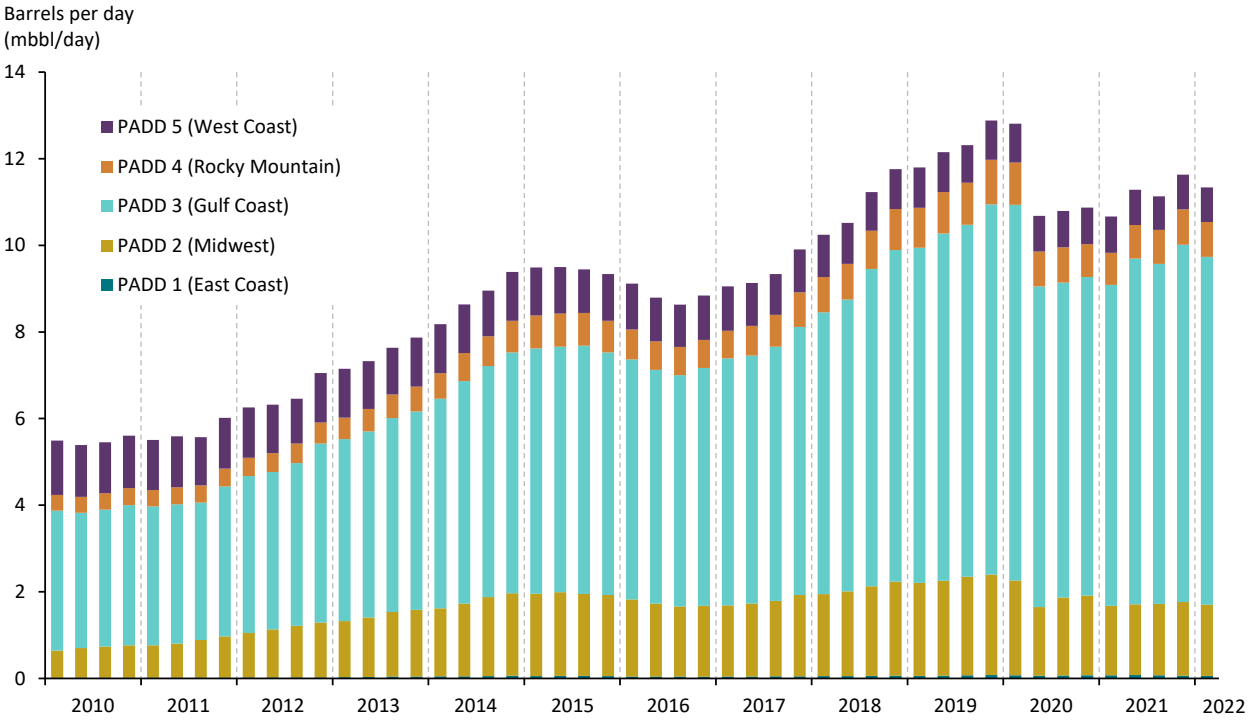
Russia is the third-largest oil producer in the world. Its output in January 2022 was 11.3 million barrels per day, and it made up 14 percent of the world's total supply in 2021.[1] Russia ranks as the world's largest oil exporter.[2] It consumes about 3.5 million barrels per day while exporting more than 7 million barrels of crude oil and other petroleum products per day, shipped primarily through pipelines but also by tankers.[3]

About 60 percent of Russia's oil exports go to OECD Europe, representing roughly a third of these countries' oil imports. China represents the second-largest export market for Russian oil at roughly 20 percent of exports. In contrast, the U.S., one of the world's largest oil producers, imports less than 10 percent of its oil from Russia.[4]

As a result of the escalation of the Russo-Ukrainian conflict, which began on February 24, 2022, the IEA estimates that by May 2022, 3 million barrels per day of Russian oil output, representing almost 3 percent of the world's production, could be removed from the global oil market as sanctions take hold and buyers shun Russian exports.[5] Analysts estimate that roughly 4.8 million barrels per day of Russian oil were previously exported to countries now backing sanctions against Russia.[6] Russia may redirect some of these exports to non-sanction-backing countries such as India or China, but such a move may take time and may not make up entirely for the lost sales volumes. Some recent reports suggest the drop in Russian oil exports has thus far been less than previously predicted.[7]

Saudi Arabia and UAE control about 2 million to 2.5 million barrels per day or more of spare capacity that could make up for some of Russia's supply shortfall, but they have so far signaled that they will not provide relief.[8] Increased supply could also come from the U.S., but new capacity would take months to come online. In the short term, stock releases from various countries have helped dampen the supply shock. In the U.S., the Biden administration agreed to release 1 million barrels per day over six months from the Strategic Petroleum Reserve.[9] An increase in longer-term production capacity could also materialize; U.S. production remains roughly 1 million barrels per day below its pre-pandemic levels (see Quarterly Production of U.S. Crude Oil chart), and the Biden administration has been encouraging the industry to increase domestic production.[10] Finally, ongoing negotiations with Venezuela and Iran may lead to additional supply in the long run.

Quarterly Production of U.S. Crude Oil
Q1 2010–Q1 2022



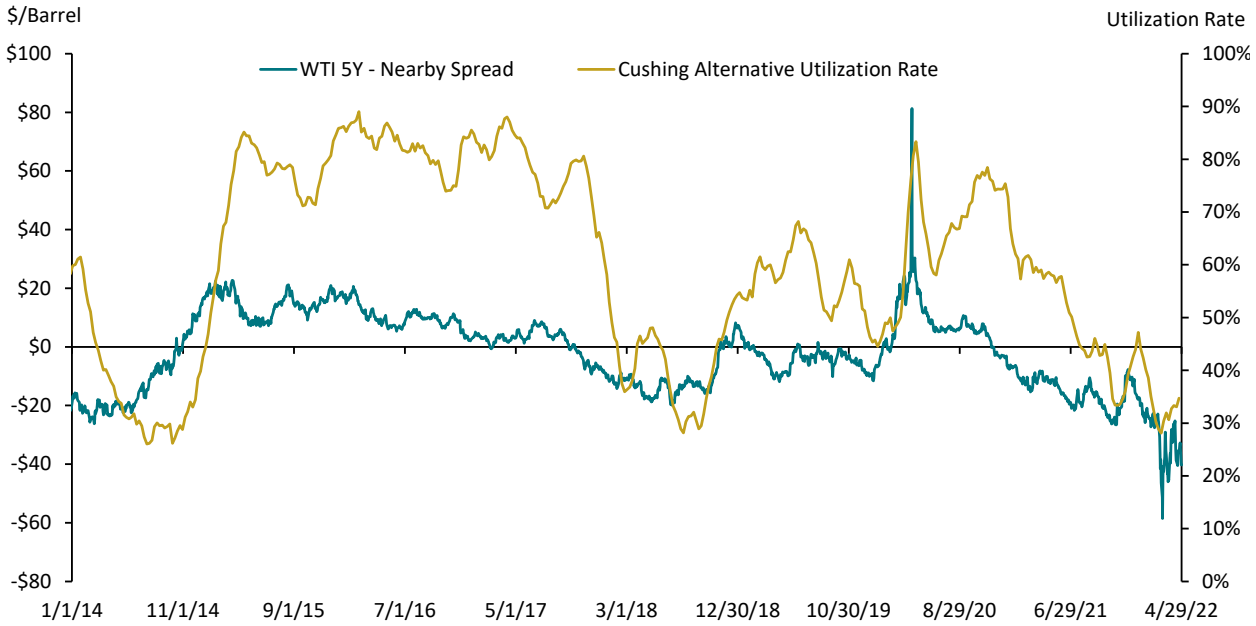
Source: Energy Information Administration
Note: Figure represents quarterly barrels per day averages of US field production of crude oil by Petroleum Administration for Defense Districts (PADD).

U.S. petroleum prices

The prospects of such a significant supply disruption have contributed to the price of West Texas Intermediate crude oil surging to an end-of-day high of $123.64 on March 8, 2022, a level not seen since 2008.

In raw-material markets, futures typically have higher prices for longer maturities to reflect the cost of storage over time as well as future demand expectations—a structure known as contango. However, when scarcity fears grip a market and demand remains robust, the forward curve structure can flip into backwardation. Two years ago on April 20, 2020, lower oil consumption linked to the COVID-19 pandemic, a strong contango (nearby prices lower than farther-out prices), and high resulting storage utilization, contributed to the U.S. WTI benchmark hitting an all-time low, and ultimately going into negative territory for the expiring futures contract. Since then, concurrent with prices rebounding, the U.S. WTI futures curve flipped from contango to backwardation (nearby prices higher than farther-out prices) starting in late 2020, as demand rose faster than supply. Following the escalation of the Russo-Ukrainian conflict, the U.S. WTI futures curve entered super backwardation with the nearby WTI contract reaching a record of almost $60 per barrel above the five year deferred contract on March 8, 2022.

Spread Between 5 Year and Nearby CME WTI Futures
1/1/14–4/29/22

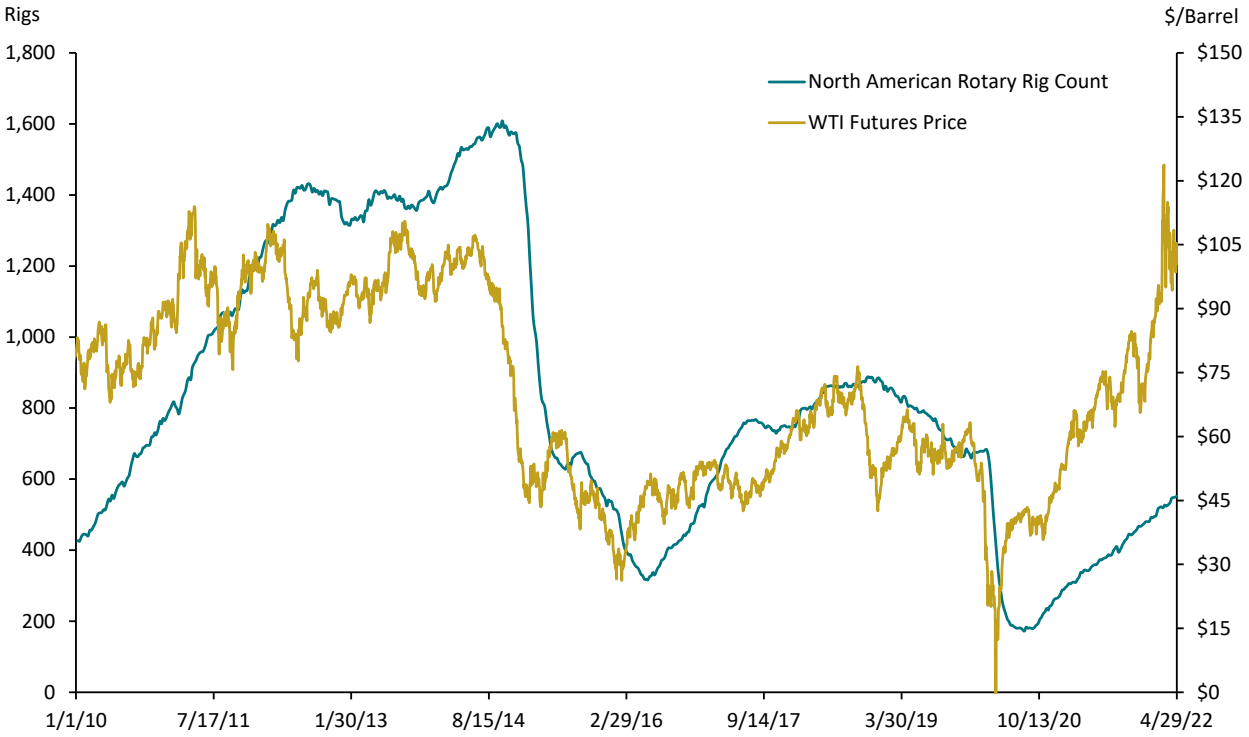


Source: *Refinitiv*; U.S. Energy Information Administration
Note:
1. The WTI futures contract spread is the difference in the price of the 5 year and closest to expiry (front month) futures contracts on West Texas Intermediate traded on NYMEX on any given day.
2. Alternate Utilization Rate measures crude oil stores in tanks as well as crude oil in pipelines and in transit by rail in proportion to the sum of the tanks' working storage capacity and stocks in transit. Weekly utilization rates were calculated from weekly crude oil stocks compared to the most recent available semiannual storage and stocks in transit figures released by the EIA.

Backwardation has implications for investments that could ease the supply shock in the medium to long term. If oil prices are expected to fall in the future, oil producers and investors may be hesitant to invest in building rigs that take a year or more to come online—they face the risk that future oil prices are not going to be high enough to make the investment worthwhile. The current deferred prices may nevertheless be enough of an enticement for American oil firms to increase capacity. The latest statistics surrounding permit application for new rigs in the

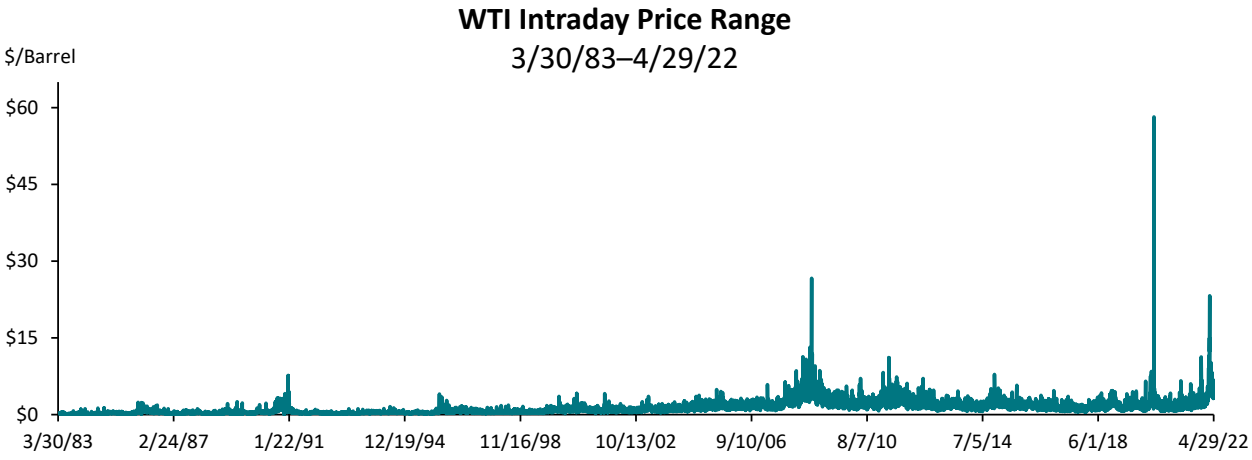
U.S. Permian Basin suggest that crude oil suppliers in America may be responding to higher prices and gearing up to increase production. Rystad Energy, an independent energy research and business intelligence company, reported that an all-time record of 904 horizontal drilling permits were awarded in March 2022 in the Permian Basin that lies beneath Texas and New Mexico.[11] Even assuming that these permit applications lead to new drilling, this added capacity would likely take months to come online.

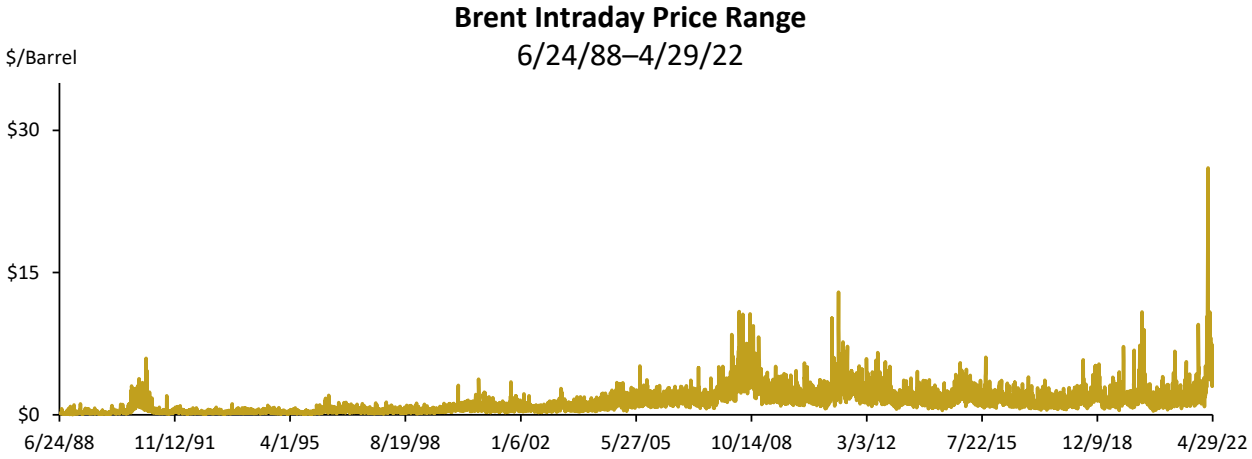
Number of U.S. Oil Rigs
1/1/10–4/29/22



Source: Baker Hughes; *Refinitiv*
Note: The "WTI Futures Price" on 4/20/2020 was -$37.63

The uncertainty surrounding supply fundamentals, exacerbated by the escalation of the Russo-Ukrainian conflict, and the risk that consumption levels may slump due to slower economic growth caused by COVID-19 restrictions in China and the threat of tighter U.S. monetary policy to curb inflation, has led to a sharp increase in price volatility. Intraday price swings surpassed $20 a barrel, one of the highest daily moves on record for WTI futures.[12]



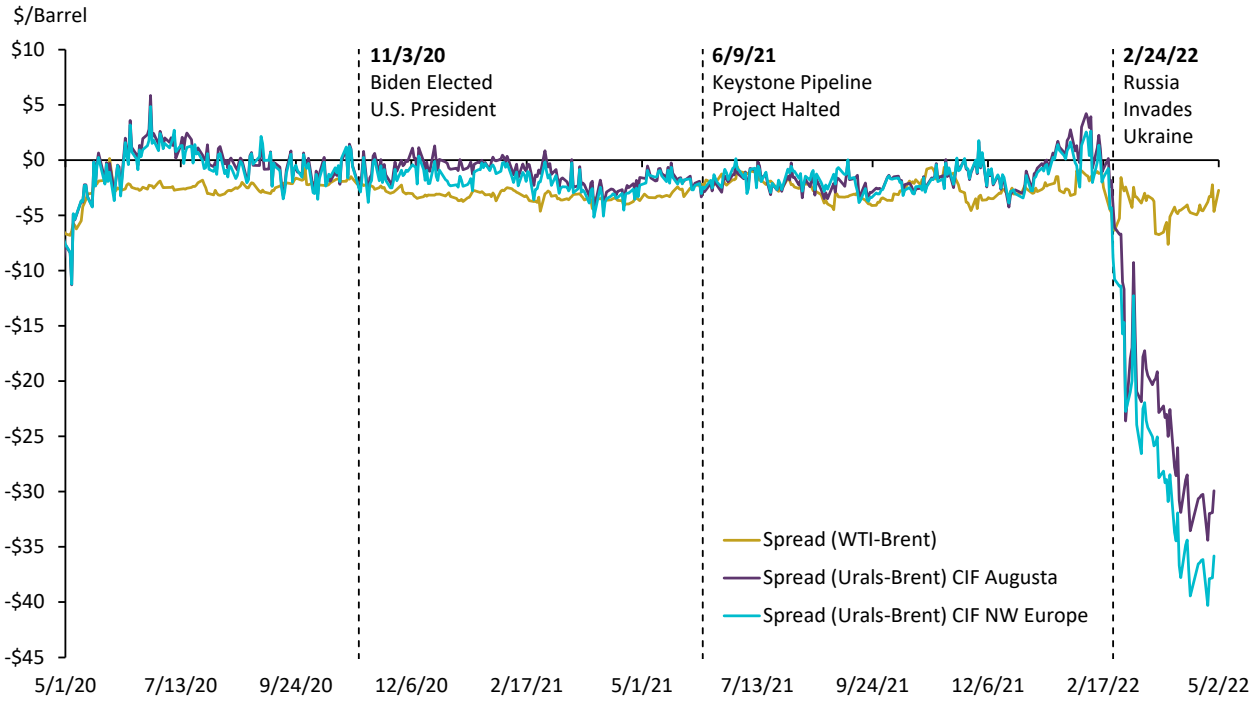


Source: *Refinitiv*
Note: The WTI futures contract is the price of the futures contract on West Texas Intermediate traded on NYMEX closest to expiry (front month) on any given day. The Brent futures contract is the price of the (front month) futures contract on Brent traded on ICE closest to expiry on any given day. The Refinitiv tickers for these are CLC1 and LCOC1 respectively.

European petroleum prices

In Europe, the Brent benchmark price for North Sea oil has behaved similarly to WTI, but the Urals benchmark price for Russian oil has diverged from world oil prices due to the world's response to the escalation of the Russo-Ukrainian conflict.

WTI and Brent Spread vs. Urals and Brent Spread
5/1/20–5/2/22



Source: *Refinitiv*
Note: The WTI futures contract is the price of the futures contract on West Texas Intermediate traded on NYMEX closest to expiry (front month) on any given day. The Brent futures contract is the price of the (front month) futures contract on Brent traded on ICE closest to expiry on any given day. The Refinitiv tickers for these are CLC1 and LCOC1 respectively. Urals CIF Augusta and Urals CIF Northwest Europe are calculated by applying derived differentials for Urals crude cargoes destined to Augusta and Northwest Europe respecitively.

Global events—and in particular, the Russian government's actions—have had major impacts on the price of Urals oil relative to Brent. For example, in June 2020, Urals traded at a premium of more than $2 per barrel to Brent when Russia reduced its oil output for export, with loadings from Russia's Baltic ports falling from 4.4 million tons in June to 2.5 million tons in July.[13] In 2022, the fear of a Russian invasion of Ukraine and subsequent sanctions first led Urals to be priced above Brent. The Urals CIF Augusta–Brent spread reached $4.21 on February 4, 2022, as purchasers tried to stock up on oil in January and early February. Then, on February 24, the day the Russo-Ukrainian conflict escalated drastically, Urals differentials hit an all-time low relative to Brent, dropping to a discount of $11 per barrel.[14] By the end of March, the differential hit a record -$25 and reached a low of -$34.41 on April 24, 2022.[15] In both cases, Russia's actions led to an increase in world oil prices, but the impact on Urals was different. In 2020, Russia limited supply, while in 2022, oil purchasers became reluctant to purchase Russian oil.

The proximity of the Urals CIF Augusta benchmark to non-sanction-backing countries such as India or China relative to the Urals CIF NW Europe could be a driver for its recent relative price strength.

As for European futures curves, the CME Group Inc. (CME) and Intercontinental Exchange Inc. (ICE) futures markets offer cash-settled futures on the spread between Urals and Brent, but not futures on Urals alone, reflecting that Brent is the more dominant benchmark for Europe. A Urals forward curve can, however, be constructed from the Brent futures curve and the Brent–Urals forward differentials. Brent, like WTI, has been in super backwardation, reflecting high near-term demand relative to supply.

Market players' funding needs and futures contract open interest

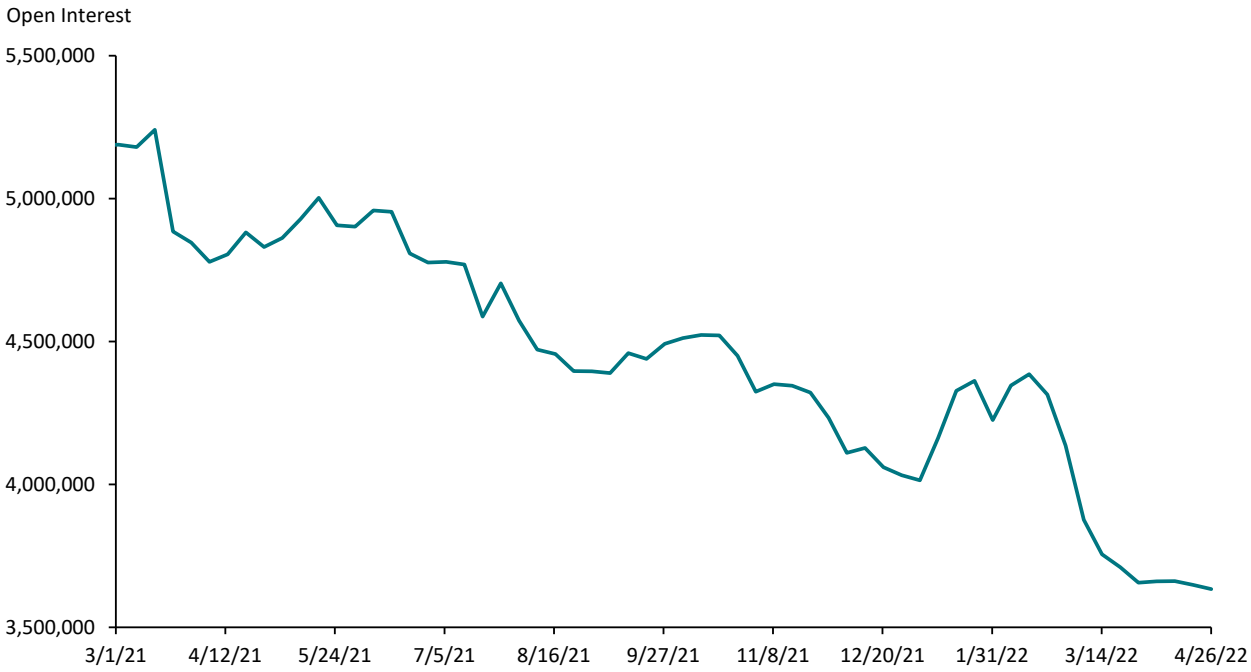
These extraordinary price movements have resulted in a large spike in funding needs—higher outright crude oil prices mean physical players require larger letters of credits from banks to finance the cost of shipping their oil cargoes around the world. Higher prices also increase the requirement for cash, or "margin," that the companies must put down to cover part of the value of futures positions that they typically use to hedge the prices of long-term contracts or physical inventories.

Furthermore, the increased price volatility has led to a rise in the cost of trading oil futures for market participants. As volatility surged, the margin requirements on the two major crude oil futures contracts were raised several times. The ICE increased initial margin requirements on nearby Brent futures from $7,600 in January 2022 to $11,920 per contract (representing 1,000 barrels) as of March 25, 2022.[16] Similarly, between the beginning of the escalation of the Russo-Ukrainian conflict and March 11, 2022, the CME increased initial margin requirements on the NYMEX WTI contract by over 30 percent to $12,000.[17] This means that market participants must put up more cash than before in order to take a position in these futures contracts. Higher price volatility also means that banks will require higher collateral ratios from physical players to support additional loans. Therefore, physical players will not be able to use the full amount of additional collateral value their oil stocks gain because of higher prices.

As a result, the existing credit lines of many firms are exhausted, and such firms are seeking to raise additional cash, cutting positions, or both.[18]

Open interest in the main oil futures contracts (WTI and Brent) plunged to a six-year low on April 19, 2022, as prices spiked. Between February 24 and April 19, 2022, Brent and WTI saw the equivalent of nearly 700 million barrels worth of contracts liquidated.

WTI & Brent Futures Open interest
3/1/21–4/26/22



Source: *Refinitiv*
Note: Chart shows WTI and Brent futures open interest. The Refinitiv RICs are 1CFTC067651OI and 1ICELCOOI, respecitively.

Hedging impact of Urals/Brent differential

The collapse of Urals crude oil prices relative to WTI and Brent will likely result in trading losses for certain physical players. Firms that had bought (and had yet to sell) Russian oil or had contracts to buy Russian oil at pre-established differentials will have suffered large losses on their physical position as Urals prices decreased. If they had hedged those deals with short Brent or WTI futures positions, these physical losses would not be properly offset.

Spotlight: Crude Oil Benchmarks

As laid out in "Battle of the Benchmarks: Brent Crude Oil and West Texas Intermediate," there are two major benchmarks of crude oil: the Brent North Sea Crude (commonly called Brent Crude) and the West Texas Intermediate (WTI). The two benchmarks have contrasting features in terms of where the oil is produced, how it is stored and transported, and the way it is traded in international markets.

Crude oil is typically characterized as light, medium, or heavy, depending on its API gravity, and as either sweet or sour, depending on its sulfur content. Light, sweet crude oil is less expensive to refine and is therefore typically more expensive than heavier and sour crude oils.

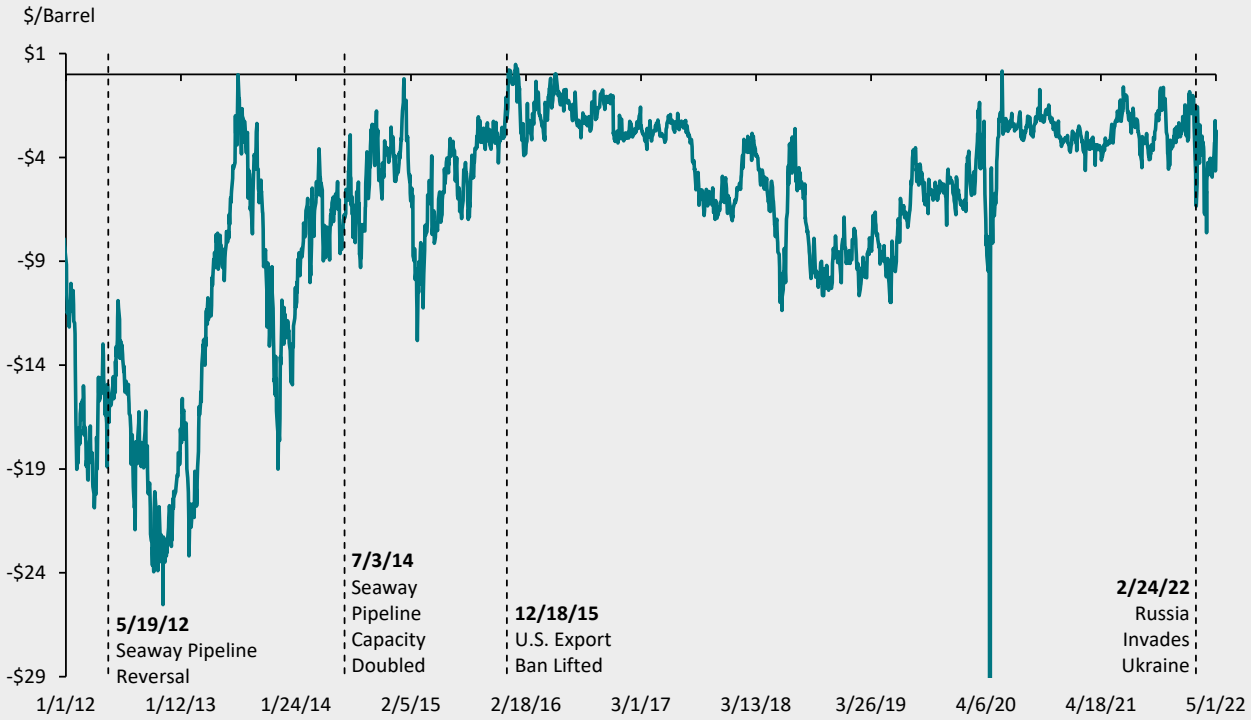
Russia produces several different types of crude oil, but its main export blend is "Urals," which is a medium, sour crude. Because Urals is medium and sour, it typically trades at a discount to Brent, on average $1.64 per barrel.[19]

Both WTI and Brent are light, sweet oils but WTI has a slight edge over Brent on account of its lower sulfur content, making it moderately "sweeter" and thus easier to refine. For this reason, WTI should theoretically trade at a premium over Brent.

However, regional differences exist, such as transport and storage limitations at the inland Cushing, Oklahoma, delivery point for WTI. For a large part of the first decade of this century, WTI did trade at a premium, that is, the Brent–WTI spread was negative. Over the last decade, however, the shale revolution in the U.S. has brought large volumes of oil into the market, making the U.S. one of the largest oil producers in the world. In line with the economic principles of demand and supply, as the total volume of oil production increased in the U.S., this put downward pressure on WTI. The Brent–WTI spread has generally been positive in the last decade.

Another reason for the Brent–WTI spread is the logistical challenge for the U.S. to transport oil from landlocked production hubs through a network of pipelines and to ship it overseas. This impinges on the overseas demand for oil from the U.S. (WTI). In contrast, Brent is produced at or closer to sea, making it easier to reach its overseas destinations. The U.S., however, has invested heavily in its pipeline infrastructure to enable it to send large vessels of oil from its shores to international buyers.

Spread between WTI and Brent Futures Prices
1/1/12–5/2/22



Source: *Refinitiv*
Note: The spread is calculated as the price of WTI futures contract closest to expiry minus the Brent futures contract closest to expiry. These prices are represented on Refinitiv as CLC1 and LCOC1 respectively. CLC1 trades on NYMEX and LCOC1 trades on ICE. The spread on 4/20/20 was -$63.20.

An evolving Brent benchmark composition

The Brent benchmark is based on the value of five North Sea crude grades.[20] In February 2021, Platts had announced that WTI Midland[21] would be added to the Brent benchmark effective July 2022, but a month later Platts announced it was delaying any change to the Brent benchmark.[22] In 2022, North Sea production is expected to fall below an average of one cargo per day in the benchmark grades, according to Platts, which manages the benchmark.[23] In order for Brent to continue to reflect the market despite this declining production of traditional North Sea crude, two proposals of additional grades were considered: (1) Johan Sverdrup, a North Sea crude grade, but one that is heavier and more sour than the current benchmark grades and thus more similar to Urals oil; or (2) U.S. WTI Midland, which has an inland loading point.[24] On February 14, 2022, Platts proposed including U.S. WTI Midland crude oil in its Dated Brent benchmark starting from June 2023.[25] Platts argues that this proposal makes sense because U.S. "WTI crude has become popular with buyers in Northwest Europe since the U.S. relaxed export restrictions in 2015" and "WTI Midland is seen as closer to existing Brent grades than the more heavy and sulfurous Johan Sverdrup."[26] WTI Midland would be included in Dated Brent as a CIF Rotterdam price netted back to a virtual North Sea FOB price to compete with the benchmark's other North Sea grades.[27] The addition of WTI Midland will likely add substantial complexity to the Dated Brent contract given the variable quality of U.S. exports and the additional complications of adding transatlantic freight costs into the benchmark calculations. Furthermore, concerns that the large production volumes of WTI Midland could "swamp" the deliverable mechanism and cause "extreme volatility" will need to be addressed.[28]

Endnotes

[1] "Oil Market and Russian Supply," IEA, https://www.iea.org/reports/russian-supplies-to-global-energy-markets/oil-market-and-russian-supply-2, accessed May 29, 2022.

[2] Saudi Arabia is the world's top exporter of crude oil but Russia takes the top spot when including crude oil as well as petroleum products.

[3] "Oil Market and Russian Supply," IEA, https://www.iea.org/reports/russian-supplies-to-global-energy-markets/oil-market-and-russian-supply-2, accessed May 29, 2022.

[4] "Oil and Petroleum Products Explained," EIA, https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php, accessed May 29, 2022.

[5] "Oil Market and Russian Supply," IEA, https://www.iea.org/reports/russian-supplies-to-global-energy-markets/oil-market-and-russian-supply-2, accessed May 29, 2022; "Oil Market Report - April 2022," IEA, https://www.iea.org/reports/oil-market-report-april-2022.

[6] "Here's Where Russian Oil Flows," *Washington Post*, March 8, 2022, https://www.washingtonpost.com/business/2022/03/08/russia-oil-imports-ban.

[7] "Russian Oil Trade Goes Dark, But Exports Continue," *Energy Intelligence*, March 16, 2022, https://www.energyintel.com/0000017f-92c6-dea0-a7ff-96df2ed80000.

[8] "Oil Market Report - February 2022," IEA, https://www.iea.org/reports/oil-market-report-february-2022.

[9] "Fact Sheet: President Biden's Plan to Respond to Putin's Price Hike at the Pump," The White House, March 31, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/31/fact-sheet-president-bidens-plan-to-respond-to-putins-price-hike-at-the-pump/.

[10] "Fact Sheet: President Biden's Plan to Respond to Putin's Price Hike at the Pump," The White House, March 31, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/31/fact-sheet-president-bidens-plan-to-respond-to-putins-price-hike-at-the-pump/.

[11] "Record Permian Well Permits Point to Growing U.S. Oil Supply," *Bloomberg*, April 13, 2022, https://www.bloomberg.com/news/articles/2022-04-13/record-permian-well-permits-point-to-growing-u-s-oil-supply?sref=aHrd9Iuo.

[12] WTI futures saw its largest intraday price swing on April 20, 2020, when the nearby futures price dropped by roughly $60 a barrel. Intraday price swings for Brent Futures saw the highest daily move on record.

[13] "Urals U-Turn as Europe Shuns Expensive Russian Oil," *Hydrocarbon Processing*, June 26, 2020, https://www.hydrocarbonprocessing.com/news/2020/06/urals-u-turn-as-europe-shuns-expensive-russian-oil.

[14] "Ukraine Crisis Will Disrupt Crude Flows Even without Sanctions," *Hydrocarbon Processing*, February 25, 2022, https://www.hydrocarbonprocessing.com/news/2022/02/ukraine-crisis-will-disrupt-crude-flows-even-without-sanctions

[15] Refinitiv.

[16] "Brent Crude Futures," ICE, https://www.theice.com/products/219/Brent-Crude-Futures/margin-rates, accessed May 29, 2022; Brent Crude Futures," ICE, http://web.archive.org/web/20220310184732/https://www.theice.com/products/219/Brent-Crude-Futures/margin-rates, accessed May 29, 2022.

[17] "Surging Oil Futures Margins Are Latest Challenge Facing Traders," *Bloomberg*, March 11, 2022, https://www.bloomberg.com/news/articles/2022-03-11/surging-oil-futures-margins-are-latest-challenge-facing-traders?sref=aHrd9Iuo; "Wild Price Swings Make Oil Futures Too Hot to Handle," *Bloomberg*, March 10, 2022, https://www.bloomberg.com/news/articles/2022-03-10/wild-price-swings-make-oil-futures-too-hot-to-handle?sref=aHrd9Iuo.

[18] "Trafigura Seeks PE Funding as Commodity Surge Triggers Margin Calls," March 15, 2022, https://www.bloomberg.com/news/articles/2022-03-15/trafigura-seeks-funding-from-private-equity-as-commodities-soar?sref=aHrd9Iuo.

[19] Vladimir Hajko and Jiří Neubauer, "The Causal Relationships between Brent and Urals Oil Price Benchmarks," 18th Annual International Conference Enterprise and Competitive Environment, March 2015, https://www.researchgate.net/publication/284154160_The_causal_relationships_between_Brent_and_Urals_oil_price_benchmarks. There are two Urals benchmark: Urals Med for delivery in the Mediterranean, typically Augusta, Italy, and Urals NWE for delivery in northwestern Europe, typically Amsterdam, Rotterdam, or Antwerp. See "Specifications Guide: Europe and

Africa Crude Oil," Platts, February 2022, https://www.spglobal.com/commodityinsights/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/emea-crude-methodology.pdf.

[20] "Specifications Guide: Europe and Africa Crude Oil," Platts, February 2022, https://www.spglobal.com/commodityinsights/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/emea-crude-methodology.pdf.

[21] WTI is the U.S. benchmark for crude oil trading on NYMEX. WTI is priced at Cushing, Oklahoma—the point of delivery for futures contracts trading on NYMEX. WTI Midland is the price of oil at the Permian Basin.

[22] "Pricing Agency Platts Defers Changes to Dated Brent Oil Benchmark," *Reuters*, March 10, 2021, https://www.reuters.com/article/us-oil-platts-brent/pricing-agency-platts-defers-changes-to-dated-brent-oil-benchmark-idUSKBN2B302P.

[23] "Pricing Agency Platts Defers Changes to Dated Brent Oil Benchmark," *Reuters*, March 10, 2021, https://www.reuters.com/article/us-oil-platts-brent/pricing-agency-platts-defers-changes-to-dated-brent-oil-benchmark-idUSKBN2B302P.

[24] "Brent Benchmark Complex: Evolving necessity," Platts, July 2021, https://www.theice.com/publicdocs/Brent_Benchmark_Complex_Evolving_Necessity.pdf

[25] "S&P Global Platts Proposes Including US WTI Midland Crude in Dated Brent, Keeps Benchmark on FOB Basis," S&P Global, February 14, 2022, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/021422-s-p-global-platts-proposes-including-us-wti-midland-crude-in-dated-brent-keeps-benchmark-on-fob-basis.

[26] "S&P Global Platts Proposes Including US WTI Midland Crude in Dated Brent, Keeps Benchmark on FOB Basis," S&P Global, February 14, 2022, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/021422-s-p-global-platts-proposes-including-us-wti-midland-crude-in-dated-brent-keeps-benchmark-on-fob-basis.

[27] Cost, insurance, and freight (CIF) and free on board (FOB) are international shipping agreements used in the transportation of goods between buyers and sellers. Under CIF contracts, the seller assumes responsibility for costs and liabilities until the shipment arrives at the destination, at which time the risk is transferred to the buyer.

Under FOB contracts, the buyer is responsible for shipping and other costs, as well as insurance as soon as the goods are loaded onto the vessel and during the voyage. See "BP Backs Inclusion of WTI in Dated Brent," *Argus*, December 2, 2021, https://www.argusmedia.com/en/news/2280471-bp-backs-inclusion-of-wti-in-dated-brent; "Hurdles Remain for WTI Addition to Benchmark," *Argus*, February 21, 2022, https://www.argusmedia.com/en/news/2303965-hurdles-remain-for-wti-addition-to-benchmark.

[28] BP Backs Inclusion of WTI in Dated Brent," *Argus*, December 2, 2021, https://www.argusmedia.com/en/news/2280471-bp-backs-inclusion-of-wti-in-dated-brent.

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